

Predator and Scavenger Modification of Recent Equid Skeletal Assemblages¹

A.C. D'ANDREA² and R.M. GOTTHARDT²

ABSTRACT. This paper reports on the modification by carnivores of recent equid skeletal remains in the Ross River area, Yukon Territory. The objective of this study is to characterize carnivore modification of skeletal assemblages in terms of bone alteration, carnivore preference for certain bone elements or portions, and patterns of survivorship of elements at recent kill/scavenging sites. The most common types of carnivore alteration observed were tooth furrows, punctures, and curvilinear fracture on smaller elements. Chipping and polish occurred infrequently. Survival of skeletal elements depends on the degree of carcass utilization. Cranial and axial elements were present at all sites; scapulae, innominates, and limbs were absent or dispersed at well-utilized sites.

Key words: taphonomy, skeletal modification, archaeological interpretation, faunal analysis, wolves, horse kills, southern Yukon

RÉSUMÉ. Les auteurs rapportent la modification par des carnivores de restes squelettiques équidés récents dans la région de Ross River, au Yukon. L'étude vise à caractériser les modifications d'ensembles squelettiques par des carnivores en termes de modification des os, de préférence des carnivores pour certains éléments osseux et des éléments restants à des sites récents d'abattage et d'activité nécrophage. Les types de modifications les plus communément observées étaient les sillons de dents, les trous et les fractures curvilignes sur les éléments plus petits. Les éclats et le poli n'étaient que peu fréquents. Les éléments squelettiques survivants dépendent du degré d'utilisation de la carcasse. Les éléments crâniens et axiaux étaient présents à tous les sites; les omoplates, les os du bassin et les membres étaient absents ou dispersés aux sites très utilisés.

Mots clés: taphonomie, modification squelettique, interprétation archéologique, analyse de la faune, loups, abattage de chevaux, sud du Yukon

Traduit pour le journal par Maurice Guibord.

INTRODUCTION

In October 1982 the recent skeletal remains of five horses (*Equus caballus* L.) were collected from four sites in the area of Ross River, Yukon Territory. Post-mortem modification and disturbance of the skeletal remains was in all cases the result of predation and/or scavenging by carnivores. The objective of this study is to characterize examples of: 1) the kinds of damage inflicted by carnivores on bone; 2) the location of damage on bone elements; and 3) the patterns of survivorship of bone elements at kill/scavenging sites. Investigations along these lines (e.g., Binford, 1981; Bonnicksen, 1979; Brain, 1981; Haynes, 1980a, 1981, 1982, 1983; Hill, 1979, 1980; Morlan, 1980) have contributed to the interpretation of modified bone specimens in known and suspected archaeological contexts. We chose to study these specimens because of our interest in North American collections of Pleistocene age for which the differentiation of the causes of bone modification has posed problems (Binford, 1981; Bonnicksen, 1983; Morlan, 1983; Meyers *et al.*, 1980). The size and specific provenience of this sample requires that one use caution in drawing general conclusions from it. However, observations of bone breakage, apparent carnivore preference for certain bone elements or portions of elements, and consistent patterns of survivorship of elements at recent kill/scavenging sites are important in developing a better understanding of how to interpret the fossil record.

SITE LOCATIONS AND KILL SITUATIONS

Four localities in the Ross River area (Fig. 1) were visited in October 1982, where wolf kills of horses had been reported by the conservation officer, Jerry Michalski, and a local outfitter,

Werner Koser. All the horses belonged to the outfitter who periodically rented them out to sheep hunters. When not in use, the horses ranged freely in the hills outside of the town. Localities 1 and 2, on the Pelly and Ross rivers, respectively, represent wolf kills which were witnessed by the conservation officer in March 1981. The kill circumstances at localities 1 and 2 were similar; in both cases the horses were cornered and brought down on the edges of steep slopes. The conservation officer reported seeing approximately 30 wolves in the area of locality 1 at the time of the kill. Since these kills occurred in late winter, a time when carcasses are usually more abundant than earlier in the year, one would not expect the wolves to have utilized the carcass fully. Full carcass utilization is more common during late autumn and early winter when fewer carcasses are available (Haynes, 1982:270). In the light of a recent increase in the wolf population of southern Yukon, how-

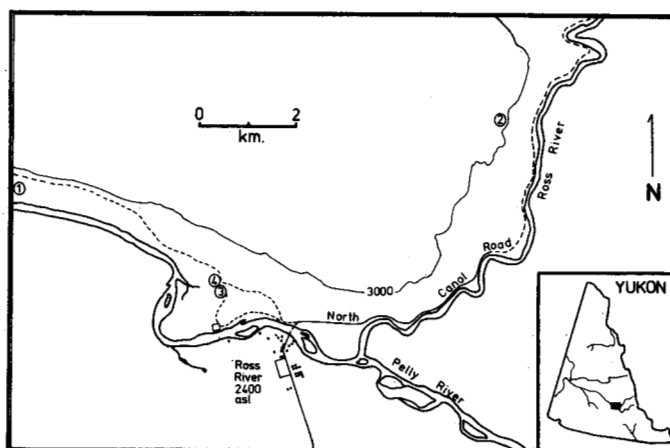


FIG. 1. Location of horse skeletons.

¹Northern Yukon Research Programme Contribution No. 48

²Department of Anthropology, University of Toronto, Toronto, Ontario, Canada M5S 1A1

ever (J. Michalski, pers. comm. 1982) and particularly in view of the large number of wolves sighted in the area of locality 1, "normal" conditions of predator-prey interaction may not pertain.

Localities 3 and 4 are near an abandoned airstrip approximately 1 km from the outfitter's house. The outfitter reported in October 1982 that a mare and foal had been killed in this area "roughly two years ago". The area of localities 3 and 4 normally serves as a garbage dump. Old and infirm horses are also brought there to be shot and the carcasses are left in place to decompose. These activities may have attracted scavengers to the area, resulting perhaps in a higher-than-normal degree of carcass disturbance and element mixing.

We infer that scavenging by wolves (*Canis lupus* L.), bears (*Ursus arctos* L. and *U. americanus* Pallas), and red foxes (*Vulpes vulpes* L.) had occurred at all four sites and that scavenging by dogs (*Canis familiaris* L.) certainly occurred at localities 3 and 4.

The literature on wolf kills indicates that the carcasses of domesticated animals killed by wild carnivores are often only partly consumed; human disturbance of feeding animals is an obvious influencing factor (Pulliainen, 1965:239; Mech, 1970:188; Young, 1944:271). At localities 1 and 2, for example, most of the damage probably occurred in later episodes of scavenging rather than during the actual kill since the wolves were disturbed during the kill and initial feeding.

BONE MODIFICATION BY ELEMENT

The following describes overall patterns of gnawing and fracture for the various skeletal elements in the Ross River sample. The terminology used is after Binford (1981) (see Fig. 2).

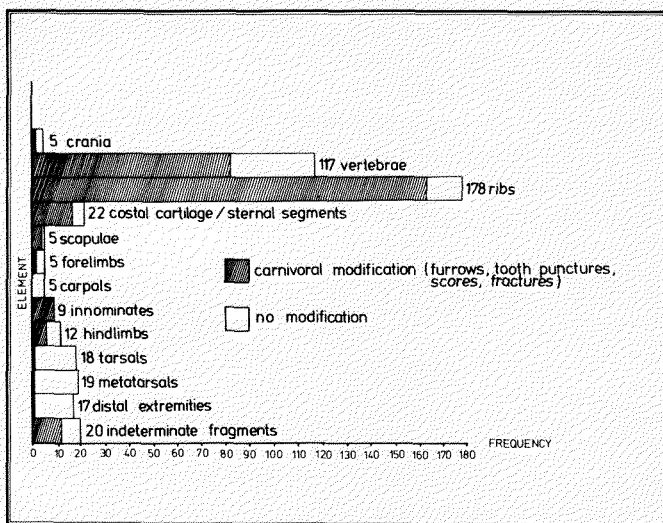


FIG. 2. Representation of skeletal elements and frequency of gnawing by element for the Ross River sample.

Crania

The four complete crania examined were generally untouched except for two instances of tooth furrows on nasal

bones, and light tooth furrows on a mandibular condyle. All mandibles were complete and fully articulated but separated from the rest of the crania.

Vertebrae

A total of 117 vertebrae was collected, of which 82 showed evidence of carnivore modification (primarily tooth furrows and punctures). The spinous processes of thoracic vertebrae were generally well gnawed and broken, with sometimes as much as 50% of the process having been removed, and gnawing on the body of the vertebrae was observed as well (see Binford, 1981:65). Cervical vertebrae were gnawed at the transverse processes, as were the lumbar and sacral vertebrae. Caudal vertebrae were generally absent in the sample, occurring only at the lightly utilized locality 4.

Ribs

Ribs recovered at the four localities were generally well utilized; the greatest fragmentation occurred at the most heavily utilized locality 3, whereas locality 4 had a few complete and unmodified ribs. Modification (gnawing and fracturing) occurs primarily at the distal end where notching (as described by Binford, 1981:66) also is common. Curvilinear fracturing of ribs occurs primarily at the distal end and may be associated with gnaw marks but not necessarily so. Curvilinear fracture was observed on 86 out of a total of 178 ribs and rib fragments, and in 53 cases gnaw marks were not in direct association or were entirely absent. In a few cases, the ribs were reconstructed along the fracture surfaces and, in one instance the tip of a fractured rib was rounded, presumably as the result of being mouthed by a wolf.

Pelves

Feeding by wolves on large ungulates often begins in the rump area (Haynes, 1982:271:Table 1), resulting in generally well-utilized pelves. In the case of the Ross River sample, gnawing occurred on most innominate fragments in the form of isolated tooth furrows and punctures on the tuber sacral, tuber coxae, ischial arch, and the crest of the ilium.

Scapulae

Of the five complete scapulae recovered, four exhibited the characteristic crenulated edges (see Binford, 1981:70) produced by gnawing along the vertebral border. Damage on other parts of the scapulae was not observed.

Humeri

Forelimbs were absent from localities 1, 2, and 3. This is not surprising since the scapula, and hence the entire forelimb, is relatively easily detached from a carcass (Binford, 1981:122). Shallow furrowing was noted on the lateral tuberosity of one of the two complete humeri collected from locality 4.

Radio-Ulnae

No evidence of gnawing in the form of tooth punctures, furrows, or scores was observed on the three complete radio-ulnae examined. One radio-ulna from locality 4, however, was found to have a spiral fracture (Bonnichsen, 1979:70-71) at the distal end with no associated gnawing marks. Gnawing marks may have been present on the proximal end of the specimen but this was not recovered. Alternatively, this fracture may have been caused by natural injury or post-mortem trampling by other horses.

Carpals/Metacarpals

Metacarpals were not present at any site and of the few carpals recovered, none was found to have been gnawed.

Femora

Of the five complete femora examined, three showed evidence of light furrowing on the trochanter major, third trochanter, lateral condyle, and the medial aspect of the trochlea. Since no complete patellae remained at the sites, perhaps the trochlea were scarred in the process of removing this element.

Tibiae

A total of four complete tibiae were examined. One had tooth furrows on the tuberosity and lateral condyle. No fractured tibiae were noted.

Tarsals/Metatarsals

Fracture was observed on one vestigial metatarsal from locality 4. The tuber calcis on a calcaneum from locality 2 was gnawed. This is a common feature of carnivore-gnawed assemblages (Binford, 1981:76; Jourdan, 1976:255).

Phalanges

None of the phalanges was gnawed; however, two hoof coverings from locality 2 were found to have tooth furrows.

SITE SUMMARIES

Haynes's terminology for stages or degrees of carcass utilization is followed in the description of the Ross River bone assemblage. Haynes (1982:275:Table 2) defines light, moderate, full, and heavy utilization of bison carcasses based on the extent to which various skeletal elements have been gnawed. Degree of carcass utilization or scavenging is also reflected by extent of skeletal disarticulation and dispersal (Binford, 1981:207). The actual patterns of bone and bone portion dispersal and survivorship for the four Ross River localities are illustrated in Figures 3-9.

The kill at locality 1 (Figs. 3, 4) can be described as moderately to fully utilized — almost all surviving elements showed some form of alteration by carnivores. No long bones were recovered; these had probably been dragged away by

scavengers. Wolves have been observed to "run several hundred meters carrying an articulated lower limb of a bison" (Haynes, 1982:275). The large number of wolves seen in the area at the time of the kill may have been a factor in the degree of carcass utilization at locality 1. Scavenging by bears is also a possibility, as a bear den was located nearby. The den was not searched for horse remains since it was occupied at the time of our study.

Following Haynes's classification, the kill at locality 2 (Figs. 5, 6) can be considered only lightly utilized. Both hindlimbs were recovered in the kill area and dispersal of elements was comparatively limited.

Locality 3 (Figs. 7, 8), in the vicinity of the outfitter's residence, contained the remains of an adult horse shot by the outfitter. The skeletal remains were the most fragmentary and widely dispersed of all the Ross River samples. The degree of scavenging at locality 3 does not conform to the expected pattern of wolf scavenging described by Haynes (1982:268), who states that scavenged carcasses of bison and moose are not usually as heavily utilized by wolves as are those of actual kills. The fact that dogs were the primary scavengers at locality 3 probably accounts for the dispersed nature of the remains. Dogs spend more time scavenging opportunistically than do wolves in packs, who prefer to hunt live prey (Haynes, pers. comm. 1984).

At locality 4 (Fig. 9), which is used by the outfitter as a disposal area for horse carcasses, the skeletal remains of at least six horses were found. The two individuals (one adult and one juvenile) that were collected showed evidence of post-mortem disturbance. The foal was reported by the outfitter as a wolf kill. Evidence of ankylosing spondylitis on the posterior thoracic and anterior lumbar vertebrae, together with healed fractures and osteoarthritis of ribs, was noted on the adult. This individual may have been shot by the outfitter. Disturbance of the skeletal remains of these two individuals was moderate; however, the degree of damage to the bones indicates only light utilization of the carcasses. Again, dogs were probably the major scavengers. Light utilization of the locality 4 carcasses, compared to that seen at locality 3, suggests that scavengers were deterred by the presence of other carcasses in more advanced stages of decay.

SUMMARY AND DISCUSSION

A few summary statements can be made concerning the observed patterns of modification and disarticulation of horse carcasses by wolves in the Ross River area:

- 1) Tooth furrows, punctures, and, more rarely, scoring are the primary types of carnivore modification;
- 2) Few occurrences of chipping and flaking were observed on fracture surfaces;
- 3) Many instances of curvilinear fracture were observed on smaller elements (e.g., ribs). Curvilinear fracture occurred less commonly on long bones; and
- 4) Rounding and abrasive polishing occurred rarely.

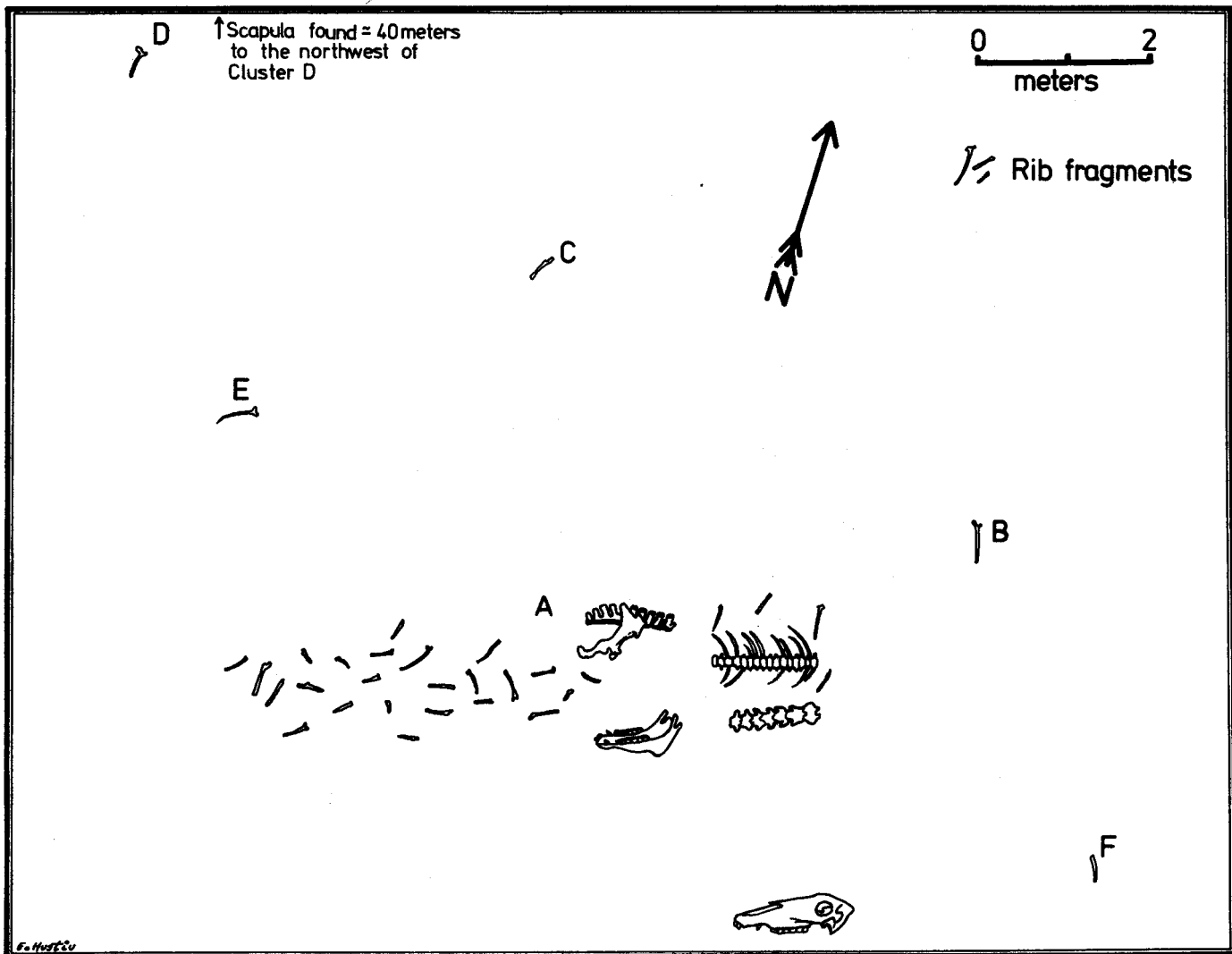


FIG. 3. Distribution of skeletal remains at locality 1.

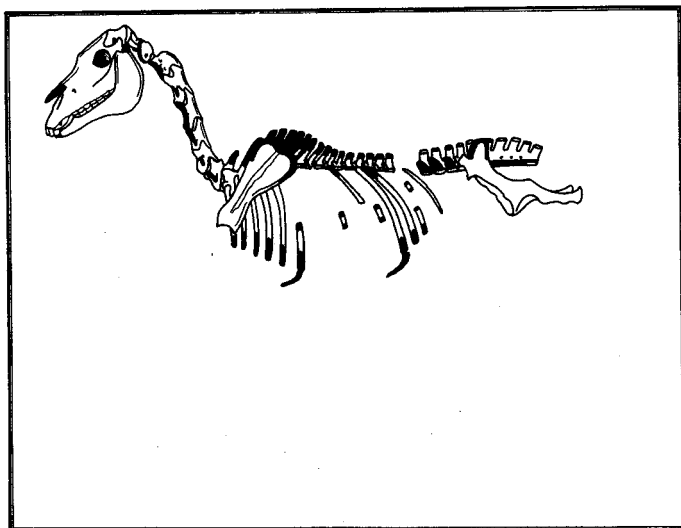


FIG. 4. Carnivore modification of skeletal remains at locality 1. The shaded areas represent locations at which carnivore gnawing was observed.

Modification was observed most commonly on:

- 1) bones with thin cortex such as ribs and scapulae;
- 2) processes and tuberosities; and
- 3) epiphyses of long bones.

Excluding the data from locality 4 (an anomalous situation because of abundant carcass remains), general patterns of element distribution of the skeletal remains were:

- 1) Cranium and cervical vertebrae generally in close proximity but not articulated;
- 2) Thoracic cage with attached ribs, sometimes with one or two posterior cervical or anterior lumbar vertebrae attached;
- 3) Lumbar vertebrae/sacrum/pelvis with a few posterior thoracic vertebrae and (rarely) caudal vertebrae attached;
- 4) Scapulae almost always detached and frequently far removed from the original carcass location; and
- 5) Hindlimbs and forelimbs usually absent at well-utilized sites; scattered ribs and rib fragments represent either the original carcass location or individual gnawing areas.

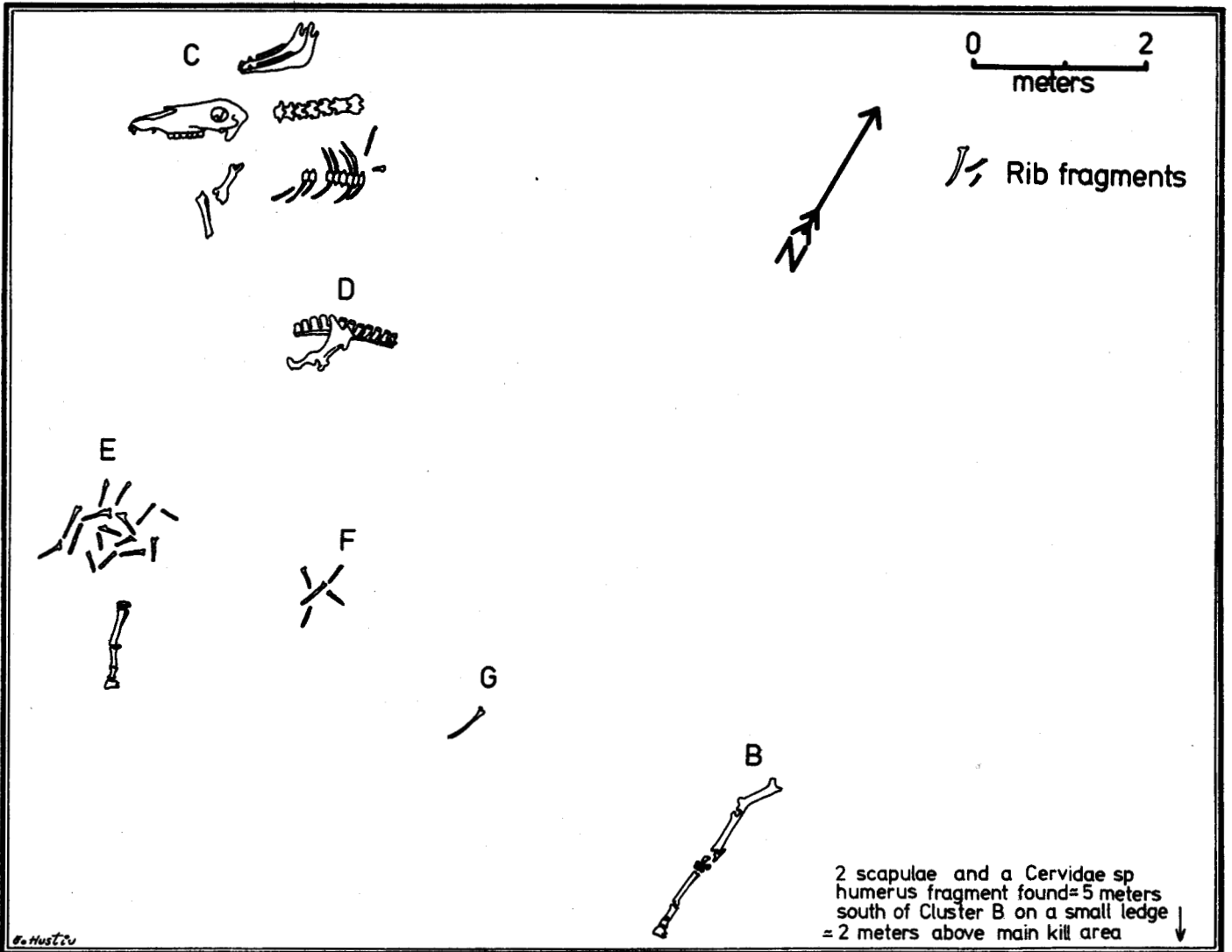


FIG. 5. Distribution of skeletal remains at locality 2.

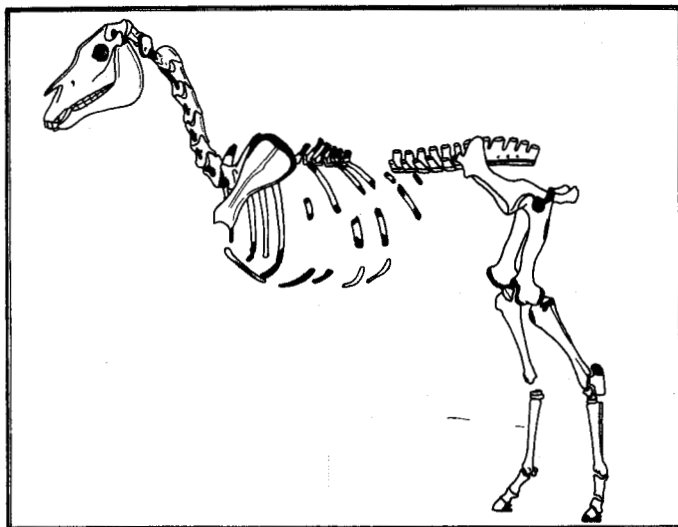


FIG. 6. Carnivore modification of skeletal remains at locality 2. The shaded areas represent locations at which carnivore gnawing was observed.

From this sample, the major components of kill/scavenging sites appear to be cranial and axial elements. Scapulae are generally widely scattered and limb bones are, in most cases, absent. The pattern of disarticulation observed at the Ross River sites is most similar to that described by Haynes (1982:269ff) for moose (*Alces alces*) and white-tailed deer (*Odocoileus virginianus*), where few limbs remain attached to the carcass, the vertebral column is highly segmented, and skeletal elements are widely scattered. Somewhat different patterns of disarticulation have been observed by Haynes for the larger carcasses of bison (*Bison bison*) (1982:269ff).

As has been noted above, many of the modifications observed on the Ross River horse bones (e.g., tooth furrows, tooth punctures) and their locations are quite similar to descriptions given by Binford (1981) and Haynes (1982). A study by Jourdan (1976:254-257) also addresses the problem of carnivore modification of horse bones excavated from La Bourse, a second-to-fifth-century A.D. archaeological site in Marseilles. The midden at La Bourse yielded a wide variety of faunal remains that had been gnawed by dogs. Jourdan describes the alterations on the skeletal remains of 41 horses

(*Equus* sp.) and asses (*Asinus* sp.), primarily pinpointing the location of gnawing on various elements, particularly limbs. Although the gnawing appears to be more intense than that observed on the Ross River specimens, it occurs on the same parts of bones, most significantly the nasal bones and the ascending ramus of the cranium, the vertebral border and the coronoid process of the scapula, the proximal ends of the humerus, radius, and tibia, the iliac crest and pubic symphysis of the innominate, and the proximal and distal ends of the femur. It is interesting that none of the long bones described by Jourdan was fractured as the result of carnivore action. With the exception of one specimen (locality 4) where cause of fracture cannot be established with certainty, this is also the tendency in the Ross River sample.

We conclude with the observation that in this study the nature of most bone modification by modern northern carnivores is distinctive and consistently patterned. A few occurrences of polish, chipping, and curvilinear fracture not associated with evidence of gnawing are types of modifications deserving closer attention, particularly in view of the degree of overlap with some forms of human modification of bone postulated for collections of Pleistocene age. Comparisons are underway of carnivore modifications described in the Ross River equid sample and in other published reports with the Pleistocene equid collections at the Northern Yukon Research Programme (N.Y.R.P.), University of Toronto. A prelimin-

ary analysis of the equid collections at the N.Y.R.P. laboratory, undertaken by Yorga (1982), attempted to describe patterns of green-fracturing and gnawing on various skeletal elements. Many of the Old Crow fossil equid bones have definitely been modified by carnivores. The patterns observed on radio-ulnae, metacarpals, and metatarsals, however, do not fit the observed patterns of bone modification by carnivores as described by Binford (1981) and Jourdan (1976). In the Old Crow equid collections many fractured surfaces were observed without associated evidence of carnivore gnawing (Yorga, 1982:45-64). Possibly the bone modification activities of some of the larger Beringian carnivores (*Arctodus simus* Cope, *Homotherium serum* Cope, *Panthera leo* L.) have resulted in patterns of damage markedly different from those inflicted by modern canids. Bonnichsen (1973), for example, has observed the disinclination of large cats to gnaw bone. Breakage of long bones in this case need not be associated with numerous tooth marks. At this stage of investigation, other potential agencies of bone modification (trampling, accidental fracture in life, fluvial processes, and human agency) should also be considered to explain this observed pattern.

ACKNOWLEDGEMENTS

The bones in this study were identified and analyzed using comparative collections in the Howard Savage Faunal Osteoarchaeology Laboratory in the Department of Anthropology, University of Toronto. We would also like to thank H.G. Savage for his help in describing the pathological specimens and the *Canis* sp. remains. W.N. Irving provided laboratory facilities and additional funding for this study and we gratefully acknowledge his support. We would also like to express our thanks to Emil Hustiu who drew the figures and to Maryjka Michajlowycz who helped with the identification of some elements. We thank G. Haynes for a brief but informative discussion.

The field portion of the study was supported by the Department of Indian and Northern Affairs, Northern Scientific Training Grants (University of Toronto). Jerry Michalski and Werner Koser of Ross River provided invaluable assistance in locating the horse remains in the field. Special thanks are in order to Ingrid Kritsch-Armstrong and Laurence A. Pavlish who commented on various drafts of the manuscript.

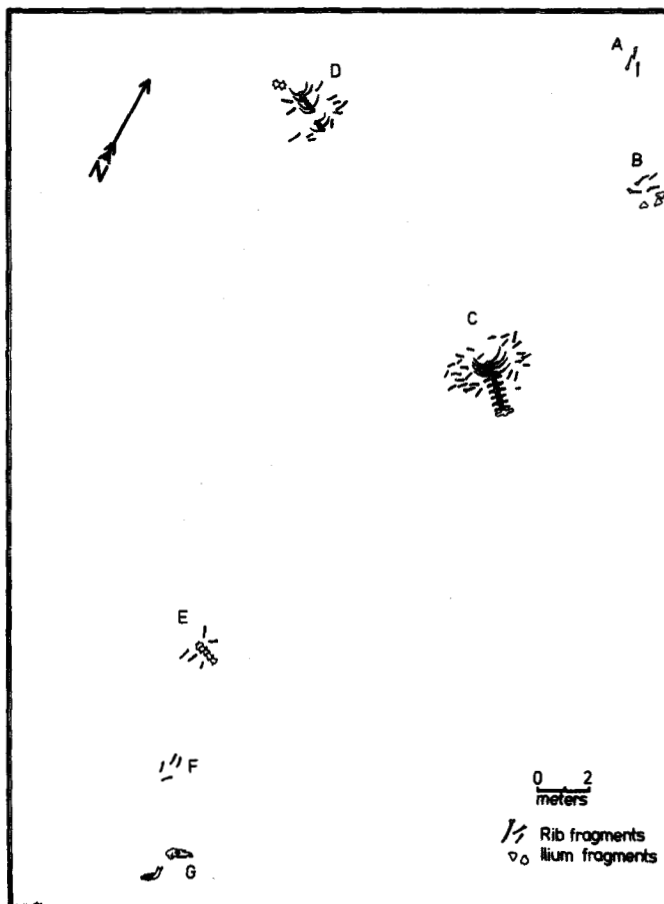


FIG. 7. Distribution of skeletal remains at locality 3.

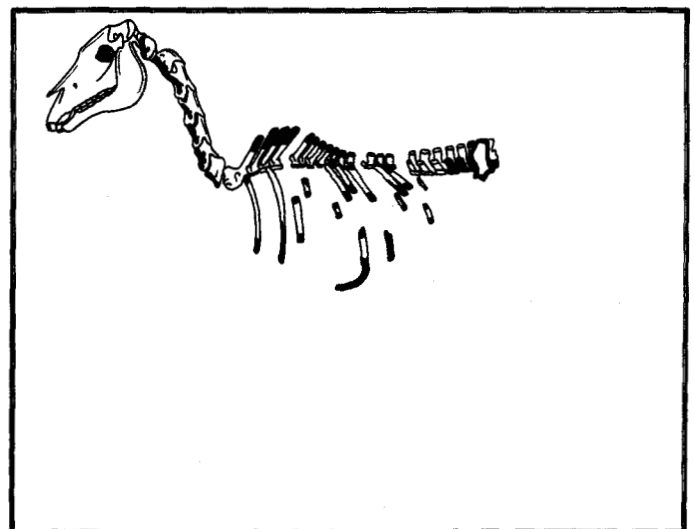


FIG. 8. Carnivore modification of skeletal remains at locality 3. The shaded areas represent locations at which carnivore gnawing was observed.

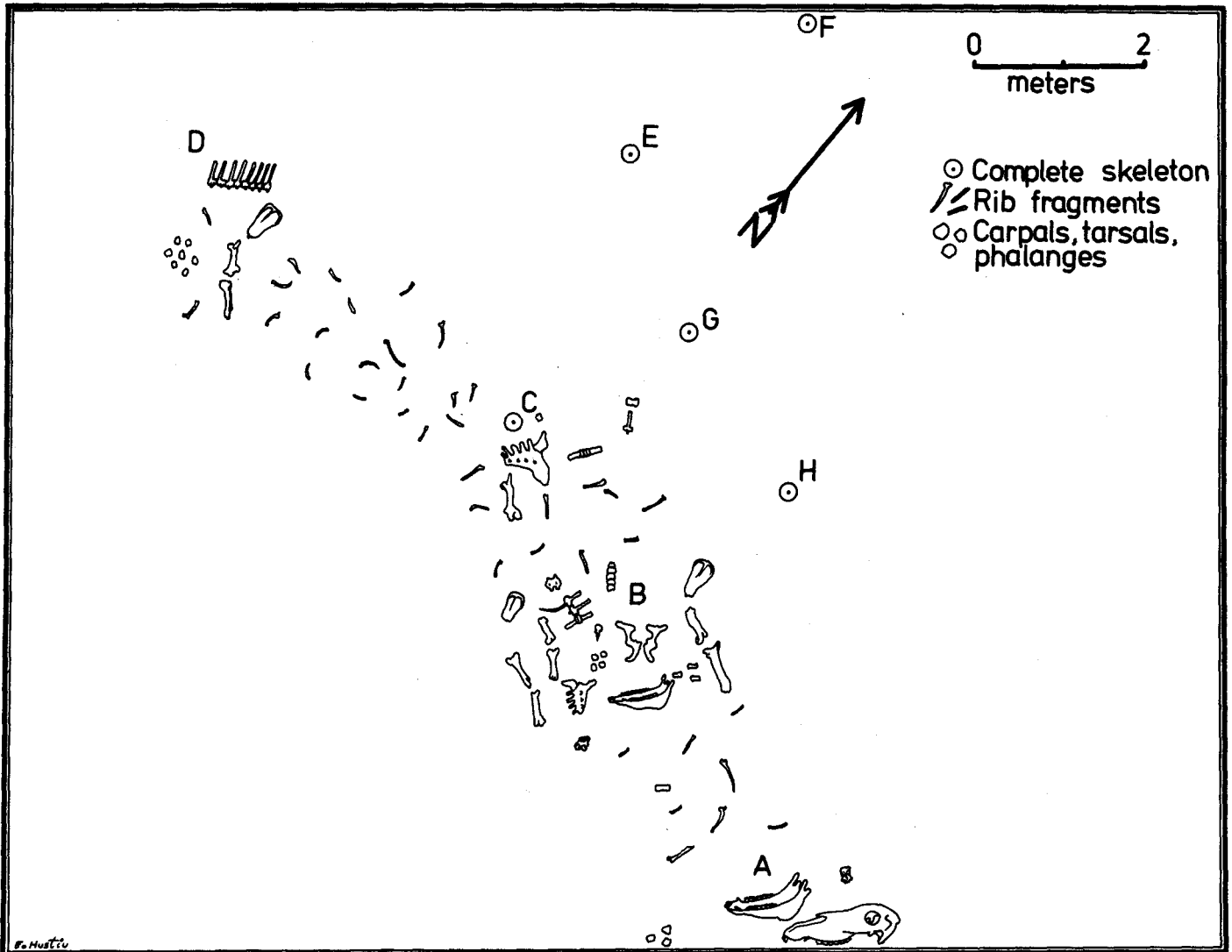


FIG. 9. Distribution of skeletal remains at locality 4.

REFERENCES

- BINFORD, L.R. 1981. *Bones: Ancient Men and Modern Myths*. New York: Academic Press. 320 p.
- BONNICHSEN, R. 1973. Some operational aspects of human and animal bone alteration. In: Gilbert, M. (ed.). *Mammalian Osteo-Archaeology: North America*. Columbia, MO: Missouri Archaeological Society. 9-24.
- _____. 1979. Pleistocene Bone Technology in the Beringian Refugium. *Archaeological Survey of Canada Paper No. 89*. 297 p.
- _____. 1983. The broken bone controversy: some issues important for the study of early archaeological sites. In: Lemoine, G. and MacEachern, A. (eds.). *Carnivores, Human Scavengers and Predators: A Question of Bone Technology*. Proceedings of the Fifteenth Annual Conference, The Archaeological Association of The University of Calgary, Calgary. 271-284.
- BRAIN, C.K. 1981. *The Hunters or the Hunted?* Chicago: University of Chicago Press. 365 p.
- HAYNES, G. 1980a. Prey Bones and Predators: Potential Ecologic Information from Analysis of Bone Sites. *Ossa* 7:75-97.
- _____. 1980b. Evidence of Carnivore Gnawing on Pleistocene and Recent Mammalian Bones. *Paleobiology* 6(3):341-351.
- _____. 1981. Bone Modifications and Skeletal Disturbances by Natural Agencies: Studies in North America. Unpublished Ph.D. thesis, Department of Anthropology, Catholic University of America. 527 p.
- _____. 1982. Utilization and skeletal disturbances of North American prey carcasses. *Arctic* 35(2):266-281.
- _____. 1983. Frequencies of spiral and green-bone fractures on ungulate limb bones in modern surface assemblages. *American Antiquity* 48(1):102-114.
- HILL, A.P. 1979. Disarticulation and scattering of mammal skeletons. *Paleobiology* 5(3):261-274.
- _____. 1980. Early postmortem damage to the remains of some contemporary East African mammals. In: Behrensmeyer, A.K. and Hill, A.P. (eds.). *Fossils in the Making*. Chicago: University of Chicago Press. 131-152.
- JOURDAN, L. 1976. *La Faune du Site Gallo-Romain et Paléo-chrétien de la Bourse (Marseille)*. Marseille: Editions du Centre National de la Recherche Scientifique Aix-Marseille. 338 p.
- MECH, L.D. 1970. *The wolf: The Ecology and Behaviour of an Endangered Species*. New York: Natural History Press. 348 p.
- MEYERS, T., VOORHIES, M., and CORNER, R. 1980. Spiral Fracture and bone pseudotools at paleontological sites. *American Antiquity* 45(3):483-489.
- MORLAN, R.E. 1980. *Taphonomy and Archaeology in the Upper Pleistocene of the Northern Yukon Territory — A Glimpse of the Peopling of the New World*. *Archaeological Survey of Canada Paper No. 94*. 398 p.

- _____. 1983. Spiral fractures on limb bones: which ones are artificial? In: Lemoine, G. and MacEachern, A. (eds.). *Carnivores, Human Scavengers and Predators: A Question of Bone Technology*. Proceedings of the Fifteenth Annual Conference, The Archaeological Association of The University of Calgary, Calgary. 241-270.
- PÜLLIÄINEN, E. 1965. Studies of the Wolf (*Canis lupus* L.) in Finland. *Annales Zoologici Fennici* 2:215-259.
- YOUNG, S.P. 1944. *The Wolves of North America*. Part 1. Washington, D.C.: American Wildlife Institute. 285 p.
- YORGA, B.W.D. 1982. Quantitative Analysis of Fossil Bone Materials from Northern Yukon Research Programme Collections. Unpublished manuscript on file at the Northern Yukon Research Programme Laboratory, Department of Anthropology, University of Toronto, Toronto, Ontario M5S 1A1. 185 p.