LATE PLEISTOCENE EQUIDS IN EASTERN BERINGIA: DENTAL CHARACTERISTICS AND MORTALITY PROFILES OF Equus lambei *FROM THE BLUEFISH CAVES, YUKON TERRITORIES, CANADA*

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Summary

*The Bluefish Caves of northern Yukon, Canada, have yielded the earliest evidence of human occupation of Eastern Beringia. They have also provided us with the largest and most complex in situ late Pleistocene fauna ever recovered in this region, if not in all of Beringia. This paper presents research results on an important component of the Bluefish fauna, the equids (*Equus lambei*). More specifically, it presents data derived from the study of a relatively large sample of horse teeth recovered from the three caves. As well as contributing to the reconstruction of Full and Late Glacial landscapes in the Bluefish Basin, Eastern Beringia, this research contributes to our knowledge of the Late Pleistocene Beringian equid,* Equus lambei.

Résumé

Les Équidés du Pleistocène tardif de l'est de la Béringie : caractéristiques dentaires et courbes de mortalité de* Equus lambei *des grottes Bluefish, Territoires du Yukon, Canada.

*Les grottes Bluefish, dans le nord du Yukon, Canada, recèlent les témoins les plus anciens d'occupation humaine dans la Béringie de l'Est. De plus, ces grottes contiennent une faune parmi les plus grandes et les plus complexes du Pléistocène tardif jamais découvertes in situ dans cette région. Cet article présente les résultats d'une recherche sur un membre important de la faune de Bluefish, le cheval (*Equus lambei*). Cette recherche est spécifiquement orientée vers l'étude de la dentition de ce cheval, témoin relativement abondant dans les trois grottes. Tout en approfondissant nos connaissances sur* Equus lambei, *cet article vise à contribuer à la reconstitution de l'environnement dans le Bassin Bluefish.*

Zusammenfassung

Spätpleistozäne Equiden in der östlichen Beringregion: Zahnmerkmale und Sterbealtesprofile von* Equus lambei *aus den Bluefish-Höhlen im Yukongebiet, Kanada.

Die Bluefish Caves in Nord Yukon, Kanada, erbrachten den frühesten Nachweis menschlicher Besiedlung im östlichen Beringgebiet. Ebenso lieferten sie uns den umfangreichsten und komplexesten pleistozänen in situ - Faunenkomplex, der in dieser Region bekannt geworden ist. Dieser Beitrag behandelt die Forschungsergebnisse zu einer bedeutenden Komponente der Bluefish-Fauna, den Equiden (Equus lambei). *Das Schwergewicht liegt auf Daten, die anhand einer großen Menge von Pferdezähnen aus den drei Höhlen gewonnen werden konnten. Die Ergebnisse erweitern unser Wissen über die hoch- und spätglaziale Landschaft im Bluefish-Becken und das spätpleistozäne Pferd,* Equus lambei.

Key Words

Equus lambei, *Bluefish caves, Full/Late Glacial, Skeletto-chronology, Eastern Beringia.*

Mots clés

Equus lambei, *Grottes Bluefish, Pléniglaciaire, Tardiglaciaire, Squeletto-chronologie, Béringie orientale.*

Schlüsselworte

Equus lambei, *Bluefish-Höhlen, Hoch- und Spätglazial, Skeletto-Kronologie, Östliches Beringgebiet.*

Introduction

The paleoenvironmental record for Eastern Beringia is preserved intact in numerous deposits in the northern Yukon, Northwest Territories and Alaska. These deposits provide us with a continuous record of environmental conditions during the last glacial period, or Wisconsinan (Hughes *et al.*, 1981; Harington, 1979; Morlan, 1980). They have been the focus of several multi-disciplinary projects, such as the Yukon Research Programme, the Yukon Refugium Project, and long-term study of Pleistocene vertebrate fossils undertaken by the Canadian Museum of Nature (C. R. Harington).

Eastern Beringia, including the interior basins, unglaciated lowland areas such as the Bonnet Plume, Old

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Crow, Bluefish and Bell basins, played a part in the history of habitation in the New World, particularily during the maximum expansion of the Cordilleran and Laurentide ice sheets. For this reason archaeologists seek better understanding of Late Pleistocene environments in Eastern Beringia.

The floral and faunal communities of Pleistocene Eastern Beringia are still poorly known but appear to have differed fundamentally from present tundra communities (Harington, 1979; Guthrie, 1980, 1982, 1985; Matthews, 1982). A better understanding of Pleistocene faunal communities in Eastern Beringia has been hampered by the lack of *in situ*, identifiable biocenoses (Matthews, 1982; Guthrie, 1985). For example, the Mammoth Fauna, an apparently widespread Pleistocene fauna, is believed to be dominated by bison, horse and mammoth (Guthrie, 1980, 1982, 1985; Matthews, 1982; Vereshchagin and Baryshnikov, 1982), and only loosely associated with elements such as *Saiga*, *Ovibos*. At the Bluefish Caves, northern Yukon, however, elements of the Mammoth Fauna are found together with both *Saiga* and *Ovibos*, in close stratigraphic association.

The presence of abundant faunal and palynological remains *in situ* in the three caves which make up the Bluefish Caves complex, make this an invaluable assemblage for furthering our knowledge of animal communities and their environment in East Beringia.

This paper adds to our knowledge of a dominant member of the Mammoth Fauna: the horse. Preliminary research on the dental morphology of *Equus lambei* and thin-sectioning of equid teeth from the Bluefish Caves for the purposes of establishing season of death is presented. Dental morphology is believed to be a useful tool for making taxonomic determinations of Pleistocene fossil horses (Azzaroli, 1990: 341; Prat, 1976, 1980; Eisenmann, 1980, 1986, 1991).

The Horses at Bluefish Caves

Horses have been discovered at Bluefish Caves in a stratigraphic context spanning the last 15,000 years of the late Pleistocene. These fossils have potential for establishing the relationship between the behaviour and morphology of Beringian equids, and paleoenvironmental changes occuring during the late Pleistocene.

Dating of *E. lambei* remains in Eastern Beringia

Equus lambei, the horse represented in the Bluefish fauna, was the dominant equid form in the steppe-like terrain of East Beringia during the late Wisconsinan (Sher, 1971: 153; Harington and Clulow, 1973: 724). *E. lambei* appears in pre-late Wisconsinan deposits in Dawson, Old Crow and Alaska, and in Illinoian age deposits in Alaska. At Bluefish, *Equus lambei* specimens have been radiocarbon dated to approximately 22-23 Kyrs bp at the earliest and 12 Kyrs bp at the latest.

A relatively small, broad-skulled horse, *Equus lambei* strongly resembles Late Pleistocene equids from Siberia (Harington, 1977; see also Eisenmann, 1986: 72). The type specimen, from Gold Run Creek, Alaska, was first described by Hay in 1917.

Originally described as a member of the genus *Asinus*, *E. lambei* is now assigned to the caballine group on the basis of physical traits described by Harington (1989) and multivariate analyses carried out by Eisenmann (1980, 1986). Eisenmann noted close similarities between *Equus lambei,* late Pleistocene Siberian horses, *Equus przewalskii* and modern Arabian breeds. Similarily, Forsten (1988a: 163) states that *E. lambei,* the Yukon horse, was "the easternmost representative of a circumpolar species of small, caballoid, horse of which Przelwalski's horse and the tarpan were the last wild Eurasian survivors."

The Bluefish Caves have yielded 505 horse cheekteeth, so far: 306 maxillary and 218 mandibular. The teeth were sorted into anatomical positions, and the total number of teeth for each anatomical position was calculated. The dental MNI (Minimum Number of Individuals) based on cheek teeth is 51 individuals. Twenty-five individuals from Cave I, 13 from Cave II and 13 from Cave III.

Mandibular cheekteeth were measured on 7 dimensions, maxillary teeth on 5 dimensions. Measurements were taken following Turnbull (1986), at the occlusal surface for ease of comparison with Eisenmann's morphometric data (Eisenmann, 1980).

In this paper, the quantitative data are used to confirm the taxonomic affiliation of *E. lambei*, to describe the dental characteristics of *E. lambei* more fully and to construct age profiles for horse for each cave using eruption/wear-data and tooth-height tables, after Levine (1982). A series of qualitative observations were also made on the cheek teeth following Eisenmann (1986: fig. 19).

A representative sample of teeth (equal to dental MNI *minus* poorly-preserved teeth) was taken from each cave for thin-sectioning. Thirty-eight samples were taken, 18 from Cave I, 7 from Cave II and 13 from Cave III. The sampled teeth were set in resin blocks, and thin-sectioned using standard petrographic methodology (Burke, 1992; Burke and Castanet, 1995). The resulting thin-sections were viewed under transmitted, polarized light and determinations of season of death were made.

Results

Qualitative dental characteristics of *E. lambei* are only roughly similar to those of *E. przewalskii*, which Eisenmann considers typical of wild horses (1986: fig.19). The average number of enamel folds on P3 and P4 is higher in our sample of *E. lambei* (6 rather than 4-5), the frequency of isolated hypoglyphs on M^3 is much less (10.3% rather than 47%), the frequency of open post-fosettes on M^3 is higher (34.5% rather than 27%) and the frequency of dP^1 in adult specimens less (16% instead of 25%). These differences can probably be attributed to genetic differences between populations - or rather between the regional population of *E. lambei*, at Bluefish, and the average values for *E. przewalskii* as sampled by Eisenmann. The variation observed in these qualitative characteristics for cabalines, therefore, suggests that such characteristics may not be of practical use in establishing taxonomic affiliation.

Morphometric data from the present sample were compared with mean values for *E. prezwalski*, *E. caballus*, *E. kiang*, *E. hemionus*, and *E. asinus* (fig. 1, 2). The data show that *E. lambei* most closely resembles other Pleistocene caballoids, rather than the stenonid group (of which *E. kiang*, *E. hemionus*, and *E. asinus* are part). Mean tooth size is slightly larger than the means given in Eisenman (1980, 1986) for *E. caballus*. But as Forsten (1982) has noted, there exists a high degree of individual variation in equid body-size, as well as geographic variation between horse populations. Only tooth length and protocone length are shown here (fig. 1, 2), as Forsten (1982) has shown that the protocone index (Eisenmann, 1980, 1986) is not valid for taxonomic characterisations because of: 1) size differences observable within the same subspecies of horse; and 2) allometric associations between the recorded dimensions and overall body size.

There exists another means of differentiating between caballoids and stenonids. Forsten (1988b: 24), for example, notes a basic difference between "U" pattern caballoids, which include *E. caballus L.*, and "V" pattern stenonids,

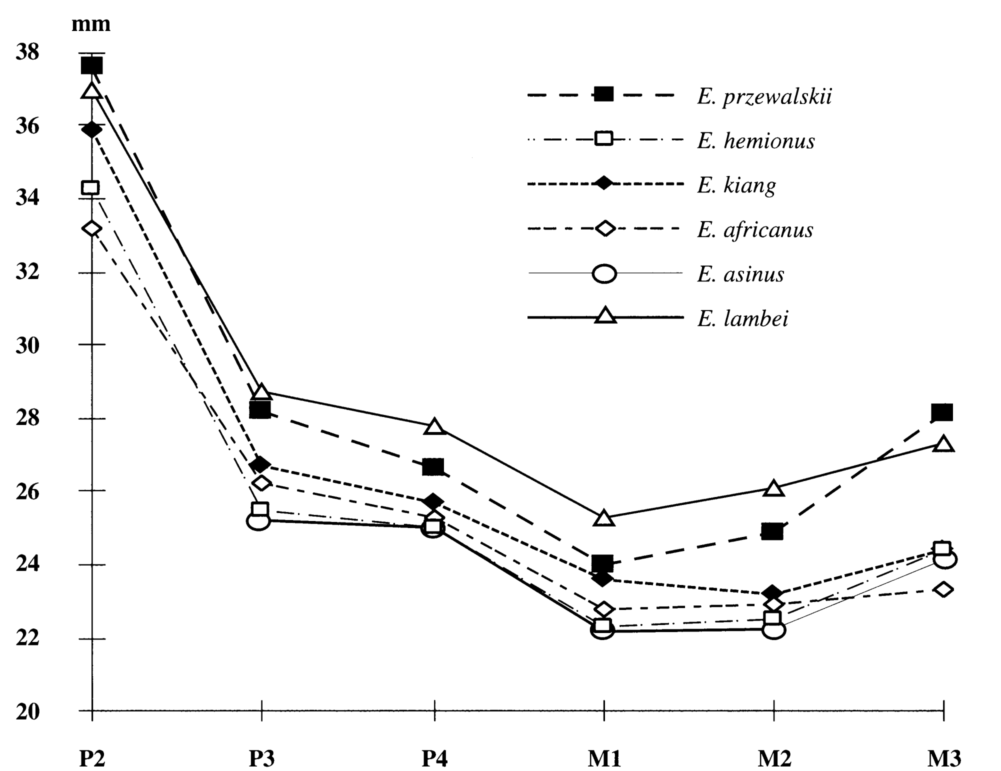

Fig. 1: Mean occlusal length (mm) upper teeth, with modification from Eisenmann (1986: fig. 16).

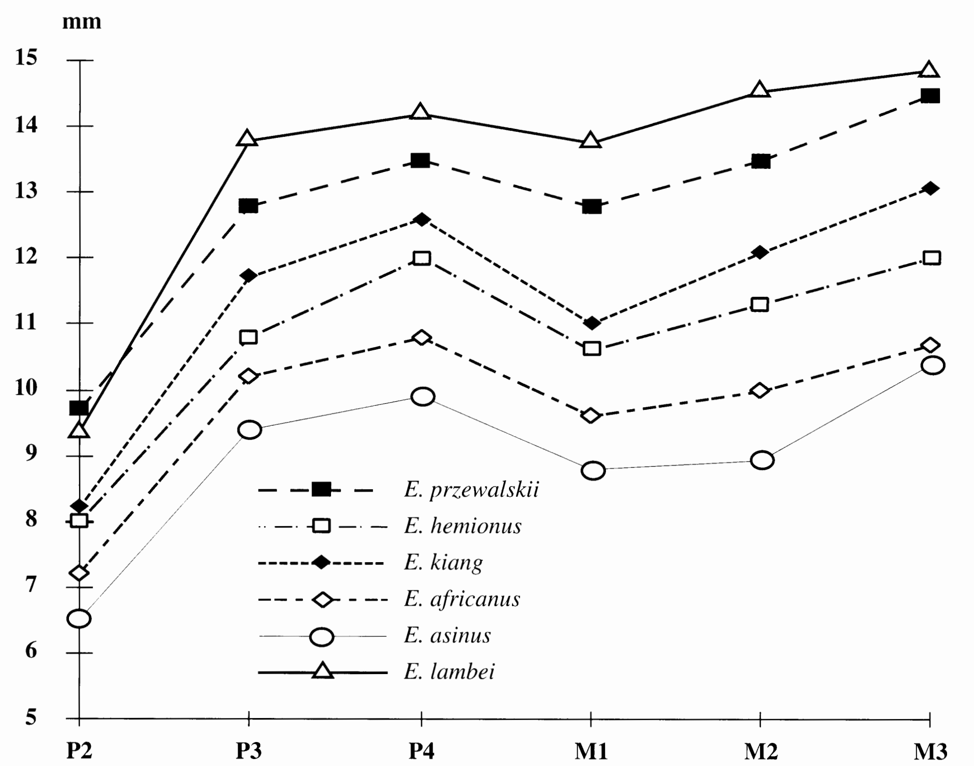

Fig. 2: Mean protocone length (mm) for the upper teeth of various equids, with modification from Eisenmann (1986: fig. 17).

which include fossil stenonid horses (*Equus stenonis* Cocchi), *E. zebra* L., *E. greyvi* Oust., *E. burchelli* (Gray), *E. asinus* L., *E. hemionus* Pallas and *E. kiang* Moorcr. The Bluefish horses show a typically caballoid, "U" shaped entoflexid pattern.

Canine Teeth

A surprising number of horses in the Bluefish fauna have large, well-developed canines. In Cave I, only one adult anterior jaw is present and it contains a well-developed canine tooth. In Cave II, 3 of 5 adult anterior jaws contain well-developed canine teeth. In Cave III, 11 out of 14 anterior jaws (of which 2 are immature) contain canines, i.e. 11 out of 12 adult anterior jaws have well-developed canine teeth. Given that modern horses are "virtually monomorphic in skull dimensions... except for small canine teeth in males" (Berger, 1986: 21) several possibilities are raised by these data. 1) A succession of small bachelor bands came to grief near the caves. 2) Selective predation on prime adult males was taking place. 3) Retention of canines in females is a characteristic of *E. lambei.*

Horse herds live either in family bands composed of one adult male and females with their foals, or in bachelor bands: small, unstable groupings of fewer than 4 young males (Waring, 1983: 142). In both caves II and III there are yearlings present in the death assemblage, which would point to the presence of family bands rather than bachelor bands. The selective predation of prime-adult male horses at Bluefish is unexpected, given the several different predators active in the vicinity.

A brief survey by one of the authors (A. B.) of specimens of *E. lambei* from localities in Alaska, held at the Canadian Museum of Nature, indicates a high incidence of canines in other collections. If canines are characteristic of both sexes in *E. lambei,* as the data suggest, this could be the retention of a "primitive" or ancestral trait, shared with fossil populations of *E. stenonis* (Prat, 1976: 409) and with modern stenonids.

Mortality Patterns

The horse assemblages from the Bluefish Caves are probably the result of random sampling of a regional equid population over a relatively long (10,000 years) period. In all three caves predators, such as the wolf, bear and lion, scavengers such as the wolverine, and human agencies have been at work (Morlan and Cinq-Mars, 1982; Harington, 1989; Cinq-Mars, 1990). Given the numerous potential agents of bone accumulation, and the length of the probable period of bone deposition, any interpretation of the age and seasonality profiles is speculative. Information from other sources has already indicated that the three Bluefish caves are palimpsest deposits, i.e. the result of multiple re-occupations by different agents (Morlan and Cinq-Mars, 1982; Cinq-Mars, 1990).

Age Profiles

Age profiles were produced for each of the Bluefish Caves using upper M1 tooth heights, combined with eruption/wear data for subadult individuals (Levine, 1982). Results for cave I (N = 25) show a pattern typical of predation, i.e. prime-aged adults are best represented. Cave II shows an attritional pattern of mortality, but the number of individuals aged is small (N = 13). Cave III shows a more limited age distribution, featuring only sub-adult and prime-aged animals (up to 9 years of age) - but again, the total number of samples is low (N = 13).

The pattern in Cave I may reflect greater predator activity in the vicinity of this cave. The patterns for Caves II and III probably reflect the random nature of the population sample, given the probability that natural deaths and several agents were responsible for the pattern of deaths over a long period of time.

Seasonal Profiles

Seasonal determinations for horse using incremental analysis are at present limited to two broad categories: winter, which can be further subdivided into early spring/winter/fall; and summer, a six-month period (Burke, 1992; Burke and Castanet, 1995). However, when combined with seasonal information from eruption/wear patterns, as well as ageing information based on tooth height, the seasonal data show year-round presence of horses at Bluefish. This result is consistent with the interpretation of the deposits as palimpsests.

Paleoethology and environmental reconstructions at Bluefish Caves

The results of this study confirm the identification of *E. lambei* as a member of the caballine group. Both caballoids and stenonids inhabit steppe-like, or savannah-like regions (Berger, 1986) and are non-selective grazers capable of enduring a wide variety of climatic conditions. The principal differences between the caballines and stenonids today lies in their social organisation and migration patterns. Caballoids form small, stable bands of 4-10 individuals, whereas stenonids typically do not. Furthermore, modern stenonids migrate in large herds, while few caballoids have been observed to do so.

Paleoenvironmental reconstructions for the Bluefish Basin (Morlan, 1980; Hopkins 1982; Ritchie *et al.,* 1982) suggest a late Pleistocene environment characterised by cold winters and cool summers, low annual precipitation (190-375 mm) with drier summers and continuous permafrost. The Bluefish Caves are situated on a slope approximately 200 meters above the valley floor, in an herbaceous tundra zone. During the late Pleistocene the valley bottom consisted of sedge and grass marsh, with stands of willow (Ritchie *et al.,* 1982). Upland plateaux were vegetated with herbaceous tundra during the late Glacial, but climatic conditions would have been harsher during the full Glacial during which time the high plateaux may have been uninhabitable (Ritchie *et al.,* 1982). The interpretation of the pollen data as indicative of polar desert conditions in the uplands is contested (Guthrie, 1985).

Hypothetical desertification of the highland regions would have resulted in compression of the home ranges of horses in the Bluefish basin, with abandonment of the high summer ranges. If this were so, the mid-slope region around the Bluefish Caves would probably have been inhospitable in winter, and therefore used exclusively as summer ranges. However, incremental data indicate year-round presence of horses at Bluefish Caves, inconsistent with this reconstruction.

The presence of horses at the Bluefish Caves almost year round during the late Pleistocene is consistent with what we know of the behaviour and feeding habits of *Equus caballus* in the wild in habitats like the Granite Ranges of the Great Basin (Berger, 1986). The slopes on which the caves are situated could have constituted part of a normal Fall/Winter/Spring lowland range during the Late and full Glacial, with herds ranging onto the high plateaux during the Summer. Summer deaths near the caves could easily represent early or late seasonal movements between plateaux and valley ranges. During winter, the horses may have descended into the valley to seek shelter among the shrubs and willow stands (as reconstructed by Ritchie *et al.,* 1982). Alternatively, the slopes around the caves, and the caves themselves, may have provided protection (see d'Andrea and Gotthardt, 1984). The lowland marshes would have been avoided in the spring and fall due to biting insects, especially during the relatively warmer late Glacial.

Conclusion

E. lambei is a caballoid, similar to late Pleistocene forms in Europe. The unusually high number of canine teeth present in the Bluefish assemblages is either the result of a rather unusual pattern of predation, or as a possible genetic trait (retention of canines in females) which would then be useful in discriminating *E. lambei* from other late Pleistocene equid populations.

The age profiles for Bluefish Caves show that horse deaths in Cave I may reflect greater carnivore/human activity in the vicinity of this cave. The patterns for caves II and III probably reflect the fact that bone accumulation at the Bluefish Caves was the result of both natural deaths and the activities of several different predators over a long period of time.

The pattern of seasonal mortalities for horse at the three Bluefish caves shows that horses were present in the vicinity of the caves during most of the year. When the probably ethology of *E. lambei* is considered, based on the ethology of *E. caballus* herds living under harsh climatic conditions elsewhere, this has implications for environmental reconstructions around the caves and in the Bluefish Basin.

A year round pattern of horse deaths at Bluefish would be consistent with a pattern of herd movement similar to that observed among horses in the wild today. The area surrounding the Bluefish caves can therefore be considered part of a normal habitat for *E. lambei*. This lends support to the belief that the Bluefish basin was not a marginal habitat, or glacial refugium, during either the full or late Glacial periods. Instead, we must consider the environment of the caves to have been open, steppe-like, and inhabited by a complex fauna during both full and late Glacial periods.

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