An Unshakable Middle Paleolithic?

Trends versus Conservatism in the Predatory Niche and Their Social Ramifications

by Mary C. Stiner

The great temporal and geographic span of the Middle Paleolithic (MP) raises many questions about behavioral variation within this period and its evolutionary significance. This paper focuses on MP predator economics and its social ramifications by examining the data for possible trends in the size of the hominin ecological footprint, hunting practices, trophic level, food sharing, and the intensity with which sites were occupied. Middle Paleolithic hominins were big game hunters, and they were rather specialized in their focus on ungulate prey. Low-cost gatherable small prey were a perennial if minor contribution to MP diets at lower latitudes, but the overall breadth of the meat diet remained narrow throughout the period. Discernible trends in the MP are few. Foraging innovations of the MP include marine shellfish exploitation by 120,000 years BP (possibly earlier), galvanization of the prime-age ungulate hunting niche, and hearth-centered domestic camps. The density of zooarchaeological material seems to increase during the last 30,000 years of MP existence, implying mild increases in human populations. Important aspects of carcass processing and meat sharing in the MP do not show much variation but do indicate close cooperation and habitual sharing among group members. Contrasts to late Lower Paleolithic butchery patterns may illuminate more formal patterns of meat sharing in the MP and after. The seeming rigidity of MP hunting economics could have been the secret to its widespread success for 200,000 years.

Introduction

Variation in Middle Paleolithic (MP) behavior and ecology can be explored at many temporal and geographic scales, from local to the quasi-global. Temporal variation is seen in MP site densities, for example, and much geographic variation can be found in the prey species hunted. One may argue, nonetheless, that the MP is more clearly defined by developments with the outset and close of this long culture period than by strong trends within it. Of course all arguments about the MP come down to how much we choose to make of the variation we find, and usually this is accomplished by comparisons with recent human behavior. Though useful to a point, modern comparators are something of an Achilles' heel in evolutionary interpretation because hindsight has nothing to do with the evolutionary processes that gave rise to or were important during the MP. If compared with the Lower Paleolithic, the MP was a time of innovation. If compared with the Upper Paleolithic (UP), the MP was arguably a time of stability and inflexibility. The hallowed standard of early "modern human behavior" is only particularly relevant where and when very late MP populations first came in contact with African Middle Stone Age (MSA) or UP populations.

This review of the MP emphasizes the archaeological record of animal exploitation. While predation is but one way of examining past hominin behavior, predation is one of the most powerful interactive forces in the evolution of life. There can be no question that predation habits define a number of important themes in the human evolution story not simply with respect to food energetics and ecology but also to the bases of social cooperation and demography. I have two goals in writing this essay. The first is to document changes in hunting strategies and dietary breadth within the Mediterranean MP and between the MP and periods just before and after it. One cannot hope to cover the full volume of work that has been done on MP economics in Eurasia. I will instead focus mainly on the archaeological record of the Mediterranean Basin while bringing information from other areas to the discussion as much as possible. The Mediterranean region is a key testing ground for studies of variation in hominin subsistence because of the great variety of edible foods it offers (Blondel and Aronson 1999) and the high density of archaeological research. I will consider whether the variation observed in the faunal record is better explained by environmental fluctuations or by social, demographic, or cognitive changes. The second goal of this essay is to reconcile the scope of the observed faunal trends with the temporal and geo-

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 0011-3204/2013/54S8-0010$10.00. DOI: 10.1086/673285

graphic breadth of the MP culture period as a whole. Before the invasion of anatomically modern humans (AMH) into their range, MP populations experienced selective conditions that were somewhat distinct from those that confronted them when new, competing populations were present. The value of predatory specialization, for example, and the potential for population growth would almost certainly have changed in the face of interspecific competition.

I will also explore the position that the differences between the MP and the UP or the MSA need not have been about differences in native cognitive ability. Cognitive differences might well have existed between MP and MSA or UP populations, but the evidence we have in hand does not really point to this. Alternative explanations for the differing evolutionary trajectories of the MP, MSA, and UP may lie in the demographic potential and stability of these Late Pleistocene populations and, intimately linked to these population characteristics, the longevity and stability of knowledge-sharing institutions (sensu Henrich 2004; Poteete and Ostrom 2004). Physiology does not predict cultural differences or intelligence among recent humans, and the same may have been true among Pleistocene MP and MSA populations. Lest we forget, MP artifacts, or artifacts very much like them, were made and used by both Neanderthals and earliest AMHs in the Levant (Bar-Yosef et al. 1986; Vandermeersch 1989). Considerable planning capability is indicated for the MP from the many pathways by which flake or blade blank forms were produced (cf. Boëda 1994; Bourguignon, Faivre, and Turq 2004; Delagnes and Meignen 2006; Kuhn 1995). In fact, MP lithic reduction systems tend to be a good deal more complex—and the outcomes more elegant—than most MSA systems for working stone. Zooarchaeological data meanwhile indicate that MP hunting practices relied on deep environmental knowledge, forethought, and close cooperation among group members.

Any attempt to review variation in MP subsistence is faced with patchy evidence. More problematic, however, is the fact that possible cultural continuity or gradients between Eurasia and North Africa are underexplored. We should in principle expect evidence of behavioral variation to increase as the area of a paleoculture's distribution increases merely because of the likelihood of cultural drift. What we bump up against instead is an academic legacy of imposed geographic and paleoculture boundaries that undermines attempts to look at real variation. If we assume that the MP simply did not exist in Africa, even in areas nearest to the Mediterranean Basin, then much of the potential variability is eclipsed by an arbitrary segregation of archaeological records at the scale of continents. If, on the other hand, paleocultures such as the Aterian of North Africa can be included in the MP, then the variation embodied by the MP paleoculture will seem far greater.

Let us assume for the sake of this discussion that the MP was confined strictly to Europe and the whole of western Asia. This is still a huge area and one that encompasses tremendous ecological variation because of the latitudinal gradient, diverse topographies, and complex maritime-continental interfaces. Undaunted by variable environments, MP hominins thrived in Eurasia for about 200,000 years. They were expert hunters of large game animals wherever they lived, and they moved large quantities of food and tool stone around to suit their needs. The large game species that they hunted followed regional variation in animal community composition (cf. Grayson and Delpech 1998; Griggo 2004; Münzel and Conard 2004; Patou-Mathis 2000; Speth and Tchernov 2001; Starkovich 2011; Stiner 1994, 2005; Valensi and Psathi 2004). In this regard, MP hunters appear to have been very flexible. They were much less flexible in their use of small animals, in strong contrast to recent hunter-gatherers, UP foragers, and possibly some MSA foragers. From a modernist perspective, it seems odd that MP hominins did not expand their meat diet much at all in response to variation in biotic diversity over the more than 200,000 years of their existence in Eurasia.

One need not be a MP apologist, on the other hand, to find that opinion currently is stacked against recognizing "modernity" of any sort in the MP. There is no basis for claiming that MP populations were inherently less imaginative in solving problems. They imagined reasons to bury deceased group members (e.g., Bar-Yosef et al. 1988, 1992; Haydal et al. 1995); they turned to the sea for new foods by at least 120,000 years ago (Stiner 1994); they collected uniquely attractive objects such as rock crystals and pretty shells (e.g., Zilhão et al. 2010); they used marine sponges (Stiner 1994) and mineral pigments (Rendu 2010; Roebroeks et al. 2012); they hafted stone artifacts to organic handles (e.g., Boëda et al. 1996; Koller, Baumer, and Mania 2001; Shea 1989); they made scraping tools from marine shells (Darlas 2007:360–361; Stiner 1994:187–188; Vitagliano 1984); they used feathers from large birds (Peresani et al. 2011); and they invented or refined many distinct techniques for regulating blank form in stone working. Important findings on the MSA from the African continent, such as very early shell ornaments and bone tools (e.g., Bouzouggar et al. 2007; d'Errico et al. 2005; Henshilwood et al. 2004), have primed us to expect precocious behavioral patterns in this part of the world more generally. In the interest of healthy debate, why do seemingly innovative acts in the MP hardly register in the story of "revolutionary" human developments?

The elephant in the room is the apparently capacious brain size of the Neanderthals. Scaled to body mass, AMH and recent humans have nothing on MP Neanderthals in this regard (Klein 1999; Rightmire 2003). Argue as we may for different wiring within the brain, it could all be special pleading given the equally great metabolic burden of Eurasian MP, African MSA, and recent human brains (Snodgrass, Leonard, and Robertson 2009). Surprisingly less attention has been given to the conditions behind the final burst in hominin brain expansion during the Middle Pleistocene, which led into the MP. Behaviors loosely associated with the tail end of this neurological trend included more extensive use of caves where available, ubiquitous fire technology, and residential camps that supported diverse activities. Thereafter we see remarkable consistency in how MP people reaped the benefits of large prey through extensive meat transport to base camps, fire-centered food processing, formalized butchering, and meat sharing.

From my perspective, the lists of differences thought to distinguish the MP and late MSA (McBrearty and Brooks 2000) or the MP from the Eurasian UP (Mellars 1989, 1996) are reducible to three phenomena: (1) diet breadth and associated radiations weapons technology, (2) durable art (i.e., beads and inscribed ochre and ostrich eggshells), and (3) the degree of cultural volatility or "changeability." In these regards, some phases of the MSA and the UP do seem to have more in common with each other than either has with the MP.

Behavioral Variation Within and Bracketing the MP Period

The most obvious component of MP subsistence is large game exploitation—prey selection and capture, carcass processing, land use, and provisioning of sites with meat. Other important themes in MP subsistence are small game exploitation and foraging technology. Also important are the nature of sites and their functions as evidenced from material contents, occupation intensity, and the diversity of activities represented. Residential hub sites are very much in evidence in the MP, and their development is relevant to the nature of cooperation, delayed food returns, and domestic arenas of social interaction.

Living High in the Food Web

It is safe to say that MP people were dedicated large game hunters. While they must also have eaten plant foods, especially in lower latitude environments, MP hominins occupied many cold regions in which plant productivity was highly seasonal. In the absence of storage and milling tools for making calorie-rich seeds or nuts digestible, meat was the only high-quality food available to northern MP populations for many months of the year. Important rare finds of seeds or charred nut hulls in combustion features (Barton et al. 1999; Madella et al. 2002) and phytolith and starch grains preserved in Neanderthal dental calculus (Henry, Brooks, and Piperno 2011) simply confirm what we all expect (Jones 2009), namely, that MP hominins ate plant foods and sometimes used fire to cook them.

What too many discussions of diet breadth fail to grasp, however, is the core importance of search and processing costs of different foods in relation to their nutritional yield. This is a problem of how differing proportions of high- and low-cost food sources in the diet reflect variable human investments (sensu Stephens and Krebs 1986). Such a contrast potentially exists within the spectra both of plant use and animal use. Unfortunately, plant macro- and microfossil evidence cannot tell us much about the proportional contributions of high- versus low-cost plants to early diets. Some archaeologists turn to the technological record for answers, focusing particularly on durable milling, scraping, and pounding equipment to learn about investment and processing costs. Plant-heavy diets among recent foragers tend to correlate with emphasis on staple plant seeds and/or nuts (Keeley 1995), and heavy, durable tools are needed to extract the carbohydrates from them efficiently. Apart from fire, the MP generally lacks such tools. A distinct line of evidence from light isotopes tends to support the idea of high levels of carnivory in MP hominins in Europe (e.g., Bocherens 2009), but data on MP populations at lower latitudes are still too few.

As for variable investments in the meat diet, the zooarchaeological record is the richest source of information on the range of animals eaten and the relative importance of each type provided that the prey species possess skeletons of some kind. Faunal records present their own set of challenges to interpretation, but the inorganic components of bone and carbonate shells are well preserved in many regions of the world. Equally important, the preserved remains can be related in a consistent if generalized way to consumable organic parts within and across prey species.

Large prey in the size range of gazelles/roe deer to aurochs/bison were the core meat sources during the MP (cf. Delagnes and Rendu 2011; Gaudzinski-Windheuser and Niven 2009; Hoffecker and Cleghorn 2000; Rabinovich and Tchernov 1995; Speth and Tchernov 2007). In north-central Europe, MP hominins exploited large prey irrespective of global warming through the Eemian Interglacial (Gaudzinski 2004). A concerted focus on large prey was also typical in the biotically diverse Mediterranean Basin, where 95%–99% of the animal foods procured by weight were large herbivores (fig. 1; Stiner 2005). Within the "large prey" size window, MP hunters responded easily to variation in the species available to them, hunting mainly red deer, ibex, or wild goat in some areas; aurochs, bison, horse, or reindeer in others; and camel or fallow deer and gazelle in yet others (cf. Adler and Bar-Oz 2009; Burke 2000; Conard, Bolus, and Münzel 2012; David and Farizy 1999; Gaudzinski and Roebroeks 2000; Griggo 2004; Hoffecker 2009; Rendu et al. 2012; Reynaud Savioz and Morel 2005; Rosell et al. 2012; Stiner 2009).

Rhino and straight-tusked elephant or mammoth remains also occur at some MP sites, particularly in open settings. Whether these megafaunal species were hunted or scavenged remains an open question, but their meat clearly was exploited in some cases (Bocherens 2009; Conard and Prindiville 2000; David and Poulain 1990; Griggo 2004; Hoffecker 2009; Patou-Mathis 2000; see also Villa 1990). Megafauna remains in cave sites are uncommon if present at all probably because of the high cost of transporting their heavy bones. Megafauna generally drop out of MP records in accordance with the extinction of these species in local ecosystems (e.g., Garrard

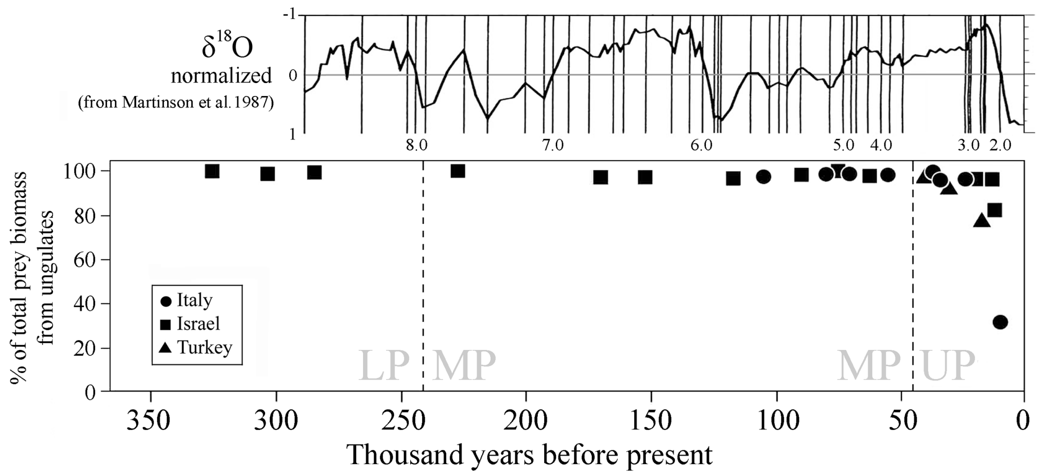

Figure 1. Percentage of total prey biomass represented by ungulate prey in three Mediterranean faunal series (adapted from Stiner and Kuhn 2006). Major climate cycles represented by the marine oxygen isotope record are adapted from Martinson et al. (1987).

1983; Hoffecker 2009; Hortolà and Martínez Navarro 2013; Stuart 1991:488–502), but aurochs-sized and smaller ungulates never lost their importance to MP hunters.

A long-standing signature of human hunting is the tendency to focus on prime-age artiodactyl prey (Stiner 1990). In reality, human-generated ungulate mortality patterns vary much more than this, but most patterns fall between nonselective and strongly biased to prime adults, averaging to a mild bias to prime adult prey (figs. 2, 3; Stiner 2005). This bias in prey age selection is widespread in the MP and UP (Gaudzinski and Roebroeks 2000; Hoffecker and Cleghorn 2000; Patou-Mathis 2000; Rendu 2010; Speth and Tchernov 1998; Steele 2004; Stiner 1990, 2005; Yesherun, Bar-Oz, and Weinstein-Evron 2007). The bias has also been documented in a few late Lower Paleolithic (LP) sites such as at Wallertheim in Germany (Gaudzinski 1995) and Qesem Cave in Israel (Stiner, Barkai, and Gopher 2011). The ubiquity of prime-focused hunting in the MP is striking, however, and may suggest a galvanization of this dimension of the large game hunting niche.

The ungulate body parts that MP hominins carried from kill sites to camps varied with circumstance, but repetitive biases are found in caves and rock shelters. Ideally we would like to have equally reliable data on prey body-part profiles across open and natural shelter contexts, but preservation often favors samples from shelters. Shelter faunas nonetheless provide us with some analytical benefits because food must be carried to them. Most group members were likely present at these sites, making sharing difficult to avoid. Evidence for meat sharing in shelters can be explored by (1) considering the quality and quantities of meat carried into them, (2) attempting to follow the path of meat redistribution on site, and (3) comparing the scope of activities at camps that may relate to modes of economic cooperation.

Ungulate skeletal representation typically varies from whole bodies to a bias favoring meaty or marrow-rich limb parts and heads (e.g., Burke 2000; Conard and Prindiville 2000; Griggo 2004; Patou-Mathis 1993, 2000; Speth and Tchernov 2001; Stiner 2005; Valensi 2000). Figure 4 exemplifies the range of variation typical of medium-sized species from consecutive layers in Üçağızlı Cave II (MP) and Üçağızlı Cave I (early UP) in southern Turkey. Here and elsewhere, MP foragers often left axial parts behind at kill sites or exploited them in the field. Differential preservation of dense versus spongy bones (following Lyman 1984) may explain the anatomical biases in some cases (e.g., Hoffecker, Baryshnikov, and Potapova 1991; Lam and Pearson 2005). However, the patterns are clearly anthropogenic in a great many other cases (e.g., Burke 2000; Conard and Prindiville 2000; Rendu 2010; Rendu et al. 2012; Speth and Tchernov 2001, 2007; Starkovich 2011; Stiner 1994, 2002, 2005) because there is no correlation to bone density, or similarly dense skeletal features are quantified across the axial and appendicular anatomy to infer body-part profiles (Stiner 2002).

The MP is rife with examples of delayed consumption of high-quality animal parts. Carrying meat and marrow-rich bones to a central place allowed for more thorough processing, but the large volumes of meat moved also testify to an ethic of premeditated sharing. Evidence for delayed meat consumption is also found at late LP sites such as at Qesem Cave (Stiner, Barkai, and Gopher 2011) and probably the open site of Gesher Benot Ya'akov (Rabinovich, Gaudzinski-Windheuser, and Goren-Inbar 2008), but the MP differs in the sheer abundance of clear-cut cases. In comparison with the stratified late LP record of Qesem Cave (Gopher et al. 2005), where butchering activities involved mainly simple defleshing and marrow extraction, MP meat sharing also appears more formalized (Stiner, Barkai, and Gopher 2011). The types of tool

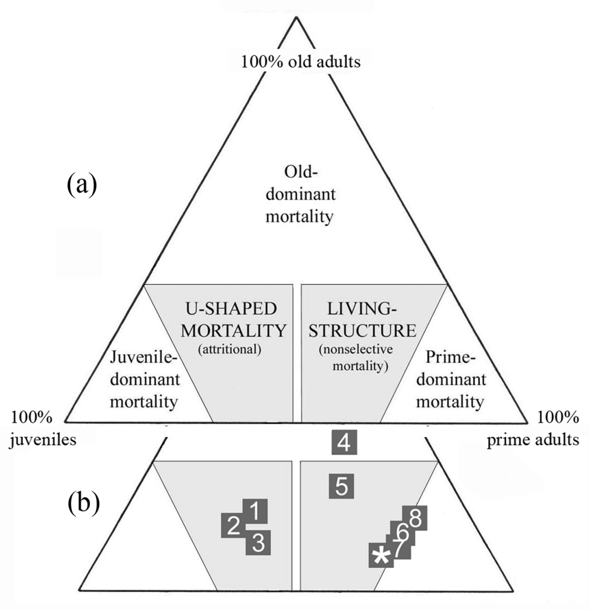

Figure 2. Models *a* and *b* averaged values for observed ungulate mortality patterns created by various human and nonhuman predators. Shaded panels represent natural variations in the age structures of living ungulate populations and thus also nonselective mortality patterns and mortality patterns caused by attritional factors such as disease, accidents, and malnutrition. Each corner of the diagram represents a strong bias toward the designated prey age group. Observed means are for recent spotted hyena (1), wolf (2), Cape hunting dog (3), tiger (4), African lion (5), Holocene and recent human hunters (6), Mediterranean Epipaleolithic and Upper Paleolithic hunters (7), and Mediterranean Middle Paleolithic hunters (8). An asterisk indicates the average for the Acheulo-Yabrudian (late Lower Paleolithic) fallow deer assemblages from Qesem Cave.

marks on the ungulate bones from Qesem Cave are redundant, and the cut-mark orientations are relatively chaotic. The latter observation indicates many procedural interruptions or diverse positions while cutting flesh and perhaps a more individualized way of consuming shared meat. MP and early UP butchering practices are more similar to one another, with much consistency in cut-mark orientations, suggesting a more complex, socially canalized way of sharing meat.

No discussion of the MP would be complete without some mention of the scavenging controversy. In the 1980s, Lewis R. Binford challenged a long-standing assumption that early hominins (particularly LP hominins) were big game hunters (Binford 1981). He even suggested that MSA and MP hominins might have been obligate scavengers of other predators' kills (Binford 1984:244–249, 1988). The second hypothesis was generally refuted by subsequent analyses (e.g., Chase 1986, 1989; Grayson and Delpech 1994; Speth and Tchernov 2007; Stiner 1990, 1994). I, a student of Binford, concluded from long study of MP faunas in Italy that "Mousterian people were competent hunters of small, medium and large ungulates but at times turned to very different foraging agendas while using coastal caves in Latium, scavenging the very same kinds of ungulates they hunted elsewhere in addition to collecting shellfish and tortoises" (Stiner 1994:371). With the pendular return to the view of MP folk as big game hunters, scavenging behavior seems to have sunk beneath our notice (but see Conard and Prindiville 2000). This is unfortunate, because nonconfrontational scavenging is a form of gathering about which we still know little for the MP. At the site of Grotta dei Moscerini in west-central Italy, probable evidence for scavenging head parts, nearly always from old animals, coincides with an unambiguous record of collecting shellfish and tortoises (Stiner 1994).

Small Game Exploitation and Its Implications

Large game hunting practices generally fail to differentiate the economies of MP and UP societies in Eurasia (see Adler and Bar-Oz 2009; Adler et al. 2006; Gaudzinski 2000, 2004; Grayson and Delpech 2003; Hoffecker 2009; Münzel and Conard 2004; Stiner 1994, 2005; Stiner, Barkai, and Gopher 2011). Economic differences are more apparent in how these paleocultures filled gaps in large game availability with small animals. In warm-temperate and subtropical environments, MP hominins favored small animals that were easy to collect—tortoises, marine shellfish, ostrich eggs, and large lizards if available. This makes good sense from the viewpoint of a prey choice (optimality) model, as the low handling costs of slow-moving or immobile small animals compensate for their small body size. Small, quick animals—particularly birds, hares, and fish—generally have higher handling costs, and MP people did not pursue these prey most of the time (Aura et al. 2002; Costamagno and Laroulandie 2004; Laroulandie 2004; Stiner, Munro, and Surovell 2000). Whatever flexibility may have existed in MP foraging systems, it seldom extended to animals or plants with high capture or processing costs.

Although habitual use of small, quick animals is rare in the MP overall, fascinating exceptions exist in southwestern Europe, usually involving rabbits (Aura et al. 2002), a colonial burrower, and some birds. La Canelettes in France contains significant numbers of cut-marked rabbit and bird bones alongside large game remains (Cochard et al. 2012). Another exception is found in the early MP at Bolomor Cave in Valencia, Spain. Here cut-marked rabbit remains occur in relatively high percentages in multiple horizons along with some birds and many tortoise and ungulate remains (Blasco and Fernández Peris 2009). The fact that these examples are localized occurrences that repeat through multiple occupations suggests that unique aspects of the locality made this unusual manner of foraging feasible. Some instances of MP bird exploitation, again very rare, associate with ochre use and may have been for obtaining large feathers (Peresani et al. 2011; Rendu 2010). Use of quick, small prey is not the rule in the MP, however, and the above examples stand out because of their rarity (Cochard et al. 2012).

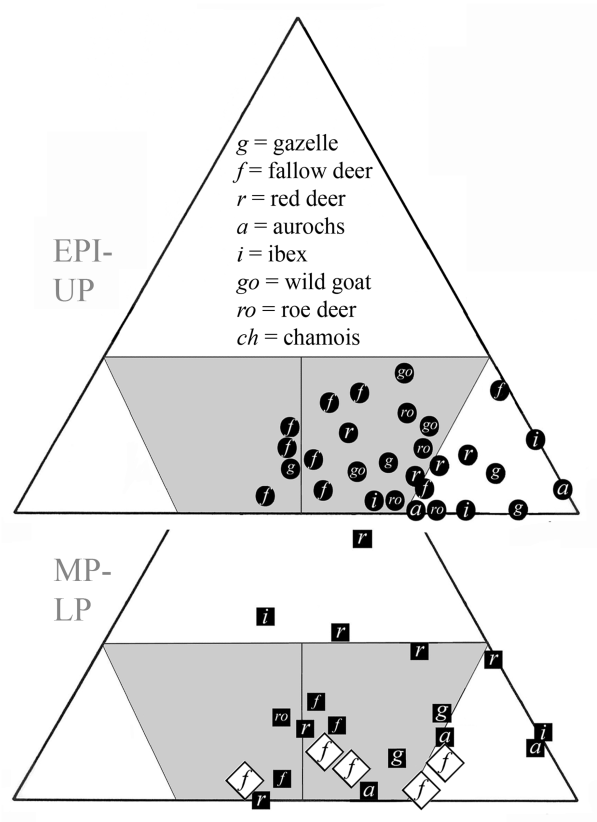

Figure 3. Observed mortality pattern distribution in artiodactyl prey from Mediterranean Epipaleolithic (EPI), Upper Paleolithic (UP), and Middle Paleolithic (MP) assemblages from Israel (Hayonim Cave, Meged Rockshelter, Kebara Cave), Lebanon (Ksar 'Akil), Turkey (Üçağızlı I Cave), and various cave sites in west-central and northern Italy. Acheulo-Yabrudian (late Lower Paleolithic) cases from Qesem Cave appear as diamonds.

A major shift in the overall breadth of the meat diet in the Mediterranean region coincides with the MP-UP transition (fig. 5; Stiner 2001; Stiner et al. 1999). Differences in small game use between the two Paleolithic periods are made all the more fascinating by the fact that diet diversification and intensified use of resources can support a larger population base. In the Levant, this transition in small game use is linked to harvesting pressure on sensitive tortoise populations. The mean sizes of tortoises declined (Speth and Tchernov 2002; Stiner et al. 1999), and unnatural skewing is evidenced in the age (size) structure of the harvested animals, which points to heavy exploitation by humans in particular (Stiner 2005:139–147). These findings imply that human populations in the region first exceeded the potential of high-ranked, high-return resources to support them after about 50,000 years ago (see Speth and Clark 2006 for effects within the late MP). Declining availability of high-yield resources, which raises search costs, is considered the main reason why foragers turn to foods that give a lower return for the effort (Stephens and Krebs 1986:17–24). Middle Paleolithic foragers' great dependence on large game and on slow-moving and slow-growing small animals such as Mediterranean tortoises implies that MP populations were consistently small and highly dispersed. Given that the first detectable human demographic pulse occurred more or less at the threshold of the MP-UP cultural transition, some very late Mousterian populations may have been uniquely affected by expansions of early UP populations in Eurasia.

The African MSA is not as extensively documented as the Eurasian MP. Especially troubling is the data gap for the interval 60,000–20,000 years ago (within marine isotope stage [MIS] 3) in both South and North Africa (Steele and Klein 2009) and spotty reporting in East Africa. There are hints of a greater range of subsistence and technological behaviors in some areas and phases of the MSA (reviewed by McBrearty and Brooks 2000; Steele and Klein 2009). Scarce bird remains are reported in some North African sites, small mammal remains (hare and hyrax) in the Ethiopian site of Porc-Epic (Assefa 2006), catfish bones in Aduma Middle Awash Valley sites (Yellen et al. 2005), and early bone harpoons (Yellen et al. 1995) and grinding tools that may have been suitable for processing seeds or nuts (McBrearty and Brooks 2000). These cases do not seem to constitute a single trend but rather oscillate substantially with environmental changes (especially in MIS 4; Clark and Kandel 2013). The MSA data nonetheless suggest a contrast to the MP, even to the MP in warmer climes. Better documented jumps in diet breadth occur in African Late Stone Age sequences (Klein 1999; Steele and Klein 2009) and post–Large Glacial Maximum sequences in Eurasia (Munro 2004; Stiner 2001; Stiner et al. 1999).

Evidence of early shellfishing has attracted new attention. It is said by some to be evidence of precocious expansions in dietary breadth and cognitive advances during the MSA in South Africa (Marean et al. 2007). The MP has not figured much in this discussion, but it should (see Colonese et al. 2011). Evidence for probable MP shellfishing in the Mediterranean region—mainly limpets, large clams, mussels, oysters, and turbans—has been widely reported in archaeological works of the 1950s onward at Gibraltar (Baden-Powell 1964; Garrod et al. 1928); on the Italian coasts of Liguria, Lazio, and Puglia (Blanc 1958–1961; Palma di Cesnola 1965, 1969); and at Haua Fteah in Cyrenaica, North Africa (Klein and Scott 1986). Detailed taphonomic studies are available for only some of these sites, but recent results confirm that hominins exploited shellfish at Cueva Perneras and Cueva de los Aviones in Spain (Zilhão et al. 2010), Kalamakia Cave in Greece (Darlas 2007), Grotta dei Moscerini in Italy (Stiner 1994), Üçağızlı Cave II in southern Turkey (Stiner 2009), and in Morocco (Steele and Alverez-Fernández 2011). Several of the MP sites on Gibraltar contain shellfish remains, and although some are almost certainly archaeological, their attribution to hominin activities continues to be controversial (cf. Barton 2000; Erlandson and Moss 2001; Fernandez-Jalvo and Andrews 2000; Finlayson et al. 2008; Freeman 1981; Klein and Steele 2008; Stringer et al. 2008). The earliest secure case

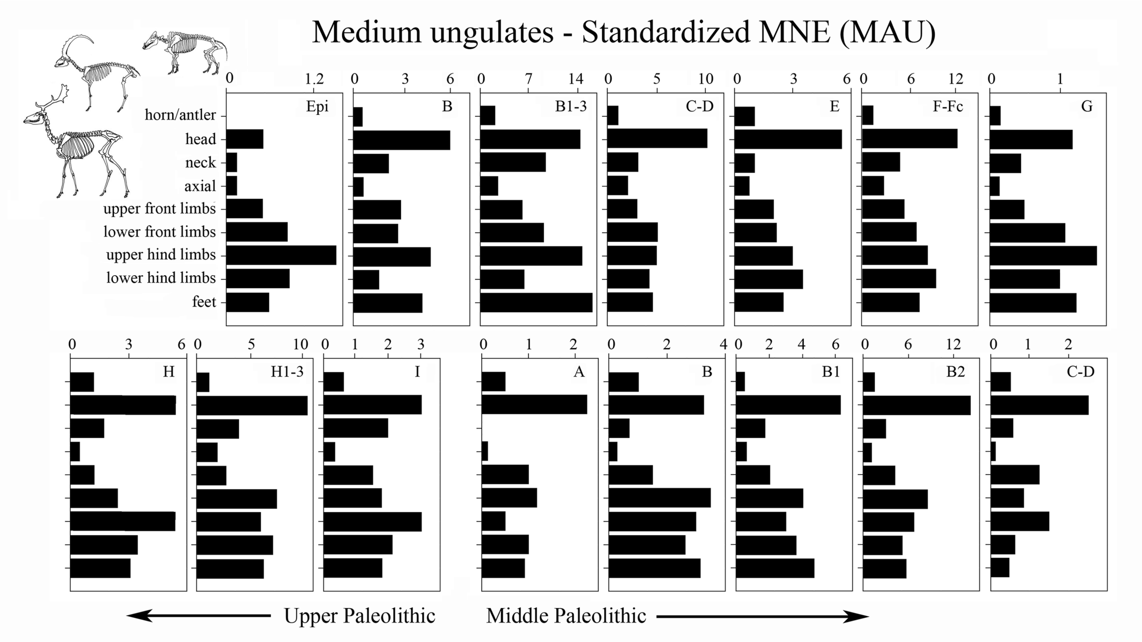

Figure 4. Comparison of standardized skeletal element frequencies (observed MNE/expected MNE) by layer and anatomical region for medium-sized ungulate prey at the Epipaleolithic and early Upper Paleolithic site of UcI (layers EPI though I, youngest to oldest) and the Middle Paleolithic site of UcII (layers A through C-D in bottom row, arranged youngest to oldest) in southern Turkey. Unevenness in the anatomical profile indicates biases in body-part representation relative to the complete animal anatomy. Dental elements were not used for the calculations of head-part abundance.

for MP shellfish exploitation comes from Grotta dei Moscerini, a deeply stratified cave site on the Gaetan coast of Italy that spans 115–65 ka (Stiner 1994:180–192).

The earliest record of MSA shellfish exploitation at Pinnacle Point (PP13B) in South Africa has been dated to about 160 ka (Marean et al. 2007). Taken at face value, shellfishing on the South African coast began roughly 40,000–50,000 years before it appeared on Mediterranean shores. However, geological studies of shoreline changes indicate that much of the Mediterranean archaeological record is now submerged or has been lost to the erosion with marine transgression following the Last Interglacial (Lambeck 1996; Van Andel and Tzedakis 1996). Given that all of the known shell-bearing MP sites occur at or just a few meters above modern sea level, one can assume that earlier coastal occupations have been scoured clean by waves or inundated by rising seas (reviewed in Bailey and Flemming 2008; Colonese et al. 2011). For the moment, 115–110 ka is merely the minimum age for shellfish collecting in the Mediterranean region. Suggesting significantly different behavioral thresholds between the MP and MSA for marine foraging therefore is premature.

Marean et al. (2007) argue that early shellfishing in South Africa fueled a demographic expansion of MSA populations along coastlines northward into Eurasia. The energetic basis of this proposition is highly questionable, but even if such a thing occurred, the expanding MSA populations would soon have bumped into Mediterranean Neanderthals already in the habit of gathering mussels, limpets, and turbans from shoreline rocks and digging for clams buried in the sand. The idea that the coast was a main corridor for colonization is doubtful in any case given that good shellfishing areas were virtually absent along the coast from Egypt to northern Galilee. Importantly, Clark and Kandel (2013) show that the quantities of shells in coastal MSA are low as a rule and on par with those in the MP sites.

Labor Allocation and Foraging Equipment

This is not a paper on Paleolithic technology, but a few remarks about foraging implements are relevant to any consideration of hominin subsistence. First, it is clear that late LP and MP hominins routinely hunted large game animals long before the development of stone-tipped and bone-tipped weapons. In Eurasia, stone-tipped weapons appear in the later MP as localized traditions. Hafted Levallois points are reported in the Levant (Shea 1989, 1993), for example, and bifacial *Blattzspitzen* in Germany (Müller-Beck 1988) along with rare pointed bone artifacts (Conard, Bolus, and Münzel 2012). Modest weapons diversification therefore is suggested by the late MP. Bifacial stone and bone points are also reported in the African MSA (McBrearty and Brooks 2000; Shea 2009). Because stone-tipped weapons are not universal to the MP

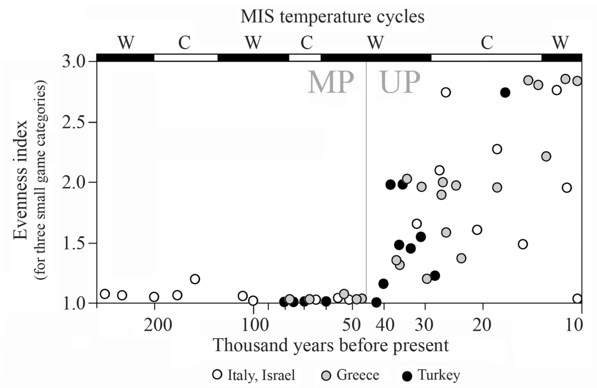

Figure 5. Changes in evenness in the exploitation of three small prey categories based on the inverse of Simpson's index (1 = least even and the narrowest diet; 3 = most even and therefore the broadest meat diet). Prey are low-cost slow game and higher-cost quick-running terrestrial mammals and quick-flying birds; fish are very rare and therefore are excluded. Black-filled circles represent the Üçağızlı II-I faunal series; unfilled and gray-filled circles denote other Mediterranean series in Italy and Israel (from Stiner 2001). Sources: late MP from Kebara Cave ca. 65–50 ka (Speth and Tchernov 2001); Paleolithic Italy, Israel, and Turkey (Munro 2004; Stiner 1994, 2001, 2005, 2009; Stiner, Barkai and Gopher 2011); Greece, Klissoura Cave 1 (Starkovich 2011); Franchthi Cave (Stiner and Munro 2011). (Adapted from Stiner 2001, 2005.)

or the MSA, however, wooden spears were almost certainly the default weapon of choice. In Eurasia, this represents a continuation of late LP hunting equipment (cf. Jacob-Friesen 1956; Thieme 1997).

The evidence forces us to decouple suppositions about Paleolithic hunting capabilities and complex hunting weapons. Improvements in weapons design are typical of the UP (e.g., Knecht 1997), and increased weapons efficiency or reliability may have reduced an individual's procurement time, risk per foray, and the minimum hunting party size needed to capture large animals. Middle Paleolithic hunters nonetheless managed very well without complex weapons, relying instead on extensive cooperation among group members. The importance of cooperation in MP big game hunting is underscored by the apparently low population densities of the period. Close teamwork would have been utterly essential to MP hunting success and maintaining minimum party size a perennial concern.

While there is no necessary link between the ability to bring down large game animals and weapons complexity, there is a predictable relation between the exploitation of small, quick animals and technologies that reduce capture costs in Paleolithic Eurasia. This is because the quick prey are small and the returns are too low relative to human metabolic needs in the absence of tools that make harvesting efficient (sensu Oswalt 1976). Making and maintaining the harvesting tools also incurs costs, which some later Paleolithic infrastructures eventually came to support. We have seen that MP people could obtain quick animals if they wanted to but seldom chose to do so. Early radiations in small game hunting equipment are reported in some MSA records of Africa (e.g., fishing; McBrearty and Brooks 2000), apparently in connection with expanding dietary breadth.

Expanding dietary breadth has labor and social connotations. The benefits of niche (labor) separation within human groups should increase as the diet broadens over long periods of time because of less overlap or symmetry in personal schedules and the locations where various foods can be obtained. Such within-population diversification would be most advantageous in environments where key resources occur at disparate locations or times or if distinct methods and tools are required to obtain them efficiently. These conditions may also result in greater autonomy with respect to what individuals add to a pool of shareable foods.

To appreciate the social ramifications of expanding diet breadth across the MP-UP, one must consider diversification in technology and diet simultaneously. Upper Paleolithic populations readily diversified along either dimension or both in response to environmental circumstance. They produced, for example, weatherproof clothing and related items to support the food quest in cold areas and diverse food harvesting equipment in warmer areas. Acknowledging that we know little about organic artifacts of any Paleolithic period, the MP nonetheless shows less flexibility in both technology and the scope of the meat diet. There is considerable evidence for hide working in the MP (Meignen et al. 1989; Villa, Bon, and Castel 2001), suggesting that European Neanderthals wore skin garments. However, evidence of working dry hide (cured leather) in the form of microwear traces on stone artifacts is comparatively scarce in the MP (e.g., Anderson-Gerfaud 1990; Beyries 1987; Lemorini 2000; Martínez-Molina 2005). It is only with the UP that the types of artifacts commonly associated ethnographically with tailored, weather-resistant clothing—bone needles and awls—also became a regular part of the Eurasian archaeological record. Upper Paleolithic society seems to have differed from MP society because of a wider range of economic and social roles.

Kuhn and Stiner (2006) hypothesize that MP women, children, and men all participated more consistently and directly in large game hunting than is generally seen among recent foragers or UP foragers. This is not to say that socioeconomic roles among MP individuals by age or gender were identical. Rather, the point is that a comparatively narrow economic focus on large game and very low population densities constrained labor organization and land use in historically unique ways. Like other predators that hunt socially, humans can gain significant advantages over large prey if some members of the hunting party act as artificial surrounds or funnels that move the quarry toward the killers. (Only substantive increases in weapon efficiency can alter this dynamic.) Individual roles in MP hunting would have varied from direct physical contact with prey to diverse, safer tasks for helpers. In such small-scale societies that lacked sophisticated killing tools, group members had to be available on short notice much of the time. Beating the bushes, carrying meat and bones back to camps, processing carcasses, and tanning hides were all essential to gaining high payoffs from a hunt. More helpers meant that more meat and bone could be carried back to camps, cutting losses to scavengers and allowing more to be gained from the meat, marrow, and hides of large prey animals. Given the perennial risk of groups being stretched too thin and the apparently limited development of regional social networks, within-group proximity would also have been the main safety net for MP people.

Site Function and Occupation Intensity

Two modes have been noted in MP site data: (1) ephemeral occupations with high mobility and (2) relatively intensive occupations with high material inputs. The two conditions do not seem to represent a single continuum. The relative frequencies of ungulate and lithic materials are positively and strongly correlated in the richer cave sites (Moncel and Daujeard 2012; Riel-Salvatore and Barton 2004; Stiner and Kuhn 1992), implying that tool manufacture and maintenance were intimately connected to large game exploitation. The relation is weaker or nonexistent in sites with scant materials and high rates of tool retouch and exotic raw materials (e.g., Grotta Guattari, Grotta dei Moscerini [Kuhn 1995], and Yarımburgaz Cave in Thrace [Kuhn and Stiner 2010]). Delagnes and Rendu (2011) propose that the duration or length of lithic reduction sequences may also have varied with mobility and hunting strategies. The sparse hominin occupations in caves tend to intercalate or be intermixed with carnivore occupations (Brugal and Jaubert 1991; Gamble 1999; Patou-Mathis 2000; Speth and Tchernov 1998; Stiner 1994; Stiner, Arsebük, and Howell 1996; Straus 1982; Villa and Soressi 2000). Gamble (1986) was among the first to examine the distribution of this phenomenon across the Mediterranean area. Where hominid components are thin, carnivore components often are thick and easily recognized (e.g., Aura et al. 2002; Brugal and Jaubert 1991).

Other MP sites instead are dominated by hominid-generated debris. Early MP examples in the Levant include Hayonim Cave (Stiner 2005) and Misliya Cave (Yesherun, Bar-Oz, and Weinstein-Evron 2007). The quantities of faunal material in these sites are not tremendous relative to sediment volume, but all of the high-quality ungulate body parts that we would expect to be valued by hunters are represented along with hearth traces and evidence of butchering and marrow processing. Later MP examples are both more common and often richer in material, such as in Kebara Cave (Bar-Yosef et al. 1992; Speth and Tchernov 1998) and Qafzeh Cave (Rabinovich and Tchernov 1995). Comparable situations are reported throughout Europe (e.g., Chase 1986; David and Poulain 1990; Farizy, David, and Jaubert 1994; Gaudzinski 1995; Jaubert et al. 1990; Stiner 1994). Some of the variation in the density of material in MP sites must relate to the season of occupation (e.g., Boyle 2000; Hoffecker and Cleghorn 2000; Patou-Mathis 2000; Pike-Tay et al. 1999), and it seems likely that cold-weather camps may have lasted longer (e.g., Conard, Bolus, and Münzel 2012). However, the generally opposing relation between hominin and carnivore presence signals an important divide in the function of sites within MP territories. This phenomenon continues through the early UP in some regions, suggesting that low population densities could be part of the explanation.

The MP site record is not entirely trendless. There is an increase in the number of sites after about 70 ka (e.g., Mirazón Lahr and Foley 2003; Van Andel et al. 2003). The ravages of time complicate interpretation of this trend but cannot explain it away. Moreover, a higher proportion of the later MP sites were occupied more intensively. For example, human occupation intensity in the long consecutive sequences of Hayonim (early MP) and Kebara Caves (late MP) has been compared through integrated analyses of faunal and lithic assemblages, hearth features, and wood ash deposits (Meignen, Speth, and Stiner 2006; Meignen et al. 2010). The MP occupations in Hayonim Cave are repetitive in content but small in scale. Thermoluminescence dates suggest a sediment accumulation rate of about 1 m per 10,000–15,000 years. By contrast, each meter accumulated in roughly 3,000 years in Kebara Cave (Goldberg and Bar-Yosef 1998), and the densities of lithic artifacts are also much higher.

While the intensity of human presence at Hayonim was generally low, all stages of stone tool production are in evidence (Meignen et al. 2010), and raw material came mainly from local sources (Delage, Meignen, and Bar-Yosef 2000). Ungulates and tortoises were exploited repeatedly, and evidence of fire-aided food preparation is widespread (Stiner 2005; Weiner, Goldberg, and Bar-Yosef 2002). Also common is evidence of postdepositional burning of bone and lithic material, indicating considerable reuse of certain locations within the cave (Stiner et al. 2001). The variety of economic activities represented tells us that Hayonim cave served mainly as a residential camp. Complete on-site core reduction and a diversified tool kit rule out the possibility of a special use site (Meignen et al. 2010). The pace of material buildup (density) was significantly higher overall during the late MP in Kebara Cave (Albert et al. 2000, 2003; Goldberg and Bar-Yosef 1998; Meignen et al. 2010; Weiner, Goldberg, and Bar-Yosef 2002). A concentrated bone midden occurs along the north wall in Units XI-IX (Speth and Tchernov 1998), and carcass processing and consumption occurred at spatially discrete locations inside the cave (Speth and Clark 2006; Speth and Tchernov 2007). Hearth features are prevalent and deeply stacked with little or any sediment formation between lenses (Bar-Yosef et al. 1992; Meignen, Bar-Yosef, and Goldberg 1989). A full suite of lithic production is represented in Kebara (Meignen et al. 2010), generally on local flint, and the tools were used for diverse tasks, including butchery, woodworking, cutting, and scraping of hard and medium materials (Plisson and Beyries 1998; Shea 1991). The absence of exotic raw material and the complete reduction sequence of cores in the site indicate large, well-stocked encampments of prolonged duration (Meignen et al. 2010). Some MP layers in Kebara Cave display considerable heterogeneity in site structure, apparently in response to rapid debris buildup. The relegation of bone trash along the peripheries of habitation areas is expected to increase with the duration of an occupation (Binford 1978, 1991, 1998; Brooks 1984; Galanidou 2000; Gorecki 1991). This condition is not seen in the early MP of Hayonim Cave even though this site and Kebara served mainly as residential encampments. There evidently was more impetus to manage domestic space in the later, denser site.

Residential camps are places where all group members may congregate and engage in a wide range of activities. By this definition, residential camps are clearly in evidence throughout the MP and UP. If we try to count the number of distinct activities in dense sites, however, there seem to be fewer represented in MP camps than in UP camps (and fewer still in the late LP camps). Trends in the complexity of site activity histories may be undermined by differential preservation but not where durable classes of technological material are involved.

There is at least one other aspect of site use—the centrality of fire—that may define the MP period as a whole. Fire technology emerged well before the MP (Alperson-Afil and Goren-Inbar 2010; Gowlett et al. 2005; Karkanas et al. 2007; Preece et al. 2006), but the record of fire becomes ubiquitous with the beginning of the MP (e.g., Albert, Berna, and Goldberg 2012; Fernández Peris et al. 2012; Goldberg et al. 2012; Roebroeks and Villa 2011; Rolland 2004; Vallverdú et al. 2012). Hearths were magnets for carcass processing activities in MP residential sites (Rosell et al. 2012; Speth 2006; Stiner 2005; Vallverdú et al. 2012; Vaquero and Pastó 2001), and they probably were intensely social spaces as well (Foley and Gamble 2009; Gamble 1999). Evidence of fire is not preserved in every MP site, but it is as common in MP sites as it is in UP sites if time-dependent preservation is taken into account (Roebroeks and Villa 2011). Sandgathe et al. (2011) take a different view, arguing that fire only became a regular part of life in the late MP, and that earlier use of fire was limited to curation of live coals obtained from natural fires. It is difficult to reconcile Sandgathe et al.'s interpretation against the rich, long-term fire records in the late LP site of Qesem Cave based on the distribution of burned bones (Stiner, Barkai, and Gopher 2011), the early MP of Hayonim Cave (Weiner, Goldberg, and Bar-Yosef 2002) and Bolomor Cave (Fernández Peris et al. 2012), or geologist A. Segre's observations from the excavation of Grotta dei Moscerini (Stiner 1994:46–52). Repeated use of fire in these early cultural series spans distinct climate cycles and environmental regimes. It is interesting that MP fire records are much clearer in some regions than in others and not necessarily in the coldest environments. Whether this anomaly reflects regional behavioral differences or taphonomic differences in preservation potential (Goldberg et al. 2012) is not fully resolved, but probably it is due to the latter.

Evidence Summary

It is a good deal easier to find subsistence trends between the MP and the periods before and after it than within the MP itself. The transition from the late LP to early MP seems gradual with respect to dependence on large game, basic hunting equipment, aspects of blade technology, and prey age selection. One possible contrast to the late LP is a more complex pattern of meat butchering and sharing based on cutmark data, but more work is needed on this issue. Another contrast to the LP is the consistent and rather more complex "residential" nature of many MP sites, including the ubiquity of fire. The emergence of burial customs and pigment use also set the MP apart from the late LP. These practices almost certainly relate to important social developments in the MP even if we do not know just what they were about. The shifts between the MP and early UP tend to be more abrupt, although not with respect to big game hunting or the dense-ephemeral site contrast within territories. However, the UP displays novel solutions for managing foraging risk through clear expansions in dietary breadth, the use of artistic media, and rapid technological diversification. A number of archaeologists argue that these qualities of the UP contributed to greater population stability and environmental carrying capacity.

These observations have led to an impression of MP populations as proverbially stuck in the mud, left behind by evolution. Sampling and preservation issues notwithstanding, the late MP may hint at a few subtle changes within the period. Hominin populations may have grown, based on site structure evidence and numbers of sites, although there are few if any indications of increased predator pressure on large or small animals resources (but see Speth and Tchernov 2007 on Levantine cases). Dated burials also cluster in the later part of the MP. And the late introduction of stone-tipped hunting weapons suggests mild increases in hunting efficiency in some regions. MP meat diets nonetheless remained narrow nearly everywhere.

Part of the explanation for greater diet breadth in the African MSA could be environmental, because so much of the MP range falls in higher latitude environments, where the choice of animal and plant foods would have been less varied. The same cannot be argued for the contrast between the Mediterranean MP (including the late MP) and the early UP, as both existed sequentially in the same parts of the world and each weathered many shifts in climate, environment, and food supplies. Dietary and technological evidence show us that both MP and UP societies depended on systems of divided, collaborative labor, but MP activities indicate a narrower spectrum of on-site activities and probably greater uniformity in ranging patterns of group members.

The most readily visible differences between the early and late MP seem to be about numbers of people—rates of site visitation, population density at the regional scale, and possibly social group sizes. The potential for population growth in the MP would have been severely constrained by frequent residential moves and an economy based on a high-quality but unpredictable nutrient supply (Boone 2002; Münzel and Conard 2004; Stiner, Munro, and Surovell 2000). Of course, MP females maintained viable levels of reproductive success through thick and thin. How did they pull it off, if the social safety nets of the MP did not extend very far beyond the boundaries of small groups? In the absence of reliable regional networks, group coherence, vigilant concern for group members, and close cooperation would have been utterly critical to MP survival. One would also expect males to remain in natal territories through adulthood if large game hunting were the core of the economy. Recent findings by Lalueza-Fox et al. (2011) on the late MP individuals from El Sidron Cave suggest that may indeed have been the case.

Why Is There Not More Variation within the MP?

One of the great challenges to studying the MP is explaining the appearance of stasis in spite of the considerable intelligence of these hominins. Middle Paleolithic humans existed on narrow meat diets across a wide range of latitudes. Why was there not more variation in small game use in the biotically diverse Mediterranean Basin? The prey animals were there. The typically low population densities of the MP are part of the answer. A heavy dependence on large game implies a very high position in the food web, and it seems that consumer abundance seldom exceeded the supply of high-quality foods at the regional scale. While large game animals can yield high average return rates, they associate with high variances in supply (reviewed in Kelly 1995; Kuhn and Stiner 2006) and thus limit the reproductive potential of any highly carnivorous population. These populations compensate with high mobility, which also facilitates recolonization where local extinctions occurred.

It is striking that even the late MP cultural record changed only a little, because this is generally when AMH populations expanded into Eurasia. The conservative nature of MP culture may have been the outcome of a very successful and long-standing adaptation, one that became fixed via the process of specialization. Paleolithic archaeologists, including me, have vacillated to and fro in attempts to classify hunter-gatherer foraging as more specialized or generalized. Some of the confusion stems from how the terms may be applied at several distinct scales of behavior. All hominins were omnivores, for example, and omnivorousness connotes a "generalist" feeding strategy. Specialization is only informative if considered for one well-controlled aspect of econiche at a time. Middle Paleolithic hominins were unusually specialized in their focus on large game, with limited supplementation from small game animals. Streamlining and elegance are common signatures of specialization along with a narrower tolerance range in one or more dimensions of niche (Pianka 1978:253–256). Specialization brings greater efficiency in the exploitation of certain core resources that in turn may reduce the group's ability to be efficient in exploiting others. Because of this, it is difficult for specialists to retreat from time-hardened success. Middle Paleolithic populations went far down the path of large game specialization, a path made possible in part by high ungulate biomass during the ice ages (e.g., Discamps 2011).

The low population densities of the MP raise questions about the importance of cultural drift, because isolation can foster regional variation and distinct trajectories of change over the long term. Of course high mobility and the telegraphic scent of fire meant that MP folk were not totally cut off from one another. Considerable temporal and spatial variation nonetheless exists in the details of MP stone working. Rather than periodic, directional diffusion of novel ways of doing things, we see rather stochastic patterns or reappearance of a set array of technological variants in different areas (e.g., Delagnes and Meignen 2006; Kuhn 2013; Moncel and Daujeard 2012; Peresani 2012; Vaquero et al. 2012). This pattern may be a consequence of demographic factors in that low-density populations are subject to comparatively high rates of local extinction and recolonization. These conditions would reduce the probability of cumulative cultural evolution via complex learning traditions while promoting some degree of nondirectional variation in material culture (Premo and Kuhn 2010; Stiner and Kuhn 2006). The MP has the appearance of a stable adaptation with plenty of flexibility built into it. But it was headed nowhere in particular—no evidence of strong directional selection—consistent with the status of a successful and well-tuned system. The MP was not a dead end in itself but rather the victim of the historically unique colonization by a competing population.

A Zooarchaeological Agenda

The evidence synthesized in this essay exposes some clear-cut opportunities for further research. Specifically, how different were MSA and MP population responses to food supplies if, for example, we compare them during climate intervals of more stability and less stability at a millennial scale (see also Clark and Kandel 2013)? So-called Mediterranean-type environments exist in southern Europe, the Levant, North Africa, and South Africa. The temporal and spatial records are not yet well connected in climate science, but these regions can serve as geographic laboratories. The null hypothesis would be that climate is not the driver of human behavioral evolution. Siddall and colleagues (Siddall, Chappell, and Potter 2006; Siddall et al. 2003) identify the climate intervals of 40–80, 120–140, and 160–200 ka as particularly variable based on Red Sea–Ocean proxies for global sea level changes. They identify the climate intervals of 80–120, 140–160, and 200–220 ka as least variable. The most recent contrasting pair of intervals, 40–80 and 80–120 ka, seem particularly suitable for comparisons of MP and MSA strategies because faunal and other data are fairly abundant.

In order to undertake such a comparison, two other things must be done. First, zooarchaeologists must get away from making lists of anecdotal evidence and focus on systematic, quantitative analysis of the full scope of the animal diet (big, small, vertebrate, and shelled invertebrate). Richard Klein and colleagues have set a remarkable precedent for a holistic mode of data presentation in South Africa, a practice that sadly is out of vogue. The same limitations once applied to zooarchaeological work in Eurasia, but this has changed in the past few decades, and now there are complete faunal accounts for much of southern Eurasia. Second, although we cannot hope to calibrate quantitative faunal data to plant consumption for the Paleolithic in any region, what we can do is compare the faunal record in quantity and character with the record of durable plant processing equipment in a more controlled manner. The idea would be to look for evidence of heightened processing investments in plant use. Scattered reports, mainly anecdotal, suggest that ground-stone artifacts are fairly common in some MSA records. Given that these artifacts are not a notable part of MP records, here lies a potential contrast waiting for systematic consideration. Of course small MSA milling equipment suitable for preparing mineral and organic pigments must be distinguished from large implements suitable for seed processing, but experimental evidence provides some expectations. Such a strategy might provide an alternative way of looking at the problem of how and why the MP and MSA seem different from one another and assessing the independence of their evolutionary trajectories.

Acknowledgments

This paper is an outcome of the 2012 Wenner-Gren Symposium held in Sweden and titled "Alternative Paths to Complexity: Evolutionary Trajectories in the Middle Paleolithic and Middle Stone Age." I am deeply grateful to the organizers of this conference, Erella Hovers and Steve Kuhn, and to Wenner-Gren colleagues Leslie Aiello and Laurie Obbink for their many efforts in making this one of the most stimulating and enriching symposia in which I have had the honor to participate. I also thank Jamie Clark and two anonymous *Current Anthropology* reviewers for their thoughtful and critical remarks on an earlier version of this paper that certainly helped improve it.

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