

Chapter 12

CHANGING THE FACE OF THE EARTH: HUMAN BEHAVIOR AT SEDE ILAN, AN EXTENSIVE LOWER-MIDDLE PALEOLITHIC QUARRY SITE IN ISRAEL

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ABSTRACT

The Middle Pleistocene flint extraction and reduction complex of Sede Ilan is presented as a model for human behavior related to both raw material economy and landscape perception. The organized, large scale quarrying and flintknapping is dated to the Lower Paleolithic (represented by handaxe manufacture) and the Middle Paleolithic (dominated by the use of the Levallois technique). No evidence of Later Paleolithic or Neolithic-Chalclithic extraction and reduction was found at the Sede Ilan complex. The chapter discusses the following issues: (i) the familiarity of Middle Pleistocene Hominins with the landscape and natural resources; (ii) long-term use of specific flint outcrops and recurrent, large-scale use of designated industrial areas; (iii) the significant alteration of the pristine landscape; (iv) quarry landscape maintenance; (v) the possibility of traditional ecological knowledge, land-use legacies, and resource management and conservation practiced at the Sede Ilan quarrying complex. Our major conclusion is that the extensive Sede Ilan quarrying landscape reflects the talent of prehistoric man to procure large quantities of flint using a rare combination of knowledge, sophistication, and care.

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INTRODUCTION

Prehistoric man was constantly looking for stone. As soon as ancient hominins started to use stone tools on a regular basis, some 2.6 million years ago and most probably even earlier than that, the search for stone became second nature. Recently it has been argued that the earliest African tool makers were highly familiar with the different outcrops available along the rift valley and made selective use of specific raw materials (e.g., Stout *et al.* 2005). This is actually the earliest example of a conceptual change in human–nature relationship, when people started looking at nature as a resource, as a supplier of their technological needs and demands. This is most probably the moment in human history when the conceptions of “raw material” and “resources”, so familiar to our modern ears and minds, took shape. All prehistoric groups living in the old world from the Oldowan cultural complex onwards made extensive use of large quantities of stone and must have made a significant impact on the natural environment (e.g., Stiles *et al.* 1974; Biagi and Cremaschi 1998; Stiles 1998; Petraglia *et al.* 1999; Paddayya *et al.* 2000; Barkai *et al.* 2002; Vermeersch 2002; Barkai *et al.* 2006; Paddayya *et al.* 2006; Sampson 2006; Biagi 2007). The systematic production of designed, well planed, stone tools required complex behavior concerned with the location and exploitation of carefully selected stone sources. It must be stressed that alongside the procurement from selected sources, people during all times used random surface raw material as well. In other words, it appears that since the dawn of human technology two separate stone procurement strategies were applied: a simple strategy that exploited stone available on the surface of the earth (slopes or wadi beds) and a complex strategy using selected stone sources from primary geological contexts. Evidence for stone quarrying during the Early Pleistocene is still not widespread (e.g., Petraglia *et al.* 1999; Paddayya *et al.* 2000, 2006), while Middle Pleistocene quarry sites are already part of the archaeological landscape at many places (e.g., Barkai *et al.* 2002, 2006, Sampson 2006). A new study of the cosmogenic isotope ^{10}Be in flint artifacts from Middle Pleistocene caves in Israel has confirmed the use of quarried stone as early as 400 kyr (Verri *et al.* 2004, 2005) and recent field work has uncovered several Middle Pleistocene extensive quarry complexes in Northern Israel (Barkai *et al.* 2002, 2006).

It seems to us that the fact that Middle Pleistocene stone-tool makers were indeed using stone from primary geological contexts is well established now, and the discussion should be focused on better understanding complex human behavior supporting such impressive operations and human capabilities reflected in these earliest industrial areas in the history of humanity.

Recent discoveries in Northern Israel revealed extensive Lower–Middle Paleolithic flint quarry complexes where immense quantities of raw material were extracted and reduced. These huge Paleolithic “industrial areas” are a testimony to large scale works of Paleolithic man and his impact on the pristine environment. Sede Ilan is one of these complexes.

We would like to use the Sede Ilan data in order to discuss the following issues:

- The familiarity of Middle Pleistocene hominins with the landscape and natural resources.
- Long-term use of specific flint outcrops and recurrent, large-scale use of designated industrial areas
- The significant alteration of the pristine landscape
- Quarry landscape maintenance
- The possibility of traditional ecological knowledge, land-use legacies, and resource management and conservation practiced at the Sede Ilan quarrying complex.

The extensive Middle Pleistocene flint extraction complex of Sede Ilan is used as a model for the extent of energy investment, knowledge, and what we see as some sort of ecological wisdom revealed in the establishment, long-term exploitation, and maintenance of this industrial area.

We will show that the specific location of the Sede Ilan extraction complex was carefully selected, based on an intimate acquaintance with the natural environment and an understanding of the long-term potential of this locality in supplying rock for the never-ending demands of Acheulian and Mousterian flint knappers. Another reason for the selection of this specific locality might stem from its physiographic setting and proximity to the most prominent topographic landscape marker in the region – Mt. Tabor. We will try to follow the logic behind the organization of quarrying operations and maintenance activities, possibly aimed at the preservation of the stone resources for long-term use. The numerous extraction and reduction localities will help us demonstrate the recurrent use of this specific industrial area throughout the generations, possibly reflecting a linkage between distinct human groups and this quarrying complex kept throughout time. The

scale of extraction and reduction activities at Sede Ilan will be used to demonstrate the extensive alteration of the natural landscape by Middle Pleistocene hominins, the creation of culturally induced mega-scars in the pristine environment, and the creation of a quarried landscape.

Selected archeological and anthropological studies will be used to bridge the gap between the mute data from Sede Ilan and our ambition to understand how people were actually operating at the site and the more general human behavior related to such Paleolithic industrial areas. We are fully aware of the possible methodological flaws embedded in the use of modern ethnographic records for reconstructing Paleolithic life-ways (e.g., Binford 2001) and therefore only examples directly related to cultural attitudes and conceptions towards natural resources will be used.

The search for stone played an important role in the daily activities of Middle Pleistocene hominins in the Levant, and the long-lasting bond between the prehistoric groups of the Lower Galilee and the Sede Ilan industrial area must have had special significance in functional, social, ecological, and symbolic terms. Our study of the Sede Ilan Middle Pleistocene industrial complex aims at unfolding the complex relationships between man and stone and its bearing on human technological, social, and cognitive abilities.

THE SEDE ILAN LOWER-MIDDLE PALEOLITHIC INDUSTRIAL AREA

The Sede Ilan extraction and reduction complex is located in the Lower Galilee, Israel, some 10 km northwest of the Sea of Galilee (Barkai *et al.* 2006). This complex is comprised of hundreds of tailings piles and is similar in scale, density, and cultural characteristics to the Mt. Pua complex (Barkai *et al.* 2002). Modern activities have damaged this expansive Paleolithic industrial area. However, large parts are still available for archeological and geological investigations.

An air photograph taken before modern construction reveals the huge extent of the Sede Ilan complex (Figure 12.1). It lies on the slopes of two plunging folds, and the quarry activity is mainly focused on one flint-bearing horizon. Noteworthy is the close proximity of the most prominent topographic feature at the Lower Galilee, Mt. Tabor, to the Sede Ilan complex (Figure 12.2). Although Eocene flint is ubiquitous throughout the landscape, flint diagenesis



Figure 12.1 Air photo of the extraction landscape at Sede Ilan (white spots are tailing piles).

reaches its acme in development at Sede Ilan. Owing to geological structure and stratigraphic relationships in the area, prehistoric quarry activities are tightly focused along the limbs and hinges of these two folds. The flint-bearing horizon has been mined to the limits of Paleolithic technology, particularly where closely spaced joints have been accentuated by karstic activity.

Where the quarry fronts are developed along the limbs and hinges of the two folds, the style of mining varies depending upon elevation and bedrock structure. Mining activity focused along the hinge of the fold may be oriented towards gathering flint between joint surfaces where karstic activity has loosened them from the bedrock matrix. However, flint occurring along the limbs of the folds is mined through the purposeful development of highly organized quarry fronts. The zones of extraction appear to have been maintained, with mine tailings intentionally back-filled towards the opposing edges of each quarry front and on top of exhausted extraction fronts. This was performed in order to stabilize the back walls of the remaining declivity, clear the waste material from the actual extraction front, and keep the unexploited areas available for future use.

Complementing this sophisticated quarry development is a chain of operation (*chaîne opératoire*) of mining tools that are designed, manufactured, and implemented from basalt and limestone materials, attesting to the ingenuity of Lower–Middle Paleolithic



Figure 12.2 The quarried landscape of Sede Ilan with Mt. Tabor in the background.

mining endeavors. Specifically, basalt was gathered from the high plateau above the site and brought into the quarry fronts where at least five diagnostic tool types were manufactured. The basalt mining toolkit is complemented by an assemblage of curated wedges fashioned from siliceous limestone (some of which were recovered from open joints).

Field work at Sede Ilan was conducted by the authors in January 2005 and July 2006, and included preliminary geological mapping and a test excavation at one of the large tailings piles at the eastern edge of the complex (Figure 12.3). The excavation was carried out in the elongated pile No. 3 (henceforth SE3) in $2 \times 2 \text{ m}^2$. The pile consisted of broken limestone blocks mixed with lithic artifacts and raw material blocks, as well as a prominent component of basalt items (Figure 12.4). SE3 is 15 m long and 8.6 m wide at its center. The test excavation is located at the southern edge of this pile, at a place where the deposits are relatively thin. At the northern edge of SE3 the tailings pile reaches an elevation of 130 cm above ground surface and slopes towards the south to only 30 cm above surface level. The excavated material, which is 50 cm thick, rested on accentuated and levered limestone blocks. Flaked lithic artifacts are abundant throughout the depth of excavated smashed limestone blocks. It appears that the



Figure 12.3 The test excavation at tailing pile No. 3 at Sede Ilan.

waste material was piled on top of either an exhausted extraction front or a specific area with low extraction potential. The pile is clearly aligned with other similar piles, located along a selected flint horizon at the eastern edge of the Sede Ilan complex (Figure 12.5). The waste piles along this line are similar in scale and are placed 20–30 m from each other. It seems to us that the extraction activity took place along a flint horizon

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spread to a length of dozens of meters at the slope of the Sede Ilan small spur. Several extraction localities were placed at similar distances along this line and the waste material resulting from extraction was intentionally piled at specific places, most probably in order to concentrate the waste and clear potential areas for future extraction (note a similar strategy at the Mt. Pua and site 164 complexes, Barkai *et al.* 2002, 2006).



Figure 12.4 A close look at knapped lithic artifacts, broken limestone blocks, and basalt items from tailing pile No. 3 at Sede Ilan.

The lithic industry found within the numerous workshops is rich in primary reduction products and blanks, highlighted by the predominance of Levallois cores and debitage, and large flake production with a minor component of bifacial tool preforms.

The Sede Ilan SE3 lithic assemblage (see Barkai *et al.* 2006 for a detailed report with figures): Noteworthy components observed on the surface, prior to the test excavation, were Levallois cores and handaxes. The SE3 assemblage from the first excavation area (2×2 m) excavated in 2005 ($n = 480$) is rich in cores ($n = 99$) and shaped items ($n = 73$), and we suggest this area was used for relatively advanced stages of blank reduction and tool shaping. Shaped items include *ad hoc* tools only, with no early-stage bifaces, handaxes, or other shaped items apart from retouched blanks. Some of the retouched flakes were shaped on Levallois blanks. Only few tested nodules were found at SE3, in contrast to the high frequency of Levallois cores, reinforcing the impression that the advanced flaking stage was the focus at SE3. The general character of the large tailing piles at Mt. Pua (Barkai *et al.* 2002, 2006) and Sede Ilan are similar and this observation is interpreted as reflecting continuous flint reduction processes, including advanced flaking stages.



Figure 12.5 Tailing pile No. 3 at Sede Ilan (SE3) within the quarrying landscape and surrounding piles.

In addition to the flaked flint assemblage, flint blocks ($n = 69$) with no evidence of flaking were also recovered from the SE3 excavation unit. Flint nodules still embedded within the limestone karrens ($n = 16$) were found as well. A rich basalt assemblage was also recovered, including long and narrow items ($n = 6$); large and round basalt cobbles ($n = 7$); flat, tapering rectangular wedge-like items, some with thinned edges ($n = 28$); and basalt fragments ($n = 65$). Limestone flaked artifacts were also recovered during excavation, including thin and small limestone flakes ($n = 42$), thick and large limestone flakes ($n = 29$), and limestone cores ($n = 7$). While a few of the limestone flakes may have been the result of smashing the limestone blocks in order to extract the flint nodules, the bulk of the limestone cores, and the thin and small limestone flakes, may be indicative of a limestone production trajectory at the site. It is proposed that the limestone flakes were hammered into tightly sealed joints, thereby permitting diurnal temperature changes and seasonal weather patterns to further accentuate the joint surfaces. The limestone cores index the end of a production trajectory focused towards the protracted exploitation of the land through the use of a plug-and-feather method.

Although field investigations at Sede Ilan are only preliminary and based on initial geological mapping and a small scale test excavation, the Lower–Middle Paleolithic quarrying and workshop complex is interpreted as both expansive and sophisticated. Hominin utilization of these specific Eocene flint outcrops seems to be recurrent and a quarry toolkit of local basalt and limestone was employed. Quarry debris were piled in waste piles, and flint reduction, focusing on the Levallois technique and the production of large flakes, took place on top of these tailings piles.

Acheulian and Mousterian lithic traditions in the Levant are characterized by intensive use of flint resources for the production of handaxes during the Acheulian, and Levallois products in the Mousterian, both of which necessitate the use of high quality homogeneous flint that can be usually found in primary geological sources.

The presence of Levallois cores and debitage, as well as early-stage handaxes, suggests that the quarrying activity is related to the late phase of the Acheulian complex of the Lower Paleolithic period (e.g., Goren 1979; Goren-Inbar 1985). Large flake production is a well known Acheulian cultural marker and it is clear that the use of these quarry complexes began during

Lower Paleolithic times. The use of the Levallois technique in the Levant began during the Middle or Late Lower Paleolithic (e.g., Goren-Inbar 1985) and a possible connection between handaxe reduction and the Levallois technology was suggested (De-Bono and Goren-Inbar 2003). Thus, the co-occurrence of handaxes and Levallois technology is attributed to the Late Lower Paleolithic period. It is possible, however, that the use of these flint sources continued during the Middle Paleolithic by Mousterian flint knappers, as indicated by the relative dominance of Levallois technology. No post Middle Paleolithic artefacts were found on the tailing piles and quarrying localities. The rocky landscape seems to have remained very much unchanged since the Middle Pliocene apart from some possible karstic activity. The Sede Ilan complex is surrounded by agricultural activity and worked field, but the rocky hill where the Paleolithic extraction and reduction took place was never exploited in modern times. It seems to us that this complex has been surprisingly left untouched since Middle Pliocene times.

HUMAN BEHAVIOR AT THE SEDE ILAN INDUSTRIAL AREA

The vast use of flint during the Lower and Middle Paleolithic periods in the Levant has been self evident since the early days of prehistoric research, but no real progress has been made in studying Paleolithic flint procurement strategies until the last decade. The location of several Middle Pleistocene industrial areas and the study of cosmogenic isotopes in flints from the Tabun and Qesem caves indicated the existence of systematic, large scale, and long lasting human endeavors towards obtaining the stone they needed (e.g., Barkai *et al.* 2002; Verri *et al.* 2004, 2005; Barkai *et al.* 2006).

Flint extraction complexes are a special type of archeological site, very different from habitation sites or other task specific sites like hunting or butchering localities. These early industrial areas demonstrate a narrow range of activities concentrated around locating, extracting, and reducing favorable stone sources. Notwithstanding this, the special nature of such sites holds the potential of touching issues hitherto unexplored by the main stream of Paleolithic research, thus promoting our understanding of mundane activities as well as the world views of Middle Pleistocene hominins. In the following section we would like to use the Sede Ilan site as a case study for such insights.

THE FAMILIARITY OF MIDDLE PLEISTOCENE HOMININS WITH THE LANDSCAPE AND NATURAL RESOURCES

The Sede Ilan quarrying complex is located within a specific Eocene formation in the Lower Galilee. This is actually an island of an Eocene limestone formation especially rich in flint nodules in a big “sea” of other geological formations devoid of the desired flint. The quarrying complex perfectly matches the outlines of this Eocene formation and our survey indicated evidence for Paleolithic extraction activities covering the whole extent of this specific geological formation. Other exposures of similar Eocene formations are known in the Lower Galilee, some at a very close distance from Sede Ilan. We have visited several such localities a few kilometers only from Sede Ilan and observed potential flint sources at each and every locality. At least two of these Eocene formations bear witness to small scale prehistoric flint extraction and reduction activities, but the sporadic nature of these activities did not allow for an assignment to any familiar Levantine prehistoric cultural entity. It is, however, clear that other potential flint sources exist in the vicinity of the Sede Ilan complex and we cannot rule out the possibility that some of these were exploited in Paleolithic or Neolithic–Chalcolithic times. None of these, however, is similar in scale or intensity to Sede Ilan. The Sede Ilan Eocene formation is not only rich in flint sources, but is also located adjacent to a small basalt outcrop at its northern edge. Other basaltic outcrops are rather abundant in the Lower Galilee, but at Sede Ilan a combination of two desired raw materials – flint and basalt – was extensively exploited by Middle Pleistocene hominins. One of the special characteristics of the Sede Ilan complex is the ubiquitous use of extraction tools made of basalt, and therefore the location of this quarrying complex perfectly uses these two geological formations. The familiarity of contemporary hunting and gathering societies with their surroundings is very well documented in the anthropological literature and this intimate environmental knowledge is gained by constant movements within the landscape and shared “environmental gossip” between group members (e.g., Bird-David 1992; Lye 2002). Middle Pleistocene hunter-gatherers roamed around the Levantine landscape for hundreds of thousands of years and most probably had excellent environmental

knowledge and a perfect acquaintance with the natural resources. Their decision to place the major flint industrial area at Sede Ilan resulted from such environmental knowledge and the extent of quarrying operation at the site stands as a testimony to the wise decision they made. It is of note that in spite of continued later presence of people in the lower Galilee, evidence of post Lower–Middle Paleolithic exploitation was not recognized at Sede Ilan. This is rather strange, due to the fact that flint-using groups were still roaming that landscape at least during the Neolithic period and potential high quality raw material is still found in abundance at Sede Ilan. We have no explanation for this state of affairs since it is clear to us that Neolithic man also had highly intimate familiarity with the landscape, and the possibility of not recognizing the potential of Sede Ilan as a raw material source is simply out of the question. We find it hard to believe that the site escaped the experienced eye of Neolithic flint miners and the question of why Paleolithic Sede Ilan was left untouched during later periods must remain open for the time being.

LONG TERM USE OF SPECIFIC FLINT OUTCROPS AND RECURRENT, LARGE-SCALE USE OF DESIGNATED INDUSTRIAL AREAS

The Sede Ilan quarrying complex is comprised of hundreds of extraction and reduction localities (Figure 12.1), representing episodes of focused exploitation of selected flint horizons. Some of these quarrying localities, such as the Sede Ilan pile No.3 (SE3), are very large (over 120 m² surface area and *ca.* 1.3 m in depth) while other localities are smaller. Evidence for flint extraction and reduction were documented from both large and small tailing piles but an in depth comparative study of the whole complex had not yet been conducted. It should be mentioned that during our survey a few tailing piles with no clear evidence of quarrying activity were observed and this phenomenon awaits further investigations as well. Going back to the hundreds of quarrying localities, one remains astonished at the immensity of human activity and the duration of exploitation of this specific industrial area. It is, of course, impossible to use the number of extraction localities and their volume in a simple equation and come out with the scale and duration of human activity at the site. We have no idea regarding

the time it takes to locate a desired flint outcrop, prepare suitable extraction tools, extract flint, reduce the selected nodules, and create a tailing pile such as SE3. We do not know how many individuals were operating at each extraction and reduction locality, and at the moment we have no clue regarding the question of whether each locality was exploited independently or perhaps several localities were used simultaneously. Following our understanding of Middle Pleistocene societies (e.g., Gamble 1999; Gamble and Poor 2005) we find it hard to believe that regiments of hominins took over Sede Ilan and exploited the quarry landscape like locusts. Taking into account the available ethnographic studies of stone quarrying conducted among simple societies in Australia, Papua New Guinea, and Polynesia (e.g., Binford and O'Connell 1984; Burton 1984; Jones 1984; Jones and White 1988; Pétrequin and Pétrequin 1993a,b Hampton 1999) it becomes clear that all these groups were repeatedly exploiting specific stone sources for generations; the mode of exploitation was rather slow according to the group's needs; quarrying expeditions were small; and the stay at the quarry site was always rather short. In addition, it appears that in all cases stone quarries were conceived as highly important, dangerous, and sacred places; in many cases ceremonies are conducted before and after quarrying; and the quarrying activity itself is performed solely by males. Although it seems that all modern ethnographic examples of stone quarrying share similar, cross-cultural, characteristics, it is hard to apply these shared practices and conceptions to Middle Pleistocene Sede Ilan. However, we believe that the ethnographic evidence reinforces our contention regarding the scale and duration of human activity at Sede Ilan. We argue that Middle Pleistocene hominins recognized the never-ending potential of the Sede Ilan area in supplying raw material for their lithic industries and kept coming back to the area for generations and generations. Sede Ilan most probably served as a major raw material source for Lower-Middle Paleolithic communities occupying the Lower Galilee and was visited by small quarry expeditions on a regular basis for thousands of years. This is not of much help in understanding the intra-site variability in the size of extraction localities; and it would be simplistic to suggest that a large tailing pile represents a relatively long quarry operation by a relatively large quarrying expedition, while the small piles represent short visits by smaller groups. However, understanding the pace and duration of human activity at the site

might help reconstruct this long and complex human endeavor. Why was Sede Ilan, of all other raw material sources, the focus of quarrying activity for so long? Why was this specific source visited and exploited throughout the generations, becoming a large scale industrial area and a quarried landscape? We believe that the simple and straightforward answer, the presence of rich flint sources and adjacent basalt outcrops, is by all means valid, but not satisfactory. The answer might lie in the topographic and geographic setting of Sede Ilan, serving not only as a raw material source but as a landmark, a landscape beacon embedded in the collective memory and tradition of Lower-Middle Paleolithic societies of the area. Sede Ilan is located in very close proximity to Mt. Tabor, the most prominent topographic landscape marker in the region. It is well known that modern hunter-gatherers orient themselves in the landscape using prominent features such as rivers, significant rock features, and mountain peaks (e.g., Lye 2002) and special landscape features might have had special significance to prehistoric communities (e.g., Bradley 2000). We therefore would like to suggest that these two extraordinary features, Mt. Tabor as a natural peak and Sede Ilan as man-made "monumental landscape" were significant landmarks in the "maps" of Middle Pleistocene hominins and were most probably used to orient individuals and groups towards traditional routes. The significance of the Sede Ilan industrial area developed with time, as one group after the other passed near Mt. Tabor and extracted flint at the same place over and over again, until the place became embedded within the collective memory not only as an supply point on the way but as a place of special significance, connecting past, present, and future activities.

THE SIGNIFICANT ALTERATION OF THE PRISTINE LANDSCAPE

The impact of Paleolithic man on the natural environment is usually considered negligible, mostly due to the rather limited technological means employed by early hominins and modern hunter-gatherers and low population densities (e.g., Simmons 1989; Goudie 1990; Redman 1999). Other have claimed, based on ethnographic studies, that hunting and gathering societies had a non-materialistic view towards nature, viewed nature as a "giving environment", or had a set of norms and conceptions that controlled

the alteration of the pristine landscape (e.g., Reichel-Dolmatoff 1976; Bird-David 1990; Lye 2002, 2005). It is agreed upon by most scholars that the impact of man on the environment became significantly more pronounced during Neolithic times with the advent of agriculture, village-life, and a demographic expansion (e.g., Simmons 1989; Redman 1999). Others have emphasized the impact of Neolithic stone mining activities on the landscape, claiming this was not only the most practical and efficient method of obtaining large quantities of stone, but also that the large extent of Neolithic mining operation destroyed natural landscapes, thus demonstrating human control over nature (Field 1997). Our discoveries at Sede Ilan and other similar Middle Pleistocene industrial areas (Barkai *et al.* 2006) represent, for the first time, large scale landscape alteration by Paleolithic hominins. Although we are dealing with relatively simple technologies and low population densities, it is clear that flint extraction by Lower-Middle Paleolithic communities, over long periods at the same location, resulted in a massive alteration of the pristine landscape and the creation of “Mega scars” in the environment. Most of the activities of Middle Pleistocene hominins are documented at cave and open-air sites where no evidence of massive landscape alteration is evident. Quarry sites reveal a different aspect of human–nature relationship in the Paleolithic. The extensive use of flint in the Levant required the procurement of large quantities of raw material, and this transformed the landscape. Lower–Middle Paleolithic communities left a pronounced mark in the landscape and, surprisingly, some of these quarry sites escaped modern disturbances and survived to this very day. Middle Pleistocene hominins in the Levant changed the face of the earth and made a pronounced impact on the natural environments; and therefore the dichotomy between the Paleolithic and the Neolithic periods regarding the transformation of the landscape must not be regarded to be as sharp as commonly accepted. We fully agree that the monumental quarrying landscape presented by the Sede Ilan site and other similar complexes reveal an unfamiliar aspect of Middle Pleistocene hominins that stands in sharp contrast to the common view of these communities as “harmless” in terms of landscape alteration. This is why more research should be invested in Paleolithic stone procurement strategies for expanding our understanding of the wider range of activities performed by pre-modern hominins and their impact on the environment.

QUARRY LANDSCAPE MAINTENANCE

The reconstruction of quarry operation at Sede Ilan indicated a rational sequence of activities aimed, in our opinion, at using to exhaustion the selected raw material outcrops, backfilling the exhausted extraction fronts by quarry debris, and reducing the selected quarried nodules on top of the tailing pile, thus leaving the unexploited area around the exhausted extraction front undamaged and available for future extraction. This process repeats itself at the Sede Ilan quarrying complex, although investigated by excavation at one tailing pile only. One might point out the fact that a series of five tailing piles of similar size at the eastern edge of Sede Ilan are aligned along one specific flint horizon (Figure 12.5) and located at even distances from one another (20–30 m). This scenario repeats itself in other parts of the Sede Ilan complex and was observed at other Middle Pleistocene quarry complexes as well (Barkai *et al.* 2006). This seems to us a systematic quarrying procedure following strict rules aimed at maintaining the quarry landscape and preserving the unexploited outcrops for future use. The quarrying operation is highly organized and the location of the individual extraction localities is set according to a plan taking into account the geological structure of the complex and the characteristics of the available flint horizon. Looking at the air photograph of Sede Ilan (Figure 12.1), it seems that the extraction localities were strictly placed according to the bedding and the location of the outcrops. In our view, this followed a master plan and was not randomly affected by decision taken at the individual level. The fact that flint-knapping took place on top of the quarrying debris piles seemed odd to us in the first place. But when we realized that this pattern repeats itself at least in three Middle Pleistocene quarry complexes, we realized this may be a clue to understanding quarry organization and maintenance. We see no apparent reason for reducing the nodules and shaping the flint cores and tools on top of the tailing piles, apart from the wish to leave the area between the piles clean and available for future exploitation. The huge amount of flint extracted at these quarry sites resulted in large quantities of reduction debitage and debris that would easily cover the surface between the piles. Although some flints were found between the tailing piles, it is clear that most flint working took place on top of the piles, and we see this pattern as directed towards constantly maintaining the quarry

landscape and following the master plan of the Sede Ilan future exploitation.

TRADITIONAL ECOLOGICAL KNOWLEDGE, LAND-USE LEGACIES, AND RESOURCE MANAGEMENT AND CONSERVATION

We believe that the data and interpretation presented thus far allow us to touch upon issues related to the conceptual environmental worldviews and practical activities of Middle Pleistocene hominins. The insights from the study of the extensive Lower–Middle Paleolithic quarry complex of Sede Ilan enables us to join the lively discussion regarding the environmental knowledge of pre-industrial societies, the complex histories of land-use, and the debate concerning the ecological awareness of small-scale societies.

It is beyond the scope of this chapter to try and cover the vast anthropological, historical, and ecological literature on the subjects mentioned above, but it should be stressed that this is the first attempt to present such evidence from the early stages of human prehistory and enlarge the perspective of modern, relevant, environmental issues, to the Middle Pleistocene. It is our contention here that profound human ecological knowledge and environmental awareness appeared at least as early as the Middle Pleistocene and accompanied humanity until recently, as long as humans kept the traditional hunting and gathering way of life. The origins of the so-called “contemporary” debate regarding ecological and nature conservation issues are rooted deep into our prehistoric past and the study presented here enlarges our perspective regarding the environmental perception of prehistoric man.

It is well accepted now that indigenous, aboriginal societies worldwide demonstrate a comprehensive and intimate acquaintance with the ecological and environmental systems, usually termed “Traditional Ecological Knowledge” (e.g., Berkes *et al.* 2000; Ellen *et al.* 2000; Turner *et al.* 2000; Davis and Wanger 2003). This knowledge is shared by contemporary “simple” hunter-gatherers (“Immediate-Return societies,” e.g., Bird-David 1990, 1992; Lye 2002, 2005) and we have every reason to believe that our data from Sede Ilan reflects a well-developed traditional ecological knowledge, at least regarding the level of familiarity with the natural resources and the continuous exploitation of the chosen industrial area for generations.

While in the discussions of contemporary issues in ecology and conservation the importance of understanding land-use legacies is obvious (e.g., Foster *et al.* 2003), Paleolithic evidence for prolonged exploitation of the Levantine environments is meager despite the clear human presence throughout time. It is well established at many cave and open-air sites that Lower and Middle Paleolithic communities occupied the Mediterranean Levant through generations and generations, and recently it has been suggested that both Early Modern humans as well as Neanderthals used specific territories in a repeated manner during the Middle Paleolithic (Hovers 2001). The industrial complex of Sede Ilan is presented here as a case of land-use legacies during the Middle Pleistocene Levant, as throughout the ages this specific location was visited and exploited over and over again. The possibility that Sede Ilan was used as a traditional territorial marker is not ruled out and the question of some sort of restricted access to this rich source is left for future thought.

But does the evidence presented for the degree of quarry maintenance and the repeated use of specific, well defined, outcrops at Sede Ilan truly reflect conscious and planned behavior aimed at a degree of control over the natural resources and its conservation? Were Middle Pleistocene hominins indeed aware of the degree of exploitation and the damage they were inflicting upon Nature? We believe the answer to these questions is positive and see this awareness as a plausible explanation for the repeated and strict exploitation system at Sede Ilan and other contemporary quarry complexes, amongst the more practical explanations. We are, however, aware of the hot debate regarding the scale of Nature conservation among small-scale societies (e.g., Alvard 1993; Berkes 1999; Smith and Wishnie 2000; Ichikawa 2001; Dods 2002) and we argue that our study supports the so-called “Ecologically noble savage” hypothesis.

CONCLUSIONS

Prehistoric archeology has a large potential for making a contribution towards the understanding of contemporary environmental issues and taking sides in environmental debates. This chapter is an example of a step towards this aim. The management of modern ecosystems and landscapes could benefit from the imprints left by prehistoric societies on the landscape and the study of their impact on the natural environment (e.g., White

1967; Van der Leeuw and Redman 2002; Barnosky *et al.* 2004; Butzer 2005; Hayashida 2005).

The long-term perspective provided by the archaeological record on the exploitation of the natural environment by prehistoric man shows that Middle Pleistocene hominins in the Levant used huge quantities of flint extracted from well-chosen sources. These extraction complexes or industrial areas were exploited repeatedly in a well-planned manner through constant maintenance of the quarried landscape. The quarry landscape had become a landscape beacon and must have had a central place within the conceptual and practical realms of prehistoric communities occupying the Lower Galilee.

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