Chapter 1

BUTCHERING AND SCAVENGING AT THE MIDDLE PALEOLITHIC SITE OF STAROSELE

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INTRODUCTION

The Starosele collection of animal bones from Alexander Formozov's original excavations in 1952-1956, originally reported by Formozov (1958) and subsequently re-analyzed (Vereshchagin and Baryshnikov 1981; Gvozdover et al. 1996), is heavily dominated by *Equus hydruntinus*. Traces of butchering activity are mentioned in the original report, as is the presence of bone retouchers. As a result of the obvious numerical importance of horse, and the location of the site in a steep-sided box canyon, Starosele has been referred to in the literature as a communal hunt, or jump-site (Lioubin and Barychnikov 1984: 227), and as an example of highly specialized hunting practices (Vereshchagin 1967; Gábori 1976: 133).

Formozov thought that the Middle Paleolithic occupation of Starosele took place during the Riss-Würm Interglacial (Formozov 1958: 47). The presence of arctic fox and reindeer in these deposits, as reported by Formozov, was taken by Klein (1965: 48), however, as indicative of a glacial epoch. Gábori (1976: 123) described Middle Paleolithic faunas from Crimea as generally steppic in character—with the exception of Shaitan-Koba and Starosele, which contained sub-arctic indicator-species. Recently excavated faunal assemblages from Starosele, discussed in this research, are also generally indicative of steppic conditions with chronological changes in the microenvironment of the site. Climatic conditions at the site also evolve over time, with glacial (or sub-arctic) indicators in the lowermost levels (Table 1-1; Chapters 4 and 5).

During his excavations at Starosele, Formozov distinguished two "levels" below and above a significant rock-fall, which differed in a clustering of artifacts and bones in the lower level, versus more thinly and evenly distributed material above it (Klein 1965: 47). He considered these two levels, however, as essentially the same in all respects and described all of the materials as a single unit in his 1958 monograph on the site (Demidenko 1998). Consequently, the faunal remains resulting from Formozov's excavations are always reported in the literature as a single assemblage. Recent re-excavation of the site has revealed the existence of *four* distinct archeological levels dated to the Middle Paleolithic (Marks et al. 1998). There is a very high probability that the faunal assemblages described in Formozov (1958) and discussed later in the literature derive from more than one level. This is supported by the author's 1997 inspection of a small portion of the original faunal collection from Starosele, housed at the Institute of Geology RAS, Laboratory of Quaternary Geology, in Moscow. The state of preservation of the bones would appear to confirm that several levels are conflated as one. Some of the bone clearly derived from what is now recognized as Level 2, while some clearly derived from either Levels 3 or 4. Community structure and paleoenvironmental reconstructions based on these earlier reports should therefore be treated with a great deal of caution.

In the new faunal analysis, based on the 1993-1995 excavations of Starosele, the overall similarity in taxonomic representation between levels at Starosele is offset by significant differences in depositional history and cultural context. Spatial analyses of the faunal assemblages are restricted in this report, due to the fact that the modern excavations were necessarily limited in extent, and represent an unknown sample of the original site area. Nevertheless, several characteristics of the faunal assemblages, examined in detail below, allow us to interpret the sequence of human and animal occupations at the site, relative to major landscape events and transformations. Finally, the large mammal fauna from Starosele, in conjunction with microfauna and malacofauna data, help build a picture of the local and regional environments (Chapter 7). While steppic habitats were clearly dominant, the site itself is located in a box canyon within which a riparian microenvironment existed at times.

THE RECENT FAUNAL COLLECTION FROM STAROSELE

Faunal assemblages from four archeological levels (Levels 1 to 4) are described in detail below. A mixed assemblage (Level 0), derived from disturbed levels above the uppermost Middle Paleolithic occupation level (Level 1), is also briefly described. Fauna was also collected from archeologically sterile soils below Level 4, and this collection is referred to as "Below 4."

A large percentage of the total collection from Starosele was identified in the field. Faunal remains from recent excavations at Starosele number 10,979 pieces in total, excluding the small collections from archeologically sterile levels and the microfaunal and malacological assemblages (see Table 1-1). Just over thirty percent of the collection is identifiable to either

TABLE 1-1
Starosele, NISP and MNI (in parentheses) by Level

	Level 4	*Level 3*	*Level 2*	*Level 1*	*Level 0*	*Below 4*	*Total*
Equus (all)	326 (4)	380 (8)	182 (3)	1108 (12)	69	164	2229
Saiga tatarica	1 (1)	25 (2)	5 (1)	31 (2)	1	–	63
Cervus elaphus	– –	7 (1)	– –	8 (2)	–	–	15
Rupicapra rupicapra	– –	1 (1)	– –	2 (1)	–	–	3
Cervus sp.	2 (1)	10 (1)	2 (1)	9 (1)	–	–	23
Bos/Bison	3 (1)	8 (1)	2 (1)	37 (1)	6	1	57
Rangifer sp.	– –	1 (1)	– –	– –	–	–	1
Sus scrofa	– –	1 (1)	– –	– –	1	–	2
Ovicaprid	– –	– –	– –	– –	1	–	1
Hyena crocuta	– –	6 (1)	3 (1)	3 (1)	1	–	13
Ursus sp.	– –	2 (1)	– –	2 (1)	–	–	2
Vulpes vulpes	– –	31 (2)	– –	1 (1)	1	–	33
Canis sp.	– –	7 (1)	– –	17 (1)	3	–	27
Canis lupus	– –	1 (1)	– –	– –	–	–	1
Unidentified Carnivore	– –	8 (1)	– –	2 (1)	–	–	10
Subtotal							*2480*
Small Mammal	–	20	1	4	2	–	27
Medium Mammal	5	20	14	35	3	2	79
Small artiodactyl	3	63	14	116	4	1	201
Large artiodactyl	25	23	2	74	5	–	129
Equus/Bos Sized Mammal	21	164	30	175	14	21	425
Megafauna	–	–	–	2	–	–	2
Subtotal							*863*
Unidentified Mammal	246	4650	548	1898	14	–	7356
Total	*632*	*5426*	*803*	*3524*	*125*	*469*	*10979*

taxon, or minimally, to element and size class. Size classes used for this research are: *Equus*/ Bos-sized (OXO); Large Artiodactyl, i.e., Cervus-sized (LAR); Small Artiodactyl (SAR); Medium Mammal (MM); and Small Mammal (SM). Rib and vertebral fragments are generally identifiable only to size class.

Fragmentation in each level is measured on identified elements only: each bone is scored in terms of completeness using a scale of 1 to 4 (less than 25%, 25-50%, 50-75%, 75-100%). Results are discussed in the appropriate sections below, but it is clear that fragmentation is both extensive and intense (Lyman 1994: 333).

Unidentifiable fragments of bone were sorted into two size classes—under 2 cm and over 2 cm—before being counted and weighed in the field (by D. Ens, I. Moravetz, V. McKinley, and K. Peach). The total number of unidentified fragments over 2 cm long is 3,896. The total number of unidentified fragments under 2 cm in length is 3,121. A portion (N=619) of the unidentifiable fragments was not sorted by size class. The total weight of unidentifiable fragments over 2 cm long is 12.905 Kg. The weight of unidentifiable bone fragments under 2 cm could not be calculated since many of the entries (N=60) weighed less than 10 grams (the minimum limit of the scales available for use in the field).

TAXONOMIC IDENTIFICATION

The majority of the identifiable bone in the Starosele collection belongs to *Equus hydruntinus*, confirming original findings (Formozov 1958). *Equus hydruntinus* is defined by small, relatively primitive teeth, generally small body-size and by the elongation and antero-posterior thickening of its metapodials, considered an adaptation to arid conditions (Eisenmann 1992: 48). This small Middle to Late Pleistocene Equid is generally distributed across the Eurasian Steppes and is often referred to as a "wild ass," despite its closer relationship with the Stenonid horses of Europe than to either Asinus or Hemionus (Forsten 1986; Eisenmann 1992). In this study, metrical analysis of the dental remains, in conjunction with the examination of enamel patterning, confirms the identification of the Equid remains as *Equus hydruntinus* (Eisenmann and Patou 1980; Eisenmann 1992). Post-cranial Equid bone is assigned to *Equus hydruntinus* on the basis of overall size. The metapodia also show the characteristic elongation and antero-posterior thickening. The only other Equid present in the collection, in very small numbers, is the wild horse (*Equus caballus*)—a much larger-bodied species with a similar geographic distribution during the Late Pleistocene. Caballine remains were mostly fragmentary and were defined on the basis of size.

The second most important species in the collection is *Saiga tatarica* (Table 1-1 and figs. 1-1, 1-2). In this study, *Saiga tatarica* follows the usual definition of Pleistocene Saiga (Vereshchagin 1959; Harrington 1981; Barychnikov and Tikhonov 1994) and is the taxonomy adopted here. Identification was made on the basis of recent comparative post-cranial material from the Museum of Nature, Hull (Quebec) and recent cranial material from the Manitoban Museum. Published descriptions, particularly of cranial material (Barychnikov and Tikhonov 1994), were also helpful. Because of the fragmented nature of the Starosele remains, no attempt was made to establish its precise taxonomic status (relative to *Saiga borealis*, for example).

All other mammalian taxa were identified using reference collections of both recent and archeological specimens housed at the Institut de Paléontologie Humaine (I.P.H., Musée National d'Histoire Naturelle, Paris). The bovid remains were too fragmentary to ascribe to either *Bos primigenius* or *Bison priscus*. The single specimen of *Rangifer* (probably *R. tarandus*) is not out of place in a Late Pleistocene context in Crimea. The hyena is defined as *Crocuta crocuta* on the basis of its close similarity with specimens at the I.P.H. The fox is defined as *Vulpes vulpes*; no specimens of arctic fox were identified. *Canis lupus* is identified

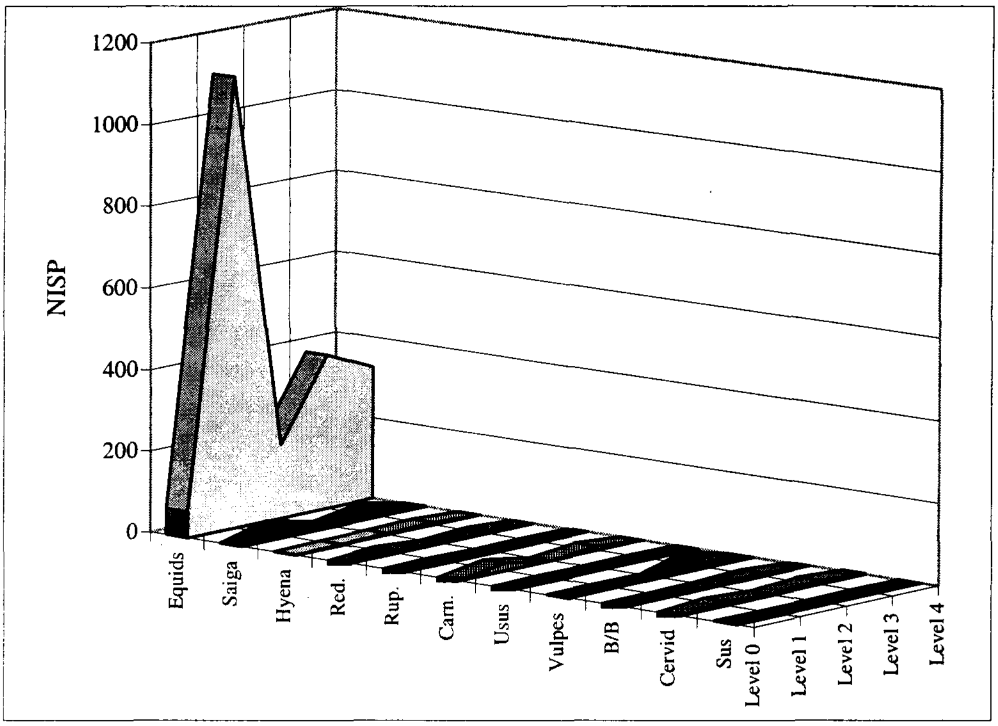

Fig. 1-1—Starosele, relative taxonomic abundance (NISP per taxon) by level.

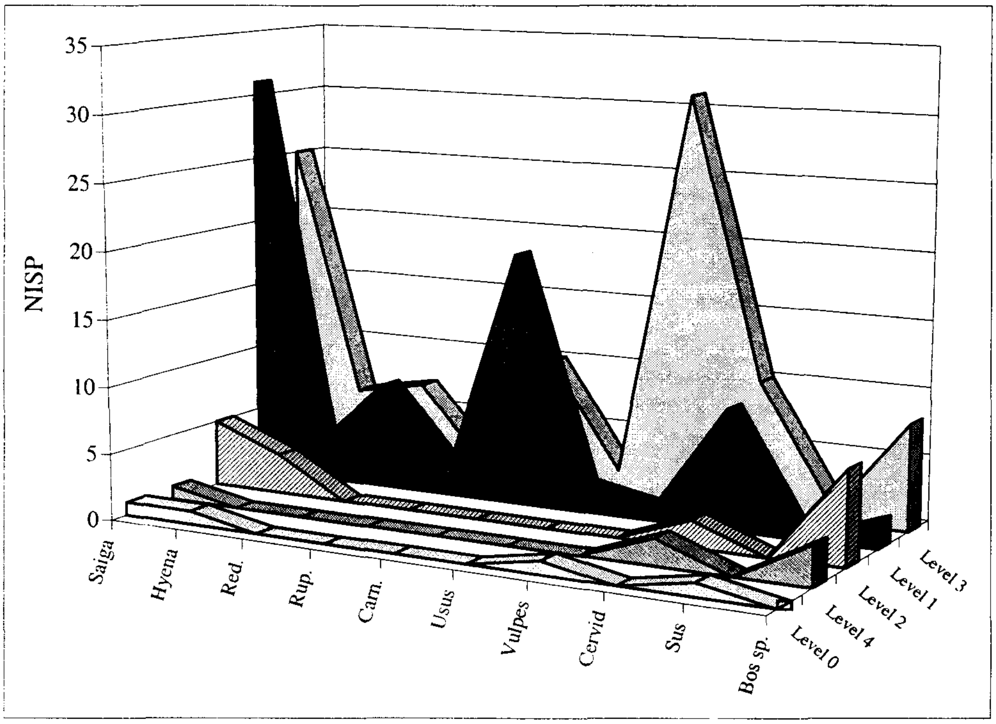

Fig. 1-2—Starosele, taxonomic abundance of all mammals, excluding equids.

in one case. Among the unidentified carnivores (Table 1-1) is at least one suspected Felid in Level 1 (a second phalanx). The total list of species represented at Starosele is quite typical of Pleistocene animal communities described for Crimea (e.g., Vereshchagin 1959; Patou-Mathis 1993; Barychnikov and Tikhonov 1994). The presence of each animal, and its environmental significance, is covered in more detail in Chapter 7.

Bird bone was recovered in small quantity (N=21) and was identified by Dr. J. Mlikovski (Charles University, Praha). There were eight identifiable fragments. Species identified include a grey partridge, alpine swifts, jackdaws, and red-billed choughs in Level 2 (N=7), and a single jackdaw specimen from Level 1. The swifts, jackdaws, and choughs are all cliff-nesting species, and the presence of newly fledged birds indicates that these species were probably nesting in proximity to the site. Grey partridge, a cold-steppe dweller, is not out of place in Level 2, a generally steppic fauna. All of these species are preyed upon by foxes (Mlikovski, personal communication 1997), although the partridge may have been preyed upon by humans, too.

STATISTICAL ANALYSES

The equid bones from Levels 4 through 1 were subjected to the following analyses: a first null hypothesis of no human patterning of the assemblage (that is, natural attrition, or element survivorship patterns) was established using equid bone collected from the archeologically sterile sediments excavated in Stratum F, below Level 4. This collection (Below 4), which contains at least 5 individuals, was used to establish expected values for each bone element, which were then compared to observed element representations (MNE) for each level using a Chi-square test. A second null hypothesis of carnivore ravaging was run using Hill's (1975) data (cited in Binford 1981, as Hill 1978) for hyena kills of zebra, an equid equivalent in size to *Equus hydruntinus*. Hill's data actually represent surface collections over a large area (Potts, personal communication 1998). As such, they represent an unknown number of kills, with no real control over the effects of trampling, weathering, or scattering. Nevertheless, for this test, Hill's data (as reported by Binford 1981: 214-215) were converted to MNE values; based on the working hypothesis that the most numerous element (mandibles) gives an accurate picture of MNI, the ratio of MNI to MNE was calculated. This ratio was used to generate expected values of MNE for each element per level at Starosele. Expected and observed values were then tested for each level using a Chi-square test.

A series of regressions was run to establish to what extent patterns in the assemblages are explainable as the result of economic decisions predicated on meat, marrow, or an index of food utility (FUI). In other words, the regressions were used to establish whether or not bone element survivorship patterns could be predicted by: meat value (the meat-weight normally associated that element), marrow value (the quantity of marrow contained in the bone), or on the basis of a food utility index (FUI) calculated using both meat and marrow weight (and which therefore reflects the total economic value of associated tissues). These values are reported for equids by Outram and Rowley-Conwy (in press). Another regression was used to establish whether or not element survivorship was related to bone density. Density-mediated bone destruction has been established as an important determinant of relative abundance (e.g., Lyman 1985; Grayson 1989) and must be discounted before element representations are interpreted in terms of human behavior. Results for each test will be presented below in the appropriate sub-section.

Linear and non-linear (natural log-transformed) regressions were run for both NISP and %MNI for each level, against equid meat weight, marrow weight, and food utility index (FUI) values for each bone element (Outram and Rowley-Conwy, in press). Another set of regressions was run for NISP against equid bone density values (Lam et al. unpublished ms).

Bone density values were originally calculated for *E. caballus*, but it seems reasonable to expect that the relative density of equid bone elements is similar between species. For this analysis, the epiphyseal bone scans were averaged to produce single values for the proximal and distal epiphyses; mid-shaft scans were already single values. Linear regression models for bone density did not yield satisfactory results: the residuals tended to be non-normally distributed, and/or were heteroskedastic. Heteroskedasticity was measured visually, and confirmed using Spearman's rank correlation coefficient (testing the residuals against logdensity). Log-transformed models were slightly better: residuals were normally distributed for all levels but Level 3, but were still heteroskedastic. Adding one to the variables before the log transformations, so as to avoid complications caused by zero entries, resulted in a much more satisfactory statistical model.

OTHER ANALYSES

In addition to these statistical analyses, element representations are compared with Voorhies's (1969) fluvial transport categories. Since Level 4 and Level 3, in particular, are interbedded with fluvial deposits, it is necessary to establish whether or not these bone assemblages were affected by water-transport. Voorhies (1969) groups elements according to their susceptibility to water transport. Bones with large surface to weight ratios, or less density, are more susceptible. The presence or absence of the Voorhies Groups, therefore, is an indication of possible water transport and strength of flow.

Since hyena and other carnivores are present in all levels at Starosele, the possibility of carnivore patterning of the element representations must be explored as thoroughly as possible. Binford (1981) defined the parameters of element survivorship (on the basis of the ratio of proximal to distal epiphyseal survivorship) that are characteristic of carnivore ravaging (the "ravaging zone") and element representations are compared with these. This particular analysis is hindered by the fact that few epiphyseal elements are present in any of the Starosele assemblages.

Finally, equid mortality patterns (the age and sex structure of the death assemblages) are used to reconstruct herd-structure and to reconstruct seasonal mortality patterns, where possible. The extent and type of fragmentation and the direct actions of predators and/or scavengers (cut marks, gnawing) are also described. Butchering and gnawing marks were examined using a low-powered light microscope. This method of observation has been shown in a recent study (Blumenschine et al. 1996) to be perfectly adequate for discriminating between butchering, percussion marks, and gnaw-marks.

Element representations for equids, and equid-sized animals (recorded as OXO cf. Equus), are expressed in the tables as follows: number of identified specimens (NISP); minimum number of individuals (MNI); MNI for each element expressed as a percentage of the maximum MNI value (%MNI), and minimum number of elements (MNE). For most elements, except for long-bone shafts, the minimal animal units (MAU, *sensu* Binford 1981) are equivalent to MNE due to the method chosen to calculate MNE and therefore are not displayed in these tables. The addition of equid-sized bone (OXO cf. Equus, i.e., bone not identifiable as *Equus hydruntinus*, but identical in size) to the equid bone counts is deemed logical, since no other similar-sized animal is present in the assemblage and some bone elements, such as vertebrae and ribs, were typically only identifiable to a size category. NISP is a standard calculation tabulated for ends, or epiphyseal portions (proximal, distal) and for mid-shaft and epiphyseal fragments together (shaft + ends) for each long bone category (Tables 1-3, 1-6, 1-8, and 1-10). MNI was calculated using two methods: first using epiphyses alone, and then using both long-bone shafts and epiphyses. MNI values were calculated on epiphyses alone by segregating left and right-sided elements and segregating fused and unfused elements, finally summing the proximal and distal epiphyses. MNI was calculated using shafts by summing the portions (entered as 25%, 50%, 75% and 100%) without segregating by side or age; thus producing a minimum number of elements (MNEu) which was then divided by the number of times the element normally occurs to produce an MNI (shaft) count. Dental remains were only used in the calculation of MNI when they were associated with bone, in which case teeth were scored as jaw or mandible portions. Single teeth were not used. Foetal individuals are discussed separately and were not used to calculate MNI or MNE. MNE was calculated (1) as the sum of unsided epiphyses, and (2) as described above (the sum of all bone portions, divided by 100). Percent MNE (%MNE) is calculated as: MNE (observed)/ MNE (expected).

RESULTS: LEVEL 4

Level 4 is deposited at the top of geological stratum F, which consists of large boulder gravels, interbedded with fine-grained sediments. The depositional history of stratum F is clearly an episodic sequence of high-energy stream flow, with intermittent periods of low-energy deposition (Marks et al. 1998). Sediments in Level 4 are red and clayey, deposited by a low-energy stream. These sediments have resulted in a characteristic surficial color on the bones. Erosion from the plateau above the canyon resulted in the addition of colluviated sediments to the alluvium. The sedimentary environment in Level 4 has resulted in very good bone preservation.

Only a small sample of lithic artifacts was recovered from Level 4. Although the bones were recovered in conjunction with lithic artifacts, there were no identifiable clusters of either bone or tools. An oval area of burned soil and wood charcoal is described by the excavators (Marks et al. 1998) but is not securely identified as a hearth. Neither the lithics nor the bones cluster significantly near the putative hearth. The excavated area, however, appears to have been on the extreme margin of a denser occupation excavated by Formozov (Marks et al. 1998, Marks and Monigal 1998).

Several alternative hypotheses present themselves. The original hypothesis of a communal hunt, involving a herd of horses driven into the box canyon or over the cliffs above the site, should be considered. Animals carried away by floodwaters could also have been deposited on top of stratum F, and subsequently been scavenged by humans travelling into the canyon along the stream margins, before being covered by the fine-grained sediments of Level 4. Alternatively, a temporarily dry and stable land surface above stratum F could have been occupied for a short time by humans transporting bone to the site. Finally, individual bones may have been transported and left behind by receding waters, humans subsequently occupying the drying surface. Each of these hypotheses is considered in detail below.

The dominant component of Level 4 fauna is *Equus hydruntinus*, based on both NISP and MNI values. Species diversity is extremely limited in this level and other components (*Saiga tatarica*, *Cervus sp.*, and *Bos sp.*) are represented by very small NISP values (Table 1-1, fig. 1-2). Minimum numbers of individuals (MNI) in this level are highest for equids (MNI=4, based on mandibles) and low (MNI < 3) for each of the other species (Table 1-2).

Because the modern excavations are limited in extent, it is difficult to judge how much of the original Level 4 occupation surface(s) has been sampled. Furthermore, because Formozov (1958) did not recognize four archeological levels, it is impossible to know how many of the 287 horses reported by him for the entire site (Formozov 1958) belong to Level 4. Given the probably truncated sample from Level 4 then, an attempted reconstruction of equid population structure (for the recent excavations) is not a fruitful avenue of research.

Lack of taxonomic diversity could be used to support a hypothesis of specialized hunting, or the communal hunting of horse herds at Starosele, Level 4. The presence of other species

TABLE 1-2
Starosele, Level 4, Element Representation of Equids

	NISP	*MNE*	*MNI*	*%MNI*
Skull	3	3	3	0.75
Mandible	9	6	4	1
Atlas	–	–	–	–
Axis	–	–	–	–
Cervical Vertebra	–	–	–	–
Thoracic Vertebra	–	–	–	–
Lumbar Vertebra	–	–	–	–
Sacrum	–	–	–	–
Pelvis	1	1	1	0.25
Ribs	–	–	–	–
Scapula	1	1	1	0.25
Humerus, proximal	–	–	–	–
Humerus, distal	–	–	–	–
Radius, proximal	–	–	–	–
Radius, distal	–	–	–	–
Ulna	2	2	1	0.25
Carpals	–	–	–	–
Metacarpal, proximal	5	5	2	0.5
Metacarpal, distal	2	2	1	0.25
Accessory Metacarpals	1	1	1	0.25
Femur, proximal	–	–	–	–
Femur, distal	–	–	–	–
Tibia, proximal	1	1	1	0.25
Tibia, distal	1	1	1	0.25
Tarsal	–	–	–	–
Astragalus	–	–	–	–
Calcaneus	–	–	–	–
Metatarsal, proximal	5	5	4	1
Metatarsal, distal	1	1	–	–
Accessory Metatarsals	1	1	1	0.25
First Phalanx	4	3	3	0.75
Second Phalanx	–	–	–	–
Third Phalanx	–	–	–	–
Upper Teeth	47	N/A	2	0.5
Lower Teeth	55	N/A	5	1.25

in small numbers could be the result of incidental hunting of animals encountered while pursuing this strategy. The lack of species diversity could also reflect the ephemeral nature of the human occupation of Level 4, indicated by the paucity of lithic artifacts (Marks and Monigal 1998). The lack of taxonomic diversity in Level 4 is also consistent with a hypothesis of flash flooding—trapping horse herds in the canyon and the resultant deposition of drowned animals on the gravels of stratum F. The taxonomic abundance recorded for this level (figs. 1-1, 1-2) would, therefore, be a measure of the relative abundance of various species in the local animal community at the time of flooding.

TABLE 1-3
Starosele, Level 4, Equid Long Bone Representation

	NISP	*SUMu*	*MNEu*	*MNIsh*	*%MNI*	*SUMs*	*MNEs*	*MNIe*
Humerus	6	175	2	1	0.25	100	1	0
Radius	9	225	3	2	0.5	175	2	0
Metacarpal	8	300	3	2	0.5	150	2	2
Femur	2	50	1	1	0.25	25	1	0
Tibia	10	250	3	2	0.5	200	2	1
Metatarsal	8	250	3	2	0.5	175	2	4

NISP includes both shafts and epiphyses
(SUM)u = unsided element portions (shafts and epiphyses)
MNIsh–based on MNEu/N of each element in the body
(SUM)s = sided element portions (shafts and epiphyses)
MNIe–based on epiphyses only

TABLE 1-4
Starosele, Evidence of Fluvial Transport (categories after Voorhies 1969)

	Group I *easily moved*	*Group I & II*	*Group II* *gradually removed*	*Group II & III*	*Group III* *lag deposit*
	rib, vertebra, sacrum, sternum	scapula, phalanx, ulna	femur, tibia, humerus, metapodial, pelvis, radius	ramus	skull, mandible
Level 4	present	present	present	present	present
Level 3	present	present	present	present	present
Level 2	present	present	present	absent	present
Level 1	present	present	present	absent	present

Element Representation in Level 4

Equid element representation in Level 4 does not indicate fluvial transport of bones, or the presence of a lag deposit of bones following flood subsidence. Voorhies (1969) fluvial transport groups are all present with the possible exception of Group I (Table 1-4). If one considers the *Equus*/Bos size-class, however, it becomes apparent that Group I bones (ribs, vertebrae, sternal and sacral elements) are present, but were not definable as *Equus hydruntinus*. It seems logical, therefore, to state that bones from each of the different Voorhies Groups are present, indicating that fluvial transport has probably not patterned element representation in this level. This does not mean that water action is not responsible for the presence of equids—merely that water is not responsible for differentially transporting elements of the equid skeletons. A flash flood could still have stranded the carcasses of drowned animals at the high-water mark. A subsequent period of low-energy receding waters could have deposited the fine-grained sediments of Level 4, thus protecting the remains.

A Chi-square test of element representation for this level against the Below 4 collection (the null hypothesis) proved significant at the a=0.05 level. Although this test was run for all levels, it is probably best for the Level 4/Below 4 test, since Level 4 and deposits below Level 4 are part of the same general depositional environment (Stratum F). In other words, human presence in Level 4 (attested by the presence of cultural materials) can be demonstrated to have patterned the element representation in this level in a meaningful way.

A significance test between Hill's zebra kill data and Level 4 did not indicate a significant relationship, that is, the presence of hyena does not explain a significant percentage of the variation in element representation. Linear and non-linear regressions of equid bone against meat weight and marrow weight were inconclusive. This indicates that selective transport of elements by humans (or hyenas) did not occur, at least on the basis of either of these criteria. Non-linear regressions (data+1, log transformed) against bone density show significant results at the a=0.05 level: 42.4 % of the variation is explainable using bone density ($r^2=0.424$, p-values<0.001); residuals are normally distributed and homoskedastic.

Fragmentation in Level 4

The mean size of identified bone in Level 4 is 58.9 mm. The extent of fragmentation is high in this level (fig. 1-3) and the ratio of whole to fragmentary bone is 22:646. Whole or nearly whole bone represents only 5.5% of the identified bone total (N=400) and most of the complete bones are individual teeth or podial elements, such as phalanges. More than half of the identifiable bone samples for which portion sizes were scored (N=217) scored 25% or lower (fig. 1-3). Evidence of green fracture is not uncommon, and dynamic loading on bone producing bone flakes, though rare, is present. Green-bone fractures are not reliably attributable to human agencies alone (Johnson 1985), but do offer corroborating evidence in the presence of butchering marks and other evidence of human activity.

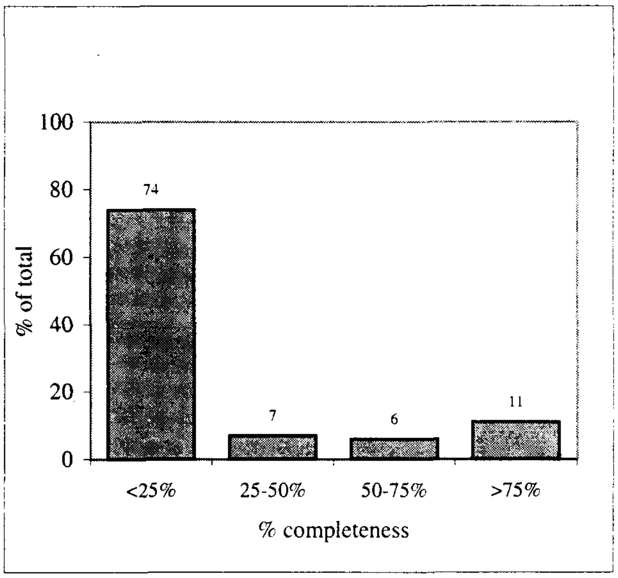

Fig. 1-3—Starosele, Level 4, fragmentation patterning.

Diagenesis in Level 4

Despite the generally good surficial preservation of the bones, some erosion and/or pitting is visible. The damage is generally due to rootlets, indicating that an active humus layer formed over flood deposits. This is consistent with the geologist's description of the top-most soils in stratum F (Marks et al. 1998). Root damage is fairly pervasive (N=103) but generally mild (1 on a scale of 1-3). Weathering, on the other hand, is rarer (N=11) and bones do not appear to have lain exposed on a ground surface for significant amount of time. All of the above confirms the archeologists' impression that artifacts are not rolled or damaged by stream action (Marks and Monigal 1998) and that Level 4 represents a momentary lull in the high energy depositional contexts above and below it.

Human Agency in Level 4

Two kinds of bone damage attributable to human agency have been identified in this level. A small number of bones bear evidence of having been cut and/or chopped, others are battered in a manner consistent with their use as retouchers in lithic tool production. Cut or chop marks are rare: only 10 bones (0.015 % of NISP; 0.25% of identified bone) show clear evidence of butchering scars. Five of the butchered bones are large mammal bone fragments. Three of the remaining butchered bones are long bone midshaft fragments. Two bones are related to dismembering: one equid acetabulum was chopped, and one equid ulna was cut at the oleocranon. One cut bone is particularly informative since tooth marks clearly overlie cutmarks, highlighting the sequence of events in this level. Humans clearly had prior access to the animal remains, and were succeeded by a large scavenger, probably hyena. Battered bones which are clearly diagnostic of an intentional pattern of scarring (striae accompanying the battering scars and consistent with their use as retouchers) are not common (N=3); three additional bones have indeterminate battering scars.

Other Predator/Scavenger Agency in Level 4

Three size classes of scavengers have left signs of their activities in Level 4. Gnawing scars consistent with a large carnivore/scavenger (hyena-sized) is observed on 5 bones. A

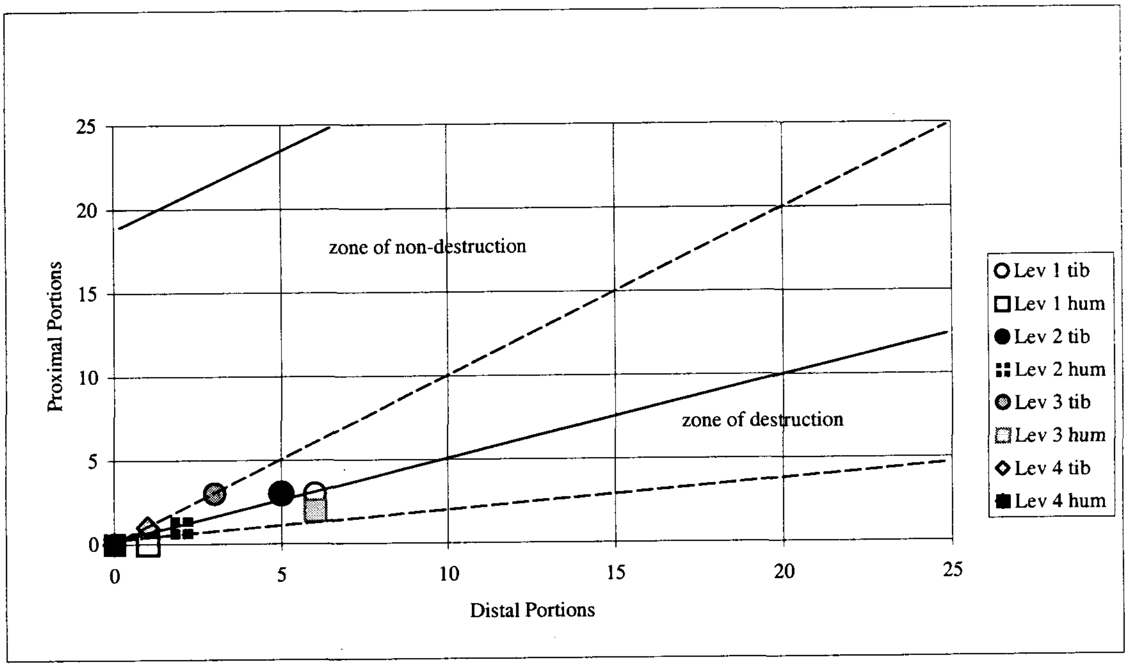

Fig. 1-4—Starosele, evidence for carnivore ravaging based on epiphyseal survivorship of tibiae and humeri.

smaller scavenger (fox or mustelid-size) was also present (N=3) and a single bone showed evidence of rodent gnawing. A polished bone flake may have resulted from hyena gnawing on green bone, and subsequent swallowing and partial digestion of the flake. No carnivore/ scavenger remains were identified in the assemblage. These results are consistent with lack of evidence, based on Binford's (1981) "carnivore ravaging" data, for extensive damage to the assemblage due to carnivore gnawing (fig. 1-4).

Equid Herd Structure and Seasonality in Level 4

Post-cranial remains yield an MNI of four equids: one juvenile, and three adults (Table 1-2). Assuming a herd structure to similar to caballine horses in the wild, the juvenile horse would normally be expected to live with a family, or harem, herd. There are too few well-represented categories of complete teeth to warrant using crown heights to establish the age structure of this assemblage.

Discussion: Level 4

The element representation for equids in Level 4, and the results of the tests performed on this assemblage, in conjunction with evidence for human butchering and some gnawing of bone, indicate that whole carcasses were present at the site. There is no direct evidence for the transportation of bone either to or away from the site. Whole carcasses were summarily butchered by humans, probably during a short stay at the site, and then scavenged by hyenas. The extent of bone fragmentation, much of it occurring on green bone, indicates that human butchering probably included smashing of bone for marrow.

RESULTS: LEVEL 3

Level 3 is contained in a gravelly silt layer interbedded in the large boulder gravels of stratum D. The faunal assemblage is relatively large (N=5,312) and more complex than Level 4 and species diversity is greater. This last fact is partially attributable to sample size, but probably also reflects a more complex human occupation of this level. Equids dominate the assemblage once again, but Saiga are present in greater number (N=25), as are fox (N=31), hyena, and bear (Table 1-1, figs. 1-2, 1-6). Chamois (*Rupicapra rupicapra*), red deer (*Cervus elaphus*), bovids (*Bos sp.*), pig (*Sus sp.*), and reindeer (*Rangifer tarandus*), as well as several species of bird, add to the diversity. The environment around the site can be partially reconstructed on the basis of this fauna, which is unevenly divided between riparian (*Sus sp., Cervus elaphus*), steppic (*Equus, Saiga, Bos/Bison*), and boreal (*Rangifer*) environments. The sure-footed chamois is not out of place in the Crimean Mountains, or the locally rocky terrain around Starosele.

Bone distribution in Level 3 generally coincided with lithic distributions and clustered weakly around an amorphous fireplace (Marks et al. 1998). The assemblage is clearly not a flood or lag deposit, as confirmed by element representation patterns which show representation of all of the Voorhies Groups (Table 1-4). Preservation is generally good and bird bones, as well as foetal equid bones, have survived burial. Fox (*Vulpes vulpes*) remains (NISP=31, MNI=2) are concentrated around Squares F20/G20. The fox remains are very well preserved, and some of the more fragile bones, such as scapulae, are present. It seems likely that this small scavenger denned among the rocks after humans and hyenas had departed.

TABLE 1-5
Starosele, Level 3, Element Representation of Equids

	NISP	*MNE*	*MNI*	*%MNI*
Skull	3	1	1	0.17
Mandible	8	8	6	1
Atlas	–	–	–	–
Axis	–	–	–	–
Cervical Vertebra	5	2	1	0.17
Thoracic Vertebra	1	1	1	0.17
Lumbar Vertebra	–	3	–	–
Sacrum	–	–	–	–
Pelvis	1	1	1	0.17
Ribs	15	7	2	0.33
Scapula	1	1	2	0.33
Humerus, proximal	2	2	2	0.33
Humerus, distal	6	4	3	0.5
Radius, proximal	4	4	2	0.33
Radius, distal	1	1	1	0.17
Ulna	2	1	1	0.17
Carpals	–	–	–	–
Metacarpal, proximal	4	4	3	0.5
Metacarpal, distal	3	3	1	0.17
Accessory Metacarpals	1	1	1	0.17
Femur, proximal	2	2	2	0.33
Femur, distal	3	3	2	0.33
Tibia, proximal	3	2	2	0.33
Tibia, distal	3	2	2	0.33
Tarsal	–	–	–	–
Astragalus	–	–	–	–
Calcaneus	–	–	–	–
Metatarsal, proximal	2	2	1	0.17
Metatarsal, distal	–	–	–	–
Accessory Metatarsals	2	2	1	0.17
First Phalanx	–	–	–	–
Second Phalanx	2	2	1	0.17
Third Phalanx	1	1	1	0.17
Upper Teeth	47	N/A	2	0.33
Lower Teeth	75	N/A	4	0.67

TABLE 1-6
Starosele, Level 3, Equid Long Bone Representation

	NISP	*SUMu*	*MNEu*	*MNIsh*	*%MNI*	*SUMs*	*MNEs*	*MNIe*
Humerus	31	750	8	4	0.67	600	3	3
Radius	27	1075	11	6	1	475	5	3
Metacarpal	9	300	3	2	0.33	75	1	3
Femur	20	625	7	4	0.67	425	5	2
Tibia	40	1125	12	6	1	450	5	2
Metatarsal	11	225	3	2	0.33	125	2	1

NISP includes both shafts and epiphyses
(SUM)u = unsided element portions (shafts and epiphyses)
MNIsh–based on MNEu/N of each element in the body
(SUM)s = sided element portions (shafts and epiphyses)
MNIe–based on epiphyses only

Element Representation in Level 3

Fluvial transport is ruled out as a significant source of bias in this assemblage, due to the presence of all four Voorhies Groups (Table 1-4). Element representation does not indicate heavy carnivore ravaging of the assemblage (Table 1-5), but equid humeri do fit into Binford's (1981) "ravaging zone" (Table 1-6; fig. 1-4), indicating some patterning due to carnivore action. Gnaw marks observed on some of the bones (see below) confirm the presence of hyena at the site. A Chi-square test against Hill's hyena kill data fails to indicate a correlation, however. As stated above, the null hypothesis (no human agency responsible for patterning) based upon comparison with the Below 4 collection is probably not as instructive for the levels above Level 4, since the depositional environment changed significantly. A Chi-square test confirmed that element representation patterns in the Level 3 equid assemblage are significantly different from the collection which accumulated naturally in stratum F.

Linear and non-linear regressions of Level 3 element representation, expressed both as NISP and as %MNI against meat-weight, showed no significant patterning. Regressions of NISP against marrow weight were also inconclusive. A linear regression of %MNI against marrow, however, was significant at the a=0.10 level, and explains 39.11% of the observed variation in %MNI for this level (r^2= 0.3911, residuals are normal and there is no evidence of heteroskedasticity). The implication is that marrow weight was a significant factor in establishing the pattern of element representation in Level 3. This has interesting implications in terms of scavenging and transport behaviors when combined with the results of the regression against FUI. Regressions of FUI (Outram and Rowley-Conwy in press) against NISP and %MNI did not reveal any significant patterning based on food utility. Element patterning in Level 3, therefore, can support a hypothesis of differential transport biased in favor of high marrow-weight elements (for equids). The ratio of upper to lower teeth in this assemblage also indicates a differential representation of skulls and mandibles, probably due to the transportation of mandibles to the site. Bone density failed to explain a significant proportion of the variation in bone elements in Level 3 (in any of the regressions).

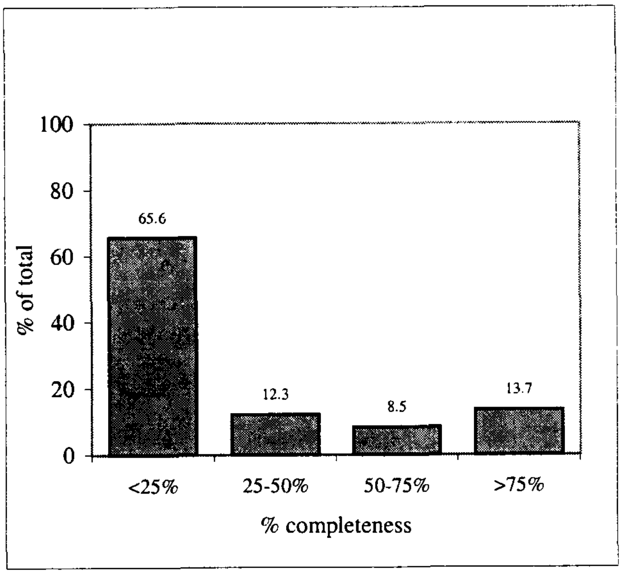

Fig. 1-5—Starosele, Level 3, fragmentation patterning.

Fig. 1-6—Starosele, Level 3, *Vulpes vulpes* femur, atlas, scapula, and radius.

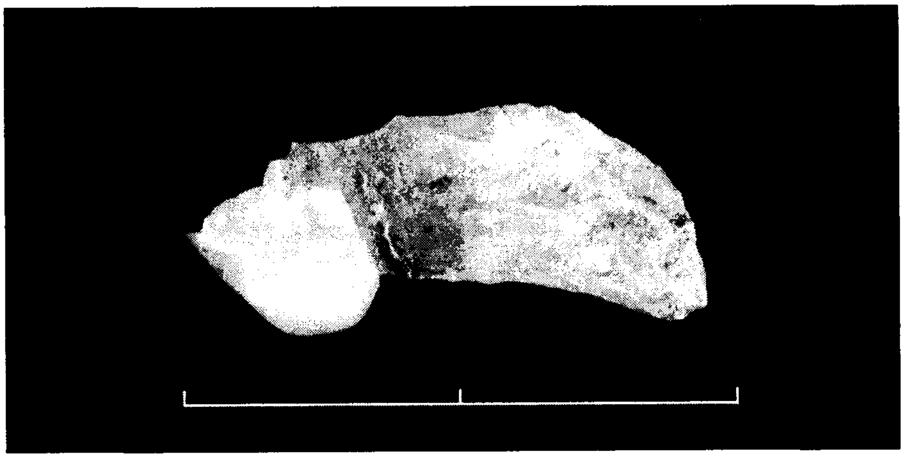

Fig. 1-7— Starosele, Level 3, *Ursus sp.* molar with cut mark.

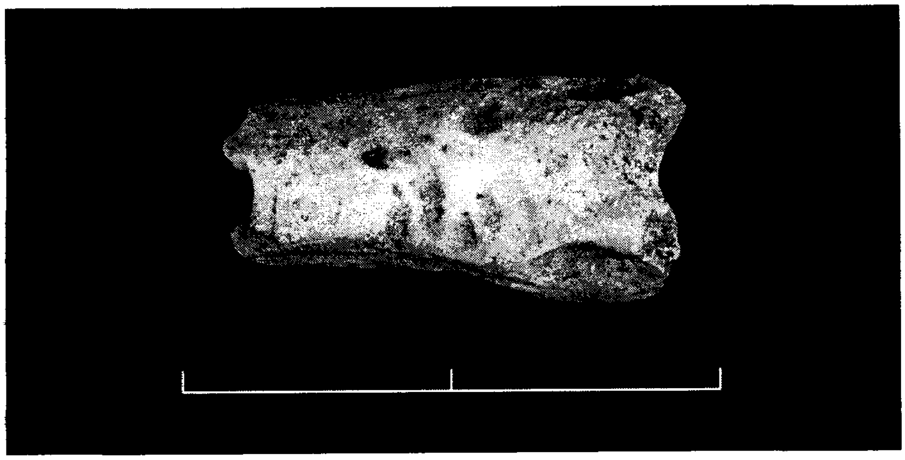

Fig. 1-8— Starosele, Level 3, Saiga first phalanx with tooth furrows from a small-sized scavenger.

Fragmentation in Level 3

The extent of fragmentation in Level 3 is high: the ratio of whole to fragmentary bone is 72:5312. Average fragment size of identified bone in this level is 55.24 mm. Whole bone represents 10% of the identified bone total (N=700) and most of the whole bones are individual teeth or small, dense post-cranial bones (with the exception of the bird and fox remains). Seventy percent of the bone samples for which portion sizes were scored (N=594) scored 25% or lower (fig. 1-5).

Green bone produces a characteristic spiral fracture when it is dynamically loaded (Johnson 1985). Spiral green-bone fractures are not necessarily indicative of human agency, however (e.g., Haynes 1983). Green-bone fractures are relatively frequent in the assemblage. In addition, one bone flake and a bone fragment with a clearly flaked edge are recorded. Like spiral fractures, flaking is indicative of dynamic loading on green bone (Johnson 1985), potentially due to butchering, but also attributable to hyenas which are equally capable of producing high loading on bone with their jaws. How much of the breakage observed in this level is due to human agency, and how much is the result of hyena activities cannot be discerned.

Diagenesis in Level 3

Rootlet etching is common (N=2,007, or 38%) though generally mild (scored as 1 on a scale of 1 to 3). Weathering is not common (N=35) and is not severe (scored 1 or 2 on a scale of 1 to 3). It appears that the bones lay on the surface long enough to be scavenged by hyena and fox before being buried in a humus zone for some time.

Human Agency in Level 3

Butchery marks in the form of cutting and chopping of bone are identified in this level (Cut N=36, Chop N=8). Twenty-four of the butchered bones are large or unidentifiable mammal bone fragments. A single skull fragment (of a small to medium sized mammal) displays a cut mark. The remaining butchered bone, most of which is equid or "OXO" sized (N=13) includes six mid-shaft tibia fragments, three mid-shaft humerus fragments, one proximal-medial radius fragment, and one rib. One cut mark was observed on a fragment of a bear molar (fig. 1-7). Battering (retouching use-wear) is visible on 11 bones (of which three are indeterminate in origin).

Other Predator/Scavenger Agency in Level 3

Gnaw marks are common (N=38) and several bones are partially digested (N=6). Hyenas, whose remains are found in this level, are the most likely agents of this bone modification. It seems likely that much of the breakage may also be assigned to hyenas. One Saiga first phalanx is marked by a series of fine, parallel grooves across the diaphysis which are probably tooth furrows of a small (fox-sized) scavenger, though they superficially resemble skinning marks (fig. 1-8). Gnaw marks left by a small scavenger, perhaps a fox, are not frequent and in one case clearly overlie cut marks. Human bone modification clearly preceded scavenging in this level, as well.

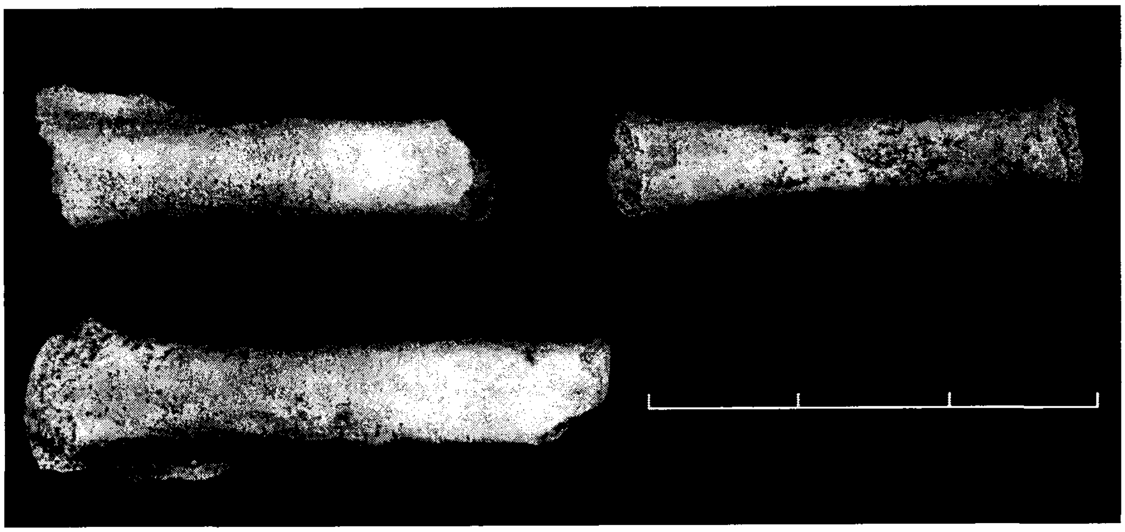

Fig. 1-9—Starosele, Level 3, fetal *Equus hydruntinus* femora and metacarpal.

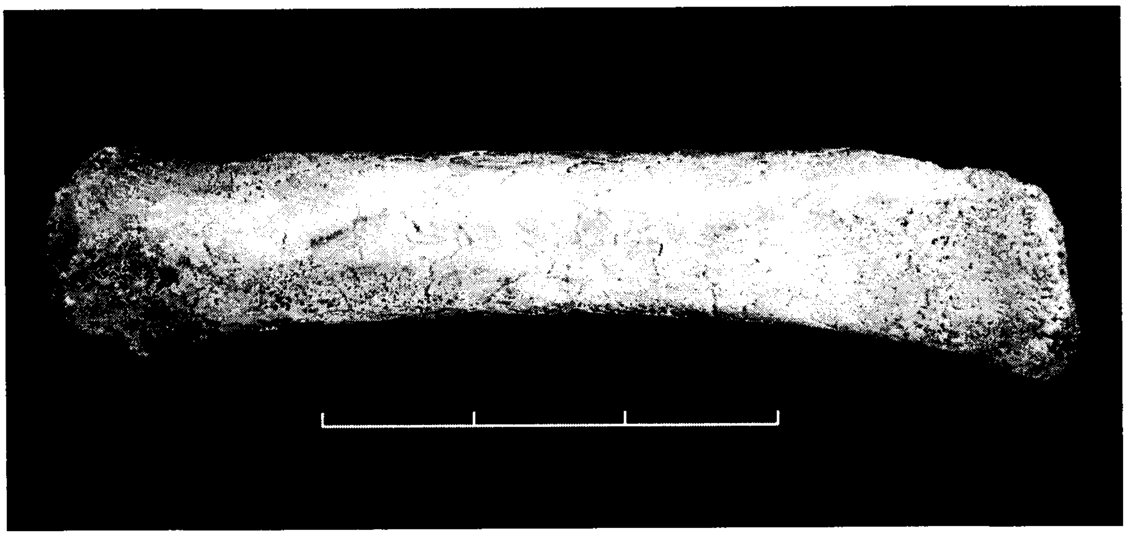

Fig. 1-10—Starosele, Level 3, fetal *Equus hydruntinus* radius.

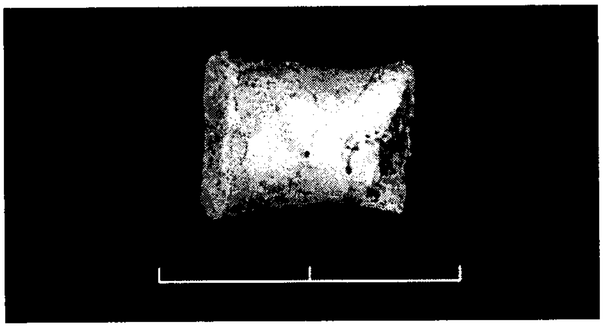

Fig. 1-11—Starosele, Level 3, fetal *Equus hydruntinus* phalanx.

Equid Herd Structure and Seasonality in Level 3

Six equid individuals—five adults and a juvenile (unfused tibia, metacarpals, and phalanges)—can be identified in this level on the basis of post-cranial elements. At least two juveniles are represented on the basis of individual dental remains (single dP2's); single teeth were not used to calculate MNI in any of the assemblages, however, unless associated with bone.

Foetal remains identified in Level 3 (N=23) include ten bones clearly identifiable as equid. Of these, five provide estimates of age. At least two equid foetuses are present on the basis of these bones, which are spatially distributed in squares H22, F20, and I21. The age at death of these animals is estimated on the basis of a comparison with published x-rays of foetal hoses (Ginther 1979: fig. 9.51); comparing the size of the fossil elements with modern horse foetuses results in estimates of foetal age. The normal foaling season for horse (*Equus caballus*) is April. Mares gestate for about 325 days. Assuming similar developmental rates between *Equus hydruntinus* and modern horses, the fossil foetal femora and accompanying metacarpal (fig. 1-9) belonged to a foetus between 100-160 days old, probably much closer to 100 days. The fossil radius (fig. 1-10) is approximately 160 days of age, or somewhat older, as is the phalanx (fig. 1-11). The foetal equids in Level 3, therefore, indicate a potential occupation span of one to three months (maximum) during late summer/fall (assuming the mares conceived at the end of May).

Discussion: Level 3

Based on the observations made above, it seems reasonable to suggest that humans were the primary agents of bone destruction, and probably accumulation, in Level 3. Furthermore, there is evidence of the differential transportation of bone onto the site, with elements selected according to their marrow content. The site was occupied in the late summer or fall. Further destruction of bone (and, potentially, additions to the assemblage) by hyenas and foxes occurred after humans had left the site. Long bones in the Level 3 assemblage clearly suffered a high degree of fragmentation, most likely due to human action, and may have been processed for marrow. Given the relatively large number of lithic artifacts associated with Level 3, the presence of a hearth and butchering marks, evidence of taxonomic diversity, and the foetal development stages, it is likely that Level 3 was occupied for a longer time, and site function was relatively more complex, than the other levels sampled in these excavations.

RESULTS: LEVEL 2

Level 2 contains a small faunal assemblage, badly altered by post-depositional dissolution. The archeological deposits themselves are more restricted in their distribution than the preceding levels and contain fewer tools (Marks et al. 1998). Level 2 lies in Stratum C, which formed amongst the detritus of several rockfalls originating from the limestone cliff overhanging the site. The land surface upon which Level 2 formed sloped to the west and south. Slopewash probably was promoted by local spillway erosion from the cliffs above. Bones cluster on the western edge of the site (Marks et al. 1998). The faunal assemblage was probably affected by slope-wash during deposition, and subsequently by water infiltration.

As in previous levels, Level 2 fauna is dominated by equids. Despite the small size of the assemblage, however, there is considerable taxonomic diversity. Saiga, hyena, bovids, and cervids are all represented, though they are not numerous.

TABLE 1-7
Starosele, Level 2, Element Representation of Equids

	NISP	*MNE*	*MNI*	*%MNI*
Skull	9	3	2	0.67
Mandible	3	3	3	1
Atlas	–	–	–	–
Axis	–	–	–	–
Cervical Vertebra	2	1	1	0.33
Thoracic Vertebra	–	–	–	–
Lumbar Vertebra	5	4	1	0.33
Sacrum	–	–	–	–
Pelvis	3	1	1	0.33
Ribs	5	2	1	0.33
Scapula	1	1	1	0.33
Humerus, proximal	1	1	1	0.33
Humerus, distal	2	2	2	0.67
Radius, proximal	2	2	1	0.33
Radius, distal	1	1	1	0.33
Ulna	2	1	1	0.33
Carpals	1	1	1	0.33
Metacarpal, proximal	2	2	1	0.33
Metacarpal, distal	3	3	2	0.67
Accessory Metacarpals	–	–	–	–
Femur, proximal	–	–	1	0.33
Femur, distal	1	1	–	–
Tibia, proximal	3	3	3	1
Tibia, distal	5	5	3	1
Tarsal	2	2	1	0.33
Astragalus	–	–	–	–
Calcaneus	1	1	1	0.33
Metatarsal, proximal	4	4	3	1
Metatarsal, distal	2	2	2	0.67
Accessory Metatarsals	2	2	1	0.33
First Phalanx	5	4	2	0.67
Second Phalanx	2	2	1	0.33
Third Phalanx	4	3	1	0.33
Upper Teeth	20	N/A		
Lower Teeth	23	N/A		

TABLE 1-8
Starosele, Level 2, Equid Long Bone Representation

	NISP	*SUMu*	*MNEu*	*MNIsh*	*%MNI*	*SUMs*	*MNEs*	*MNIe*
Humerus	9	200	2	1	0.33	175	2	2
Radius	12	325	4	2	0.67	175	2	1
Metacarpal	6	200	2	1	0.33	100	1	2
Femur	4	200	2	1	0.33	100	1	2
Tibia	14	350	4	2	0.67	200	2	3
Metatarsal	7	300	3	2	0.67	175	2	3

NISP includes both shafts and epiphyses
(SUM)u = unsided element portions (shafts and epiphyses)
MNIsh–based on MNEu/N of each element in the body
(SUM)s = sided element portions (shafts and epiphyses)
MNIe–based on epiphyses only

Element Representation in Level 2

Equid element representation does not indicate heavy carnivore damage (fig. 1-4, Tables 1-7, 1-8) or water transport (Table 1-4). The equid remains are relatively intact, and the ratio of lower to upper equid teeth is almost 1:1, indicating that complete heads (and perhaps carcasses) are present. There is no tangible evidence for slope-action affecting element distribution. Post-depositional water infiltration of this level can be presumed to be responsible for the diagenetic changes observed (see below), but not for altering the element representations of the equids. For all other taxa, podial elements are the best-represented bone category.

There is no significant relationship between element representation in this level and either Hill's hyena kill data (as reported in Binford 1981) or the pattern of bone representation in Below 4. Regressions of MNI and NISP against meat weight, marrow weight, and FUI were inconclusive. Bone density, on the other hand, explains 31.1% of the variation in equid element representation (data+1 log transformed regression, normally distributed, homoskedastic residuals). It seems likely that these elements are illustrative of the preferential survivorship of denser bones—whether humans or hyenas were responsible for these additions to the record is unclear.

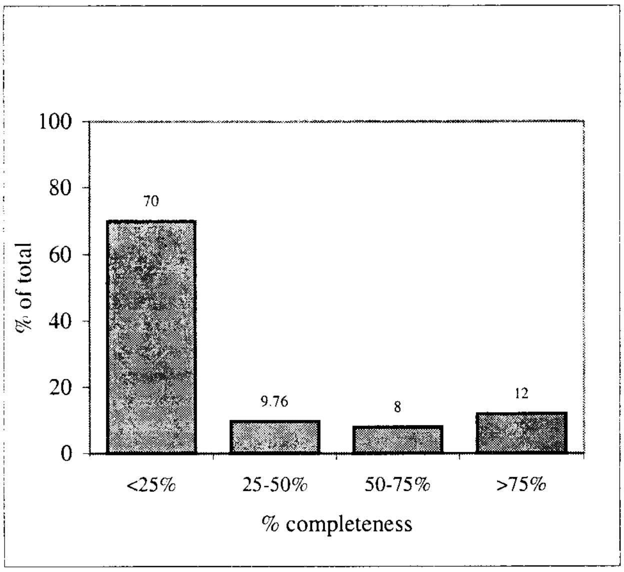

Fig. 1-12—Starosele, Level 2, fragmentation patterning.

Fragmentation in Level 2

The Level 2 assemblage is less fragmented than the other levels. The ratio of whole to fragmentary bone is 29:805. Whole bone represents 11% of the identified bone total (N=258). Once again, bones scored as complete are usually individual teeth or small, dense post-cranial bones such as podial elements, patellae, etc. Mean fragment size (identified bone only) is 51.62 mm. Two-thirds of the bone samples for which portion sizes were scored (N=212) ranked 25% or lower (fig. 1-12). Average identifiable fragment size is 51.62 mm.

Green fractures are present, judging by the frequency of spiral fractures on shaft fragments. One bone flake removal scar is noted.

Diagenesis in Level 2

Chalky, white concretions coated many of the bones in Level 2, obscuring surface features. These concretions are attributable to carbonate depositions caused by water infiltration. Pedogenic carbonates characterize the overlying deposits of Stratum B (Marks et al. 1998). Some of the bones are marked by dissolution cavities (N=7) which may be attributable to this process, rather than to carnivore actions (digestion). Sediment abrasion (N=5) may be the result of rolling, or, perhaps, trampling. One bone shows polishing, attributable to a variety of processes including water action, licking by canids, or, perhaps, some form of use-wear. Generally mild rootlet damage is not infrequent (N=75, or 29% of identified bone) and weathering (N=12, or 4.6% of identified bone) is also noted.

Human Agency in Level 2

Surficial preservation of bone in this level is generally poor, potentially masking signs of human modification. Sedimentary abrasions—due to erosion, slope movement, or trampling—further obscure the bone surfaces. A single definitive cut mark has been identified. Only two bones were "battered," but the battering is indeterminate in nature (i.e., not identifiable as purposeful). One bone flake removal scar is noted, as are numerous green fractures, all evidence of dynamic loading on fresh bone, though not necessarily through human action. The archeologists have reported finding partly articulated mammal remains in this level and a relatively small lithic artifact sample, with no discernible clustering (Marks and Monigal 1998). This seems in keeping with the general lack of evidence for extensive human processing of the bones.

Other Predator/Scavenger Agency in Level 2

Clear evidence of gnawing is infrequent (N=2). One sample (which also has dissolution cavities) is possibly gnawed.

Equid Herd Structure and Seasonality in Level 2

There are two adult equids, one sub-adult, and one foetus (foetal NISP=2, MNI=1) in the Level 2 assemblage. The two adults and the sub-adult are aged using dental wear stages. The presence of a mare carrying a foetus, approximately 80-100 days in age, once again indicates a late summer occupation of the site.

Fledgling birds indicate a mid- to late-summer deposition for Level 2 (Mlikovsky, personal communication 1997). In stark contrast to other levels at Starosele, there are several bird species in this otherwise small assemblage of bird-bones (NISP=7). Identified taxa include alpine swifts, red-billed choughs, jackdaws, and grey partridge. Most of the birds are unlikely to have been human prey given their size, the fact that they are cliff-dwellers (and would probably have been nesting in the limestone cliffs above the site—natural deaths would have occurred at the foot of the cliffs), and their state of preservation. The exception may be the grey partridge, but no butchering marks were found on any of the bird bones. The grey partridge is an indicator of cold, steppic (but not necessarily glacial) conditions.

Discussion: Level 2

The pattern of element representation is somewhat skewed in favor of podial elements and heads (Table 1-7). The presence of partly articulated podial elements was reported by the archeologists (Marks et al. 1998). A bias towards heads and distal limbs would support a hypothesis of transported, scavenged elements. Regressions against meat/marrow or food utility show no significant relationship, supporting a scavenging hypothesis. The fact remains that bone density played an important part in structuring element representation in this assemblage, as indicated by statistical tests discussed above. Diagenesis, therefore, is a possible cause of the apparent bias towards less meat-rich elements, since these denser elements are also the least valuable in terms of meat or marrow.

The agency, or agencies, responsible for patterning Level 2 fauna are not readily identifiable. Humans occupied Starosele Level 2 during the same seasonal time frame as Level 3, but the occupation appears to have been less structured and more ephemeral. The assemblage is too small and badly preserved to yield much more in the way of useful interpretation.

RESULTS: LEVEL 1

Level 1 is probably a palimpsest deposit, formed in the fine-textured sediments of Stratum B, and characterized by the formation of pedogenic carbonates (Marks et al. 1998). Level 1 is up to 30 cm thick in places, and may be the result of a single activity set or of multiple, though ephemeral, occupations of similar nature (Marks and Monigal 1998). The land surface upon which Level 1 formed slopes to the west and the south and may have resulted in an aggradation of the original level. Artifacts cluster densely around a distinct hearth in Squares I23 and J23, around which concentrations of bone charcoal are also reported (Marks and Monigal 1998). Bone distribution correlates well with both lithic distribution and the location of the hearth.

Level 1 contains a large (N=3,652), and diverse faunal assemblage (Table 1-1, figs. 1-1, 1-2). The observable species diversity is partially attributable to sample size. Species diversity may also reflect the palimpsest nature of Level 1. The limited activity set implied by the lithic patterning and the nature of the tools (Marks and Monigal 1998) lends itself more to an interpretation of a single, short-term (possibly single-season) hunting and butchering camp, however.

Bone preservation is generally fair in this level, though dissolution cavities are frequent. Dissolution may be due to chemical processes in the soil, rather than to the digestive juices of carnivores. Sediment abrasions, rolling, and trampling are evident and consistent with movement along the sloping surface of the level. There is good evidence for gnawing (hyena), as well as human butchering activities, and limited bone modification. Despite these preservation biases, some bird-bone is preserved in this assemblage, as indicated by the presence of a single jackdaw (NISP=1).

Element Representation in Level 1

Element representation patterns in Level 1 cannot be attributed to carnivore ravaging, either by comparison with Hill's data (as reported in Binford 1981) or with Binford's (1981) "ravaging zone" data (fig. 1-4, Tables 1-9, 1-10). Although humeri ostensibly fall inside the "ravaging zone," a single humeral epiphysis was recovered in this level. Regressions on meat, marrow, and FUI failed to establish any significant correlation. The ratio of upper to lower equid teeth indicates that mandibles and skulls were both present in roughly equivalent numbers. On the other hand, bone density explains 35.3% of the variation in element representation in a data+1, log transformed regression, with normally distributed, homoskedastic residuals. Preservation, therefore, played the most visible role in patterning element representations.

TABLE 1-9
Starosele, Level 1, Element Representation of Equids

	NISP	*MNE*	*MNI*	*%MNI*
Skull	13	3	3	0.25
Mandible	13	13	8	0.67
Atlas	–	–	–	–
Axis	–	–	–	–
Cervical Vertebra	6	2	1	0.08
Thoracic Vertebra	1	1	1	0.08
Lumbar Vertebra	5	5	1	0.08
Sacrum	1	1	1	0.08
Pelvis	9	3	3	0.25
Ribs	4	2	1	0.08
Scapula	3	1	1	0.08
Humerus, proximal	–	–	–	–
Humerus, distal	1	1	1	0.08
Radius, proximal	7	7	4	0.33
Radius, distal	6	6	4	0.33
Ulna	7	5	2	0.17
Carpals	7	7	2	0.17
Metacarpal, proximal	8	8	5	0.42
Metacarpal, distal	6	6	4	0.33
Accessory Metacarpals	5	4	1	0.08
Femur, proximal	2	2	2	0.17
Femur, distal	5	5	2	0.17
Tibia, proximal	3	3	2	0.17
Tibia, distal	6	6	4	0.33
Tarsal	6	3	2	0.17
Astragalus	2	1	1	0.08
Calcaneus	3	3	2	0.17
Metatarsal, proximal	20	20	12	1
Metatarsal, distal	5	5	3	0.25
Accessory Metatarsals	12	11	2	0.17
First Phalanx	15	7	2	0.17
Second Phalanx	8	8	2	0.17
Third Phalanx	12	11	3	0.25
Upper Teeth	194	N/A	5	0.42
Lower Teeth	183	N/A	5	0.42

TABLE 1-10
Starosele, Level 1, Equid Long Bone Representation

	NISP	*SUMu*	*MNEu*	*MNIsh*	*%MNI*	*SUMs*	*MNEs*	*MNIe*
Humerus	26	1150	12	6	0.5	500	5	1
Radius	37	950	10	5	0.42	575	6	4
Metacarpal	21	625	7	4	0.33	350	4	5
Femur	33	950	10	5	0.42	475	5	2
Tibia	45	1250	13	7	0.58	575	6	4
Metatarsal	40	1150	12	6	0.5	500	5	12

NISP includes both shafts and epiphyses
(SUM)u = unsided element portions (shafts and epiphyses)
MNIsh–based on MNEu/N of each element in the body
(SUM)s = sided element portions (shafts and epiphyses)
MNIe–based on epiphyses only

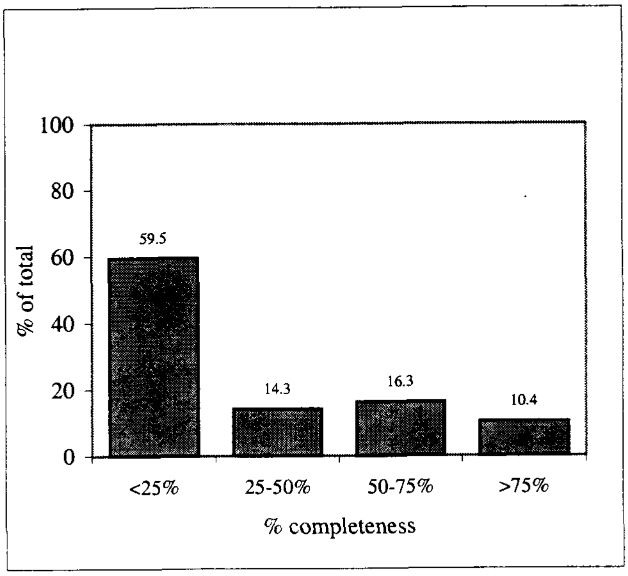

Fig. 1-13—Starosele, Level 1, fragmentation patterning.

Fragmentation in Level 1

The extent of fragmentation is very high in this level, and the ratio of whole to fragmentary bone is 178:3652. Two-thirds (N=1,170) of the bones for which portion size was recorded (N=1,587) scored 25% or lower (fig. 1-13). Only 10% of the recorded bone was whole. Whole bone is mostly represented by individual teeth. Long bones were typically fractured spirally, and the presence of some bone flakes indicates that bones were intentionally smashed to expose the marrow cavity. Hyenas were active in this level, visiting the site after humans departed based on one bone with tooth marks overlying cut marks. Evidence of the further reduction and destruction of bone due to hyenas is apparent in the number of digested bone fragments (N= 6).

Diagenesis in Level 1

Dissolution cavities are a fairly common occurrence in this level (N=50, unassociated with traces of gnawing). These may be the result of natural, sedimentary processes rather than digestive processes. Several bones also show surficial polishing (N=6); whether due to water action or canid gnawing, digestion, or licking, is unknown. Some gnawed bones show signs of dissolution and polishing.

Root damage (N=138, 7.3% of identified bone) and weathering (N=42) are not infrequent. The weathering is scored relatively high (2-3 on a scale of 1 to 3). Sedimentary abrasions are identified in 8 cases (plus one indeterminate case) and are probably due to post-depositional movement in the downsloping deposits.

Human Agency in Level 1

Definite signs of battering (percussors) are visible on equid, equid-sized, and saiga bones (N=10). Cut (N=8, plus 3 indeterminate) and chop (N=5, plus 1 indeterminate) marks are visible. Two of the butchered bones are large mammal fragments, one Saiga first phalanx has a cut mark; the other butchering scars are distributed on a wide variety of equid or 'OXO' sized bones, including one acetabulum (cut), one proximal femur, a scapula, two mid-shaft tibia fragments, a proximal ulna fragment (chop), two proximal metapodia, and one vertebral fragment. Battering is identified in 10 cases. Some bone fragments are burned (N=11). In conjunction with the lithic evidence and strong clustering around a distinct hearth, the faunal remains would indicate butchering and processing activities taking place on site.

Other Predator/Scavenger Agency in Level 1

Gnawing is visible (N=34) and probably due to the activities of hyenas or similar-sized scavengers. Dissolution attributable to partial digestion is identified in 3 cases.

Equid Herd Structure and Seasonality in Level 1

Post-cranial remains yield an MNI of 12 individuals, based on proximal metatarsals (Table 1-1), to which one foetal horse must be added (foetal NISP=5). Two right deciduous upper P4's are juveniles. As many as 7 sub-adult individuals are present in this assemblage based on right upper deciduous P4's, if the remainder of the dP4's, which are fragmentary, are treated as portions, added together, and divided by 100. Difficulties in estimating portion sizes of broken teeth make this a rather risky estimate, however. Moreover, single teeth have not been used to calculate MNI's for any assemblage in this study. Six adults (five mature, one senescent) are also identified on the basis of dental remains. It is clear, regardless of how one treats the dental remains, that juveniles are present, possibly even in equal numbers to adults. Foetal development indicates late summer. Age representation of equids in this level implies either a family herd type of social group and, perhaps, deliberate selection of juveniles, regardless of the number of hunting episodes this palimpsest deposit may represent.

Discussion: Level 1

The ratio of skulls to mandibles indicates the probable presence of whole horse heads (and potentially, therefore, whole carcasses) in this level. This is consistent with the archeologists' interpretation of a toolkit in this level as an indicator of primarily butchering activities (Marks and Monigal 1998). A hypothesis of scavenging can be rejected on the grounds that Level 1 lies in a stratum that did not accumulate due to flooding episodes (such as stratum F), the thalweg having gradually become deeply incised over time. Drowned animals would not have occurred naturally at the site during the time of deposition of Level 1. It is unlikely that complete horses (or even horse heads) would have been transported any distance by scavenging people.

The accumulated archeological and zooarcheological evidence points to a primary strategy of hunting equids, probably by driving animals up the box-canyon in which the site is situated. Deaths probably occurred very near the site, otherwise economic decisions predicated on meat weight, marrow content, or food utility values would have governed the transport of portions of the horse carcasses. While carrying out this strategy, and during the human occupation of the site, other, typically smaller-bodied prey such as Saiga (see fig. 1-2) were hunted as encountered locally.

RESULTS: LEVEL 0

The small faunal collection (N=131) designated as Level 0 was collected from the disturbed sediments in Stratum A. This unit is composed of modern colluvial loams and contained debris from A.D. eighteenth century quarrying and pit and hearth construction. In a few areas, pit construction and burials disturbed the Level 1 deposits, so that Paleolithic-age artifacts were mixed in with recent human burials, domesticated animals, and ceramic sherds (Marks et al. 1998: 76; Monigal et al. 1998). In spite of the disturbances, the Paleolithic-age faunal material was easily distinguished from modern material by color and density, and was set aside as Level 0. Equids are still dominant in this level, but species diversity is high relative to other levels (figs. 1-1, 1-2). This is probably due to the mixed nature of the deposits and the collection strategy. Analysis of this collection was not attempted beyond a basic, descriptive level.

Two juvenile equids (dP4's worn) are present. A single foetal rib is difficult to assign to a developmental stage, but is probably consistent with foetal development in other levels. One bovid metatarsal is unfused distally, as is a saiga-sized metapodial. Root damage (N=23) is generally moderate (scored 2, out of 1-3). Weathering is not frequent (N=12) but is severe when it occurs, supporting the archeologists' description of this assemblage as mixed (Marks et al. 1998). The Level 0 faunal collection probably formed over a relatively long period of time, with some bone lying exposed for much longer periods of time than the rest of the assemblage. A single bone shows indeterminate signs of battering. Scavenger activity is attested, there is evidence of gnawing (including rodent gnawing) but it is rare. A single bone flake shows signs of having been passed or partially digested by a carnivore.

CONCLUSIONS

The general lack of evidence of carnivore gnawing and the small quantity of carnivore remains found at Starosele confirms that these animals were not the primary bone collectors. The presence of tooth furrows overlapping butchering marks in Level 3, for example, indicates that a "swing-shift" of hyena moved in and scavenged residual bone after the human occupation of the site. Hyena was present in all levels except Level 4 and probably accounts for some of the fragmentation and element representation patterning observed.

During the period of accumulation of the lowermost Stratum F, humans traveled up the box canyon in which Starosele is situated, walking along the gravel and boulder-strewn thalweg after floodwaters had receded. They briefly occupied the site, leaving behind a living floor, or find-horizon: Level 4. The Level 4 occupation may not have been an isolated event, but it is a happy accident for the archeologists that the find horizon was preserved by the subsequent deposition of a fine, protective layer of clayey sediments. This level may record one of a series of forays into the gorge, undertaken with the specific purpose of scavenging the stream banks after flash flooding. The alternative interpretation is that herds of horses were driven into the box canyon and killed on the site. The general lack of species diversity in Level 4 lends more support to the hunting hypothesis. The presence of apparently naturally deposited equid bones (and almost total absence of other species) in the archeologically sterile deposits below Level 4 lends some support to the scavenging hypothesis, however. There is no clear seasonal evidence in the Level 4 fauna.

Level 3 also formed in a generally turbulent depositional environment (Stratum D), although the thalweg was more deeply incised than in Stratum F and the land surface around the site may have been more stable (Marks et al. 1998). Sediment deposition following the occupation of Level 3 occurred in a relatively calm, low-energy regime. In this level, coincident with a distinct change in lithic technology and in the composition of the lithic toolkit (Marks and Monigal 1998), there appears to have been a shift in site function. Differential transport of marrow-rich elements to the site is apparent when one considers the element representations for horse in this level, and the correlation between elements present and marrow indices. Species diversity in Level 3 supports a longer-term, more complex occupation of the site, as does evidence for two distinct stages of early foetal development.

Whereas in all other levels, the site appears to have been briefly occupied as a butchering station, Level 3 appears to be a base camp, occupied for a longer period of time, where primary butchering co-occurred with bone transport and secondary butchering. The change in site function in Level 3 does not detract from the overall impression of a local economy based on the exploitation of equids—probably during seasonal migratory movements.

Level 2 is a short and somewhat quixotic occupation: a small number of relatively complete equid carcasses are present in this small, poorly preserved assemblage. There is no single, clear agent of bone accumulation, or any explanation for the pattern of element representation in this level beyond natural preservation biases (that is, bone density clearly played a role in determining survivorship patterns). In this level, as in Levels 4 and 1, human activities were apparently restricted to the butchering and processing of equid bone, either from scavenged carcasses found locally, or from animals driven up the box canyon and killed there.

Level 1, a palimpsest, is a relatively large assemblage, with considerable taxonomic diversity (probably partially as a result of assemblage size). Juvenile equids appear to have been well represented, indicating that family herds, and perhaps juveniles preferentially, were selected as prey. Whole carcasses were being butchered at the site during the accumulation of this level—the palimpsest nature of the horizon makes further definition of the function of the site impossible. The combined archeological and zooarcheological evidence for Level 1 points to a primary strategy of hunting equids, probably by driving animals up the box-canyon in which the site is situated. Other taxa, relatively well represented in this level, were probably hunted singly on an encounter basis.

MIDDLE PALEOLITHIC HUNTING STRATEGIES

Equid remains heavily dominate the recently excavated fauna at Starosele, confirming the results first reported by Formozov (1958). This could be interpreted as evidence for a deliberate prey-selection strategy, or specialization, on the part of the Middle Paleolithic occupants of the site. Saiga, which dominates other Middle Paleolithic fauna in the region (see Chapter 2), is present in three levels, as are small numbers of other prey species. Species diversity has been used elsewhere to support a hypothesis of unsystematic hunting by Middle Paleolithic people (Mellars 1989). The significance of the correlation between element representation and marrow, together with the high ratio of lower to upper equid teeth, might indicate active scavenging in Level 3, but probably indicates that hunting episodes took place in different locations, at some distance from the site.

Enough data exist to support claims of a primary, systematic, and long-term strategy of horse (*Equus hydruntinus*) procurement at Starosele, whether hunted or scavenged. In almost all levels (Levels 4, 2, and 1), it appears that whole equid carcasses were being dismembered at the site, and bones were probably smashed for marrow. Seasonal indicators indicate the site was occupied during late summer or fall, at least in Levels 3, 2, and 1. Bearing in mind that the precise size of the original assemblages will never be known, the age structure of the death assemblages for Levels 4 to 1 (recent excavations only) point to the exploitation of family herds (composed primarily of mares and juveniles). Seasonal, late summer/fall exploitation of horses is indicated in Levels 3 and 1, based on foetal development. The seasonal evidence indicates that humans were probably taking advantage of predictable, migratory herd movements along the main Bakchisarai valley to drive small groups of equids into the Starosele canyon. Given their numerical lack of importance, other prey species present (in Levels 3, 2, and 1) probably represent opportunistic hunting, or scavenging, while carrying out this primary strategy.