Summary: In the 8th-7th centuries BCE the southern border of Judah included the southern Lowland (Shephelah), the southern hill country and the Beer-sheba–Arad Valley. In this southern fringe of Judah, Judeans lived side by side with tribes that were of Edomite and Arab origin. In the 4th-3rd centuries BCE the Province of Idumea included all the areas of the Beer-sheba–Arad Valley, the southern Shephelah and the southern Judean Hills; the majority population in the region was Idumean and Arab. The borders of Yehud had shrunk to a line north of Beth-Zur in the hill country and Azekah and the Ellah Valley in the Shephelah, and most of the Judahite population was concentrated around Jerusalem. Explanations for these historical, geopolitical, cultural and demographic changes have been well-discussed by scholars; in this paper, we provide a set of paleo-environmental data that sheds new light on this process. Palynological and sedimentological information show that during the late 6th through the mid-5th centuries BCE (~ 520-450 BCE) dryer climate conditions were prevalent in the region. During the early Hellenistic period, wet climate conditions and intense olive horticulture characterized the region. Since in the steppe-marginal areas of the southern Levant, even minor climatic variation can result in major environmental change, the main argument of this paper is that the dry conditions in the early Persian period caused a process of abandonment of most of the villages in the southern parts of the former Kingdom of Judah, triggering nomadization of some elements of the local population and immigration to the core areas of the province of Yehud of others. After the destruction of the Kingdom of Judah and the collapse of the southern settlement and military system, this process provoked a demographic vacuum in the southern Lowland (Shephelah), the southern hill country and the Beer-sheba–Arad Valley that encouraged the immigration of nomadic elements into it. The gradual increase in moisture in the late 5th and 4th centuries BCE probably reinforced a cultural progressing, by stabilizing the
settlements that were highly dependent on water resources and local agriculture. The semi-nomadic elements could have easily settled in the area and quickly created the settlement alignment of the province of Idumea.

Résumé: Au 8ème et 7ème s. av. n. è., la frontière sud du royaume de Juda incluait le sud de la plaine côtière (Shéphélah), le sud de la zone montagneuse ainsi que la vallée de Beer-sheba et Arad. La population judéenne vivait dans l’ensemble de cette région, aux côtés de tribus d’origines édomite et arabe qui vivaient à l’extrémité sud de Juda. Aux 4ème et 3ème s., la province d’Idumée comprenait toute la zone de la vallée de Beer-sheba et Arad, le sud de la Shéphélah ainsi que le sud des collines judéennes; la population édomite et arabe était majoritaire dans la région. Le territoire de Yehud s’arrêtait à une ligne au nord de Beth-Zur dans la zone montagneuse, et à Azékah et la vallée d’Elah dans la Shéphélah; la plupart de la population judéenne était concentrée autour de Jérusalem. Les explications pour ces changements historiques, géopolitiques, culturels et démographiques sont bien connues; nous présentons toutefois de nouvelles données paléoenvirronnementales qui apportent un nouvel éclairage. Les informations palynologiques et sédimentologiques montrent que vers la fin du 6ème et la première moitié du 5ème s. (environ 520-450) des conditions climatiques plus sèches étaient récurrentes dans la région. Le début de l’époque hellénistique, en revanche, est marqué par des conditions climatiques humides dans la région, permettant une intense oléiculture. Étant donné que dans les zones marginales des steppes du Levant sud, même des variations climatiques mineures peuvent provoquer des changements environnementaux importants, la thèse principale de cet article est que les conditions arides du début de l’époque perse ont causé l’abandon de la plupart des villages dans les zones sud de l’ancien royaume de Juda, ainsi que l’immigration de la plupart des habitants vers le cœur de la province de Yehud.

Ce processus a provoqué un vide démographique qui a encouragé l’immigration de groupes nomades à la place, une immigration qui avait en tout cas déjà commencé suite à la destruction du royaume de Juda et l’effondrement de l’habitation dans le sud ainsi que du système militaire. La montée progressive de l’humidité vers la fin du 5ème et au 4ème s. a probablement renforcé le développement de la culture, en stabilisant les habitations qui étaient fortement dépendantes en eau et en agriculture locale. Les groupes semi-nomades ont pu s’installer facilement dans la région et atteindre en un rapide processus l’alignement de l’habitation dans la province d’Idumée.

Mots-clés: Période perse, Yehud, Idumée, Paleo-environnement

Keywords: Persian period, Yehud, Idumea, Paleo-environment, pollen

Introduction

This study puts the missing pieces of a well-known historical and archaeological puzzle into place. It shows how augmenting geopolitical and demographic data with environmental information and insight generates processes that are both more complete and more comprehensible. In this
paper we deal with a well-known historical and archaeological starting line — the southern border of Judah in the 8th-7th centuries BCE, when the southern Lowland (the Shephelah), the southern hill country and the Beer-sheba–Arad Valley were all part of the Kingdom of Judah (Pl. VIIa); when a small Judahite population lived in the area, side by side with Edomites and Arabs. We deal with a clear and well-based finish line — the border of Idumea in the 4th-3rd centuries BCE, which included all the above-mentioned areas, with Idumean and Arab tribes living there, side by side with an unknown number of the remnants of the Judahite population. The borders of Yehud had by now shrunk to the area north of Hebron in the hill country and to the line of Azekah and the Ellah Valley in the northern Shephelah (Pl. VIIb). Most of the Judahite population was now concentrated around Jerusalem.¹ In addition, we also deal with the dramatic historical, geopolitical and demographic process in between.

What were the reasons for these historical, geopolitical, cultural and demographic changes? Why did these changes occur and how can we describe the process of the change in the borders and in the population? Some of the answers to these questions are well known and have been discussed at length.² But a new perspective for this process of change has recently been identified — the reconstruction of past vegetation and climate conditions in the southern Levant. In this paper, we present these two well-known historical and archaeological starting and finish lines, together with acknowledged explanations for the changes that took place in between. We then introduce the new paleo-environmental data that constitute a missing element crucial for understanding the dramatic changes that occurred in the southern part of the Land of Israel between the 6th and 3rd centuries BCE.

The Southern Border of Judah in the Late First Temple Period

By the late Iron IIa, when the administrative center in Tel Beer-sheba (Stratum V) and the fortress in Arad (Stratum XI) were founded, the Beer-sheba–Arad Valley was probably the southern boundary of Judah.³ The area developed and reached its peak in the Iron IIb, with the center

2. Ibid., with further literature.
in Tel Beer-sheba (Strata III-II), the citadel in Arad (Strata X-VIII), and some other towns and citadels that were founded in the area, like Tel ‘Ira (Stratum VII), Tel ‘Aro’er (Strata IV-III), Tel Malḥata (Stratum IV) and Bir es-Saba’. During this period, and under Assyrian patronage, Judah became integrated into the Arabian trade network that traversed the Beer-sheba-Arad Valley en route to the harbor in Gaza, and it prospered as a result.

Sennacherib’s 701 campaign brought this thriving system to a halt. The administrative center of the region, Tel Beer-sheba, was destroyed and was never restored — probably as part of the Assyrian policy of


6. I. Beit-Arieh, Tel Ira: A Stronghold in the Biblical Negev, Monograph Series of the Institute of Archaeology of Tel Aviv University 15, Tel Aviv 1999, pp. 170-173.

7. Y. Thareani, A Town in the Desert: Geographical, Economic and Sociopolitical Perspectives, Ph.D. dissertation, Tel Aviv University, Tel Aviv 2010, pp. 55-271; id., Tel ‘Aro’er: The Iron Age II Caravan Town and the Hellenistic-Early Roman Settlement, Jerusalem 2011, table 1.1.


11. Aharoni, op. cit. (n. 4), pp. 5-6; Singer-Avitz, ibid., p. 11.
preventing Judah from reestablishing its holdings in the region.\textsuperscript{12} Destruction levels have also been unearthed in Arad,\textsuperscript{13} and Tel ‘Ira (Stratum VII),\textsuperscript{14} with partial destruction that was exposed in Tel Malḥata\textsuperscript{15} and Tel ‘Aro’er.\textsuperscript{16}

While new phases of settlement were already initiated in Tel Malḥata and Tel ‘Aro’er in the early 7th century BCE, the settlement in the citadel of Arad (Stratum VII) was probably reestablished only in the second half of the 7th century,\textsuperscript{17} and the settlement in Tel ‘Ira (Stratum VI) and probably also in Bir es-Saba’ were rebuilt only in the late 7th century, after a long settlement gap.\textsuperscript{18} In the late 7th century, probably after the Assyrian withdrawal from the Levant, when Judah was able to return to the Beer-sheba–Arad Valley,\textsuperscript{19} three fortresses were built on its eastern side: Ḥorvat ‘Uza, Horvat Radum\textsuperscript{20} and Horvat Ṭov;\textsuperscript{21} another fortress was founded at Ḥorvat ‘Anim.\textsuperscript{22} In addition, small sites were built and existed alongside

\begin{enumerate}
\item Thareani, loc. cit. (n. 10), pp. 184-191.
\item Herzog, loc. cit. (n. 3), p. 98.
\item Beit-Arieh, loc. cit. (n. 8), pp. 22-23.
\item The evidence for continuity between Tel ‘Ira Strata VII and VI is meager, and it seems that there was a gap in between.
\item Beit-Arieh, \textit{ibid.}
\item \textit{Ibid.}, p. 118.
the fortresses during this period: Tel Masos, Tel Shoqet, Ḥorvat Yittan, Mount Yatir and Ḥorvat Ḥur.23

As demonstrated by I. Koch and O. Lipschits,24 there was a decrease in the administrative involvement of the central regime in the Beer-sheba–Arad Valley during the early 7th century, as only four late lmlk stamped handles and two concentric incised handles were unearthed in the region, all at Arad.25 It is clear that the administrative system based on stamped jar handles did not reach that region until the late 7th century, as reflected in the find of four stratified Rosette stamped handles from the new Judahite administrative center at Tel ‘Ira (Stratum VI), alongside three more stamped handles unearthed at Arad (Strata VII-VI), and four Rosette stamped handles unearthed at Tel Malhata (Stratum III). Thus, it may be that even if some of the Judean population did return to the Beer-sheba–Arad Valley during the first few decades after the 701 Assyrian campaign, there is no evidence for royal administrative involvement until the late part of the 7th century.26

As against the disappearance of Judahite administration in the early 7th century stands the prosperity of sites in the southern part of the Beer-sheba–Arad Valley, such as Tel Malḥata and Tel ‘Aro’er, where clear signs were discovered of Edomite dominant material culture, probably already in the second half of the 8th century, with a quick recovery after the 701 Assyrian campaign.27 It might be that this Edomite population became sovereign over the Beer-sheba–Arad Valley during the 7th century, at least until the Assyrian withdrawal in the beginning of the last third of the 7th century.

Edomites in the Southern Border of Judah in the Late First Temple Period

In the First Temple period, the border between Judah and Edom ran through the ‘Arabah. The geographical conditions, the biblical references28

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28. See, e.g., Gen 36:41; Num 34:3-4; Josh 13:2; 15:1, 21; Jud 11:16-18; 1 Kgs 9:26, etc.
and the archaeological evidence indicate that the ‘Arabah was considered part of Edom. The area west of the ‘Arabah in the direction of the Beersheba–Arad Valley was the natural area of expansion for the Edomites and was even called “the Mountain of Se’ir.”

The spread of Arabian and Edomite elements into the expanse between the ‘Arabah and the Beer-sheba–Arad Valley and into the valley itself had already taken place in the second half of the eighth century. This
Edomite-Arab minority could gain from the 701 destruction and to take the control over the trade route. Ahlström suggested that the Edomites actually controlled the region during the 7th century, and, based on a more solid archaeological ground, P. Bienkowski and E.J. Van der Steen have suggested that Tel Malhata (Stratum III) replaced the destroyed Tel Beer-sheba as the main center of the region. It might be that after 701 these Edomite-Arab groups, with their capital at Tel Malhata, with ‘Aro’er as its main shrine, and also with ‘Aro’er as an important settlement, entered the vacuum left by the destruction of the Judahite administrative center, forts and settlements. With the support of the Assyrians, the Edomite groups attained semi-autonomous status and controlled the trade routes that passed through the Beer-sheba–Arad Valley.

Only during the late 7th century, with the change of the geopolitical conditions after the Assyrian withdrawal, was Judah able to restore its status and presence in the territories outside the highland area. It gained control over the Beer-sheba–Arad Valley, which thrived under Egyptian hegemony, when Ashkelon became the major harbor and trade center. The renewed involvement of the Judahite administration in the trade route is reflected in the discovery of four stratified Rosette stamped handles from the new Judahite administrative center at Tel ‘Ira (Stratum VI) and three additional stamped handles from the fortress at Arad (Strata VII-VI), which was a central point in an array of forts on the eastern fringe of the valley, which, as previously stated, included Ḥorvat ‘Uza, Ḥorvat Radum and Ḥorvat Ṭov. It seems that the four Rosette stamped handles unearthed at Tel Malhata (Stratum III) reflect the integration of this town within the renewed Judahite administration in the region. Although not a single 7th century stamped handle was found at Tel ‘Aro’er, the discovery of Judahite ostraca, weights and other typical elements of the material

33. Pace Finkelstein, loc. cit. (n. 10), pp. 157, 166.
34. The connection of these Edomite groups to and the cooperation with the kingdom of Edom was not necessary at all: Lipschits op. cit. (n. 4), pp. 242-244; Beit-Arieh, op. cit. (n. 8), p. 30.
culture at the site\textsuperscript{37} may attest to its affiliation with the Kingdom of Judah.

The renewed control of the Kingdom of Judah over the Beer-sheba–Arad Valley probably intended to block the Edomite-oriented and Arab semi-nomadic population from expanding to the northern parts of the valley. There is no direct evidence for this Judahite objective, which might indicate the first rivalry in more than a century between Judah and the Edomite population living in this area.\textsuperscript{38} However, as already pointed out by O. Lipschits,\textsuperscript{39} only a meager amount of Edomite pottery was unearthed in late 7th century BCE strata, including Arad Strata VII–VI,\textsuperscript{40} Tel Masos Stratum I,\textsuperscript{41} and Tel Ira VI,\textsuperscript{42} as against the pottery assemblage of Stratum VII, which did include such pottery (mainly decorated bowls and Edomite jugs).\textsuperscript{43} Since Edomite pottery was unearthed in the southern part of the Beer-sheba–Arad Valley, such as in Ḥorvat ‘Uza and Ḥorvat Radum,\textsuperscript{44} we may conclude that the Judean goal was to push the semi-nomadic groups south of the line of the Judean citadels and settlements along the valley. These groups continued to exist along the southern part of the valley.

This reconstruction emphasizes the importance of the existence of the Judahite forts and settlements along the Beer-sheba–Arad Valley in the specific settlement and demographic situation of the end of the 7th and the early 6th centuries, and the special importance of the destruction of the border fortresses and the end of the Judean administrative presence in the valley. This was the historical point from which the Edomite and Arab groups could easily penetrate into the vacant areas of the destroyed kingdom. This is also the reason why the question of the Edomites’ role and involvement in the destruction of the Judahite southern border is so important for understanding this process.

\textsuperscript{37} Thareani, op. cit. (n. 7) 2011, p. 307.
\textsuperscript{39} Lipschits, op. cit. (n. 1), pp. 142, n. 35.
\textsuperscript{42} Freud, loc. cit. (n. 14), p. 218.
\textsuperscript{43} Ibid., pp. 194-196, 203.
The Collapse of the Judahite Southern Border and Its Aftermath

During the Babylonian siege, and possibly even before, in 597, during the years after the first Babylonian campaign, the Kingdom of Judah did not have the manpower, the means and the administrative ability to maintain the garrison forces that manned the fortresses; relationships between the capital and the fortresses fractured, and the central authority dissolved.

At this point there was no longer any reason for the system of fortresses that marked and protected the southern border of the kingdom to exist. As the system of fortresses fell, so fell the system of settlements. And the door opened for the semi-nomadic groups to become a destructive force. When the border was breached, those groups began to infiltrate into the periphery of the Kingdom of Judah, destroying some of the settlements that stood in their way and expelling some of the populace that resisted them. They advanced from the Negev to the Judean hills and the southern Shephelah. Some of the destructions discovered at the Negev sites may have been the result of struggles between the inhabitants of the Kingdom of Judah and the nomadic groups that rose up from the south; there is no reason to attribute them to a Babylonian-initiated military campaign.


46. As summarized by Lipschits *op. cit.* (n. 1), pp. 36-97, the Babylonians concentrated their efforts in Jerusalem and also destroyed the border fortresses on Judah’s western border, but it is doubtful that they had an interest in fighting military campaigns deep into the southern and eastern frontier of the kingdom of Judah.
DRY CLIMATE DURING THE EARLY PERSIAN PERIOD

Two ostraca found in Arad (Nos. 24, l. 20; 40, l. 10, 15), and the Edomite ostracon found in the destruction stratum of Horvat 'Uza, deserve attention. These findings have generally been interpreted as evidence of an Edomite military threat to Judah, even before the destruction of Jerusalem, and of tangible military pressure on the eve of the destruction.

This premise relies principally on both the background to Jeremiah's words (13:19) “The towns of the Negeb are shut up with no one to open them” and on the interpretation of the expressions of hatred toward the kingdoms of Transjordan, particularly Edom, in Ezekiel (25:12-14), as well as in the Book of Obadiah and in segments from the Psalms and Lamentations.

Nonetheless, these expressions of hostility toward Edom have no support in the description of the destruction in 2 Kings and Jeremiah.

47. On the ostraca, see Aharoni, op. cit. (n. 45), pp. 72-76; Lemaire, op. cit. (n. 45), pp. 188-193, 207-208. For a discussion of the information obtained from the ostraca regarding Edom’s share in the destruction, see Aharoni, loc. cit. (n. 45), pp. 160-161; Beit-Arieh, op. cit. (n. 30), p. 311, with further literature.


distress”), the verse in Jeremiah 40:11 contains a description of the return of the refugees who found asylum in Edom.\textsuperscript{52}

It appears that the archaeological and historical evidence of the destruction of southern Judah attests to a long and complex process that is not directly connected to the Kingdom of Edom, but to the Edomite and Arab tribes that already began to establish themselves along the southern border of Judah before the destruction. One may hypothesize that the fortresses that had been built on Judah’s southern border were designed to bring stability to the border and impose the kingdom’s authority over the nomadic groups that lived close by. In contrast to some scholarly views, one may reasonably assume that these nomadic groups were not part of the Kingdom of Edom but, rather, a border population that dwelled between Edom and Judah.\textsuperscript{53} An economic symbiosis was gradually created between the nomadic elements and the royal fortresses and settlements in the Beer-sheba–Arad Valley. Nonetheless, the predatory nature of these groups was surely a major factor in the tension that periodically developed between the population in the forts and settlements and the nomadic groups. As long as the kingdom was able to impose its authority over the nomads, the situation remained stable. As the kingdom progressively weakened, probably already at the beginning of the 6th century, after the Babylonian campaign of 598/7, its ability to withstand pressure from the south steadily declined. The only support for this reconstruction can be found in the words of Jeremiah (13:19), but the farfetched interpretation attached to these words should not be accepted. They express the increasing danger, just as stated in the Arad ostraca, from the same period, but are not evidence of the Edomite seizure of the eastern Negev. One may assume that the next phase in the Edomite process of establishing itself took place only after the Babylonian siege and the conquest of Jerusalem.

Historically, it can be reconstructed that after the destruction of the Negev sites in the early 6th century, the tribal population of Edomite and Arab origin penetrated in a slow and gradual process into the relatively uninhabited areas of the Negev and later to the southern Judean hills and the southern and central Shephelah, which had remained desolate since the Assyrian campaign of Sennacherib (701). It can be assumed


\textsuperscript{53} Lipschits, \textit{op. cit.} (n. 1), pp. 141-146, and cf. Herzog, \textit{op. cit.} (n. 4), pp. 242-244.
(see I. Eph’al)\textsuperscript{54} that this infiltration and migration was a prolonged process that continued through the Babylonian period in the 6th century and during most of the Persian period in the 5th and 4th centuries.

**The Southern Border of the Province of Yehud and the Province of Idumea in the Late Persian and early Hellenistic Periods**

During the 4th-3rd centuries the Negev, the southern Judean hills and the southern Shephelah were part of Idumea,\textsuperscript{55} while the borders of Judah shrank to the line of Beth-Zur in the hill country, and to the line of Azekah and the Ellah Valley in the Shephelah.\textsuperscript{56} In the Zenon Papyri (nos. 59006 and 59015) Maresha and Adoraim are mentioned as cities in Idumea,\textsuperscript{57} and they continued to be so in the Hasmonean period, when Maresha\textsuperscript{58} and


\textsuperscript{58} 1 Maccabees 5:66; 2 Maccabees 12:35; Josephus, *Antiquities* XII: 8, 6 = 353.
Adoraim\textsuperscript{59} were described as foreign cities\textsuperscript{60} that also maintained rule over their rural surroundings.\textsuperscript{61} Adolam was included during this same period in the southwestern border of Judah,\textsuperscript{62} a reflection of the continuation of the existence of the borders between Judea and Idumea between the Late-Persian and Late-Hellenistic periods. According to the excavations at Mareshah,\textsuperscript{63} and according to the archaeological surveys and excavations (see below), it is clear that the main period of change in this area and the crystallization of the new settlement and demographic pattern occurred during the 4th century.

The Idumaean Incursion

What happened between the late Iron Age and the Late Persian and Early Hellenistic period? The usual explanation for the difference between the starting line presented in this paper and the finish line is that Arab and Edomite groups invaded from the southern Negev to the former Judean territories. The Nabataean invasion to Edomite territories accelerated this process of invasion, and in any case new populations replaced old ethnic groups that lived in these territories before them.

In the Persian period, the bulk of the population in all these areas were of Edomite and Arab origin.\textsuperscript{64} Evidence of their presence may be found both in the mention of Geshem, the Arabian, among the neighbors of Judah in the Persian period, and the first mention of Idumea as a circumscribed geographical and administrative unit in 312, as attested by Antigonus Monophthalmos. Aramaic ostraca, dated to the Persian period and
found in Beer-sheba, Arad, and additional sites within Idumea contain a preponderance of Edomite and Arab names, but also some Judean names — evidence that a Judean population of unknown size remained in the area.

New Perspective on the Idumean Incursion to Southern Judah in the 6th-4th Centuries BCE — Past Vegetation and Climate Conditions

The Regional Setting

The southern Levant receives most of its rainfall from the mid-latitude Cyprus cyclones which move eastward over the Mediterranean and then cross the region from west to east. As a result, annual precipitation is high on the coast and in the north, and shrinks toward the south, where the north Sinai coastline forms the southern limit in which rain clouds can form. The Negev Desert, which occupies the southernmost part of the Levantine region, is already a part of the global desert belt of 30° N latitude. The humid influence of the Mediterranean also diminishes sharply eastwards due to the local orographic effect of the southern Levantine highlands, which run parallel to the coast and cause a “rain shadow” desert (the Judean Desert). The vegetation belts change accordingly (Pl. VII), with aridity increasing towards the south and east, from Mediterranean vegetation (precipitation >400 mm/year) via a transitional zone characterized by semi-arid Irano–Turanian steppe vegetation (~ 400-200 mm/year of

70. While the Negev Desert was formed due to global air-circulation patterns, the Judean Desert is a local phenomenon. The southern border of the latter is adjacent to the northeastern border of the Negev Desert.
annual rainfall) to the Saharo–Arabian Desert type vegetation (precipitation <200 mm/year).\textsuperscript{71}

In order to evaluate possible links between past climate conditions and economical-demographical process, the most sensitive climate-human links recorder zone is the one discussed in this article: the transition zone between the Mediterranean environment and the desert, that is the semi-arid steppe zone (Irano-Turanian, also described as dwarf-shrublands) (Pl. VIIc). This zone enables a combination of dry-farming (mainly barley) and pastoral subsistence economy. Years of improved precipitation have pushed it to the south and east, while dry years have driven it to the north and west. Settlements situated near perennial sources of water may have managed to survive longer in periods of increasing aridity, whereas other sites may have been abandoned.

The migration of this semi-arid steppe zone is reflected in the regional pollen diagrams (Lake Kinneret [Sea of Galilee] and the Dead Sea) by changes in the arboreal Mediterranean pollen values: decreasing percentages of the natural Mediterranean tree pollen indicate the shrinkage of the natural Mediterranean maquis/forest and the shifting of the semi-arid boundaries to the north and west due to less available moisture; increasing arboreal pollen values mark the opposite. The pollen records from Lake Kinneret and the Dead Sea (Ze’elim) are sensitive to the conditions in both the Mediterranean area and the Irano-Turanian vegetation belt, as the two lakes collect wind-driven pollen from these two adjacent zones (Pl. VIIc). In addition to air-born pollen, they receive stream-driven pollen mainly through the Jordan River, but also via local streams.

Changes within the frequencies of cultivated olive pollen\textsuperscript{72} are not only a good indicator for human economic preference and decisions but also


to change in the available moisture since olive, like other Mediterranean trees, requires at least 400 mm of annual rain in order to thrive. Previous palynological studies from the region showed that olive and the natural Mediterranean trees occupy the same ecological niches.

The palynological diagram

In Pl. VIII, a simplified palynological diagram, which covers the Late Bronze-Early Hellenistic period time interval (ca. 1300-300 BCE), is presented composed of integration of data from the Dead Sea (Ze’elim) and Lake Kinneret. While the latter was only subjected to palynological investigation, within the Dead Sea record sedimentological study accompanied the palynological analysis.

region’s pollen diagrams, which is considered to reflect the intensification of (domesticated) olive cultivation (D. Langgut, M.J. Adams and I. Finkelstein, “Climate, settlement patterns and olive horticulture in the southern Levant during the Early Bronze and Intermediate Bronze Ages (ca. 3600–1950 BCE),” *Levant* 48, 2016, pp. 1-18, with further literature.

73. Detailed information concerning the habitat and the requirements of olive were recently summarized by Langgut et al., *ibid*.


75. A more detailed palynological diagram of Lake Kinneret was recently published by D. Langgut et al., “Vegetation and climate changes during the Bronze and Iron Ages (~3600-600 BCE) in the southern Levant based on palynological records,” *Radiocarbon* 57, 2015, fig. 3 and appendix 1. The chronology of the record is based on accelerator mass spectrometry (AMS) radiocarbon dates of terrestrial short-lived organic remains which were used to create an age-depth model (D. Langgut, J. Finkelstein and T. Litt, “Climate and the Late Bronze Collapse: New Evidence from the Southern Levant,” *Tel Aviv* 40, 2013, pp. 149-175; Langgut-Adams-Finkelstein, *loc. cit.* (n. 72): table 1). The sequence is characterized by homogeneous lithology (V. Schiebel, *Vegetation and climate history of the southern Levant during the last 30,000 years based on palynological investigation*, Ph.D. Dissertation, Bonn 2013) and therefore it is not presented here. Assuming a uniform sedimentation rate in Lake Kinneret, the resolution of the palynological sampling is ca. 40 years.

76. The outcrop was extracted from the Ze’elim Gully which dissected the Ze’elim terrace located beneath the Masada plain on the southwestern side of the Dead Sea (Pl. IXa). Sediments which were embedded in the lake during the Holocene were exposed in the last two decades due to continuous anthropogenic retreat of the lake (currently >100 cm/year). The Ze’elim River (Nahal Ze’elim) that enters the Dead Sea at the Ze’elim terrace drains the southern part of the Judean Desert carrying waters and sediments that originate on the eastern flank of the central highlands ridge (Pl. IXa). Detailed description of the stratigraphy, sedimentology, radiocarbon chronology and palynology of this section is presented by D. Langgut et al., “Dead Sea Pollen Record and History of Human Activity in the Judean Highlands (Israel) from the Intermediate Bronze into the Iron Ages (~2500-500 BCE),” *Palynology* 38, 2014, pp. 280-302 and E. Kagan et al., “Dead Sea level changes during the Bronze-Iron Age transition,” *Radiocarbon* 57, 2015, pp. 237-252. It was sampled for pollen analysis at ca. 5 cm intervals, which represents about three decades between samples: Langgut et al., *loc. cit.* (n. 75).
Based on the Lake Kinneret pollen diagram during the time interval under study, two dry phases are evident: the first event occurred during the end of the Late Bronze Age (ca. mid-13th century-end of 12th century BCE),\(^{77}\) while the second one was identified during the Persian period. These dry events were recognized based on a pronounced decrease in arboreal pollen percentages (not exceeding 14.2% and 17.7\(^{78}\), respectively). Based on the age-depth model this dry event covers the 520-450 time interval, yet since it is a statistical model, inaccuracy of several decades should be taken into consideration. Olive percentages appear in higher frequencies during the Persian period dryness in comparison to the Late Bronze dry event (8.9-10.8% vs. 1.8-5.2%, respectively). Therefore it seems that the Persian period dry event was less severe than the Late Bronze climate crises, and that olive orchards were prevalent near Lake Kinneret at that time (mainly west and northwest of the lake).\(^{79}\) The reconstruction of the Dead Sea levels corroborates this assumption (Pl. VIII): R. Bookman (Ken-Tor) et al.\(^{80}\) suggest that during the Late Bronze, Dead Sea levels reached a minimum of −414 m bsl (below sea level) while during the Persian period dry event, Dead Sea stands reached only −409.5 m bsl. In addition, based on the Lake Kinneret pollen record the duration of the Persian dryness was shorter and most probably lasted only several decades, while the Late Bronze climate crises lasted about a century and a half.

The Iron I and the Early Hellenistic period are characterized by the highest arboreal and olive pollen percentages, which indicate both high available moisture and intense olive cultivation (olive pollen reached a maximum of 28.7% and 53.6%, respectively). During the Iron IIA still humid conditions are prevalent based on the relatively high arboreal percentages (up till 37.6%), though olive pollen percentages decline dramatically. The Iron IIB and IIC and the early phase of the Persian period are characterized by stable and moderate climate conditions based on the arboreal pollen percentages; yet the olive pollen curve shows that more intense olive cultivation occurred in the region during the Persian period in comparison to the previous period (Iron II).

\(^{77}\) Discussed in detail at Langgut et al., loc. cit. (n. 75).

\(^{78}\) At the same time, the dramatic decrease in arboreal pollen was also documented in a lower resolution pollen study which was performed on the same core (Schiebel, loc. cit. (n. 75), fig. 5.1).

\(^{79}\) More details about the source of the fossil pollen grains is available based on an investigation of recent pollen (Langgut-Adams-Finkelstein, loc. cit. (n. 72), supplement material).

The Dead Sea (Ze’elim) palynological diagram represents mainly the situation in the southeastern Judean Highlands since most of the pollen originated from this area. Along the Dead Sea (Ze’elim) section, two episodes of sand and aragonite crusts deposition occurred, representing accumulation in a shore environment, and therefore indicating a decline in Dead Sea levels and less precipitation in the Dead Sea drainage basin. The first dry phase appears at the lowest part of the profile, which covers the Late Bronze Age; pollen was not preserved in this section, probably due to oxidation. The second accumulation of sand and aragonite crusts is dated to the Persian period.

The Iron I time interval displays relatively high oaks and olive pollen percentages (22.9% and 9.4%, respectively), representing a well-developed natural Mediterranean forest/maquis and intense olive cultivation in the


82. The chronological framework of this record is less accurate than Lake Kinneret’s chronology due to some chronological uncertainties and limitations of the 14C dating method (Langgut et al., loc. cit. (n. 76); Kagan et al., loc. cit. (n. 76)). Therefore, the exact transitions between the different historical periods is not available for this record. Yet, some lithological encores can be used: the two seismites which appear in the middle of the Dead Sea (Ze’elim) sedimentological section were dated by E. Kagan et al. (*id.*), “Intrabasin paleoearthquake and quiescence correlation of the late Holocene Dead Sea,” *Journal of Geophysical Research: Solid Earth* 116, 2011, fig. 5) to the mid-8th century. Two seismites were also found at this time in the Ein Gedi core (C. Migowski et al., “Recurrence pattern of Holocene earthquakes along the Dead Sea transform revealed by varve-counting and radiocarbon dating of lacustrine sediments,” *Earth and Planetary Science Letters* 222, 2004, p. 301) and Ein Feshkha outcrop (Kagan et al., loc. cit.). The tops of the two seismites are separated by 10 cm of sediments or less at the three sites (Ze’elim, Ein Gedi and Ein Feshkha), indicating a few decades between the two events. Due to this short interval between the two earthquakes, it is currently not possible to accredit a specific date to the events, but one of them is attributed to the earthquake mentioned in Amos 1:1 in the days of Uzziah King of Judah (787-736) and Jeroboam II King of Israel (788-747). Austin et al. (S.A. Austin, G.W. Franz and E.G. Frost, “Amos’s earthquake: An extraordinary Middle East seismic event of 750 BC,” *International Geology Review* 42, 2000, pp. 657-671) suggest a date of ~750 for Amos’s earthquake. For the accumulation of the sands and aragonite crusts at the upper part of the section (probably represents few decades of deposition), the time range of 553-339 BCE was suggested by E. Kagan et al., “Intrabasin paleoearthquake and quiescence correlation of the late Holocene Dead Sea,” *Journal of Geophysical Research: Solid Earth* 116, 2011, pp. 304-311, fig. 5.

83. Accumulation of sands at the same period was also identified in a nearby sediment core (T. Litt et al., “Holocene climate variability in the Levant from the Dead Sea pollen record,” *Quaternary Science Reviews* 49, 2012, pp. 95-105), representing less precipitation in the northern Dead Sea drainage basin. The climatic implications of the lake fluctuations could be extended to larger areas in the southern Levant that are under similar atmospheric conditions (that is, climate systems which originated from the Mediterranean Sea).

84. Kagan et al., loc. cit. (n. 82).
Judean Highlands. Since the beginning of the Iron II and until the Persian period, both oaks and olive curves are inconsistent and exhibit low percentages (not exceeding 1.9% and 2.9%, respectively). Still, during most of this period sediments (mostly detritus) accumulated in lacustrine environment, representing high-stands of the Dead Sea. The low pollen frequencies may therefore be related to human pressure on the highlands vegetation (deforestation, intense grazing), rather than representing dry climate conditions. Indeed, surge in human activity that started in the Iron I reached its zenith during the Iron IIB-C (8th-7th centuries), with 520 settlements in the hill country, including a peak in the Judean Highlands.\textsuperscript{85} The almost total disappearance of pines (\textit{Pinus} – a pioneer tree in Mediterranean forest rehabilitation\textsuperscript{86}) indicates that the Mediterranean maquis/forest in the Judean Highlands was under strong anthropogenic pressure. Only at the beginning of the Hellenistic period there is evidence of the recovery of the natural vegetation together with an increase in olive pollen, representing more intense olive cultivation in the region and climate amelioration (total arboreal trees reached a maximum of 8.8%).

The Paleo-environmental reconstruction: regional and historical perspective

The data presented here point to dryer climate conditions towards the late 6th and during the first half of the 5th century (~ 520-450) with gradual climate amelioration during the following decades. The 4th century was already characterized by wet climate conditions. The paleoclimate reconstruction is based on the Lake Kinneret pollen record and the Dead Sea (Ze’elim) pollen and lithological record. The two records corroborate each other and hence strengthen the reliability of the results. These climate fluctuations are also supported by the Dead Sea lake level reconstruction.\textsuperscript{87} These past climate conditions represent the situation in the entire Mediterranean and steppe semi-arid zones of the southern Levant, since they


\textsuperscript{86.} E.g., Baruch, \textit{loc. cit.} (n. 74); id., “Palynogical evidence of human impact on the vegetation as recorded in Late Holocene lake sediments in Israel,” in S. Bottema, G. Entjes-Nieborg and W. Van Zeist eds, \textit{Man’s Role in the Shaping of the Eastern Mediterranean Landscape}, Rotterdam 1990, pp. 283-293.

\textsuperscript{87.} Bookman (Ken-Tor) et al., \textit{loc. cit.} (n. 80).
are under similar atmospheric conditions (precipitation which mostly originated from the mid-latitude Cyprus cyclones).

The dry climate in the Early Persian period affected the entire region, and even in the area around Jerusalem there are indications for a long period of drought, economic problems and shortage of agriculture supply. Descriptions of this situation can be found both in the prophetic literature from the Early Persian period as well as in the historiographical descriptions in Ezra-Nehemiah. However, the implications of these conditions on the climatically vulnerable semi-arid zones of the southern Hill Country, the northern Negev Desert and the southern Shephelah, were much more dramatic, destructive on the one hand in the long period of dry climate, and with many options for settlement and development of agriculture in this area during the wet period that started in the Late Persian period and continued in the Early Hellenistic period.

The Implication of the Climate Conditions in the Persian and Early Hellenistic Periods on the History of the Establishment of the Province of Idumea

As presented and summarized above, in the steppe-marginal areas of the southern Levant, even minor climatic variation can result in major environmental change. This is why dryer climate conditions during the late 6th to mid-5th century (~ 520-450), along with the absence of a major political and military force in this arid and remote area, was a major cause of the abandonment of most of the villages in the southern parts of the former Kingdom of Judah; it probably also had a major effect on the immigration of some of the population to the core areas of the province of Yehud, and possibly also on the nomadism process of other parts of this population. In any case, the conditions in this period caused a demographic vacuum that encouraged the emigration of nomadic elements, emigration that had already begun after the destruction of the Kingdom of Judah and the collapse of the southern settlement and military system. It might be that the successful take-over of northern Arabia by Nabunidus and his move to Taymāʾ (553-543) caused the disappearance of the Kingdom of Edom and probably the integration of its territory within greater Arabia. Groups of Nabateans, Arabs and Edomites migrated

88. And see, e.g., Haggai 1:6, 10-11; Nehemiah 5:3.
to the empty areas of the southern part of the former Judean Kingdom, and this population can be attested in the Late-Persian and Early Hellenistic periods in Mareshah and the area around it and combine the core population of the Province of Idumea.\(^90\)

The gradual increase in moisture which characterized the region in the late 5th and 4th centuries, probably encouraged a cultural change, by stabilizing the settlements which were highly dependent on water resources and local agriculture. The semi-nomadic elements could easily settle in the area and create in a fast process the settlement alignment of the Province of Idumea. According to the excavations at Mareshah,\(^91\) and according to the archaeological surveys and excavations (see below) it is clear that the main period of change in this area and the crystallization of the new settlement and demographic pattern occurred during the 4th century.

The developments in Idumea and the southwestern parts of Yehud in the 4th century have already been noted by many scholars, and have usually been explained by the reorganization of the Persian empire following the revolts in Egypt, when the Egyptians freed themselves from the Persian yoke (preserving their independence until 343). During this time, The Achaemenides may have understood that the Land of Israel, and mainly the southern parts of it, became the most important border area of the empire and a potential battlefield between the Persian army and many of its enemies. It may be that this period was the most important one in the history of this region since the Babylonian conquest and destruction at the end of the 7th and the beginning of the 6th century,\(^92\) and it probably was the reason for and the period during which the Achaemenides established their rule and reorganized the administration and the security along the roads in the southern parts of the coastal area,

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\(^92\) Briant, *op. cit.* (n. 89), pp. 646-655, 663-666, with further literature in pp. 991-992; Lipschits, *op. cit.* (n. 89), pp. 36-38.
the southern Shephelah and along the Beer-sheba–Arad Valley. This is when a fort was built at Tel Beer-sheba (Stratum H3) (which later yielded some 40 Aramean ostraca dated to 359-338 with Idumean, Arab and Judahite names); when a small fort was built at Tel Arad (Stratum V) (and which also yielded about 85 Aramean ostraca, indicating the importance of this site as a military and administrative center in the 4th century); and when the main administrative center at Lachish (Stratum I) was erected. This is also the period when most of the forts and administrative centers grew up along the roads in the Negev area, and the date of the many unprovenanced Aramaic ostraca, from which one can learn of the importance of the southern Shephelah and the Beer-sheba–Arad Valley to the Persian economy, military and administration.

The improved climate conditions during this period was an important factor in this change in settlement, demography and history of the area where the province of Idumea developed. This change also allowed the semi-nomadic population to settle in the southern Judean hills, the southern Shephelah and the Arad Valley, and it can be the background for a probable second wave of immigration to this quite vacant area. This is the best explanation of the data from the archaeological surveys. After the crisis of the early 6th century there is a great measure of continuity in the settlement of the central and southern Judean Shephelah south of the Ellah Valley. Of the 55 sites that existed in this area during the Persian period, 44 were already occupied by the Iron Age, and only 11 sites were built during this period. The low number of new sites in this area during the Persian period can be explained by the dryer climate conditions, and although we do not have clear historical and archaeological data, it seems likely that the penetration of the Arab and Idumean tribes

94. Ibid., pp. 363-364, with further literature.
97. Lemaire, op. cit. (n. 67).
to this region was very slow, most population probably maintained its semi-nomadic nature, and the main change occurred only when climate amelioration began in the Late Persian period. The archaeological data from the surveys indicates that between the Late Persian and the Hellenistic period a sharp change occurred in the area around Mareshah and Lachish when only 26 out of 55 Persian period sites continued to exist in the Hellenistic period (47%), and 123 new sites were established in this area, bringing the number of small sites around Mareshah and Lachish to 149.\(^99\)

Surveys cannot provide the exact date of the change in settlement, but the many focused excavations and salvage excavations can point to a probable date for this change in the 4th century. Along the line of the Ellah Valley, probably inside the borders of the Province of Yehud, a large village existed at Tel Azekah in the Late Persian–Early Hellenistic period, side by side with the small village in the nearby settlement at Khirbet Qeiyafa (Stratum III). The date of this stratum was defined by its excavators as the Late Persian–Early Hellenistic period,\(^100\) and recently, based on pottery as well as on numismatic grounds, D. Sandhaus and I. Kreimerman\(^101\) established the dates of the two phases of this stratum as the late 4th-3rd centuries. It seems that in the area to the north and west of Azekah there was a continuity in the rural settlement,\(^102\) as indicated recently in the excavations in the area of Beth-Shemesh.\(^103\)

During this period Mareshah became the center of the new Province of Idumea.\(^104\) To the southeast of Mareshah, Persian period remains were uncovered at Tel ‘Eton, including the foundations of a massive building at the top of the mound, and remains of a small village that surrounded it. A. Faust, H. Katz and P. Eyall\(^105\) described the large building as a fort but it could also be the central building of a small village, a kind of a farmhouse or a local estate. Based on local and imported pottery the

99. Ibid., pp. 141-142.
Persian phase of the site should be dated to the 4th century, its existence continued to the early 3rd century. Also at Tel Halif, remains of a building from the Persian period were excavated, together with other scattered remains from this period, and this was probably also the situation in Khirbet el-Qom. Also the date of the residency at Lachish, that was first dated by O. Tufnell to the 5th century, and later dated by A. Fantalkin and O. Tal to the early 4th century, is part of the above picture, even if the nature of this structure is of a more official character and the reasons for its establishment are different from the other rural settlements in the region.

In the hill country, a large public building with two Persian period phases was excavated in Jabel Nimra, very close to the ancient site of Tel er-Rumeide (Hebron). Based on the pottery and on a silver coin it seems that the main phase in the history of this site should be assigned to the Persian period and the second phase to the Late 5th and 4th centuries. The destruction of the structure was assigned to the end of the 4th century. Also in Khirbet Lutzifar in the southern Hebron highlands, beside some sherds from the Iron II and the Hellenistic period, the survey showed that 90% of the finds should be dated to the Persian period. According to Y. Baruch, this site was probably a local fort and served as a road station; he dated the erection of the site to the later part of the Persian period (personal communication).

106. Ibid., p. 113.
110. Fantalkin-Tal, loc. cit. (n. 95); id., loc. cit. (n. 95).
114. Ibid.
Conclusion

The semi-arid steppe zone of the southern Levant offers exceptional insights into human-environment interactions. Here we address an environmental threshold defined as a climate change to dryer conditions that limit the complexity of settlement pattern and economic opportunities during the early phase of the Persian period. This paper therefore presents a new perspective for a very dramatic change in the borders, settlement pattern and demography in the history of the southern part of the Land of Israel that are parallel to regional changes in vegetation patterns and climate conditions. The uniqueness of this study rests with the fact that for the first time a high resolution environmental reconstruction is available for the southern Levant during the period under discussion. The integration of the vegetation and climatic information together with an archaeological effort to distinguish different phases throughout the Persian period contributed dramatically to a better understanding of this crucial period in the history of the region. Between the well-known historical and archaeological starting and finish line, together with the accepted explanations for the changes that occurred in between, the new environmental data comes as a very important missing part of this puzzle, one that completes our understanding of the dramatic changes that occurred in the southern part of the Land of Israel between the 6th and the 3rd centuries BCE.

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DRY CLIMATE DURING THE EARLY PERSIAN PERIOD

APPENDIX

A note concerning the movement of plants across the Persian Empire

During the Persian period, the southern Levant was already characterized by a long history of olive (Olea) horticulture. Palynological, archaeobotanical, molecular and archaeological evidence point to the southern Levant as the locus of olive domestication, which began most probably during the mid-5th millennium BCE. During the Early Bronze Ib the southern Levant was already typified by substantial olive oil production on an industrial scale. In the northern Levant, it seems that the initial management of olive tree crops appears to have lagged somewhat, and began only in the Early Bronze II-III. Yet, during the following periods, the entire Levantine region was characterized by a well-developed olive horticulture. Within a new palynological diagram from Lake Parishan in southwest Iran, which covers the time period of ca. 2000 BCE–500 CE, a short duration peak of olive pollen was documented, starting at ca 500 BCE and lasting throughout the Achaemenid and Seleucid times. This peak points to significant olive cultivation within the region located close to the capital area of the Achaemenid empire, especially since Olea is not native to this region. At the same time that the peak in olive pollen was recorded, a significant amount of pine (Pinus) pollen was documented in the Lake Parishan palynological diagram. The occurrence of pine pollen is also suggestive of the planting of Pinus in the southern Zagros, given the total absence of the genus in the flora of Iran. Based on the pollen evidence of the presence of both olive and pine during the Achaemenid and Seleucid times, it can be hypothesized that the Persians encountered these trees especially after their conquests in the Eastern Mediterranean and then introduced them into their homeland. This hypothesis also seems to be corroborated by the fact that the term used to indicate the olive in the Achaemenid

115. Langgut-Adams-Finkelstein, loc. cit. (n. 72), with further literature.
116. Ibid., fig. 4; P. Sorrel and M. Mathis, “Mid-to late Holocene coastal vegetation patterns in Northern Levant (Tell Sukas, coastal Syria): Olive tree cultivation history and climatic change,” The Holocene 26, 2016, pp. 858-873.
117. M. Djamali et al., “Olive Cultivation in the Heart of the Persian Achaemenid Empire: New Insights into Agricultural Practices and Environmental Changes Reflected in a Late Holocene Pollen Record from Lake Parishan, SW Iran,” Vegetation History and Archaeobotany 25, 2016, fig. 3. Olea pollen appears during historical periods in several other palynological diagrams from Iran. Yet, within all these diagrams the presence of olive cannot easily be linked to local cultivation due to the lack of other archaeological evidence and/or not suitable habitat requirements. The appearance of olive pollen was attributed to a long distance air-borne transportation from cultivars or natural stands from farther regions (for example, the Almalou pollen diagram from northwestern Iran) – M. Djamali et al., “Notes on arboricultural and agricultural practices in ancient Iran based on new pollen evidence,” Paléorient 36, 2011, pp. 175-188. This was also the interpretation given to Olea pollen within the Lake Van pollen diagram from north-east Turkey – W. Van Zeist and H. Woldring, “A postglacial pollen diagram from Lake Van in East Anatolia,” Review of Palaeobotany and Palynology 26, 1978, pp. 249-276.
Elamite and Persian languages (zadaum, zaita, zayt) were West Semitic loanwords (in Hebrew: zaeit, in Arabic ziyeton).

At the same time, on the other side of the Persian empire, palynological evidence points to tree importation from the other direction: from Persia into the Levant. Several years ago we identified pollen grains of citron (*Citrus medica*) in a royal Persian garden in Ramat Rahel near Jerusalem, dated to the 5th-4th century BCE, when the region was under the hegemony of the Persian empire.\(^{120}\) Our investigation showed that citron seems to have made its way to Ramat Rahel from the artificial Achaemenid royal palatial gardens.\(^{121}\) While the east-west migration of citron was as an elite product destined for luxurious gardens (first in Ramat Rahel Royal Persian garden and later in Roman gardens owned by the affluent\(^{122}\)), olive west-east migration was most probably as a cash crop.

The introduction of olive into the heart of the Persian Achaemenid empire in southwest Iran therefore represents a dual movement. The relatively short duration of olive cultivation can be explained in light of improvement in trade routes, which made it more efficient to import the final products. The cessation of olive cultivation could also be as a result of climate; the Irano-Turanian environment of southwest Iran is harsher than the Mediterranean vegetation zone where olive cultivation thrives. Orchards could have been paralyzed due to waves of extremely low temperatures, which characterized this region from time to time.

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\(^{121}\) More information concerning the mechanism by which citron was adapted, as well as the concept of *pardesu*, is available at Langgut *et al.*, *ibid.*, and D. Langgut, “Prestigious fruit trees in ancient Israel: First Palynological Evidence for Growing *Juglans regia* and *Citrus medica*,” *Israel Journal of Plant Sciences* 62, 2015, pp. 98-110.
