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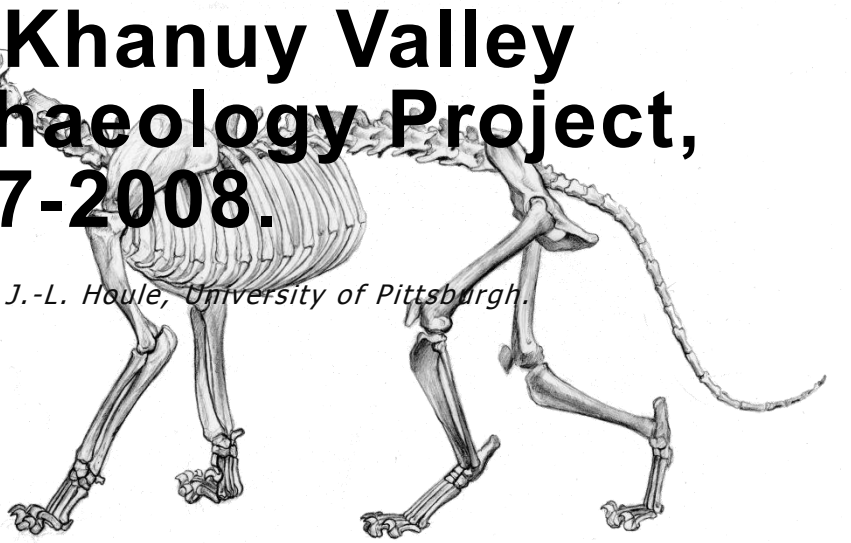
Xiongnu Period Faunal Remains from the Khanuy Valley Archaeology Project, 2007-2008.



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

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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 Mongolian (Makarewicz, 2006; Viner, 2009). Much of this previous work has focused on the Bronze Age period, but this report examines the Xiongnu period remains excavated alongside those examined by Viner (2009).

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 in the Xiongnu period.
iii. To ascertain economic and seasonal strategies.
iv. To better understand the Xiongnu environment.

2. Methods

This report is based upon the identification and recording carried out by Viner in 2009, a complete account of the methods used in those processes can be found in Viner (2009).

Ovis aries (domestic sheep) is aged according to Moran and O'Connor (1994) and *Equus* sp. (horse) according to Silver (1969) and Levine (1982).

The binomial name is used for all species throughout this report. 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.

3. Results

The overall condition of the assemblage was highly fragmentary, with just 41 fragments (3.65%) from the assemblage being identifiable under the protocol (Figure 1). Fragments from MAC, QUE, MAB, SHA, GER and HOA showed signs of being root damaged, whilst burnt or calcined fragments were recorded from all sites except GER, JUL, SAL and TOP. Identified specimens from HUN, MAB and QUE were characterized as being in a good state of preservation, whilst those from HOA, WFA, JUL and SHA

were recorded as being in a bad to awful state of preservation. The pattern of fragmentation is reflected in the unidentified fragments, with contexts characterised as exhibiting moderate to awful preservation and exceptions present in the contexts MAC A-8, 15-2, QUE 3, 0-10 and QUE 5, 0-10, which were all were all recorded as having faunal remains in generally good condition. Traces of butchery and carnivore gnawing were extremely rare and present on none of the unidentified fragments.

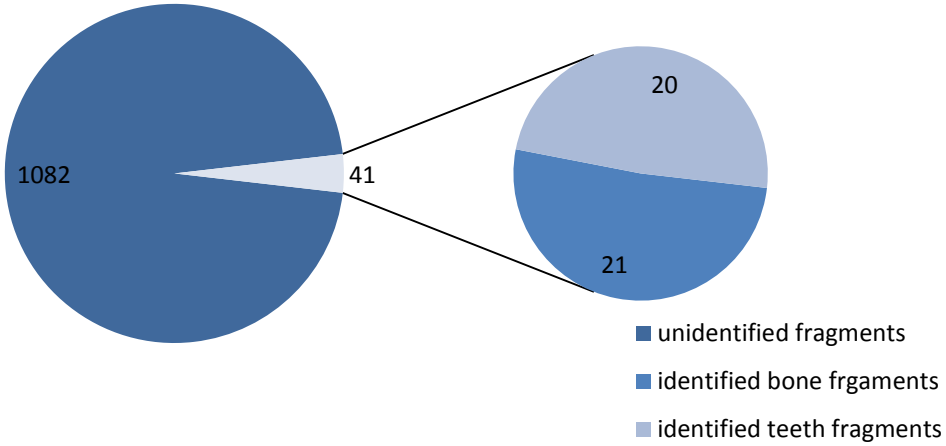
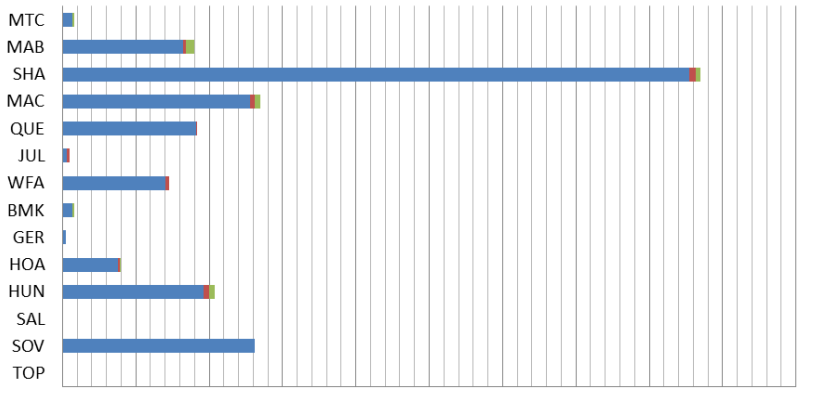


Figure 1: NISP (Number of Identified SPecimens) as proportion of total assemblage

Breaking the assemblage down by site, it can be seen that several sites do not contribute to the NISP in any way at all – TOP, SOV, SAL and GER, of which TOP and SAL do not have any faunal remains from contexts dated to the Xiongnu period (Figure 2). Further to this, HOA, BMK, JUL, QUE and MTC also contribute very little to the NISP (between one and two specimens) or (with the single exception of QUE, like SOV in the previous list) to the total number of fragments in the assemblage (Figure 2). It can also be seen that the majority of the assemblage originates from just one site – SHA, although its NISP figure (8) is identical to that of HUN and MAB and only one more than MAC (Figure 2).



	TOP	SOV	SAL	HUN	HOA	GER	BMK	WFA	JUL	QUE	MAC	SHA	MAB	MTC
unidentified frgaments	0	131	0	96	38	2	7	70	3	91	128	427	82	7
identified bone	0	0	0	4	1	0	0	3	2	1	3	5	2	0
identified teeth	0	0	0	4	1	0	1	0	0	0	4	3	6	1

Figure 2: Fragments associated with securely dated Xiongnu contexts, by site.

The sites from which the faunal assemblage is drawn reflect the modern day summer/winter campsite transhumance pattern (Houle et al., 2008, 5). In order to make the individual assemblages ever so slightly more statistically robust, they will from here on in be grouped with reference to this characteristic.

3.1. Results from sites in present day summer campsite zone

The specimens identified from the summer sites provide a total NISP of 19 (Figure 3), nearly half (0.46) the total NISP (Figure 1). This figure can be neatly divided into small, medium and large mammals (Figure 3) 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.

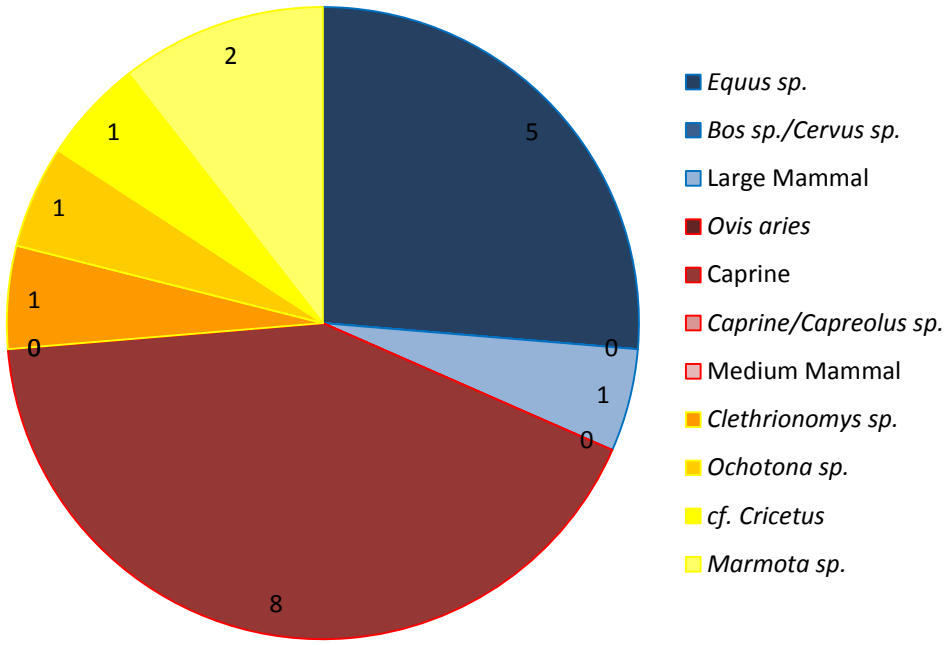


Figure 3: Species representation, by NISP, on sites in the present day summer campsite zone.

Of the six large mammal specimens identified in the assemblage from the present day summer campsite area, five were *Equus* sp, whilst the remainder was recorded as simply Large Mammal (Figure 3). If the assemblage is representative this presents a 0.83 probability that the specimen identified as Large Mammal is also *Equus* sp., this specimen is a rib and so cannot contribute any further to the dataset. A tibia was recovered from SHA which was fused distally but not proximally, giving an age at death of between 2 and 3 years of age (Silver, 1969, 286). A broken *Equus* sp. molar or premolar was also recovered from SHA., two further molar/premolars were identified among the assemblage collected from MAB and a 2nd premolar was recovered from HOA. A further *Equus* sp. tooth fragment was also recovered from HOA, but this was not identifiable under the protocol and has not been included in these statistics.

All of the medium mammal specimens identified in the assemblage from the present day summer campsite area were recorded as being caprine. The bones included a cf. caprine 2nd phalanx from HOA, which was fused, giving a minimum age of 5 months (Moran and O'Connor, 1994, 272) and a 3rd phalanx and possible radius shaft from SHA. The latter showed signs of having been gnawed by carnivores. A single maxillary caprine molar was recovered from MTC, another molar, two molar/premolars and a 3rd molar, all maxillary, were recovered from MAB. The 3rd molar was noted as being of larger than average size and the possibility

of it originating from *Capra sibirica* (Siberian ibex) was noted by Viner.

Small mammals made up the smallest part of the assemblage from the present day summer campsite area and consisted entirely of wild animals. Of these, one was a lagomorph (*Ochotona* sp. (pika)) and four were rodents. The *Ochotona* sp. specimen was a distal humerus, from MAB. The rodents were represented by mandibles of *Clethrionomys* sp. and cf. *Cricetus* from SHA as well as a proximal femur of *Marmota* sp. from SHA which showed signs of carnivore gnawing. A distal tibia of *Marmota* sp. was also found at MAB, which had two cut marks on the epiphysis.

By combining the above NISP data with the site location information (disaggregating the sites in the present day summer campsite zone), it is possible to calculate the MNI (Minimum Number of Individuals) that must have contributed to the assemblage (Figure 4). These figures broadly follow the pattern identified in the NISP data – caprines make up the single biggest component, followed by *Equus* sp. *Marmota* sp. is the most frequent component of the wild mammal assemblage.

Equus sp.	Caprine	*Clethrionomys* sp.	*Ochotona* sp.	cf. *Cricetus*	*Marmota* sp.
3	4	1	1	1	2

Figure 4: MNI (Minimum Number of Individuals) for sites in the present day summer campsite zone.

3.2. Results from sites in present day winter campsite zone

The NISP from the sites in the present day winter campsite zone is 22 (Figure 5) (0.54 of the total NISP), comparable with the figure from those sites in the present day summer campsite zone. Dividing this figure into small, medium and large mammals, as per the last dataset produces a noticeably different pattern, however (Figure 5). Where the sites in the summer campsite zone produced a range of 5-8 in these categories, with medium mammals being the largest, the sites in the winter campsite zone have a range of 3-13, with the largest category (large mammals) being more than double the size of the second largest (medium mammals, 6) (Figure 5).

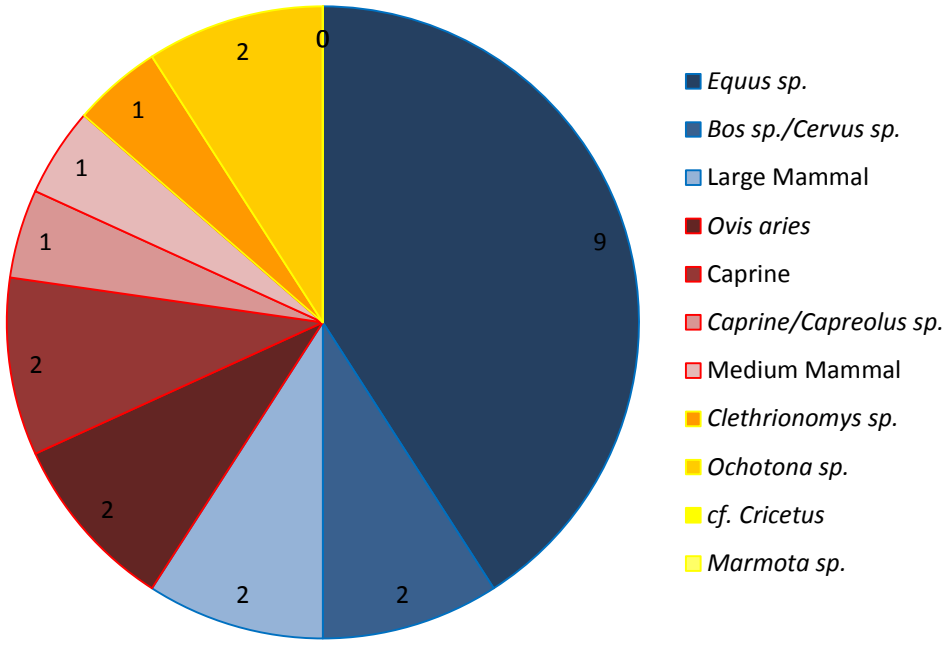


Figure 5: Species representation, by NISP, on sites in the present day winter campsite zone.

Small mammals in the mini-assemblage were identified from an *Ochotona* sp. mandible (from MAC) and maxilla (from HUN) and a *Clethrionomys* sp. mandible (from HUN).

A rib from a medium mammal was recovered from HUN and a caprine/*Capreolus* sp. radius from QUE. A caprine incisor and a proximal metacarpal were both recovered from MAC, the latter of which exhibited cut marks. Two *Ovis aries* humeri were also recovered from HUN, both of which came from the same side, and so represent different individuals. Thus it can be seen that there is a 0.77 probability that all medium mammals in the assemblage are caprine, if it is representative, and a 0.33 probability that they are *Ovis aries*. One of the *Ovis aries* humeri from HUN was fused distally, representing a minimum age at death of 3 months (Moran and O'Connor, 1994, 272).

Those specimens identified to the "Large Mammal" category included a femur from WFA and a fragment from HUN. WFA also produced a *Bos* sp./*Cervus* sp. 3rd phalanx, whilst BMK produced a *Bos* sp./*Cervus* sp. incisor. HUN revealed a maxillary *Equus* sp. molar/premolar and a mandibular 3rd molar in moderate wear, meaning that the individual was probably between 3 and 6 years of age at death (Levine, 1982, 247). The faunal remains from MAC also contained a maxillary *Equus* sp. molar/premolar, as well as an Equus sp. mandible containing the 1st, 2nd and 3rd molars and exhibiting numerous small cutmarks on the lingual side. MAC contained a 3rd phalanx from *Equus* sp. as well as a cf. *Equus*

mandible. WFA contained a proximal horse metatarsal, which showed some signs of having been gnawed by rodents. JUL also contained a proximal Equus sp. metatarsal, as well as a tibia, which was fused distally, meaning that the individual must have been at least 20 months old when it died, following uniformitarian assumptions (Silver, 1969, 286). It follows that there is a 0.69 probability that those specimens recorded as "Large Mammal" are in fact *Equus* sp. and a 0.15 probability that they are *Bos* sp./*Cervus* sp.

Equus sp.	*Bos* sp./*Cervus* sp.	*Ovis aries*	Caprine	Caprine/*Capreolus* sp.	*Clethrionomys* sp.	*Ochotona* sp.
4	2	2	1	1	1	2

Figure 6: MNI (Minimum Number of Individuals) for sites in the present day winter campsite zone.

By combining the above NISP data with the site location information (disaggregating the sites in the present day winter campsite zone), it is possible to calculate the MNI (Minimum Number of Individuals) that must have contributed to the assemblage (Figure 6). These figures broadly follow the pattern identified in the NISP data – *Equus* sp. make up the single biggest component, followed by *Bos* sp./*Cervus* sp., *Ovis aries* and *Ochotona* sp.

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 the genus *Cricetus, Marmota* or to *Clethrionomys* sp. *Clethrionomys* is a no longer used name for the *Myodes* genus. Two species of *Myodes* occur within the present day Arkhangai province – *Myodes rufocanus* and *Myodes rutilus* (grey red-backed vole and northern red-backed vole) (Batsaikhan et al., 2010, 122-125). In common with all other members of this genus, both species prefer woodland habitats (Batsaikhan et al., 2010, 122-125). *Cricetus* sp. is a genus represented in the world today by one species – *Cricetus cricetus* – which does not occur in present day Mongolia, nor are there records for it having occurred there in the past (G. Nechay, 2000). It is a synanthropic species frequently associated with arable agriculture (G. Nechay, 2000).

Given the discussion that takes place below, it is suggested that those specimens identified here as cf. *Cricetus* should be considered as an identification not to genus level, but to the sub-family *Cricetidae* which includes several other genera and species, including *Cricetulus barabensis*, which has been suggested as present in Holocene contexts of the Khanuy valley elsewhere (Broderick, 2010). For similar reasons it is suggested that those specimens identified as *Clethrionomys* sp. should be considered as an identification to the sub-family *Arvicolinae*, which includes species whose habitat preference is more similar to that of the other species identified.

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). Of these two species, it has been suggested elsewhere that *Ochotona dauurica* is present within Holocene contexts of the Khanuy valley (Broderick, 2010) and it is assumed that those specimens identified in this assemblage also belong to this species.

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 may also make up a significant proportion of the diet of *Mustela eversmanni* (steppe polecat), which is known to be present in the Akhangai 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 $35m^2$, 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 it has been suggested elsewhere as being present in Holocene contexts of the Khanuy valley (Broderick, 2010), 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).

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).

Equus is almost exclusively a grazing genus, and neither *Equus Caballus* nor *Equus Prezwalski* 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).

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 herdsmen 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 (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 the most common wild species at those sites in the present day summer campsite area, but is completely absent from those in the winter campsite area (Figure 3; Figure 4; Figure 5; Figure 6). Cutmarks on one specimen clearly demonstrate its utilisation by human populations. Today, Marmota sibirica is hunted in the summer months, for its meat and for its fur (Broderick, field notes, 2010). 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.

Bos sp./*Cervus* sp. showed the reverse pattern to *Marmota sibirica*, being present only on those sites in the present day winter

campsite area (Figure 3; Figure 4; Figure 5; Figure 6). 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 maximises the meat yield (Broderick, field notes, 2010). 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. If wild resources were managed along similar lines, there would be an argument to be made for these remains being more likely to be *Bos* sp. than *Cervus* sp. – the latter would also deteriorate in condition during the winter months.

The origins and nature of *Bos* sp. in Mongolia are still poorly understood. The line of reasoning argued here suggests that these are domestic forms, but of what precise species it is impossible to say.

Equus sp. follows a similar pattern to *Bos* sp., although present on the sites in the present day summer campsite area it is in far fewer numbers than on those sites in the present day winter campsite area (Figure 3; Figure 4; Figure 5; Figure 6). It was possible to age one specimen from those sites in the present day summer campsite area, which gave an age of 2-3 years old, and also one from those sites in the present day winter campsite area, which gave an age of 3-6 years old. In the Khanuy valley today, horses are slaughtered at 2-3 years of age for their meat (Broderick, field notes, 2010), comparable with this data. 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).

It is impossible to say for certain whether the aged specimens represent animals butchered for their meat or fallen animals, but this does raise the possibility that a cultural preference for tender meat may have been valued over economic optimisation in the Xiongnu, as well as present day, Khanuy valley.

Caprines were the second largest part of the assemblages overall, and the largest from those sites in the present day summer campsite areas (Figure 3; Figure 4; Figure 5; Figure 6). This could reflect a similar pattern as in the present day Khanuy valley, where caprines represent a year-round meat supply (Broderick, field notes, 2010). Cutmarks on the metacarpal from MAC probably represents skinning processes. That age estimates were only obtainable from epiphyseal fusion stages (and only fully fused bones at that) make it difficult to account for age at death of the animals.

It has not been possible to discern any clear pattern of element distribution within the assemblage for any species. The presence

of carnivores – either domestic or wild – has been demonstrated through the recorded presence of gnawing patterns, even though their physical remains are absent from the assemblage. Signs of gnawing by rodents at WFA indicate that bones at this site were probably left on the surface for some time prior to deposition.

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, field notes, 2010). 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.

5. 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.

Interpretation of the assemblage is compatible with a pastoral economy similar to that of today. Wild resources were utilized in the form of *Marmota sibrica* (and possibly *Cervus elaphus* and *Capra sibirica*) for their meat and/or fur, whilst livestock may have been preferentially grazed near *Ochotona daaurica* colonies (another variation on the Schlepp 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.

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Appendices

Appendix 1: Dictionary of animals referred to in the text

Binomial (Latin) name	English name	French name
Bos grunniens	yak	yak
Bos taurus	domestic cow	vache domestique
Capra sibirica	Siberian ibex	ibex
Capreolus pygargus	Siberian roe deer	chevreuil de Sibérie
Cervus elaphus	red deer	cerfélaphe
Cricetus cricetus	European hamster	grand hamster
Equus caballus	domestic horse	cheval domestique
Equus przewaskii	Przewaski's horse	cheval de Przewalski
Marmota sibirica	Siberian marmot	marmotte de Sibérie
Mustela eversmanni	steppe polecat	putois des steppes
Myodes rufocanus	grey red-backed vole	campagnol de sundevall
Myodes rutilus	northern red-backed vole	campagnol boreal
Ochotona alpina	alpine pika	pika de l'Altaï
Ochotona daaurica	Daurian pika	pika de Daourie
Oenanthe isabellina	isabelline wheatear	traquet isabelle
Ovis aries	domestic sheep	mouton domesitque
Pyrgilauda davidiana	Père David's snow finch	niverolle de David
Vulpes corsac	corsac fox	renard corsac