Settlement Fluctuations and Environmental Changes in Israel’s Coastal Plain During the Early Bronze Age

Avraham Faust¹ and Yosef Ashkenazy²

The possibility of a decline of settlement in the coastal plain during the urban phases of the Early Bronze Age has been noted in passing by many researchers, but as these were usually working on a local or regional scale, the evidence has not yet been addressed systematically. In the present paper, we seek to quantify the extent of this decline, and attempt to explain it, by linking the archaeological data to climatic evidence which seems to point to environmental change at that time. In particular this took the form of increased precipitation which would have intensified existing drainage problems leading to increased flooding and the transformation of arable land into unhealthy marshland, which would have encouraged a decline in human settlement activity. We propose that these processes are responsible for the fact that the ‘urban revolution’ of the Early Bronze Age (characterized by large, densely occupied, fortified and relatively complex settlements) appears to have by-passed much of the coastal plain, where such developments are not attested before the 2nd millennium BC.

Keywords: urbanization, environmental change, Early Bronze Age, Israel, coastal plain

Introduction

The Early Bronze Age of the Southern Levant has been studied extensively over the years. It marks the point at which the ‘urban revolution’ is usually thought to have reached the region, and the period is generally regarded as one of prosperity (e.g. Broshi and Gophna 1984; and below). In the case of the coastal plain, the urban phase of the period (Early Bronze Age [EB] II–III) is actually marked by a palpable decline of settlement, a fact that while noted by some scholars (see below for details) has not yet been addressed systematically. In fact, as this article will demonstrate, the coastal plain (Fig. 1) was practically devoid of large-scale settlement during the EB II–III.

In the first part of this paper we attempt to prove this pattern and to show that the ‘urban revolution’ of the late 4th and 3rd millennia BC did not extend to most coastal regions. In the second part of the paper we suggest an explanation for the abandonment of this region, for what is, in fact, a period of some 700 years. In the last part of the paper we comment briefly on the implications of our study for several wider issues, in particular the relationship between the environment and human activity, and for our understanding of the relationship between Egypt and the Levant in the late 4th to 3rd millennia BC.

Notes on Chronology

There is considerable disagreement on the exact dating of the various phases of the EB. In short, traditional chronologies such as that used by Mazar (1990, 92, 108), which dated the EB I to 3300–3050 BC and the EB II–III to 3050–2300, have been revised to take account of a growing body of radiometric data, and there is now a tendency to date the beginning of the EB I to 3600 BC or even earlier (Segal and Carmi 2004; Gophna 2004, 2; Golani 2004, 10, 46; Philip 2001, 169). In this paper we follow a fairly traditional dating for the phases of the EB, i.e., 3500–3000 for the EB I and 3000–2300 for the EB II–III. EB I is not subdivided, as the nature of the available data did not allow such precision, while EB II–III is treated as a single period,

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as the phenomenon to be discussed spans both sub-periods. While perhaps a minor shortcoming, this does not obscure on the overall trends.

The Phenomenon

Introduction

Early Bronze Age settlement in Israel has received much scholarly attention (de Miroschedji 1989; Ben Tor 1992; Joffe 1993; Gophna 1995; Greenberg 2002; Philip 2003; van den Brink and Levy 2002). The EB, and especially its developed phases, the EB II–III, are the periods during which urbanization is first attested in the region, and when the first large, stratified human communities appeared. (Note that this study follows conventional wisdom regarding the dating and definition of urbanism, and does not seek to engage with ongoing debates concerning the point at which urban settlements first appeared [e.g., Paz 2002], nor whether the EB settlements in the southern Levant should really be considered ‘urban’ [Philip 2001; 2003; Chesson and Philip 2003; Faust and Golani 2008].

In the southern Levant generally, the process of urbanization was accompanied by unparalleled demographic growth. While there are no detailed studies regarding the preceding eras (see, for example, Ben Tor 1990, 6), there seems to be agreement that the EB II–III exhibited a demographic peak (e.g., Broshi and Gophna 1984). Based on the excavations of tells and surveys of vast areas, scholars have approximated the number of inhabitants in Israel during the various periods (Table 1), with the population during the EB II–III estimated by Broshi and Gophna (1984) as around 150,000. This peak was followed in the succeeding Intermediate Bronze Age (c. 2300–2000 BC), by a drastic decline in population and a collapse of the urban system (Gophna 1992), with a subsequent recovery and reurbanization during the Middle Bronze Age II (c. 2000–1600 BC) (Broshi and Gophna 1986). While the figures quoted above are no more than approximations, the main trends appear fairly secure, especially as all studies used the same methods and coefficients (see Table 1, for a summary of the various studies).

Settlement in the Coastal Plain in the Early Bronze Age

From the late 4th millennium BC onward, the eastern Mediterranean was generally characterized...
by intensive trade along its shores (e.g., Stieglitz 1984; Marcus 1998; 2002; see more below). Such trade is usually accompanied by ports and auxiliary agricultural settlements along the coast, and in many cases by a complex network of settlements and terrestrial trade routes (cf. Stager 2001). Surprisingly, however, while there is abundant evidence for both maritime trade, as well as for general demographic and settlement growth in other parts of the country during the EB II–III, settlement in the coastal plain was drastically reduced during this period. While for the purposes of the present paper, the coastal plain is defined as encompassing those areas which are both in the coastal plain, and less than 12 km from the coastline, the patterns observed here can be identified using other definitions of the coastal plain as well (see below).

Studies reporting a decline in settlement in various parts of the coastal plain include Gophna (1990, 163, 165); Gophna and Portugali (1988, 15); Portugali and Gophna (1993); Finkelstein (1995, 62); Getzov et al. (2001, 28); Yannai (2002, 78). However, as these were usually focused upon specific local areas the wide extent of the phenomenon has not generally been identified nor addressed in the literature (see also Ben-Tor 1992, 84; Raban 1985, 14; Yannai 2006, 5, and below). Some studies probably did not identify the overall pattern of the phenomenon reported here because they were focused upon very small areas. Others, however, used a broad definition of the coastal plain, and as a result the picture was confused by the inclusion of EB II–III sites which really lie on the foothills of the central uplands rather than the coastal plain proper. Although he did not carry out a detailed study, Raban (1985, 14) does refer to a large-scale abandonment, and a gap in settlement in the coastal plain was also noted in passing by Getzov et al. (2001, 43) and Yannai (2006, 5).

Sources of Evidence

The observation that the EB II–III period witnessed a demographic decline in the coastal plain is based upon the following two datasets.

Planned excavations as summarized in the New Encyclopedia of Archaeological Excavations in the Holy Land

The first database was compiled from the excavations published in the Hebrew edition of the New Encyclopedia of Archaeological Excavations in the Holy Land (NEAEHL; Stern 1993b: note that most entries are identical to those in the English version, but this particular database is drawn from the Hebrew edition). The number of individual sites that were reported is 499. However, as some settlements were occupied in more than one period, we have identified a total of 2214 different occupations or strata.

The evidence published in this volume concerns mainly institutional or other planned excavations, often those undertaken on major or urban sites. As such, this reflects the ‘urban bias’ familiar to Near Eastern archaeology wherein excavation has traditionally been focused upon large sites (London 1989), a tendency described by Ahlstrom (1982, 25) as ‘tell minded’. Of course, these volumes do include some small sites (and at times, particular phases of occupation within large tells may be represented by fairly small settlements), as well as the results of salvage excavations. However, as the bulk of the data come from planned excavations undertaken on large sites, this database shows a marked bias towards large, urban settlements, and can be regarded as representing mainly the urban sector.

We accept that the NEAEHL does not include all the relevant information. Omissions are inevitable, while some sites were discovered only after its compilation. Examples include the large, fortified EB centre of Tel Sakan near Gaza (de Miroshchedji

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Table 1 Summary of demographic changes in Israel during the Bronze Age. The table columns include (i) the chronology, based on a fairly traditional dating, (ii) the period, (iii) the demographic characteristics of the period, (iv) the estimated demography, and (v) the sources for the estimated figures

<table>
<thead>
<tr>
<th>Schematic Time Range (BC)</th>
<th>Period</th>
<th>Characteristics</th>
<th>Estimated Demography (throughout the country)</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>3500–3000</td>
<td>Early Bronze I</td>
<td>Mostly rural period (proto-urban)</td>
<td>50,000 (7)</td>
<td>Ben Tor 1990, 6</td>
</tr>
<tr>
<td>3000–2300</td>
<td>Early Bronze II–III</td>
<td>Urban period</td>
<td>150,000</td>
<td>Broshi and Gophna 1984</td>
</tr>
<tr>
<td>2300–2000</td>
<td>Intermediate Bronze Age</td>
<td>Rural period, with greatly decreased population</td>
<td>15,000</td>
<td>Gophna 1992, 155–56</td>
</tr>
<tr>
<td>2000–1600</td>
<td>Middle Bronze II</td>
<td>Urban period</td>
<td>150,000</td>
<td>Broshi and Gophna 1986</td>
</tr>
<tr>
<td>1600–1200</td>
<td>Late Bronze</td>
<td>Urban period, but with decreased population</td>
<td>60,000</td>
<td>Broshi 1993, 423</td>
</tr>
</tbody>
</table>

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et al. 2001), which was excavated only after the NEAEHL has been published and Tel Poran, where a trench cut during construction work revealed a probable EB III fortification (Gophna 1977), but which is also not reported in the NEAEHL. We believe that this source can serve as a representative database, because the vast majority of planned excavations are included and the omissions are likely to be distributed evenly across all periods and regions; and so are not expected to change the overall picture significantly.

Salvage excavations as reported in Hadashot Arkheologiyt

The second database consists of the record of salvage excavations undertaken throughout Israel and published in the journal, Hadashot Arkheologiyt (Archaeological News), between 1961 and 2003 (compiled by A. Faust and Z. Safrai). This includes some 3592 occupations or strata (as above, calculated to include occupations at a single site which date to different periods as separate entries). Salvage excavations are usually carried out when a small site is discovered just before or during construction (Faust and Safrai 2005, 141–42). Matters of time, cost and current environmental and heritage protection frameworks means that under such circumstances developers usually work around large sites (whether known before the project commenced, or discovered during surveys conducted in advance of development). Such sites are often left as green areas within cities or neighbourhoods, or are simply bypassed by road builders. Actual salvage excavations are therefore more frequently carried out on small sites, and thus the salvage record offers a window on the rural sector. This aspect of the evidence has not yet been studied systematically, and the analysis presented below draws upon information contained in a new database, one that summarizes and interprets the published evidence for salvage excavations (Faust and Safrai 2005; forthcoming). While there are a few large sites that have been the subject of salvage excavations and are therefore included in this database (mainly cases when modern settlements are already located on archaeological sites, and developers cannot avoid damaging the remains), broadly speaking, this database appears to strongly biased towards the rural sector.

Each database is dominated by information representing a distinct category of settlement activity, ‘urban’ and ‘rural’. While the first might be referred to as a database of ‘planned excavations’ and the second a database of ‘salvage excavations’, for our purposes they are taken as proxies for the ‘urban’ and ‘rural’ aspects of settlement respectively. Finally, while this paper deals with all sites in the coastal plain in which EB II–III remains were discovered (Table 3, Fig. 9), some errors or omissions are almost inevitable in both databases. Such mistakes, however, are likely to be random, and distributed evenly across all periods, and are therefore unlikely to impact significantly on the overall results.

Survey data

The results of archaeological survey projects will not be discussed in detail here. In many cases chronological attributions are not well defined. For example the following surveys of the coastal plain do not distinguish between sub-periods of the EB (Ronen and Olami 1978, xv; 1983, viii; Kochavi and Beit Arieh 1994, 9*, 15*; Olami et al. 2003, 11*–12*, 16*; Berman et al. 2004, 12*, 17*; Berman and Barda 2005, 35*; Olami et al. 2005, 10*; Stark et al. 2005, 11*). In addition, the chronological attributions given by some surveys are either unreliable or hard to verify (see Faust and Safrai 2005, 149–53, for discussion, examples and references; also extensive discussion in Faust 2007, 5–6; and Joffe 1993, 5–21). We are therefore in complete agreement with the following statement:

... regardless of methods, formation processes have so completely transformed the landscape and archaeological record of the southern Levant, and western Asia, that survey data as a class of evidence must be considered with a much higher degree of skepticism than has been the case in the past. Simply put, survey data should not be used as the sole basis for archaeological reconstructions or sociopolitical inference. (Joffe 1993, 6)

In a sense, the salvage excavations can replace the surveys as a source of information regarding the rural sector (which the surveys are usually regarded as salvaging from oblivion; see Faust and Safrai 2005). That said, when survey data is sufficiently detailed, the results are in broad agreement with the patterns presented here on the basis of excavations (Frankel and Getzov 1997, 30*, 229; Gophna and Ayalon 1998, 10*; Ne’eman 1990, 15*; also the marked absence of EB evidence noted by Ne’eman et al. 2000). A few micro-regions will be considered in detail below, and where possible the evidence from relevant surveys will also be discussed, to reveal that they appear to confirm the results of the excavation data.

Analysis: the ‘Urban Database’

An examination of the ‘urban database’ reveals a clear anomaly in the data from the coastal plain
during the EB II–III (Table 2) in that settlement was extremely limited (see Gophna 1990, 163, 165; Gophna and Portugali 1988, 15; Portu
gali and Gophna 1993; Finkelstein 1995, 62; Getzov et al. 2001, 28; Yannai 2002, 78) and comprised only six sites (Ashkelon, Tel 
Gerisa, Tel Megadim, Tel Keysan, Tel Kabri and Rosh Ha-Nikra), most of which had only insignificant remains (see below). Thus the wave of urbanization and demographic growth that is so apparent in many parts of the southern Levant has left few indications in the coastal plain. In fact, the number of EB II–III sites is similar to the number assigned to the preceding EB I period, c. 3500–3000 BC, and the succeeding Intermediate Bronze Age (or EB IV period), dates to c. 2300–2000 BC. This is all the more striking in that the EB I is generally seen as a ‘proto-urban’ period, and the Intermediate Bronze Age is a period characterized by non-urban, dispersed settlement. There are no ‘major’ sites in these two periods and their low representation in the database is therefore expected. That lack of a distinct increase in ‘central’ settlement in the coastal plain during EB II–III, the absence of any truly large settlements, and the rudimentary nature of the finds in most of the six EB II–III sites mentioned above, suggests that the 3rd millennium BC ‘urban revolution’, which is apparent elsewhere in the southern Levant, did not extend to the coastal plain. This region witnessed its initial phase of urbanization only a thousand years later, during the beginning of the 2nd millennium BC (Middle Bronze Age).

In fact, given that the EB II–III period was rather longer than either the EB I or the Intermediate Bronze Age, the number of sites per time-unit is actually smaller for the EB II–III than for the preceding and succeeding eras (‘time normalization’, see Table 2 and below). While urban sites, which comprise the majority of sites in this database, usually continue in occupation for a lengthy period, the poor nature of the finds in this period makes it unlikely that they existed throughout the EB II–III (see also Table 3). Thus for example the ‘normalized’ figures indicate a stronger settlement decline (by a factor of 2.7) in the coastal plain during EB II–III than is evident during the Intermediate Bronze Age. However, out of caution, we do not base our arguments upon the normalized figures.

### Table 2

<table>
<thead>
<tr>
<th>Period</th>
<th>Estimated Demography (throughout the country)</th>
<th># of ‘major’ coastal plain sites (NEAELH)</th>
<th># of ‘minor’ coastal plain sites (Salvage Excavations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Bronze I</td>
<td>50,000 (?)</td>
<td>5 (1)</td>
<td>17 (3-4)</td>
</tr>
<tr>
<td>Early Bronze II–III</td>
<td>150,000</td>
<td>6 (0.86)</td>
<td>4 (0.57)</td>
</tr>
<tr>
<td>Intermediate Bronze Age</td>
<td>15,000</td>
<td>7 (2.33)</td>
<td>7 (2.33)</td>
</tr>
<tr>
<td>Middle Bronze II</td>
<td>150,000</td>
<td>27 (6.75)</td>
<td>21 (5.25)</td>
</tr>
<tr>
<td>Late Bronze</td>
<td>60,000</td>
<td>25 (6.25)</td>
<td>18 (4.5)</td>
</tr>
</tbody>
</table>
cannot be the case in the coastal plain as no large settlements have been detected. The decrease in the number of sites in the coastal plain is illustrated in Figure 2.

The ‘rural database’ also enables us to study the scale of settlement in the coastal plain relative to that in other regions at different periods. While the absolute values are largely meaningless, as they result from modern construction activities (and the coastal plain is the most populated part of present-day Israel), settlement trends between chronological periods are significant, as they show the extent to which settlement increased or decreased over time in each area (for details see Faust and Safrai 2005). Taking the database as a whole, settlements in the coastal plain comprised 26–41% of the total number of sites in most sub-periods of the Bronze Age. However, for the EB II–III the figure was only 10.5%, around one third of that of the preceding EB I period (Fig. 3). This confirms that not only did the number of sites decrease, but that the importance the coastal plain as a component of wider settlement activity in the southern Levant declined dramatically during EB II–III.

The extensive Egyptian presence in the southern coastal plain which characterized EB I reveals a marked decline around the transition to EB II (Levy and van den Brink 2002, 21, 24, 29; de Miroscheji 2002, 45–48; Marcus 2002, 407–08). While this issue will be discussed in detail below, for now it is worth noting that this is appears in-line with the wider settlement evidence.

**The statistical significance of the ‘Rural Database’**

The database of rural settlement provides a unique, large, and highly detailed source of settlement data. The fact that it is based on excavation rather than survey data enhances its reliability (Faust and Safrai 2005; the full database and its analysis will be published in the forthcoming publication by Faust and Safrai). Although, from a statistical point of view, the database may appear too small to identify conclusively the pattern of fluctuations in settlement in the coastal plain, this is a relatively small area (the study area as defined here covers less than 2400 sq km), while the number of excavated sites per unit area is probably among the highest in the world.

We estimated the significance of our results by assuming a null hypothesis according to which the average coastal plain ratio is 25.6%. This value is the ratio of the total number of coastal plain settlements for the periods discussed here (67 sites) to the total number of settlements sites from those periods within the rural database (a total of 262 sites). Thus, using this null hypothesis, the probability of a site being in the coastal plain is \( p = \frac{67}{262} = 0.256 \). Given this probability and using the binomial distribution it is possible to estimate the standard deviation from the average of 0.256 for each of the periods. This is \( \sqrt{np(1-p)/n} \) where \( n \) is the total number of sites for each period. We find that the standard deviation is less
Table 3 This table shows the EB II–III sites in the coastal plain that were reported in both databases (see also Fig. 9). Included is information on their location, elevation, the nature of the finds reported, and our interpretation of their function during this time. The data is based first and foremost on that published by Stern (1993b) and Hadashot Arkheologiyot, but since not all the technical information was published there, it is supplemented, when necessary, with data from more recent publications (e.g., Golani 2003) and regional studies (e.g., Frankel et al. 2001). Due to the rudimentary nature of finds from most of the sites, we did not attempt to reconstruct the size of the settlements, and only referred to their assumed character.

<table>
<thead>
<tr>
<th>No.</th>
<th>Site</th>
<th>Reference point</th>
<th>Location</th>
<th>Elevation (and additional comments)</th>
<th>Distance from the sea (from today’s shoreline)</th>
<th>Nature of finds</th>
<th>Suggested function of the site during EB II–III</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Rosh Ha-Nikra</td>
<td>16122765</td>
<td>Northern coastal plain; situated on the edge of a Cenomanian Turonian ridge, just above the plain.</td>
<td>43 m above present msl c. 1 km</td>
<td>Fortified settlement, of relatively limited area (Tadmor 1993, 1289)</td>
<td>Anchorage, or more likely a settlement with a nearby anchorage</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Tel Sumeriya /Giv/at Yassaf</td>
<td>15892629</td>
<td>Northern coastal plain; on a kurkar ridge.</td>
<td>28 m above msl about 2 km</td>
<td>Only pottery; not in situ (Yoge and Roichman 1985, 10–11)</td>
<td>Small anchorage or a village supplying services to the anchorage</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Kabri</td>
<td>16322681</td>
<td>Northern coastal plain, near the upper Cenomanian-Turonian hills; inland site.</td>
<td>about 60 m above msl More than 4 km</td>
<td>Architecture and pottery (from the EB II, only pottery) (Kempinski 1993, 840)</td>
<td>Probably connected with the Galilee settlement system</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Tel Keysan</td>
<td>16432532</td>
<td>Northern coastal plain (Acco plain); on senonian-paleocene hills.</td>
<td>42 m above msl Almost 8 km</td>
<td>EB II fortification, but no dwellings. No EB III remains (Humbert 1993, 863)</td>
<td>The site was probably connected with the lower Galilee system</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Qiryat Ata</td>
<td>16052450</td>
<td>Northern coastal plain</td>
<td>20–30 m above msl Between 1–1.5 km</td>
<td>Urban settlement during the EB II (no EB III) (various reports in the Hadashot Arkheologiyot database; see also Golani 2003).</td>
<td>A town; probably part of an inner settlement system</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Tel Megadim</td>
<td>14522366</td>
<td>Carmel coastal plain; a few metres</td>
<td>Practically on the coast c. 3–5 km (reachable from the sea through the Yarkon river)</td>
<td>Pottery. Not in situ (Broshi 1993, 1001).</td>
<td>Anchorage</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Tel Gerisa</td>
<td>13191665</td>
<td>Sharon/Yarkon basin; on the Yarkon river. Situated on the edge of a kurkar ridge.</td>
<td>33 m</td>
<td>Unfortified settlement (Herzog 1993, 482)</td>
<td>Anchorage</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Yahud</td>
<td>13981598</td>
<td>Central coastal plain; alluvial</td>
<td>about 40 m</td>
<td>12 km EB II pottery only (Gudovitch 1999, 42*).</td>
<td>An inland site, probably part of the Tel Bareaqot or Tel Dalit system (below).</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Nizzanim</td>
<td>115127</td>
<td>Southern coastal plain; situated on a kurkar ridge.</td>
<td>More than 20 m More than 1.5 km</td>
<td>EB III settlement, probably a village (Yekutieli and Gophna 1991, 156)</td>
<td>A supporting village of an anchorage during the EB III?</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Ashkelon</td>
<td>10701190</td>
<td>Southern coastal plain</td>
<td>20–30 m On the sea</td>
<td>Large amount of pottery, and limited domestic architecture (Stager 1993)</td>
<td>Anchorage (perhaps even large settlement in the EB III)</td>
<td></td>
</tr>
</tbody>
</table>

We should note that while the table includes all the coastal sites, of both databases, in which EB II–III remains were discovered, it is possible that due to the magnitude of the work involved in compiling the databases a site or two were lost due to typographical mistakes or similar errors. Such mistakes, however, are random, and would probably have the same influence on all periods. They are not expected to have any influence on the statistics of the coastal plain phenomenon (above). In addition, as already noted, there are a few excavated sites which were not reported in the discussed database, and these are not mentioned in the table (though their nature is discussed in the text).
than 0.071, thus indicating that the ratio during almost all periods is well outside the null hypothesis assumption. For EB II–III the proportion of sites in the coastal plain is 0.105 which lies more than two standard deviations below than the mean ratio of 0.256.

The total number of sites per period is large enough to support the use of the normal distribution approximation to the binomial distribution. In that case we estimate the probability for ratio of coastal plain sites that is larger than the EB II–III ratio of 0.105 as: $P[Z > (Y - \mu)/\sigma] = 98.35\%$ where $Y = 0.105$, $\mu = 0.256$, and $\sigma = 100 \times \sqrt{0.256 \times (1 - 0.256)}/38 = 7.1\%$. Thus, the probability that the EB II–III coastal plain ratio of 0.105 occurs by chance is 1.65%, suggesting high significance for EB II–III coastal plain settlement decline.

We carried out an additional test in order to verify the statistical significance within the rural database, i.e., to what degree do the statistics of the sites within the database represent the overall statistics. For this, we considered all the reported sites (i.e., all the excavations that were reported, and not only the settlements) of the Bronze Age era (548 sites), and performed the following tests. We randomly selected a subset from the 548 sites and asked two unrelated arbitrary questions: (i) what is the number of cemeteries/burials in the subset and (ii) what is the number of sites located within the 'Judea' region (encompassing both the Judean highlands and the Judean, lowlands/Shephelah). The statistics of the entire period (i.e. 194 cemeteries and 91 sites in Judea) serve as the control for the statistics of the chosen subsets, and the deviations from the statistics of the entire period give us some indication concerning the significance of EB II–III results that are based on a relatively small number of sites. We performed 1000 such random selections of 67, 38, 54, 59, 44 sites as for the total number of 'rural' sites of the different Bronze Age periods — EB I, EB II–III, Intermediate Bronze Age (IBA), Middle Bronze Age (MBA) and Late Bronze Age (LBA) respectively. We then calculated the mean number of cemeteries and sites in Judea and obtained the following standard deviations — EB I 5.5%, EB II–III 7.6%, IBA 6.2%, MBA 6%, and LBA 7%. These figures suggest that indeed the ratio for the coastal plain during the EB II–III (10-5%) is significantly low with respect to the EB I (25.4%), MBA (35.6%), and LBA (40.9%) as the means are more than one standard deviation further apart. The IBA, with 13%, is also an exception. This, however, was a period of major decline across the southern Levant, and the database is therefore limited. The statistics therefore support the hypothesis that the population of the coastal plain reached a significant low point during the EB II–III period, one that was out of character with the situation as documented in other parts of the southern Levant at this time.

Clearly future revisions to the chronological framework, such as a lengthening of the EB I period, will influence in particular those calculations which consider site numbers in terms of the length of individual periods. However, the phenomenon of a decline in EB II–III would still be apparent even if EB I was to be lengthened by a century or two. Furthermore, any such chronological revisions would have the same impact throughout the country, and thus the settlement trends in the coastal plain during the EB ought to remain distinctive, regardless of minor chronological adjustments.

**The Coastal Plain in previous archaeological studies**

While some previous studies did observe a decline in settlement in the coastal plain during the EB II–III, they did not generally elaborate on the phenomenon (Gophna 1990, 163, 165; Gophna and Portugali 1988, 15; Portugali and Gophna 1993; Finkelstein 1995, 62; Getzov et al. 2001, 28; Yannai 2002, 78). While in some cases this reflects a very localized project (e.g., Gophna 1990), some studies dealing with rather larger areas also did not realize the extent of, or even the tendency towards, a large-scale abandonment during EB II–III (Broshi and Gophna 1984; Gophna and Portugali 1988; Falconer and Savage 1995, and to some extent Joffe 1993 and Esse 1991). The apparent discrepancy requires explanation.
One possibility is that the difference results from the way in which the ‘coastal plain’ was defined by different projects. In the present case, we have restricted the area under investigation to that located within 12 km of the coast. This might indeed be part of the explanation. In parts of the southern coastal plain in particular, there were EB II–III sites such as Tel ‘Erani in areas usually regarded as lying within the inner coastal plain. We feel that including the so-called ‘inner coastal plain’ could be misleading, and hence we have taken a more limited definition in this case. At any event, the different definitions of the studied area are only partially responsible for the discrepancy, and we believe that several past studies included within the coastal plain sites that were not geographically part of the region.

In one of the most detailed studies of the coastal plain, Gophna and Portugali (1988) estimated the number of inhabitants in the region during the EB II as some 17,000 people (Gophna and Portugali 1988, 15). Regardless of the veracity of this particular figure (or our ability to estimate ancient population accurately), we note that a population of this magnitude stands in contradiction to our view that occupation was low in the coastal plain at this time. There are, however, several factors that may explain this discrepancy. First, Gophna and Portugali (1988, 15) explicitly noted that during the EB II ‘both settlement and population were concentrated in a narrow strip along the hilly flanks of the eastern sideshore of the coastal plain’ (see also their figs 4, 5).

Not only does this area lie somewhat farther inland from the coast than the easternmost limits of the 12 km zone, but many of the sites discussed, especially the larger ones, are not located on the coastal plain itself, but on the limestone slopes of the upland to the east, and hence should not be included within a strict definition of the coastal plain (e.g., Tel Dalit and Bareqet among many others).

The maps of Gophna and Portugali (1988: 12) relied upon the earlier work of Broshi and Gophna (1984), but it is clear from these that the area which they defined as the coastal plain included the slopes of the upland zone and the ‘inner coastal plain’ (see Broshi and Gophna 1984, 48, table 9; or the inclusion of Tel es-Safi and Tel Miqneh, which are clearly irrelevant for the processes discussed here). In fact, the work of Broshi and Gophna has been highly influential, and subsequent scholars have referred to their data (e.g., Falconer and Savage 1995), and have therefore perpetuated both their very wide definition of what constitutes the coastal plain, and the practice of including sites which were located on the limestone hills to the east of the plain.

The work of Joffe (1993) is interesting in this respect, in that while he did not devote special attention to the coastal plain, perusal of his maps reveals a significant decline in settlement in the area during the EB II, in comparison to EB I (Joffe 1993, maps pp. 40–41, and pp. 74–75). There is less evidence from the text, however, that Joffe identified this decline and he states, for example, that ‘the
strongest hierarchical distribution of sites is seen in the Jordan Valley, Judah and the Coastal Plain’ (Joffé 1993, 73). Later he wrote that ‘the strongest cluster in the Coastal Plain is to the south of Aphek situated on the limestone foothills above the Lod Valley, including Tel Gimzo and the fortified sites of Tel Bareqet and Tel Dalit. Further to the south only a few sites, Tel el-
‘Areini (Tel Erani), Tel Poran and Tel Nagilah, are known in the EB II’ (ibid.). It is clear that the major sites around which his analysis is built were located either in the inner coastal plain or the foothills. Thus his (Joffé 1993, 73) ‘strongest cluster’ does not lie with in the coastal plain as defined here.

Falconer and Savage devoted particular attention to the coastal plain, writing (1995, 52, also 38, 54) that ‘if there was a “heartland” of Levantine urbanism, it was the Mediterranean coastal plain’. They then went on to mention a number of sites, including Dor, Aphek, Gezer, Tel Erani and Ashkelon. However, their reference to cities in the coastal plain during the EB II–III (Falconer and Savage 1995, 52–53) is puzzling, and appears to result from projecting Middle Bronze Age II realities into the EB landscape. Not only is the nature of the EB sites unearthed in the coastal plain unclear (see above and below), but Tel Dor, for example, did not even exist in the EB (e.g., Stern 1993a, 358). It appears that Falconer and Savage identified the presence of cities in the coastal plain during the EB II–III through a combination of a very wide definition of the region, including the inner coastal plain in the south, and through the misattribution of key sites to the EB II–III period.

Our data does not, therefore, actually contradict that of previous studies. Rather the latter failed to observe the EB II–III settlement decline discussed here for a combination of reasons. First, previous studies referred to a broad definition of the coastal plain and hence included also very eastern sites, located in the ‘inner’ coastal plain (mainly in the south). While this is of course justified, it is part of the reason why the pattern was not identified. This, however, is not the main reason. More important, is the fact that many studies referred to sites which were located in the limestone hills, just above the coastal plain, as part of the latter region, hence identifying coastal plain sites even when the alluvial plain was devoid of any. The result was to give an impression of sustained settlement of a kind which is not actually evident in the coastal plain proper. Finally, we suspect that some studies have projected the image of the developed coast of later periods, as propagated by Braudel (1973) among others, on to the EB, thus leading to the expectation that certain key coastal sites would have been occupied during the EB.

Abandonment in focus: consideration of specific micro-regions within the Coastal Plain

The data presented above, demonstrates that the coastal plain proper was practically devoid of settlements during most of the 3rd millennium bc. Interestingly, the few settlements unearthed are generally concentrated in two specific areas, in the northern coastal plain, and, during the EB III in particular, at the southern edge of the southern coastal plain. Even then, however, settlement was extremely limited.

Before attempting to explain the large-scale abandonment, we wish to show the processes of settlement decline in more detail, by examining the evidence from a few ‘case studies’ based upon specific micro-regions for which reliable information has been published. In contrast to our previous procedure, for this part of the discussion we will use survey data.

The Northern Sharon and the Nahal Hadera Basin

The settlement data from the area around the site of En Esur, and the Nahal Hadera basin, have been discussed by Yannai (2006, 6–8), who notes that most of the sites were discovered during construction work.

We shall first discuss the entire northern Sharon, which includes the basins of Nahal Alexander, Nahal Hadera and Nahal Tanninim, and will later limit discussion to the Nahal Hadera basin alone. In total, some 15 sites were dated to the Ghassulian Chalcolithic, including En Esur, Burga, Khirbet Baza‘ah, Hadera, Mezer, H. Rogum, the Fishponds at Kibbutz Ha-
Ma‘apil, Ma‘abarot, Olesh, Sha‘ar Efrayim, et-Taiyiba, Kh. el Jalama (near Taiyiba) and Tenuvot. Yannai (2006, 6, and references therein) notes that sites dated to the early phases of the EB I were found, in addition to that at En Esur, at the fish ponds at Ma‘abarot, at Kibbutz Mishmar Ha-Sharon, at et-Taiyiba, at the fish ponds of Kibbutz Ha-Ma‘apil, as well as Khirbet el-
Jalama and Olesh. Sites were also discovered at the Carmel Coast, e.g., Mayan Dor, and additional sites at Sheikh Helu, Kh. Bazi‘ah and Mezer, and probably also at Baqa el-Garbiyeh and Magal. The total number of settlements in the early phases of the EB I was similar to that of the Chalcolithic period. However, Yannai (2006, 6) notes that ‘with the exception of Magal and the establishment of the settlement at Tel Ifshar, the settlements at all these sites were abandoned by the later phases of the EB I’. In fact, Yannai suggests that during the later phases of the EB I, settlement was concentrated in a few relatively large settlements (e.g., En Esur, Magal and Afeq) in the inner part of the Sharon plain,
rather than spread across a larger number of small settlements (ibid.).

Concerning the EB II–III, Yannai simply writes that ‘with the exception of Magal (in our “rural” database only a tomb is reported), which flourished in the EB II–III, no sites dating to that period are known in the Sharon Plain at the foot of the Carmel range’. He also mentioned a number of out-of-context EB sherds within the Middle Bronze Age rampart at Tel Burga, but suggested that these were brought there as part of a fill from elsewhere. Other sherds were found at the southern cemetery at En Esur, although no settlement was observed.

Since most of the sites discussed above were concentrated in Nahal Hadera basin, we get very similar results when we limit our discussion to this region. Based upon Yannai (2006, 7–8, tables 1.1, 1.2) 11 Late Chalcolithic sites were identified, and the number remained broadly similar in the Early EB I (12 sites), while the Late EB I witnessed a decline to four sites. The latter were usually larger than their predecessors, and may point to a growing concentration of people in larger and denser settlements, rather than a population decline beginning in late EB I. However, only one site — Magal — existed in the EB II–III period, and it was located in the innermost part of the Sharon, some 16 km from the coastline, on the chalky Eocene hills, not on the plain.

The evidence from the northern Sharon exemplifies the process by which the abandonment of the coastal plain took place. The Chalcolithic and EB I were well represented, followed by a process of settlement concentration in the later EB I, followed relatively quickly by near-total abandonment.

The Lod Valley

Like many other parts of the coastal plain, the Lod Valley, or more precisely, the Lod Valley and the western slopes of the uplands, was studied in detail by Gophna and his colleagues (1989; 1996; Gophna and Beit Arieh 1997). During the EB I several villages developed in the region, with Gophna (1989, 99) noting that some were situated in the alluvial valley, while others were located on the limestone hills, about 3 km east of the alluvium. The sites include Tel Lod and Bareqet south (on the alluvium) and Tel Dalit, Abu el-Hubban, Tel Gimzo and Mizpeh Modiin on the limestone hills. These sites are dated to the late EB I (Gophna 1989, 100), and represent a large demographic increase in comparison with previous periods (Gophna 1989, 100–01).

Gophna (1989, 102) notes that during the EB II a notable change in settlement patterns took place in the Lod Valley. The site of Lod, where the main settlement near the alluvium existed during EB I was abandoned, as well as the small village of Bareqet (south). During the EB II all the settlements were located on the limestone hills only.

This is contemporaneous with developments in what Gophna believed was urbanization and the building of fortifications at limestone sites such as Tel Dalit (Gophna 1989, 103), and Tel Bareqet, which is situated just above the alluvium, and was recently subject to a large scale salvage excavation (Gophna 1989, 102; and now Paz and Paz 2007). Despite the abandonment of sites, Gophna estimated a large population increase during this period, compared to the EB I (Gophna 1989, 104). During the EB III there were major changes in settlement patterns, and most sites were abandoned.

A similar pattern can be seen in the discussion of the finds of the entire Lod survey. Gophna and Beit Arieh (1997, 10*-11*) report 10 EB I sites (located both in the alluvial valley and the limestone hills).

The number of sites shrank to five in the EB II, but those included the fortified sites of Tel Dalit and Tel Bareqet (referred to as a fortified site near Khirbet Burnat). It is important to note that ALL these sites were located on the limestone hills, not the coastal plain proper! These fortified settlements were abandoned by the end of the EB II, and only small unfortified settlement existed during the EB III (Gophna and Beit Arieh 1997, 10*).

It is clear that Gophna had identified the pattern in which settlement moved from the coastal plain to the slopes of the hill-country. However, his inclusion of Samaria’ foothills, within his consideration of the coastal plain (Gophna 1989, throughout; 1996, 157), resulted in ‘settlement’ being present in the region in all periods, thus masking the extent of the abandonment, which was therefore identified only at the local level. This may be why Gophna, who identified the pattern in many sub-regions, never treated it as a broad-scale phenomenon.

Herzeliah map

The third area to receive a slightly more detailed discussion is the ‘Herzelia map’ (Gophna and Ayalon 1998). Ten sites dated to the EB I were reported, six of which were small campsites, and four larger settlements (Gophna and Ayalon 1998, 10*, 61). All six small sites were located near the coast, as were two of the larger sites (sites 71, 73). A third (somewhat larger) site is located on the second kurkar ridge (site 90), and the fourth is located further inland, at Tel...
Qana (site 97). The latter might have been connected to the settlement system near Tel Aphek. Gophna and Ayalon (1998, 10*) reported, however, that ‘none of the sites yielded remains of later Early Bronze Age periods’ (i.e. EB II–III), and it is interesting to note that more remains from the Intermediate Bronze Age (termed Middle Bronze Age I by Gophna and Ayalon) were discovered than from the EB II–III period. Large scale settlement was resumed in the Middle Bronze Age II period (Gophna and Ayalon 1988, 10*–11*).

Intermediate summary
All lines of evidence point towards the coastal plain as having been a fringe area during the EB II–III, with significantly reduced settlement, urban and rural alike. Not only was there a great decline in comparison to the settlement of the EB I, but the number of sites was smaller than that recorded for the Intermediate Bronze Age — a period of major decline in settlement throughout the country (see Table 2). Notably, while both archaeological finds and Egyptian sources indicate maritime trade along the Levantine coast, all the way from Egypt to Lebanon during the EB II (e.g., Stieglitz 1984; Harrison 1993; Marcus 2002), no port dated to this period has yet been identified along the Mediterranean coast of Israel.

Explaining the Phenomenon

Theoretical explanations
The point of interest now moves to the cause of such a major settlement decline in the region during what was a period of flourishing settlement and urbanization in most other regions of the southern Levant. Put another way, we might ask why did urbanization not take place in the coastal plain?

Various cultural and historical reasons such as military campaigns, reduced security conditions and epidemics can account for the abandonment of settlements and even entire regions (papers in Cameron and Tomka 1993; Inomata and Webb 2003; Tainter 1988; 1999; Manahan 2004; Nelson and Schachner 2002, and references therein). However, the duration of the phenomenon — some 700 years — and the fact that it extended to an area likely to have encompassed several ancient polities (see Finkelstein 1995, 59–64), make such explanations unsatisfactory. Moreover, the duration of the phenomenon covers several distinct phases of Egyptian involvement with the Levant, which undermines Egyptian policy as an explanation for the abandonment. Egyptian activity in the region, for purposes such as slave-raiding, would surely have left marks not only in the desertion of sites, but through evidence for an Egyptian presence, and while there is ample evidence for the latter in the coastal plain during the EB I, there is nothing to support it for the EB II–III (see also Marcus 2002, 407).

Environmental evidence
We believe that an important episode of environmental change underlies the decline of settlement in the coastal plain during EB II–III (for a discussion of the relationship between environment and settlement in the Levant, see Rosen [2007], with references). While the relation between environmental factors and human settlement, and the impact of the former on the latter are highly contested, and such explanations sometimes dismissed as ‘environmental determinism’, several sources of data provide evidence for important environmental changes in the coastal plain during the EB.

Bar-Matthews et al. (1997; 1998) constructed a δ18O record from speleothems from the Soreq Cave west of Jerusalem and interpreted as a proxy for local precipitation. According to their interpretation the EB II–III was a humid period (Fig. 4), and enhanced precipitation around the beginning of EB II–III is also indicated by a speleothem from a different cave in the Jerusalem region (Frumkin et al. 1999).

Frumkin et al. (1991; 2001) approximated the fluctuations of the level of the Dead Sea based on salt caves from Mount Sedom (southern Dead Sea region). As the Dead Sea is a terminal lake, disconnected from the global ocean systems, changes in its sea level most likely indicate variations in net precipitation in the region. The evidence points to precipitation in the Dead Sea region as having been significantly raised during the EB I and the beginning of EB II (Fig. 5). More recent studies have also provided evidence for a high Dead Sea level during the EB II–III (Fig. 6; Enzel et al. 2003; Bookman et al. 2004; Migowski et al. 2006).

Rosen has studied the geomorphology of watercourses in the inner coastal plain, and concluded on the basis of several sections from Nahal Lachish that ‘the combined information from the channel and floodplain deposits tentatively point to a somewhat moister climate, and a higher water table during the EB than at present’ (Rosen 1986, 56). This appears to have changed during the Intermediate Bronze Age which was ‘unstable’ and ‘marked the end of the moist phase’ (Rosen 1986, 57). This is followed by a gap in the sediment record during the 2nd millennium
BC (Middle and Late Bronze Ages), which she concluded (Rosen 1986, 57) might be ‘related to a lowered water table and presumably drier climatic conditions’.

While the above data sets are independent of each other, they all lead to the conclusion that there were environmental changes during the period discussed here, and that these changes involved increased precipitation (even moderate increase), during much of the 3rd and even the 4th millennium BC.

Environmental scenario

But how could increased precipitation have had a negative impact on human settlement? In many parts of the Near East, it is not increased rainfall, but aridity that is viewed as responsible for settlement decline (e.g., Weiss et al. 1993; Cullen et al. 2000; Weiss and Bradley 2001; Enzel et al. 2003; Rosen 1995).

The coastal plain is a sensitive ecological region. It is characterized, both on land and on the continental shelf, by a topography composed of longitudinal kurkar (aeolianite) ridges which run parallel to the coast, alternating with red soils (hamra). Along much of the coast itself there are sand dunes (Tsoar 2000; Cohen-Seffer et al. 2005). The coastal plain is flat, only slightly higher than sea level, and because it is intersected by these kurkar ridges, it suffers from severe drainage problems. In fact, some of the valley bottoms lie below the water table (Fig. 7; Karmon 1959; 1971; cf. Raban 1985, 11; for the distribution of swamps in 1925, see also Grossman 2004, 155; and Fig. 8). Under such circumstances, increased precipitation would result in flooding in the valleys by elevating the local water table which would worsen the existing drainage problems. Percolation of water would have been reduced, and it is likely that more sediment, mainly clays, would have been deposited in the sluggish riverbeds, leading to a restriction of river outflow. Drainage problems would be intensified if sand was deposited along the shores, restricting the river outlets, as seems to have happened during the EB II–III (Horowitz 1979, 343; Sivan 1982; Issar 2003; for the accumulation of sand at about 3,000 BC, see also Gvirtzman et al. 1998, 37–39, 42–43; Ritte 1998, 61–64, 68; Cohen-Seffer et al. 2005). The main source of this sand is the south to north sediment transport of the Nile River.

The majority of the traditional agricultural soils and ancient settlements in the coastal plain were

![Figure 6](image-url) Dead Sea level fluctuations according to Enzel et al. 2003

![Figure 7](image-url) A west–east section of the Sharon coastal plain (after Karmon 1971, 17). Note the several low valleys which are one of the major reasons for the severe drainage problems in the coastal plain area of Israel. The Sharon is the most sensitive region (ecologically) in the coastal plain, and is used here to exemplify the problematic nature of the area. Similar problems, although on a smaller scale, exist in most parts of the coastal plain. For the distribution of swamps as late as 1925, see Fig. 8
concentrated in the river valleys (Karmon 1959). However, those same rivers are known to have drainage problems, and deterioration of drainage conditions could have converted these otherwise fertile lands into inhospitable swamps, and thus restricted the range of economic possibilities. Growth of swamps may also have made movement and transport more difficult, restricting trade and exchange, leading to further decline. A higher water-table could also lead to the decay of roots of various crops, making agriculture practically impossible, while there are a range of diseases associated with marshes, such as malaria and bilharzias, which may have contributed to demographic decline.

The settlement evidence indicates that the abandonment of the coastal plain covered the whole of EB II–III. Thus if the process is attributable to enhanced precipitation, this must have begun earlier, in late EB I. This is not inconsistent with the climatic evidence discussed above. That said, anthropogenic activity may have accelerated the process of environmental deterioration. For example, urbanization in the uplands might have been accompanied by deforestation leading to a higher level of run-off (for anthropogenic influences, see for example Rosen 1995; 2007; Wilkinson 1999). At present, however, we do not have enough evidence to assess the likely contribution of human action to this process and the available evidence does not point to major deforestation (see Rosen 2007, 137; for the connection between urbanization and the abandonment of the coastal plain).

The recovery of the coastal plain from the great settlement decline of EB II–III, was a slow process. The late 3rd millennium BC (the Intermediate Bronze Age) saw a great demographic decline throughout the southern Levant (Table 1), and the number of sites throughout the region is low. Although the Intermediate Bronze Age was drier than the preceding EB II–III period, the onset of urbanization in the coastal plain was delayed by wider regional developments until the 2nd millennium BC, with full scale urbanization achieved in this region only in the early centuries of the 2nd millennium BC (Middle Bronze II).

**Figure 8 Map showing the extent of swamp-land in 1925 (after Grossman 1994, 155)**

**Figure 9 Map showing the location of excavated EBA II–III sites in the coastal plain reported in both databases. The numbers correspond to the site numbers in Table 3**

*Direct evidence for the extent of marshes in the Coastal Plain during the EB II–III*

It is not, however, only the temporal correspondence of the environmental change and settlement decline...
that link the two. There are more direct archaeological indications for flooding in the coastal plain during the EB II–III.

1) Palaeontological data constructed by Horowitz (2006) from the excavations of the EB I site of En Esur (some 12 km from the coast), indicate that the percentage of marsh vegetation species increased dramatically and systematically from the Chalcolithic period toward the end of the EB I (from 47.83%–91.67%). Horowitz (2006, 268) concluded that ‘the extensive marshes thus seem to be the main reason for the desertion of the site at “En Esur”’. Moreover, the final EB I settlement remains were covered by a ‘layer of black soil’, which ‘was exposed above the remains of stratum II’, the late EB I settlement (Yannai 2006, 282). The excavator concluded from this evidence that the site had stood abandoned for quite some time, and added that ‘at the bottom of this marsh soil was a light gray and white layer that clearly separated the marsh soil from the settlement remains below and represents the first sedimentation of salts on the bottom of marsh’. Even more important, is the discovery of a small Intermediate Bronze Age settlement, exposed in Area C at En Esur, just above the layer of black marsh soil (Yannai 2006, 282). The Intermediate Bronze Age remains, therefore, date the deposition of the marsh soil to the EB II–III, and thus strengthen the suggestion that the growth of marshland was the reason for the abandonment of the site.

2) Excavations at the Tel Aviv’s Exhibition Grounds, located some 3 km from the coast, have revealed a number of layers dating to the EB I and the beginning of the EB II, stratified beneath a layer of hard, black clay (Ritter-Kaplan 1984, 3). The pollen found in this clay is interpreted as indicating a wetter climate and ‘swampy conditions’ (Ritter-Kaplan 1984, 4; Horowitz 1979, 112, 253–56). As at En Esur, a new settlement dating to the Intermediate Bronze Age was established on top of this hard clay, indicating that the swampy conditions has ceased, and dating these firmly to EB II–III.

3) Another line of evidence, though less direct, is faunal remains. Horwitz and Tchernov (1990) have summarized the faunal record for hippopotamus from archaeological sites in Israel. Teeth and worked bone, which are probably imports, have been found on many settlements, including inland examples (1990, 67–68). In contrast, unworked bone, while less common in the archaeological record, might well constitute evidence for ‘locally hunted’ hippopotamus (1990, 68). Horwitz and Tchernov (1990, 72) claim that all of the sites from which unworked hippopotamus bones have been reported (during the Holocene) are located within the coastal plain (in the broadest sense), and that ‘no hippopotamus bones have reported from sites further inland’. Interestingly, of the nine Holocene sites listed, four date to the EB (one is dated to the Chalcolithic, and only four for entire remainder of Bronze and the Iron Ages (Horwitz and Tchernov 1990, 71). Only two of the four EB sites are settlements. At Tel Erani, the remains were dated to the EB II (Yeivin 1957, 265), and at Tel Aphek they date to EB I–II (Hellwig and Gophna 1984). The other two EB find-spots fall within EB II–III (see below). Thus the overrepresentation of the EB in terms of sites producing unworked hippopotamus remains is quite marked, especially in light of the above-mentioned low representation of EB settlements in the coastal plain. In contrast, while there were many more Middle Bronze Age settlements in the area, in only one instance have hippopotamus bones been reported.

It is even more interesting to note that a number of hippopotamus bones (dated to the EB) were discovered outside of settlements, during construction works in the valleys of the Yarkon River and the Tanninim River (Crocodile River) (Bytinski-Salz 1965). The original uncalibrated dates reported by Bytinski-Salz (1965, 38–39), were (1) 3990 ± 230 BP and (2) 4300 ± 160 BP. The two dates calibrate as follows: (1) cal bc 3300–1700 (2σ), (2) cal bc 3400–2450 (2σ). While the standard deviations are rather wider than would be expected today, the results are not inconsistent with an EB date for the remains. (The dates were calibrated by Elisabetta Boaretto using Oxcal 3-10 2005, and we would like to thank her for her assistance).*

Hippopotami live in a marshy, or swampy, freshwater habitat (Bytinski-Salz 1965, 69, 70–72, 74; see also Haas 1953), and recovery of bones dating to the EB supports the argument that conditions in the coastal plain were particularly wet in this period. That the overrepresentation of hippopotamus in faunal record of the EB is apparent not only in settlements, but also in the record of chance finds uncovered during construction, is of great importance, and we suggest that the latter represent the remains of hippopotamus herds that would have thrived in the swamps of the coastal plain, rather than material of anthropogenic origin. These bones are clearly not a result of trade, and can safely be used to infer environmental conditions. Finally, it

*Editor’s note: The laboratory dates for these numbers were identified in October 2008 as being H-1755 and H-1756 respectively.
should be noted that both Tel Erani and Tel Aphek are located on the eastern fringes of the coastal plain (more than 12 km from the coast) and the presence of hippopotamus bones this far from the coast may be an indication of the degree to which swamps had spread.

Thus, both the climatic and archaeological data are consistent with the scenario suggested above, according to which an increase in precipitation occurred during the 4th and 3rd millennia BC, changing the environment of the coastal plain, and leading to a marked demographic decline in the region.

Further Implications

*Human settlement and environment: a discussion*

There are a few interrelated issues regarding the relations between human settlement and environmental change which require further discussion: (i) the nature of the reasoning connecting the two; (ii) the role of increased precipitation, rather than aridity, as a factor in abandonment processes in the Near East; (iii) the nature of human-environment relations and the role of cultural response; and (iv) relations between Egypt and the Levant.

*The Reasoning (1)*

The impact of climatic changes on human settlement is a hotly debated issue in the scientific literature. On one hand some researchers have adopted a deterministic approach (e.g., Huntington 1911; Issar 1995; 2003; Enzel et al. 2003; Migowski et al. 2006) suggesting that climatic changes have direct impact on humans, and they tend to explain shifts in settlement as resulting from climatic changes. Others have stressed the plasticity of human societies and their ability to adapt to changes in circumstances and thus to overcome the effect of climate change (e.g., Albright 1940; Rubin 1989; Rosen and Rosen 2001).

The overly-deterministic nature of some of the former studies, may have resulted in a degree of skepticism among archaeologists working in the Southern Levant, towards certain types of explanation. The virtual exclusion of climatic or environmental explanations from the archaeological discourse in the region in 'historical' periods, may be an artefact of these developments. For example, while many scientists concur today with the view that the late 3rd millennium BC was a period of growing aridity (see papers in Dalfes et al. 1994; Weiss et al. 1993; Cullen et al. 2000; Weiss and Bradley 2001), climate change is sometimes accorded a low priority as an explanatory possibility from traditional archaeological discussions of the collapse of the EB urban system, and the transition to the much lower intensity settlement record characteristic of the Intermediate Bronze Age. Many traditional archaeological discussions of the EB III–Intermediate Bronze Age transition, fail to treat environmental change seriously as a possible factor in the collapse of the urban system. Moreover, many studies that do consider it, either rejecting it (e.g., Mazar 1990, 142), or leaving the matter unresolved (e.g., Amiran and Kochavi 1985, 362; Ben Tor 1992), do it very briefly, often in no more than a sentence or two.

Richard (1987, 34), in a detailed summary article, devotes a relatively long discussion to the collapse of the EB urban system and possible reasons for this, but has only one sentence on the possible impact of climatic changes: ‘it should also be noted that a shift to drier conditions, for which there is some climatological evidence (including textual documentation for drought slightly later in Egypt), may have also played a role in the process of deurbanization’. We argue that scholars have generally failed to engage with the issue in a serious way, even if only to reject it. Dever (1989), who combines environmental impacts with other factors in a systematic explanation, is something of an exception.

This reaction may be understandable, as some of the more deterministic discussions are overly-simplistic and use the archaeological data in a rather arbitrary manner. For example, even during what is regarded as the extreme aridity of the late 3rd millennium BC, linked to a climatic event that has been suggested as the trigger for the collapse of the Akkadian empire (Weiss et al. 1993; Cullen et al. 2000; Weiss and Bradley 2001; but see Zettler 2003), there was a marked increase in settlement in the arid Negev desert of southern Israel (see Fig. 2 above, Gophna 1992; Dever 1995; Cohen 1999). Such apparent contradictions have brought into question notions of a clear, simple connection between climatic change and fluctuations in human settlement (see also Bruins 1994, 310). That said, we believe that the effective exclusion of climate or environmental changes from archaeological discussion is probably an ‘over-reaction’ on the part of many archaeologists (mainly archaeologists whose backgrounds lie in history and material culture, rather than scholars from other sub-fields such as Rosen 1995, 2007, 128–48).

*The Reasoning (2)*

While all scholars would agree that climate could influence human settlement, it is difficult to provide a
direct link between the two phenomena. As a result, the simultaneous co-occurrence of climate change and settlement shifts was sometimes sufficient to raise a scenario in which the latter was the result of the former (e.g., Enzel et al. 2003), but this is a problematic reasoning that was not always accepted, and it added to the discomfort and negative attitudes among many researchers toward the deterministic approaches. Here, however, lies one of the strengths of the present study. We not only presented evidence for the simultaneous co-occurrence of environmental changes and settlement decline; we presented a detailed scenario that explained and connected the two, and, more important, even added more direct (‘archaeological’) evidence showing that the processes suggested have indeed occurred at the time, thus strengthening the scenario presented here.

Increased precipitation as limiting factor

Since much of the Near East is a semi-arid and arid region, many scholars have been interested in the effect of processes of aridification on settlement (Dafes et al. 1994; Weiss et al. 1993; Issar 1995; Cullen et al. 2000; Weiss and Bradley 2001; Enzel et al. 2003; Rosen 1995; 2007, 128–48). However, the scenario suggested indicates that under certain circumstances, increased precipitation could also provide a push towards settlement decline. This highlights the subtleties involved in the study of environmental changes, and underscores the need to conduct regional studies with higher resolution and with due attention to specific local conditions.

It is well known that the Levant is composed of discrete units, which do not necessarily share the same settlement processes. As Falconer and Savage (1995, 54–55) observe

_the advent of cities in the 3rd millennium BC, and their rejuvenation in the early 2nd millennium BC followed different courses of development. Further, when dissected geographically, settlement data from both periods reveal distinct, sometimes divergent settlement trajectories _...

This is indeed demonstrated clearly by the diversity of processes detectable within the Levant during the EB, with the various sub-regions undergoing rather different episodes of growth and decline according to rather different temporal rhythms. As we have seen, some regions, such as the coastal plain, did not undergo urbanization at all during the 3rd millennium BC.

Settlement and Environment — Determinism and Human Action

Before concluding, we note that it is not only ecological factors that influence human settlement. Environmental changes can initiate responses from human societies, thus a given set of environmental changes can lead to different settlement and demographic responses, depending on the way in which humans groups respond to developments (Rosen and Rosen 2001; Rosen 1995). Regarding the EB II–III, it is likely that the urbanization process and the associated tendency of human groups to concentrate in larger and denser sites (Kempinski 1978; Gophna and Portugali 1988; Portugali and Gophna 1993) accelerated the process of abandonment in the coastal plain. The region had not only become less attractive for settlement in a general sense, but it was particularly ill-suited as a setting for the larger communities that were increasingly becoming the norm in other parts of the southern Levant, and around which wider social and economic systems were increasingly structured.

This is exemplified in the detailed information we possess about settlement processes in the Nahal Hadera basin (Yannai 2006 and above). In this region it is quite clear that the agglomeration of population in larger settlements was in train by the late EB I. However, as population concentrated within larger settlements, changing environmental conditions rendered these entities increasingly hard to sustain, leading to their eventual abandonment. It is possible that without the agglomeration process, populations in the coastal region could have adapted to the environmental changes. However, it is likely that the contemporaneity of two incompatible processes — one cultural and the other environmental — amplified the dramatic decline in settlement in the coastal plain.

We suggest that the population which moved out of the coastal plain during this process of abandonment most likely migrated to nearby regions, and is probably responsible for part of the population increase detectable in regions such as Shephelah, where there is evidence for a dramatic increase in population at this time (Levy 2004, 282–85), and the western slopes of the uplands where population growth can be observed during the EB II (Gophna 1989, 104 and above).

Relations between Egypt and the Levant during the EB

Contacts between Egypt and the Levant during the EB have received a great deal of scholarly attention (Gophna 1987; Brandl 1992; Ben Tor 1991; van den Brink and Levy 2002; Gophna and Milevski 2003).
Simply put, the EB I appears to have been characterized by an Egyptian presence in the southern coastal plain, perhaps extending as far north as the Yarkon River, and whatever their exact nature, Egyptians relations with the area appear to have been intensive. Broadly contemporary with the transition to EB II, however, there is a dramatic change. The massive Egyptian presence in the southern coastal plain ceased (Gophna 1987; Oren 1989; Ben Tor 1991; Brandl 1992; Marcus 2002), and at the same time Egyptian maritime contacts with Byblos in Lebanon were greatly intensified, with Egyptian ships now travelling the Levantine littoral en route from Egypt to Byblos and back, the so-called ‘Byblos Run’ (Marcus 2002, 407–08 with references). The two processes are surely connected, and the former is sometimes explained as a result of the latter (Ben-Tor 1982; 1986; Stager 1992; Brandl 1992; Marcus 1998, 111; 2002, 407).

Marcus (2002, 407–08) succinctly summarized the process as follows:

*The end of the EB I period is accompanied by the cessation of an Egyptian presence in the southern Coastal Plain, and a conspicuous decrease in Egyptian finds throughout the southern Levant during the EB II–III periods ... Many scholars have seen this trend as a result of the increasing Egyptian utilization of maritime transport, which culminates in claims of state-sponsored ventures and intimate cultural relations with Byblos ... This maritime network is reflected in increasingly substantial archaeological, textual and pictorial evidence for the technology and size of sea-going vessels. The dominant role of seafaring in long-distance contact is complemented by the abandonment of the North Sinai terrestrial route.*

We believe that our reconstruction of developments in the coastal plain can usefully contribute to our understanding of the reasons for the development of the maritime route to Byblos, and the abandonment of the overland coastal routes. Environmental change in the coastal plain, as described above, would have made a significant contribution to the disruption of the overland route that had previously served as a bridge between Egypt and Lebanon/Syria (for the highway, see Aharoni 1979), and would have encouraged the Egyptians to develop an alternative connection.

However, a maritime route would still have required anchorages along the Mediterranean coast (Marcus 1998, 111; 2002; Gophna 2002). And we suggest that the evidence from Tel Rosh-HaNikra, Tel Gerisa, Tel Sumeriya/Givat Yassaf and other sites (Table 3, Fig. 9) represents precisely the remains of either anchorages, or the small settlements which would have developed around them. The scattered finds at these sites are not the remains of agricultural settlements embedded within a primarily terrestrial economic system, let alone part of a complex system of trade (Marcus 2002, 408), but rather point to the existence of minor anchorages suitable for the Egyptian ships travelling to Byblos and back, or of small settlements which may have supplied the anchorages with food. Two sites in the coastal plain appear to have been rather larger, Qiryat Ata and Ashkelon. The former was indeed a large settlement at the time, but was probably disconnected from the sea and was part of an ‘inland’ settlement system, as in the case of nearby Tel Keysan (Humbert 1993, 862). Ashkelon might have comprised a rather larger coastal centre, given both the amount of EB pottery reported and the site’s more southerly, and thus rather drier, location (the drier circumstances in the area might in part explain the apparent recovery of this region during the EB III, when sites like Nizzanim, Tel Poran and Tel Sakan were also settled).

It is clear, however, that the coastal settlements discussed here cannot be viewed as major ports, participating in and supplying international trade, and thus generating prosperity further inland, cf. the ‘port power’ model of Stager (2001). Even if Ashkelon was a relatively large settlement in EB III, it appears likely that it was of primarily local importance.

**Conclusions**

While the EB II–III period is generally characterized as marked by unprecedented demographic expansion and urbanization throughout the region, archaeological evidence indicates that the coastal plain region of Israel was almost abandoned at this time. The coastal plain, however, is a sensitive ecological niche, and there is clear evidence for increased precipitation at the time, for the transfer of sand to Israel’s coast, and for the transformation of settled land into a marshland. We propose that increased precipitation and blocking of river outlets intensified the existing drainage problems in the coastal plain, leading to extensive flooding, the transformation of arable land into marshes, and the spread of diseases. Together these factors explain the observable settlement decline in the region and meant that the onset of urbanization processes were delayed in the coastal region for more than one millennium, compared to many other regions of the southern Levant.

Our paper also shows that even in a semi-arid region like the Near East, increased rainfall can be a limiting factor. This is because the Levant is composed of discreet ecological niches and a
particular change may generate rather different outcomes in different settings. The decline in settlement in the coastal plain at precisely the time of the ‘urban revolution’ elsewhere is a case in point. Moreover, the changed ecological conditions in the coastal plain may also explain the shift from an overland to a maritime route for Egyptian interaction with the Levant.

Finally, the cultural changes which underpinned the ‘urban revolution’, namely the drive for people to concentrate in larger, denser settlements, also contributed to the drastic decline, as under its new conditions the coastal plain was simply not suited to support such settlements. While it is possible that without those cultural changes, populations in the region could have coped with environmental change, the combination of the two processes led to dramatic changes in human occupation of the coastal plain necessary.

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**Bibliography**


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