

# Report of the Khanuy Valley Archaeology Project 2011



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## **1. Introduction**

The *Khanuy Valley Archaeology Project* aims to provide a better understanding of the nature of the social and economic organization of Late Bronze Age and Iron Age Xiongnu period (mid second millennia BCE to early first century CE) societies of north-central Mongolia, so as to investigate social change during this pivotal period in Mongolian history.

Together with the on-going study of the numerous monumental stone-built mortuary and ritual sites in the Khanuy River Valley, this research project focuses specifically on the domestic component, that is, the habitation sites associated with the monumental landscape.

### **1.1 Research Area and Environmental Setting**

The Khanuy Valley research area (N 48° 05' / E101° 03') is located north of the Khangai (Hangai) mountain range in Arkhangai aimag's Ondor Ulaan sum. The Khanuy River itself is a tributary of the Selenge River and meanders through the Valley's generally treeless grasslands, with wooded areas (mixed pine, larch, and birch forest) typically found only at elevations above 1700 m. Environmental data for Mongolia and the surrounding northern regions show that the environmental conditions that prevailed during the Late Bronze Age and the Xiongnu period in north-central Mongolia can be described as broadly similar to those of today, but with possibly warmer and wetter climate regimes (Prouse 2005). In fact, geochemical records from lakes in the Khanuy Valley (Strano et al. 2007), as well as sedimentological evidence and pollen analysis suggest that between 3570 and 1500 years ago (the Late Bronze and Iron Age) the climate was more humid (Peck 2000) and that grasslands were expanding, thus increasing the volume of grazing possible—a condition that also characterized the surrounding regions of Lake Baikal (Feng 2001; Horiuchi et al. 2000; Karabanov et al. 2000; Peck et al. 2002), the Egiin Gol-Selenge Valley (Prouse 2005) and the Minusinsk Basin (Bokovenko 2006, 863 Fig.2; Koulikova 2003, 255-74; van Geel et al. 2004). Furthermore, an analysis of archaeological charcoals and wild plant remains from Bronze and Iron Age habitation contexts in the Khanuy Valley research area confirms that the local environmental conditions were similar to those of today (Wang / Wang 2009).



## **2. SUMMARY OF 2011 ACTIVITIES**

### **2.1 Research and Education Activities:**

As a component of the long-term *Khanuy Valley Archaeology Project*, the 2011 field season (the last part of a 2 year program) aimed at addressing an important question in the anthropological literature on nomadic pastoralism, that is, the impact of major economic and social changes on nomadic society and pastoral subsistence—a question still very pertinent today in various world regions. The project consisted of a multidisciplinary endeavor that included archaeology, zooarchaeology, and geoarchaeology (including new archaeometric methods) in order to document the transformation of the domestic economy of mobile pastoralist groups inhabiting the Khanuy Valley region of central Mongolia from the Late Bronze Age to the Iron Age period when the first state-like nomadic polity, the Xiongnu, appeared on the Eurasian steppes. Concretely, this research project aimed at evaluating continuity and change in the range, organization and variation of household activities as the region was incorporated into a regional-scale polity. The objective of this research was to find out if and how households responded to and participated in the broader political and economic system and investigate the effects, if any, of large-scale political processes on household economic organization amongst mobile pastoralists.

In order to evaluate this, multicomponent occupation areas (habitation sites) known from previous survey in the Khanuy River Valley were investigated through targeted excavations in order to provide a better understanding of site structure and in order to yield larger samples of artifacts and faunal remains for sampling variation both within and between areas of occupation. The 2011 field season consisted in both geochemical testing (phosphate and electrical conductivity) and in the archaeological sampling of four multicomponent seasonal habitation sites. We also tested a geochemical anomaly at a 5<sup>th</sup> site in order to investigate the possibility of metal production at this site. In addition, highly controlled ethno-zooarchaeological research was conducted at a present-day summer campsite in the Valley for comparative and interpretative purposes. Furthermore, a site with evidence of important lithic production was investigated through survey and targeted test-excavations. Finally, we mapped a newly discovered large Turkic Period site.

Save for the lithics production site, ceramics as well as faunal remains were the most common materials recovered through the excavations, although we did uncover evidence of metallurgy in the form of iron slag at three sites of the four investigated habitation sites. Soil samples were gathered for soil chemistry analysis and microstratigraphy, yet we were not able to ship the samples for analysis. Distributional and comparative analyses (including statistical analyses) of the recovered artifacts and faunal remains are currently being undertaken.

## **2.2 Training and Development:**

The 2011 field season provided training in archaeological fieldwork to 9 Mongolian students from National University and Ulaanbaatar University, as well as 16 North American, European and Australian students from various universities. These students were trained in screened excavations, artifact analysis, zooarchaeological analysis, geoarchaeology, mapping and ethnoarchaeology (Figure 1).



Fig. 1. Students and volunteers excavating a habitation site

### **2.3 Outreach Activities:**

Public outreach in the field in Mongolia was a continuous and informal process. We regularly visited and conversed with local herders as well as with local administrators, during which time we explained the nature and worth of our scientific research, as well as the importance of protecting cultural patrimony. To date, talks about some of the results of this research project have been given in the Department of Folk Studies and Anthropology, Western Kentucky University (USA), at a workshop on Archaeology in Mongolia at Eastern Tennessee State University (USA), and at several conferences in the UK.

### **2.4 Physical Collection (artifacts, samples, etc.):**

The artifacts recovered from excavations comprise a physical collection of utility for future research in the region. The collection is presently under the care of the National Museum of Mongolia (Ulaanbaatar, Mongolia).

## **3. Archaeological Excavations of Habitation Sites**

During the 2011 field season (May and June) 4 multicomponent seasonal habitation sites that were known from previous survey and test excavations in the Khanuy River Valley research area were investigated more intensively through targeted excavations and geoarchaeology. Two of these habitation sites are strongly believed to be located in winter/Spring time campsite locations, while the two others are believed to be located in summer time campsite locations based on ethnographic observation and archaeological data (Houle 2010). The following sections summarize the methods and results of the excavations at these habitation sites (Figure 2). The artifacts recovered consist primarily of ceramics and faunal remains dating to both the Late Bronze Age and Iron Age Xiongnu periods.

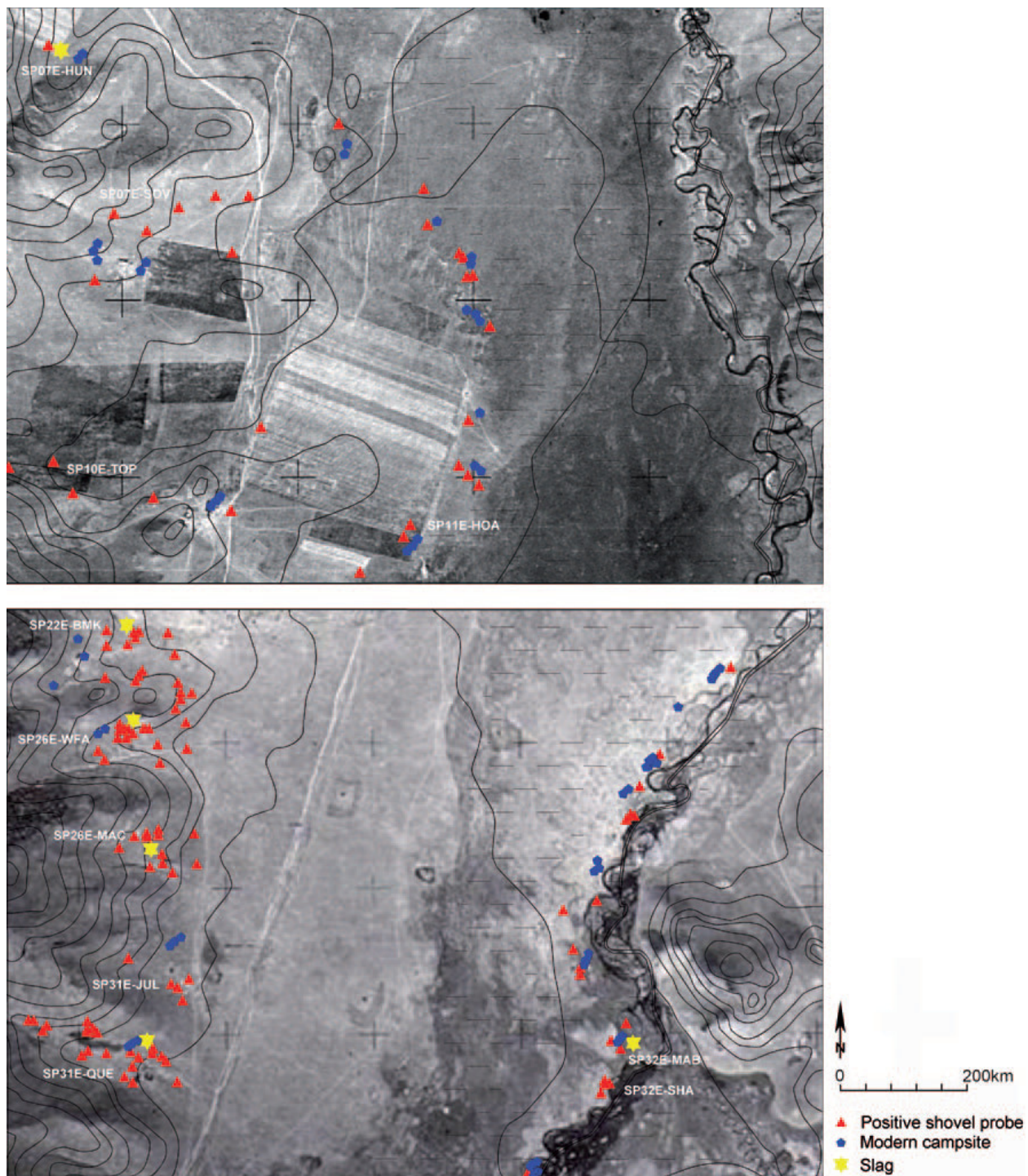


Fig. 2. Location of habitation sites mentioned in this report. Those excavated in 2011 are SP32E-MAB, SP26E-MAC, SP07E-SOV, SP07E-HUN, and SP11W-SAL.



### **3.1 Stratigraphic Setting and Excavation Methods**

The relatively arid-steppe soil which covers not only the lowland but also the rocky hills and mountains in the research area is a sandy-gravelly (sometimes rubbly) chestnut-colored soil poor in humus content (Munsell 10YR 3/2 to 4/4). The A-horizon soil stratum almost never exceeds 20cm outside the floodplain and overlies a gravelly layer. This gravelly layer is almost ubiquitous throughout the valley's research area and sometimes includes coarser pebble to cobble clast size rocks. A sandy to clayey grayish often compact and mostly sterile layer underlies the whole sequence. The former, and occasionally the latter when the gravelly layer was not clearly present, often formed the stratigraphic limit of our excavations. As clear stratigraphic layers have not been seen in previous excavations in the evenly deflating steppe of central Mongolia, units were excavated by arbitrary levels of 5 cm using a trowel until the sterile layer was reached (often no more than around 20 cm below the surface). All soil was systematically screened through 6 mm wire mesh. These excavations confirmed the lack of clear stratigraphic layering.

While all artifacts (and ecofacts) within a unit were recorded according to its stratigraphic context within which they were excavated, diagnostic artifacts, diagnostic faunal remains, as well as features and samples were recorded more precisely using three dimensional coordinates and labeled accordingly. Organic materials were collected from good/secure contexts for radiocarbon dating and particular care was taken to recover faunal remains in these excavations through systematic screening (using 6 mm wire mesh).

## 3.2 Sites

(Reported by Jean-Luc Houle and Julia K. Clark)

### 3.2.1 SP32E-MAB

GPS Coordinates: 48°04'37" N 101°04'55" E (Zone 47U N: 5326949 N 655069 E)

Site Context: Mixed Bronze Age and Iron Age/Xiongnu.

This occupation area is located within 200 m of the Khanuy River channel and is situated exactly at the same place as a modern-day summer campsite. The terrain is mostly flat except close to the floodplain, and the area is characterized by grassy vegetation. The extent of this occupation area is less than 1 ha in area. No burials are associated with this occupation area. Today, one campsite usually sets up here during the summer. Three 2m x 2m units and one 1m x 1m unit (Figure 3) were excavated here this year in order to explore the western edge of SP32E-MAB-14 where slag (possibly steel) was discovered in 2010 (see 2010 Report). The average maximum depth of excavations was 15 cm below the surface. Most of the artifacts were found around 10 cm below the surface, with only occasional artifacts found at slightly greater depths. Excavations at this site yielded numerous Bronze Age and Xiongnu Period ceramics, charcoal, a undiagnostic iron fragment, and two microliths. Yet, no other slag was discovered.



SP32E-MAB17 (closing picture)



SP32E-MAB18 (closing picture)



SP32E-MAB19 (closing picture)



SP32E-MAB20 (closing picture)

Fig. 3. SP32E-MAB excavation units

### **3.2.2 SP26E-MAC**

GPS Coordinates: 48°05'23" N 101°02'16" E (Zone 47U N: 5328281 N 651741 E)

Site Context: Mixed Bronze Age and Iron Age/Xiongnu.

This occupation area is located within a valley draw along the western foothills and down-slope (south) from a concentration of six Late Bronze-Age 'slope' burials. A slight slope characterizes the area itself, with little to no vegetation other than grass. A steep but narrow gully eroded by an ephemeral stream runs to the southwest on the southern edge of the site. There are several rodent burrows within the site area. The site itself is one of the smallest occupation areas (ca. 2 ha) in the research area and it is located on a fairly high terrace with no access to water and with little shelter from the cold winter winds. Despite its odd setting, the site is consistent with the location of modern-day winter/spring campsites in the valley. There is no evidence of recent occupation in the draw though a few bullet casings found in the area suggest that it has been used fairly recently for hunting. Nearby modern habitation areas are within a kilometer or two in lower draws on either side of the site and are occupied in the spring and winter.

Shovel probes and test excavation initially located the site in 2004. Additional investigation and excavation was conducted in 2007 and again in 2010. Fieldwork in 2010 included a geochemical survey which revealed phosphorous and electrical conductivity anomalies which were further investigated with excavation. Six 6m x 6m excavation units were selected with the hope of exploring these areas but only 5 (MAC9, MAC10, MAC11, MAC12, and MAC13) were excavated in the 2010 season. One 6m x 6m and two 2m x 2m units were excavated this year.

### **SP26E-MAC 14**

The location of MAC14 had been determined in the 2010 field season, but due to time constraints, it was not excavated until the 2011 field season. MAC14 is a 6m x 6m unit that was strategically placed over a high phosphate concentration detected in the geochemical survey in 2010. The unit was subdivided into smaller 2m x 2m units (identical to the system used in 2010) identified by a letter-number combination corresponding to the row (A, B, or C from north to south) and column (1,2 or 3 from west to east). There was a large rodent hole located in the south-central portion (B3) of the excavation unit and a smaller one on the east-central portion

(C2). The soil near these holes was highly disturbed and gravelly sediments were deposited around them. Vegetation in the unit prior to excavation included grass and small shrubs.

SP26E-MAC14 was excavated in 2 levels to a final depth of 15 cm below the surface (Figure 4). While excavators identified artifacts (ceramics, bone, and charcoal) in all units except B2 in level 1, most were found primarily in the north east corner (especially units B1 and C1) of the excavation. Medium stones ranging from 5-15 cm in length were numerous and trended from A1, through A2, A3 and into B3 and did not appear to be cultural. Gravel was located about 7-8 cm below the surface in C1's north west corner, but was found to be only a thin lens. A concentration of thick, likely Bronze Age sherds was found in the northern portion of B1 and likely extends into the northern wall. The base of the second level (15 cm below the surface) was predominantly fine gravel or the large stones first uncovered in level 1. No artifacts were recovered in the lower few centimeters of this level. No features were identified in MAC14. No clear stratigraphic layers were present above the gravel layer.



Fig. 4. MAC14 Final (15 cm). May 29, 2011.

### **SP26E-MAC15 and SP26E-MAC16**

SP26E-MAC15 is a 2m x 2m unit that was strategically placed adjoining the western edge of SP26E-MAC13 (A1) which had been excavated in 2010 revealing a small concentration of mineral coal. SP26E-MAC16 was put immediately to the south of SP26E-MAC15 (adjacent to SP26E-MAC13's A2) and was also a 2m x 2m unit (Figure 5 a and b). These two units were excavated at roughly the same time and both were excavated to a final depth of 20 cm in 3 levels.



Ceramic sherds (apparently all Xiongnu Period), animal bone (including carbonized and calcined fragments), charcoal, fragments of mineral coal and a small piece of iron were found in these units. Additionally, an area of reddish stained earth, probably burnt, was found in the west central portion of SP26E-MAC15 (Figure 6). Concentrations of both sherds and calcined animal bone were found just above this feature. A consolidated bulk soil sample was taken in the wall near this feature and some loose bulk samples were taken within the feature itself. The eastern half of the feature was removed, the feature was photographed and then the western half was removed. It was circular in shape and roughly bowl shaped, though the boundaries became fairly diffuse with greater depth and absolute shape is uncertain. While the feature extended beyond 20 cm below the ground surface and was excavated until it ceased, the excavation of the unit did not go beyond level 3 (20 cm). No artifacts were present in the bottom few centimeters of this unit and a somewhat compacted, fine gravel layer was found in nearly the entirety of both SP26E-MAC15 and SP26E-MAC16. It may be that a heat source on the surface may have caused the soil color change and that it impacted soils beneath the prehistoric ground surface.



Fig. 5a. SP26E-MAC15 (top of photo) and SP26E-MAC16 (bottom of photo) final (15-20 cm). May 31, 2011.



Fig. 5b. Bulk soil sample in west wall of SP26E-MAC15. May 31, 2011.

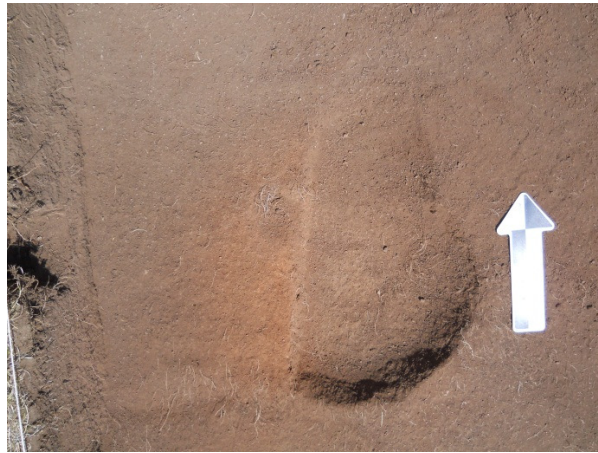


Fig. 6. Burnt earth feature in SP26E-MAC15.

### **3.2.3 SP07E-SOV**

GPS Coordinates: 48°11'16" N 101°04'48" E (Zone 47U N: 5339263 N 654591 E)

Site Context: Mixed Bronze Age and Iron Age/Xiongnu

The SP07E-SOV habitation site is located in a small valley draw along the western hills of our research area. There is a slight southwest trending slope. Grass is the only vegetation in the area. A modern day winter/spring campsite occupies the draw and likely overlies much of the site. Additionally, areas of the site appear to be disturbed by both human and animal actions including holes of various kinds, piles of manure, corrals and eroded areas.

SP07E-SOV had been identified by shovel probes in 2007 and test excavations were conducted in 2008. Fieldwork this year (2011) included both a geochemical survey and excavation. Five units, each 6m x 6m were planned for this field season. After the completion of the first 6m x 6m unit (SOV9), the local family asked that no additional large units be excavated in the area. We were only granted permission to further excavate four smaller units (2m x 2m).

### **SP07E-SOV9**

SP07E -SOV9 is a 6m x 6m unit that was divided into 9 smaller subunits as described above in the description of SP26E-MAC14. It was excavated to a final depth of 10 cm where a compacted, sterile, light colored gravel layer covered the unit (Figure 7). Scattered throughout the unit was evidence of rodent burrowing suggesting that there was some mixing of the matrix. There was no visible stratigraphy in the soil above the gravel layer. Relatively few artifacts (bone and undiagnostic ceramics) were recovered from this site. No features were identified in SP07E-SOV9.

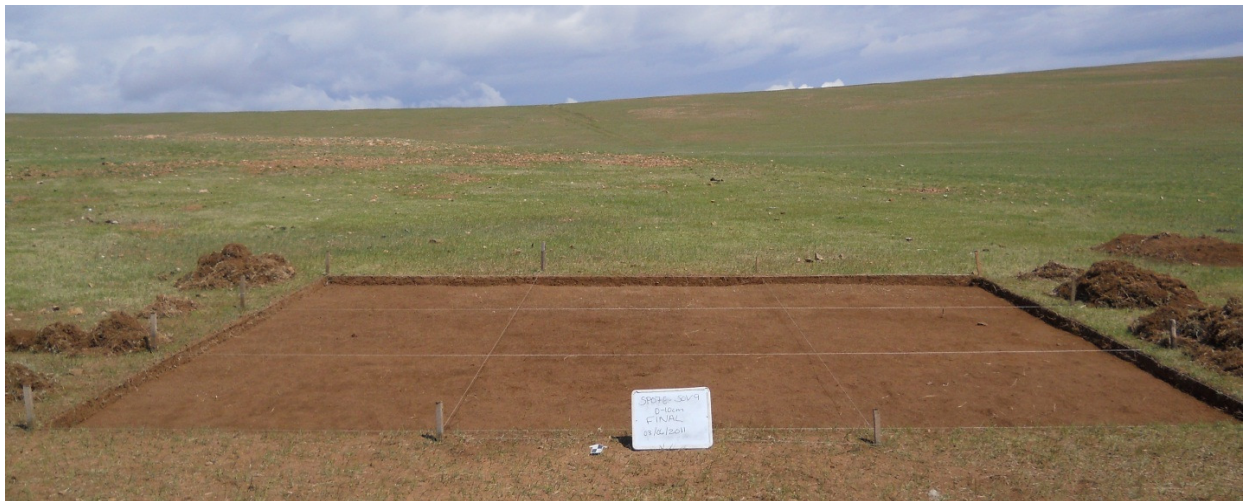


Fig. 7. SOV9 final (10 cm). June 3, 2011.

### **SP07E-SOV10, SOV11 and SOV12**

SP07E-SOV10, SOV11, and SOV12 are 2m x 2m units that were dispersed around the SOV site south of SP07E-SOV9 (Figures 8 a,b,c). These units were excavated to a depth of 10 cm below the surface, though SOV11 extended to 15cm below the surface. These units were strategically placed based on the results of the geochemical survey. SP07E-SOV10 was placed in an area of high phosphate and high electrical conductivity. SP07E-SOV 11 is located in an area of average phosphate. SP07E-SOV12 is located in an area of low phosphate. All three units contained some ceramics, charcoal, and animal bones. SP07E-SOV10 also contained a single piece of slag and a diffuse dark stain was found in the southern portion (Figure 9). A bulk soil sample was taken in this area. The surface of SP07E-SOV12 was littered with modern burnt bone fragments and had



three modern wooden stakes in the unit's northwest section. No stratigraphy was visible above the sterile level in each unit.



Fig. 8a. SOV10 final (10cm). June 4, 2011.

Fig. 8b. SOV11 final (15cm). June 4, 2011.

Fig. 8c. SOV12 final (10cm). June 4, 2011.



Fig. 9. SOV10 Blackened earth feature.

### 3.2.4 SP07E-HUN

GPS Coordinates: 48°11'54" N 101°04'15" E (Zone 47U N: 5340418 N 653878 E)

Site Context: Mixed Bronze Age and Iron Age/Xiongnu.

This site is located within a fairly narrow but relatively deep valley draw that opens onto a tributary valley to its north (that tributary river is now dry). The site is located on a slight to moderate northwest sloping terrain with, nonetheless, a fairly flat relief and little to no vegetation

other than grass. The extent of this occupation area is about 2.3 ha in area and there are no burials located within or near it. The site shares the draw with a modern winter/spring camp that was unoccupied at the time of excavation and may not have been used in the last few years. The site was identified by shovel probes in the 2007 field season and 8 test excavations were conducted in 2008. Fieldwork in 2011 included a geochemical survey and a single 2m x 2m test excavation unit (SP07E-HUN9).

### SP07E-HUN9

SP07E-HUN9 was strategically placed in an area of high electrical conductivity as shown by the geochemical survey. Due to time constraints, this unit was treated as a test excavation and so was conducted with shovels, though the soil was still screened (Figure 10a). The final depth of the unit was 30 cm below the surface. Gravel was found throughout most of the unit between 20 and 30 cm. A large rodent hole was located in the eastern part of the unit and the soil in this area was greatly disturbed. Lenses of gravel and clay on the eastern side of the unit were related to the rodent activity. Artifacts were relatively numerous—ceramics, bone, charcoal, mineral coal, slag, and a bronze fragment were found in this unit. Additionally, a dark colored feature with concentrations of charcoal, ceramic sherds and burnt bone was excavated on the west side of the unit (Figure 10b). A soil sample was taken within the feature. The feature continued into the western wall of the unit.



Fig. 10a. SP07E-HUN9 final (30cm).  
June 13, 2011.



Fig. 10b. SP07E-HUN9 blackened  
feature. June 13, 2011.

#### 4. Lithics Site (Report by Oula Seitsonen)

##### SP11W-SAL

GPS Coordinates: 48°10'06" N 101°05'10" E (Zone 47U N: 5337114 N 655103 E)

Site SP11W-SAL was located during a survey in 2007, and test excavated in 2008, when eight 2 x 2 m squares were dug at the site. Depth of the archaeological deposits varied from 5 to 15 cm in depth, with relatively few finds (Table 1). Of special interest was the biggest sample of lithics so far encountered in the whole Khanuy Valley research area. However, none of these derived from the excavation units but instead from the surface next to them, and still, this assemblage included only 23 lithic artifacts. Motivated by the presence of lithics, until then rare in the general area, the site was intensively re-surveyed and test excavated in 2011.

Type	Total	%
Lithics (surface finds)	23	22.5 %
Bronze Age ceramics	32	31.4 %
Later ceramics	34	33.3 %
Faunal remains	13	12.7 %
Total	102	100.0 %

*Table 1. Finds in 2008.*

##### Surface survey

Surveyors carried out the investigation by walking at five meter intervals along north-south running transects over an area of ca. 600 x 300 meters, with an extended area studied with fewer surveyors, altogether covering an area of nearly 900 x 500 meters. All the artefacts located on the surface were measured to their find location using a Geodimeter 500 series total station (and a transit, when our generator was not working properly). Each find spot received its own x, y and z coordinates; artifacts found within 30 cm from each other were combined together under the same coordinates (Fig. 11; all GIS analyses were carried out using ArcGIS 9.3 and MapInfo software). All the observed finds were not collected, but were still mapped and their raw material and general characteristics recorded. Such detailed documentation of surface find distributions over such a large area has rarely been carried out at archaeological sites in Mongolia.

Surface distribution of the artifacts shows several distinct concentrations. The site can be separated into three major find areas (Fig. 12): Area 1 in the lower lying part on the former agricultural fields; Area 2 ca. 150 meters west of the Area 1, on top of the ridge rising west of the Area 1, with finds reaching all the way to the hilltop; and Area 3 ca. 150 meters south of the others, in the southern end of the hill, where the finds fade away towards south. Area 1 has been under mechanized agriculture in the Soviet period, which probably explains the relatively good surface visibility of artifacts. Then again, in the Area 2 artifacts are visible on the surface due to very sparse soil build-up on the ridge top, as well as due to erosion effects.



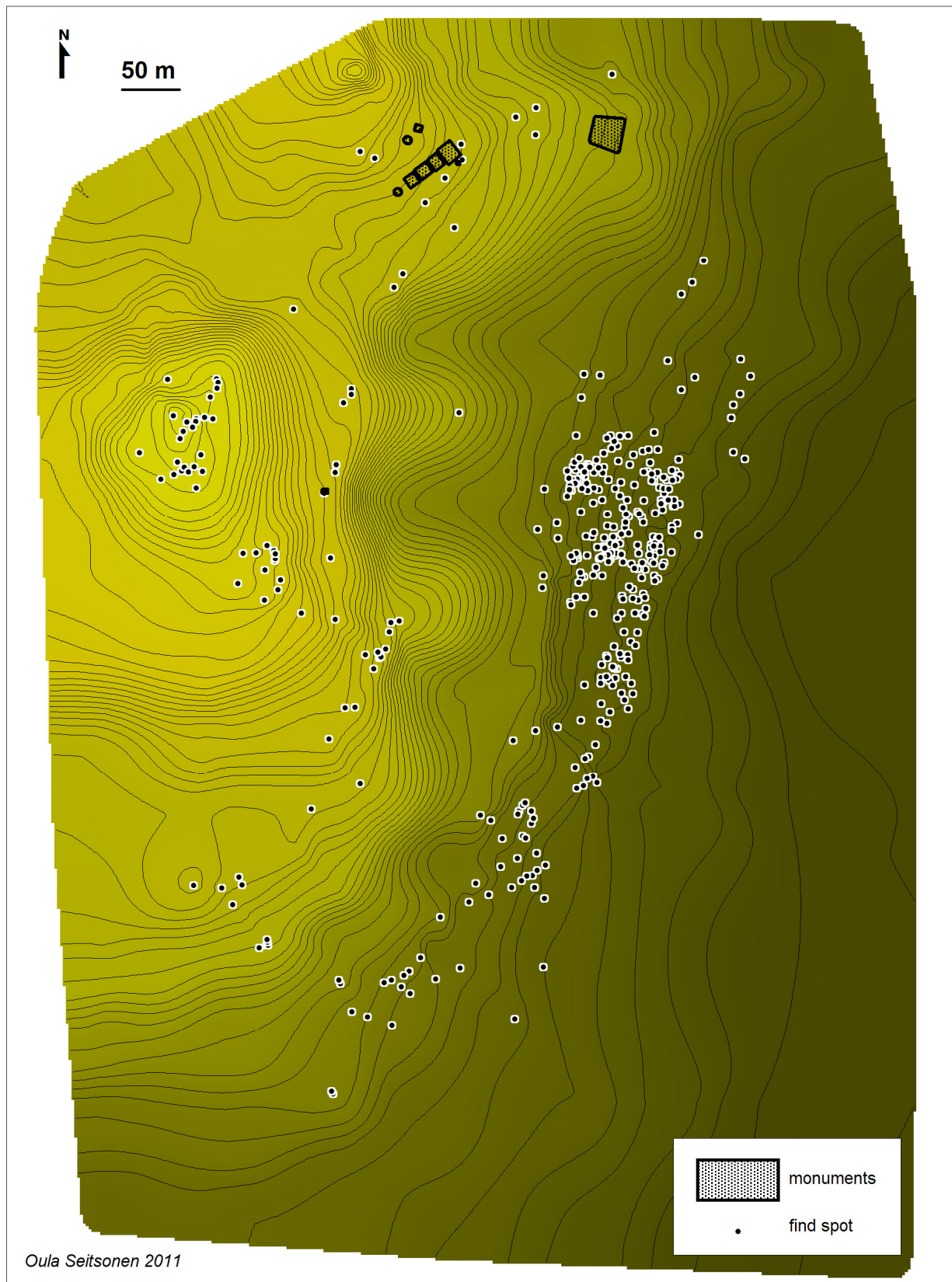


Fig. 11. All the recorded find spots, shown with black dots.



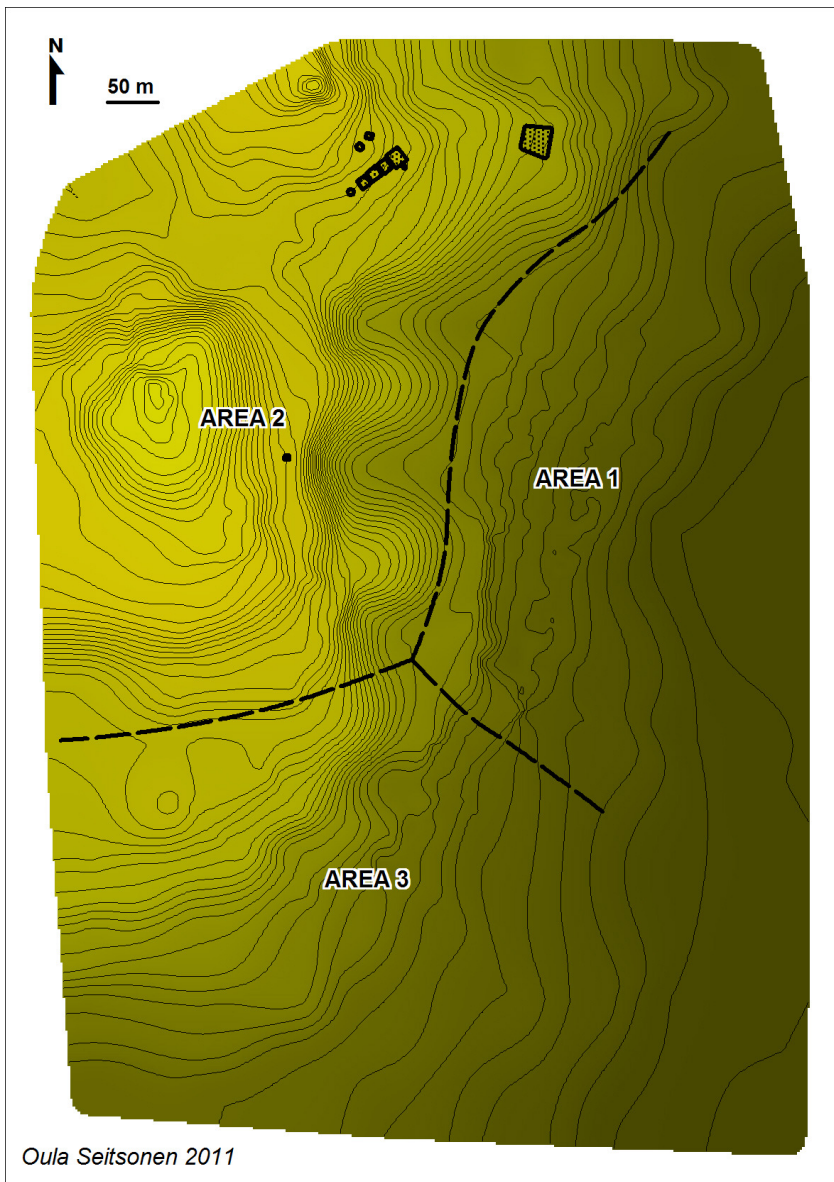


Fig. 12. Find areas within the site.

### Test excavations in the Area 1

Five new 1 x 1 meter trenches were opened in the Area 1 in 2011 to test the association of surface lithic concentrations with the underlying archaeological deposits. Three test pits (SAL-9, 10, 11) were placed in the densest surface concentrations, and two in the higher (SAL-12) and lower (SAL-13) edges of the Area 1 (Fig. 13).

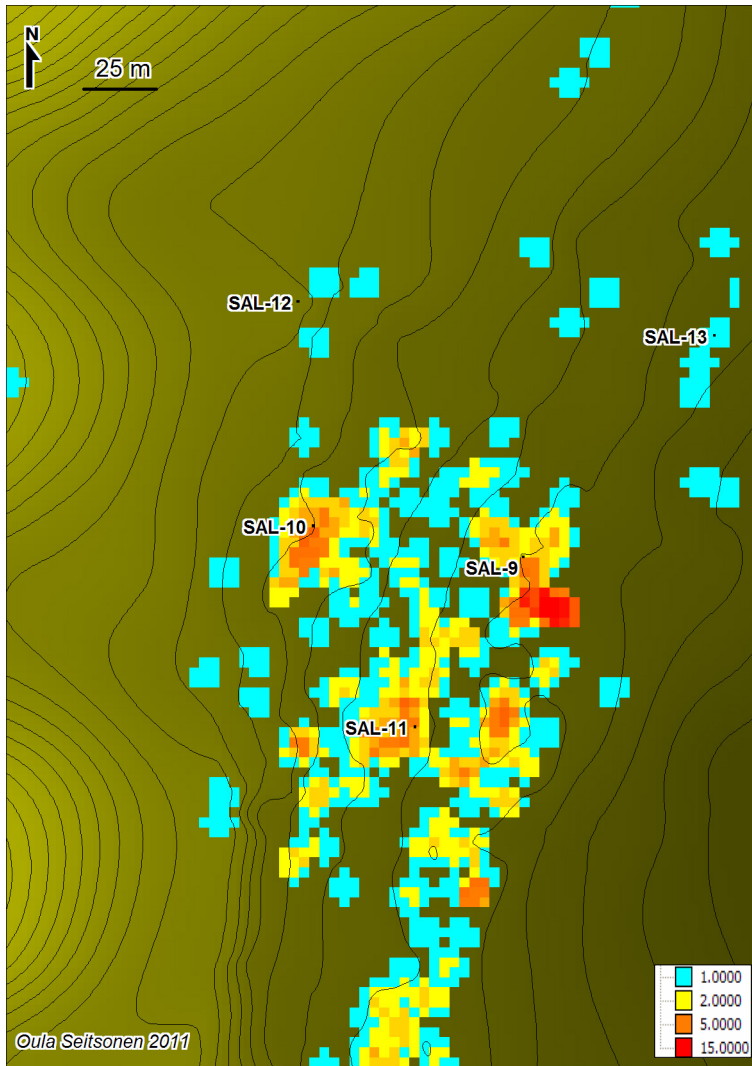


Fig. 13. Location of test units excavated in 2011 and find densities in the area 1.

All the units SAL-9 through -13 were dug in 5-10 cm technical spits, and showed a similar stratigraphy, with three distinct stratigraphic layers:

Layer 0= sod, ca. 3-7 cm

Layer 1= homogenous, humic brown soil with lot of roots, ploughed field layer, reaching to the depth of 30-40 cm in the trenches SAL-9 – 10 and SAL-13, and to ca. 20 cm in SAL-12.

Layer 2= hard packed, lighter brown gravelly layer, from 30-40 cm downwards

After reaching the bottom of layer 1 (humic brown ploughed layer), at least one corner of the square was dug deeper into the layer 2 (hard packed light brown gravelly layer), to test that the base of archaeological deposits had been reached. Layer 2 proved to be sterile in all of the test pits.

Units yielded very few finds, all of these very small in size (Table 2). Thus no conclusive evidence for interpreting the connection between surface finds and archaeological deposits was acquired. Therefore the excavation finds will be discussed in the following section together with the surface finds.

	<b>Lithics</b>	<b>Ceramics</b>	<b>Faunal remains</b>	<b>Total</b>	<b>%</b>
SAL-9	7	1	2	10	45.5%
SAL-10	5			5	22.7%
SAL-11	3	1		4	18.2%
SAL-12			2	2	9.1%
SAL-13	1			1	4.5%
<b>Total</b>	16	2	4	22	
<b>%</b>	72.7%	9.1%	18.2%		100.0%

Table 2. Finds from the test pits in 2011.

### **Spatial distribution of finds**

The spatial distribution shows several distinct find concentrations over the surveyed area (Fig. 14). Since the test excavations did not provide information of the connection between surface finds and underlying deposits in the Area 1, the possibilities are, that either most of the surface finds in this area derive from downhill erosion, or the mechanized ploughing and freeze-thaw cycle has brought most of the larger finds to the surface. However, preliminary lithic technological analyses suggest that there is technological consistency within the find concentrations, at least in some cases showing Paleolithic features, suggesting they might belong to assemblages deriving roughly from the general area, although mixed by agriculture.

### **Find assemblage**

Lithic assemblage includes 460 artifacts, which is many times more than were earlier known from the whole Khanuy Valley research area and the adjoining region. Also, over 60 ceramic sherds, one iron ring, and one piece of slag were recorded (Table 3). Several of the potsherds seem to be connected to the Bronze Age; however, the ceramic analyses are ongoing. Lithic analyses are also ongoing, and a detailed technological account will be published later.

<b>Type</b>	<b>Total</b>	<b>%</b>
<b>Lithics</b>	460	86.6 %
<b>Iron ring</b>	1	0.2 %
<b>Iron slag</b>	1	0.2 %
<b>Ceramics</b>	65	12.2 %
<b>Faunal remains</b>	4	0.8 %
<b>Total</b>	531	100.0 %

Table 2. All finds in 2011.

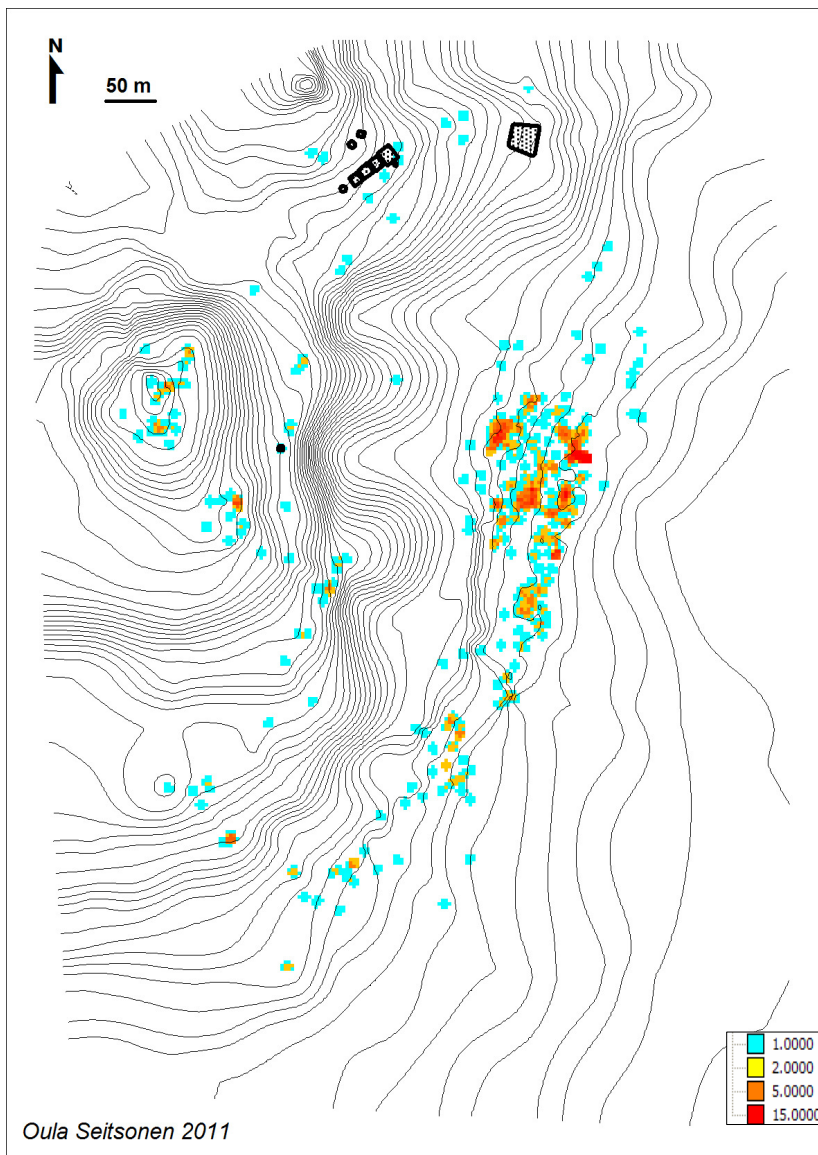


Fig. 14. Preliminary distribution map showing find concentrations within the site (finds interpolated using Kernel smoothing with a 10 m search radius).

Dominant raw material of the lithics is metasedimentary rock, which is readily available throughout the research area as different sized pebbles. Also chert-like, more fine-grained raw materials with greenish and grayish tinges were used; these appear to be non-local raw materials. Besides these, a few flakes of quartz were found.

As already mentioned, the lithic finds located within same concentrations show in many cases consistent technological characteristics. In some concentrations these suggest Middle and Late Paleolithic origins for the artifacts: for instance, a Levallois-like core (Fig. 15:a) and microblade cores (Fig. 15:b) and microblades (Fig. 15:c,d,e). However, the few lithics acquired through excavations and connected with Bronze Age ceramics from this and other sites in the Khanuy Valley suggest that the microblade technology continued to be utilized in the Bronze Age.

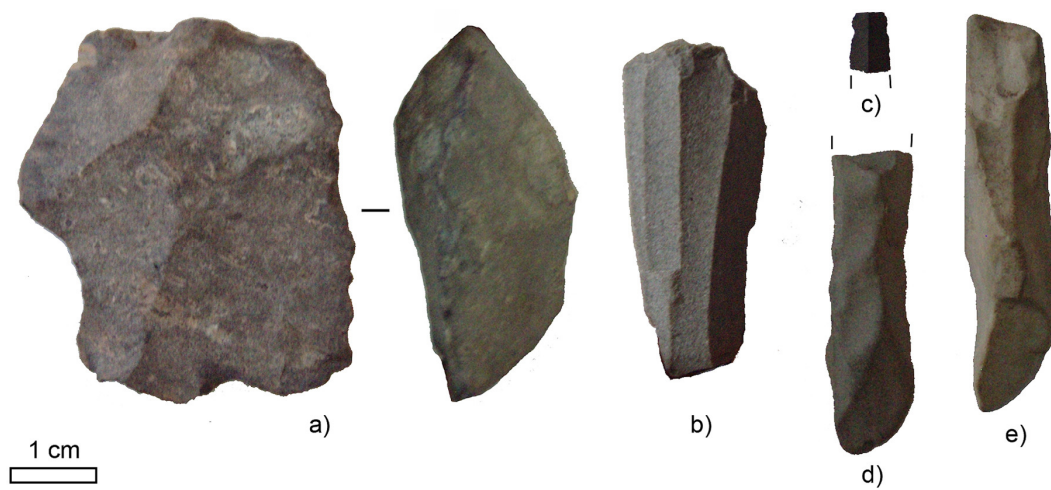


Fig. 15. Lithic finds from SP11W-SAL (photographs: O. Seitsonen 2011).

## **5. Ethno-Zooarchaeology**

### **(Synopsis by Barbara Betz)**

Alongside the archaeological investigations and interviews with the local population, a complex ethno-zooarchaeological research project was conducted at an abandoned summer campsite (Figure 16). This was to complement the one carried out at a winter campsite in 2010 (see 2010 Field Report). First, we divided the entire campsite – approximately 24,000 square meters, as defined by its former occupant – into a grid of two meter squares. Within each square, all faunal material evident on the surface was bagged and collected, and then recorded following the same methodology as was all of the project's archaeological material. Because the two meter grid is the same size as the excavation units on the archaeological sites of Khanuy Valley, these ethno-zooarchaeological sites can be mapped, used to identify any spatial patterns of distribution in the faunal data, and compared directly to the archaeological material. The other purpose of this exercise was to collect a modern dataset that specifically describes the faunal materials found, for use as a baseline in comparisons with the archaeological material. We now have an idea of what faunal material is present at a site shortly after abandonment today as well as a modern sample of hundreds of teeth (with wear stages) and thousands of bones (with biometric, pathological, postmortem alterations and taphonomic data) to compare with archaeological samples. In addition to the fact that building a faunal reference collection based on modern local material is a useful exercise on its own, this ethno-zooarchaeological project will provide further insights into site use, herd management and any improvements or introductions of livestock in the past. Over the past two field seasons, the following datasets have been recorded for analyses on recently abandoned summer and winter campsites:

- 1) Spatial mapping of all non-organic artifacts (metal, ceramic, plastic, glass, fabric)
- 2) Spatial mapping of faunal remains by quantity
- 3) Spatial mapping of faunal remains by taxon
- 4) Spatial mapping of faunal remains by evidence of burning
- 5) Spatial mapping of faunal remains by evidence of butchery
- 6) Age related (epiphyseal fusion stages, tooth wear, etc.) and biometric data for thousands of long bones and hundreds of teeth



The goal of this research is to provide a better understanding of what kind of faunal remains and artifact scatter an archaeologist should expect to find in this particular type of seasonal site and why they should expect to find them in these specific locations and conditions.



Fig.16. Ethno-zooarchaeological research being carried out at a temporarily abandoned summer campsite (Upper). Lee Broderick and Barbra Betz recording finds (Lower)



## **6. Turkic Period Site**

A newly discovered large Turkic Period site was fortuitously discovered just west of our research area (48° 10' 12" x 101 ° 02' 42") (Figure 17). Over 1100 ceramic sherds were discovered on the surface of the site alone (Figure 18). This is significant because there is otherwise very little evidence of Turkic period occupation in the research area. Noteworthy, this site is located far away from the main river valley and tucked away in a side valley.

A systematic surface survey was done of the whole site. Surveyors walked straight lines back and forth from west to east and were spaced .5 seconds apart (c. 20-30 m) using a handheld GPS unit. Visibility on the surface was good to very good and marmot burrowing activity had brought up to the surface many artifacts.

Two major concentrations of artifacts were discovered, one close to the center of the map shown below and the other one in the northwestern section of the site and near the floodplain. The first main cluster revealed hundreds of ceramic sherds and evidence of burning in the form of burnt clay and charcoal. Many ceramic sherds and animal bones were also affected by the burning. The second smallest cluster also revealed hundreds of Turkic Period ceramics, lithic material and iron ore.

The only non-Turkic period artifact found at this site was a Medieval iron spearhead (Figure 19). No formal analysis of the material has been conducted.

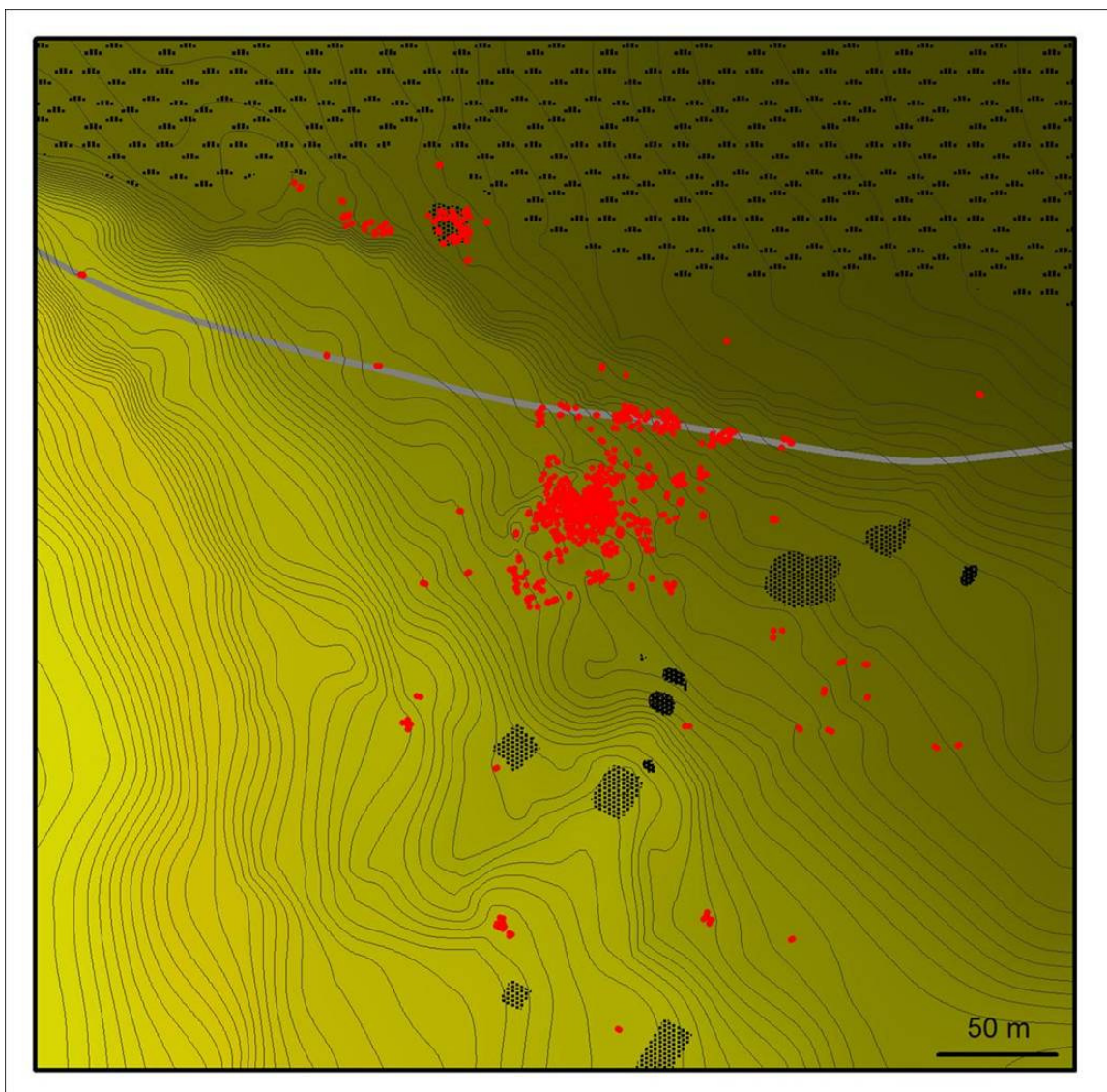


Fig. 17. Turkic Period Site (SAN). Red dots indicate location of ceramic sherds.



Fig. 18. Turkic Period ceramic Sherds



Fig. 19. Medieval iron spearhead

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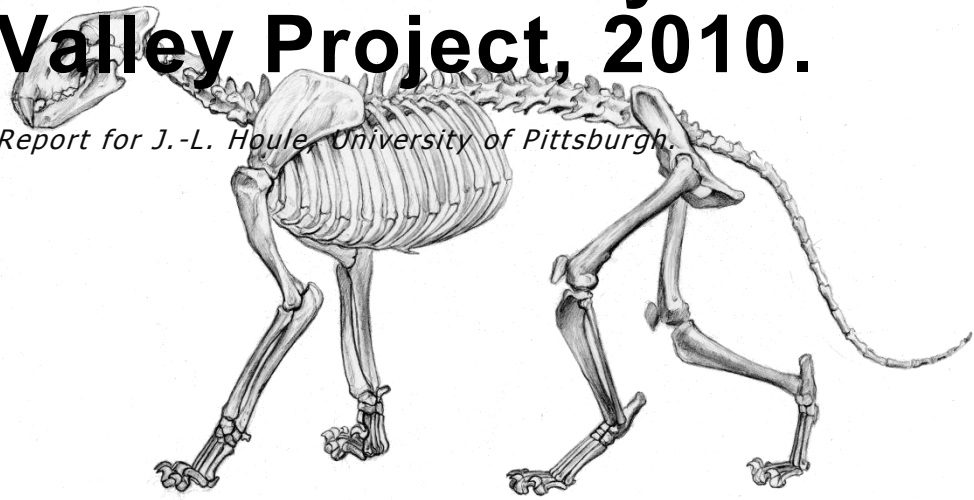
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**APPENDIX**  
**(Faunal Report from 2010 Field Season)**

# The Faunal Remains from the Khanuy Valley Project, 2010.

*Report for J.-L. Houle, University of Pittsburgh.*



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*All images and other figures are author's own unless clearly stated otherwise.*

# 1. Introduction

Analysis of zooarchaeological assemblages from domestic sites in Mongolia is a practice very much in its infancy. Previous work has been focused, as in this report, on the Khanuy valley, in the Arkhangai province of northern central Mongolia (Makarewicz, 2006; Viner, 2009; Broderick, 2010). This report examines the remains excavated during the 2010 field season of the Khanuy Valley Project.

Research aims and objectives include:

- i. To gain information about the wild and domestic animal species represented.
- ii. To gain information about the exploitation of wild and domestic animal species.
- iii. To ascertain economic and seasonal strategies.
- iv. To better understand the palaeoenvironment.
- v. To identify changes in any or all of the above between the Xiongnu period and the preceding and subsequent phases of occupation.

# 2. Methods

A full account of the methods used in identification and recording of the assemblage can be found in the appendices.

The binomial name is used for all species throughout this report. Taxonomy follows Wilson and Reeder (2005) for mammals and Voous (1977) for birds. For convenience, their common (English) name is used in brackets alongside the binomial name when the animal is first mentioned, and a dictionary of all the animals mentioned is provided in the appendices. The word caprine is used when referring to an animal that may be a sheep or a goat.

All bones in the assemblage were identified by comparison with the specimens held in the reference collection of the Khanuy Valley Field Project, where possible, which continued to be assembled and improved during the 2010 field season.

In brief, all teeth were counted (maxillary and mandibular) and a pre-determined selection of skeletal parts was recorded and used in counts. Specifically, these parts are as follows: zygomaticus; occipital; supraorbital; atlas; axis; scapula (glenoid articulation); distal humerus; proximal humerus; distal radius; proximal radius; proximal ulna; carpal 2-3; distal metacarpal; pelvis (ischial part of acetabulum); distal femur; proximal femur; distal tibia; proximal tibia; calcaneum (sustentaculum); astragalus (lateral side); scaphocuboid; distal metatarsal and proximal parts of the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> phalanges. At least 50% of any given part had to be present for it to be recorded. The presence of large (cow or horse sized), medium (sheep or pig sized) and small vertebrae and ribs

were recorded. Horncores with a complete transverse section were also recorded.

For birds, the following elements were always recorded, along the same lines outlined above for mammals: scapular (articular end), proximal coracoids, distal humerus, proximal humerus, proximal radius, distal radius, proximal ulna, proximal carpometacarpus, distal femur, proximal femur, distal tibiotarsus, proximal tibiotarsus and distal tarsometatarsus.

The pelvis and main long bones were recorded for amphibians.

Potentially diagnostic fish bones were photographed in order to prompt identification away from the field when suitable reference material was to be found.

The separation between *Ovis aries* (sheep) and *Capra hircus* (goat) was attempted on the following elements: mandible; dP<sub>3</sub>; dP<sub>4</sub>; M<sub>1</sub>; M<sub>2</sub>; M<sub>3</sub>; distal humerus; distal metapodials (both fused and unfused); distal tibia; astragalus and calcaneum, using the criteria described in Boessneck (1969), Payne (1985; 1969); Kratochvil (1969) and Halstead, et al.(2002).

The separation between *Dama dama* (fallow deer) and *Cervus elaphus* (red deer) was attempted on the following elements: scapula; distal humerus; proximal radius; distal radius; proximal metacarpal; distal metacarpal; distal tibia; astragalus; calcaneum; proximal metatarsal; distal metatarsal and first phalanx, using the criteria described in Lister (1996).

Wear stages were recorded for P<sub>4</sub>, dP<sub>4</sub>, M<sub>1</sub>, M<sub>2</sub>, and M<sub>3</sub> of *Bos* (cattle), caprines and *Sus* (pig), both isolated and within mandibles. Tooth wear stages follow Grant (1982) for *Bos*, Bull and Payne (1982) for *Sus* and Payne (1973; 1987) and Jones (2006) for caprines.

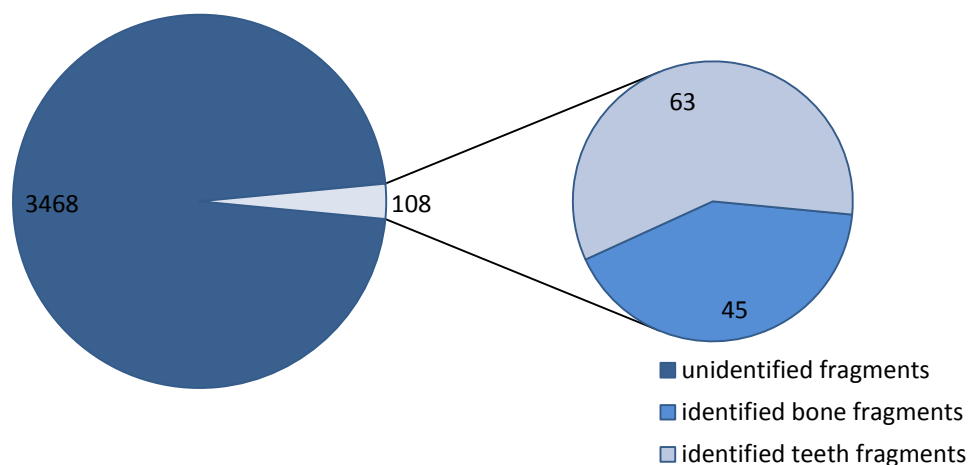
A mammal bone epiphysis is described as “fusing” once spicules of bone have formed across the epiphyseal plate, joining epiphysis to metaphysis, but while some ‘gaps’ are still visible between the epiphysis and diaphysis. An epiphysis is described as “fused” once these gaps along the line of fusion have disappeared. Fusion stages follow Moran and O’Connor (1994) and Zeder (2006). Bird bones with ends that are incompletely ossified were recorded as “juvenile”. Where mammal bones were fused, or fusing, and bird bones were not juvenile specimens, metapodial measurements were taken according to Payne (1969), measurements for *Sus* teeth were taken following Payne and Bull (1988), whilst all other measurements taken followed the criteria laid out by von den Driesch (1976).

*Equus* sp. (horse) bones and teeth are aged according Silver (1969) and Levine (1982).

The bones from this site are presently kept in storage at the National Museum of Mongolia.

### 3. Results

The overall condition of the assemblage was highly fragmentary, with just 108 fragments (3.11%) from the domestic assemblage being identifiable under the protocol (Figure 1). This assemblage consists of those remains excavated from MAB and MAC, which is kept separate from the assemblages excavated at the monumental sites KYR1 and KYR 119 throughout this report. Fragments from MAC and MAB showed signs of being root damaged, burnt or calcined. Generally speaking, those bones from MAC showed greater damage by weathering and root etching than did those from MAB (Figure 2). Ratios of burning, in particular, were noted as being similar to those recorded from a modern day winter campsite in the same area (Figure 3), the similarity being slightly greater for MAC than for MAB (Figure 4).



*Figure 1: NISP (Number of Identified SPecimens) as proportion of total assemblage from domestic sites (MAB and MAC).*

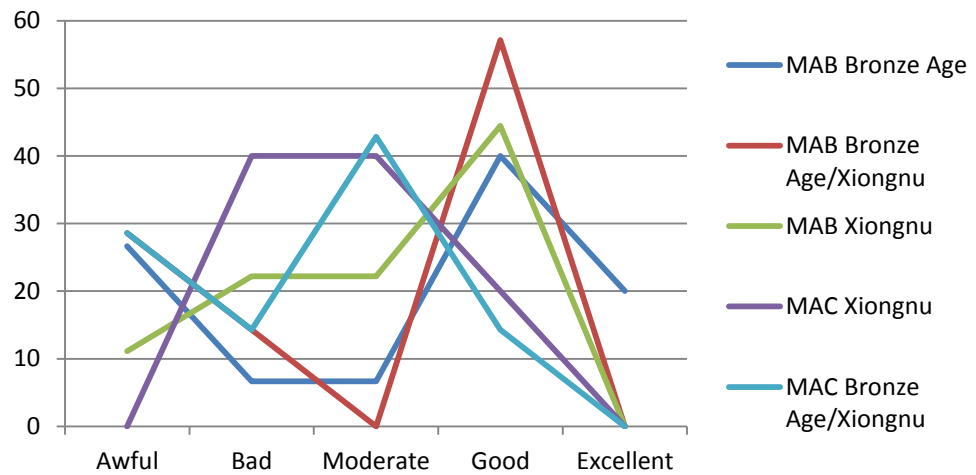


Figure 2: Preservation condition of countable elements from domestic sites, expressed as a percentage of the total recorded in the "bones" database for each site.

The NISP from the monumental sites (KYR1 and KYR 119) was much lower, despite coming from a much larger assemblage, representing just 9 fragments from a total of 5,302 (0.17%). These fragments were almost ubiquitously calcined (Figure 3), a pattern significantly different from that observed at the two domestic sites (Figure 4).



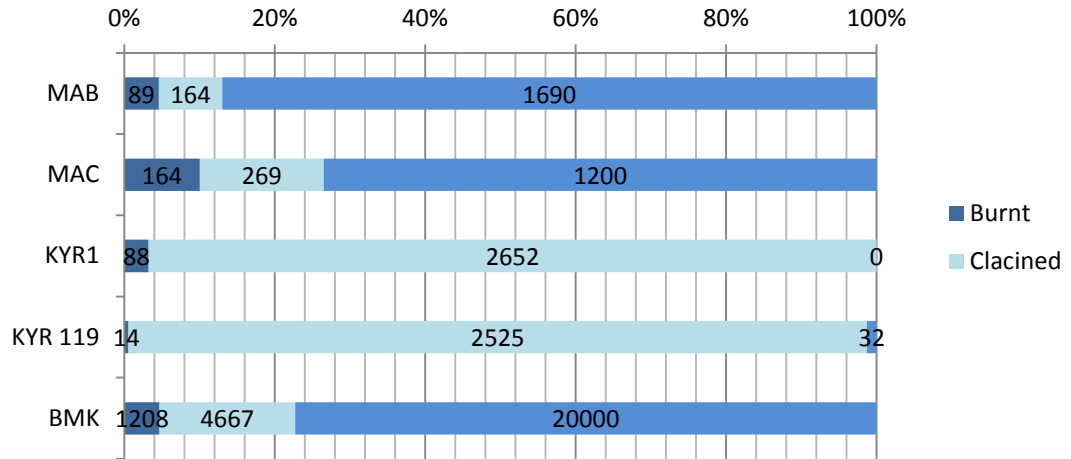


Figure 3: Ratios of burning (low intensity, "burnt" and high intensity, "calcined") for each site shown against ratios from the modern day winter campsite of BMK (BMK data from Broderick, 2011).

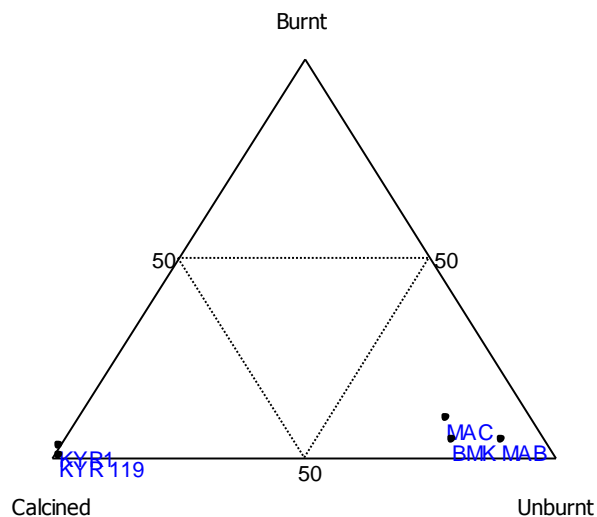


Figure 4: Tri-polar plot for percentages of burnt, calcined and unburnt fragments, including the modern day winter campsite of BMK (BMK data from Broderick, 2011).

In order to extract the largest dataset possible from the assemblage, and so increase the statistical validity of interpretations, as much effort was made as possible to obtain information from those fragments not countable under the protocol, but instead assigned to the 'fragments' section of the database (see Appendix 2: Recording Protocol). These fragments cannot be used for fine resolution analytical units such as MNI, since they may represent duplicates, but can be included in more coarse analysis, such as NISP. It was

possible to speciate some of these 'non-countable' elements and by adding them to the 'countable' elements it is possible to increase the NISP figures for MAC and MAB to 6.29% of the assemblage (Figure 5). This represents a significant improvement over the base figure here and over previous zooarchaeological analyses in the region (Broderick, 2010; Makarewicz, 2006; Viner, 2009). It is these revised figures that will be used through the remainder of this report.

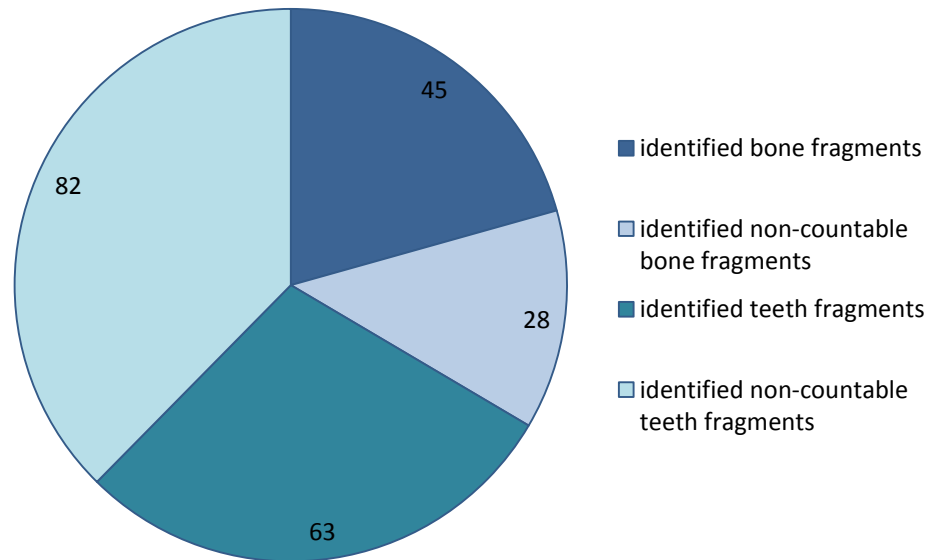


Figure 5: Revised NISP figures ('countable' plus 'non-countable' elements) for domestic sites (MAB and MAC).

The effect on the monumental sites (KYR1 and KYR 119) is less dramatic, increasing the NISP figure by just one individual (present at KYR 119).

### 3.1. Results from the domestic sites (MAB and MAC)

All contexts at MAB and MAC were routinely sieved using 6mm gauze. MNI figures for all grouped assemblages are so low as to be meaningless, never exceeding 2 for any given species on any particular site in one period, and are not used in this report. They are, however, included for reference in the appendices (Appendix 3: MNI Figures).

#### 3.1.1 The Bronze Age Assemblage

The specimens identified from the Bronze Age layers at MAB (in the present day summer campsite zone (Houle et al., 2008)) provide a total NISP of 53 (Figure 6), 0.27 of the total NISP (Figure 5). This figure can be neatly divided into small, medium and large mammals, birds and fish (Figure 6Error! Reference source not found.) in which the medium and large

sized mammals are represented by domesticated, or relatives of domesticated, species and the small mammals are represented by wild species – with the exception of *Capreolus pygargus* (Siberian roe deer) as a wild medium mammal. The domestic mammals account for 0.83 of the total Bronze Age assemblage from MAB. The Bronze Age assemblage for MAC (in the present day winter campsite zone (Houle et al., 2008)) consisted of a single specimen of *Bos sp.*

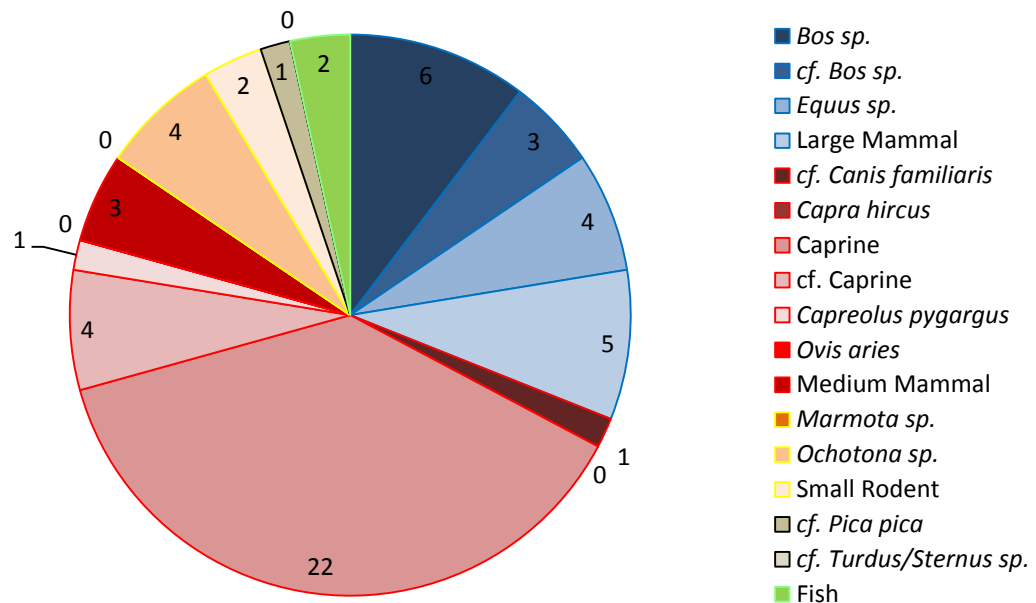


Figure 6: Species representation, by NISP, for Bronze Age layers from MAB.

Of the eighteen large mammal specimens identified in the assemblage from the present day summer campsite area, six were *Bos sp.* and a further three were *cf. Bos sp.*, four were *Equus sp.* (Figure 6). It was not possible to speciate a further five specimens, which were recorded simply as “Large Mammal”. These unspeciated bones came from a single deposit of 5 ribs in MAB12 (A2), which were noted as having been broken when fresh. It was also noted that they were associated with a *Bos sp.* tooth, at the time of excavation. A *Bos sp.* humerus, from MAB12 (B2) was broken into three pieces and had an FFI of one. It was also possible to record an FFI for two further specimens of *Bos sp.*: a metatarsal from MAB11 (B2) (FFI = 3) and a *cf. Bos sp.* metapodial also from MAB11 (A3) (FFI = 6).

A *cf. Bos sp.* 2<sup>nd</sup> phalanx was recorded from MAB15 (A3) which, though heavily abraded, showed signs of a burden/traction related pathology (lipping). *Equus sp.* remains comprised only teeth, of which it was not possible to determine any ageing information. It was possible to record a wear stage of ‘g’ from a *Bos sp.* M1/M2 – the same tooth mentioned

above as being found in association with the ribs – representing an age at death of 2-5 years.

Of the 30 specimens identified as medium mammals in the assemblage, 22 were caprines and a further 4 were cf. caprine (Figure 6). In addition to three further specimen identified as non-specific “Medium Mammals” (one of which had a helical fracture observed), a 1<sup>st</sup> phalanx from MAB12 (B3) was recognised as being *Capreolus pygargus* (Siberian roe deer). cf. *Canis familiaris* (dog) was also identified from MAB14 (A1), where a highly worn maxillary first molar was recovered.

A second molar, of a caprine, was recovered from MAB11 (B2) which was at wear stage 9A, which would translate to an age at death of 2-7 years. A caprine humerus was recovered from MAB15 (C3) which showed an FFI of 3 and exhibited signs of carnivore gnawing. Three caprine astragali of sufficient preservation to permit biometric analysis were recovered from MAB15 (C2), MAB12 (C2) and MAB11 (B2) respectively; these are plotted in Figure 7.

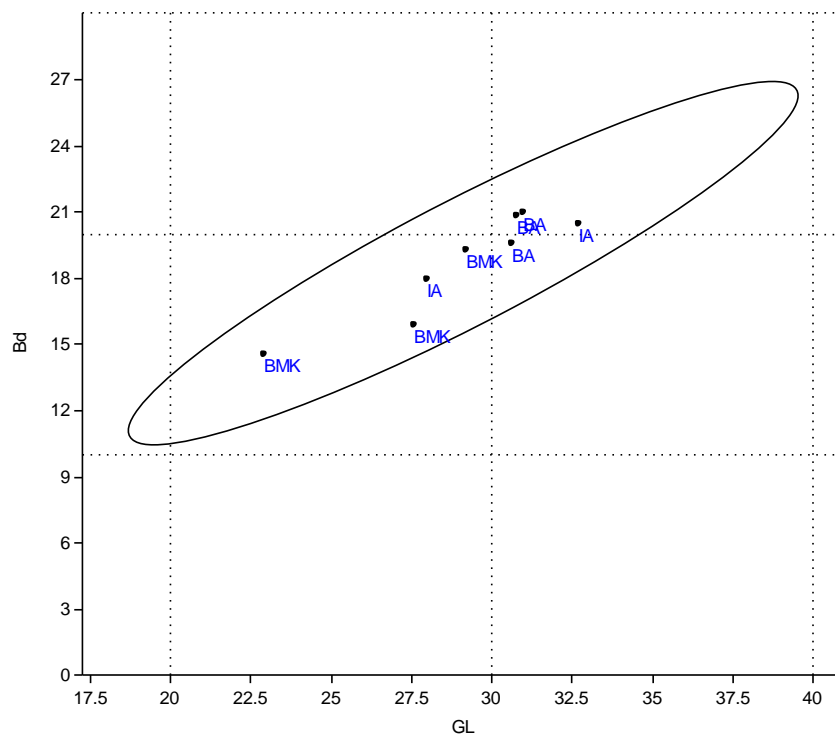


Figure 7: Caprine astragali plots of greatest breadth at distal end (Bd) against greatest lateral length (GL) from Bronze Age (BA), Xiongnu (IA) and modern (BMK) samples from the Khanuy valley, circle drawn at 1 SD (BMK data from Broderick, 2011).

Of the wild resources recovered, one of the fish bones (a vertebra from MAB11 (B3)) was later identified to the family *Salmonidae* (salmonid) with the aid of a laboratory reference collection and photographs. The single bird specimen, cf. *Pica pica* (magpie), was a phalanx recovered from MAB15 (B1) which had clearly been burnt. Among the small mammal remains, a cranium and right mandible of *Ochotona* sp. (pika) were recovered from MAB12 (B1) and a right mandible of a small rodent from MAB12 (C3) which were intact, so permitting measurements of the tooth row; these were 8.1, 7.7 and 4.7mm, respectively.

Of the unidentified specimens recovered from this period, a helical fracture was observed on a further specimen and two possible worked bones were recovered from MAB13 (B2).

### 3.1.2 The Bronze Age/Xiongnu assemblage

The specimens identified from the mixed Bronze Age/Xiongnu layers at MAB provide a total NISP of 26 (Figure 8), 0.12 of the total NISP (Figure 5). This figure can be neatly divided into small, medium and large mammals, (Figure 8) in which the medium and large sized mammals are represented by domesticated, or relatives of domesticated, species and the small mammals are represented by wild species. The domestic mammals account for 0.77 of the total Bronze Age assemblage from MAB.

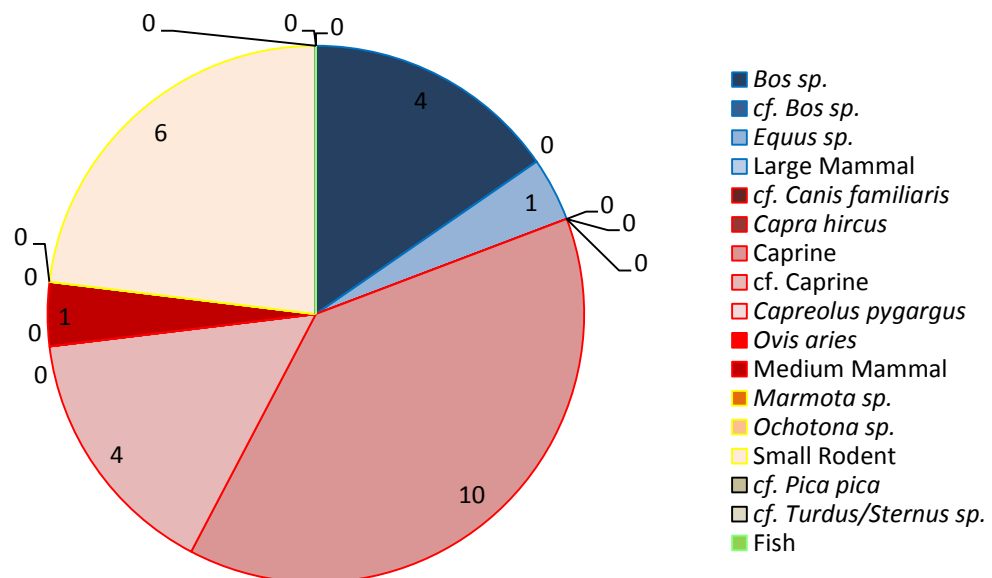


Figure 8: Species representation, by NISP, for Bronze Age/Xiongnu layers from MAB.

The specimens identified from the mixed Bronze Age/Xiongnu layers at MAC provide a total NISP of 9 (Figure 9), 0.04 of the total NISP (Figure 5). This figure consists of medium and



large mammals, all of which are domesticated, or relatives of domesticated, species (Figure 9).

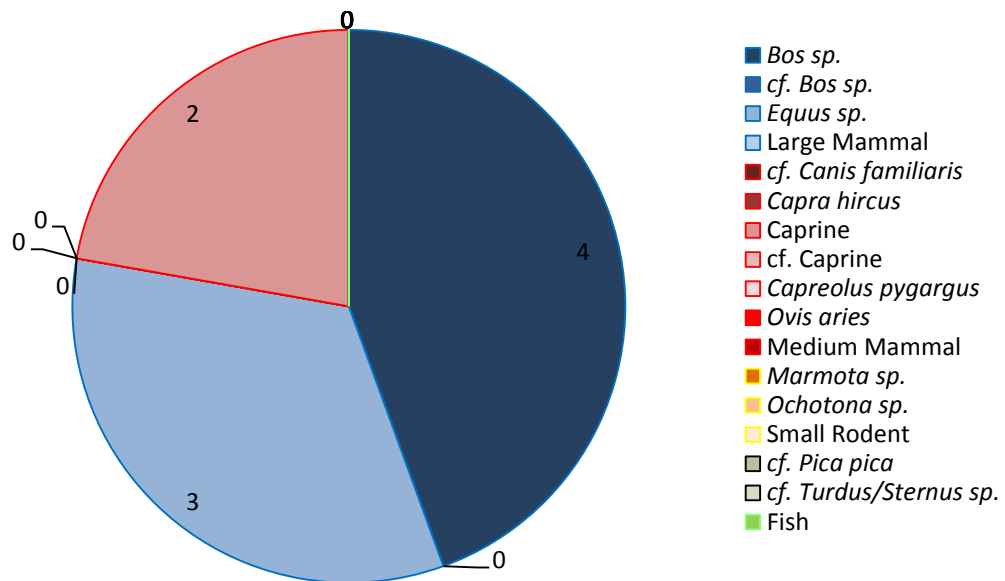


Figure 9: Species representation, by NISP, for Bronze Age/Xiongnu layers from MAC.

Large mammals in the Bronze Age/Xiongnu assemblage from MAB were *Bos sp.* (n=4) and *Equus sp.* (n=1). Of 15 medium mammal specimens recorded in the assemblage, 10 were caprine and a further 4 were *cf. caprine* (Figure 8). It was possible to record a wear stage for a caprine dp4 from MAB13 (B3) (23L) and a caprine M2 from MAB13 (A3) (9A). This would translate to ages at death of approximately 13-30 months and 2-7 years, respectively. An unfused distal *cf. caprine* metapodial was recorded from MAB13 (B3), whilst FFI values of 5 and 3 were recorded for a *cf. caprine* tibia (MAB12 (A1)) and a caprine proximal metacarpal (MAB15 (B3)) respectively. In addition to the identified specimens, seven unidentifiable specimens from this period at MAB were noted as having helical fractures (three from MAB13 (B3), one from MAB13 (C1), two from MAB14 (B2) and one from MAB11 (A1).

6 small rodent remains were also recorded in the Bronze Age/Xiongnu assemblage from MAB (Figure 8) including a cranium and right mandible from MAB13 (C4) and MAB13 (B3) which were intact, so permitting measurements of the tooth row; these were 6.3 and 7.7 and respectively.

Large mammals accounted for the greater part of the Bronze Age/Xiongnu assemblage from MAC, where *Bos sp.*, *Equus sp.* and caprines were all noted as present (Figure 9). An *Equus sp.* M3 was found at MAC10 (B2) with calculus and an *Equus sp.* radius was recovered from MAC12 (A3) with an FFI of 2, in addition to a chop mark. The caprine remains consisted of two tibias, one from MAC13 (B1) with an FFI of 5 and one from MAC12 (A3) with an FFI of 6. An additional helical fracture was noted on an unspciated specimen from MAC13 (B1).

### 3.1.3 The Xiongnu assemblage

The specimens identified from the Xiongnu layers at MAB provide a total NISP of 48 (Figure 10), 0.22 of the total NISP (Figure 5). This figure can be neatly divided into small, medium and large mammals, and birds (Figure 10) in which the medium and large sized mammals are represented by domesticated, or relatives of domesticated, species and the small mammals and birds are represented by wild species. The domestic mammals account for 0.73 of the total Bronze Age assemblage from MAB.

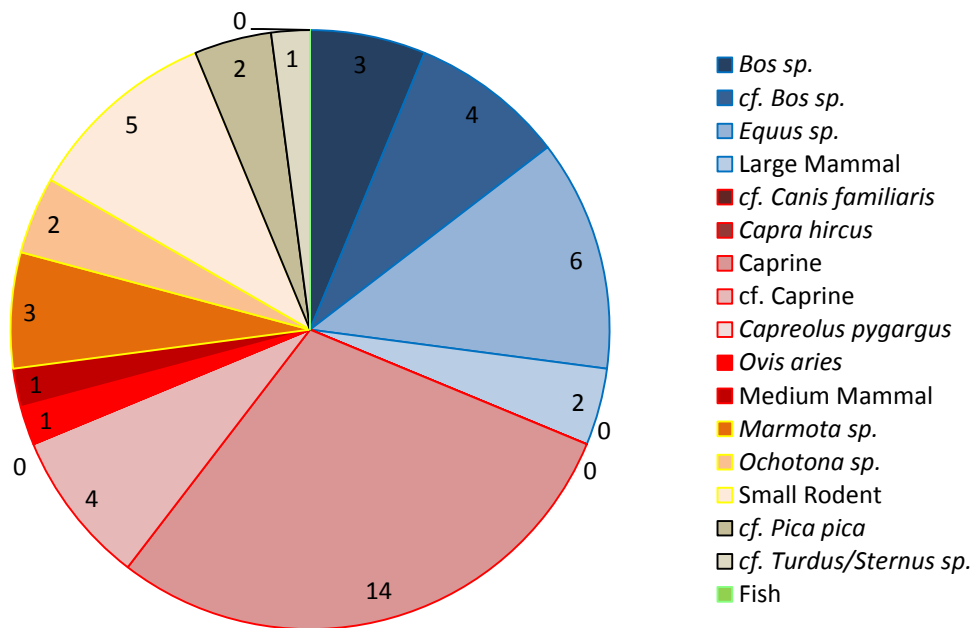


Figure 10: Species representation, by NISP, for Xiongnu layers from MAB.

The specimens identified from the Xiongnu layers at MAC provide a total NISP of 62 (Figure 11), 0.28 of the total NISP (Figure 5). This figure can be neatly divided into small, medium and large mammals (Figure 11) in which the medium and large sized mammals are represented by domesticated, or relatives of domesticated, species and the small mammals are represented by wild species. The domestic mammals account for 0.89 of the total Bronze Age assemblage from MAB.

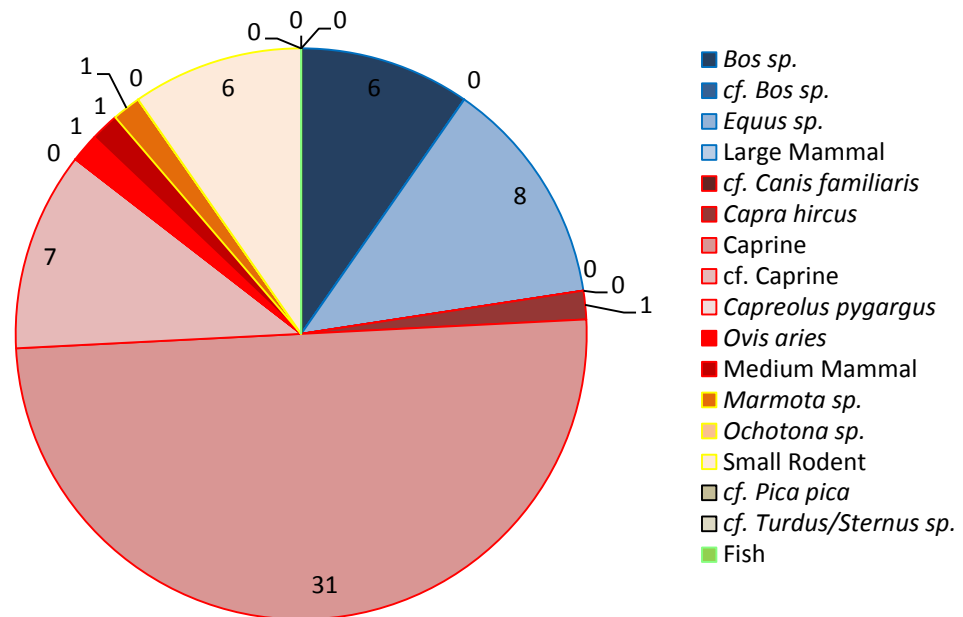


Figure 11: Species representation, by NISP, for Xiongnu layers from MAC.

Of the fifteen large mammal specimens identified in the assemblage from the present day summer campsite area, three were *Bos sp.* and a further four were *cf. Bos sp.*, six were *Equus sp.* (Figure 10). It was not possible to speciate a further two specimens, which were recorded simply as “Large Mammal”. These unspeciated bones were a humerus from MAB13 (B1) and a radius from MAB15 (A2), both of which were noted as having helical fractures.

Of the 10 specimens identified as medium mammals in the assemblage, 14 were caprines, a further 4 were *cf. caprine* and another was *Ovis aries* (Figure 10). This specimen was a maxillary M1 recovered from MAB15 (C3). Mandibular caprine teeth were recovered from MAB13 (C1) and MAB14 (B1), these were an M1/2 and an M2, both at wear stage 9A, giving ages at death of approximately 1-7 and 2-7 years, respectively. Two caprine astragali of sufficient preservation to permit biometric analysis were recovered from MAB15 (C3) and MAB11 (A2) respectively; these are plotted in Figure 7. A third caprine astragali was also recovered from MAB15 (B2) which showed signs of having been digested.

A rib from a medium mammal was recovered from MAB12 (A1) which showed signs of having been broken when fresh and also featured a cut mark. A further, unidentified, specimen from MAB11 (C1) also featured a cut mark and six other unidentified specimens from Xiongnu MAB showed signs of helical fracture.

A small rodent mandible of sufficient preservation to obtain a tooth row measurement was recovered from MAB13 (B2), this was recorded as 4.0mm.

Of the fourteen large mammal specimens identified in the assemblage from the present day winter campsite area, six were *Bos* sp. and eight were *Equus* sp, (Figure 11).

Of 42 specimens identified as medium mammals in the assemblage, 31 were caprines, a further 7 were cf. caprine and additionally both *Ovis aries* and *Capra hircus* were identified (Figure 11). These specimens were a maxillary M1 recovered from MAC10 (C1) and a right mandible from MAC13 C2, respectively. This latter specimen could assigned an age at death, on the basis of tooth wear and eruption, of 22-30 months. Four other caprine teeth of sufficient preservation to provide a wear stage were recovered:

- M<sub>3</sub>, 11G (age at death >42 months), MAC11 (C3)
- M<sub>2</sub>, 11A, (age at death 68-84 months) MAC12 (B1)
- P<sub>4</sub>, U (age at death 22-30 months), MAC13 (B2)
- M<sub>1</sub>, 12A (age at death 42-84 months), MAC13 (C2)

In addition to these cranial elements, a digested caprine cuboid was found at MAC10 (C3) and a distally fused caprine humerus with an FFI of 2 was found at MAC12 (A2). Another medium mammal specimen showing signs of helical fracture was found at MAC10 (C2) and two further unidentified specimens showing signs of helical fracture were also found.

A small rodent mandible of sufficient preservation to obtain a tooth row measurement was recovered from MAC10 (C3), this was recorded as 6.0mm.

#### **3.1.4 The Assemblage from other contexts**

A number of contexts contained mixed ceramic material, and so were not possible to date to any specific period. Most of these contain later, Chinese or Turkic, material, however and so it is likely that these contexts date from after the Xiongnu period.

Those identifiable specimens from MAB consisted of one large mammal, two caprines and one *Marmota* sp. (marmot), representing .02 of the total NISP (Figure 5). Those identifiable specimens from MAC consisted of one unspciated large mammal, one *Bos* sp., three *Equus* sp. And three caprines, representing .04 of the total NISP (Figure 5).

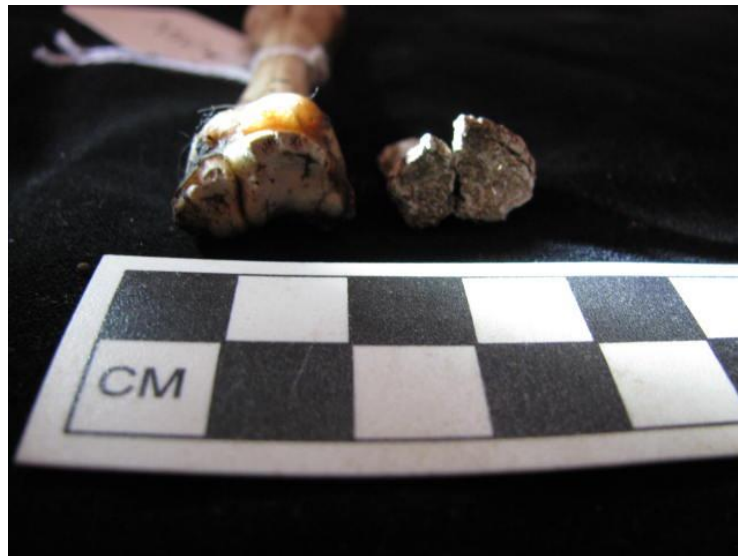
The *Bos* sp. specimen was a mandibular P<sub>4</sub>, from a Xiongnu/Chinese context located in MAC13 (A1) which had a wear stage of g, indicating an age at death of 41-50 months. Additionally, three unspciated fragments from MAB were noted as showing signs of helical fracture, two of these were from Bronze Age/Xiongnu/Turkic contexts, and one from a Bronze Age/Turkic context.

### **3.2.Results from the monumental assemblage**

Although NISP figures have already been given for the two monumental sites, the proportions of NISP v. total assemblage are not directly comparable between the two sites, due to different recovery strategies. KYR1 was routinely sieved using

3mm gauze, so minimising the risk of losing material, where as specimens were collected from KYR 119 by hand, without any sieving. Identifiable specimens are generally towards the larger of the recovered specimens from the sites, however, and the extremely fragmentary, calcined nature of both sites has, in any case, been demonstrated (Figure 3).

Three identifiable specimens were recovered from KYR1, all of them from stone circle 2. These were all calcined specimens identified to caprine and consisted of a fusing proximal metapodial (Figure 12), a distal metapodial and a 1<sup>st</sup> phalanx, (Figure 13).



*Figure 12: Caprine metapodial, shown next to two month old Ovis aries (from the Khanuy Valley Project reference collection) (cm scale).*



*Figure 13: Caprine 1<sup>st</sup> phalanx, shown next to two month old Ovis aries (from the Khanuy Valley Project reference collection), proximal articulation on left, distal on right (cm scale).*

Calcined caprine phalanges were also recorded among the material from KYR 119; a first phalanx from stone circle 3 and two second phalanges from both stone circle 2 and stone circle 4. Further to this, a medium mammal radius was recorded from stone mound 1, also calcined, making a total NISP of six for the site.

Among the unidentified specimens, a definite cut mark was observed on a specimen from KYR1 stone circle 1, with further



possible cut marks observed on specimens from KYR 119 stone mound 1 and stone circle 2. An unfused diaphysis, of unknown element or species, was also recorded from KYR1 stone circle 2.

## 4. Interpretation

Several burrowing species were identified within the assemblage. The firm identification of burrowing species in archaeological assemblages is fraught with difficulty, for obvious reasons. The potential for intrusion of these species is great and they also often have a severe impact upon the artefactual and stratigraphic record (Dunwell and Trout, 1999).

To be consistent, these animals have to all either be included or discounted in the analysis, since the reasons for discounting them should apply to all. Given that the soil in the Khanuy valley is highly compact (Broderick, personal observation) it is anticipated that any burrowing action and resulting bioturbation should be clearly visible and noted during excavation, furthermore, it is likely to result in mixed contexts. Given that no evidence for bioturbation was attached to the context information, and that the contexts analysed here have been dated on the basis of their ceramic artefact typology, burrowing species have been included in the interpretation.

As shall be discussed below, some at least, have been demonstrated to be in the zooarchaeological record through human agency, whilst others have clearly argued cases for close habitation with humans in the context of the environment. Thus, although some may be intrusive, it is assumed that most are not.

### 4.1 Ecology and Environment

The wild mammals recognised in this report were identified to the genus *Ochotona*, to *Marmota* sp., as small rodents or as *Capreolus pygargus*. Of the birds, *Pica pica* was firmly identified and a further specimen was identified more loosely as a passerine, most probably a small member of the genera *Turdus*/*Sturnus* (thrushes and starlings). Of other vertebrates, a fish of the family *Salmonidae* was recognised.

Of those small mammals identified only as small rodent, those providing tooth row measurements from Xiongnu MAC and Bronze Age/Xiongnu MAB are most likely to be *Tamias sibiricus* (Siberian chipmunk). These are the smallest sciurids occurring in the general region today, with the Khanuy valley being just south of their present known distribution, and preferring a wooded habitat (Batsaikhan et al., 2010, 96-97). A find of similar size, 5.8mm, from the modern day winter campsite of BMK (Broderick, 2011) would seem to indicate that its modern range does extend this far however, probably

restricted to the patches of woodland occurring in the hills. 5.8mm (mandibular) corresponds to the lowest value recorded by Allen for this species in Mongolia, while the other measurements are medians (Allen, 1940, 691). The presence of *Tamias sibiricus* at MAC would fit with this model of distribution, but its inclusion in the assemblage from MAB is a little more difficult to explain. Palynological studies from the recent past in Mongolia are still rare, but work in the nearby Khangai mountains indicates that there may have been a period of deforestation, perhaps related to increased aridity, around 1700-1500BP (Tarasov et al., 2004). If true, this data may be complementary in explaining the range shift of *Tamias sibiricus* on a local scale.

Other tooth row measurements taken from small rodents in the assemblage can be fairly confidently assigned to the *Sciuridae*, on the basis of their dental formulae, and yet their measurements are much smaller even than *Tamias sibiricus*, the smallest sciurid present in the region today. At present this data is unsatisfactory, belying interpretation and perhaps demanding a second examination of the original material.

*Ochotona* are a genus of primitive lagomorphs supremely adapted to wide open environments, owing to the situation of their eye sockets, which enables them to perceive threats from above, such as raptors, more easily than many other small vertebrates (Allen, 1938, 524). There are thought to be thirty different species of *Ochotona* extant in the world today (Chapman and Flux, 2008, 2), two of which are known to inhabit the general region of the Arkhangai province in Mongolia - *Ochotona dauurica* and *Ochotona alpina* (daurian pika and alpine pika) (Batsaikhan et al., 2010, 74-77). Tooth row measurements obtained from specimens from MAB of 8.1mm (maxillary) and 7.7mm (mandibular) both fall within the range for specimens of *Ochotona dauurica* from Mongolia published by Allen (1938, 552) and considerably below the standard for *Ochotona alpina* (Allen, 1938, 532). Accordingly, it is assumed that all those specimens identified in this report belong to the species *Ochotona dauurica*.

The presence of *Ochotonidae* in Asian ecosystems is crucial to their well-being, as they often form the base of animal food chains, being highly fecund small to medium sized herbivores (Smith et al., 1990, 15), and engineer their environment to their own benefit and, inadvertently, to the benefit of other species. Populations of *Ochotona dauurica* can fluctuate wildly, with up to 90% mortality per year, due to the effects of predation, disease and food availability, in years where populations are high, they may account for up to 60% of the diet of some of the larger raptors (Smith et al., 1990, 14-16). It is the preferred prey of *Otocolobus manul* (Pallas's cat) (Ross et al., 2010) and may also make up a significant proportion of the diet of *Mustela eversmanni* (steppe polecat), which is known to be present in the Arkhangai province (Batsaikhan et al., 2010, 233), although this relationship is poorly researched (Smith et al., 1990, 16).

*Ochotona dauurica* usually inhabits damp, low lying regions of the steppe which are subject to periodic flooding (Smith et al., 1990, 29). The species lives in pairs, but in overlapping territories; communal burrows may cover up to 35m<sup>2</sup>, whilst population densities of up to 300 per hectare have been recorded (Smith et al., 1990, 29-30). *Ochotona* generally have a high body temperature which enables them to survive extreme cold environments, but renders them weak in hot environments (Yang, 1990).

The architecture of *Ochotona dauurica* (haystacks and burrows) may also support a number of other herbivores, including other lagomorphs as well as rodents and birds, in particular *Oenanthe isabellina* and *Pyrgilauda davidiana* (isabelline wheatear and Père David's snow finch) are both known to nest in *Ochotona dauurica* burrows (Smith et al., 1990, 16). The burrow systems also serve to increase biomass and prolong growth seasons for plants in the immediate vicinity, as *Ochotona dauurica* loosens and improves soil (Smith et al., 1990, 16-17, 29-30).

There are 14 species of *Marmota* sp. extant in the world today (Barash, 1989, 5), of which one is known to inhabit the general area of the Arkhangai province today – *Marmota sibirica* (Siberian marmot) (Batsaikhan et al., 2010, 82-83). This is the only species to occur widely in Mongolia today and the assumption is made here that those remains identified to *Marmota* sp. are *Marmota sibirica*. Like *Ochotona daurica*, *Marmota sibirica* is known to be a keystone species (Murdoch et al., 2009, 431), assisting in soil renewal, influencing plant communities and having several other animals make use of their architecture, including *Vulpes corsac* (corsac fox) (Murdoch et al., 2009).

*Marmota* sp. are adapted to periglacial conditions, hibernating during extreme cold spells and droughts (Barash, 1989, 8), they shun woodland and instead prefer grassland environments (Barash, 1989, 12).

*Pica pica* is widely distributed in the old world and is often associated with man, scavenging off rubbish and other food (Mullarney et al., 1999, 330). They can gather in large flocks of up to 25 individuals (Mullarney et al., 1999, 30) and such large flocks have been observed in the Khanuy Valley today (Broderick, 2011).

*Salmonidae* are a family of pelagic and freshwater fish, 11 species of which are native or endemic to Mongolia (Froese and Pauly, 2010). Of these, four are known to exist in the Selenge drainage system:

- *Brachymystax lenok* (lenok)
- *Thymallus arcticus baicalensis* (arctic grayling)
- *Coregonus migratorius* (omul)
- *Hucho taimen* (taiman)

Of the domestic species identified, *Ovis aries* is also a species which prefers open pasture (Squires, 1975; Harris and Yalden, 2008, 625). A wide variety of breeds have been developed since its original domestication, some of which can survive

extremes of temperature (Squires, 1975). *Capra hircus* prefers dry ground and is a species descended from one common in Central Asia (Harris and Yalden, 2008, 630).

*Equus* is almost exclusively a grazing genus, and neither *Equus Caballus* nor *Equus Przewalski* make use of browse, instead, their diet is dominated by grasses and sedges, which they can access even through snow (Salter and Hudson, 1979; Harris and Yalden, 2008, 558). As such, they are well adapted to extreme cold temperatures but can also survive in hot climates provided that there is enough forage and water (Salter and Hudson, 1979).

Of the non-domestic larger mammals, *Capreolus pygargus* prefers a forest habitat (Batsaikhan et al., 2010).

## **4.2 Economy and Human Interaction**

Owing to their small size, *Ochotona* are rarely utilised directly in any human economies, however, large numbers of *Ochotona* were caught in Russia up until the mid-twentieth century for their fur, which was used to make felt (Smith et al., 1990, 17, 29).

*Ochotona dauurica*, in common with other *Ochotona*, makes haystacks for subsistence during the winter, these can be as large as 5kg per animal, and are used by larger herbivores in winter, when the tops of the haystacks may still be visible above the snow (Smith et al., 1990, 16). It has been observed that some Mongolian herdsman preferentially graze their livestock near large populations of *Ochotona dauurica* for this reason (Loukashkin (1940) in Smith et al., 1990, 16).

In China (and, briefly, in Russia), *Ochotona dauurica* has been seen as a pest due to perceived competition for grazing with domestic livestock, although it has been suggested that any competition for grazing may only be a reality when grasslands are already overgrazed by domestic livestock and that population control of the species may be best achieved through lowering stocking densities of livestock (Smith et al., 1990, 17-18, 29-30). Recent work pertaining specifically to *Ochotona dauuria* in Mongolia, however, has suggested a negative correlation between populations and livestock overgrazing (M. Komonen et al., 2003). The use of their haystacks for domestic livestock, as suggested above, would very likely have a similar negative impact on their population (removal of haystacks causes population decline over winter (Zhong et al., 2008)).

*Marmota sibirica* is present in the Xiongnu and later assemblages at MAB (Figure 10), while one specimen is present in the Xiongnu assemblage from MAC (Figure 11). Cutmarks on a *Marmota* sp. tibia from Xiongnu phase MAB, found in previous phases of excavation (Broderick, 2010) clearly demonstrate its utilisation by human populations. Today, *Marmota sibirica* is hunted in the summer months, for its meat and for its fur (Broderick, 2011). Taken together these two facts may imply a similar use of *Marmota sibirica* as a seasonal resource in the Xiongnu period.

*Marmota sibirica* is also known to commonly harbour fleas carrying the plague virus *Yersinia pestis* (Biggins and Kosoy, 2001, 909), a zoonotic disease commonly fatal to humans (Krauss et al., 2001, 218). Indeed, spread of this disease from Mongolia has sometimes been blamed for the Black Death in Mediaeval Europe (e.g. Slack, 1989). The potential presence of this disease, together with the potential for small to medium carnivores which could attack young livestock, probably argues for habitation sites occurring some distance from *Marmota sibirica* colonies.

The simplest explanation for the presence of fish on an archaeological site is always human agency, and there is nothing here which would suggest otherwise. Fish is today a taboo food in Mongolia and it is not known when this first developed, with some attributing it to Buddhism (Blunden, 2008, 208) although a link to shamanic beliefs has also been suggested (Broderick, 2011). The evidence here would suggest that the taboo was not enforced in the Bronze Age Khanuy Valley. *Thymallus arcticus baicalensis* can grow up to 35cm long (Kottelat, 2006), *Coregonus migratorius* can grow up to 56cm in length and is today an important food source around Lake Baikal (Dulmaa, 1999). *Brachymystax lenok* can grow up to 70cm long and is today an important game fish (Dulmaa, 1999) and *Hucho taimen* can reach 200cm in length and is today probably the most important sport fish for Mongolian tourism (Dulmaa, 1999; Blunden, 2008, 210).

Of the birds found on the site, although they might conceivably have been deliberately caught, for consumption or other reasons, it is considered more likely that they entered the assemblage through accidental inclusion. Although a carbonised phalanx, such as that of *Pica pica* found at Bronze Age MAB, is often associated with cooking, *Pica pica* is particularly associated with sites of human habitation (Mullarney et al., 1999, 330) and modern day site maintenance practices present serious issues of equifinality for the zooarchaeologist. These practices involve the burning of all fallen livestock and refuse (Broderick, 2011) and it should be noted that the ratios of burning in the archaeological assemblages from domestic sites is comparable with that from modern day campsites (Figure 4).

When discussing ratios of burning at the sites, it should be noted that there is a higher proportion at MAC than at MAB (Figure 3) and that MAC is more similar to the modern day winter campsite assemblage than MAB (Figure 4). Since burnt bone will survive longer than unburnt, when undisturbed, it may be anticipated that this proportion would increase with time, moving it still closer to MAC and further from MAB. It has already been stated that MAC is located in the present day winter campsite zone and MAB in the summer – this evidence points to further support for a similar pattern of occupation in the past.

*Bos* sp. was present at MAB and MAC in all periods except post Xiongnu MAB. It was also the most numerous large mammal, by NISP, on both domestic sites in the Bronze Age, but falls behind *Equus* sp. in the subsequent phases. In many ways, this is contrary to what might have been expected, since *Bos* sp. has been a very rare find in Bronze Age Mongolian



assemblages before now, which had led to the belief that it may be a new, exotic animal in this period (Houle, 2010). In the Khanuy valley today, *Bos* sp. are slaughtered in small numbers when first moving to the winter campsite; at this point the animals are in peak physical condition after the summer grazing and so slaughtering then maximises the meat yield (Broderick, 2011)). The meat can then be preserved for storage throughout the ensuing winter. Slaughtering the animals after arrival at the winter campsite, rather than before leaving the summer campsite can probably be explained by a variation of the Schlepp effect – in essence it's much more energy efficient to make the animal carry its own meat to the winter campsite.

The origins and nature of *Bos* sp. in Mongolia are still poorly understood, two species are present in the Khanuy Valley today – *Bos grunniens* and *Bos Taurus* – but no method has yet been devised for distinguishing between their skeletal remains. The presence of a possible traction related pathology on a *Bos* sp. phalanx at Bronze Age MAB is of real interest, since it would indicate a domestic type. Such pathologies are generally associated with ploughing (eg. Groot, 2005; Isaakidou, 2006; Telldahl, 2005), but that seems unlikely given the context. Today the only use of *Bos* sp. for traction in the Khanuy Valley is to pull carts for the transporting of goods, and when a family moves campsite (Broderick, 2011). Although the pathological effects of such activity might be presumed to be less than for ploughing, a *Bos* sp. first phalanx with a similar pathology was also identified at the modern day campsite of BMK (Broderick, 2011).

Fracture patterns of the *Bos* sp. remains at Bronze Age MAB would also indicate that they were being utilised for marrow extraction at that time, a practice still common in the area today (Broderick, 2011; Houle, 2010). The absence of fracture (excepting two generic large mammal specimens) and butchery data for *Bos* sp. from MAC may be an artefact of the generally harsher taphonomy present on the site (Figure 2).

*Equus* sp. was present in all phases at both domestic sites, except for Bronze Age MAC and post-Xiongnu MAB, in the Xiongnu period it was the most numerous large mammal, by NISP, and the second most numerous animal overall (Figure 10; Figure 11). The M3 recovered from Bronze Age/Xiongnu MAC would indicate that the animal was at least two years of age at death (Levine, 1982). This tooth also had a build-up of calculus, which forms in adulthood (Waldron, 2009, 240) and begins to form in the front teeth of *Equus* sp. before the rear teeth (Hillson, 1986, 302), it therefore seems likely that the horse in question was much older than two years. In the Khanuy valley today, horses are slaughtered at 2-3 years of age for their meat (Broderick, 2011), elsewhere in Mongolia, the Khalkha also slaughter their horses for meat at this age (Levine, 1990, 730), this represents a recent development however, following a culturally acquired preference for more tender meat, and traditionally horses would have been slaughtered for meat by the Khalkha at 14-15 years of age, following the end of their useful (working or breeding) lives (Levine, 1990, 730-731). Either interpretation would seem acceptable based on this information. From the same site and

period, evidence for butchery and marrow extraction of *Equus* sp. was recorded, compatible with the modern day large mammal exploitation strategy practised in the area described above.

Caprines were the largest part of the assemblage overall. Both *Ovis aries* and *Capra hircus* have been demonstrated to be present in the Khanuy Valley by at least the Xiongnu period (Figure 10; Figure 11). Today, *Capra hircus* is a valuable resource, due to the high price fetched for its fleece, while *Ovis aries* is primarily kept for its meat (Broderick, 2011), this is most likely a recent development however, and the presence of both species is probably better read as a risk minimising strategy to cope with an ever changing environment.

Caprines are most commonly slaughtered at the summer campsites in the Khanuy Valley today (Broderick, 2011), and it's important to note that their presence at MAC does not necessarily contradict this pattern. It is sometimes easy to confuse a dead animal with a slaughtered animal in zooarchaeological reports, but the two are not the same thing. Caprines are today housed over winter in the Khanuy Valley, but there will inevitably be casualties every year. Fallen stock is usually burned on the edge of the site as soon as weather conditions allow (Broderick, 2011). It's interesting to note in this context that the only recorded butchery of caprines occurred at MAB.

Similarly, it's interesting to note that the Xiongnu assemblage from MAB had by far the greatest number of fresh bone breaks, generally associated with marrow extraction. It seems likely that MAC was only occupied during the Xiongnu period, a phenomenon that may have been associated with population pressure brought about through climatic deterioration (Houle, 2010). This theory is given greater credibility given the environmental data outlined above, and the increased evidence of marrow processing in this period at MAC may be related to the same phenomenon.

Where age at death estimates were available for caprines, they all broadly indicated the slaughter of adult animals on the domestic sites. The greater survivability of adult, as against juvenile, caprine bones should caution against the elevation of this interpretation however, particularly in light of the small NISP and the high degree of fragmentation. For the same reasons, it has not been possible to discern any clear pattern of element distribution within the assemblage for any species. The biometric data would appear to suggest that caprines kept in the Khanuy Valley today are of the same size as those kept in the past, and therefore of the same genetic stock, without any 'improvement'. It's worth noting, however, that an increased sample size may yet point to the present population being smaller than those in the past. Since this data came from astragali, their role in games in Mongolia today, and elsewhere in the past (Dandoy, 2006), is perhaps also pertinent to cultural discussions.

The presence of *Canis familiaris* has been recorded at Bronze Age MAB. This is significant, since although carnivore gnawing had been detected previously (Broderick, 2010), this

is the first time that *Canis familiaris* has been found in an archaeological context in the region. Although hard to conclusively differentiate from *Canis lupus* (wolf), the high state of wear on the tooth, combined with signs of carnivore gnawing on a caprine humerus from the same site, would argue in favour of the former. Digested bones in the Xiongnu phase of both domestic sites would suggest the species' continuing presence in this period. Today, *Canis familiaris* is often a tolerated guard rather than a pet or hunting or herding companion (Broderick, 2011). That some hunting occurred alongside herding in the Bronze Age period can be demonstrated by the presence of *Capreolus pygargus* in the assemblage.

The high frequency of carbonized and calcined bones in the assemblage raises difficult questions for interpretation, owing to issues of equifinality. Previous analysis of this type of remain in the Khanuy valley has been interpreted as evidence of use of animal bone for fuel (Viner, 2009), however, animal bones are also burnt as means of disposing of domestic refuse, and of disposing of fallen livestock in the Khanuy valley today (Broderick, 2011). Any of these interpretations are compatible with the data, although the near ubiquity of the material probably argues in favour of some kind of combination.

#### **4.3 Unusual activities: The interpretation of the assemblages from the monumental sites**

The identification of caprines, and only caprines, among the assemblage from the monumental sites is of some worth, since although it has been known for some time that the stone circles surrounding khirigsuurs contained the cremated remains of mammals, the precise species had not previously been determined (Allard and Erdenebaatar, 2005)

Burnt bone can shrink in size by up to 20% (Shipman et al., 1984) and so although the bones recovered are roughly the same size as a 2 month old caprine held in the reference collection this does not mean that the animal remains deposited at Stone Circle 2, KYR1 were the same size in life. It was possible to reassemble a 1<sup>st</sup> phalanx from this deposit, and from other deposits in the monumental assemblage, all of which were fused. Fusion of the epiphysis to the diaphysis occurs in the first phalanx by around 12 months of age (except in the case of castrates) and, depending on which author you read, may begin as young as six months (Moran and O'Connor, 1994). The presence of an unfused diaphysis of an unknown element in the stone circle 2, KYR1 context, however, clearly indicates that the individual deposited there was a juvenile and so it seems most likely, based on this, the fused first phalanx and the size of the recovered bones, that the individual was less than a year old.

Due to the effects of shrinkage, noted above, it is widely assumed that traces of butchery are obliterated by the effects of burning on bones. In fact, however, cut marks remain largely unaffected by burning (Herrmann and Bennett, 1999; Pope and O. C. Smith, 2004) and one was clearly visible on a

fragment recovered from stone circle 1, KYR1. Two further possible cut marks were observed on material recovered from KYR 119.

All of the data considered here indicates that a young caprine was butchered and its remains were burned at a high heat, before being deposited in the various contexts described (mainly stone circles, but also a stone mound at KYR 119). This is of interest since rituals involving animal sacrifice in many parts of the world frequently concern their formalised slaughter and subsequent deposition (Lauwerier, 2004, 67; Luff, 1996, 2; Popkin, in press; Wait, 1985, 244).

As for the physical nature of the assemblage, there are parallels of highly calcined material with barely anything recognisable except phalanges from Northern Europe in early prehistory (Ingrem; Ukkonen; Amundsen; pers. com.).

## 5. Future Work

- i. Faunal analysis in Mongolia is in its infancy, and further detailed excavation and analysis is needed of animal bone assemblages from domestic/habitation sites.
- ii. Further work on assemblages from monumental sites, particularly stone circles, should be carried out in order to test the interpretations made here.
- iii. Higher resolution butchery recording methods would complement the use of FFI for analysing dietary preferences and stress, particularly in light of observed modern day marrow extraction methods in the Khanuy valley (Broderick, 2011).
- iv. The prevalence of caprines needs to be assessed in greater detail to determine whether their domination was a persistent feature of the Bronze Age/Xiongnu economy.
- v. The appearance of domestic cattle in Mongolia is an issue deserving of further research. As yet the timing of the appearance of domestic types of *Bos sp.* is unclear, and whether domesticates were allochthonous or autochthonous needs to be explored.
- vi. Related to this, methods need to be developed to distinguish the skeletal remains of *Bos taurus* from *Bos grunniens*. These methods should be inexpensive if they are to be widely adopted.
- vii. The appearance of *Canis familiaris* in Mongolia is an issue deserving of further research. The timing of the appearance of *Canis familiaris* is unclear.
- viii. The origins and appearance of the taboo on eating fish are areas which should be questioned and could be informed by further research.
- ix. Further microfaunal studies would complement our understanding of the development of the Holocene environment of the region as provided by macro-scale studies by providing a micro-scale indicator.
- x. Given the fragmentary character of faunal assemblages in the study area, some benefit may be derived from the application of Protein Mass Spectrometry in order to

identify bone fragments to genus level, or from histological studies or DNA analysis to identify species.

## 6. Conclusion

An analysis of the preferred habitats of all of the species identified as present on the sites – wild and domestic – has shown that the Khanuy valley was most probably a grassland landscape, similar to that of today. The presence of several species able to withstand extremes of temperature, together with one with a preference for periodic flooding, suggests that the Xiongnu climate may also have been similar to that of today in the Khanuy valley, with melting snow creating annually marshy areas in the valley bottom. The presence of *Tamias sibiricus* at Xiongnu MAC, in conjunction with regional palynological data, indicate that there may have been more forest at that site in the past than today.

Interpretation of the assemblage is compatible with a pastoral economy similar to that of today. Wild resources were utilized in the form of *Marmota sibirica* and *Capreolus pygargus* for their meat and/or fur, whilst livestock may have been preferentially grazed near *Ochotona daaurica* colonies (another variation on the Schleppe effect may suggest that campsites were deliberately sited near these colonies for proximity of better grazing, hence their presence on the sites). The dominance of caprines and *Equus* sp. throughout the assemblage, suggests a herd structure similar to that of many pastoralists in the Khanuy valley today. The economic role and introduction of *Bos* sp. and *Canis familiaris*, in particular, are deserving of further research in this respect.

The assemblages from the monumental sites were made up exclusively of (probably juvenile) caprines, which had been butchered before being burnt at a high temperature and then deposited in the ground.

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# Appendices

## Appendix 1: Dictionary of animals referred to in the text

Binomial (Latin) name	English name	French name
<i>Bos grunniens</i>	yak	yak
<i>Bos taurus</i>	domestic cow	vache domestique
<i>Brachymystax lenok</i>	lenok	truite lenok
<i>Canis familiaris</i>	dog	chien
<i>Capra hircus</i>	domestic goat	chèvre domestique
<i>Capra sibirica</i>	Siberian ibex	ibex
<i>Capra/Ovis</i>	caprine	mouton ou chèvre
<i>Capreolus pygargus</i>	Siberian roe deer	chevreuil de Sibérie
<i>Coregonus migratorius</i>	Baikal omul	omoul
<i>Equus caballus</i>	domestic horse	cheval domestique
<i>Equus ferus przewalskii</i>	Przewalski's horse	cheval de Przewalski
<i>Hucho taimen</i>	taimen	taimen
<i>Mammalia</i>	large mammal	mammifère grand
<i>Mammalia</i>	medium mammal	mammifère de taille moyen
<i>Marmota sibirica</i>	Siberian marmot	marmotte de Sibérie
<i>Mustela eversmanni</i>	steppe polecat	putois des steppes
<i>Ochotona alpina</i>	alpine pika	pika de l'Altaï
<i>Ochotona daurica</i>	Daurian pika	pika de Daourie
<i>Oenanthe isabellina</i>	isabelline wheatear	traquet isabelle
<i>Otocolobus manul</i>	Pallas's cat	chat de Pallas
<i>Ovis aries</i>	domestic sheep	mouton domestique
<i>Passeridae</i>	songbird	oiseau chanteur
<i>Pica pica</i>	magpie	pie
<i>Pyrgilauda davidiana</i>	Père David's snow finch	niverolle de David
<i>Rodentidae</i>	small rodent	rongeur petit
<i>Salmonidae</i>	salmonid	salmonidé
<i>Tamias sibiricus</i>	Siberian chipmunk	tamias de Sibérie
<i>Thymallus arcticus baicalensis</i>	Arctic grayling	ombre arctique
<i>Vulpes corsac</i>	corsac fox	renard corsac

## Appendix 2: Recording Protocol

This system is based on a modified version of that outlined by Davis (1992). A number of revisions have been made which reflect the specific research aims of the current project and that will efficiently explore its characteristics. The elements and zones listed below have been chosen based on a number of criteria including:

- 1) potential for identification to skeletal element and species by specialists of varying experience
- 2) survivability
- 3) potential for providing information on the age and/or sex of an animal
- 4) potential to provide useful measurements.

The system is based on three main database structures, one for teeth, one for bones recordable under the protocol (countable elements) and one for all other fragments (non-countable elements).

Non-countable elements (fragments) are those specimens which are not used for any high-resolution quantitative analysis and include identifiable but partial bones and all other elements or parts of elements which are not included in the list of regularly recorded teeth and bones (see below). As much information as possible is recorded for these specimens in the comments field including, where possible, attribution to species, genus, family (for fish and bird) or Large mammal (Cervus/Bos/Equus size), Medium mammal (Capreolus/Ovis/Sus size), Small mammal (Oryctolagus/Felis size) or Rodent.

Countable elements (bones and teeth) are recorded when at least 50% of the articulation or of the occlusal surface is present.

Amphibian bones are recorded when either end of the following bones is present: humerus, radioulna, femur and tibiofibula. The acetabulum is also recorded.

A Fracture Freshness Index is recorded for all countable elements, which follows the criteria laid out in Outram (2001; 2002).

For a description of how measurements are taken see Albarella and Davis (1996), Davis (1992) and von den Driesch (1976). The following measurements are taken:

### TEETH

Equids:  $L_1$ ,  $W_a$  and  $W_d$  (as in Davis 1987) (only teeth which can be positioned, i.e. we know which tooth it is) ( $W_d$  is only taken on molars)

Cattle:  $dP_4W$ ,  $dP^4W$ ,  $M^1W$ ,  $M^2W$ ,  $M^3W$ ,  $M_1W$ ,  $M_2W$ ,  $M_3L$  and  $M_3W$

Caprine:  $dP_4W$ ,  $M_1W$ ,  $M_2W$ ,  $M_3L$  and  $M_3W$

Pig:  $dP^4$  (L,WP),  $M^1$ ,  $M^2$  &  $M^{12}$  (L, WA,WP),  $M^3$  (L,WA,WC),  $dP_4$  (L,WP),  $M_1$ ,  $M_2$  &  $M_{12}$  (L,WA,WP),  $M_3$  (L,WA,WC, WP), H.

Carnivores:  $P_4$ ,  $M_1$  (L & W),  $P_1$ - $M_3L$  (canids),  $P_3$ - $M_1L$  (felids),  $P_2$ - $M_3L$  (canids),  $P_1$ - $P_4L$  (canids),  $P_2$ - $P_4L$  (canids),  $M_1$ - $M_3L$  (canids), H.

### BONES

Horncores and antlers: min and max diameter of the base, greatest length (only bovids)

Atlas: H, BFcr (only for pig)

Scapula: mammals SLC

Humerus: mammals = GLC, BT (ungulates), Bd (all other mammals), HTC, SD



birds = GL, SC, Bd  
 Radius: mammals = GL, SD (when GL is taken)  
 Metacarpal: cattle = GL, SD, BatF, Bd, a, b, 3, 6.  
               caprines = GL, SD, Bd, a, b, 1, 3, 4, 6.  
               pig = GL  
               cervids = GL, SD, Bd, 3.  
               horse = GL, SD, Bd, Dd  
 Pelvis: mammals = LAR (LA)  
 Femur: mammals = GL, SD (when GL is taken), DC  
           birds = GL, Lm, SC, Bd, Dd  
 Tibia: mammals = GL, Bd, Dd, SD (ant-post, when GL is taken)  
           birds = GL, La, SC, Bd, Dd.  
 Astragalus: bovids and cervids = GLI, GLm, Bd, DI  
               pig = GLI, GLm  
               carnivores = GL  
               equids = GH, GB, BFd, LmT  
 Calcaneum: mammals = GL, GD  
 Metatarsal: cattle = GL, SD, BatF, Bd, a, b, 3, 6.  
               caprines = GL, SD, Bd, a, b, 1, 3, 4, 6.  
               cervids = GL, SD, Bd, 3, 6.  
               pig = GL  
               birds = GL, SC, Bd.  
               horse = GL, SD, Bd, Dd  
 Phalanx 1: equids = GL, Bp, Dp, SD, Bd, Dd.  
 Additional measurements may be taken, and are included in the  
 "comments" field when recorded.  
 The sheep/goat distinction is attempted on the following elements:  
 horncore  
 dP<sub>3</sub>, dP<sub>4</sub>, M<sub>1</sub>, M<sub>2</sub> & M<sub>3</sub>  
 permanent lower molars  
 Humerus  
 Metacarpal  
 Tibia  
 Astragalus  
 Calcaneum  
 Metatarsal  
 The frog/toad distinction is attempted on the pelvis.

## LIST OF FIELDS FOR THE THREE DATABASE STRUCTURES:

### Teeth

ID = automatically generated specimen record number  
 SITE  
 YEAR = year of excavation  
 BOX = box number  
 CTX = context  
 CAT # = catalogue number  
 COL = type of collection  
 EL = maxilla or mandible  
 LJ=loose tooth or jaw  
 SIDE  
 TAX = taxon  
 I1  
 I2  
 I3  
 I (=I/C in ruminants)  
 dI1  
 dI2  
 dI3  
 dI/dC

C  
 dC  
 P1  
 P2  
 P2L<sub>1</sub>  
 P2Wa  
 P2Wd  
 P3  
 P3L<sub>1</sub>  
 P3Wa  
 P3Wd  
 P4  
 P4L (L<sub>1</sub> in equids)  
 P4Wa (W in carnivores)  
 P4Wd  
 P  
 dP2  
 dP3  
 dP4  
 dP4L  
 dP4W  
 M1  
 M1L (L<sub>1</sub> in equids) (C in cattle upper tooth)  
 M1WA (W in caprines and carnivores) (Wa in equids)  
 M1WP (Wd in equids)  
 M1hyp  
 M2  
 M2L (L<sub>1</sub> in equids) (C in cattle upper tooth)  
 M2WA (W in caprines) (Wa in equids)  
 M2WP (Wd in equids)  
 M2hyp  
 M3  
 M3L (L<sub>1</sub> in equids) (C in cattle upper tooth)  
 M3WA (W in bovids) (Wa in equids)  
 M3WC (Wd in equids)  
 M3hyp  
 M12  
 M12WA  
 M12WP  
 M12hyp  
 M  
 P/M  
 P1/M3 L (P3/M1 L in felids)  
 P2/M3 L  
 P1/P4 L  
 P2/P4 L  
 M1/M3 L  
 H

Comments

### **Bones**

ID = automatically generated specimen record number

SITE

YEAR = year of excavation

BOX = box number

CTX = context

CAT # = catalogue number

COL = type of collection

PRES = preservation  
 EL = anatomical element  
 SIDE  
 TAX = taxon  
 FUSP = prox fusion  
 FUSD = dist fusion  
 FFI = Fracture Freshness Index  
 BUTCH = butchery  
 BURN = burning  
 GNAW = gnawing  
 GL (=GLI in astrag.) (=GH in equid astragalus) (=GLC in humerus) (=H in atlas)  
 Bd (=GB in equid astragalus) (= BT in humerus) (=BFcr in atlas)  
 Dd (=DI in astrag.) (=BFd in equid astragalus) (=3 in metapodials) (=DC in femur) (=GD in calcaneum)  
 HTC (=LmT in equid astragalus) (=GLm in astragalus) (=6 in metapodials)  
 LAR  
 SD (=SC in birds) (=SLC in scapula)  
 Lm (=La in tibiotarsus)  
 BatF  
 a  
 b  
 1  
 4  
 Comments

### **Fragments**

ID = automatically generated specimen record number  
 SITE  
 YEAR = year of excavation  
 BOX = box number  
 CTX = context  
 CAT # = catalogue number  
 COL = type of collection  
 Ver L = large vertebra  
 Ver M = medium vertebra  
 Ver S = small vertebra  
 Rib L = large rib  
 Rib M = medium rib  
 Rib S = small rib  
 Comments = recording of all additional discernible information, including species and element

### **CODES**

**COL** (=type of collection):  
 HC = hand collected  
 CS = from coarse sieving  
 FS>10 = from fine sieving (>10mm fraction)  
 FS>5 = from fine sieving (>5mm fraction)  
 FS<5 = from fine sieving (<5mm fraction)

### **PRES** (=preservation)

A = awful  
 B = bad  
 M = medium  
 G = good  
 E = excellent

**ELEM** (=anatomical element):

U = unknown

X = maxilla

N = mandible

OC = occipital

ZY = zygomaticus

SU = supraorbital arch

AT = atlas

AX = axis

SC = scapula

CO = coracoid (prox end)

HU = humerus dist

OTHU = humerus prox

RA = radius dist

OTHRA = radius prox

UL = ulna

C3 = carpal 3 or 2+3 (=carpal 2+3 - i.e. capit-trapez.- in bovids and cervids; carpal 3, distal row - i.e. capit. - in equids, pig and carnivores)

MC1 = metacarpal (=carpometacarpus, prox end, in birds)

MC2 = 1/2 metacarpal

MCIII = third metacarpal (pigs/carnivores)

MCIV – fourth metacarpal (pigs/carnivores)

PE = pelvis (acetabulum, ischial part)

FE = femur dist

OTHFE = femur prox

PA = patella

TI = tibia dist (=tibiotarsus in birds)

OTHTI = tibia prox

FI = fibula (prox)

AS = astragalus

CA = calcaneum

SCU = scafo cuboid (bovids & cervids) or scafo id (equids) or cuboid (pigs and carnivores)

MT1 = metatarsal (=tarsometatarsus in birds)

MT2 = 1/2 metatarsal

MTIII = third metatarsal (pigs/carnivores)

MTIV – fourth metatarsal (pigs/carnivores)

MP1 = metapodial

MP2 = 1/2 metapodial

P1 = phalanx 1

P2 = phalanx 2

P3 = phalanx 3

HC = horn core or antler

SH = Shell

OTH = all the others (specify element in comments)

**L/J:**

L=loose tooth

J=Jaw

A jaw is defined as a tooth having adjacent to it at least another half tooth/alveolus or an equivalent length of bone

**Hypoplasia:**

P=present (one line)

PP=present (two or more lines)

**TAX** (=taxon):

B = *Bos*  
O = *Ovis/Capra*  
OVA = *Ovis aries*  
CAH = *Capra hircus*  
S = *Sus*  
CEE = *Cervus elaphus*  
DAD = *Dama dama*  
CAC = *Capreolus capreolus*  
EQ = *Equus*  
EQC = *Equus caballus*  
EQA = *Equus asinus*  
CAF = *Canis familiaris*  
VUV = *Vulpes vulpes*  
FEC = *Felis catus*  
MUN = *Mustela nivalis*  
MUP = *Mustela putorius*  
MUE = *Mustela erminea*  
MUX = *Mustela erminea/nivalis*  
LE = *Lepus*  
LEE = *Lepus europaeus*  
ORC = *Oryctolagus cuniculus*  
LAG = Lagomorphs  
CAS = *Castor*  
RA = *Rattus*  
RAR = *Rattus rattus*  
RAV = *Rattus/Arvicola*  
APO = *Apodemus*  
MUM = *Mus musculus*  
SMU = Small *Murinae*  
ART = *Arvivola terrestris*  
CLG = *Clethrionomys glareolus*  
SRO = Small rodent  
LRO = Large rodent  
ERE = *Erinaceus europaeus*  
TAL = *Talpa*  
SOA = *Sorex araneus*  
SMI = Small *Microtinae*  
CD = *Cervus/Dama*  
DC = *Dama/Capreolus*  
CB = *Cervus/Bos*  
CV = *Canis/Vulpes*  
OCC = *Ovis/Capra/Capreolus*  
GNP = *Gallus/Numida/Phasianus*  
GP = *Gallus/Phasianus*  
GN = *Gallus/Numida*  
GAG = *Gallus gallus*  
ANA = *Anas*  
ANS = *Anser*  
SCR = *Scolopax rusticola*  
PEP = *Perdix perdix*  
PUP = *Puffinus puffinus*  
PHC = *Phalacrocorax carbo*

BUB = *Buteo buteo*  
 MIM = *Milvus milvus*  
 FAL = *Falco* sp.  
 ACN = *Accipiter nisus*  
 PL = *Pluvialis* sp.  
 PLA = *Pluvialis apricaria*  
 PLS = *Pluvialis squatarola*  
 VAV = *Vanellus vanellus*  
 GAN = *Gallinago gallinago*  
 COL = *Columba*  
 TU = *Turdus*/*Sturnus*  
 CO = *Corvus* sp.  
 COM = *Corvus monedula*  
 COF = *Corvus frugilegus/corone*  
 COC = *Corvus corax*  
 PIP = *Pica pica*  
 GAR = *Garrulus glandarius*  
 PSF = *Passeriformes*  
 AMP = *Amphibia*  
 RAN = *Rana* sp.  
 BUF = *Bufo bufo*  
 TES = *Testudinidae*  
 URS = *Ursus* sp.  
 FAC = *Falco columbarius*  
 CTC = *Coturnix coturnix*  
 LU = *Lutra* sp.  
 MEM = *Meles meles*  
 NUA = *Numenius arquata*  
 GAL = *Galliformes*  
 STV = *Sturnus vulgaris*  
 CIR = *Circus* sp.  
 LA = *Lagopus* sp.  
 STV = *Sturnus vulgaris*  
 MES = *Mergus serrator*  
 TUI = *Turdus iliacis*  
 ALA = *Alauda arvensis*  
 STE = *Sterna* sp.  
 STS = *Sterna sandvicensis*  
 FISH = Fish  
 MAR = *Marmota* sp.  
 OCH = *Ochotona* sp.  
 BUU = *Buccinum undatum*  
 F-S = *Salmonidae*  
 When the identification is uncertain a question mark is put at the end (e.g.  
 CEE? B?)

**FUS** (=fusion):

F = fused  
 G = fusing  
 H = fused/fusing  
 UD = unfused diaphysis  
 UE = unfused epiphysis  
 UX = unfused diaphysis + epiphysis  
 J = juvenile (for birds)

**BUTCH** (=butchery):

P = chopped

T = cut(s)

S = sawn

PT = chopped + cut(s)

SP = sawn + chopped

TS = cut(s) + sawn

"blank" = absent or not recordable

**BURN** (=burning):

S = singed

B = burnt

C = calcined

"blank" = absent or not recordable

**GNAW** (=gnawing):

C = gnawed by carnivores

D = partially digested

R = gnawed by rodents

CR = gnawed by carnivores and rodents

"blank" = absent or not recordable

**I1, I2, I3, I, dI1, dI2, dI3, dI, C (other than pig), dC, P1, P2, P3, P, dP2, dP3, P/M, M:**

P = present

"blank" = absent

**C (pig):**

M = male

F = female

AM = male alveolus

AF = female alveolus

P = present

"blank" = absent

**P4, dP4, M1, M2, M3, M12(=M1 or M2):**

wear stage

P = present, but wear stage not recordable (or not recorded)

"blank" = absent

**Measurements:**

All in tenths of millimetres.



### Appendix 3: MNI Figures

MAB, Bronze Age:

<i>Bos sp.</i>	<i>cf. Bos sp.</i>	<i>Equus sp.</i>	Large Mammal	Fish
1	0	1	0	1
<i>cf. Canis familiaris</i>	<i>Capra hircus</i>	Caprine	<i>cf. Caprine</i>	<i>Capreolus pygargus</i>
1	0	2	0	1
<i>Ovis aries</i>	Medium Mammal	<i>cf. Pica pica</i>	<i>cf. Turdus/Sternus sp.</i>	
0	0	1	0	
<i>Marmota sp.</i>	<i>Ochotona sp.</i>	Small Rodent		
0	1	1		

MAB, Bronze Age/Xiongnu:

<i>Bos sp.</i>	<i>cf. Bos sp.</i>	<i>Equus sp.</i>	Large Mammal	Fish
1	0	1	0	0
<i>cf. Canis familiaris</i>	<i>Capra hircus</i>	Caprine	<i>cf. Caprine</i>	<i>Capreolus pygargus</i>
0		1	1	0
<i>Ovis aries</i>	Medium Mammal	<i>cf. Pica pica</i>	<i>cf. Turdus/Sternus sp.</i>	
0	0	0	0	
<i>Marmota sp.</i>	<i>Ochotona sp.</i>	Small Rodent		
0	0	1		

MAB, Xiongnu:

<i>Bos sp.</i>	<i>cf. Bos sp.</i>	<i>Equus sp.</i>	Large Mammal	Fish
1	0	1	0	0
<i>cf. Canis familiaris</i>	<i>Capra hircus</i>	Caprine	<i>cf. Caprine</i>	<i>Capreolus pygargus</i>
0	0	1	1	0
<i>Ovis aries</i>	Medium Mammal	<i>cf. Pica pica</i>	<i>cf. Turdus/Sternus sp.</i>	
1	0	1	1	
<i>Marmota sp.</i>	<i>Ochotona sp.</i>	Small Rodent		
1	1	2		

MAB, Others:

<i>Bos sp.</i>	<i>cf. Bos sp.</i>	<i>Equus sp.</i>	Large Mammal	Fish
0	0	0	0	0
<i>cf. Canis familiaris</i>	<i>Capra hircus</i>	Caprine	<i>cf. Caprine</i>	<i>Capreolus pygargus</i>
0	0	1	0	0
<i>Ovis aries</i>	Medium Mammal	<i>cf. Pica pica</i>	<i>cf. Turdus/Sternus sp.</i>	
0	0	0	0	
<i>Marmota sp.</i>	<i>Ochotona sp.</i>	Small Rodent		
1	0	0		

MAC, Bronze Age:

<i>Bos sp.</i>	<i>cf. Bos sp.</i>	<i>Equus sp.</i>	Large Mammal	Fish
1	0	0	0	0
<i>cf. Canis familiaris</i>	<i>Capra hircus</i>	Caprine	<i>cf. Caprine</i>	<i>Capreolus pygargus</i>
0	0	0	0	0
<i>Ovis aries</i>	Medium Mammal	<i>cf. Pica pica</i>	<i>cf. Turdus/Sternus sp.</i>	
0	0	0	0	
<i>Marmota sp.</i>	<i>Ochotona sp.</i>	Small Rodent		
0	0	0		

MAC, Bronze Age/Xiongnu:

<i>Bos sp.</i>	<i>cf. Bos sp.</i>	<i>Equus sp.</i>	Large Mammal	Fish
1	0	1	0	0
<i>cf. Canis familiaris</i>	<i>Capra hircus</i>	Caprine	<i>cf. Caprine</i>	<i>Capreolus pygargus</i>
0	0	1	0	0
<i>Ovis aries</i>	Medium Mammal	<i>cf. Pica pica</i>	<i>cf. Turdus/Sternus sp.</i>	
0	0	0	0	
<i>Marmota sp.</i>	<i>Ochotona sp.</i>	Small Rodent		
0	0	0		

MAC, Xiongnu:

<i>Bos sp.</i>	<i>cf. Bos sp.</i>	<i>Equus sp.</i>	Large Mammal	Fish
1	0	1	0	0
<i>cf. Canis familiaris</i>	<i>Capra hircus</i>	Caprine	<i>cf. Caprine</i>	<i>Capreolus pygargus</i>
0	1	2	0	0
<i>Ovis aries</i>	Medium Mammal	<i>cf. Pica pica</i>	<i>cf. Turdus/Sternus sp.</i>	
1	0	0	0	
<i>Marmota sp.</i>	<i>Ochotona sp.</i>	Small Rodent		
1	0	2		

MAC, Others:

<i>Bos sp.</i>	<i>cf. Bos sp.</i>	<i>Equus sp.</i>	Large Mammal	Fish
1	0	0	0	0
<i>cf. Canis familiaris</i>	<i>Capra hircus</i>	Caprine	<i>cf. Caprine</i>	<i>Capreolus pygargus</i>
0	0	0	0	0
<i>Ovis aries</i>	Medium Mammal	<i>cf. Pica pica</i>	<i>cf. Turdus/Sternus sp.</i>	
0	0	0	0	
<i>Marmota sp.</i>	<i>Ochotona sp.</i>	Small Rodent		
0	0	0		