Dry Climate in the Middle Bronze I and Its Impact on Settlement Patterns in the Levant and Beyond: New Pollen Evidence

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Dry Climate in the Middle Bronze I and Its Impact on Settlement Patterns in the Levant and Beyond: New Pollen Evidence*

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**Introduction**

Recently studied fossil pollen records from the Sea of Galilee and the Ze’elim ravine located on the western shore of the Dead Sea reveal climatic fluctuations in the Levant in the Bronze and Iron Ages.\(^1\) The study was carried out in an unprecedented resolution of dense 40-year time intervals between one pollen sample and another\(^2\) and deployed a robust radiocarbon dating scheme. This enabled, for the first time, a detailed reconstruction of climate conditions in historical periods, including the identification of short-term events that can be missed in low-resolution pollen studies. The Sea of Galilee and Ze’elim (Dead Sea) records corroborate each other and hence strengthen the reliability of the results. Tracing these climate fluctuations is based on the identification of shifts in vegetation frequencies: high arboreal pollen percentages of the members of the Mediterranean forest/maquis\(^3\) represent humid climate conditions.

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\(^1\) D. Langgut, I. Finkelstein, and T. Litt, “Climate and the Late Bronze Collapse: New Evidence from the Southern Levant,” *Tel Aviv* 40: 149–75; 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): 1–23, respectively; for pollen identification, a reference collection of Israeli pollen flora was used (Steinhardt Museum of Natural History, Tel Aviv University), as well as regional pollen atlases.

\(^2\) Compared to samples per 180–200 years in, e.g., T. Litt et al., “Holocene Climate Variability in the Levant from the Dead Sea Pollen Record,” *Quaternary Science Reviews* 49 (2012): 95–105, for the same period of time.

\(^3\) The most dominant trees are evergreen and deciduous oak (*Quercus calliprinos* and *Quercus ithaburensis* pollen type respectively). Other Mediterranean trees appear in lower percentages: *Phillyrea, Pistacia spp.*, *Pistacia* (pistachios), *Pinus halepensis* (Aleppo pine) and *Ceratonia siliqua* (carob tree). Cultivated olives (*Olea europaea*) were combined within the natural elements of the Mediterranean forest/maquis represent humid climate conditions.
while lower percentages of these plants and a parallel increase in percentages of dwarf shrubs and herbs represent a reduction in precipitation. A major dry period traced in the Sea of Galilee and Ze’elim pollen diagrams in the ~1250–1100 BCE time interval seems to have played a role in the “crisis years” at the end of the Late Bronze Age. In this case, the pollen record is supported by archaeological evidence for destruction layers and by ancient Near Eastern texts—both of which point to the same time interval. Other changes in the Bronze and Iron Ages were apparently milder, but could still influence human activity in the region, especially in the semi-arid, Irano-Turanian vegetation zone in the south and east (defined by ~400–200 mm rainfall isohyet; Fig. 1a). In this marginal area, even minor climatic variation can result in major environmental change. One such change—a dry period in ~2000–1800 BCE—is the subject of this article.

The Environmental Setting

The 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 Mediterranean and then cross the region from west to east. This content downloaded from 132.66.161.108 on Wed, 15 Oct 2014 02:42:56 AM
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Figure 1—a. Present vegetation cover and rainfall isohyets (after M. Zohary, *Plant Life of Palestine (Israel and Jordan)* [New York, 1962] and A. Shahar and T. Sofer, *The New Atlas of Israel* [Jerusalem, 2011], respectively). b–d. Distribution of settlements in the southern coastal plain (after Gophna and Potugali, “Settlement and Demographic Processes in Israel's Coastal Plain”), with the location of the semi-arid (steppe) environment in the: b. Intermediate Bronze Age. c. Middle Bronze Age I. d. Middle Bronze Age II–III.
wind-driven pollen from these two adjacent zones. In addition to air-born pollen, they receive stream-driven pollen from large sectors of the Levant—mainly through the Jordan River (Fig. 2), but also via local streams. Though these records do not represent the situation in the northern Levant, (e.g., the northern part of the Beq’a of Lebanon, the Orontes, and the area of Aleppo and the region to its east), they cannot be very different since the entire Levantine region is dominated by the same humidity source—the Mediterranean (Cyprus cyclones).

Climate Conditions, 2500–1500 BCE

Below, we describe the paleo-environmental conditions in the southern Levant ~2500–1500 BCE as they emerge from the Sea of Galilee and the Ze’elim pollen diagrams. In terms of the archaeology of the southern Levant, this period covers the Intermediate Bronze (Early Bronze IV) and the Middle Bronze Ages. In the northern Levant, it covers much of the Early Bronze IV and the Middle Bronze Ages. The two regions present different settlement systems (even in the Mediterranean zone): cities dominating rural and pastoral groups in the north, and agro-pastoral/rural areas in the south.

In our high-resolution Sea of Galilee and Ze’elim pollen records, the Intermediate Bronze (~2500–1950 BCE) is characterized by relatively high percentages of Mediterranean arboreal vegetation, representing a well-developed, widespread Mediterranean forest/miquis. Within this fairly wet period, a short-duration and relatively mild dry event was identified in the Sea of Galilee pollen record at ~2300 BCE (Fig. 3). Slightly.

10 EDJ 3, 4 and 5 in M. Lebeau, ARCANE I Jezirah (Turnhout, 2011).
11 See chart in ibid., 12.
12 Regev et al., “Chronology of the Early Bronze Age in the Southern Levant.”
later, a more prolonged and harsher dryness is evident in the decreasing percentages of the Mediterranean arboreal pollen in the Sea of Galilee and Ze’elim pollen records at 2000–1800 BCE. This dryness is also evident in the lithological record of our Ze’elim core: during this time, sediments were deposited in a terrestrial environment (e.g., sand, beach ridge) rather than in a lake environment as they were during previous and subsequent periods; this was the result of the shrinkage of the Dead Sea. The Hula Lake pollen record also points to dryer climate conditions based on a decline in the arboreal pollen percentages around 2000–1900 BCE.  

This time-frame (2000–1800 BCE) covers the very end of the Intermediate Bronze Age (Early Bronze IV) and the Middle Bronze I. The latter period is conventionally dated to ca. 2000/1950–1800/1750 BCE, or, following the Tell el-Dab’a stratigraphy and chronology, to ca. 1950–1700 or 1920–1720 BCE. It seems that, during this arid phase, the Mediterranean maquis/forest shrank and the semi-arid boundaries shifted to the north and west. It is noteworthy that the decrease in the percentage of trees was not accompanied by an increase of secondary anthropogenic palynological indicators, which denotes that the shrinkage of the Mediterranean maquis/forest was a result of climate rather than man-induced changes.

The dry phase in the Middle Bronze I (~2000–1800 BCE) was milder compared to the severe dry climate phase at the end of the Late Bronze Age (~1250–1100 BCE): arboreal percentages reached a minimum of 18.7% and 13.1% (respectively, from the total terrestrial pollen sum). In comparison, during the Early Bronze IB wet period, arboreal pollen percentages reached a maximum of 59.5%. Olive pollen frequencies also declined dramatically in both dry phases with minimum values of olive pollen at 3.2% during the Middle Bronze I dry spell and 1.8% during the Late Bronze climate crisis. These pronounced lows represent the shrinkage of olive orchard distribution, probably as a result of less available moisture.

Higher arboreal percentages were documented in the southern Levant pollen records starting in ~1800 BCE and during the Middle Bronze II–III (~1750/1700–1550/1500 BCE), probably representing a wetter period and hence a renewed shift of the Mediterranean vegetation zone to the south and east, with a parallel withdrawal of the semi-arid steppe zone. However, the Sea of Galilee arboreal/non arboreal ratios (Fig. 3) seem to indicate that the Mediterranean maquis/forest was less wide-ranging than during the Intermediate Bronze Age, with maximum values not exceeding 37.9% arboreal pollen during the Middle Bronze II–III, compared to 47.5% in the Intermediate Bronze. This could be an outcome of somewhat lower precipitation, but also could have resulted from human pressure, e.g., clearance of woodland. Indeed, demographic recovery in the Middle Bronze II–III is evident from the dramatic expansion of the urban sector and from the recovery of the rural settlement system. Evidence for more humid conditions during the later phases of the Middle Bronze is also provided by the lithology of our Ze’elim core, which points to rising lake levels, as well as by other Dead Sea paleoclimate records.

**Climate during the Late 3rd–Early 2nd Millennium: A Regional Comparison**

Somewhat drier climate conditions in the southern Levant during the Intermediate-Middle Bronze Age transition are also evident from other (non-pollen) paleoclimate proxies. However, none of the available records indicates severe arid conditions. The

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14 van Zeist et al., “Holocene Palaeocoeology of the Hula Area.”
17 E.g., *Plantago lanceolata* (ribwort plantain) pollen type; Barchu “Palynological Evidence of Human Impact.” The lithology of our Ze’elim core (see above), confirms the palynological observation of natural dryness rather than man-induced changes.
18 Langgut, Finkelstein, and Litt, “Climate and the Late Bronze Collapse.”
Soreq Cave speleothems isotopic record points to a decrease in precipitation ~2200–1900 BCE, which is mainly evident in the increasing values of the $^{13}$C with a peak at 2000 BCE. However, the estimated annual rainfall during this aridity did not drop below 500 mm.\(^{21}\) Declining levels of the Dead Sea during the period of 2250–1900 BCE also indicate increased arid conditions, though lake levels were still above the sill.\(^{22}\) The isotopic composition of tamarisk wood from the Mount Sedom Cave on the south-western margins of the Dead Sea shows a succession of droughts at ~2200–1930 BCE, with a prominent but short-lived dry event at approximately 2020 BCE, followed by a longer event at approximately 1930 BCE that ultimately killed the tree,\(^{23}\) meaning that the dry event could have lasted even longer. In Jordan, stream incision occurred sometime around 2000 BCE or shortly thereafter (i.e., Wadi el-Wala and Wadi esh-Shallalah). Drier climate conditions had caused a drop in the water table and created a flash flood regime that led to the erosion of floodplain sediments.\(^{24}\)

Regional Perspective

Best-known and most-debated is the so-called 4.2 ka BP event, a proposed climate anomaly at ca. 2200 BCE, which ostensibly created cool, dry conditions over much of the planet.\(^{25}\) The collapse of the Akkadian empire has been explained by this rapid aridity event.\(^{26}\)


\(^{22}\) I.e., the threshold separating the northern and southern basins; Migowski et al., “Holocene Climate Variability and Cultural Evolution.”


\(^{24}\) C. E. Cordova, “Floodplain Degradation and Settlement History in Wadi al-Wala and Wadi ash-Shallalah, Jordan,” *Geomorphology* 101 (2008): 443–57; Cordova suggests that cultural landscape changes could also have been one of the causes for the stream incision around 2000 BCE.


The extent and effects, and even actuality, of this climate anomaly have, however, been debated.\(^{27}\) In areas neighboring the Akkadian empire, some Early Bronze Age cities continued to flourish and the pronounced break came only around 2000–1900 BCE.\(^{28}\) Moreover, the rise of the state of Ur III contradicts the notion that the ca. 2200 BCE event had a profound and immediate impact on southern Mesopotamia.\(^{29}\) Additionally, and in contrast to the 8.2 ka BP climate event (~6200 BCE), there is no accepted causal mechanism for a climate anomaly at 2200 BCE,\(^{30}\) and there are


\(^{29}\) Ibid., 156.

\(^{30}\) N. Roberts et al., “Climatic, Vegetation and Cultural Change in the Eastern Mediterranean during the Mid-Holocene Environmental Transition,” *The Holocene* 21 (2011): 147–62. It has been proposed that volcanic eruptions were at least one of the reasons for severe droughts of great magnitude, which lasted about 300 years and affected the eastern Mediterranean (e.g., Weiss et al., “Genesis and Collapse”). Although some volcanic activities are within this time frame, several scholars have already pointed out the difficulty of finding a direct link between relevant high-magnitude eruptions and a global climate change (e.g., B. J. Peiser, “Comparative Analysis of Late Holocene Environmental and Social upheaval: Evidence for a Global Disaster around 4000 BP,” in *Natural Catastrophes During Bronze Age Civilisations*, ed. B. J. Peiser, T. Palmer, and M. E. Bailey, BAR International Series 728 (Oxford, 1998), 117–39; Finné et al., “Climate in the Eastern Mediterranean and Adjacent Regions”). The eruptions seem to be more on a regional scale than on one with a global impact, particularly given that they...
no signals of abrupt climate change in the ice-core records.

The palynological evidence for drier climate conditions in the Levant starting around 2000 BCE is corroborated by two Eastern Mediterranean palynological records: a decrease in arboreal pollen and a parallel increase in steppe-like elements indicative of less available moisture is evident in Lake Eski Acıgöl (central Anatolia) between ~2300–1850 BCE, and in Lake Van (eastern Turkey) around the same time. However, these records do not point to an event unique in magnitude. Other than pollen, a sudden rise in the input of gypsum-rich sand into Lake Tecer (central Anatolian plateau) at ~2000–1800 BCE indicates drier climate conditions. Based on pedogenic carbonate coatings, K. Pustovoytov, K. Schmidt, and H. Tabald report that aridity is evident in south-eastern turkey since ~2000 BCE. The two carbon isotope studies of Lake Eski Acıgöl Pollen Evidence Compared with the Near Eastern Environment, published in Palaeohistoria 43/44 (2003): 1–34, and Plantago lanceolata in the Levantine region during some specific humid phases during the Late Bronze Age (~2000–1700 BCE), published in Quaternary Research 66 (2006): 432–41, both provide evidence for drier conditions in the Near East, but the record does not indicate a severe regional aridity.

Two palo-climate studies show a prominent dry spell further to the south: eolian dust of Mesopotamian origin which was deposited in the Gulf of Oman is indicative of a severe regional aridity dated to ~2100–1800 BCE. A severe drought is also evident from the analysis of brine sediments from the northern Red Sea at about 2200–2000 BCE, but the record ends at about 1950 BCE. It is important to note that the higher intensity of the dry events that emerge from these two southern records, in comparison to the Eastern Mediterranean (including Levantine) records, might result from differences in the major climate systems that are responsible for humid conditions in the two areas: while the Levantine and most of the eastern Mediterranean are mainly influenced by the middle- to high-latitude westerlies (from the North Atlantic Ocean), the southern part of the Near East is also under the control of other climate systems (e.g., the Indian and African monsoon systems).


However, some paleoclimate data indicate that the monsoon system was also partially responsible for increasing humidity in the Levantine region during some specific humid phases during the Pleistocene and the Early Holocene (e.g., sapropel accumulation on the eastern Mediterranean sea floor; M. Rossignol-Strick, 2006: 432–41).
the broad synthesis of Roberts et al., the crises that brought about the end of Early Bronze Age cultures in the Near East occurred one after another during a ca. 400-year time span. They suggest that environmental consequences of climatic dryness occurred earlier (~2250–2200 BCE) in continental regions and only later (~2050–1900 BCE) in areas closer to the coast.

To sum up, a short duration dryness dated to ~2300 and a more pronounced longer event dated to ~2000–1800 BCE are indicated by recent, high-resolution, well-dated southern Levant pollen records. Other regional paleo-climate records point to a progressive event that lasted several centuries (~2300–1800 BCE), or a series of droughts that occurred over an extended period of time. This aridity, which is evident from the Levantine and the eastern Mediterranean paleo-climate records (all of which are mainly influenced by the same humidity source—the Mediterranean), was most probably not a very severe one. In other words, in areas that are characterized by Mediterranean climate (where precipitation >400 mm/year), the dryness was most probably not devastating. On the other hand, in the semi-arid Levantine steppe environments (~400–200 mm/year), which were highly populated during the wetter Early Bronze period, this dryness had a dramatic impact on the inhabitants.

**Settlement Patterns**

Is there evidence for a dry phase ~2000–1800 BCE in the archaeological record? Needless to say, a moderate dry event should be difficult to detect in the wet areas of the Levant, such as the Jezreel Valley or the coastal plain north of the Yarkon River, where a slight decline in precipitation would not necessarily lead to change in subsistence strategies. The spotlight should therefore be on the southern and eastern semi-arid transition zones, which receive less than 400 mm of rain annually. In what follows, we wish to first focus on the southern Levant, which is represented in our two pollen records, and then look at the situation further to the north.

**The Southern Levant**

The southern part of the southern Levant is better recorded archaeologically (e.g., almost fully covered by surveys) than its eastern steppe sectors. We refer to the southern coastal plain, the southern Shephelah, the south Hebron hills, and the Beer-sheba Valley.

Theoretically, in these regions a dry event could leave its mark on several archaeological media, such as the archaeobotanical and archaeozoological records. Yet, in order to reach long-term observations one needs a number of reports that cover at least the two phases of the Middle Bronze, and preferably a longer period of time. Unfortunately, almost no such record exists. One faunal report that fits this description is that of Aphek, where the transition from the Middle Bronze I to the Middle Bronze II is characterized by a change to more cattle and fewer sheep and goats. This shift may be understood as reflecting wetter conditions in the Middle Bronze II–III, but the site is located too far to the north, and the changes could have been initiated by factors other than climate.

Though settlement patterns are affected by a variety of factors, they provide a sensitive archaeological medium to detect possible climate oscillations in semi-arid areas—even mild ones. In the area discussed here, expansion of settlements to the south may indicate wetter conditions, whereas a shift to the north may hint at a dry phase. This is true mainly for small sites, which were villages and farmsteads removed from perennial water sources and that subsisted mainly (sometimes solely) on agriculture and animal husbandry.


The semi-arid environment the change was much more dramatic—from one to eight sites and from five to 30 built-up hectares. In the southern coastal plain, then, the Middle Bronze I features a clear shift to the north, with almost complete desertion in the semi-arid environment; settlement activity expanded to this area in the Middle Bronze II–III.48

The Shephelah (the northern part of which is in the Mediterranean zone) features 48 undivided Early Bronze II–III sites that are estimated to have covered 125 built-up hectares, 23 Intermediate Bronze settlements with a total built-up area of 36 hectares, a dramatic decrease to 13 sites which covered 40.5 hectares in the Middle Bronze I and an increase to 24 settlement with a total built-up area of 65 hectares in the Middle Bronze II–III.49 The southern sector of this region (south of Lachish, today receiving less than 400 mm of rain annually) was densely settled in the Early Bronze II–III but relatively sparsely settled in both phases of the Middle Bronze.50 The detailed Lachish and Amaziah survey maps in the southern Shephelah (~350 mm annually at Amaziah) demonstrate these trends well.51 Note that the sites which feature continuity of activity are mostly the main mounds, while rural sites almost disappear in the Middle Bronze I.

No Intermediate Bronze settlement (to differ from cemeteries) is known in the hill country south of Hebron (400 mm rain annually in this town and decreasing southwards). Most of the sixteen Middle Bronze I sites recorded in the entire Judean hills are located in the middle and northern parts of the area (that is, in the Mediterranean zone). Settlement activity spread to the south of Hebron in the Middle Bronze II–III.52 No intermediate Bronze and Middle

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**Table 1—Coastal Plain Sites**

<table>
<thead>
<tr>
<th>No. sites</th>
<th>Built-up hectares</th>
<th>Entire coastal plain</th>
<th>Gaza coastal plain and further south</th>
<th>percentages of built-up area in semi-arid environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>EB III</td>
<td>IBA</td>
<td>MB I</td>
<td>MB II–III</td>
<td>EB III</td>
</tr>
<tr>
<td>No. sites</td>
<td>12×</td>
<td>16</td>
<td>45</td>
<td>59</td>
</tr>
<tr>
<td>Built-up hectares</td>
<td>80</td>
<td>14</td>
<td>180</td>
<td>210</td>
</tr>
</tbody>
</table>

* Gophna and Portugali, “Settlement and Demographic Processes in Israel's Coastal Plain.”

**Notes:**

45 Gophna and Portugali, “Settlement and Demographic Processes in Israel’s Coastal Plain,” (cemeteries not included).


47 S. L. Cohen, Canaanites, Chronologies, and Connections (Winona Lake, IN, 2002), Figs. 15–16.

48 Gophna and Portugali, “Settlement and Demographic Processes in Israel’s Coastal Plain.”


Bronze I settlement is known in the Beer-sheba Valley (receiving less than 200 mm of rain annually). The Middle Bronze II–III features the two rampart sites of Tel Masos and Tel Malhata, as well as the small Tel Malhata nearby.53

As we have already noted, rural sites may be more sensitive than the main urban centers for detecting settlement oscillations that result from climate change, as the latter may supplement their subsistence by long-distance trade, craft activities, etc. Nonetheless, the pattern described above emerges also when one examines the settlement history of the main mounds in the southern lowlands (Fig. 4 and Table 2). A significant number of urban centers are known in the Early Bronze III, extending as far south as Tell es-Sakan south of Gaza and Tel Halif in the southern Shephelah,54 but not reaching the area of Nahal Besor and the Beer-sheba Valley (~200–100 mm rain annually). The southernmost urban centers in the Middle Bronze I were Ashkelon on the coast (located in the Mediterranean climate zone) and Tell Beit Mirsim (slightly north of Tel Halif, ~300 mm of rain annually) in the upper Shephelah.55 A large number of mounds were settled in the Middle Bronze II–III, including southern sites such as mounds along Nahal Besor, Tel Halif in the Shpehelah and Tel Masos and Tel Malhata in the Beer-sheba Valley.56

A word of caution is in place here: the expansion of fortified centers as far south as the area of Nahal Besor and the Beer-sheba Valley must have been influenced by a combination of factors, including trade, demographic density and security needs. Climate conditions—a dry event in the Middle Bronze I and wetter conditions in the Middle Bronze II–III—are another factor; important as they may be, however, they cannot stand alone. Note, for instance, the prosperity in the southern lowlands, down to the Tell el-Farah (Nahal Besor)–Tel Sera line, in the Late Bronze III (the days of the 20th Dynasty in Egypt)—a period that is characterized by severe dry conditions in the region.57

53 I. Beit-Arieh, Map of Tel Malhata (144) (Jerusalem, 2003), 11.
54 N. Getzov, Y. Paz, and R. Gophna, Shifting Urban Landscapes during the Early Bronze Age in the Land of Israel (Tel Aviv, 2001); less than 300 mm of rain falls annually along this west-east line.
55 Cohen, Canaanites, Chronologies, and Connections.
56 Down to the 200–100 mm isohyet today; see map in Kempinski, “Middle Bronze Age,” 167; see E. D. Oren, “The ‘Kingdom of Sharurahu’ and the Hyksos Kingdom,” in The Hyksos: New Historical and Archaeological Perspectives, ed. E. D. Oren, University Museum Monograph 96 (Philadelphia, 1997), 253–83, who emphasized the shift to the south in the Middle Bronze II–III.
57 Langgut, Finkelstein, and Litt, “Climate and the Late Bronze Collapse.”

Table 2—Main multi-period urban centers in the southernmost Levantine lowlands

<table>
<thead>
<tr>
<th>Site</th>
<th>Region</th>
<th>EB III</th>
<th>MB I</th>
<th>MB II–III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tel Lachish</td>
<td>Upper Shephelah</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Tell Nagila</td>
<td>Lower Shephelah</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Tell el-Hesi</td>
<td>Lower Shephelah</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tell Beit Mirsim</td>
<td>Upper Shephelah</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Tel Halif</td>
<td>Upper Shephelah</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ashkelon</td>
<td>Coast</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Tell el-Ajul</td>
<td>Coast</td>
<td>-</td>
<td>?</td>
<td>+</td>
</tr>
<tr>
<td>Tel Haror</td>
<td>Coastal Plain</td>
<td>?</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Tel Sera</td>
<td>Coastal Plain</td>
<td>-</td>
<td>-</td>
<td>+ [MB III]</td>
</tr>
<tr>
<td>Tell Jemmeh</td>
<td>Nahal Besor</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Tell el-Farah south</td>
<td>Nahal Besor</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Tel Malhata</td>
<td>Beer-sheba Valley</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Tel Masos</td>
<td>Beer-sheba Valley</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

* For a detailed catalogue for the Middle Bronze, see A. A. Burke, “Walled up to Heaven”: The Evolution of Middle Bronze Age Fortification Strategies in the Levant, Studies in the Archaeology and History of the Levant 4 (Winona Lake, IN, 2008), 228–319.
Turning to the eastern flank of the southern Levant, it is difficult to assemble the relevant information regarding settlement systems in Jordan. First, the very identification of pottery in surveys carried out there is sometimes questionable.\(^{58}\) Second, there is no distinction between early and late Middle Bronze sites.\(^{59}\) Still, data from surveys provide some interesting information. Let us start south of Wadi Mujib (receiving 300 mm rainfall annually, and even less farther south): in the Early Bronze II–III, settlement activity, including fortified sites, spread as far south as the Kerak plateau;\(^{60}\) the situation farther south, in the area of Wadi el-Hasa, is not clear.\(^{61}\) Intermediate Bronze settlements are attested in the Kerak plateau\(^{62}\) as well as the Wadi el-Hasa region.\(^{63}\) It is difficult to delineate the southernmost line of the settled land in the Middle Bronze Age; one summary indicates that only two of twenty Intermediate Bronze Age sites in southern Jordan were occupied in the Middle Bronze.\(^{64}\) The entire 2nd millennium—Middle and Late Bronze alike—is missing from the Edomite plateau;\(^{65}\) note that this is the only part of the Levant where both the south and east factors (regarding climate) are at work.

North of the Mujib, in the Madaba plain (with a rainfall of 250 to 400 mm), forty-six Early Bronze sites were recorded, but only fourteen Middle Bronze sites, with not even one dating to the Middle Bronze I.\(^{66}\)

Information about the steppe areas further north in Jordan is not available.\(^{67}\) It is noteworthy, however, that in a well-watered Mediterranean region such as the Gilead (northwest Jordan, ca. 300–600 mm annually), the number of Early Bronze and Middle Bronze sites recorded by S. Mittmann\(^{68}\) is almost the same.

Moving to south-western Syria, in the Hauran also no decline in the Middle Bronze has been observed.\(^{69}\) Though this region receives ca. 300–250 mm of rain annually, its nature as a steppe zone is balanced by its many small groundwater sources.\(^{70}\) The area of Damascus, too, though it receives only ca. 250 mm of rain annually, is well-watered by streams from the Anti-Lebanon mountain range and hence does not represent a true steppe zone.

To sum-up this overview of the settlement patterns in the semi-arid zones in the southern Levant, the southern line of permanent (especially rural) settlement activity shifted to the north in the Middle Bronze I relative to the Early Bronze III and even to the Intermediate Bronze.\(^{71}\) It extended again to the south in the Middle Bronze II–III.

The Northern Levant

The northern part of the Beq’a of Lebanon, located in the rain shadow of the Mount Lebanon range, today receives an average of 230 mm of rain per year. In an area like this, even a small decrease in precipitation may have had a devastating effect on subsistence economy and settlement systems. Survey works conducted in this area provide data regarding settlement pat-

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\(^{59}\) G. Palumbo, The Early Bronze Age IV in the Southern Levant (Rome, 1991), 61, and “The Early Bronze Age IV,” in Archaeology of Jordan, ed. MacDonald, Adams, and Bienkowski, map on 237; see also 244.


\(^{62}\) Steele, “Early Bronze Age Socio-Political Organization,” Fig. 8.

\(^{63}\) G. Palumbo, The Early Bronze Age IV in the Southern Levant (Rome, 1991), 61, and “The Early Bronze Age IV,” in Archaeology of Jordan, ed. MacDonald, Adams, and Bienkowski, map on 237; see also 244.

\(^{64}\) Ibid., 243.


terns in the periods under discussion: sixty-seven Early Bronze II–III, sixteen Intermediate Bronze, twenty-eight Middle Bronze I, and sixty Middle Bronze II–III sites have been recorded in the Beq’a.72

The steppe area near Homs (ca. 400 mm rainfall annually, at Hama slightly farther to the north, 370 mm) features a decline of the settlement system in the Middle Bronze relative to the Early Bronze IV.73 The survey around nearby Qatna reveals a peak in settlement activity in the Early Bronze IV, with seventeen sites, and a moderate decline to twelve settlements in the Middle Bronze; this could have been the result of population flocking to the huge city of Qatna. Still, the details are interesting: the area that was deserted in the Middle Bronze Age is the eastern flank, along Wadi Mydan.74

The steppe area east of the Hama-Aleppo line, along the 200 mm isohyet (located south of the Jabbul Plain, discussed below) also flourished in the Early Bronze IV. In the Middle Bronze, the number of sites diminished, mainly in the east, where the agriculturally less-attractive areas were virtually abandoned. In the western sector of this area, the population now concentrated in the wetter areas, where occupational density increased.75

Moving farther north, one of the most detailed studies in the steppe belt was conducted at the site of Umm el-Marra and its vicinity—the Jabbul Plain—located east-south-east of Aleppo. Umm el Marra (ca. 300 mm rainfall) was at least partially abandoned in the late third millennium, at the end of Early Bronze. This

low occupation phase lasted ca. 2000–1800 BCE—in the Middle Bronze I (possibly a slightly shorter period, according to G. Schwarz et al.).76 In the Middle Bronze II, the site prospered again.77 The archaeo-zoological evidence shows a shift in the Middle Bronze to animals better adapted to drier conditions.79 Plant remains, too, demonstrate that the area around the site was more steppe-like in the Middle Bronze than in the third millennium.79 The settlement pattern in the vicinity of Umm el-Marra is no less interesting; it marks a certain abandonment process in the early second millennium BCE. Twenty-five of the forty-seven Early Bronze sites in the area were abandoned, mainly in the drier eastern sector of the area. Middle Bronze I sherds were found at four sites only. Late Middle Bronze occupation was traced in a large number of sites.80 Centers in drier environmental zones in the region were more seriously affected by the decline in the late third millennium than others.81


78 Ibid, 435.

79 Ibid.


81 Schwartz et al., “From Urban Origins to Imperial Integration”: 185.
Regarding the upper Euphrates, Cooper describes a century-long abandonment in the late third millennium and regeneration in the early second millennium. Wilkinson and Danti date the processes slightly differently, with peak prosperity in the late third millennium and decline in the early second millennium.

The Khabur area (ca. 200 mm rainfall annually) featured a phase of “plundering and desertification,” possibly as a result of warfare, ca. 2350 BCE, followed by a period of marked decline and abandonment in the EDJ 4c period, dated ca. 2200–2100 BCE. This trend continued in the EDJ 5 period, ca. 2100–2000 BCE, and probably into the very early second millennium. From the settlement history perspective, the 2200–1900 BCE time-interval creates a continuity of decline after great prosperity earlier in the third millennium, and if one incorporates what we know from the Jabbul Plain and the Upper Euphrates (i.e., prosperity in the late third millennium and decline thereafter), instability and settlement decline in the north-east lasted for over five centuries, between ca. 2350–1800 BCE. Indeed, Schwartz shows that decline in the late third and early second millennia may have taken place in slightly different times in different parts of northern Syria. In fact, they suggest two phases of degeneration, one in ca. 2300–2200, and another ca. 2000–1900. Note that in the Sea of Galilee pollen record, a short dry event was dated to ~2300 BCE, and a more prolonged arid phase was dated slightly later, to 2000–1800 BCE.

A pivotal question is the reason (or chain of reasons) for settlement decline in the north: socio-political urban collapse possibly related to Akkadian imperialism, land degradation, a long, dry period, or a combination—socio-political troubles first (ca. 2350–2200 BCE) and climate later (2200–1900/1800 BCE).

In any event, evidence for decline in the semi-arid zones in both the southern and northern Levant in the early second millennia BCE (in certain areas in the north the trend could have started somewhat earlier) seems to be robust. Large areas seem to have been abandoned. So the question is: where did these people go?


85 Danti, “Late Middle Holocene Climate and Northern Mesopotamia,” 155.

86 For areas further to the east see also Koliński, “The Upper Khabur Region,” and Pfälzner, “The Question of Desurbanisation.”

87 Lebæ, ARCANÆ I Ježirah, 374.

88 Ibid., 376; Weiss, “Quantifying Collapse”; for correlation between the Early Jeziarah periods (EDJ) and the traditional nomenclature, see the table in Lebæ, ARCANÆ I Ježirah, 12. For nuances in the Khabur area, see Danti, “Late Middle Holocene Climate and Northern Mesopotamia.”

89 Lebæ, ARCANÆ I Ježirah, 377.


91 Termined by Weiss et al., “Genesis and Collapse,” as the Khabur Hiatus I. For the area around Tell Brak, see C. Colantoni, “Touching the Void: The Post-Akkadian Period Viewed from Tell Brak,” in Seven Generations, ed. Weiss, 45–64.


93 See also Danti, “Late Middle Holocene Climate and Northern Mesopotamia”; T. J. Wilkinson et al., “Late Chalcolithic and Early Bronze Age Landscapes of Settlement and Mobility in the Middle Euphrates: A Reassessment,” LEVANT 44 (2012): 139–85.

94 For a date of the “Akkadian collapse” according to radiocarbon samples from Tell Leilan ca. 2250–2220 BCE, see H. Weiss et al., “Tell Leilan Akkadian Imperialization, Collapse and Short-Lived Reoccupation Defined by High-Resolution Radiocarbon Dating,” in Seven Generations, ed. Weiss, 163–92.

95 Koliński, “Upper Khabur Region”, Danti, “Late Middle Holocene Climate”; Pfälzner, “The Question of Desurbanisation.” Some argue that the notion of dramatic abandonment is created by a gap in the archaeological data (J. A. Ur, “Cycles of Civilization in Northern Mesopotamia, 4400–2000 BC,” Journal of Archaeological Research 18 [2010]: 413). Note that the 4.2 ka dry event is pronounced mainly in the Khabur area: Danti, “Late Middle Holocene Climate,” 165.


97 M. A. County and H. Weiss, “The Scenario of Environmental Degradation in the Tell Leilan Region, NE Syria, during the Late Third Millennium Abrupt Climate Change,” in Third Millennium BC Climate Change and Old World Collapse, ed. H. N. Dalfès, G. Kukla, and H. Weiss (Berlin, 1997), 107–47.

Migration to “Greener” Areas in the Middle Bronze I

The most logical answer to this question is that under growing instability and more arid conditions, people from the steppe parts of the Levant would have moved to more amenable, that is, “greener” neighboring areas, such as the northern valleys and fertile parts of the coastal plain of the Levant. This can be checked by looking at the results of surveys: was there significant population growth in these areas in the Middle Bronze I compared to previous centuries?

Movement within the Levant

Let us start with several cases from the southern Levant (see Table 3). In the central coastal plain of Israel between the Yarkon River and the head of Mount Carmel, Gophna and Portugali recorded 2 Early Bronze III sites, covering a built-up area of 12 hectares; 12 Intermediate Bronze settlement sites covering 7.5 built-up hectares; and 28 Middle Bronze settlement sites with 60 built-up hectares. In the Acco plain, 18 Early Bronze II–III sites cover a built-up area of 80 hectares, 10 Intermediate Bronze sites cover 20 hectares, and 29 Middle Bronze sites cover 130 hectares; no breakdown to Middle Bronze I and Middle Bronze II–III was provided by this study. In the western Jezreel Valley, settlement grew significantly from the Early Bronze III and the Intermediate Bronze (15 and 20 sites, covering a total built-up area of 29 and 20 hectares respectively) to the Middle Bronze Age. Yet, the Middle Bronze was taken in these studies as one, undivided unit, which makes it difficult to assess the situation in the early phase of the period. In the central Jordan Valley (the eastern Jezreel Valley and the well-watered area around Beth-shean), settlement changed from 36 Early Bronze II–III and 86 Intermediate Bronze sites, to 36 sites in the Middle Bronze I. In the upper Jordan Valley, between Hazor and Dan, a settlement decline was observed in the Early Bronze III (3 compared to 21 sites in the Early Bronze II). Eleven Intermediate Bronze sites and 12 Middle Bronze I sites have been recorded; no data on the total built-up area is provided. Though the data do not enable the desired detailed analysis, it is clear that the transition from the Intermediate Bronze to the Middle Bronze I features an increase in both the number of settlements and their built-up area.

The northern Levant provides a similar picture. The Amuq Valley is characterized by a dense landscape of mounds, which were inhabited continuously in the Bronze and Iron Ages. The fertile Akkar plain experienced a first peak in settlement activity in the Early Bronze IV, and this the system continued...

Table 3—Settlement patterns in relevant lowland regions

<table>
<thead>
<tr>
<th>Region</th>
<th>EB III</th>
<th>IBA</th>
<th>MB I</th>
<th>MB undivided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central coastal plain</td>
<td>12</td>
<td>10</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>No. of sites</td>
<td>11</td>
<td>22</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Built up hectares</td>
<td>80</td>
<td>20</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Coastal plain of Acco</td>
<td>18</td>
<td>10</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Western Jezreel Valley</td>
<td>15</td>
<td>20</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>No. of sites</td>
<td>29</td>
<td>10</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Built up hectares</td>
<td>20</td>
<td>20</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Central Jordan Valley</td>
<td>36</td>
<td>20</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>No. of sites</td>
<td>36</td>
<td>10</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Upper Jordan Valley</td>
<td>3</td>
<td>11</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

* Each researcher has his/her own way of estimating size of sites in a given period and this may lead to major differences in the results. Therefore, the important information is in the trend, not necessarily in the exact numbers.

* A large number of these sites are apparently cemeteries.
The Middle Orontes. Especially noteworthy is the Middle Bronze. Continuity is also reported in the Early Bronze IV; most of them continued into the Middle Bronze. Continuity is also reported in the Middle Orontes. Especially noteworthy is the difference between east and west within areas on the margin of the semi-arid belt: sites in the east were abandoned, whereas areas 20 km to their west show continuity of habitation.

The Nile Delta

Another possible answer to the question of apparent population depletion is migration of at least a part of the population to further-off regions of the ancient Near East. The two immediate candidates are watered areas in Anatolia and the Nile Delta. In what follows we wish to concentrate on the latter.

People from the Levant settled in the Nile Delta from early times, including the First Intermediate Period. Yet the best known and one of the most important such migrations took place in the Middle Bronze, with the settlement of Asiatics in the northeastern Delta. The peak of this process is dated to the Second Intermediate Period; yet, for this article, the crucial question is its beginning.

According to Manfred Bietak, the beginning of settlement of Asiatics at Tell el-Dab’a occurred in the later part of the 12th Dynasty, that is, in the late 19th century BCE. Their material culture—for instance the tradition of intramural burials—indicates the urban background of at least part of the population. Scholars are divided regarding the origin of these people. Based on Neutron Activation Analysis of storage jars from Tell el-Dab’a, P. McGovern suggested connections with southern Canaan—82 of the 97 jars tested were found to have originated from this region. Egyptian pottery found in Ashkelon may point in the same direction. J. M. Weinstein and D. Ben-Tor opted for a similar solution, based on 14C results from Tell el-Dab’a.

For a summary of settlement patterns in the late Early Bronze and Early Bronze/Middle Bronze transition in southern Turkey, see Wilkinson et al., “Late Chalcolithic and Early Bronze Age Landscapes.”
on the evidence of scarabs. Taking into consideration the architectural traditions and other traits of material culture, Bietak\textsuperscript{119} sought the origin of the Tell el-Dab’a settlers mainly in the northern Levant. D. A. Aston,\textsuperscript{120} and A. Cohen-Weinberger and Y. Goren\textsuperscript{121} opted for the same conclusion based on typology and petrographic evidence for pottery vessels from Tell el-Dab’a, respectively. For the latter, over 70% of the Middle Bronze I Tell el-Dab’a imported pottery came from the northern Levant and only 10% from the northwestern Negev. At the same time, Bietak\textsuperscript{122} emphasized the mixed character of the settlers in the Delta. Note, for instance, that clay sealings found at Ashkelon attest to connections between this important south Levantine urban center and Egypt during the late 12th Dynasty.\textsuperscript{123}

All in all, even if a major component of the groups that settled in the Delta in the Middle Bronze I arrived from the northern Levant, the geographical proximity and some archaeological evidence indicates that a certain number of people must have been of south Canaanite origin. The results of the survey in northern Sinai are noteworthy in this connection: the survey revealed evidence for ca. 300 Intermediate Bronze findspots\textsuperscript{124} and a somewhat similar number of Middle Bronze findspots.\textsuperscript{125} Oren (personal communication) estimates that 40% of the latter date to the Middle Bronze I. The latter number stands in contrast to the settlement decline in southern Canaan. These findspots demonstrate the connection between people from the southern Levant and the Delta. Indeed, had there been a climate change towards drier conditions in the early second millennium BCE, the semi-arid areas of both the southern and northern Levant would have been affected. The movement of people from the steppe areas in the southern Levant to Egypt would be expected. Prolonged droughts in steppe zones in the north, such as the Beq’a of Lebanon, the Jabbul Plain and the Upper Euphrates, as well as economic opportunities in Egypt,\textsuperscript{126} could have caused people to move from these regions to the secure environment of the Nile Delta.

Conclusion

The low precipitation that characterized the 2000–1800 BCE interval, evident by new, well-dated high-resolution pollen records from the southern Levant (i.e., from the Sea of Galilee and Ze’elim in the Dead Sea), had significant impact on settlement patterns in the entire region. During that time—the very late Intermediate Bronze and the Middle Bronze I in terms of archaeology—the 400 mm rainfall isohyet, marking the boundary between the Mediterranean and Irano-Turanian vegetation zones, shifted to the north and west. As a result, permanent settlements withdrew from the southernmost margins of Canaan and the population in north-eastern semi-arid zones, such as the Beq’a of Lebanon and to east of the Homs-Hama-Aleppo line, shrank in size. For this reason, significant numbers of people may have moved to “greener” parts of the Levant. Economic advantages may have attracted others to the well-watered Nile Delta. We suggest that the beginning of settlement of Asiatics in the north-eastern Delta is at least partially connected to this dry climate phase in the Levant. Wetter conditions in the Middle Bronze II–III caused the settlement system in the Levant to recover and re-expand in the south, down to the areas of Nahal Besor and the Beer-sheba Valley, and in other steppe zones in the northern Levant. Settlement of Asians in the Delta continued and intensified—this time mainly for economic reasons.

\textsuperscript{119} Bietak, “Avaris, Capital of the Hyksos Kingdom,” and “From Where Came the Hyksos . . . ?”; see also R. Schiestl, “Tomb Types and Layout of a Middle Bronze IIA Cemetery at Tell el-Dab’a, Area F/I, Egyptian and Non-Egyptian Features,” in \textit{The Bronze Age in the Lebanon: Studies on the Archaeology and Chronology of Lebanon, Syria and Egypt}, ed. M. Bietak and E. Czerny (Vienna 2008), 243.

\textsuperscript{120} D. A. Aston, “Ceramic Imports at Tell el-Dab’a during the Middle Bronze IIA,” in \textit{Middle Bronze Age in the Levant}, ed. Bietak, 43–87.


\textsuperscript{122} Bietak “Avaris, Capital of the Hyksos Kingdom,” 98–99.

\textsuperscript{123} Bietak, “Relative and Absolute Chronology of the Middle Bronze Age,” 42; I. E. Stager, “The MB IIA Ceramic Sequence at Tel Ashkelon and Its Implications for the ‘Port Power’ Model of Trade,” in \textit{Middle Bronze Age in the Levant}, ed. Bietak, 361.


\textsuperscript{125} Oren, “Kingdom of Sharuhen!,” 275.

\textsuperscript{126} Bietak, “From Where Came the Hyksos . . . ?”