Chapter 2

KABAZI V: FAUNAL EXPLOITATION AT A MIDDLE PALEOLITHIC ROCKSHELTER IN WESTERN CRIMEA

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INTRODUCTION

Kabazi V is a collapsed rockshelter in the line of limestone cliffs bordering the Alma River valley and its tributary valley, the Kalinovaya. First discovered in 1983, the site is currently being excavated by A. I. Yevtushenko. Although the lithic assemblages from Kabazi V have been extensively analyzed and published (Kolosov et al. 1993; Yevtushenko 1995, 1998), the faunal assemblages have not. The Kabazi V faunal assemblages described in this report were excavated during the 1986, 1990, 1993, and 1994 field seasons. Occupation levels at Kabazi V occur within four major stratigraphic units: Units I, II, III, and IV (Yevtushenko 1998a). These stratigraphic units correspond to major depositional sequences whose evolution is largely shaped by the history of the rockshelter, its collapse, and subsequent slope formation processes (Yevtushenko 1998a). Archeological levels are numbered sequentially within each stratigraphic unit (e.g., Level I/1 is the first archeological level in Unit I, and so on). A total of eighteen archeological levels have been excavated to date. The excavator has also grouped the occupation levels into cultural complexes on typological grounds (Yevtushenko 1998).

The faunal collection analyzed in this report derives from stratigraphic Units I, II, and III. Sediments from Unit I are disturbed, and little fauna was recovered from archeological Levels I/1 and I/2. Unit II corresponds to geological stratum D, a period of rapid deposition of soils over the collapsed rockshelter by colluvial and possibly eolian sedimentation processes (Yevtushenko 1998a). A series of six archeological levels containing heavily fragmented faunal remains is preserved in Unit II. The base of Unit II (stratum D) is composed of limestone blocks, resulting from the rockshelter collapse. Unit III is therefore sealed. Unit III corresponds to stratum E, which was divided by geologist C. R. Ferring into three sub-strata on the basis of an erosional disconformity (Yevtushenko 1998a). This unit is composed of a series of thin deposits, or living floors, containing hearths, which accumulated under the rockshelter and yielded somewhat more fragmentary bone assemblages than those of Unit II. Levels III/1, III/1a, III/2, and III/3 of Unit III are examined in this report.

Taphonomically, the three stratigraphic units of Kabazi V present the researcher with three distinct problem sets. As a result, and due to the generally small size of bone assemblages from each level, assemblages from the same units are grouped into collections for most of the following discussion except where noted.

Taxonomic identifications were done using modern reference collections at the University of Manitoba, and modern and paleontological reference collections at the Institut de Paléontologie Humaine (Musée National d'Histoire Naturelle, Paris) and at the Canadian Museum of Nature (Hull, Quebec). The basic methodology for establishing taxonomic identifications is outlined in Chapter 1.

RESULTS

A total of 7,292 faunal remains were processed from Unit I (155 remains), Unit II (4,856), and Unit III (2,281). As a whole, 24.5% of the collection (NISP = 1,787) was identifiable to taxon, or minimally, to size class. Of the sample, 8.9% (N = 650) was identifiable to taxon/size category and element. Size classes used for this research are: *Equus*/Bos-sized (OXO); Large Artiodactyl sized, i.e., red-deer sized, (LAR); Small Artiodactyl (SAR); Medium Mammal (MM); and Small Mammal (SM). Rib and vertebral fragments are generally identifiable only to size class. The OXO class is probably dominated by equids (*E. hydruntinus*) and the SAR class is likely dominated by *Saiga tatarica* (compare fig. 2-1 and fig. 2-2).

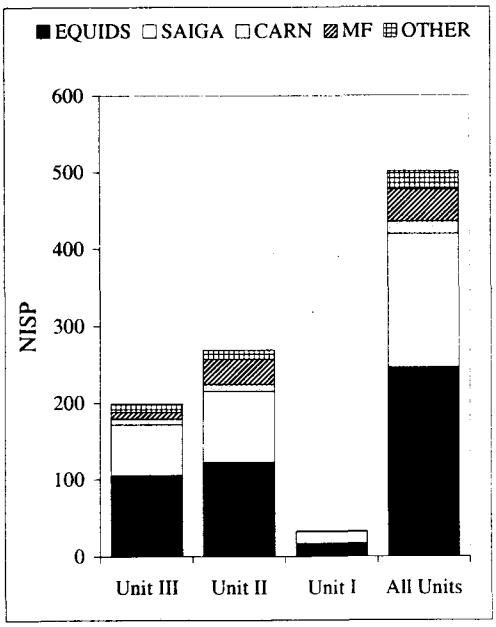

Fig. 2-1—Kabazi V, identified taxa per unit.

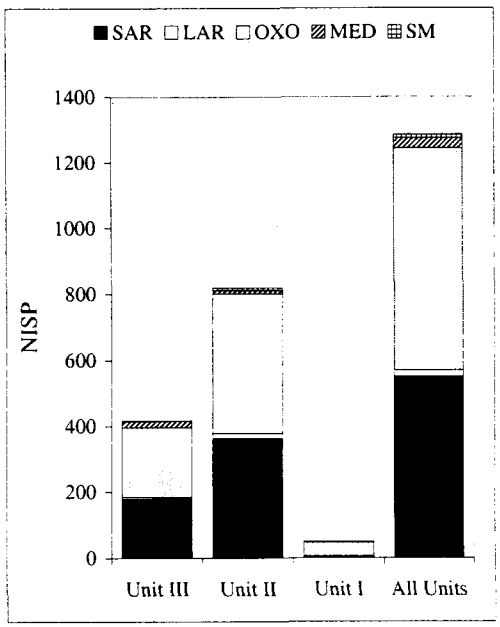

Fig. 2-2—Kabazi V, size class representation.

The remainder of the bones was counted and sorted according to size (greater or less than 2 centimeters). Most of the unidentifiable bone fragments are shaft fragments and 95.5% of the fragments are under 2 cm maximum length.

TAXONOMIC IDENTIFICATION

The Kabazi V faunal collection is globally dominated by *Saiga tatarica* and equids, including *E. hydruntinus*, *E. caballus*, and *Equus sp.* (Tables 2-1, 2-2; fig. 2-1). Other taxa are significantly less numerous than *Equus* and Saiga and include, in order of importance, *Cervus elaphus, Crocuta crocuta, Bos/Bison sp., Sus sp., Vulpes cf. vulpes, Ursus sp.*, a large artiodactyl *cf. Rangifer*, an ovicaprid, and very fragmentary megafaunal elements (some of which are attributable to Coelodonta). In addition, a small number of bird bones are present and have been identified as raptors.

Together, Saiga and the SAR class fragments represent 40.4% of the total identifiable specimens (fig. 2-2). Saiga alone represents 9.7% of NISP. The equids and the OXO class represent 54.2% of NISP. Bones definitely attributable to *E. hydruntinus* represent 3% of

NISP. Carnivores, often represented only by teeth, comprise 0.8% of NISP. The ratio of MNI to NISP is very low overall.

Relative taxonomic abundance does not change much from unit to unit, if sample size and

TABLE 2-1
Kabazi V, Identified Taxa (NISP)

	Unit I	*Unit II*	*Unit III*
Equus hydruntinus	11	23	20
Equus caballus	1	2	–
Equus sp.	5	98	86
Saiga tatarica	15	92	66
Bos/Bison sp.	–	3	2
Cervus elaphus	–	2	1
Capreolus capreolus	–	–	2
Sus scrofa	–	2	2
Cervus sp.	1	3	–
Ovicaprid	–	1	–
cf. Rangifer	–	–	1
Coelodont	–	12	3
Crocuta crocuta	–	3	–
Ursus sp.	–	2	1
cf. Vulpes	–	1	–
Canid	–	2	5
Unidentified carnivore	–	1	1
Lepus sp.	–	–	1
Aves (Raptor)	–	1	3

its probable effect on taxonomic diversity are taken into consideration. A very small collection from Unit I, Levels I/1 and I/2 (disturbed deposits) yielded only 83 taxonomically identifiable bones, dominated by Saiga and *Equus hydruntinus* (Tables 2-1, 2-2). No other species could be identified from this unit. Unit II is dominated by Saiga and *E. hydruntinus*, as is Unit III. Both Unit II and Unit III contain other, less numerically important taxa, in similar proportions. Carnivores are present in Units II and III, and represent 0.8% and 1.1% of the total NISP per unit, respectively (fig. 2-1). Carnivores include hyena (the most numerous taxon present), fox, a medium-sized canid, and bear.

TABLE 2-2
Kabazi V, Minimum Number of Individuals[1]

	Unit I	*Unit II*	*Unit III*
Equids	2	8	7
Saiga	3	8	8
Carnivores[2]	1	4	3
Levels sampled (N)	2	5	4

[1]For species other than *E. hydruntinus* and Saiga, MNI = 1 (see Table 2-1).
[2]Includes all carnivores; in all levels MNI = 1.

Environmental Significance of the Identified Taxa

The fauna of Kabazi V is generally dominated by an open, steppic component composed of Saiga and *Equus*. Other taxa—in some cases indicative of very different environmental conditions—are also present in Units II and III, however (Table 2-1). The presence of pig (*Sus* sp.) and red deer (*Cervus elaphus*) indicates that the environment near the site during the time of human occupation of Units II and III included a closed (woodland/forest) humid component, as well as an open steppic component. Wild pig and red deer, well-attested elsewhere in the region, though never numerous (Vereshchagin 1967), indicate both the presence of tree cover and ready access to water. In all probability, these taxa inhabited the river valleys below the site where both water and tree cover must have been available, at least seasonally. Paleoenvironmental reconstructions for Kabazi V must take into consideration the position of the site at the interface between what were two distinct environmental zones: the open plain, or cuesta above the site, and the river valley below.

The single large artiodactyl specimen identified potentially as *Rangifer tarandus* (from archeological Level III/1) might indicate a rigorous cold period. *R. tarandus* is reported in small numbers in other Middle Paleolithic sites in Crimea (e.g., Kolosov 1986; Gvozdover et al. 1996; Chapter 1, this volume). At Kabazi V, however, it occurs with the more mesic suid, and therefore could be a member of a remnant population on the brink of extirpation.

The presence of raptors in Units II and III is easily explainable due to the location of the site below a prominent limestone cliff (part of the Kabazi massif), which provides ideal nesting sites for numerous bird species. A variety of hawks, and even eagles, are frequently seen drifting high above the site to this day.

Human Exploitation of the Environment

In all probability, the people using Kabazi V rockshelter during the formation of Unit III, or camping on the slope covering the collapsed shelter during the formation of Unit II, were exploiting both the cuesta above, and river valley environments below the site. The clear dominance of steppe-dwelling fauna (saiga and equids), however, indicates that the focus of hunting activities by humans was on steppic species, rather than on species dwelling in the river valley. Although other climatic indicators seem to point to changes in the local and regional environment of the site during the formation of Units I, II, and III (see Chapters 4-6), changes in the dominant prey species are not apparent. Faunal exploitation patterns at Kabazi V did not change much over time, despite an evolution in the local landscape and climate.

Taphonomy of the Kabazi V Faunal Assemblages

Based on observations made on identifiable bones at Kabazi V, post-depositional taphonomic factors differ in Units I, II, and III, and we may expect bone preservation to reflect these differences. In Unit I, sediments accumulated on a distinct slope, and were reworked as a result of slope-wash, rolling, and redeposition. In Unit II, the archeological horizons were deposited in the open-air, on a relatively stable slope, but in a context of relatively rapid sedimentation rates (Yevtushenko 1998a). Deposits accumulating rapidly over the Unit II occupation levels should have provided some protection from trampling, weathering, and rolling—though weathering should still have played an important role in bone preservation. Soil formation over archeological occupations in Unit III was relatively slow (due to the rock-shelter), hypothetically leaving bones exposed to trampling, but the protected nature of the depositional context should have limited weathering effects.

Weathering

Weathering effects (cracking, exfoliation, root etching) were scored on identifiable bone only. The collection from Unit I is too small to evaluate properly, but bone preservation appears generally poor. Unit II shows expected signs of weathering on bone surfaces; cracking and exfoliation are apparent, as well as root etching. These weathering effects appear to have been slight, however. The most affected archeological levels are Level II/3 (weathered bone, N=28) and Level II/4 (weathered bone, N=7). In all, 3.3% of the NISP for Unit II showed distinct signs of weathering and 1.3% of the NISP was etched. Visual appraisal of the overall condition of the unidentifiable bone confirms that bone from Unit II was generally mildly weathered and root-etched, as well as showing traces of carbonate adhesions. This pattern of mild weathering in an open-air locale can be attributed to the fairly rapid rate of sedimentation noted above. Lack of root etching in Unit II is at least partly attributable to the sloping nature of the deposits, which were exposed to erosional processes and would not have been favorable to vigorous plant growth.

The pattern of weathering in Unit III is somewhat more severe and runs counter to expectations. Surficial damage was noted in 4.8% (N=30) of NISP, and root damage occurs in 3.4% (N=21) of the identifiable bone. Most of the weathering and root damage, however, occurs in archeological Levels III/1a (weather, N=13; root, N=2) and III/1 (weather N=11, root N=16). Unidentified bone from these levels is generally unaffected by root and weather damage. Levels III/2 and III/3 show few signs of weathering. Since this was a sheltered locale, weathering was not expected to be severe in Unit III. An analysis of the horizontal distribution of weathered bone in Unit III (Levels III/1a and III/1) reveals that most of the weathered bone is situated towards the front and to the south of the rockshelter.

Trampling

Unit II bone shows little sign of trampling (surficial polish or multiple parallel abrasions). Only 1.0% (N=11) of identified bone showed signs of polish or abrasions attributable to trampling. Unit III bone also shows little sign of trampling, only 1.8% of identifiable bone (N=11). The generally slight evidence of trampling in these collections may indicate that the site was either occupied only briefly, or only occupied by a small number of people. In all probability, the intervals between successive occupations were sufficiently long to allow protective layers of sediment to be deposited on the abandoned living floors. In the case of Unit III, where sedimentation was slow, this may even indicate relatively long occupational hiatuses (e.g., more than one year).

Bone Destruction by Non-Human Agents

The presence of various carnivores at the site, particularly the presence of *Crocuta*, requires that bone survivorship must be assessed in the light of possible bone destruction by agents other than humans. Evidence of carnivore gnawing, and leached or polished bone resulting from exposure to gastric juices, is found in Unit II (gnawed N=3, regurgitated N=7) and in Unit III (gnawed N=1, regurgitated N=3). In total, 0.9% of identifiable bone in Unit II was carnivore damaged, and 0.7% of the bone in Unit III. Most of the gnawed and regurgitated bone in Unit II is found in Level II/4, where a partial hyena mandible was also found (fig. 2-3). Rodent gnawing was only identified in two cases, in Unit I and in Level II/4, which accords well with the relatively small microfaunal assemblage recovered from the site (Chapter 4).

Given the archeological context, and the relative scarcity of carnivore-induced trauma,

human agents are the most likely agents of bone accumulation and destruction at Kabazi V, with the scavenging activities of other carnivores being carried out peripherally, probably after the site was abandoned by its human inhabitants.

Bone Destruction by Humans

Evidence of hearths occurs in all levels of Unit II. According to the excavator, large quantities of burned bone were recovered from these levels (Yevtushenko, personal communication 1996). In Unit III, hearths were found in each level, and burned bone was also recovered in quantity. No wood charcoal was recovered in either Unit II or Unit III (Yevtushenko, personal communication 1996). It is therefore likely that bone was used as a combustible and will have affected bone survivorship patterns. Even if bone was not being used as fuel, but was burned as a result of food preparation or the disposal of cooking refuse, patterns of bone survivorship at Kabazi V will have been affected by a variety of factors including burning. Burning affects the degree to which carnivores/scavengers further damage bone (Lupo 1995) and may partly explain the general lack of evidence of gnawing.

A detailed study of bone survivorship patterns is hampered by the degree of fragmentation and the unknown quantity of bone charcoal discarded prior to this study. The pattern of element survivorship does not appear to change much between Units II and III, however (Table 2-3). It should be borne in mind that teeth have inflated NISP counts relative to other elements, due to their natural abundance and generally high survivorship. It is apparent that podial elements (metapodials, astragali, calcanei, phalanges) and crania (skull fragments and teeth) dominate the element distribution (Table 2-3). Globally, skull fragments and teeth represent 39.0% of the total number of identified elements (N=650) in Table 2-3. Podial elements represent 31.5% of the total. Scapulae, ribs, vertebrae, and other elements are all clearly under-represented in this distribution.

The relative over-representation of feet and skulls could indicate that a "gourmet" strategy—whereby only choice, meat-bearing bones are transported to the site—was not employed (Binford 1981). Perhaps Saiga and the relatively small *Equus hydruntinus* were easily transported in large portions—maybe even as complete carcasses in the case of Saiga. It seems more likely, however, in light of other taphonomic indicators, that bone destruction during processing and the use of long-bones for fuel resulted in the differential preservation of meat and marrow-rich relatively less dense limb-bones, as well as the relatively fragile and meat-rich elements such as ribs and vertebrae.

Cutmarks are not common in the Kabazi V assemblage, though this is probably a result of the pattern of bone destruction documented (both fragmentation and burning). In Unit I, no marks were identified. In Unit II, few (N = 8) bones bore clear cutmarks, and in Unit III only 9 bones with cutmarks and 4 bone flakes (potentially the result of human butchering) were identified (0.57% of the total NISP). Cut marks are concentrated on podial elements, such as phalanges, astragali, and calcanei. Bone fragments used as retouchers (to shape and re-sharpen flint tools) at Kabazi V are reported elsewhere (Yevtushenko 1995, 1998b).

Bone Refitting

In all three units, some bone refitting was possible. In Unit I, two series of first and second Saiga phalanges articulate. In Unit II, Level II/4, two equid molars refitted into a mandibular fragment; in Level II/4a two equid molars refitted; in Level II/7, an equid distal tibia articulated with a metatarsal and an accessory metatarsal, and a Saiga calcaneus articulated with an astragalus. In Unit III, Level 1, three equid teeth could be refitted. These refits indicate that entire lower limbs (feet, metapodia, and distal tibia) were brought to the site. In

TABLE 2-3
Kabazi V, Element Representation, for All Taxa[1]

NISP	*Unit I*	*Unit II*	*Unit III*
Skull	3	31	33
Upper tooth	5	41	18
Lower tooth	8	59	56
Sub-Total	*16*	*131*	*107*
Sesamoids	1	6	9
Carpals/tarsals	2	23	10
Astragalus	2	8	3
Calcaneus	0	5	0
First phalanx	5	21	9
Second phalanx	2	3	2
Third phalanx	4	5	10
Metapodia	2	42	31
Subtotal	*18*	*113*	*74*
Humerus	0	9	23
Radius/ulna	1	18	24
Femur	0	11	6
Tibia	2	18	17
Patella	2	1	0
Subtotal	*5*	*57*	*70*
Pelvis	0	5	1
Scapula	0	6	2
Vertebra	0	15	4
Ribs	1	13	12
Subtotal	*1*	*39*	*19*
Total	*40*	*340*	*270*

[1]Excluding *Aves*; includes only bones identifiable both to element and to taxon or size class; excludes teeth unassignable to upper or lower tooth rows, tooth fragments, incisors.

[2]Includes skull fragments unidentifiable to taxa, and mandibular fragments.

all probability, whole mandibles, if not whole skulls, were also transported to the site.

Taphonomy: Conclusions

The pattern of bone survivorship observed at Kabazi V is likely a result of the combined effects of human transport decisions, food preparation patterns, discard and post-depositional processes including non-human ravaging, and weathering factors related to the topographic location of the site. All of these factors will have acted to increase the relative representation of denser bones, such as podial elements and teeth. Given the archeological context and the relative lack of evidence of carnivore activity, processing by humans is the most likely cause of fragmentation at Kabazi V. The degree of fragmentation of the assemblage is high overall: 95% of the indeterminate bone has a maximum length of less than 2 cm. The remainder of the indeterminate bone ranges between 2 and 5 cm in length. High fragmentation, together with a quantity of burned bone, indicates intense bone processing took place in all units. This would be consistent with the identification of the site as a base camp. Here, bone was

Fig. 2-3—Kabazi V, *Crocuta crocuta* lower molars.

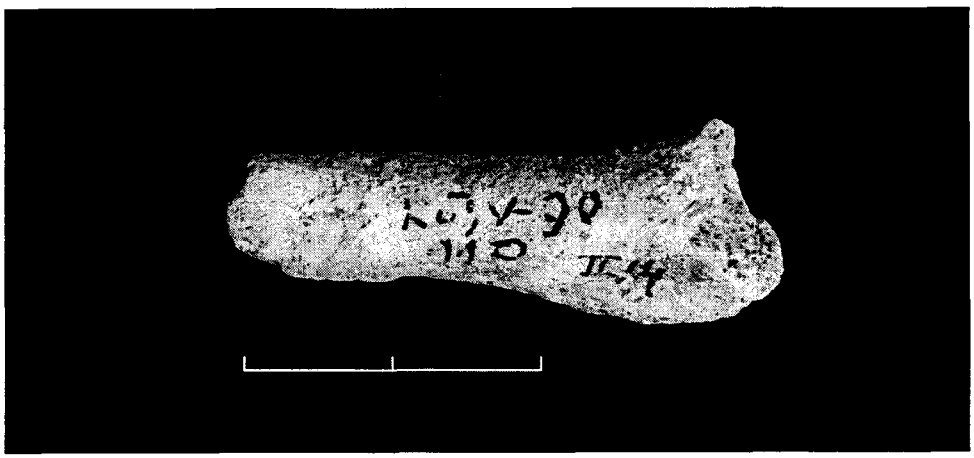

Fig. 2-4—Kabazi V, fetal *Equus hydruntinus* femur.

probably processed for both grease and marrow, food preparation occurred, and bone may have been used as fuel.

SEASONALITY AND AGE

MNI counts per species in each level rarely exceed single individuals (Table 2-2). Mortality profiles are therefore not available. Adults and juveniles of both Saiga and *Equus hydruntinus* were hunted in both Unit II and Unit III, however; fetal bone is present in both of these units. In Level II/4, a fetal equid femur can be estimated as slightly more than 100 days old (fig. 2-4). (Age of fetal elements was estimated using data obtained from x-rays of modern horse fetuses at various gestation stages, see Ginther 1979: fig. 9.51.) Equids in the wild typically conceive within a well-defined period, gestating over the winter and giving birth in April. As a result, these fetal elements can be used to estimate the season of occupation for Level II/4 as late summer or perhaps early fall. Other fetal bone, of indeterminate species, is present in Levels II-A, II/4, II/7, and III/1a. Since these most likely belong to Saiga or *Equus*, they suggest a roughly late summer to winter death. The presence of fetal bone, some of it probably Saiga, would support Barychnikov's conclusion (Barychnikov et al. 1994) that Saiga was reproducing in Crimea. Unfortunately, none of the indeterminate fetal bone is definitively identifiable as Saiga. In Level II/3, a partial fetal radius and femur, both probably equid, are similar in age to the Level II/4 individual. Aging data tend to support a hypothesis of late summer/fall occupation, though less concretely. Juvenile Saiga occur in Levels I/2, II-A, II/4, II/4a, II/7, III/1 and III/2, based on epiphyseal fusion. Teeth were rarely complete enough to permit aging using use-wear schedules, unfortunately. Since Saiga give birth within a short window from mid to end-April (Bannikov et al. 1961), these juvenile animals may be summer/late summer, or perhaps winter deaths. In Unit III, Levels III/1 and III/2, Saiga metapodia with unfused distal epiphyses indicate juvenile (in both cases probably late summer) mortality.

CONCLUSIONS

Site Function

Kabazi V was apparently used as a base for the processing of animal carcasses for meat, marrow, and/or grease, judging by the intensity of bone breakage patterns and the location of cut-marks. Whole carcasses may have been brought onto the site, but element representation patterns are too biased by a combination of human processing, burning, and post-depositional damage, to test this possibility.

Occupations appear to have been short-lived, or consisting of small numbers of occupants. Fetal equid and juvenile Saiga indicate a series of late summer/early winter occupations of Kabazi V. It is also clear from the data that gravid horses were hunted in the fall/early winter, or perhaps in late summer. The fact that bone was being burned for fuel supports an advanced season of occupation (fall/early winter), when the south-facing slope on which the site is situated would not have provided enough radiant heat for comfortable sleeping and ambient temperatures would have been lower. Intervals between re-occupations were sufficient to allow the accumulation of sediments which protected living floors from further trampling and/or weathering, especially in Unit II, and in Levels III/2 and III/3. The timing of occupations, site function, and prey selection patterns seem to have been fairly consistent throughout Units II and III. Changes in cultural complex do not appear to have had much impact on animal exploitation patterns.

Patterns of Animal Exploitation at Kabazi V

Kabazi V is well-situated geographically to monitor two distinct ecosystems: the open grasslands/steppes (or cuestas) above the site and the more humid, possibly forested, river valleys below it. The Middle Paleolithic occupants of Kabazi V hunted primarily steppe-dwelling Saiga and *Equus hydruntinus*. This does not mean that the inhabitants of the site hunted primarily on the steppes, however. Kabazi V is also well-situated to monitor the movements of animals in and out of major river valleys such as the Alma, which would have acted as channels to movements during migration periods, or refuges and sources of scarce water during periods of rigorous cold or drought.

Both of the dominant prey species at Kabazi V prefer dry, open grasslands, with Saiga in particular being intolerant of uneven, broken ground (Bannikov et al. 1961; Sher 1969) and therefore unlikely to be found on the slopes around the site. *Saiga tatarica* is a migratory species, gathering in vast herds during spring and late fall migrations, when their movements can be very unpredictable (Bannikov et al. 1961). Herds move hundreds of kilometers overnight and migration patterns can be very difficult to predict from one year to the next. During certain times of the year, however, water and snow are important limiting factors on their movements (Bannikov et al. 1961; Sher 1969), and are thus good predictors for their behavior. During dry winters, and during unusually dry summers when steppe plants are desiccated, saiga seek permanent water sources, or patches of snow (Sher 1969), often venturing into river valleys that they otherwise shun.

Equus hydruntinus may have behaved like steppe dwelling equids (such as *E. Kuon*) today, migrating in large herds across vast distances. Like saiga, equids generally prefer stable ground, avoiding steep slopes and uneven footing. However, feral horse herds in mountainous regions today make use of valley bottoms for their winter ranges, sheltering from the wind, and use valley slopes where snow is not deep (Waring 1983).

In their study of Paleolithic predation on saiga in Crimea, Barychnikov et al. (1994) uncovered a pattern of early summer/summer mortality in a number of Mousterian sites. Nevertheless, the authors also note the presence of late fall/winter deaths at Prolom II (Barychnikov et al. 1994: 468). They suggest a general pattern of winter predation focussed on males weakened by the rut (a hypothesis originally advanced by Rakov 1963), which cannot be confirmed here given the fragmentary nature of the Kabazi V assemblage. The prevalence of males is confirmed at a number of Middle Paleolithic sites in Crimea, other than Prolom II. The presence of fetal bones tentatively attributable to saiga suggests females also were preyed upon during the period following the rut, however. The stage of gestation is not advanced enough for them to be described as hampered in any way by their gravid state; that is, they would not have been easier prey. Barychnikov et al. suggest that, due to its rapid unpredictable movements, saiga is unlikely to have been selectively hunted by tracking. Hunting saiga with the aid of deadfalls and ambushes is proposed (Barychnikov et al. 1994: 468).

Thus, hunters taking saiga and horse, like the Middle Paleolithic hunters at Kabazi V, could have encountered their prey in the valleys or in the cuestas, depending upon the season. The seasonal evidence for Kabazi V seems to indicate a repeated pattern of late summer/fall occupations. This would support the identification of the site as a home base, occupied during fall migration seasons, and situated to take advantage of the presence of two major prey species in the valleys below the site. Whether the animals were hunted collaboratively, or selectively tracked by individuals, cannot be determined with the present data. Evidence for the probable occupation of Kabazi V by a small number of people for relatively short periods of time does not infer one or the other behavior. Other prey species, less abundant naturally (a result of their ethology, e.g., pigs and red deer) were probably hunted as

encountered in the valley below the site—but were probably not a major factor in human decisions regarding site emplacement.