

# Climate and the Late Bronze Collapse: New Evidence from the Southern Levant

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A core drilled from the Sea of Galilee was subjected to high resolution pollen analysis for the Bronze and Iron Ages. The detailed pollen diagram (sample/~40 yrs) was used to reconstruct past climate changes and human impact on the vegetation of the Mediterranean zone of the southern Levant. The chronological framework is based on radiocarbon dating of short-lived terrestrial organic material. The results indicate that the driest event throughout the Bronze and Iron Ages occurred ~1250–1100 BCE—at the end of the Late Bronze Age. This arid phase was identified based on a significant decrease in Mediterranean tree values, denoting a reduction in precipitation and the shrinkage of the Mediterranean forest/maquis. The Late Bronze dry event was followed by dramatic recovery in the Iron I, evident in the increased percentages of both Mediterranean trees and cultivated olive trees.

Archaeology indicates that the crisis in the eastern Mediterranean at the end of the Late Bronze Age took place during the same period—from the mid-13th century to ca. 1100 BCE. In the Levant the crisis years are represented by destruction of a large number of urban centres, shrinkage of other major sites, hoarding activities and changes in settlement patterns. Textual evidence from several places in the Ancient Near East attests to drought and famine starting in the mid-13th and continuing until the second half of the 12th century. All this helps to better understand the ‘Crisis Years’ in the eastern Mediterranean at the end of the Late Bronze Age and the quick settlement recovery in the Iron I, especially in the highlands of the Levant.

**KEYWORDS** Climate change, Paleoclimate, Pollen, Late Bronze collapse, Crisis years, Sea of Galilee, Levant, Hatti, Ugarit, 20th Dynasty

The settlement history of the Levant in the Bronze and Iron Ages was characterized by striking oscillations: urban growth and decay in the lowlands; waves of settlement and periods of decline in the highlands of both Cis- and Transjordan and waves of settlement

and long periods with no evidence of sedentary activity in the arid zones. Causes for decline or collapse phases have been sought in violent invasions, plagues, earthquakes (e.g., Cline 2011), climatic changes (below) and systemic disfunction (for the Early Bronze as a case study, see review in Dever 1989).

The most dramatic of these oscillations took place in the Late Bronze–Iron I transition. In the lowlands, many of the hubs of the city-states as well as secondary towns were destroyed. This is the first wave of destruction known in the Levant. Some cities, such as Hazor in the north and Lachish in the south, were totally ravaged and did not recover from the shock for a long period of time, while other places, such as Megiddo, were partially destroyed and recovered relatively quickly (Finkelstein 2003). The hill country is characterized by record low settlement activity in the Late Bronze Age and an unprecedented wave of settlement in the ensuing Iron I (Finkelstein 1995). This turbulent period of transition, which took place in the late 13th and much of the 12th centuries BCE, is the focus of this paper.

Both the collapse and recovery in the southern Levant were components of much broader events that brought about the destruction of the world of the Bronze Age. The ‘Crisis Years’ in the eastern Mediterranean encompassed the fall of the palatial system in the Aegean Basin, the Hittite empire in Anatolia, the maritime copper power-house of Alashiya (Cyprus) and prospering trade centres such as Ugarit on the coast of Syria and the decline of Egypt, which included the withdrawal from its province in Canaan (Ward and Joukowsky 1992; Drews 1993). In western Syria and Canaan the revival of the settlement systems in the Iron I led to the emergence, two centuries later, of the territorial kingdoms known from the Hebrew Bible and the Assyrian records (e.g., Schwartz 1989; Sader 2000). These were probably the biggest and most remarkable collapse and revival processes in the history of the eastern Mediterranean.

There is broad consensus on two issues: (1) that the events of the ‘Crisis Years’—from Greece and Anatolia via the Levant to Egypt—were all connected (e.g., Ward and Joukowsky 1992); (2) that they were accompanied by considerable movement of people by sea and land (Stager 1995; Oren 2000; Yasur-Landau 2010). This is best manifested in the well-known accounts of the confrontation between Ramesses III and the Sea Peoples and in the dramatic letters found in Ugarit that describe sea-born raids on settlements along the coast (Yon 1992; Singer 1999: 719–723). Both are dated to the early 12th century BCE.

Scholars have long deliberated the reasons that brought about the collapse of the world of the Late Bronze Age, trying to identify ‘prime movers’ that initiated the chain of events, among them climate change (summary in Drews 1993). The first to link the ‘Crisis Years’ to a climate event was Carpenter, in regard to the fall of the Mycenaean world (1966). Starting in the 1960s, and based on tablets found in Hattusha, Ugarit, Emar on the Euphrates and Aphek in Israel, researchers have pointed to evidence for droughts and famine at the end of the Late Bronze Age (Astour 1965; Klengel 1974: 170–174; Na’aman 1994: 243–245; Zaccagnini 1995; Singer 1999: 715–719; 2000; 2009: 99). These textual clues, which were later supported by paleoclimate exact and life-science proxies, drove scholars to propose that the collapse was the result of a climate crisis in the eastern Mediterranean (Bryson *et al.* 1974; Weiss 1982; Neumann and Parpola 1987; Alpert and Neumann 1989; Kuniholm 1990: 653–654; Singer 1999: 715–719; 2000; Fagan

2004: 182–186; Kirlis and Herles 2007). However, none of these suggestions is based on a detailed, well-constrained paleoclimate record.

The study of fossil pollen grains is a powerful tool in the reconstruction of past vegetation and climate history (e.g., Bryant 1989). New palynological studies from the region confirm the occurrence of a dry phase at the end of the Late Bronze: Kaniewski *et al.* (2010) for northern Syria; Bernhardt *et al.* (2012) for the Nile Delta; Litt *et al.* (2012) and Langgut *et al.* (forthcoming) for the Dead Sea. However, the chronological frameworks of these studies and/or their sampling resolution are not sufficiently detailed to enable the identification of the exact time and duration of the dry event at the end of the Late Bronze Age. Other southern Levantine paleoclimate records that cover the Bronze and Iron Ages, such as lake level reconstructions and isotope analyses, are characterized by contradictory data and conflicting conclusions (e.g., Finné *et al.* 2011; Rambeau and Black 2011). The discrepancies result from low sampling and dating resolution.

In order to achieve a better understanding of climate conditions during the Late Bronze–Iron Age transition in the southern Levant we studied the pollen record of the Sea of Galilee (Lake Kinneret). A core of sediments extracted from the centre of the lake was subjected to high resolution pollen sampling (sample per ca. 40 years) as well as intense radiocarbon dating (both aimed at avoiding the deficiencies mentioned above). The resulting environmental reconstruction was then examined in relation to the picture derived from archaeology and the textual record.

## The study area

### Present environmental setting

Pollen tends to endure well in waterlogged and anaerobic environments (e.g., Faegri and Iversen 1992). The considerable size of the Sea of Galilee (ca. 170 sq km) lessens the influence of bank vegetation on the pollen spectra of the area, thus giving a reliable picture of the regional conditions (e.g., Horowitz 1979; Faegri and Iversen 1992). The sediments in the lake generally consist of fine, gray-to-black silts and clays poor in carbonates, in which pollen grains are well preserved (Horowitz 1979). Its drainage basin includes the eastern Galilee, the Golan Heights, the Hermon range and part of the Anti-Lebanon Mountains. The lake is fed mainly by the Jordan River and its tributaries.<sup>1</sup>

The area around the Sea of Galilee enjoys a typical Mediterranean climate (Dayan *et al.* 2007). Precipitation decreases gradually from north to south following the transition from the Mediterranean climate towards more semi-arid conditions in the lower part of the Jordan Valley south of the lake (Fig. 1). The prevailing winds are from the north and northwest, which is significant with respect to the source of the majority of the wind-born pollen embedded in the lake. Easterly winds occur especially during the spring and fall, and are associated with the Red Sea Troughs and Sharav Cyclones (Ganor and Foner 1996).

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<sup>1</sup> Although less important, several other sources supply water directly to the lake: some small streams in the northwest, such as Nahal Amud and Nahal Zalmon, and a series of wadis coming through the Buteiha in the northeast; and a number of springs, most of them saline, issuing near the shore or from the lake's bottom.

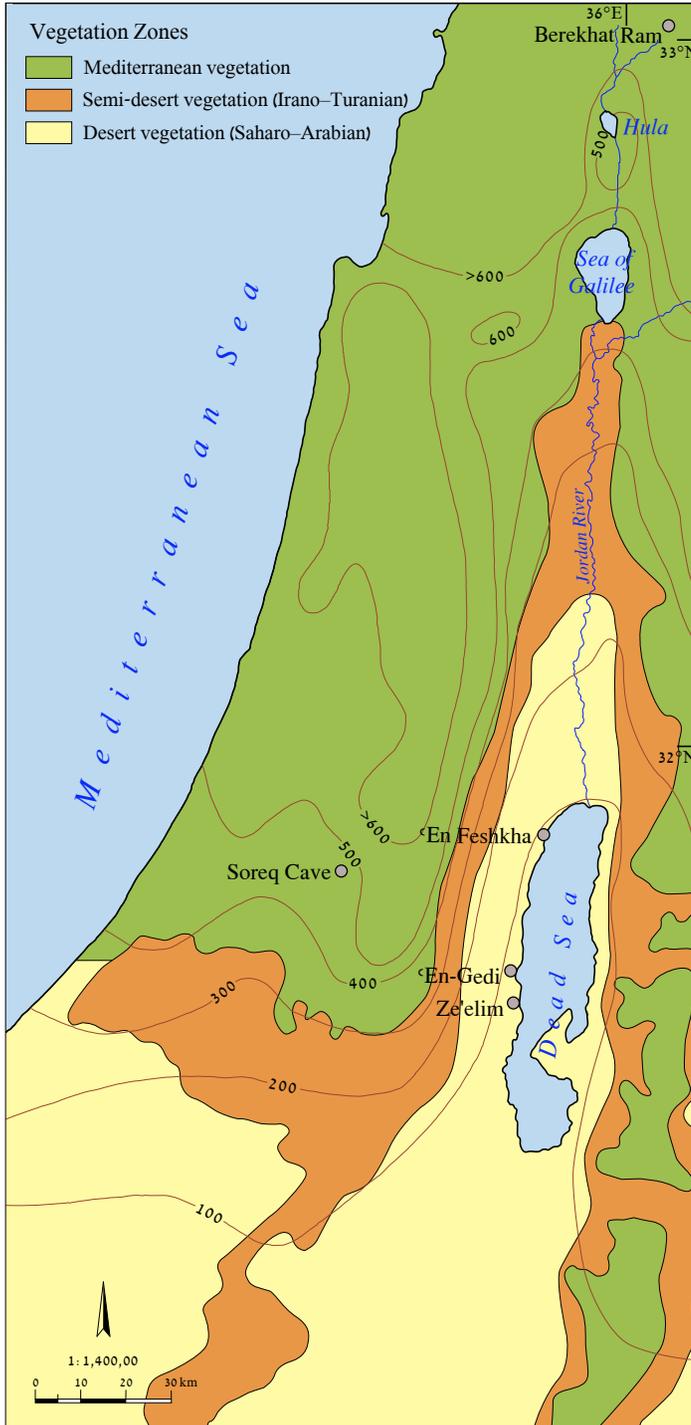


FIGURE 1 Phytogeographic regions of the southern Levant and rainfall isohyets (based on Zohary 1962 and Shahar and Sofer 2011, respectively) with the location of paleoclimate records mentioned in the text.

From the botanical perspective (Fig. 1), the greater part of the Northern Jordan Valley and the northern part of the Central Jordan Valley belong to the Mediterranean vegetation belt. The southern part of the Central Jordan Valley belongs to the Irano-Turanian belt. Some Sudanese vegetation relics are scattered in several localities and are found especially around springs (for detailed accounts of the vegetation of the area, see Zohary 1962; 1973; Waisel 1969).

### Settlement history

The area around the Sea of Galilee has been copiously surveyed, and this has provided the data needed for the reconstruction of settlement patterns and demographic transformations. The most comprehensive among the surveys were carried out in the Galilee (Frankel *et al.* 2001; Gal 1992), the Golan (Hartal forthcoming), the Beth-Shean Valley (Zori 1962; Maier 1997), the western Jezreel Valley (Finkelstein *et al.* 2006) and northern Samaria (e.g., Zertal 2004; 2008). Detailed analysis of human impact on the environment requires estimates on the size (and hence population) of each surveyed site in the different periods of its habitation, which opens the way for the study of regional demographic history. Such an estimate can be reached when the data for each site include general size and breakdown of the pottery finds by period. Unfortunately this kind of information exists only in some of the survey reports cited above (northern Samaria and western Jezreel Valley) and hence we restricted our observations (Table 1) to the number of sites.

TABLE 1  
Rough estimate of number of sites in several regions in northern Israel and neighbouring areas, from the Early Bronze Age to the end of the Iron Age\*

Region	No. of sites/ total built -up area	EB I	EB II-III	IB	MB	LB	IA I	IA II
Upper Galilee (Frankel <i>et al.</i> 2001)	No. sites	18	39	9	52	14	71	36
Lower Galilee (Gal 1992)	No. sites	26		--	28	6-9	23	57
Western Jezreel Valley (Finkelstein <i>et al.</i> 2006)	No. sites	45	EB II 22 EB III 15	20	58	35	46	66
	Total built-up area (ha)	107	EB II 31 EB III 30	20	30	40	57	71
Samaria north of Shechem (Zertal 1993)	No. sites	78	EB II 37 EB III 2	55	161	36	81	238
Golan Heights (Hartal forthcoming)	No. sites	33	93	27	132	20	64	86

\* Only habitation sites are included; pastoral groups are not represented.

EB = Early Bronze; IB = Intermediate Bronze; MB = Middle Bronze; LB = Late Bronze;

IA = Iron Age.

## Material and methods

### Fieldwork and sampling

An 18 m sedimentary record, covering almost the entire Holocene, was drilled from the inner northern part of the Sea of Galilee (near Monitor Station A of the Kinneret Limnological Laboratory) in Spring 2010. Five and a half m of this profile, which covers the section of the Bronze and Iron Ages (composite depth of 458.8–1006.6 cm), were sampled for palynological analysis at 10 cm intervals. The sedimentary description, chemical composition, magnetic conductivity and details on the compiled core are documented by Schiebel (2013; for a full description of the Bronze–Iron Ages sequence, see Langgut *et al.* in preparation).

### Chronological framework

Six samples of terrestrial short-lived organic debris were radiocarbon dated by Accelerator Mass Spectrometry (AMS).<sup>2</sup> The <sup>14</sup>C ages were calibrated to calendar years (cal. BP) defined by the 2 $\sigma$  envelope error using the OxCal v.4.2.2 program of Bronk-Ramsey Age deposition model (2008). An age-depth model was established, based on the assumption that sedimentation deposition rates are constant for the inner part of the lake (since no sediment erosion occurred). Therefore it was possible to calculate the age at different depths along the sedimentological sequence (Bronk-Ramsey 2008).

### Palynology

Fifty-six palynological samples were processed using standard pollen extraction techniques (Faegri and Iversen 1992).<sup>3</sup> Pollen grains were identified to the highest possible systemic level. For identification, a reference collection of Israel pollen flora was used (Museum of Biological Anthropology, Steinhardt National Collections of Natural History, Tel Aviv University) as well as pollen atlases (Reille 1995; 1998; 1999; Beug 2004). A simplified palynological diagram was plotted using the POLPAL program (Walanus and Nalepka 1999). The diagram is comprised of the group of Mediterranean<sup>4</sup> and cultivated olive trees versus a group of herbs and dwarf-shrubs,<sup>5</sup>

<sup>2</sup> The AMS measurements were performed at the Leibniz AMS Laboratory in Kiel, Germany and at the ETH AMS Facility, Zurich, Switzerland. Radiocarbon ages are reported in conventional radiocarbon years (before present = 1,950) in accordance with international convention (Stuiver and Polach 1977); atmospheric data was derived from Reimer *et al.* (2009).

<sup>3</sup> At least 500 terrestrial pollen grains were counted per sample. *Lycopodium* spore tablets were added in order to calculate pollen concentrations per cu cm. The calculation included all pollen types as well as indeterminable pollen grains (unidentified and degraded pollen).

<sup>4</sup> Within this group only trees common to the Mediterranean vegetation territory were included; the majorities among them are wind pollinated trees. The most dominant trees are evergreen and deciduous oaks (*Quercus calliprinos* type and *Quercus ithaburensis* type, respectively). Other Mediterranean trees appear in lower percentages: *Phillyrea*, *Pistacia* spp. (pistachios), *Pinus halepensis* (Aleppo pine) and *Ceratonia siliqua* (carob tree).

<sup>5</sup> The most dominant plants within this group are (in declining order): Poaceae (wild grasses), Cerealia pollen type (Cereals), Asteraceae (daisy family), Chenopodiaceae (goosefoot family), *Artemisia* (wormwood) and Brassicaceae (cabbage family).

representing the relative frequencies of Arboreal Pollen/Non-Arboreal Pollen (AP/NAP) ratios. The herbs and dwarf-shrubs (the non-arboreal group) are presented below in Fig. 3 as a negative image to the arboreal group and therefore the increase in their percentages is parallel to a decrease in the percentages of the Mediterranean trees (and vice versa). All trees and shrubs common to the bank vegetation of the lake (hydrophil plants),<sup>6</sup> as well as aquatic plants, were excluded from the total pollen sum (AP+NAP=100%).

The olive (*Olea europaea*) has been the most important fruit tree of the Mediterranean Basin (Zohary *et al.* 2012). Cultivated olive trees were combined with the natural elements of the Mediterranean tree group since they occupy the same ecological niches (e.g., Horowitz 1979; Baruch 1986). Today, the evergreen olive tree occurs in Israel in the Mediterranean territory both as a cultivated (the vast majority) and natural element (Zohary 1973; Zohary *et al.* 2012).<sup>7</sup> The wild olive is a minor component of the native Mediterranean *Quercus calliprinos*–*Pistacia palaestina* association (Horowitz 1979; Weinstein-Evron 1983; Kadosh *et al.* 2004; Van-Zeist and Bottema 2009; Langgut *et al.* 2011). In the late Chalcolithic, some six millennia ago, much higher olive pollen values are documented in several Levantine palynological spectra (Baruch 1990; Neumann *et al.* 2007a, 2007b; Van-Zeist *et al.* 2009; Litt *et al.* 2012; Langgut *et al.* 2013). The dramatic rise in *Olea* pollen reflects the spread of olive cultivation in the southern Levant (Cappers *et al.* 1998; Baruch and Bottema 1999). The palynological evidence is supported by archaeological findings in submerged sites along the Carmel coast (Galili *et al.* 1997), Samaria (Eitam 1993), the Jordan Valley (Gophna and Kislev 1979; Neef 1990) and the Golan Heights (Epstein 1978; 1993; 1998). Since the Early Bronze Age, the existence of large-scale olive orchards is evident from both archaeological finds (Neef 1990; Finkelstein and Gophna 1993; Frankel *et al.* 1994; Frankel 1999) and palynological data (Baruch 1990; Neumann *et al.* 2007a; 2007b; Van-Zeist *et al.* 2009; Litt *et al.* 2012; Langgut *et al.* forthcoming).

## Results

Pollen preservation was reasonable in all the analyzed samples. Pollen concentration was high and generally stable (Fig. 2). There were no signs of disturbed and reworked sediments, such as a distinctly increased percentage of indeterminable and corroded pollen or noticeably abnormal pollen concentrations.

The Mediterranean trees (the arboreal group) together with the olive are fairly well represented throughout the Sea of Galilee diagram (Fig. 3). Distinct low tree values of the Mediterranean and olive trees were documented at ~2300 BCE (depth of 847.1 cm—24.4%), ~2000–1800 BCE (depth of 769.1 cm–749.1 cm—18.7–22.2%), ~1250–1100

<sup>6</sup> Hydrophil trees linked to the bank vegetation of the lake, which were excluded, are various species of *Tamarix* (Tamarisk), *Fraxinus syriaca* (Syrian ash), *Salix* (willow), *Populus euphratica* (poplar), *Platanus orientalis* (oriental plane) and *Nerium oleander* (oleander). Hydrophil shrubs that were excluded are mainly Cyperaceae (sedges), *Typha* (cattail) and *Rubus sanctus* (holy bramble).

<sup>7</sup> In addition, some of the trees are feral and hybrids between domesticated and wild.

BCE (depth of 621.6 cm and 602.2 cm—13.1–14.2%) and ~700 BCE (521.9 cm—12.6%). Maximum tree values were recorded between ~3,150–2,900 BCE (depth of 1006.6 cm—976.6 cm—46.1–59.5%); an additional two short peaks were documented at ~1350 BCE (depth of 651.8 cm—48.5%) and at ~1000 BCE (572.2 cm—42.9%).

Below we discuss the paleoenvironmental conditions during the Bronze and Iron Ages as emerging from the Sea of Galilee pollen record and its chronology (Fig. 2, Fig. 3 and Table 2) with special focus on the Late Bronze–Iron Age transition (other periods will be treated briefly; some of them are dealt with in detail in Finkelstein and Langutt forthcoming). This is followed by a broader historical and regional discussion, integrating the archaeological

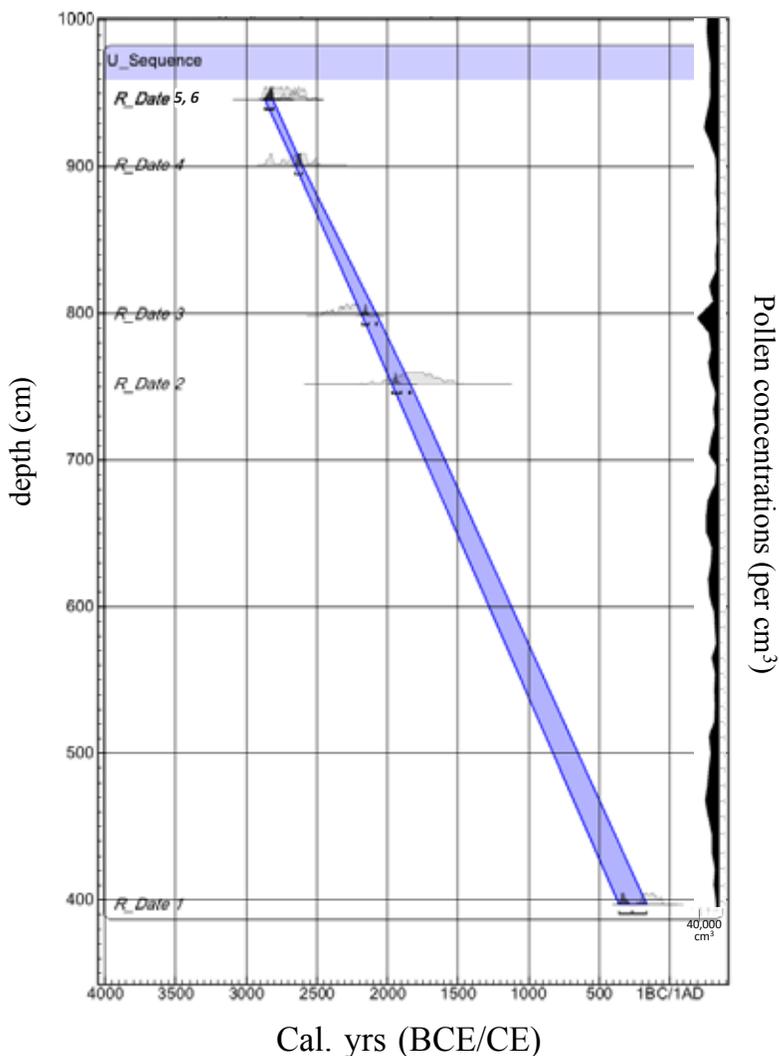


FIGURE 2 Age-depth model based on calibrated radiocarbon dates (Table 2) of the 5.5 m core section (composite depth of 458.8–1006.6 cm) drilled in the inner part of the Sea of Galilee. Pollen concentrations (per cu cm) are presented in the column on the right.

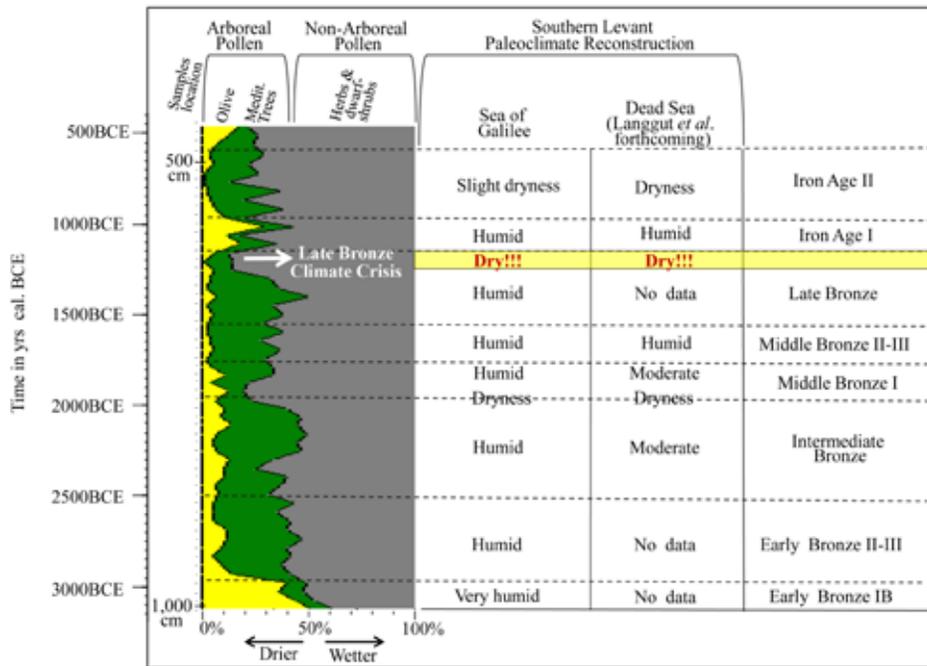


FIGURE 3 Arboreal/Non-Arboreal pollen diagram of the Sea of Galilee Bronze and Iron Ages and southern Levant paleoclimate reconstruction. Slight differences between the Sea of Galilee and the Dead Sea pollen records derive from the fact that the Dead Sea area is a meeting point of three different environments (Mediterranean, semi-arid and desert; Fig. 1), which makes it more vulnerable to climate change.

and textual evidence. Dates of the different phases of the Bronze and Iron Ages are based, as far as possible, on radiocarbon results in the last decade (Regev *et al.* 2012 for the Early Bronze and Intermediate Bronze; Finkelstein and Piasezky 2010 for the Iron Age; for the beginning of the Middle Bronze, see Bietak 2002; the transition from the Middle to the Late Bronze, now broadly fixed in the mid-16th century BCE, is yet to be verified).

## Paleoenvironmental reconstruction

### The Early Bronze Age

Our Sea of Galilee pollen diagram starts in the EB IB around 3150 BCE. This period is characterized by the highest percentages of arboreal vegetation in our sequence (up to 59.5%), indicating that it was the most humid phase in the Bronze and Iron Ages. It also features the highest frequencies of olive trees (reaching a maximum of 50.2%), representing the development of a specialized economy focused on olive trees and their secondary products. Moist conditions in the EB IB are also attested in the Jezreel Valley (Rosen 2006) and in the Dead Sea area (Litt *et al.* 2012).

This period saw the rise of Tel Bet Yerah on the southwestern shore of the lake as one of the most important urban centres in the southern Levant. Settlement activity in northern Samaria and the western Jezreel Valley reached a peak (Finkelstein and Gophna

1993; Finkelstein *et al.* 2006 respectively). The settlement pattern in the highlands represents dramatic intensification of olive culture. Evidence from the southern Coastal Plain and the Nile Delta attest to strong trade relations with Egypt (various articles in Van den Brink and Levy 2002). Secondary products of the highlands' horticulture activity must have played a major role in this network (e.g., Finkelstein and Gophna 1993; Van den Brink and Braun 2002).

TABLE 2  
Radiocarbon dating and OxCal calibration of the Sea of Galilee  
Bronze and Iron Ages core

Sample field ID and no. in age depth model	Lab. no., depth in cm and dated material	<sup>14</sup> C yrs (BP)	Calibrated age range (68% probability)	Calibrated age range (95.4% probability)
ki10/I/9.465 R_Date 6	KIA44215 946 cm Wood	4100±25	2839BC (15.0%) 2814BC	2861BC (22.9%) 2808BC
			2627BC (53.3%) 2580BC	2756BC (9.5%) 2719BC
				2704BC (63.0%) 2573BC
ki10/I/9.45 R_Date 5	KIA44214 945 cm Plant remains	4165±45	2876BC (12.0%) 2848BC	2887BC (95.4%) 2622BC
			2843BC (1.3%) 2840BC	
			2813BC (33.5%) 2738BC	
			2733BC (17.7%) 2692BC	
ki 3 R_Date 4	ETH-48429 901 cm Macrofossil twig	4086±42	2848BC (13.1%) 2813BC	2866BC (18.4%) 2804BC
			2738BC (2.0%) 2732BC	2761BC (68.0%) 2550BC
			2692BC (1.1%) 2688BC	2537BC (9.0%) 2491BC
			2678BC (48.9%) 2571BC	
ki 10 R_Date 3	ETH-48433 799 cm Macrofossil twig	3832±32	2340BC (68.2%) 2205BC	2458BC (7.0%) 2417BC
				2409BC (87.1%) 2198BC
				2162BC (1.3%) 2152BC
ki11-11a R_Date 2	ETH-48434 752 cm Macrofossil twigs	3474±104	1934BC (68.2%) 1668BC	2117BC (0.9%) 2098BC
				2039BC (94.5%) 1524BC
ki7a R_Date 1	ETH-48430 397 cm Macrofossil twig	2123±38	201BC (65.7%) 92BC	352BC (11.3%) 297BC
			68BC (2.5%) 62BC	228BC (0.8%) 221BC
				210BC (83.3%) 44BC

In the EB II and more so in the EB III a certain reduction in the arboreal vegetation is documented (not exceeding 46.2%), signaling a slight shrinkage of the Mediterranean forest/maquis. However, the most striking feature is the dramatic decline in the values of olive trees (4.4–13.8%), probably linked to changes in geo-political (rather than climatic) conditions in the region—the weakening of overland connections with Egypt and the rise of maritime links with the coast of present-day Lebanon (Marcus 2002: 407–408). It is possible, then, that the main area of export of olive oil to Egypt shifted to the northern Levant.

### The Intermediate Bronze Age

This period shows no major changes in the distribution of both Mediterranean trees (up to 47.5%) and olive trees (not exceeding 13.4%). A similar environmental picture emerges from two additional high resolution pollen profiles from the southern Levant: the Dead Sea (Langgut *et al.* forthcoming) and Berekhat Ram in the northern Golan Heights (Neumann *et al.* 2007b). Based on these pollen records, it appears that the crisis in the urban system at the end of the Early Bronze Age (ca. 2500 BCE) was not a result of climate change.

The Intermediate Bronze is a period traditionally associated with a more pastoral mode of subsistence in the southern Levant. However, the Sea of Galilee pollen evidence shows that no major shift took place in human exploitation of the environment, that is, olives retained their importance. Two events pointing to drier climate conditions were recorded at ~2350 BCE and at the end of the Intermediate Bronze/beginning of the Middle Bronze (since ~2000 BCE; more below). During these dry episodes arboreal values decreased significantly (24.4% and 22.2%, respectively).<sup>8</sup>

### The Middle Bronze Age

Since the beginning of the period and until about 1800 BCE, Mediterranean tree values retain their low values (not exceeding 21.3%), indicating that the dry event identified at the end of the Intermediate Bronze lasted about two centuries (~2000–1800 BCE) (Finkelstein and Langgut forthcoming). During the MB I, olive tree percentages appear in the same magnitude as in the previous period (3.2–12.5%), representing olive production probably only for local consumption (for similar observations based on the Zeelim [Dead Sea] pollen record, see Langgut *et al.* forthcoming). The evidence for more available moisture, which derives from the increase in Mediterranean trees around 1800 BCE, continued through the MB II–III (up to 37.9%). This pattern is consistent with the high Dead Sea stands at that time (Migowski *et al.* 2006; Kushnir and Stein 2010; Litt *et al.* 2012).

Cultural recovery in this area in the Middle Bronze is evident from both the great prosperity of Hazor, which was the largest city in Canaan at that time, and from the recovery of the rural settlement system after a low in the Intermediate Bronze Age (e.g., Broshi and Gophna 1986). Decrease in the percentage of olive trees was documented in the MB II–III (reaching a minimum of 2.6%). The reduction in olive horticulture was not connected—so it seems—either to climate change or to weakness of the settlement system; rather it has probably to do with some changes in the economic strategies that are not yet clear.

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<sup>8</sup> Somewhat more arid conditions at the end of the Intermediate Bronze were documented in the Dead Sea pollen record (Langgut *et al.* forthcoming), the declining level of the Dead Sea (Migowski *et al.* 2006; Kushnir and Stein 2010) and the isotopic composition of tamarisk wood from the Mount Sedom Cave (Frumkin 2009). A markedly dry event in the Near East was identified around 2300–2200 BCE in other studies (e.g., Weiss *et al.* 1993; the ~4.2 ka BP event). Roberts *et al.* (2011) also argued for drying ca. 2250–2200 BCE, which had greater impact in semi-arid and continental regions (upper Mesopotamia, Central Anatolia, etc.) and only later (2000–1900 BCE) affected the more humid areas (coastal Levant, Taurus Mountains, etc.). The environmental implications of climate change during the later phase of the Intermediate Bronze therefore varies from region to region (Finkelstein and Langgut forthcoming).

## The Late Bronze Age

The arboreal vegetation values remain relatively high, with a peak around 1350 BCE (48.5%), representing the continuity of a well-developed Mediterranean forest/maquis in the area. Indeed, in the detailed information provided by the Amarna tablets, dated to the same period (ca. 1360–1335/30 BCE), no droughts or famine are mentioned. The values of olive remain in their low frequencies, indicating a limited spread of olive horticulture. This coincides with a dramatic decrease in the settlement activity in the mountainous Galilee and the central highlands area starting at the end of the Middle Bronze (Finkelstein 1995; Table 1). These data indicate that the settlement crisis was man-induced rather than a result of environmental change.

The most striking feature in the entire Sea of Galilee pollen record appears at the end of the Late Bronze, between ~1250–1100 BCE; this time interval is characterized by the lowest arboreal vegetation percentages throughout the entire sequence (both Mediterranean trees and olive trees, reaching a minimum of 13.5% and 1.8% respectively). This event probably lasted slightly more than a century and is therefore a relatively prolonged event—the most pronounced dry episode during the Bronze and Iron Ages. It is noteworthy that the dramatic decrease in tree percentages was not accompanied by an increase of secondary anthropogenic palynological indicators (e.g., *Plantago lanceolata* [ribwort plantain] pollen type—Baruch 1990; Danin 2004). Shrinkage of the Mediterranean forest could not be the result of human pressure, also because of the low settlement activity in many areas at that time. This decline therefore was a result of climate rather than man-induced change.

The pollen records from the western margin of the Dead Sea (Neumann *et al.* 2007a; Litt *et al.* 2012; Langgut *et al.* forthcoming) indicate an unconformity in the sediment deposition at the end of the Late Bronze Age. At that time sediments were embedded in a terrestrial environment and not in a lake environment as they were during previous and subsequent periods.<sup>9</sup> The occurrence of a shore depositional environment represents a drop in the Dead Sea levels that was most probably the result of reduction in precipitation, mainly from the northern sources of the Dead Sea drainage basin. Roskin *et al.* (2013) report that the only evidence of dune mobilization and stabilization during the entire Holocene occurred slightly before 1000 BCE, mainly in the eastern part of the northwestern Negev, probably as a result of drier climate conditions in the region.

A dry event during the Late Bronze–Iron Age transition was detected in two other high-resolution pollen records from the Levant: Kaniewski *et al.* (2010) for the north Syrian coast and Bernhardt *et al.* (2012) for the Nile Delta. Northern pollen records from Lake Abant in the western Pontus (Bottema *et al.* 1993/1994) and from Eski Acigöl crater-lake in the central Anatolian plateau (Woldring and Bottema 2003) also point to a decrease in arboreal frequencies at the end of the Late Bronze. Some of these pollen spectra indicate

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<sup>9</sup> Litt *et al.* (2012) report that around 1300 BCE a thick sand unit accumulated in the En-Gedi core; Neumann *et al.* (2007a) describe the occurrence of sedimentological unconformity in the En-Feshkha record about the same time; at the Ze'elim ravine a coastal ridge was embedded on a shore depositional environment (*ibid.*; Langgut *et al.* forthcoming) around 1200 BCE.

a longer phase that ostensibly lasted through the Iron I.<sup>10</sup> In any event, the palynological records mentioned above suggest that the dry spell at the end of the Late Bronze took place across a vast geographical area—at least from northern Turkey to the Nile Delta. Drake (2012) argues that the Levant arid phase was shorter in duration, suggesting that it may have been milder than in other regions, such as Anatolia or mainland Greece. The Lake Van isotopic record corroborates this assumption (Litt *et al.* 2009).

### The Iron I

The Sea of Galilee pollen data for the Iron I time interval displays a significant increase in both arboreal and olive pollen percentages (up to 42.9% and 28.7% correspondingly). Thanks to higher available moisture, both the Mediterranean forest/maquis and olive orchards expanded. A maximum value of Mediterranean trees was documented around 1000 BCE. The increase in moisture during the Iron I is also evident from the Dead Sea pollen records (Neumann *et al.* 2007a; Litt *et al.* 2012; Langgut *et al.* forthcoming). The improved conditions during the Iron I enabled the recovery of settlement activity. This is evident in the revival of the urban system in the northern valleys (Finkelstein 2003), which had peaked around 1000 BCE, and in the settlement wave in the highlands of both the Galilee and Samaria, which are amenable to olive orchards (Gal 1992; Frankel *et al.* 2001; Zertal 2004; 2008; Table 1).

The dramatic growth of settlement activity in the highlands is the backdrop for the rise of Ancient Israel and other Iron I groups such as the Arameans, Ammon and Moab (Finkelstein 1995; Joffe 2002). Especially noteworthy are settlement developments on the margin of the settled lands—the spread of activity in the Beer-sheba Valley (Herzog 1994), the rise of an early Moabite territorial polity south of the Arnon River (Finkelstein and Lipschits 2011) and the appearance of Iron I sites on the Edomite plateau (Finkelstein 1992).<sup>11</sup>

### The Iron II

A slight reduction in the arboreal pollen was recorded during this period, with minimum values of Mediterranean trees around 700 BCE (12.6%). The drop in Mediterranean forest cover could have been the result of slightly reduced precipitation. Somewhat drier climate conditions are also manifested in the relatively low stand of the Dead Sea (Bookman [Ken-Tor] *et al.* 2004; Migowski *et al.* 2006) and by the isotopic records of Soreq Cave (Bar-Matthews and Ayalon 2004). The drop in the Mediterranean forest

<sup>10</sup> Note that these records were sampled in relatively low resolution: in the Abant profile the mean sampling resolution interval was 210 years per sample and in Eski Acigöl 85 years per sample. In the latter profile the dry event was also identified based on a simultaneous increase in  $\delta^{18}\text{O}$  values (Roberts *et al.* 2001). The Eski Acigöl site is located in central Anatolia, in a semi-arid environment, and therefore probably serves as a sensitive recorder for climate changes.

<sup>11</sup> These developments were not only climate-induced; they were probably related to the rise in copper production in the area of Wadi Faynan. Note that reevaluation of the pottery record seems to show that the number of Iron I settlements in Edom was smaller than listed in Finkelstein 1992.

could also have stemmed from anthropogenic pressure; surge in human activity that started in the Iron I reached its zenith during the Iron IIB (8th century BCE).<sup>12</sup> In the Northern Kingdom the sedentary population is estimated to have tripled between the end of the Iron I, around 950 BCE, and the peak of the Iron IIB in the mid-8th century BCE (Broshi and Finkelstein 1992: 55). The restricted olive orchard distribution characterizing this period (1.2–16.3%) could have resulted from less available moisture and/or intentional change in economic strategy under Assyrian rule—a shift of olive oil production to other areas such as the Shephelah (Eitam 1993; Gitin 1996; Katz 2008). Reduction in olive horticulture during the Iron II was also noted in a previous, lower resolution, pollen study from the Sea of Galilee (Baruch 1986), and also in the Hula Lake (Van-Zeist *et al.* 2009) and on the coastal plain of Syria (Kaniewski *et al.* 2010: Fig. S1).

### **A possible mechanism for the Late Bronze climate crisis**

The Late Bronze dry event was probably connected to the peak in Greenland temperature (Greenland Ice Sheet Project–GISP2; Alley 2004): The highest temperatures there in the last five millennia centered around 1200 BCE (Fig. 4). This warming possibly led to an increase in glacial melt, which resulted, in turn, in an influx of cold freshwater that lowered Sea Surface Temperature (SST) in the North Atlantic and the Mediterranean Basin. This created an anti-phase event, in which warming ultimately resulted in a drop in SST. The decline in Mediterranean SST limited freshwater flux into the atmosphere and thus reduced precipitation over land. Indeed, a significant decrease in Adriatic warm-species dinocysts (Sangiorgi *et al.* 2003) was documented at the end of the Late Bronze, suggesting that the cooling of the Mediterranean may have been rapid and significant. Simultaneous decline in warm-species foraminifera in the Aegean Sea (Rohling *et al.* 2002) also suggests cooler water.<sup>13</sup>

A similar mechanism was also proposed for other climate anomalies: Krawczyk *et al.* (2010) for the Medieval Warm Period in Western Europe (Fig. 4), synchronized with the

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<sup>12</sup> The long term effects of this anthropogenic interference probably led to a reduction in vegetation cover that resulted in higher runoff which, in turn, enhanced soil removal and lower water penetration into the ground. Intensive agriculture that is represented in the pollen data by extensive olive horticulture during the previous periods could also have led to soil deterioration.

<sup>13</sup> Cullen *et al.* (2002) and Kushnir and Stein (2010) emphasized the potential role of the North Atlantic SST oscillations to explain the Eastern Mediterranean climate change based on recent data sets. Additionally, several Eastern Mediterranean dry events in the last 60,000 years were associated with cooling periods in the North Atlantic. Minimum arboreal percentages were found in a southern Levant marine core at the same time as extremely cool events were identified in the North Atlantic (e.g., Heinrich Events, the 8.2 event; Langgut *et al.* 2011). These drier Eastern Mediterranean climatic spells were also recognized based on other climate proxies (Bar-Matthews *et al.* 1999; Bartov *et al.* 2003; Almogi-Labin *et al.* 2009; Marino *et al.* 2009).

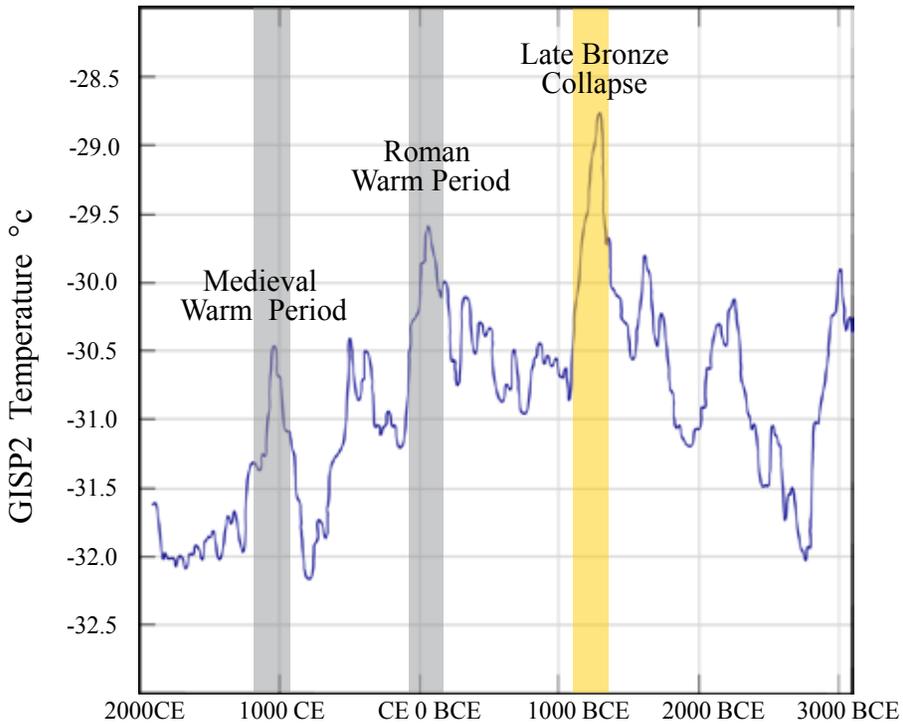


FIGURE 4 Greenland Ice Sheet Project (GISP2) temperature of the last five millennia (Alley 2004). A sharp increase occurred during the period of the Late Bronze collapse. A similar (albeit smaller) increase was reconstructed for the Roman and Medieval Warm Periods. In the latter (10th–11th centuries CE) the eastern Mediterranean withstood severe cold spells and drier climate conditions (Ellenblum 2012).

Near East 10th–11th centuries CE climate crisis.<sup>14</sup> Data from the Ionian Sea document a decline of SST during the 11th century CE (Emeis *et al.* 20000),<sup>15</sup> while the Nile records present long periods of drought (Hassan 2007). In the same way Denton and Broker (2008) describe the link between the North Atlantic Oscillation and the Little Ice Age.

## The ‘crisis years’

### The Late Bronze–Iron I transition

Could a series of dry years have a devastating effect on settlement systems in the southern Levant? The answer is positive for fringe areas, such as the southern Judean Highlands

<sup>14</sup> Meaning that climate patterns show opposed trends for the eastern Mediterranean region in comparison to those of northern and western Europe: Strong prevailing westerlies blowing towards northern and western Europe carrying moisture and heat from the Atlantic leaves the Mediterranean with higher atmospheric pressure, reduced precipitation and colder winters. When weaker westerlies blow towards the Mediterranean, atmospheric pressure is lower, and winters are warmer (e.g., Toker *et al.* 2012).

<sup>15</sup> Sampled in relatively low resolution.

(Langgut *et al.* forthcoming; Fig. 3). The question is more difficult to answer in regard to the greener parts of the Levant, such as the Galilee and the northern valleys. A good example comes from patterns of animal husbandry; when one takes a close look at the history of herd economy, as reflected in the zooarchaeological assemblages from sites in the sedentary parts of the region, no significant change in subsistence can be detected in the LB II–Iron IIA sequence (Sapir-Hen *et al.* forthcoming). In other words, a decrease of 100 mm in precipitation south of Hebron can be devastating while at Megiddo or Hazor that is not necessarily so.

In order to better understand the effects of a prolonged climate crisis, it is advisable to turn to a case study that is more proficiently documented textually. Based on detailed written sources Ellenblum (2012) has recently discussed a period of severe droughts and famine that shook different parts of the Near East in the 10th and 11th centuries CE. Two important insights from his work can be gleaned for our discussion:

- (1) A major component in the calamity—no less important than reduction in rainfall—was the phenomenon of extremely cold winters, which destroyed agricultural output, especially in the northern steppe regions. Indeed, in the case of the 10th–11th centuries CE, the process of collapse seems to have started in the north of the Near East; cold spells and the ensuing failure of crops motivated large groups of people to relocate to warmer areas in search of food; they spread havoc on their way.
- (2) It is not necessary for periods of drought to be prolonged for collapse to occur. A series of successive episodes of several bad years, each with too short intervals between them, was enough to instigate a chain of events that led to unrest and collapse from Khorasan and the Danube area in the north, through the Near East to Egypt in the south.

We believe the domino effect described by Ellenblum (2012)—cold spells, droughts and famine in the north, causing groups to invade sedentary lands in the south—explains the Late Bronze collapse.<sup>16</sup> But before turning to a reconstruction of what could have happened, we wish to focus on the exact dating of the crisis.

The high-resolution, well dated Sea of Galilee pollen record fixes the climate change between ca. 1250 and 1100 BCE. Three other high resolution southern Levant pollen records point to a dry event at the end of the Late Bronze and the transition to the Iron I (Kaniewski *et al.* 2010; Bernhardt *et al.* 2012; Langgut *et al.* forthcoming). However, since the chronological framework of the first two studies is less rigorous than the one used here, there are slight differences between these records concerning the exact time and duration of the Late Bronze dry event.

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<sup>16</sup> Nur and Cline (2000) suggested a different natural ‘prime mover’ for the Late Bronze collapse—an “earthquake storm” in 1225–1175 BCE. This idea must be rejected on several grounds: (1) it is not supported by recent paleo-seismological studies in the Dead Sea Rift (e.g., Kagan *et al.* 2011); (2) there is no reference to deadly earthquakes in the textual material; (3) there is no indication that destructions of cities were caused by seismic events; (4) destructions in the Levant continued until ca. 1100 BCE.

The Sea of Galilee dates for the crisis at the end of the Late Bronze Age are backed by two additional, independent records:

- (1) *Textual evidence* from the entire ancient Near East—from Hatti, Ugarit and Emar in the north via Aphek in Canaan to Egypt in the south. The Amarna tablets provide a detailed account of life in Canaan in a short period of several decades ca. 1360–1335/30 BCE. If there had been droughts and famine, they should have been mentioned. This means that in the mid- to second half of the 14th century BCE the climatic upheaval probably had not yet started. The first hint of troubles in the supply of grain in the north dates to the mid-13th century, when a Hittite queen writes to Ramesses II: “I have no grain in my lands” (KUB 21.38; Singer 1999: 715). The Aphek letter, which can be dated quite precisely to ca. 1230 BCE according to historically-known individuals mentioned in it (Singer 1983), refers to urgent need of grain in the north. In the late 13th century Pharaoh Merneptah reports in the Great Karnak Inscription that he “caused grain to be taken in ships, to keep alive the land of Hatti” (Wainwright 1960). The Ugarit letters describe the situation in the late 13th and early 12th century BCE. The king of Hatti writes to Ugarit (RS 20.212) about a vital grain shipment, which is “a matter of death or life” (Singer 1999: 716). A letter from a prominent Hittite official mentions “famine in the midst of my lands”. And a letter from the Urtenu archive says: “The gates of the house are sealed. Since there is famine in your house, we shall starve to death. A living soul of your country, you will no longer see” (RS 34.152; Singer 2000: 24). Finally, the price of grain in Egypt increased dramatically in the middle of the 20th Dynasty (Černý 1933), peaking in the days of Ramesses VII in the second half of the 12th century (Janssen 1975: 551–552). Put together, then, the textual evidence covers the period from the middle of the 13th century to the second half of the 12th century BCE.
- (2) *Archaeological evidence*: Detailed knowledge of the pottery assemblages, Egyptian objects and recent radiocarbon determinations help to establish a chronological framework for the collapse in the Levant. It seems that the earliest evidence for unrest related to the ‘crisis years’ is the destruction of Hazor sometime in the middle or second half of the 13th century (Ben-Tor and Zuckerman 2008). Aphek was probably destroyed in the late 13th century BCE (Gadot 2009: 583–586). Ugarit succumbed in the early years of the 12th century (Yon 1992; Singer 1999: 704–733). Other places were destroyed later. A series of sites in Israel, such as Lachish and Beth-Shean, show evidence for continuous activity at least until the days of Ramesses IV, that is, the 1140s (e.g., Ussishkin 2004: 69–70; Finkelstein 1996 respectively). A base of a statue of Ramesses VI found at Megiddo testifies that the city was still active in the 1130s (Ussishkin 1995; Finkelstein 1996). New stratigraphic, ceramic and radiocarbon evidence from the 2008–2012 seasons at Megiddo indicate that it came to an end still later, around 1100 BCE.<sup>17</sup> Therefore, the sequence of destructions in the Levant

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<sup>17</sup> This is not to say that the Egyptian domination continued as late; Egypt could have pulled out in the 1130s, while the unrest in the lowlands may have lingered on for several decades.

covers about a century and half, from the mid-13th century to ca. 1100 BCE—exactly the time of the dry event according to the Sea of Galilee pollen record.

To sum up this point, we are dealing here with a long process that took over 100 years—from sometime in the middle of the 13th century to around 1100 BCE (contra Carpenter 1966; Bryson *et al.* 1974; Weiss 1982, who suggested a short event that lasted less than a decade). Incidentally, Ellenblum (2012) describes a similar time frame—around 120 years (ca. 950–1070 CE)—for the medieval collapse in the Near East.

### The ‘domino effect’

The following attempt to describe what happened at the end of the Late Bronze Age is based on the above mentioned sets of palynological, archaeological and textual data for the Late Bronze on the one hand, and on Ellenblum’s description of events two millennia later on the other.

A period of dryness and no less important, cold spells on the northern fringe of the Mycenaean world and the Hittite empire, seemingly evident in the Abant and Eski Acigöl pollen diagrams (Bottema *et al.* 1993/1994; Woldring and Bottema 2003 respectively), and in the Lake Van isotopic record (Litt *et al.* 2009), could have initiated the process (Fig. 5). Mounting aridity led to a decrease of the vegetation cover in desert and steppe areas, which significantly reduced grazing and herding opportunities. Severe failure of crops resulted in famine, driving displaced groups southward in search of food, which in turn spread havoc and destruction and impelled other, more southerly groups to move by land and sea (for large groups of people that moved from Anatolia to the southeast in the days of Tiglath-pileser I [1114–1076 BCE], see Na’aman 1994: 235–237). Unrest disturbed land-routes as well as maritime trade in the eastern Mediterranean and finally wrecked the delicate network of the Late Bronze *koine*. The integrated, global nature of the economy of the period before troubles started is manifested by the cargo of the Uluburun shipwreck, which dates to ca. 1300 BCE (e.g., Pulak 1998; Cline and Yasur-Landau 2007). The eastern Mediterranean trade-network of the Late Bronze Age, so well-represented by the Uluburun finds, crumpled as a result of pirate activity, which is attested in several Ugarit tablets (e.g., Yon 1992; Singer 1999: 719–723). Groups of displaced people, labelled ‘Sea Peoples’ in the Egyptian texts of the days of Ramesses III in the early 12th century BCE, moved by land and sea and assaulted cities for provisions. Difficulties in Egypt,<sup>18</sup> resulting from the breakdown of the (at least partially) pharaonic-dominated eastern Mediterranean trade, caused the retreat of Egyptian administration and military forces from Canaan, contributing in turn to the instability in this territory. In the ‘green’ parts of the Levant the climate crisis was less threatening, but economic and political instability, which resulted from the situation in more northerly areas, were no less menacing. They probably increased the number of uprooted people who formed unruly groups that retreated from the urban centres—known in the Egyptian texts as *Apiru*. Such bands, even if they numbered no more than a few hundred (or even a few dozen) warriors each, could have

<sup>18</sup> For the dramatic rise in the price of grain in Egypt in the 12th century BCE, see Černý 1933; Janssen 1975: 551–552.

attacked cities, ravaged them, or at least reduced their economic and demographic power. At Megiddo, minute differences in the pottery assemblages of the end-phase in different sectors of the Late Bronze city seem to indicate that part of it was deserted a while before the end-event. In other words, the process of decline, even on a single-city level, could

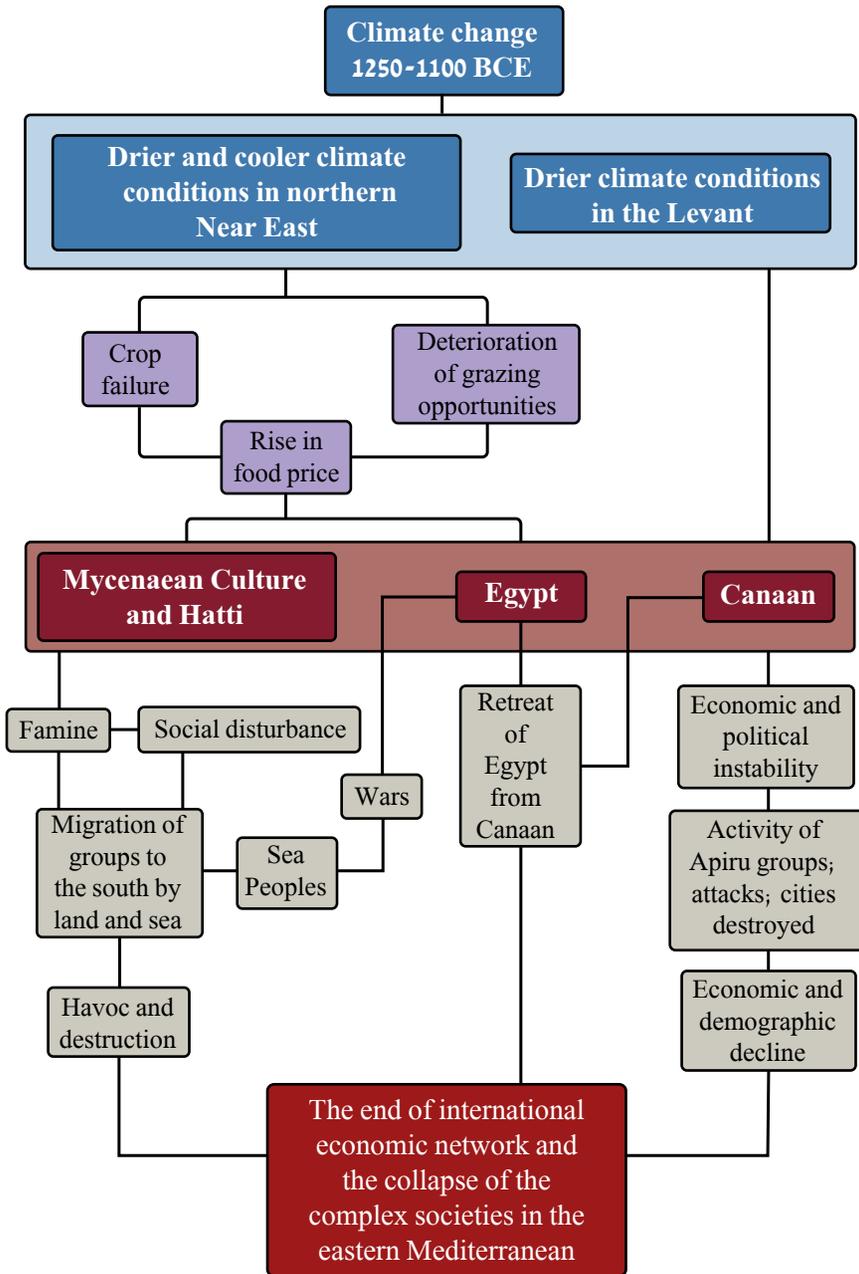


FIGURE 5 The chain of events in the eastern Mediterranean during the ca. 1250–1100 BCE Late Bronze collapse.

have been gradual (similar situations are attested in Ellenblum 2012 for the 10th–11th centuries CE crisis). In any event, there was no need for an organized army, or a vast hoard of Sea Peoples, in order to destroy cities in opportunistic raids.

The picture that emerges from the main urban centres in the lowlands of Canaan is one of devastation. The countryside, even in close proximity to the main cities, presents a more nuanced picture. Arie (2011) has recently noted evidence for destruction also in certain rural settlements in the northern valleys. But other villages in the region seem to provide testimony for continuity in habitation from the Late Bronze to the Iron I (Finkelstein 2003). This is also the picture that emerges from surveys: continuation in the settlement systems has been detected in the western Jezreel Valley (Finkelstein *et al.* 2006), the upper Jordan Valley (Ilan 1999) and the Jordan Valley south of the Sea of Galilee (Maeir 1997). What we see in the lowlands, therefore, is an interesting dichotomy: desolation in the main centres, which must have caused many to leave the cities in favour of the countryside, and a less disrupted transition in the rural sector.

In any event, unrest, manpower problems (Bunimovitz 1994) and local devastations prevented the sedentary communities in the lowlands from producing surplus grain. This forced the large numbers of pastoral nomads that seem to have characterized the demographic system of the Levant in the Late Bronze Age to settle down (Finkelstein 1995). Indeed, it seems that the wave of settlement in the highlands started as early as the late 13th century (Finkelstein 1988: 315–321), that is, before the final events in the lowlands took place in the late 12th century BCE.

A change to wet conditions during the Iron I facilitated a quick recovery of the agricultural systems in the northern regions of the Near East, which resulted in the cessation of movement of people southward. This brought about the gradual revitalization of the city-state structure in the lowlands (Finkelstein 2003). These wet conditions also promoted the expansion of the settlement system in the highlands, an expansion which laid the foundations for the rise of territorial kingdoms and new group-identities in the Levant in the early Iron II.

### **A note on climate**

We suggest that the Late Bronze climate crisis in the eastern Mediterranean was the result of simultaneous disasters that occurred in three usually independent climate zones: in the northern regions, evident not only by pollen records (Bottema *et al.* 1993/1994; Woldring and Bottema 2003), but also by the Lake Van isotopic record (Litt *et al.* 2009); in the Levant, as derived from the pollen records of the Sea of Galilee, the Dead Sea (Langgut *et al.* forthcoming) and Northern Syria (Kaniewski *et al.* 2010); and in Eastern Africa, where palynological evidence points to a significant decrease in the Nile flows (Bernhardt *et al.* 2012). It seems therefore that atmospheric circulations were integrated not only within the Mediterranean Basin but well beyond it. The crisis in the 10th and 11th centuries CE occurred in the same three climate zones (Ellenblum 2012), and lasted about the same number of years. Though in both periods there could have been annual oscillations, the long-term effects were severe. In the case of the Late Bronze Age, they had an enduring impact on the history and civilization of the eastern Mediterranean and the Near East.

## Summary

The integration of well-dated, high resolution southern Levant environmental history based on a pollen record with archaeological and textual evidence from the entire eastern Mediterranean region enables us to define the possible causes and duration of the Late Bronze collapse.

Cold spells in the northern areas of the eastern Mediterranean and decrease in precipitation across the entire region had devastating effects on agriculture productivity and grazing opportunities. Such climatic pressure led to increased food prices and to social tensions due to competition for limited resources. Groups in the north were forced to move to lands with more hospitable conditions in search of food, leaving a path of destruction and disorder and causing disruption in trade. Pastoral nomads, who depended on surplus grain in the sedentary communities, were especially vulnerable. The long-term climatic changes influenced the stability of the organized kingdoms in the region and led to systemic collapse of the previously well-integrated complex societies in the eastern Mediterranean, depopulation of large areas, urban abandonments and long-distance migration.

Wetter conditions in the southern Levant during the Iron I was the backdrop for the dramatic intensification of settlement in the highlands of the region. Two centuries later these new settlement systems gave birth to the two Hebrew kingdoms and other biblical nations—the Arameans in Syria and the Ammonites and Moabites in Transjordan.

## Acknowledgments

This study was funded by the European Research Council under the European Community's Seventh Framework Program (FP7/2007-2013) / ERC grant agreement no. 229418. We wish to thank M. Kitin, A. Almogi-Labin, O. Hyams-Kaphzan, I. Ben-Ezra, Y. Gottlieb and S. Ben-Dor Evian for their technical help and M. Stein and T. Litt's team from the Bonn Palynological Laboratory for extracting the Kinneret core.

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