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Settlement Patterns in the Wadi Arabah and the adjacent desert areas: a view from the Eilat region

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The desert environment is usually considered inhospitable, and archaeological remains are often modest and less impressive than in other regions. Accordingly, scholars have often marginalised desert cultures and their role in the history of the ancient Near East. The purpose of this article is to show that desert remains are often misconstrued, that they actually represent richer cultural complexes than have been commonly accepted, and the current view of desert history requires re-evaluation. The discussion focuses on the periods from Late Neolithic to the end of Early Bronze Age, i.e. the sixth–third millennia BC.[1]

Environmental setting

The Negev, the Wadi Arabah and Sinai are characterised by an arid to hyper-arid climate. Environmental conditions vary between regions, but generally, aridity increases as one travels south or lower in altitude.[2] In the Negev highlands, approximately 500–1020 m. above sea level, summer mid-day temperatures usually reach 30–350 C, the average annual precipitation is 80–100 mm. and the annual average potential evaporation is approximately 2600 mm. Despite the negative water balance, the terrain and climate of the Negev highlands enables growth of Irano-Turanian vegetation, and even some Mediterranean species. Vegetation is not limited to wadi beds alone, but is often to be found on the slopes as well, especially the northern ones which are less affected by solar radiation (for the flora of the Negev and Sinai, see Danin 1979, 1983). In the past, the region sustained a fairly rich fauna, including herbivores, which played an important role in human subsistence, whether game or domesticated.[3]

In the southern Negev (from south of the Ramon Crater to Eilat), environmental conditions are much harsher. In the Eilat region, the annual average rainfall is only 28 mm., while the potential evaporation rate rises to 4000 mm. annually (for the climate of the Eilat region see Ashbel 1963, and updated evaporation measurements in Goldreich 1998: 138, 140). As a result, the vegetation is Saharo-Arabian, with fewer species adapted to these conditions, and with the rare exception of the eastern 'Uvda Valley, totally restricted to the wadi beds. This means a lower carrying capacity for animal and man and a rarity of perennial water sources. Conditions in eastern Sinai are quite similar to those of the Eilat region, with one distinction: several major wadis drain rainwater from large areas. Thus, they support a fairly rich vegetation, some water sources and even some oases. The neighbouring Edomite Mountains of southern Jordan enjoy a better water balance, up to 400 mm. of rain per year. The vegetation is much denser than that of the Negev and even includes oak-juniper forests.[4] The differences in ecological conditions of the various desert zones finds clear expression in the archaeological remains.

In order to understand the implication of environmental conditions, some interpretation is required. Although the high summer temperature seems formidable, it is not the significant obstacle to living in the desert for several reasons. High heat prevails only three or four months a year (June to August or September), while comfortable daytime temperatures dominate the alternate months. More important than heat alone is heat stress, which combines temperature and humidity. In the desert, relative humidity is low (15–25% in southern Negev during hot hours, and even lower in inland Sinai and in southern Jordan), perspiration evaporates well and the body's cooling mechanism is efficient (for human physiology under heat see Zohar 1977b,c; Shapira and Sheinfeld

[1] All dates mentioned here are based on calibrated 14C dates, following OxCal 3.4 (Ramsey 2000), including quoted dates which were previously published otherwise.

[2] For various definitions of desert see Evenari *et al*. 1971: 8–10, 29–37; Nir 1977; Zohar 1977a. For the Negev Highlands climate see Evenari *et al*. 1971: 29–39; Sharon 1977; Zohar 1977a; Katsnelson 1979; Goldreich 1998.

[3] Until the early twentieth century AD the fauna of these regions was much richer than today. The severe reduction in wildlife and extinction of species occurred during and after World War I, when guns became common among the Bedouin population. For the faunal situation before the war see Qumsiyeh 1996; Shalmon 1998; Paz 2002. Still during the war, Jarvis (1941: 187–214) described a fairly rich wildlife in Sinai; he even issued orders prohibiting the hunting of several species.

[4] For the climate and flora of Sinai see Jaffe 1987; Ganor 1987. For southern Jordan see Feinbrun and Zohary 1955; Ravaq and Schmida 2000: 70–83; MacDonald 1988: 40–47; Henry 1995: 14–19, all with references.

1977a,b). When one is protected by shade and exposed to the dry wind, heat stress is significantly reduced even when the air temperature exceeds body temperature. Summer temperatures of the Negev Highlands are only slightly higher than those of Jerusalem, but the humidity is lower. Summer temperatures of the southern Negev are only slightly higher than in the Bethshan-Dead Sea Basin, but humidity is much lower (Ganor 1987). Therefore, high temperatures alone could not prevent living in the desert, certainly not for those born there. For the southern Negev another mitigating factor is important, the constant dry northern wind, which increases perspiration and further reduces heat stress. Heat, however, increases the need for drinking water, which is not always obtainable in the desert. This is the main reason why desert societies have adopted a life style that minimises physical activity and exposure to the sun during the hot hours of summer.

Typical for the desert are low winter temperatures, especially at night. Barometric highs prevail over the desert during most of the winter, with clear skies and almost no wind. In these conditions solar radiation absorbed by the earth during the day is quickly lost soon after sunset, temperatures drop drastically and quite often frost accumulates in the low areas. The cold demands no less serious consideration than the heat, and as a result, the consumption of combustible material is high. While in the fertile lands wood is readily available, in the desert it is limited and therefore constitutes an important factor in the assessment of carrying capacity.

The negative balance between precipitation and evaporation is indeed an obstacle to life in the desert. The lower the rainfall, the higher the fluctuation from year to year, or between clusters of years, and in general rain is very unpredictable. An average annual precipitation of 30 mm. means that there are years of 60 mm. and more, and years of no rain or minimal amounts that do not influence plants and animals. In addition, rains in the desert are usually concentrated in both space and time. On the one hand, that means that different areas may receive rain in different years, and on the other hand, concentrated rains create floods, which are highly important for the ecology of the desert. By virtue of the floods, the wadi beds support vegetation, which supports animals and people. Floods were essential for agriculture in the past, since outside the limited oases agriculture was possible only on the basis of the flood regime (Evenari *et al*. 1971; Avner 1998, 2002a).

Another obstacle to life in the desert is the paucity of arable land. As long as desert societies subsisted on hunting and gathering, they followed the food resources, animal and plant, and their population was in balance with the environment. Once they adopted agriculture and grazing, they were dependent on their skill to *produce* the food. Cultivation was possible only in wadi beds, where floods run, but where the soil is usually too stony. Therefore, cultivated soil had to be 'created' by means of terracing or other methods. This was possible only where the lithology, the topography and the flood regime permitted.

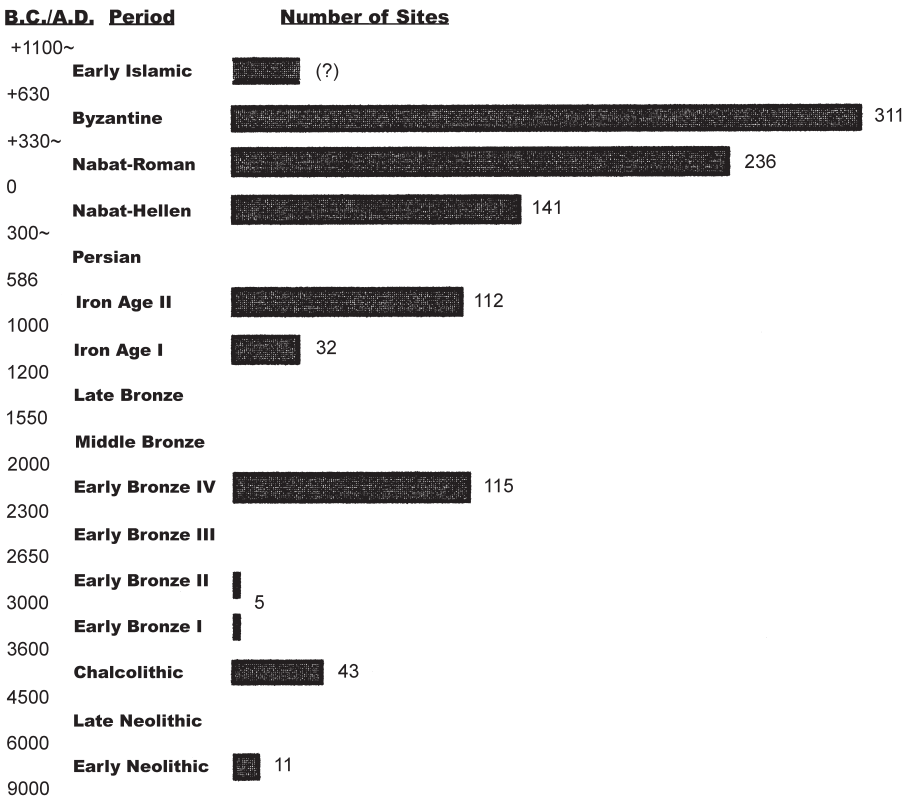
Present living conditions in the desert are not necessarily identical to those of the past. Obviously, knowledge of the ancient environment is crucial for understanding the ancient settlement pattern, given the fragile nature of the desert ecological system. Although numerous palaeoclimatic studies have been published during the last half-century, there is still debate on this question. However, accumulating data do support the view that during most of the time-span discussed here (sixth–third millennia BC) the climate was somewhat moister than at present. Nevertheless the area remained a real desert (see synthesis in Avner 1998, 2002b, with references).

Scholars' view of the desert's settlement history

Scholars working in the desert have often expressed low esteem for the desert environment, population and archaeological remains. For example, the Wadi Arabah was described as cruel, mostly impassable and a 'no man's land' (Rothenberg 1971b: 211, 220). Desert habitations are described as having 'brief life span' (Beit-Arieh 1982: 155, 1986: 51) or 'short lived and a passing phenomenon' (Haiman 1986: 16, 1989b: 185). Desert sites 'could not have existed without the support of a strong stable political and economic body' (Beit-Arieh 1984b: 22), the desert in general 'could not sustain a local population for any length of time' (Haiman 1992b: 93), and the population was 'hungry, on the verge of death' (Haiman 1992c: 304).

The first attempt to construct an overall occupational history of the desert was made by N. Glueck (1935, 1961,1968, 1970), who recorded about a thousand sites in the Negev (compiled by Baron, 1978, 1981). His basic outline was the distinction between periods of settlement and gaps. The first was characterised by permanent settlement and agriculture, whereas during the latter only a sparse Bedouin population roamed the area, destroying existing cultural remains and leaving no traces of their own (Glueck 1935: 183; 1968: 11–12, 127; 1970: 11–12, 65). The periods of settlement he identified were the Chalcolithic (almost totally restricted to the Beersheba Basin), the Middle Bronze I, the Iron Age II, and the Hellenistic-Roman-Byzantine, with some continuation into the Umayyad period. The periods of gaps in settlement were the Early Bronze, Middle Bronze II and Late Bronze Ages, Iron Age I, the Persian period and the time span from the eighth century AD to the present (Table 1).

Table 1: Number of sites per period in the Negev Survey of N. Glueck (after Baron 1981).



In numerous subsequent studies scholars adopted Glueck's 'up and down' pattern (e.g. Reifenberg 1955; Rothenberg 1967b; Evenari *et al*. 1971; Baron 1981). During the 1960s, Rothenberg conducted a survey along the southern Wadi Arabah and the Eilat area. He recorded 216 sites, including those discovered earlier by A. Musil, F. Frank and N. Glueck, while 41 additional sites were undated (Rothenberg 1967a, 1970: 7; Rothenberg and Cohen 1968). The periods of settlement he identified were the Chalcolithic, the Iron Age I (mainly related to copper production), the Nabataean, Roman, Byzantine and the Middle Ages, with gaps between them (Table 2). Generally, Rothenberg's pattern was similar to that of Glueck, but with four differences:

1. The Chalcolithic period, almost absent in Glueck's survey south of the Beersheba Basin, was a highly intensive settlement period in Rothenberg's survey;

2. From the MB I, one of the most intensive periods in Glueck's survey, Rothenberg found only one site (with two others questionable). Indeed, the same type of site was attributed by the two scholars to different periods;

3. The Iron Age I settlement (later found to begin in the LB II) was not identified by Glueck;

4. Rothenberg did not relate any site to the Early Islamic period, while Glueck described some continuity from the Byzantine to the Umayyad period. Rothenberg has published several corrections to his historical line (see below), but maintained that the southern Negev was uninhabited during most periods.

The Negev Emergency Survey, begun in 1979, opened a new chapter in Negev research. It was launched in preparation for the redeployment of the Israel Defence Forces from Sinai, and headed by Eitan (1979) and Cohen (1988). The survey primarily concentrated on the Negev Highlands, eventually covering only some 30% of the Negev area, but contributing some 13,000 previously unknown sites. About a hundred sites have been excavated. To date, nine maps have been published, covering 900 sq. km., some 12% of the Negev area (Avni 1992; Cohen 1985, 1986, 1988; Haiman 1986, 1991, 1993; Lender 1990; Rosen 1994). The ample new information basically confirmed Glueck's 'up and down' view, with one major difference. The EB II emerged as the most intensive settlement period in the desert, excluding the Byzantine–Early Islamic (Table 3).

Another survey was begun in 1982 by Anati in the Har Karkom area, where 821 sites were recorded in an area of 200 sq. km. (Anati 2001: 162). He termed the predominant period of settlement the 'Bronze Age Complex' (BAC), which includes the Chalcolithic and EB. Only a very few sites were identified as Neolithic,

Table 2: Number of sites per period in the Southern Negev Survey of B. Rothenberg (after Rothenberg 1967b).

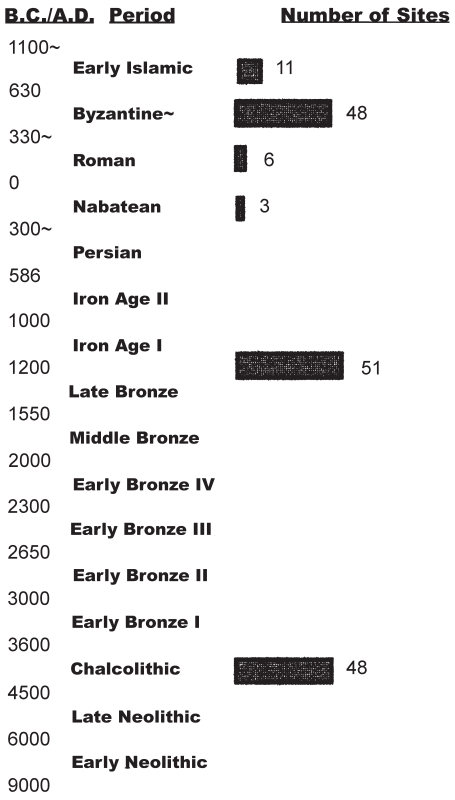


Table 3: Negev Highlands Emergency Survey. Compiled from: Avni 1992; Cohen 1981, 1985; Haiman 1986, 1991, 1993, 1999; Lender 1990; Rosen 1994.

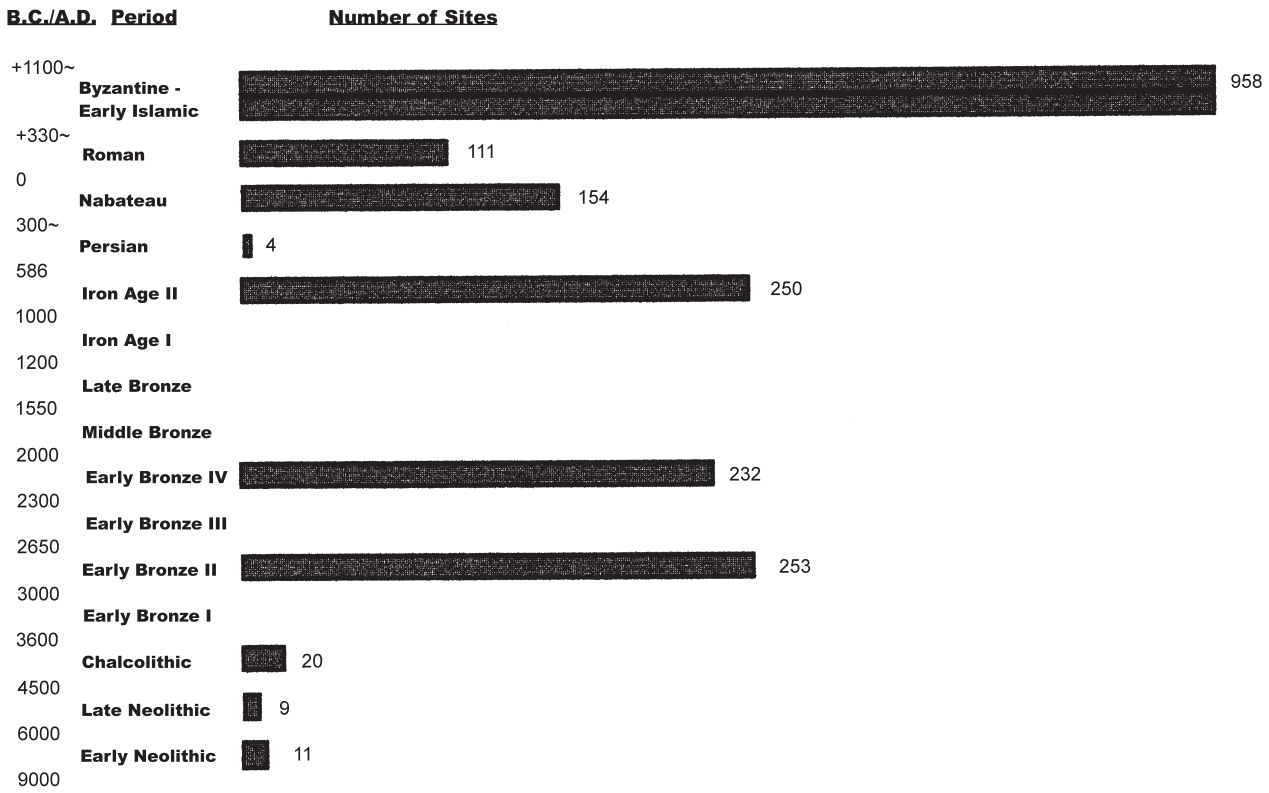
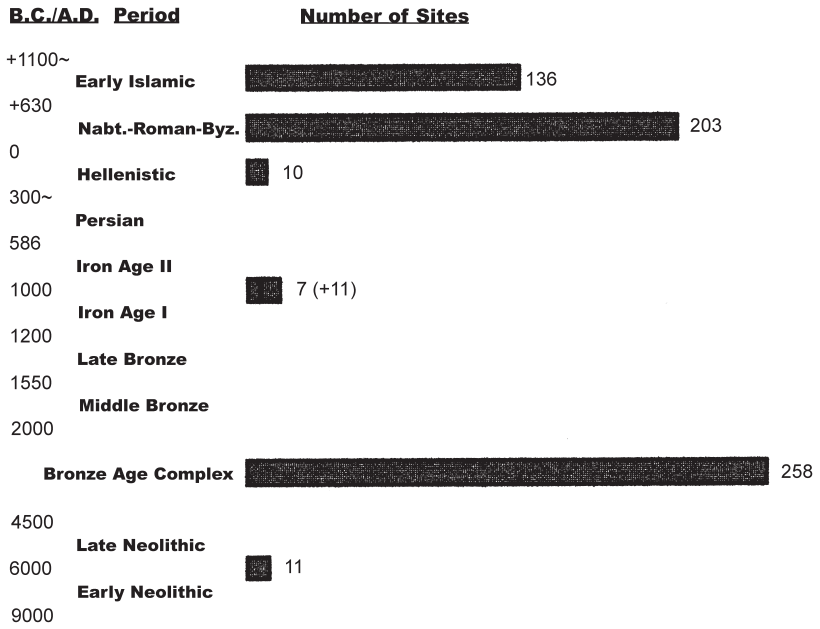


Table 4: Number of sites per period in the Har Karkom Survey of E. Anati (after Anati 2001).



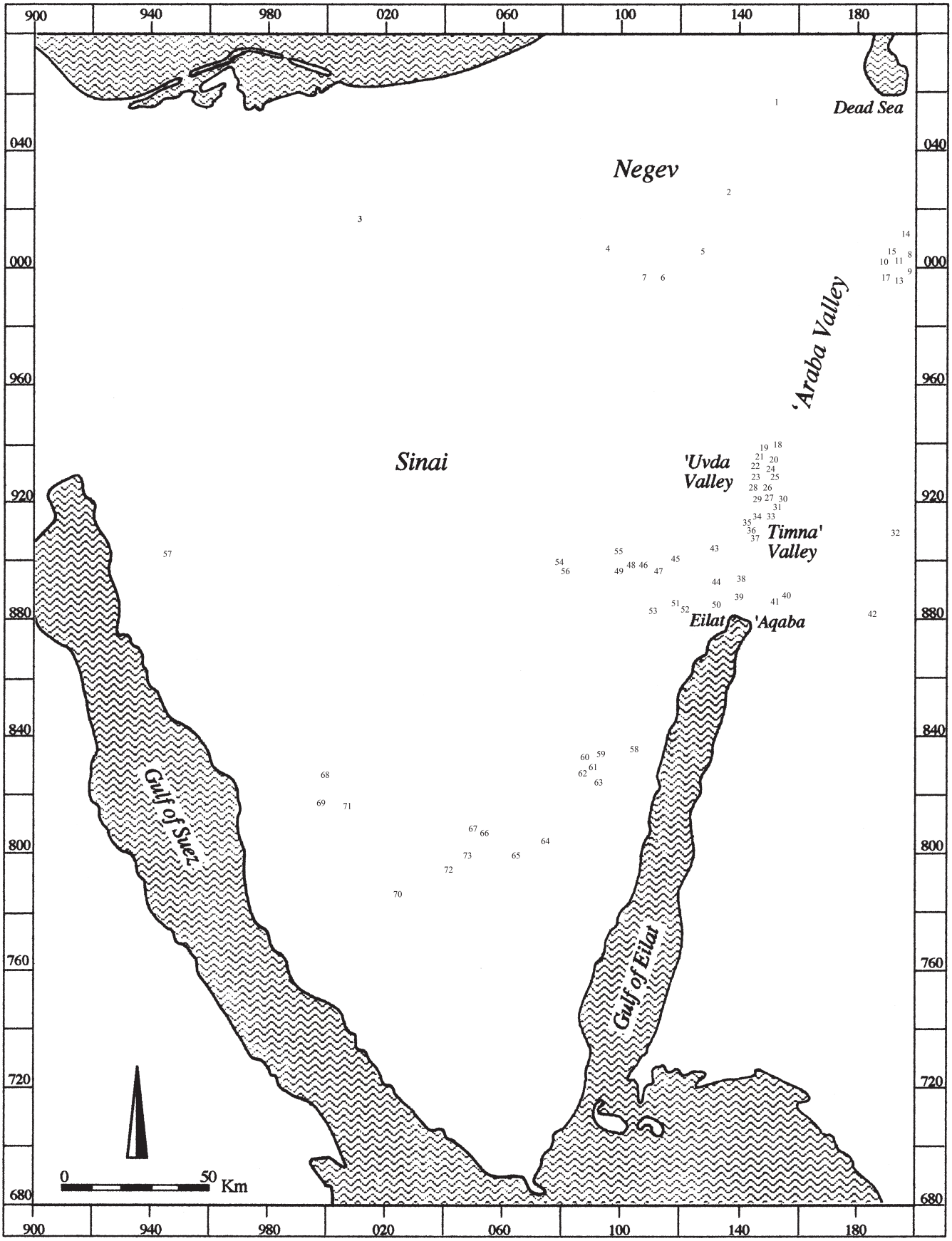
and no sites were dated to the second and first millennia BC (Table 4).[5]

Despite differences in the survey results, most scholars agree that the desert was inhabited only in certain periods, and various explanations have been suggested for the 'up and down' phenomenon. The most popular, following Glueck, relates archaeological remains to the initiative of strong polities in the neighbouring fertile lands, or even to settlers from outside the desert (Glueck 1961, 1968, 1970; Rothenberg 1970: 21–22, etc.; Amiran *et al*. 1973; Beit-Arieh 1974, 1981b, 1983; Baron 1981; Cohen 1986: 433, 1988, 1999: 75–81; Haiman 1988, 1989a,b).

Rosen (1987; 1994: 22–24) presented the clear 'up and down' settlement pattern in the survey of the Ramon Crater, but pointed to four different factors that affected settlement history. In his analysis, the external influence was only one factor, along with climatic changes, the general developments in the Near East and internal developments. A more complex explanation for the desert's settlement history was offered by Finkelstein. Based on the concept that nomads always lived in the desert but usually did not leave any remains, he suggested two different models. One is that the desert nomads prospered simultaneously with the prosperity in the fertile lands, combined with a political vacuum in the south. This situation enabled the desert tribes to take control of the Arabian trade and of copper production and trade, which contributed to their economy and political power. Their prosperity encouraged them to shift to sedentism, resulting in archaeological remains in the desert and causing them 'to become visible' (Finkelstein 1988; Finkelstein and Perevolotsky 1990). The other model has nomadic populations shifting to sedentism and leaving archaeological remains when the neighbouring fertile lands were in crisis. This crisis forced them to become farmers and produce the grain they usually acquired by trade with the settled populations (Finkelstein 1989; 1990). In another publication (1995) Finkelstein attempted to merge these theories.

Another common concept is that the desert populations were always migrants or intruders. Rothenberg (1969: 28–30, 1970: 15, 1971a: 62, 1973: 35) described a Chalcolithic invasion into the Arabah and Sinai from the north-eastern Fertile Crescent through southern Jordan, thus accounting for the ingenuity of the southern Sinai Chalcolithic civilisation. The EB II population of southern Sinai was assumed to have migrated from Arad (Amiran *et al*. 1973; Beit-Arieh 1974, 1981a,b, 1983), but also from Arabia (Beit-Arieh 1986: 52). Another theory moved the EB population in the opposite direction, from Sinai to Arad and to the Negev Highlands (Govrin 1990; Haiman 1992b: 102). Cohen (1999: 11–12) related the EB settlement remains to a population that arrived from the north or west, with developed material culture and technology. The EB IV population migrated from Central Asia (e.g. Kenyon 1966: 14; Lapp 1966: 100–13; Kochavi 1967:

[5] The survey of the Har Karkom area is not yet published, but the principal results have appeared in many publications (e.g. Anati 1986, 1987, 1993, 2001); they mainly emphasise the identification of Har Karkom as Mount Sinai, and date the Exodus to the fourth–third millennia BC. The 'BAC' concept is briefly presented as a working hypothesis, although two pottery phases were identified (EB II and MB I), and three different peoples are assumed to have lived in the area (Anati 1986: 88–100). No discussion was published to support the 'BAC' concept and terminology.



* Due to scale of map, not all sites are presented.

Figure 4.1: Map of the southern Levant desert, with 14C-dated sites.*
Site numbers refer to those in Table 5.

250–56; Mazar 1968: 68); Aharoni (1978: 80) described the MB I (=EB IV) population of the Negev as refugees from the north, while Cohen (1983) saw them as penetrating from Sinai.

The above theories, as we shall see, deserve serious criticism. One challenge comes from the southern Negev and the southern Wadi Arabah (south of the Ramon Crater and down to Eilat). In addition to the 216 sites surveyed by Rothenberg, my own surveys reveal a different settlement scenario.[6] To date, 1650 sites have been recorded in the southern Negev, and their numbers grow continuously. Surprisingly, the Eilat region (from the 'Uvda Valley to Eilat, see map in Figure 4.1) is the richest in archaeological sites in the southern Negev, despite being the most arid. Approximately 1500 sites have been recorded to date in an area of 1200 sq. km., of which only 7% have been subjected to a detailed archaeological survey (including the Timna Valley, by Rothenberg). The settlement pattern emerging from these surveys and excavations presents a continual occupational sequence covering the last 10,000 years, from PPNB to the present, with no gaps at all (e.g. Avner 1998, 2002a,b; Avner *et al*. 1994, Sebbane *et al*. 1993, Avner and Magness 1998). In this light, the question arises as to the reason for the differences in the settlement scenario that emerges from the various surveys. In my opinion, the key problem is the correct dating of sites in both surveys and excavations. This is especially crucial in the late prehistoric and early historic periods, i.e. the sixth–third millennia BC. Before entering into discussion on the chronology of the sites, three points must be stressed concerning the nature of settlement in the desert:

1. In the areas under discussion, true nomadism was never practised. In contrast to full nomads, who relied on herding alone, the southern Levantine desert populations were basically semi-nomadic and subsisted on a complex economy. They sometimes altered their mode of life toward mobility or sedentism in response to political changes (Marx 1992, 1996; Khazanov and Bar-Yosef 1993: 461–62; cf. Helms 1982; Hanbury-Tenison 1989; Finkelstein 1995) or to climatic changes (see synthesis of palaeoclimate, with references in Avner 1998, 2002b, ch. 7). One of the preconditions for true nomadism, except in rare cases, is a pack animal that can carry baggage hundreds of kilometres twice a year. In the Negev and Sinai deserts it could only be the camel (e.g. Khazanov 1986: 99–102) which was not yet domesticated in the sixth–third millennia BC (Restö 1991; Köhler-Rollefson 1993; *contra* Ripinsky 1983). Semi-nomads always leave remains, and even true nomads do so (e.g. Cribb 1991; Rosen 1992), but since we are not discussing true nomadism in the southern Levantine deserts, the debate on this point is irrelevant.

2. During the sixth–fourth millennia BC (Late Neolithic through EB I) no strong polity can be envisioned in neighbouring fertile lands that could be responsible for the archaeological remains in the desert. Therefore the desert remains must have been left by the indigenous desert population. Since the theories relating desert archaeological remains to foreign initiatives are invalid for these periods, their validity for later periods is necessarily challenged (see below).

3. The available data on the palaeoclimate during the eighth–fourth millennia BC (see note 4) points to somewhat milder conditions than today. In contrast to previous theories, there was no climatic reason for any settlement gap during this time span. If indeed monsoonal trajectories occasionally penetrated the area, as several studies suggest, then a single summer rain a year could have had a significant influence on the carrying capacity of the desert. The gradual desiccation of the third millennium BC stands in sharp contrast to the contemporary peak of settlement in the desert, and even the global climatic crisis c. 2300 BC did not force the population to evacuate the desert.

Dating of desert sites

One of the characteristics of desert remains in these periods is the rarity of diagnostic objects, mainly of flint and pottery. While PPNB sites are generally well identified by typical flint tools, with the Late Neolithic the situation changes. Yarmukian pottery is not found in the Negev, and Wadi Raba sherds are very rare. Most of the flint tools are *ad hoc* or non-standardised (Rosen 1983: 138, 2002: 27; Forenbaher 1997), while the more standardised tools had a long life-span (see below). With a few exceptions, this problem lingers into the following periods. Chalcolithic pottery of the Beersheba or Ghassul cultures is rarely found in the Negev and Sinai, and EB Canaanite pottery is also rare, with the exception of a group of sites in southern Sinai

[6] These surveys, aimed at areas selected for civilian development and military use, were published only briefly (Avner 1979, 1982, 1989a,b,c, 1993, 1997a,b,c, in press 5, Avner and Naor 1978; Avner and Roll 1996), but the major issues which emerged have been discussed in some depth (Avner 1983, 1984, 1987, 1998, 1999, 2000, 2001, 2002a,b; Avner and Avner 1999; Avner *et al*. 1994; Avner and Carmi 2001; Avner and Magness 1998; Sebbane and Avner 1993; Sebbane *et al*. 1993; Avner in press 1–6).

(Beit-Arieh 1974, 1977, 1978, 1981a,b, 1983). The flint industry basically continued through these periods with little change (see below). As a result, the general periodisation of Near Eastern archaeology is hardly applicable to the desert.

The first attempts to define desert cultures, rather than fixed periods, were made by Ronen (1970) and Kozloff (1974), who analysed flint assemblages collected by Rothenberg in surveyed sites of the Wadi Arabah and Sinai. Ronen examined the flint from two selected sites, one in Wadi Feiran, south-western Sinai, and the other in Wadi Sidri, west of Eilat in Sinai. Kozloff examined flint from a larger variety of sites and identified six different industries, including those of Ronen. Based on these studies, Rothenberg emphasised two industries, or cultures, the 'Eilatian' and the 'Timnian'. The former is described as continuing Palaeolithic traditions, with large, coarse tools and the 'Levallois technique', but also included tabular scrapers, adzes and others. The latter was characterised by smaller sized cores and tools, with tabular scrapers, adzes, knives and others, but lacking the Levallois technique. Some characteristics are shared by both industries, including end scrapers (dominant in both), tabular scrapers, drills and borers, and a large proportion of *ad hoc* tools (Kozloff 1974: 46–47; Rothenberg 1979: 111, 114). Although Ronen and Kozloff dated both industries to the fourth millennium BC, Rothenberg saw them as two consecutive cultures, which he also termed 'periods'. He formulated a cultural-chronological table for the desert in relation to the chronologies of Egypt and Israel. The Eilatian was dated 4500–3500 BC, followed by the Timnian period, 3500–2650 BC (Rothenberg 1979: 111–16, 283; Rothenberg and Ordentlich 1979; Conrad and Rothenberg 1980: 26). Later, Rothenberg published with Glass (1992) another cultural-chronological concept for the desert, in which the Eilatian and Timnian actually coexisted during the sixth to third millennia BC. This time-span was then divided into three different cultural phases, termed 'Sinai-Araba Copper Age Phases'; Early (c. 6000–2955 BC), Middle (c. 2955–2300 BC) and Late (c. 2300–2000 BC). Unfortunately, the definitions of these cultures and their chronology are questionable.[7]

A somewhat similar approach was adopted by Anati (1986, 1993, 2001) in the Har Karkom survey, where he used the term 'Bronze Age Complex' (BAC) for the Chalcolithic and Early Bronze Age as one period, c. 4600–2000 BC. Unfortunately, the artefacts and architecture representing this culture are not well dated. Presently, they are supported by only one ^{14}C date (c. 2700 Cal. BC, Anati 2001: 9), and no discussion explaining the concept has been provided.

Similar difficulties have faced the teams that surveyed the north-eastern Wadi Arabah and Wadi al-Hasa, in southern Jordan (MacDonald 1988; 1992), despite the fact that diagnostic pottery sherds are more frequent in these areas. Sites were dated as Late Neolithic–Chalcolithic, Chalcolithic–EB I, and EB I–III. Also Rosen (1994: 15–16), in the survey of the Ramon Crater, did not separate the Chalcolithic from EB.

In an attempt to overcome the difficulties in typological dating of desert sites, radiometric dating is essential for desert chronology, despite limitations of the method (see below). At present, 175 ^{14}C dates are available from the time-span of the sixth to third millennia BC (see Tables 5, 6: nine dates from the Negev Hhighlands, 71 from the southern Negev, 31 from southern Jordan and 79 dates from Sinai) and they present a very different settlement scenario from that of the various surveys. Instead of short periods of settlement and longer gaps between them, they demonstrate a full sequence of settlement and a rich variety of activities. The only period that is not well covered by ^{14}C dated is the Late Chalcolithic (early fourth millennium BC), and in my opinion this will change with further research. Even more significant is the breakdown of the dates to number of dates per century in each period. Table 7 demonstrates that the periods that were considered 'missing' in the desert, the Chalcolithic, EB I and EB III, actually appear with high numbers of dates, that generally indicate a high intensity of human presence and activity.[8]

Another point that comes to light from Tables 5 and 6 is the duration of individual sites. Although series of ^{14}C dates are presently very limited, they already now indicate that desert sites are not necessarily 'brief in life-span' or a 'passing phenomenon'. In 'Uvda Site 124/IV six dates from a single room range from c. 3000 to 2650 BC, a span of 350 years (Table 5: 22, first six dates). This room intersects earlier remains that include fifth–fourth millennium material (Avner in press 6). In Site 9, six dates from the middle stratum ranges from c. 3200 to 2700 BC, a span of 500 years (Table 5: 25), while the lower stratum is dated by artefacts to the fifth–sixth millennia, and the upper stratum is dated by artefacts to the EB IV. In Site 16 three dates range from c. 3500 to 2850 BC, a span of 650 years (Table 5: 23). No occupational gaps could be identified in the sections excavated at these sites: there was continuous occupation with

[7] Unlike in the earlier publications (1969: 28–30, 1970: 15, 1971a: 62, 1973: 35) Rothenberg emphasised now the authocthonic nature of the desert population (Rothenberg and Glass 1992). Although I fully agree with his recent view, his data-base and analysis require a detailed criticism (see Avner 2002b, ch. 1, note 16). Besides adoption of the term Timnian by D. Henry (1995, ch. 15), the cultural-chronological scheme of Rothenberg has not been widely accepted.

[8] Although the breakdown of ^{14}C dates to centuries was made 'mathematically', it still generally reflects the intensity of human presence and activity in each period.

Table 5: Late Neolithic to EB IV ^{14}C calibrated dates from southern Jordan, the Negev and Sinai, from north to south.

No.	Site name	Type of Site	Lab No.	Material	B.P.	C. B.C.	Mean	Reference
1	Har Dimon	habitation	RT1556	charcoal	4660±55	3520-3360	3440	Segal & Carmi 1996:94
	Har Dimon	"	RT1558	"	3915±50	2470-2300	2385	"
	Har Dimon	"	RT1557	"	3845±50	2410-2200	2305	"
2	'Ein Ziq	habitation	RT885A	"	3960±90	2580-2300	2440	Cohen 1999:338
	'Ein Ziq	"	RT885B	"	3850±50	2460-2200	2330	"
	'Ein Ziq	"	RT885B1	"	3880±50	2460-2290	2265	"
	'Ein Ziq	"	RT2514	wood	3700±45	2200-1980	2090	"
3	Mushabi 103	habitation	RT447B	charcoal	3800±330	2900-1700	2300	Bar-Yosef & Philip 1977:264
4	Qadesh Barnea' 3	habitation	SMU 662	"	7530±80	6450-6250	6350	Bar-Yosef 1987:577
	Qadesh Barnea' 3		Pta 3662	"	7350±80	6340-6070	6205	???
5	Hagamal site	habitation	RT2043	"	4115±50	2860-2580	2720	Segal & Carmi 1996:96
6	Kvish Harif	habitation	Pta 3374	"	5260±60	4230-3980	4105	Rosen 1984
7	Har Harif E22H	habitation	Tx 1122	"	5960±100	4960-4710	4835	Forenbaher 1997:85
8	W. Fidan 8	habitation	HD17471	"	6082±44	5050-4850	4950	Hauptmann 2000:65-6
9	Faynan 9	copp. smelt.	HD 10577	"	4140±109	2880-2580	2730	"
	Faynan 9	"	HD 10993	"	3981±50	2580-2400	2490	"
	Faynan 9	"	HD 10994	"	3973±85	2620-2310	2465	"
	Faynan 9	"	HD 10584	"	3812±77	2410-2130	2270	"
10	W. Fidan 4	habitation	HD 16327	"	4718±25	3630-3380	3505	"
	W. Fidan 4	"	HD 16380	"	4702±37	3630-3370	3500	"
	W. Fidan 4	"	HD 13776	"	4654±50	3520-3360	3340	"
	W. Fidan 4	"	HD 16379	"	4576±44	3500-3120	3310	"
	W. Fidan 4	"	HD 16378	"	4424±51	3270-2920	3095	"
11	Kh. Hamra Ifdan	habitation	HD 16533	"	4044±44	2630-2470	2550	"
	Kh. Hamra Ifdan	"	HD 16534	"	3914±45	2470-2310	2390	"
12	Ras al Naqab1	copp. smelt.	HD10574	"	3971±67	2580-2350	2465	"
13	Tel W. Faynan	habitation	HD 10567	"	6410±115	5490-5260	5375	Najjar *et al.* 1990:32
	Tel W. Faynan	"	HD 12335	"	6360±45	5470-5300	5385	"
	Tel W. Faynan	"	HD 13775	"	6312±50	5210-4950	5080	Hauptmann 2000:65-6
	Tel W. Faynan	"	HD 12338	"	6110±75	5210-4850	5030	Najjar *et al.* 1990:32
	Tel W. Faynan	"	HD 12337	"	5740±35	4680-4500	4590	"
	Tel W. Faynan	"	HD 12336	"	5375±30	4330-4110	4200	"
	Tel W. Faynan	"	TO9614	"	6370±300	5560-4960	5260	Simmons & Najjar 2002:19
	Tel W. Faynan	"	TO9615	"	6130±89	5210-5160	5185	"
	Tel W. Faynan	"	TO9616	"	6260±90	5320-5140	5230	"
14	W. Ghwair 4	copp. smelt.	HD 10573	"	4059±55	2840-2470	2655	Hauptmann 2000:65-6
15	W. Ghwair 3	copp. smelt.	HD 16529	"	3919±26	2470-2350	2410	"
16	Faynan 16	copp. smelt.	HD 10579	"	3923±61	2490-2300	2395	"

[1]. Calibration based on OxCal 3.4 (Ramsey 2000), 1 Sigma- 68.2% confidence. Mean values were calculated for the preparation of the histogram only. Dates from these sites, which are out of the range referred here, are not included in this list.

Sites where excavators are not mentioned in the references are as follows: Har Dimon- G. Tal; Mushabi 103- Sass & Klemer; Hagamal Site- Rosen; Feidan 8- Adams; Faynan 9- Adams; Feidan 4- Adams & Genz, Adams & Levy; Hamra Ifdan- Adams; Barqa al Hatiye- Fritz; 'Uvda 4- Eisenberg; 'Uvda 6- Yogev; 'Uvda 7- Sass & Goren; 'Uvda 16- Yogev; 'Uvda 9- Amiran, Arnon, Ilan and Avner; Yotvata Hill- Meshel; Yotvata 6- Meshel & Sass; Ras el Naqeb- Avner; Hashem el Taref XVII- Avner; Hashem el Taref 650, 317, 317a, W. Kyke 649, W. Malha 332, Themed 699- Kozloff; Ein Abu Rugum- Sass; W. Watir- Avner; 'Ein Um Ahmed- Goren; W. Zalaqa- Avner; W. Dab'yia- Goren, Avner; Serabit el Khadim- Beit Arieh; J. 'Adeideh- Goren; Abu Khalil- Goren; Sinai 1130/3- Biet-Arieh; Sheikh 'Awad- Beit-Arieh.

Table 5 continued...

No.	Site name	Type of Site	Lab No	Material	B.P.	C. B.C.	Mean	Reference
17	Barqa al Hetiye	habitation	HD 13975	"	4376±57	3090-2900	2995	"
	Barqa al Hetiye	"	HD 13976	"	4267±43	2920-2780	2850	"
18	'Uvda 4	habitation	RT724D	charcoal	5400±110	4350-4040	4195	Avner *et al.* 1994
19	'Uvda 96/III	threshing fl.	RT648B	"	4250±50	2920-2700	2810	"
20	'Uvda 6	sanctuary	RT628A	charcoal	6560±200	5710-5310	5510	"
	'Uvda 6	"	RT628B	"	6400±70	5470-5310	5390	"
	'Uvda 6	"	Pta 3621	"	6400±60	5470-5310	5390	"
	'Uvda 6	"	RT1739	ostrich-egg	6390±60	5470-5310	5390	Segal & Carmi 1996:97
21	'Uvda 7	habitation	RT724B	charcoal	6410±120	5490-5260	5375	Avner *et al.* 1994
	'Uvda 7	"	RT724C	"	4540±100	3490-3040	3267	"
22	'Uvda 124/IV	habitation	RT1419	charcoal	4370±100	3310-2880	3095	Avner *et al.* 1994
	'Uvda 124/IV	"	RT1452	"	4370±50	3090-2910	3000	"
	'Uvda 124/IV	"	RT1449	"	4285±60	3020-2710	2865	"
	'Uvda 124/IV	"	RT1451	goat dung	4280±60	3020-2700	2860	"
	'Uvda 124/IV	"	RT1448	charcoal	4120±60	2870-2570	2720	"
	'Uvda 124/IV	"	RT1450	"	4075±55	2860-2490	2675	"
	'Uvda 124/IV	"	RT3174	goat dung	4030±45	2620-2470	2545	Avner in press 7
	'Uvda 124/IV	"	RT3172	"	4015±40	2580-2470	2525	"
	'Uvda 124/IV	"	RT3173	"	4010±45	2580-2460	2520	"
23	'Uvda 16	habitation	RT640A	charcoal	4800±70	3660-3380	3520	Avner *et al.* 1994
	'Uvda 16	"	RT640B	"	4400±60	3260-2910	3085	"
	'Uvda 16	"	RT640c	"	4280±60	3020-2700	2860	"
24	'Uvda 17	habitation	Pta 3341	"	4320±50	29303030	2980	Beit-Arieh 2001:100
	'Uvda 17	"	Pta 3340	"	4100±50	2860-2500	2680	"
	'Uvda 17	"	Pta 3342	"	3870±40	2460-2280	2370	"
25	'Uvda 9 (124/XVII)	*massebah*[2]	Rt670D	"	7960±200	7200-6550	6875	Avner *et al.* 1994
	'Uvda 9 (124/XVII)	"	Pta 3646	"	6960±70	5890-5730	5810	Avner in press 7
	'Uvda 9 (124/XVII)	"	RT 3369	"	4130±90	2880-2580	2730	"
	'Uvda 9	habitation	RT899A	"	4530±50	3360-3100	3230	Avner *et al.* 1994
	'Uvda 9	"	RT889B	"	4520±60	3360-3100	3230	"
	'Uvda 9	"	RT864B	"	4440±180	3360-2890	3125	"
	'Uvda 9	"	RT1436	ostrich-egg	4440±60	3330-2920	3125	"
	'Uvda 9	"	RT864A	charcoal	4310±90	3110-2700	2905	"
	'Uvda 9	"	RT714A	ostrich-egg	4070±100	2860-2470	2665	"
26	'Uvda 151	*masseboth*	RT684A	"	5670±85	4610-4360	4485	Avner *et al.* 1994
27	Shaharut IV	tombs	RT899C	wood	3700±55	2200-1970	2085	Avner *et al.* 1994
	Shaharut IV	"	RT771B	"	3582±130	2140-1740	1940	"
28	'Uvda 166	habitation	RT714B	charcoal	3850±80	2460-2200	2330	Avner *et al.* 1994
	'Uvda 166	"	RT1421	charcoal	3680±50	2140-1970	2055	"
29	N. 'Issaron (Uvda 14)[3]	habitation	RT1516	charcoal	7460±95	6410-6230	6320	Carmi *et al.* 1994
	N. 'Issaron	"	RT1640	"	7135±95	6160-5890	6025	"
	N. 'Issaron	'	RT1691	"	7100±70	6030-5840	5935	"
	N. 'Issaron	"	RT1606	"	6680±85	5670-5480	5575	"
	N. 'Issaron	"	Pta 2999	"	6460±70	5480-5360	5420	"
	N. 'Issaron	"	RT1692	"	6350±90	5470-5210	5340	"
	N. 'Issaron	"	Pta 3486	"	6130±70	5210-4940	5075	"
	N. 'Issaron	"	RT1663	"	5755±85	4710-4490	4600	"
	N. 'Issaron	"	RT1608	"	5690±55	4600-4450	4525	"
	N. 'Issaron	"	RT1506	"	5635±70	4540-4360	4450	"
	N. 'Issaron	"	RT1630	"	5625±70	4530-4360	4445	"
	N. 'Issaron	"	RT1513	"	5170±55	4050-3810	3930	"
	N. 'Issaron	"	RT1518	"	4990±50	3910-3700	3805	"

[2]. The first two dates from the *massebah* at 'Uvda 9 (124/XVII) were retrieved from the same hearth, at the base of the *massebah*. The first and the earlier date is considered erroneous.

[3]. Twenty two additional dates from N. 'Issaron, stratum C, fall within the PPNB (Carmi *et al.*. 1994).

Table 5 continued...

No.	Site name	Type of Site	Lab No	Material	B.P.	C. B.C.	Mean	Reference
30	Yotvata Hill	rampart	RT1548	"	5468±55	4360-4240	4300	Segal & Carmi 1996:98
	Yotvata Hill	copp. smelt.	RT1546/7	"	4650±70	3520-3360	3340	"
31	Yotvata 6	habitation	RT1439	"	3980±60	2580-2350	2565	Avner *et al.* 1994
	Yotvata 6	"	RT1438	"	3770±50	2290-2060	2175	"
32	J. Queisa (J24)	habitation	SMU 804	"	5770±40	4690-4550	4620	Henry 1995:361
33	Samar	"kite"	RT2716	"	4080±25	2840-2500	2670	Avner *et al.* 1994
	Samar	"	Pta 3627	"	3940±60	2560-2310	2435	Holzer & Avner in press
	Samar	"	RT2715	"	3775±40	2290-2130	2210	"
34	Timna' S 27	copp. mine	Bonn 2538	charcoal	7680±120	6650-6410	6530	Unpublished (Rothenberg p.c.)
35	Timna' 39a	habitation	OxA 7632	"	5485±45	4430-4250	4340	Rothenberg & Merkel 1998
36	Timna' S28/2	copp. mine	Bonn 2363	"	4000±90	2840-2340	2590	Conrad & Rothenberg 1980
	Timna' S28	"	Bonn 2632	"	3890±70	2470-2230	2350	
37	Timna' 30	copp. smelt	Ham 215	"	4020±100	2900-2350	2625	Rothenberg 1990:71-2
38	G. Shehoret	copp. smelt.	RT591	"	4010±150	2900-2300	2600	Avner *et al.* 1994
39	Eilat IV/16	*tumuli*	RT989	charcoal	6470±80	5490-5320	5405	Avner *et al.* 1994
	Eilat IV/3	"	RT926A	"	6340±60	5470-5260	5365	"
	Eilat V/27	"	RT1215	"	6400±210	5650-5050	5350	"
	Eilat V/28	"	RT1216	"	6060±65	5050-4850	4950	"
	Eilat V/22	"	RT1214	"	5980±130	5050-4710	4880	"
	Eilat V/18	"	RT1212	"	5930±80	4910-4710	4810	"
	Eilat IV/8	"	RT1210	wood	5710±75	4680-4450	4565	"
	Eilat V/16	"	RT1211	charcoal	5640±60	4550-4360	4455	"
	Eilat V/19	"	RT1213	"	5490±60	4450-4250	4350	"
	Eilat IV/1	"	RT926	"	5400±100	4340-4040	4190	"
40	Hujeirat al Ghuzlan	habit.+copp.	Bln5076	"	5186±34	4040-4020	4030	Görsdorf 2002
	Hujeirat al Ghuzlan	"	Bln5075	charcoal	4881±32	3700-3640	3670	"
41	Tell Magass	habit.+copp.	Bln5120	"	5290±33	4220-4000	4110	Görsdorf 2002
	Tell Magass	habit.+copp.	Bln5119	"	5111±37	3970-3800	3885	"
	Tell Magass	habit.+copp.	Bln5118	"	5026±34	3940-3710	3825	"
	Tell Magass	habit.+copp.	Bln5074	"	4879±32	3700-3540	3670	"
	Tell Magass	habit.+copp.	Bln5121	"	4863±39	3700-3650	3675	"
42	Risqeh	*masseboth*	K 1467	"	6010±120	5060-4720	4890	Kirkbride 1969:195
43	Sinai 10	"kite"	Gd 7948	"	4530±60	3360-3100	3235	Eddy & Wendorf 1999:280-1
	Sinai 10	"	Gd 7953	"	4420±80	3310-2910	3110	
	Sinai 10	"	Gd 11317	"	4390±80	3270-2900	2980	
44	Ras al Naqeb	sanctuary	RT1948	"	5470±70	4440-4220	4330	Segal & Carmi 1996:
45	Sinai 47	"plaza" site	DRI 3322	"	5526±89	4460-4250	4355	Eddy & Wendorf 1999:280-1
	Sinai 47		DRI 3323	"	5353±109	4330-4040	4185	
46	H. al Taref 713a	habitation	SMU 836	"	7037±242	6200-5650	5905	Rothenberg & Glass 1992
47	H. al Taref XVII	sanctuary	RT1947	sea-shell	6580±90	5620-5470	5545	Segal & Carmi 1996:102
	H. al Taref VII (S.18)	sanctuary	ETH17505	charcoal	6575±65	5610-5470	5540	Eddy & Wendorf 1999:280-81
	H. al Taref VII (S.18)	"	ETH17506	"	6160±85	5260-4960	5110	Eddy & Wendorf 1999:280-81
48	H. al Taref 713	habitation	SMU 641	charcoal	6403±76	5470-5310	5390	Rothenberg & Glass 1992
	H. al Taref 713	"	SMU 742	"	5654±57	4550-4360	4405	"
	H. al Taref 713	"	SMU 788	"	5523±73	4460-4250	4355	"
	H. al Taref 713	"	SMU 789	"	4237±56	2920-2690	2805	"
49	H. al Taref 650	habitation	SMU 740	charcoal	5665±119	4670-4360	4515	Rothenberg & Glass 1992
	H. al Taref 650	"	SMU 822	"	5625±115	4590-4340	4465	"
	H. al Taref 650	"	SMU 743	"	4427±68	3310-2920	3115	"
	H. al Taref 650	"	SMU 642	"	4251±64	2920-2690	2805	"
50	Sinai 32	habitation	Gd 11319	charcoal	6230±140	5340-4990	5165	Eddy & Wendorf 1999:280-1
	Sinai 32	"	Gd 9749	"	5650±250	4800-4200	4500	"
	Sinai 32	"	Gd 9742	"	5380±240	4500-3950	4225	"
	Sinai 32	"	Gd 9745	"	4210±220	3110-2450	2780	"

Table 5 continued...

No.	Site name	Type of Site	Lab No	Material	B.P.	C. B.C.	Mean	Reference
	Sinai 32	"	Gd 10603	"	3910±120	2570-2200	2385	"
	Sinai 32	"	Gd 10608	"	3900±150	2580-2140	2360	"
	Sinai 32	"	Gd 9741	"	3750±580	3000-1400	2200	"
	Sinai 32	"	Gd 10605	"	3600±140	2140-1740	1940	"
	Sinai 32	"	Gd 9751	"	3100±220	1650-1000	1325	"
51	Sinai 40	hearth	DRI 3127	charcoal	6379±126	5480-5150	5315	Eddy & Wendorf 1999:280-1
52	Sinai 25	habitation	DRI 3126	"	5721±63	4680-4460	4570	"
53	Sinai 1	habitation	DRI 3269	"	5518±121	4500-4220	4360	Eddy & Wendorf 1999:280-1
	Sinai 1	"	DRI 3272	"	4639±91	3630-3130	3380	"
	Sinai 1	"	DRI 3268	"	4470±62	3340-3020	3180	"
	Sinai 1	"	DRI 3270	"	4350±73	3090-2880	2985	"
	Sinai 1	"	DRI 3273	"	3290±78	1690-1460	1575	"
54	W. Kyke 649	habitation	SMU 821	charcoal	7174±66	6160-5920	6040	Rothenberg & Glass 1992
	W. Kyck 649	"	SMU 702	"	6843±62	5780-5640	5710	"
	W. Kyck 649	"	SMU 835	"	6594±205	5720-5340	5530	"
	W. Kyck 649	"	SMU 676	"	5210±51	4220-3960	4090	"
55	W. Malha 332	habitation	SMU 675	charcoal	5789±70	4720-4540	4630	Rothenberg & Glass 1992
	W. Malha 332	"	SMU 809	"	5708±81	4680-4450	4565	"
	W. Malha 332	"	SMU 790	"	5523±69	4460-4250	4355	"
56	B. Themed 699	habitation	SMU 701	"	4355±66	3090-2890	2990	Rothenberg & Glass 1992
	B. Themed 699	"	SMU 677	"	4267±65	3020-2690	2855	"
	B. Themed 699	"	SMU700	"	4263±55	2930-2700	2815	"
57	'Ein Abu Rugum	"	RT447A		4180±300	3350-2300	2825	Sharpenseel *et al.* 1976
58	W. Watir VIII	*masseboth*	RT1845	sea-shell	5240±55	4220-3970	4095	Segal & Carmi 1996:102
59	Ein Um Ahmad	*nawamis*	RT1856	"	5815±50	4770-4600	4685	Segal & Carmi 1996:103
	Ein Um Ahmad	"	RT1857	"	5575±50	4455-4355	4405	"
	Ein Um Ahmad	"	RT1851	"	5130±50	3990-3800	3895	"
60	Ein Um Ahmad, M80	habitation	RT1859	"	5715±70	4680-4450	4565	"
61	Ein Um Ahmad, M81	"	RT1852	"	5400±70	4340-4050	4195	"
62	'Ein Um Ahmad, M52	"	RT1858	"	5190±50	4220-3950	4085	"
63	W. Zalaqa T12	*tumuli*	Pta 3645	charcoal	5690±50	4600-4450	4525	Avner *et al.* 1994:269
	W. Zalaqa T2	"	Pta 3633	"	5590±70	4500-4350	4425	"
	W. Zalaqa T2	"	RT648 E	"	5440±80	4360-4110	4235	"
64	W. Marrah	"kite"	RT1850	"	3750±45	2280-2040	2160	Segal & Carmi 1996:103
65	W. Daba'yia	*masseboth*	RT2186	sea-shell	6045±65	5040-4810	4925	"
	W. Daba'yia	habitation	RT1855	charcoal	5355±60	4320-4040	4180	"
66	J. Guna 100	habitation	SMU 659(?)	"	4065±50	2840-2490	2665	Bar Yosef *et al.* 1986
67	J. Guna 25	habitation	SMU 659(?)	"	4055±50	2840-2470	2655	"
68	S. al Khadim	habitation	RT1807	charcoal	5250±55	4220-3970	4095	Segal & Carmi 1996:104
69	J. 'Adeideh	turq. mine	RT1849	charcoal	6770±60	5720-5630	5675	Segal & Carmi 1996:103
70	Abu Khalil	*nawamis*	RT1353	ostrich-egg	5200±70	4220-3940	4080	"
71	Sinai 1130/3	habitation	RT1811	charcoal	5350±55	4320-4040	4180	Segal & Carmi 1996:104
	Sinai 1130/3		RT1809	"	5230±55	4220-3960	4090	
72	Sheikh 'Awad	"	RT1806	"	4325±55	3020-2880	2950	"
73	Sheikh Muhsein	"	HV 5296	"	4710±50	3630-3370	3500	Beit-Arieh 1977:199

some architectural changes and repairs. In Site 17, the lower stratum yielded two dates, c. 3000 and 2700 BC and the upper stratum yielded one date, c. 2400 BC. The excavator (Beit-Arieh 1989: 195) described first a gap of settlement between the two strata, corresponding to the 'missing' EB III. At the site itself, however,

no gap in the stratigraphy is discernible, and in the recent, final publication of the site (Beit-Arieh 2002) no gap is mentioned. In two cult sites in the 'Uvda Valley a general span of 4000 years was found. One is a massebah shrine ('Uvda 124/XVII) adjacent to Site 9 (Avner in press 6), and the other is the open sanctuary of 'Uvda 6. In the Eilat burial ground, ten ^{14}C dates cover a span of 1200 years, from c. 5400 to 4200 BC (Avner 1991). In eastern Sinai, several sites rendered three–five ^{14}C dates that spread over hundreds of years and even 2000 years (Table 5: 43, 48, 49, 54, 55). One site (Table 5: 50) yielded nine dates, the first three may represent an occupation period from c. 5150 to 4200 BC, the following four dates may represent another period from c. 2800 to 2200 BC, and the last two may indicate periods of settlement during the early and late second millennium BC.

It is true that ^{14}C series may represent a longer settlement span than that which occurred in reality (Buck *et al*. 1994; Gilead 1994: 3; Solow 1997). However, since in most of these sites the numbers of dates in the series are limited, it can be also claimed that they actually present only part of the true settlement sequence. A good example for this argument is the site of Nahal 'Issaron ('Uvda 14). Here, five charcoal samples were first analysed, a large number of dates for desert sites at that time, and they indicated two short periods of occupation: one c. 7000 BC for Stratum C, and the other c. 5400 BC for Stratum B (Goring-Morris and Gopher 1983: 160). However, when 30 more samples were later analysed from the site (Carmi *et al*. 1994), a range of 4500 years was received, from c. 8200 to 3700 BC, with only short gaps (Table 8). If the radiocarbon range is longer than the real life-time of a given site, the span of Nahal 'Issaron would be 'only' 3500–4000 years, still much longer than most scholars would expect to find in a desert site. I do not argue that the sites under discussion were occupied every night, or even every year throughout their lifetime. Certainly, gaps in settlement not visible in excavated sections are possible, sometimes even for several years if a long period of drought occurred. However, for the larger, historical and cultural picture, the unexpected longevity of desert sites is significant, and it must influence our notions regarding desert cultures and populations. One point still disturbs the scenario of the long duration of desert sites: the low rate of cultural sedimentation, usually not more than one metre. This question must be addressed in future excavations.

Since the ^{14}C dates from the desert sites did not match current theories, they were often questioned (orally) on the basis of three main arguments:

1. Wood is better preserved in a desert environment and an undeterminable period of time may have elapsed from the tree's death until it was burned.
2. Due to the better preservation, wood may have been repeatedly reused before burning.
3. Charcoal samples may originate from the core of tree trunks, which yield dates tens or even hundreds of years prior to the tree's death.[9]

In my judgment and experience, this is not necessarily the case, for the following reasons:

1. Combustible material is never common in the desert, therefore, any available wood is collected when found, and soon consumed.
2. The third argument may be valid, but at least in my own excavations I selected bush remains and twigs for ^{14}C dating.

The unavoidable preliminary conclusion is that ^{14}C dating of desert sites is presently more reliable and objective than typologically based dating, and the theories regarding the settlement pattern of the Negev and Sinai demand serious re-evaluation. One period which exemplifies the problem will be discussed below, the EB II.

The 'EB II florescence' of the desert

The study of the Early Bronze Age in the Negev and Sinai has undergone an interesting process of evolution. During the 1970s, EB II occupation was identified among the southern Sinai sites (Amiran *et al*. 1973; Beit-Arieh 1974, 1977, 1978, 1981a, 1983, 1989), previously defined as Chalcolithic by Rothenberg (1969, 1970). Shortly afterwards, EB II finds were identified among the Chalcolithic artefacts of Tel Esdar in the north-eastern Negev, and in MB I sites (Cohen 1978, 1981: IX, 1985: IX, 1986: 119, 215). The overall distribution of sites, however, was very limited at that time. When additional sites were found in 1978 near Kadesh Barnea, in the 'Uvda Valley and elsewhere in the Negev, they were marked as isolated spots on the map and interpreted as road stations connecting the town of Arad with its related settlements in southern Sinai (Cohen 1978; Beit-Arieh and Gophna 1981; Amiran *et al*. 1980: 14; Cohen 1985: IX, 1986: 277–78).

The unique intensity of EB II settlement was first revealed through the Negev Emergency Survey, beginning in 1979, when hundreds of sites were dated to this period and many were excavated (Table 3). A comprehensive settlement picture has been constructed, explaining the phenomenal florescence of desert settlement as initiated by Arad. This town was

[9] For further problems in ^{14}C dating of archaeological deposits see e.g. Bar-Yosef and Kra 1994: 5–7.

described as a Canaanite polity and administrative centre that colonised southern Sinai in order to monopolise the copper resources of the region, and thereby influenced the rest of the desert area (Amiran *et al*. 1973; Beit-Arieh 1974, 1981a,b, 1983, 1984a: 39–41). Accordingly, the abandonment of desert sites was assigned to the end of EB II, after some 300 or 400 years of prosperity, as a result of the fall of Arad (Beit-Arieh 1981b: 134, 1983: 48; Amiran 1986; Haiman 1986: 16; Amiran and Gophna 1989). Alternatively, the settlement demise was related to an Egyptian conquest of Sinai (Rothenberg and Ordentlich 1979; Cohen 1986: 244), although this is only evident in south-western Sinai, in the area of the turquoise mines. The discovery of an EB III settlement at Tel 'Ira, in the Beersheba Basin, was considered the 'southernmost in the country' (Beit-Arieh 1991), and it only emphasised the void in the Negev and Sinai after the fall of Arad.

However, a closer look shows that the Negev and Sinai were not deserted at all, either before or after the EB II. In the southern Negev, several sites were defined as EB I. A habitation site south of Yotvata excavated by Meshel and Sass was ascribed to this period by pottery and a sherd of an Egyptian alabaster jar (Meshel 1990: 17–19, 1993: 1517–18). In Ma'aleh Shaharut, east of the 'Uvda Valley, a tomb with masonry similar to that of the nawamis tombs was excavated in a rock shelter (Avner 1986). Inside, parts of a red-slipped, well burnished jug with an incision on its shoulder were found, which have close parallels to EB I jugs of the Bab adh-Dhra tombs on the south-east edge of the Dead Sea. Two EB I jars were discovered, one in 'Uvda Valley Site 10 and another, with a cup, in a rock shelter tomb in the Nimra Valley, south of Timna, dated to the very beginning of the EB I (Sebbane and Avner 1993). This tomb is most probably related to a nearby copper production site 300 m. away. Mine T in Timna should also be mentioned as probably belonging to this period (Conrad and Rothenberg 1980: 148–70). In a habitation site near Darb Ghaza, in Sinai, 15 km. north-west of Eilat, fragments of an Egyptian jar were found (Avner and Naor 1978), dated by R. Amiran to EB I. Twenty-one ^{14}C dates from ten different excavated sites in all regions discussed here (see Table 7) fall within the EB I time-frame. Two major sites near Aqaba, Tall Maqass, and Tall Hujayrat al-Ghuzlan, were established in the Late Chalcolithic and continued during the EB I (Khalil 1987, 1992, 1995; Khalil and Riederer 1998; Khalil and Eichmann 1999).[10] The former extends over 3000 sq. m. and the latter is two to three times larger. Their size, and the depth of cultural sediments (c. 5 m.), are quite surprising in light of the environment, indicating permanent villages. The wide range of artefacts represents subsistence on agriculture, grazing, copper industry and the manufacture of sea-shell ornaments.

In the surveys of the Wadi Hasa and the northern Wadi Arabah, 43 sites were identified as EB I on the basis of pottery, in addition to sites which were dated as Chalcolithic–EB I or EB I–III (MacDonald 1988: 155–61, 1992: 61–66). It is now clear that the large habitation site of Fidan 4 in the Faynan area, which contains copper industry remains, should be dated to the EB I, rather than to the Chalcolithic (Genz 1997; Adams 1998: 653, 1999: 108–12, etc.).

In southern Sinai, one of the only two ^{14}C dates from the 'EB II' sites excavated by Beit-Arieh actually falls within the transition from Chalcolithic to EB I (Table 1: 73), and the Chalcolithic site near Serabit al-Khadim (Beit-Arieh 1980) also contained a Dynasty I Egyptian vessel, i.e. EB I (Braun 1989, note 56). Dynasty I Egyptian vessels were found in the *nawamis* fields at Wadi Sawawin and Wadi H'bar (Arad-Ayalon unpublished),[11] and a fragment of an EB I jar was found in the habitation site of Jebel Guna 25 (Bar-Yosef *et al*. 1986: 149). All these indicate that an EB human occupation in Sinai was not unique to the EB II alone.

As for the EB III, it is true that the 'classic' ceramic indicators of the period are not found in the desert, but clues for the real EB III settlement scenario are found in two main sources:

1. During this period the number of ^{14}C dates per century from desert sites exceeded that of EB II and reached its highest level (Table 7).

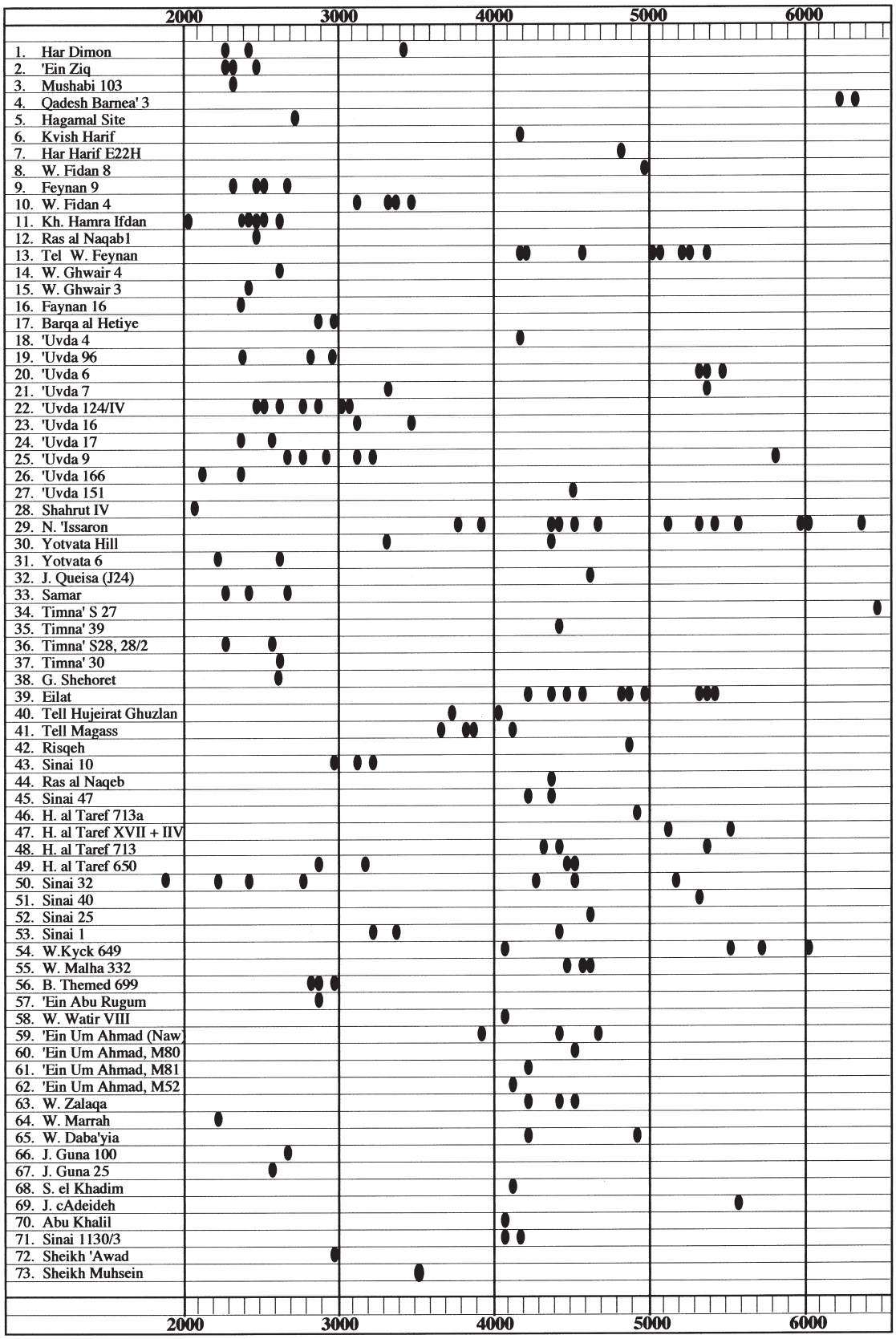
2. During EB III, copper production in the Faynan area also peaked (Levy *et al*. 2002; Adams 2000, 2002), and it must have influenced the rest of the surrounding desert. This is the period when the production of the copper bar ingots began in the Faynan area, at Khirbat Hamra Ifdan (*ibidem*), the same ingots which are well known from the 'EB IV' Negev sites (Kochavi 1968: 108–18; 1969; Dever and Tadmor 1976; Cohen 1999: 96–98, 118, 144–53, 205, 262–63, figs 58, 139b; Segal and Roman 1999; Saidel 2002: 57, pl. 14:10).

3. Adams (*ibid*. and Chapter 9, this volume) has shown, on the basis of pottery comparisons with Khirbat Hamra Ifdan, that the 'EB IV' sites of the Negev Highlands actually contain

[10] Only some of the rich metallurgical finds from these sites have been published, but they were presented by Khalil in a lecture in Amman (17 April 2000). The first radiometric dates published from both sites (Görsdorf 2002) range from mid- to late Chalcolithic, but the upper occupation phase is still attributed to EB I (see Table 5: 40, 41).

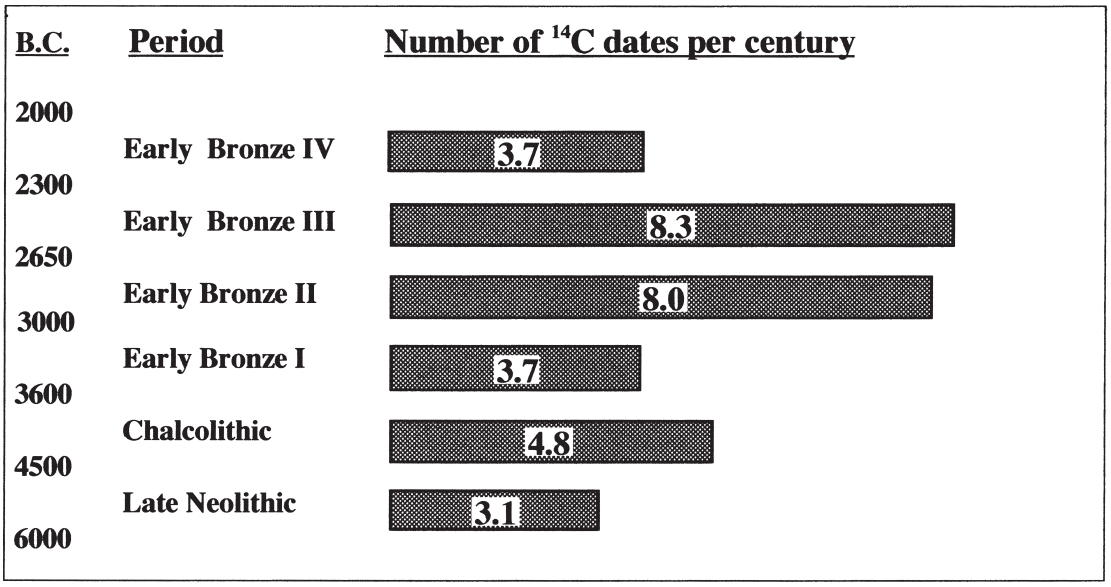
[11] I thank M. Sebbane for the references to publications of parallel Egyptian pottery. Since the *nawamis* finds were not published (by Goren or Arad-Ayalon), the matter is not discussed further herein.

Table 6: Histogram of calibrated ^{14}C dates, Late Neolithic to EB IV, from the Negev, Sinai and southern Jordan, from north to south.



* Each spot represents the mean value of one or more calibrated dates, based on OxCal 3.4 (Ramsey 2000). For the location of sites see Figure 4.1.

Table 7: Numbers of ^{14}C dates in the Negev, Sinai and southern Jordan per century in each period (an arbitrary division, based on Table 1).



EB III pottery, and should therefore be dated to both periods.

The impression is that this 'missing' period was actually the climax of settlement in the desert, and that the material culture of the EB II, including pottery, simply continued into the EB III (see below).

The unavoidable conclusion is that the cultural characteristics of the desert actually continued uninterrupted from previous periods throughout the EB, including the 'missing' EB I and EB III. Many desert sites should still be dated to the EB II (see e.g. Tables 6, 7); nevertheless, the glamour attributed to the EB II settlements of the desert is diminished by the fact that the desert was not deserted before or after. The finds and ^{14}C dates mentioned above are the results of only limited research achieved to date in both surveys and excavations. Therefore, they only hint at more intensive human presence and activity in the desert. If human societies did live in the desert during the EB I and EB III, when Arad did not exist as a town or a polity, it means that also in the EB II no external intervention was necessary to 'cause them to exist' or to 'become visible'. Moreover, Arad can be seen as a town which emerged from the desert culture, as suggested by Govrin (1990) and by Finkelstein (1991, 1995, ch. 7), and as proposed for the large EB I desert towns of Syria and eastern Jordan (Helms 1982; Hanbury-Tenison 1989).[12]

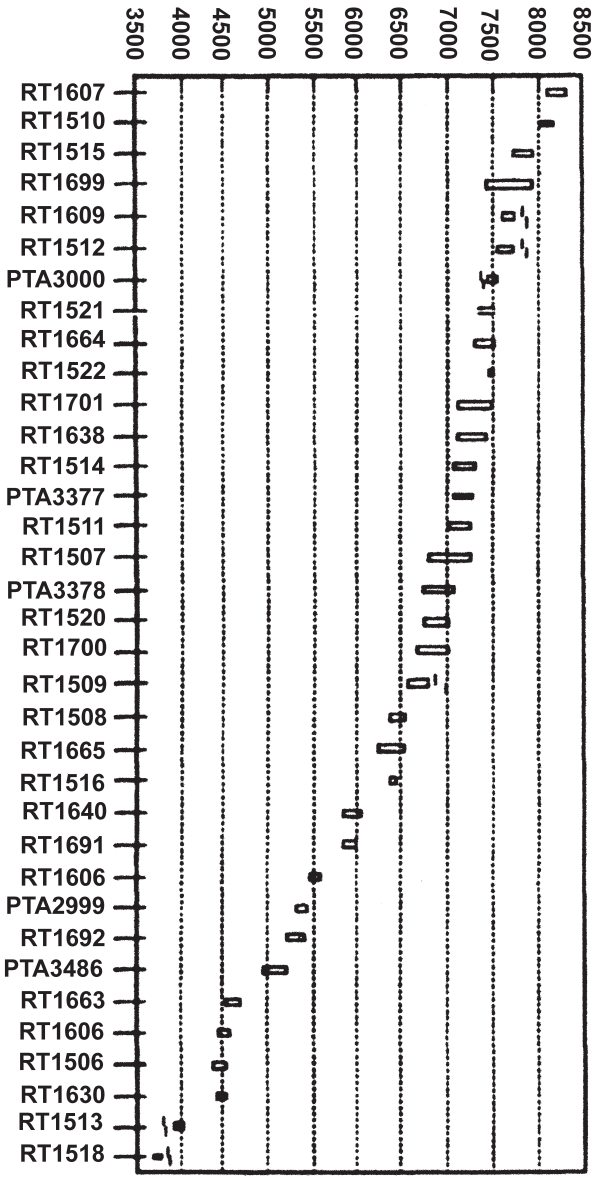
In my opinion, the common reconstruction of desert history, especially during the sixth to third millennia BC, is incorrect, and the question as to what misled scholars in their studies brings us back to the problem of dating.

While the dating of southern Sinai sites to EB II is considered well based on Aradian pottery, in the rest of the desert area this pottery is rarely found. The attribution of sites to the EB II was based mainly on two common finds, hole-mouth pottery sherds and tabular scrapers, even when some finds suggested other periods as well. For example, when flint adzes or basalt axes were collected, they were dated as EB II (e.g. Haiman 1986: 58, 115, 119, 178, 234, 235), despite the fact that they were never found in excavations in contexts other than Late Neolithic and Chalcolithic (Rosen 1997: 98; Barkai 2000, *passim*). Today, however, enough evidence exists to show that the two principal artefacts used for dating these sites had a much longer time range than previously believed, and therefore dating them exclusively to the EB II period is unjustified.

Hole-mouth cooking pots appear in 'Uvda Valley sites with early ^{14}C dates such as 4200 BC at Site 4 (Table 5:

[12] In a recent article, Beit-Arieh (2002) responded to Finkelstein's view on the origin of Arad, by emphasising the Canaanite cultural elements of the town. However, these could have been easily adopted during a quick settlement process. Although I generally accept Finkelstein's description, one point should be revised: the development of the 'Aradian house' from the nomads' rectangular tent (Finkelstein 1995: 82). Almost 100% of the thousands of tent remains in the desert are circular, 3–5 m. in diameter (see e.g. Avner 1998: 152–54). This is true of the earliest identified tent remains (fifth–fourth millennia BC), the Nabataean and even the Mamlukian tents. Therefore, there is no evidence for rectangular tents to serve as an archetype for the 'Aradian house'. The term 'Aradian' for this house may be misleading since all characteristics (the broad plan, sunken floor, benches and pillar bases) had already appeared during the Chalcolithic in the Near East (e.g. Porat 1987; Epstein 1998), and they only reached their final stage of evolution in the EB urban cultures.

Table 8: Histogram of radiometric dates from the site of Nahal 'Issaron, strata C and B (Carmi *et al*. 1994: 395).



18) and even 5370 BC at Site 7 (Table 5: 21). In the excavation of *massebah* shrine 124/XVII, next to Site 9, hole-mouth sherds were recovered in large numbers from all depths of the section (70 cm. deep), beginning only 4 cm. above a hearth dated by ^{14}C to c. 5800 BC (Avner in press 6, and here Table 5: 25, first date). In another *massebah* shrine, 'Uvda 124/IV, many hole-mouth sherds were found with LN Wadi Raba sherds (Avner *ibid*.). In southern Jordan they were found in Site J 24 with ^{14}C dates of 4620 BC (App. I: 32). According to the above data, it is possible that the arkose-ware hole-mouth cooking pots already appeared in the desert during the sixth millennium.[13]

The later occurrence of the hole-mouth jars is no less interesting. The same 'EB II' rim shapes are found in an EB III context (Beit-Arieh 1991, figs 6–8) and they extended into the EB IV, sometimes with variations in the rim shapes (e.g. Cohen and Dever 1981: fig. 11). However, their petrographic composition and manufacturing technique continued, alongside the use of carbonate temper that already appears earlier (Porat 1989: 180). In 'Uvda Site 166 the same 'EB II' shaped rims of hole-mouth cooking pots have been found with ^{14}C dates c. 2330 and 2050 BC (Table 5: 28), without any

[13] In 1977 B. Kozloff showed me the flint and pottery from his excavations in eastern Sinai, which included quantities of hole-mouth sherds. The excavations were never published, but the ^{14}C results were published by Rothenberg and Glass (1992), and they are included in Table 1. Some of the sites are dated to the sixth and fifth millennia BC, but currently it is difficult to know whether the earlier deposits contained pottery or not. The chronological discussion of Rothenberg and Glass (1992) is not informative as to the emergence of the desert pottery.

sign of later penetration or contamination of the site.[14] The conclusion is that the so-called EB II hole-mouth cooking pot, as the dominant or only pottery type in desert sites, was actually in use for some 3000 years. Rarely are other types of pottery found next to hole-mouth sherds, but they demonstrate their longevity: LN Wadi Raba sherds, Chalcolithic 'Beersheba' sherds, EB 'Aradian', or EB IV 'Southern family' pottery.

The duration of tabular scrapers was even longer. They appeared as early as the beginning of LN[15] and all types known in the EB are already present at least in the Chalcolithic (McConaughy 1979: 216; Rosen 1983, 1986, 1997: 71–80). Tabular scrapers are found in excavated sites in conjunction with ^{14}C dates of the sixth and fifth millennium BC, for example, the burial site in Eilat where more than 40 well shaped examples were dated between 5400–4200 BC (Table 5: 39). In the Risqeh site, east of Aqaba, they are dated to c. 4900 BC (Table 5: 42) and in the southern Jordanian Site J 24 to c. 4620 BC (Table 5: 32). In Tall Sabi Abyad, northern Syria (where they are termed 'tile knives'), they first appeared in Level 6, 5900–5200 Cal. BC (Copeland 1996: 315, figs 4.9, 4.16, 4.18; Verhoeven 1999: 158). As to the late occurrence of these tools, Kozloff (1974: 40) and Rothenberg (1974: 19) saw them as typical for the MB I sites (=EB IV) of central Sinai, but basing their dating on survey alone is problematic. In 'Uvda 17, however, excavated by Beit-Arieh, four out of nine tabular scrapers were found in EB IV loci, three in EB II loci, and two on the surface (Rosen 2001: 111). Also in 'Uvda 166, tabular scrapers were found with 'typical EB II' assemblages such as crescent-shaped blades and hole-mouth sherds, but with clear EB IV ^{14}C dates (see above). These examples indicate that the typical finds in desert sites can only generally date them to the sixth–third millennia BC. For more specific dating, other methods are essential.

Summary

The above discussion actually shows, in my opinion, how the difficulties in dating the sites lead to a false reconstruction of desert history, and to a misunderstanding of the desert as a habitat. The impression is that we do not really know yet how to read the desert remains. Nevertheless, some preliminary conclusions may be offered:

1. The desert is quite rich in archaeological remains, but despite the thousands of sites added to the region's inventory during the last 25 years, large areas are still unexplored, and many more sites are to be discovered. The multitude of remains that are presently known could not have possibly been left behind by 'nomads who did not leave remains' or by intruders. Neither do they owe their existence to the intervention of any foreign power, since no such power can be conceived of in the neighbouring regions during most of the sixth–third millennia BC time span. Instead, these sites represent the autochthonic desert population and their indigenous culture.

2. In contrast to expectations based on the environmental conditions in the area, and commonly accepted ideas, there were no gaps in settlement in the desert from the Early Neolithic through the EB IV (and beyond). To date, this uninterrupted sequence is derived mainly from sites in the southern Arabah, the Eilat region and eastern Sinai. However, it seems that the principal difference between this region on the one hand, and the surrounding desert on the other, does not lie in the settlement pattern. Rather, it lies in the different attitude towards the sites' dating, and to numbers of 14C dates retrieved from the sites. With ongoing research, I believe that more of the settlement 'gaps' in these parts of the desert will be also eliminated.

3. The duration of habitation, industrial, cult and burial sites in the desert, as demonstrated by ^{14}C dates, is often far longer than expected, by hundreds and even thousands of years. Even if these sites were not inhabited each and every year, the results are still highly significant for studying desert cultures, for a better evaluation of the remains, and for reconstruction of the desert's past.

4. Since the desert was less affected by military and political events than the sown lands, at least during the periods discussed, cultural changes took place in a different mode and rhythm than in the fertile zone. It is thus difficult to apply to the desert the chronological framework commonly used in the archaeology of the Near East. Attempts to construct a separate chronology for the desert (see above) are as yet unsatisfactory. At the present state of research it would be more appropriate to use unspecified terms such as 'fourth millennium' or even 'sixth–third

[14] The earlier date, c. 2330 BC, was retrieved from a hearth overlain by the room's southern wall, while the later date was taken from another hearth, 30 cm. higher, Therefore the site is safely dated as EB IV. (The excavation of the site is yet unpublished.)

[15] Yeivin and Olami 1979: fig. 14; Noy 1977: figs 7: 12, 8: 7,8; Garrard *et al*. 1985: fig. 13a, 1987: fig. 12c; Betts 1988: fig. 15: 2; McCartney 1992: figs 14, 15; Rosen 1997: 75.

millennia BC', hoping to define cultural processes, innovations and regional sub-cultures with better precision in the future.

5. A great similarity is found in habitation, cult and burial sites over a long period of time and large desert areas, including the Sahara and the Arabian peninsula (Avner 2002b, chs 4, 5, with references). This speaks for a broad desert cultural *koine*, with local variations. At the same time, commercial and cultural exchange always existed between the desert and the sown.

6. When the nature and role of specific types of sites is studied (agricultural settlements, copper production sites, cult and burial sites, etc.), and then comprehended in an integrated way, the cultural picture of the desert appears different than expected. The desert population emerges as active and creative in both material and spiritual aspects. In the latter, they even had a significant influence on the peoples of the sown lands (see especially Avner 2001, as well as previous publications).

The desert sites still have much to tell us, but today they are rapidly disappearing due to development projects, military training and lack of care. It is not clear how many will survive into the near future for visit and study.

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