CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-55832-7 — Climate and Environment in the Southern Levant, 1300–300 BCE
Dafna Langgut
Excerpt
More Information

1 Climate and Environmental Reconstruction

This Element focuses on the reconstruction of climate and environmental conditions in the Southern Levant (hereafter SL) during the period ca. 1300–300 BCE. The introduction provides an overview of what constitutes climate and environmental change, outlines the aims and structure of this Element, and defines its chronological framework (Section 1.1). It then describes the modern characteristics of the SL, particularly its climate and vegetation (Section 1.2). Finally, it introduces the paleoclimatic and paleoenvironmental proxies that were used in this Element to reconstruct past climate and environmental conditions in the study area.

1.1 Introduction

Climate has long been a fundamental force shaping human history, influencing the rise and fall of civilizations, economic prosperity and decline, as well as political stability and instability. In antiquity, fluctuations in temperature, annual precipitation, and climatic variability played a crucial role in determining agricultural yields, food security, and resource availability. These, in turn, affected trade networks, migration patterns, and the organization of societies. Periods of favorable climate fostered economic growth and urban expansion, while prolonged droughts, cooling events, or unpredictable weather often triggered crises, conflicts, and even the collapse of great empires (Butzer 1982; Weiss et al. 1993; Ellenblum 2012).

This relationship between climate and civilization is particularly evident in the SL, a region at the crossroads of Asia, Europe, and Africa. Situated on the fringe of the Mediterranean climate zone and bordering the hyper-arid desert, the Levant's hydro-climatic conditions have historically been highly sensitive to even minor global climate perturbations (Figure 1; Rosen 2007). Moreover, the region has witnessed some of the most dramatic episodes of human development. During prehistoric times, the Levantine Corridor served as a primary route for hominin migration out of Africa (Grove 2015) and contains some of the earliest evidence for the transition to agriculture (Zohary et al. 2012). In historical periods, the region experienced significant societal transformations, including the rise and fall of urban societies during the Bronze Age, the emergence of the territorial kingdoms in the early Iron Age, and the dominance of imperial powers from the later Iron Age through the following historical periods. These shifts are reflected in the archaeological record as periods of economic prosperity, decline, destruction, and sharp settlement oscillations, which include human movements between Mediterranean, semiarid, and desert environments (Finkelstein 1995; Rosen 2007). These settlement fluctuations may have been influenced by climatic shifts – such as prolonged droughts – but they could also reflect broader

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-55832-7 — Climate and Environment in the Southern Levant, 1300–300 BCE
Dafna Langgut
Excerpt
More Information

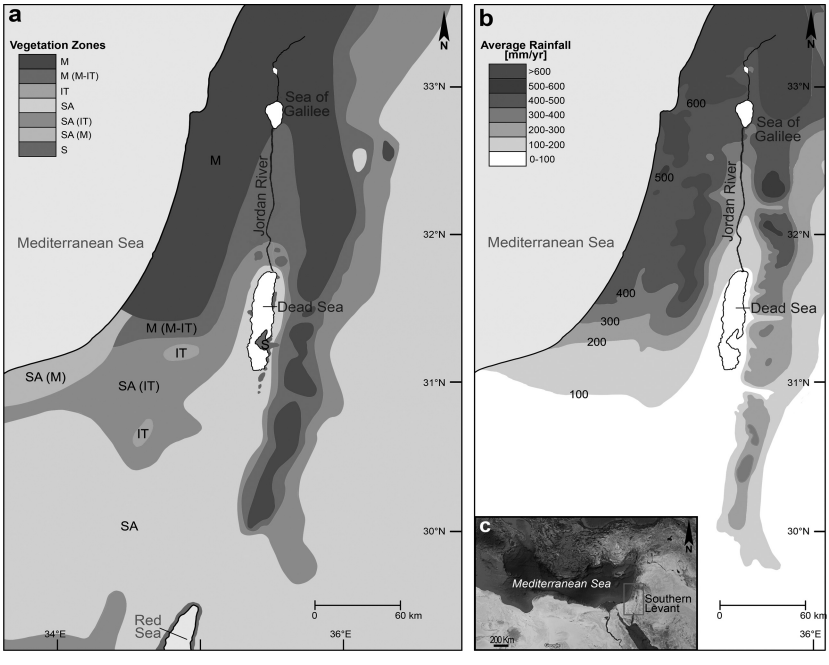


Figure 1a. Distribution of phytogeograpic zones in the SL (after Zohary 1973, 1982 and Danin 2004); M = Mediterranean zone (garrigue, maquis, woodland); IT = Irano-Turanian zone (steppeland); SA = Saharo-Arabian zone (desert); S = Sudanian zone (penetration territory); **b.** Map of the SL indicating mean annual precipitation in millimeters (Srebro and Soffer 2011); **c**. The location of the SL. Maps prepared by M. Cavanagh.

sociopolitical and economic changes, including shifts in subsistence strategies, warfare, environmental disasters (earthquakes, plagues), and political struggles (Greener et al. 2018; Cline 2021). Given the scarcity of textual evidence, scholars continue to debate the primary drivers behind these transformations – whether they were predominantly environmental or historical (Rosen 2007: 8–14; Rambeau 2010), or some combination of both.

This Element presents a regional paleoclimate[1] history of the SL, which is primarily based on pollen[2] records from the region, a powerful tool for

[1] In this Element, paleoclimate refers primarily to the reconstruction of past climatic conditions – especially variations in precipitation (humidity) and temperature – whereas paleoenvironment focuses mainly on the reconstruction of past vegetation and landscape, including human influence on the natural landscape such as deforestation and overgrazing.

[2] Pollen grains are the most durable organic material in nature and can therefore be preserved as fossils for thousands or even hundreds of thousands of years, especially under oxygen-deprived

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-55832-7 — Climate and Environment in the Southern Levant, 1300–300 BCE
Dafna Langgut
Excerpt
More Information

understanding past vegetation, climate history, and human–environment interactions (Bryant 1989; Faegri and Iversen 1989). Other paleoclimate proxies, such as reconstructions of Dead Sea Lake levels and isotopic records[3] from Soreq Cave, are also examined. Additionally, the Element explores the region's natural landscape, incorporating newly established databases on wood-charcoal remains from SL mounds, as well as the local palynological records. Beyond climate reconstruction, it evaluates changes in the natural environment, the magnitude and composition of fruit-tree horticulture, and human-induced landscape modifications such as deforestation, landscape terracing, and overgrazing.

Throughout the Element, a critical approach is taken in evaluating the role of climate and environment in shaping social and political processes. While climate is undoubtedly a key factor, it is only one among many influencing settlement patterns and subsistence strategies in the region during this period. The Element also considers the role of governing empires in crisis management and economic control, particularly examining Egypt's administration of Canaan during the Late Bronze Age (LBA). Through this interdisciplinary approach, this Element seeks to provide a nuanced understanding of climate's role, alongside other influencing factors, in shaping human societies in the ancient SL.

Although the primary focus is on the period between ca. 1300–300 BCE, this study takes a long-term perspective to better identify and contextualize climate changes over an extended timeframe – from the Early Bronze Age (EBA) through the Achaemenid period (recently reviewed by Langgut and Finkelstein 2023a). The dating of the archaeological periods in this Element follows, as far as possible, the radiocarbon results of Levantine archaeological sites from the last decade (Table 1). This broader approach allows for a more precise assessment of climate variability and its potential impacts.

This first section serves as an introduction to the two subsequent sections, which discuss climate reconstruction (Section 2) and environmental reconstruction (Section 3) in detail for the period ca. 1300–300 BCE in the SL, with a continuous examination of the potential link between climate and environmental changes and human activity. Section 4 provides a brief summary of the synthesis presented in Sections 2 and 3.

conditions such as lake bottoms and wetlands. Each plant produces a unique pollen form, serving as a kind of identification card or fingerprint that can usually be recognized under a microscope. Pollen grains can be chemically extracted from sediments and used to study the composition of past vegetation assemblages. Changes in these assemblages may indicate shifts in climate (Bryant 1989; Faegri and Iversen 1989). The study of fossil pollen is called palynology.

[3] Records of past climate based on the chemical signatures of isotopes in natural materials such as cave deposits (=speleothems), shells, and ice cores.

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-55832-7 — Climate and Environment in the Southern Levant, 1300–300 BCE
Dafna Langgut
Excerpt
More Information

Table 1 The chronological framework used in this study (following Langgut and Finkelstein 2023a and references therein).

Period	Abbreviation	Approximate Years BCE
Early Bronze Age	EBA	
Ia	EB Ia	37/3600–34/3300
Ib	EB Ib	34/3300–31/3000
II	EB II	31/3000–2850
III	EB III	2850–2500
Intermediate Bronze Age	IBA	2500–1950
Middle Bronze Age	MBA	
I	MB I	1950–1750
II–III	MB II–III	1750–1550
Late Bronze Age	LBA	1550–1150
Iron Age		
I	Iron I	1150–950
IIa	Iron IIa	950–780
IIb	Iron IIb	780–680
IIc	Iron IIc	680–586
Babylonian period	Babylonian	586–539
Achaemenid (Persian) period	Achaemenid	539–332*

* The Persian period in the SL, also termed Achaemenid, is generally dated to 539 BCE, beginning with its conquest of the Babylonian Empire, and ending in 332 BCE with its defeat by Alexander the Great.

1.2 Geographical Setting of the Southern Levant

The starting point for any climatic and environmental reconstruction is the present conditions within the study area. In the following sections, the current climate (1.2.1) and vegetation (1.2.2) prevailing in the SL will be presented.

1.2.1 Climate

The SL region is mainly influenced by rainfall that originates in the Northeast Atlantic Ocean, passing over Europe and the Mediterranean Sea. The Cyprus Low largely controls the winter rainfall temporal and spatial variability in the region (Ziv et al. 2006). During spring and autumn, synoptic systems from

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-55832-7 — Climate and Environment in the Southern Levant, 1300–300 BCE
Dafna Langgut
Excerpt
More Information

southern and southeastern origins may occur. The summers are hot, with almost no rainfall, due to the influence of the Persian Trough (Dayan et al. 2007). The Negev Desert, occupying the southernmost part of the Levant, is part of the global desert belt along the 30°N latitude (Ziv et al. 2006).

The SL is characterized by two primary precipitation gradients. The first is a sharp north-to-south transition from a subhumid Mediterranean climate, which receives over 800 mm of mean annual precipitation, to the hyper-arid conditions of the southern Negev Desert, where annual rainfall drops below 50 mm (Figure 1b). The northern Sinai coastline marks the southernmost limit where rain clouds can form. This steep precipitation gradient occurs over a span of less than 300 km (Ziv et al. 2006; Dayan et al. 2007; Srebro and Soffer 2011). The second gradient extends west to east, from the Mediterranean coast toward the Dead Sea Rift Valley. This gradient is shaped by an orographic barrier – the central ridge – which creates a rain-shadow effect. The western slopes of the ridge experience a typical Mediterranean climate, whereas the eastern slopes transition rapidly into the arid conditions of the Judean Desert. This climatic shift occurs over a distance of less than 100 km (Figure 1b). The southern boundary of the Judean Desert directly borders the northeastern edge of the Negev Desert. Unlike the latter desert, which results from large-scale global air circulation patterns, the Judean Desert is a localized climatic phenomenon (a rain-shadow desert; Ziv et al. 2006). The dominant winds in the region originate from the north and northwest, playing a major role in transporting wind-borne pollen that becomes embedded in the sediments of the Dead Sea and the Sea of Galilee (hereafter Kinneret). During the spring and fall, easterly winds also occur, primarily associated with the Red Sea Troughs and Sharav Cyclones (Ziv et al. 2006).

To assess potential links between past climate conditions and economic-demographic processes, the most sensitive zone for climate–human interactions is the transitional belt between the Mediterranean and desert environments – the semiarid steppe zone, characterized by Irano-Turanian steppe vegetation (also referred to as dwarf shrublands; Figure 1a). This transitional area supports a combination of dry farming, primarily barley cultivation, and pastoral subsistence. Periods of increased precipitation allowed for an expansion of this zone southward and eastward, while drier conditions forced it to retract northward and westward (Finkelstein and Langgut 2014). Settlements located near perennial water sources may have been able to endure longer periods of aridity, whereas those without consistent water access were more likely to be abandoned.

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-55832-7 — Climate and Environment in the Southern Levant, 1300–300 BCE
Dafna Langgut
Excerpt
More Information

1.2.2 Vegetation

The SL is composed of three main phytogeographical zones: (1) the Mediterranean, (2) the Irano-Turanian, and (3) the Saharo-Arabian. The latter also includes some tropical plants which belong to the Sudanian vegetation (Figure 1a; Zohary 1973, 1982; Danin 2004).

1. The Mediterranean region which runs along the coast and its adjacent mountainous areas (Galilee, Carmel Ridge, Samaria, and Judea). The hills feature Mediterranean maquis/forest with typical evergreen trees, mainly kermes oak (*Quercus callipprinos*), and pistachio (*Pistacia palaestina*), and, to a lesser extent, some olives (*Olea europaea*), Aleppo pines (*Pinus halepensis*), and some deciduous oaks (*Quercus boissieri* and *Q. ithaburensis*). In open fields or the understory of the maquis/forest, dwarf-shrubs such as Mediterranean buckthorn (*Rhamnus lycioides*) and sumac (*Rhus coriaria*) are present. Herbaceous species are also common (e.g., branched asphodel; *Asphodelus microcarpus*). This vegetation zone receives more than 400 mm of annual precipitation and is generally influenced by the Mediterranean climatic system together with some regional orographic phenomena. The Israeli coastal plain occupies a mix of Mediterranean and desert plants due to its sandy soil and saline environment. This sandy strip is dominated by different species of grasses (Poaceae), goosefoots (Chenopodiaceae), sand wormwood (*Artemisia monosperma*), and Mormon-tea (*Ephedra* spp.).
2. The Irano-Turanian phytogeographic zone lies from the coastal plain near Gaza to the Negev Highlands and the southern edge of the Judean Highlands and then continues northward via the Central Jordan Valley to the Kinneret. This is an almost treeless landscape with semiarid vegetation, often described as steppe or dwarf shrublands. Different species of grasses and chenopods are the main vegetal elements of this zone as well as white wormwood (*Artemisia herba-alba*). The annual rainfall is below 400 mm on average and is due mainly to Mediterranean depressions. The region is also typified by relatively broad seasonal and daily temperature distributions.
3. The Saharo-Arabian vegetation zone occupies most of the Negev and Judean Deserts, the Dead Sea region, the Arabah Valley, Sinai, and the southern and eastern portions of Transjordan. The vegetation is typified by relatively low species diversity and concentrated mostly in wadi beds. It is dominated by many members of the goosefoots and grasses, bushy bean-caper (*Zygophyllum dumosum*), white broom (*Retama roetam*), and tamarisk (*Tamarix* spp). This region has a typical desert climate: The mean annual rainfall does not exceed 200 mm and is usually lower than 100 mm. Seasonal

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-55832-7 — Climate and Environment in the Southern Levant, 1300–300 BCE
Dafna Langgut
Excerpt
More Information

and daily temperature distributions are broad. It is influenced by southern and southeastern synoptic systems, which are widespread in the spring and autumn, as well as by the western Mediterranean depressions, which mainly influence the northern part of the Negev Desert. Within these desert plants' geographical area, Sudanian territory with tropical elements occurs along the shores of the Dead Sea, in the Arabah Valley, and the Central Jordan Valley (up to about 80 km north of the Dead Sea). Some of the tropical plants are linked to freshwater springs or wadi beds; they include *Acacia*, Jujube (*Ziziphus spina-christi*), and toothbrush tree (*Salvadora persica*; Al-Eisawi 1996; Danin 2004).

1.3 Paleoclimatological and Paleoenvironmental Proxies

This section will describe the paleoclimatological and paleoenvironmental records that will be used in this Element. The emphasis in this synthesis is on records sampled at high resolution and for which a relatively reliable chronological framework is available.

1.3.1 Palynological Records

In this section, two palynological diagrams, produced by the author, will be presented in detail: the Kinneret and the Ze'elim (Dead Sea; Figures 2 and 3).[4] The diagrams will be followed by a comparison of two other high-resolution, well-dated SL palynological records: Ein Feshkha (Neumann et al. 2007a) and Birkat Ram (Neumann et al. 2007b). The four sequences present a north–south transect of 220 km along the SL (Figures 4 and 5). Palynological records are used to reconstruct past climates, primarily based on changes in the percentages of elements from the Mediterranean woodland. High percentages of arboreal pollen (AP) indicate relatively high precipitation and the expansion of the Mediterranean woodland, and vice versa (Bryant 1989). Palynological records also help to reconstruct human activities such as agriculture (mainly Oleiculture, since the olive can disperse pollen over long distances compared to other cultivated species; Langgut et al. 2014b), afforestation, and overgrazing

[4] These studies were conducted by a research group composed of the following scholars: Thomas Litt of the University of Bonn, Frank Neumann of the North-West University South Africa, and Mordechai Stein of the Israel Geological Survey, as part of a project titled "Reconstructing Ancient (Biblical) Israel: The Exact and Life Science Perspective," funded by the European Research Council (ERC, no. 229418). The project was directed by Israel Finkelstein of Tel Aviv University along with Steve Weiner of the Weizmann Institute of Science, from 2009 to 2014. The two palynological diagrams resulted from this project have already been published and discussed in detail in a series of articles (Langgut et al. 2013a, 2014a, 2015, 2016; Finkelstein and Langgut 2014; 2018; Langgut and Lipschits 2017; Langgut and Finkelstein 2023a).

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-55832-7 — Climate and Environment in the Southern Levant, 1300–300 BCE
Dafna Langgut
Excerpt
More Information

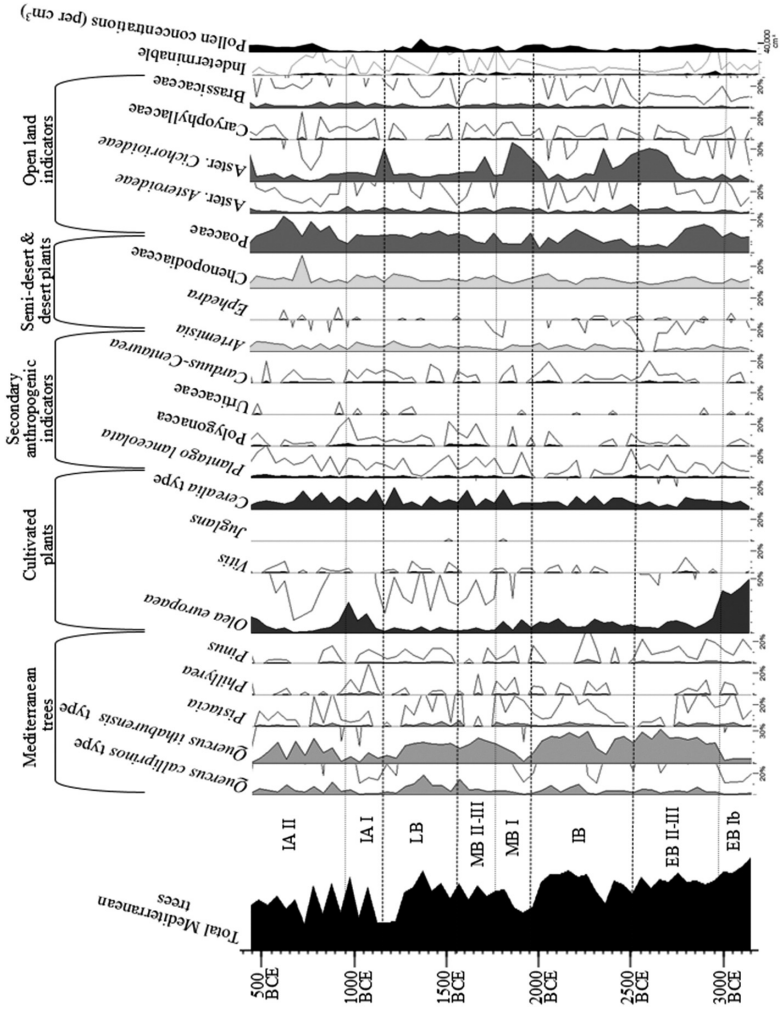


Figure 2 Concise pollen diagram of the Kinneret (see Langgut et al. 2015: fig. 3).

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE

Cambridge University Press & Assessment
978-1-009-55832-7 — Climate and Environment in the Southern Levant, 1300–300 BCE
Dafna Langgut
Excerpt
More Information

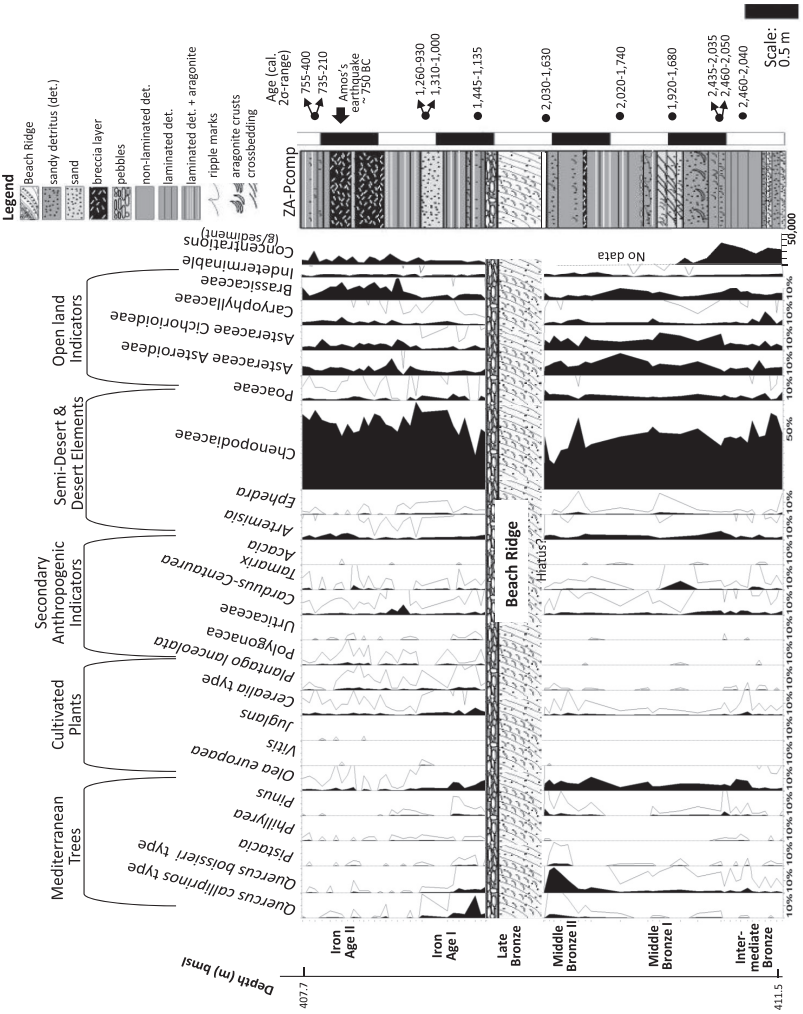


Figure 3 Concise pollen diagram of the Dead Sea (Ze'elim; see Langgut et al. 2014a: fig. 2).

© in this web service Cambridge University Press & Assessment www.cambridge.org