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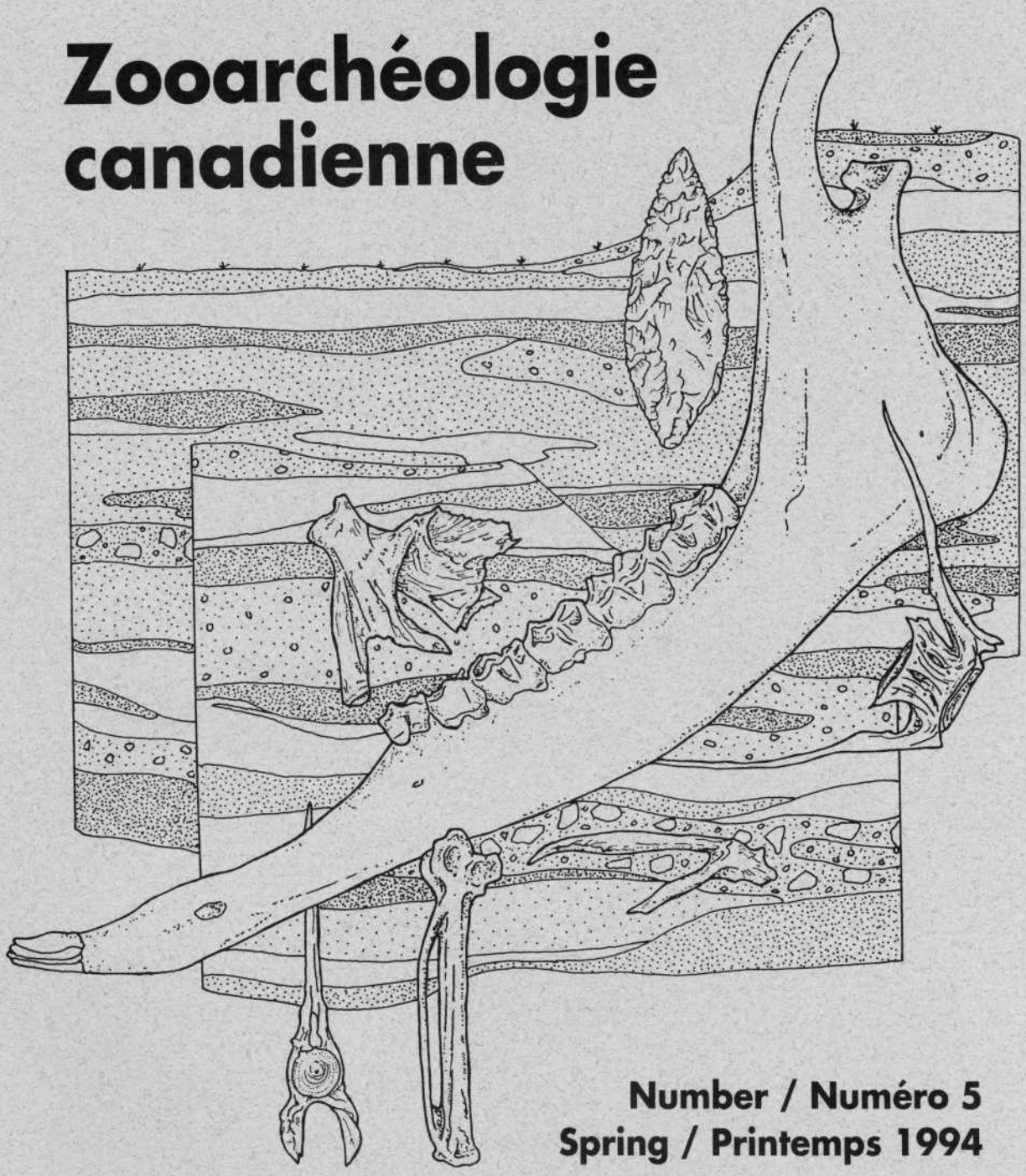

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EDITOR'S NOTE/NOTE DE L'EDITEUR

It's spring! - rather long in coming for we snow-bound easterners, but early for those on the west coast! Spring means the CAA Conference, held this year in Edmonton, and I would like to draw attention to the Zooarchaeology session, held 9 am to 12 pm on Thursday, May 5.

In this issue of *Canadian Zooarchaeology* we continue our series on regional histories of zooarchaeology, with an article on the Canadian Arctic by Chris Darwent. As Chris points out, the inaccessibility of many northern sites makes transport and complete analysis of fossil faunal material very difficult, and early archaeological reports often consisted only of laundry lists of species. However in the past 20 years, much more detailed analyses of fauna have been undertaken, as well as innovative methodologies specific to northern faunas.

My thanks to all of you who are *CZ* subscribers; please continue to support us in future years. In September we will put a call out for short biographies and publications of zooarchaeologists in Canada,to be published in Spring 1995. My thanks to Donna Naughton who has worked as editorial assistant.

Kathlyn Stewart, Editor

Canadian Zooarchaeology is published twice a year at the Canadian Museum of Nature. News, letters, articles, books or papers for review should be sent to:

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ZOOARCHAEOLOGICAL ANALYSIS IN THE CANADIAN ARCTIC

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Only within the last twenty years has the analysis of faunal remains been included as an integral part of an arctic archaeological project. This paper will explore the contributions made by zooarchaeologists to the understanding of subsistence and behavioral patterns in the Canadian Arctic.

Paleoeskimo Research

Paleoeskimo occupation of the Canadian Arctic began approximately 4000 years ago and "disappeared" with the influx of the Thule culture roughly 1000 years ago. The remains of this cultural period are characterized by a tool kit of very small lithic artifacts appropriately named the Arctic Small Tool tradition (ASTt). ASTt can generally be subdivided into the Independence I Stage (4000-3700 B.P.), the Pre-Dorset (3700-2800 B.P.), and the Dorset (2700-1000 B.P.).

Independence I sites range from Cornwallis Island to Independence Fjord in northern Greenland (Maxwell 1985, Dumond 1987, Schledermann 1990). Faunal remains from Independence I sites are rare. Four Independence I sites on the Bache Peninsula region of Ellesmere Island have yielded a total of 16 bones which includes ivory chips (Schledermann 1990). Other Independence I sites have been reported for the North Devon Lowlands region (Helmer 1991, P. McCartney 1989), although the faunal remains were virtually unidentifiable.

At Port Refuge on Devon Island, the Cold and Upper Beaches components have yielded a more complete picture of the faunal resources for this period (McGhee, 1979). A list of the number of specimens identified, minimum number counts and weight of unidentifiable bones were presented. Seal remains comprise over 90% of the Cold component assemblage. Virtually all seal elements were recorded, suggesting the animals were brought back to the sites for processing. Very few cut marks were noted, with the exception of nicks near some of the articular ends. The Upper Beaches assemblage was much smaller due to the scarcity of midden deposits and the limited amount of excavation which was done (McGhee 1979). The material from this component was identified under contract by L. Leigh Field with the assistance of Howard Savage of the University of Toronto. The list of NISP's and MNI's indicate that this component was occupied for a shorter period of time with the remains consisting primarily of waterfowl, and secondarily arctic fox.

The amount of archaeological information increases substantially during the Pre-Dorset, although faunal reports continue to be meager. According to Maxwell (1985) the range of fauna exploited by the Pre-Dorset people depends on the region of occupation. He also defines a "core area" in the vicinity of Baffin Island, Hudson Strait, Foxe Basin and Labrador for the development of Pre-Dorset and Dorset, since the diversity and persistent quantity of animals in this region is such that food could be acquired with reasonable amounts of labour (Maxwell 1985:81).

Faunal analyses from three sites on

the Bache Peninsula "indicate no particular departure in subsistence practices from earlier ASTt occupations, with sea mammal hunting continuing to provide the primary food source for the population" (Schledermann 1990:119). However, the information presented by Schledermann (1990) does not go beyond a list of species present, so it would be difficult to interpret past behaviour. A similar pattern of exploitation was also seen at the Pre-Dorset settlement of Seahorse Gully, near Churchill Manitoba (Meyer 1977). The faunal remains analysed by H. Savage demonstrated the predominant exploitation of ringed seal.

Research at the Lagoon site on Banks Island provides a much more extensive examination of Pre-Dorset faunal remains. Arnold (1980, 1981) presents both raw counts of the species recovered (NISP), and calculates the minimum number of individuals (MNI) from 859 identifiable pieces of bone from one area of the site. This faunal assemblage is dominated by bird remains, with Canada and Snow Geese being the most common species (Grant-Francis 1979). An early summer occupation of the site is indicated by the presence of medullary bone in at least four goose long bones. Since at least 40% of the ringed seal were immature when killed, Arnold (1980, 1981) speculates that it may reflect lead ice hunting, likely during late spring or early fall (when open water leads are more common). Much of the muskoxen remains were smashed into small pieces, probably to facilitate grease extraction. The other interesting aspect of this assemblage is the presence of a possible pack dog represented by three vertebrae from the lower back with flattened spinous processes and severe osteophytoses (Arnold 1979). Arnold also indicates the location of cut marks on muskoxen remains as a means of reconstructing the method of carcass reduction (1981). Differential preservation of elements based on their presence or absence is also examined, in order to explore possible butchering practices and taphonomic processes.

Over 7000 identifiable faunal specimens, dominated by small seal, were recovered from the Early Pre-Dorset occupation of the Icebreaker Beach complex of the North Devon Lowlands (Helmer 1991, P. McCartney 1989, P. McCartney and Helmer, 1989). Analyses of the faunal material revealed no variation in species composition between features. Following the work of Spiess (1976) and Bourque, Morris and Spiess (1978), seal tooth thin sections were examined in order to determine the active period of hunting from the sites on Devon Island. This technique was first used on ringed seals in the Eastern Arctic by wildlife biologists studying their behavior (Smith 1973). A comparative collection of archaeological teeth, and teeth of known age, from various areas in the Arctic, was built up by Sterling Presley of the Archaeological Survey of Canada. Presley (1987 in P. McCartney 1989) prepared and read the dental thin sections for this project, and was able to determine the year and month of death to within one month on either side. Based on his results, hunting appears to have continued virtually throughout the year, with the most active period occurring in August and November. Features may have been occupied at different seasons of the year and more than once (Helmer 1991).

Similar results from a Middle Pre-

Dorset settlement at the Twin Ponds complex (Helmer 1991, P. McCartney 1989), attests to the dependence on small seals during various seasons of the year, with little or no difference between site and feature variation.

This study of the zooarchaeological remains on Devon Island appears to be the only Paleoeskimo faunal study which has attempted to use weathering characteristics "in an attempt to gain some quantitative control over the likely rates of bone loss affecting assemblages" (P. McCartney 1989). The application of ordinal weathering stages appears in this case to have yielded ambiguous results.

Independence II (divided into Late Pre-Dorset/Transitional/Early Dorset stages by Schledermann, 1990) occupations at Port Refuge, Devon Island, were dominated by ringed seal (McGhee 1981). Following the aging criteria established by Cox and Spiess (1980) during their research on Dorset and Thule sites on the central Labrador coast, McGhee (1981) examined the degree of fusion of seal humeri. He found that the occupants of the Lower Beach site were likely hunting at the ice edge throughout the year, due to the low proportion of adult humeri, rather than at the winter breathing holes. Sectioning of the seal teeth was carried out by Presley of the A.S.C., who determined the hunts to have occurred primarily in the spring and summer. Statistical analysis of seal long bones indicated that the seals at the Lower Beach component were somewhat larger than those from the Independence I Cold site at Port Refuge. He suggests that these differences may be due to changes in the local climate and ice conditions between Independence I and II in this region (McGhee 1981:32).

Mary-Rouselliere (1976) has compared the percentage of faunal remains found at several sites in Northern Baffin Island from Early, Middle and Late Dorset, as well as Early and Late Thule. Based on the relative frequencies of species present in this region, there appears to be an increase in the pursuit of small seals during the Middle Dorset as opposed to a more generalized terrestrial and marine adaptation by the Early and Late Dorset. The contrast between Dorset and Thule is marked by an increased exploitation of whale by the Thule culture. Seasonality at these sites appears to be only tentatively assigned.

Early Dorset occupation of the Crozier Strait region was extensively studied by Helmer (1981) on Karluk Island, and Markham Point in the Central High Arctic. Small seal and musk-ox dominated theses assemblages. The relative occurrence of skeletal elements was calculated for those species considered to be of greatest economic importance based on bone counts and MNI determinations. The results indicated that butchering units for musk-ox were preferentially selected and returned to the camp, whereas, there was an almost equal representation of bone elements for seals. An examination of cut marks and bone fracture patterns was not studied extensively, however, Helmer (1981) mentions that marrow extraction had likely been performed on the ungulate remains. There were no indications of occupation during the long winter months, but this may have been due to small sample size, or they may have spent this time out on the sea ice (Helmer 1981:258).

From this same time period on the Bache Peninsula, on Ellesmere Island,

Schledermann (1990) reports similar bone frequency counts from three sites. He speculates that the "schlepp effect" (Daly 1969) may factor into the low frequency of walrus remains at the Shelf site relative to other sites in the area, suggesting a summer/fall occupation with the majority of the walrus bones being left in the vicinity of the kill. However, this interpretation is based exclusively on the relative number of specimens.

Faunal remains from the Middle Dorset occupations of the Eastern Arctic seem to have been more extensively analyzed. I believe this is due more to the interests of the researchers, rather than a larger quantity or quality of bone material.

The faunal remains from the Middle Dorset period Nanook site from the Lake Harbour region of Southern Baffin Island, were examined intensively by Arundale (1976). Some of the material was analyzed in the field based on notes and sketches, and in some cases with Inuit assistance, due to "logistical limitations" (Arundale 1976:214). Elements which could not be identified with certainty, along with all avian remains were analysed in the laboratory. The results of this study demonstrated differential transport to the middens; small seal remains tended to be more complete with larger animals disarticulated elsewhere (e.g. caribou were only partially transported from the kill). Shallow knife marks were rarely found on the bone, with virtually all cuts located on the pelvic-femoral joint. All of the ungulate remains, down to the phalanx, were cracked for marrow. This analysis provides one of the first complete lists of bird remains from a Dorset midden. As well, it examines the completeness of elements in order to study the economic or natural factors which may have influenced the site composition, taking into account biases due to recovery and identification techniques (Arundale 1976).

Extensive seasonality studies using dental annuli analysis were performed at sites along the Northern Labrador coast (Cox and Spiess 1980, Spiess 1976, Spiess 1978, Jordon 1980). Studies by Spiess (1978) on Koliktalik 1, House 1 demonstrated the primary use of *Phoca sp.* (which includes *P. hispida*, *P. groenlandica*, and *P. vitulina*), examined population demographics using epiphyseal union, determined element frequencies, and estimated the total meat and blubber content for the minimum number of individuals of the various taxa. He further relates this meat information to the minimum amount of protein needed *per diem*, based on modern analogy and ethnographic meat consumption, in order to calculate average meat intake. However, this extrapolation seems rather speculative.

The faunal remains recovered from the Northern Labrador Middle Dorset site of Avayalik Island were analysed by A. Spiess (mammalian) and S. Olson (avifauna) (Jordon 1980). Their results revealed a heavy reliance on walrus and small seal, with very little use of bearded seal, fox, polar bear, caribou and small whale. Numerous species of bird were also recovered, including the extinct great auk. Results from tooth sectioning data suggest an occupation beginning around March and extending throughout the open-water period in late summer (Jordon 1980:618).

Another Middle Dorset site, Akulialuk, along the Northern coast of Labrador was also excavated during

Torngat Project surveys (Cox and Spiess 1980). The Akulialuk midden was "essentially a solid mass of bird bones, with an occasional seal bone interspersed here and there" (Cox and Spiess 1980:662).

Faunal remains from eight Late Dorset sites in the region of the Bache Peninsula, reveal varying amounts of bone recovered (Scheldermann 1990). Small seals, birds and at some sites arctic fox, tend to be the dominant species exploited. Several fish bones were also discovered at a number of sites, which seems to be a rare find in the High Arctic.

The Late Dorset Shorty site on Southern Baffin Island, yielded nearly 500 animal bones, although not one piece of worked organic material was found (Maxwell 1985:234). The vast majority of remains were of ringed seal, with a considerable number being neonates or yearlings, suggesting the specialized capture of young seals. As well, seasonality was suggested to be late spring/summer based on the remains of duck. However, the ability to cache food remains may bias the estimation of site seasonality.

Faunal reports for the Paleoeskimo sequence of the Eastern Arctic, particularly the Canadian High Arctic are scanty. Most zooarchaeological studies have consisted of the identification of species, although some studies have listed elements and portions, and occasionally they have presented a minimum number count. Many researchers have also attempted to assign a tentative seasonality. Due to the ability to cache or store the meat, many authors have expressed their misgivings about assigning a season of occupation to a particular site (e.g. P. McCartney 1989). More recently dental annuli studies of seal (Spiess 1976, 1978, Jordon 1980, McGhee 1981, McCartney 1989) and muskoxen (Savelle and Beattie 1983) have increased the accuracy of seasonality estimates for Paleoeskimo sites.

Butchering and carcass utilization studies on a Dorset house feature from Phillip's Garden, Port au Choix, Newfoundland, has allowed for the examination of more than just the number of specimens present (Murray 1992). This assemblage consisted of over 98% harp seal remains, with evidence of whole carcass utilization and open water early winter sealing. Other studies from the Dorset period have examined the spatial and stratigraphic distribution of faunal remains (Julien 1980). A cycle of annual resource exploitation and seasonal occupation at Diana Bay in Arctic Quebec was observed using this analytical technique.

Neoeskimo Research

The initial expansion of the Thule culture appears to have taken place about 1000 years ago, originating in the vicinity of Alaska. A further marked expansion in population and geographic extent of the Eastern Thule took place presumably between the twelfth and fourteenth centuries A.D. (Maxwell 1985:261). This "Classic" Thule phase is marked by the appearance of permanent stone, sod and whalebone semi-subterranean houses. After the fourteenth century, following a colder period, whaling tends to decline (Schledermann 1979).

The analysis of Thule faunal remains began with the work of Therkel Mathiassen during the Fifth Thule Expedition, 1921-24 (Mathiassen 1927).

This Danish archaeologist recorded the number of bones excavated from various houses and refuse piles at the site of Naujan on the north coast of Repulse Bay (which separates Melville Peninsula from the mainland), and the sites of Mitimatalik and Qilalukan near "Ponds Inlet" on northern Baffin Island. Small isolated samples of the most easily recognizable specimens were collected from select features and strata in order to "give an idea of the animals that were hunted" (Mathiassen 1927:84). Mathiassen was assisted in his identification of the species by M.A. Degerbol of the Zoological Museum of the University of Copenhagen. An economy based primarily on the hunting of large baleen whales was first defined by Mathiassen, and it is this facet of Thule culture which is often the focus of later zooarchaeological research.

Following the work of Mathiassen, Collins (1955, 1956) and Taylor (1960), included a species list of the faunal material recovered from sites on or near Southampton Island. However, the identification of elements, or the number of bones recovered within a particular house feature, was not noted. Taylor and McGhee's excavations in the vicinity of Creswell Bay on Somerset Island in the early 1960's also contributed a list of the number of specimens represented at Trench 7 of the Learmonth site by unit and level (1979), but no interpretation of the material was put forth.

During the late 1960's research was carried out on the island of Silumiut (near Mathiassen's type site of Naujan) and an extensive analysis of over 45,000 very well preserved faunal specimens was undertaken in order to "characterize classic Thule sites of the Northwest Hudson Bay region" (Staab 1979:350). Due to its weight and bulk, structural whale bone was left behind at the site. Staab (1979) identified the species, elements and portions of elements recovered from the site, as well as calculated the minimum number of animals represented and possible quantity of meat available for consumption. Very few cut marks were encountered, likely due to the sharp but not heavy implements (e.g. slate, iron, copper) used by Thule people. There was also an indication of the occasional consumption of domestic dog. The season of the hunt and age of the game was based tentatively on suture closures and tooth wear.

Faunal material was identified in the field during excavation of a Thule site in the region of Cumberland Sound, Baffin Island (Schledermann 1975). The remains of test excavations on three midden deposits and one house were identified by Schledermann, with the assistance of Kanea Eetooangat. A list was made of the relative number of species present (bird was not identified below the class level, with the exception of Canada Goose) and the minimum number of animals represented within each level. Due to the nature of this analysis very little interpretation of the behavior could be attempted.

Beginning in the late 1970's the amount of research into subsistence patterns of the Thule culture increased dramatically. Interest rose in the study of both cetacean (A. McCartney 1980), and non-cetacean remains (Rick, 1980). Due to the enormous size of bowhead whales, Thule hunters would likely have butchered the animal and transported only select pieces back to the settlement. McCartney and Savelle (1985) examined

the distribution of bowhead whale elements on Somerset Island, and measured various elements in order to estimate the size of animals being culled. This enabled the examination of subsistence-settlement patterns and the differentiatiation of "major Neoeskimo ecological adjustments to the Canadian Arctic" (McCartney and Savelle 1985:53). A recent publication by Gerlach et al. (1993) enables the use of scapula measurements to estimate the size of a bowhead.

Savelle has also offered a cultural-ecological approach to the examination of faunal remains in the Central Arctic (1987). This subsistence-settlement analysis involved the documentation of Neo-eskimo hunter-gatherer mobility strategies and their relation to the location of resources, as the availability of these resources change over time (due to climatic shifts), and as technology changed. Faunal material was analysed in the laboratory from a recent site at Union River on Somerset Island, and from the Malerualik Thule site on King William Island. Material from other sites in this region were analysed in the field, with sided caribou and seal mandibles retained for tooth sectioning. Early Classic Thule residential sites tended to be located near major caribou crossings, whereas, later historic sites tend to shift to a greater emphasis on sealing. Further research has expanded on Savelle's (1987) model of the subsistence economy of the Thule culture in the Central Arctic (Savelle and McCartney 1988). Under the direction of Savelle, Whitridge (1992) has used a linear programming model to analyse optimal subsistence-settlement strategies, taking into account the need to procure raw material as well as food (Whitridge 1992).

Although the amount of whalebone found at Thule occupations is impressive, their staple diet consisted of the exploitation of a wider variety of resources, such as pinnipeds and birds, than Dorset people living in the same areas (Rick 1980, Maxwell 1985). Excavation of the Cape Garry site and retesting of the Learmonth site on Somerset Island under the direction of Allen McCartney produced numerous faunal remains with which to examine Thule winter habitations in the Creswell Bay region (Rick 1980). A sample of this material, excluding large whale bone (which was identified and left in the field) was analyzed at the Zooarchaeological Identification Centre. The material was identified and minimum numbers were estimated. Bone modifications, including cut marks were also recorded, along with an estimation of the relative meat contributions each non-cetacean species may have contributed to the diet of the Thule people (Rick 1980). Due to the problems of caching meat, a season of occupation was only tentatively assigned.

The analysis of faunal remains from the Clachan site on Coronation Gulf used dental annuli (with the assistance of Sterling Presley of the A.S.C.) to determine the season and method of hunting for the ringed seals, which were relied on heavily as a food source (Morrison 1983a, 1983b). It appears that winter breathing-hole sealing may have manifested itself rather recently, after a shift in ice conditions. Similar dependence on ringed seals was reported from the Nelson River site on Banks Island (Cooper 1981 in Arnold 1986). Although a significant portion of the diet was probably derived from whale.

Several canid vertebrae were recovered with crushed spinous process, indicating their possible use as pack animals (Arnold 1986).

Often, as in the case of Brooman Point on Bathurst Island (McGhee, 1984), sod blocks from vegetation built up on old Dorset middens were used in the construction of Thule houses. Obviously this can lead to problems in the separation of faunal assemblages. Brooman Point's assemblage was only assigned general field species identifications, and sampled for later laboratory analysis (McGhee 1984).

Faunal remains from the Ruin Island phase of early Thule culture were analysed by McCullough (1988, 1989) in order to examine hunting patterns on Eastern Ellesmere Island. Cetacean remains and a portion of one years assemblage were analyzed in the field by Elizabeth Nichols, in order to reduce shipping costs. Similar to the results obtained by Morrison (1983a, 1983b), seals were found to be the primary economic resource, hunted primarily during the spring and the fall seasons (tooth sections analysed by S. Presley). This meat was likely cached for use during the winter months. Preferential consumption of particular portions of meat and taphonomic factors may explain the differences in element frequencies.

Extensive research has been undertaken by Stenton (1983, 1987, 1991) to examine Thule subsistence patterns on Southern Baffin Island. His study of the faunal remains from the site of Peale Point, near Iqaluit, examined the change in resource exploitation from Classic Thule to the Historic period (1983, 1987). Utilizing the results from element frequency data and tooth sectioning (performed by S. Presley) of caribou and seal teeth, a general shift was found to have occurred from a mixed marine/terrestrial economy to a more marine emphasis. Stenton's (1991) research near Nettilling Lake incorporated the analysis of element frequencies and utility indices as a means of examining mobility and site function. Further evidence indicates that animals were "harvested according to availability rather than preference" (Stenton 1991:36).

The presence of domestic dog has been noted for various Arctic Thule sites (e.g. Arnold 1986, Staab 1979, Rick 1980, Stenton, 1983, 1987). Park (1987) discusses evidence for trauma on the dog skulls from Porden Point on Devon Island. His study indicates that the dogs experienced "disciplinary" blows to the face (in most cases healing occurred), as well as punctures in the frontal sinus region. The later likely occurred during fights with other dogs. There is also an indication that the dogs may have been consumed, due to the relatively small number of post-cranial elements, of which many of the long bones are fractured (Park 1987).

Research in the Mackenzie Delta region of the Western Arctic has also yielded interesting analyses of the faunal remains. Only a small sample of the faunal remains were analysed, and species recorded from a Thule site on Herschel Island in the Northern Yukon (McAdam 1978, Salter 1979 cited in Yorga 1980).

A thorough analysis was undertaken on the zooarcheological remains of the historic Inuit Kugaluk site, near Liverpool Bay (Morrison 1988). The faunal analysis was a cumulative effort (Steve Cumbaa and Darlene Balkwill of the Zooarchaeological Identification Centre; Ellen Foulkes and Chris

Monohan, birds; Ariane Burke, fish; Sterling Presley, tooth sectioning of caribou). A high species diversity, particularly in the fish and bird remains was recorded. Morrison (1988) examined the expected and observed element frequencies, and noted that taphonomic factors contributed significantly to the composition of the assemblage. Minimal Animal Units (MAU) and Modified General Utility Indices (MGUI) (Binford 1978) indicated that Kugaluk may have been a residential hunting camp, with surplus food removed during seasonal movement.

Excavations in the Mackenzie Delta region during the first phase of the Northern Oil and Gas Action Plan (NOGAP) Archaeology Project (1984-85 to 1987-88), has produced two major faunal analyses (Nagy 1988, Still 1991). This project involved representatives of the Yukon Heritage Branch, the Prince of Wales Northern Heritage Centre and the Archaeological Survey of Canada. Nagy (1988) analysed the remains of the historic Inuit site of Trail River, in the Northern Yukon, and found that the assemblage was dominated by both caribou and ptarmigan, but a wide range of resources were also exploited. The early summer site utilization (based on bird remains and caribou tooth eruption) supports the suggestion of intensive grease extraction, since caribou are quite lean at this time of the year.

An analysis of twelve faunal assemblages from the Late Prehistoric period in the Southwest Anderson Plain region (Still 1991), indicated a dependence on caribou. Bone modification was rare, with the exception of burning, which may have been used as a means of refuse disposal along with discarding material in water or by burial. One of the most recent publications of faunal analysis in the Arctic stems from the excavation of a non-native midden associated with an early twentieth century Anglican Mission on Herschel Island (Saxberg 1993). Saxberg found that although the artifacts indicate the lack of assimilation by the missionaries to living in the north, the faunal sample demonstrates that local fresh game was readily exploited.

Cultural and natural site formation processes and the taphonomic factors affecting faunal remains in the Arctic have been explored by Savelle (1984) and Sutcliffe (1990). One of the interesting discard patterns noted by Savelle (1984) during his analysis of an historic Inuit snow dwelling on Somerset Island occurred vertically down through living areas. Refuse can easily be driven into the snow, or alternatively, more snow can be piled on top of the refuse, either intentionally or unintentionally. This will produce a three dimensional pattern of discard. Savelle (1984) also mapped the faunal remains, and found differential distribution of seal and caribou elements according to activity areas within and between the dwellings.

The study by Sutcliffe (1990) in the Canadian High Arctic revealed that there is no accurate means of gauging how long bone material has remained on the surface. Pleistocene deposits can, in some cases, be as well preserved as Thule faunal remains. "Since rates vary locally, according to microenvironmental conditions, no simple generalization can be made" to establish a chronological sequence of decay stages (Sutcliffe 1990:178). Carnivores (e.g. polar bear, wolf, dog and arctic fox) have been found to seriously damage and disturb bone

initially, however, "there seems to be an early cut off point, after which no further damage occurs" (Sutcliffe 1990:177).

Recent research by Lyman, Savelle and Whitridge (1992) has enabled the examination of the relative economic importance of particular skeletal elements of phocid seal through the derivation of meat utility indices for phocid seals. In addition to this experimental data, ethnoarchaeological research was undertaken by Whitridge (Lyman et al. 1992) on the procurement of seals by the Clyde River Inuit. His results indicate that small seals are often taken from the kill site whole, or only partially disarticulated, which results in the incorporation of elements of low food value with elements of high value during transport (Whitridge in Lyman et al. 1992:539).

Interior Sites

Published reports on the zooarchaeology of the Interior Arctic, appear to be very rare. Faunal remains from the stratified sites of KjNb 6 and 7 were analyzed by N. Boucher-White and are the result of research undertaken by Gordon (1975) in the Barrenlands region between Yellowknife and Baker Lake. This assemblage spanned the Middle Shield Archaic tradition, through the Arctic Small Tool tradition, to possible Chipewyan association, with most of the identifiable specimens assigned to barrenground caribou. Only a small percentage of the material was identifiable, but a tentative winter occupation was indicated from tooth wear data and fusion stages (Gordon 1975).

Conclusion

Due to the nature of archaeological research in the Arctic, many projects have not traditionally focused on zooarchaeological remains, due often to the cost and weight of shipping and the short field season. So at best general field identifications have been made, often with the assistance of Inuit hunters, and the bones (and lithic debitage) have often been left behind. The purpose here is not to criticize these past research designs, but rather I wish to further highlight the quality of zooarchaeological analyses within the past twenty years and the contributions made by these researchers to the understanding of the prehistory and history of the North.

ACKNOWLEDGEMENTS

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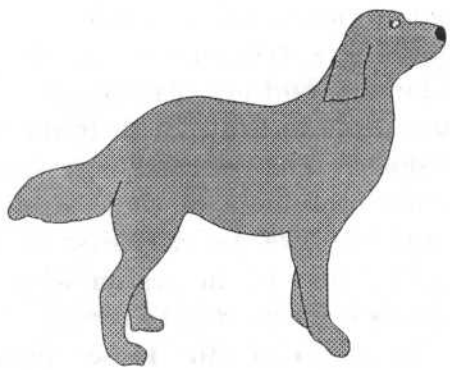

OSTEOMETRIC AND ANCIENT DNA ANALYSIS OF PREHISTORIC DOGS OF THE CENTRAL NORTHWEST COAST: WOOL DOG OR BUST!

Susan Crockford*

In 1993, Pacific IDentifications initiated a comprehensive research project to test the hypothesis that two true breeds of dogs existed prehistorically on the Northwest Coast and, if they did, to determine their unique morphological and genetic characteristics. This study is part of a larger project which aims to develop simple and economical molecular techniques that will make both archaeological and historic skeletal collections truly usable in investigating the genetic relationships within and between populations over time. This 3 year project is an industrial collaboration between Pacific ID and the University of Victoria (Dr. Ben Koop, Biology Dept./Centre for Environmental Health) and is jointly funded by Pacific ID and the National Science and Engineering Research Council of Canada (NSERC). Laboratory work on the molecular genetics aspect began September 1, 1993.

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Pacific IDentifications is a business partnership between Rebecca Wigen (MA, Anthropology) and Susan Crockford (BSc, Zoology) which specializes in the identification and analysis of animal skeletal remains. The company has been operating since 1988 and its clients are professional archaeologists and biologists affiliated with universities, museums, government research facilities and private contracting companies in the US and Canada who are involved in scientific research.

This is a continuation of work I began in 1990 on the morphological characteristics of Northwest Coast prehistoric dogs, which was partially funded by the B.C. Heritage Trust. I will be carrying out the majority of the work on this project, while partner Becky Wigen continues her 3/4 time position as lab instructor in Archaeology & Physical Anthropology at the University and works on other Pacific ID contracts.

The "wool dog" story is based on early historic and ethnographic accounts (Howay 1918; Barnett 1955) that report the presence of two types of indigenous dogs (*Canis familiaris*) kept by aboriginal people on the central Northwest Coast: a medium-sized, coyote-like animal used for hunting and a smaller, long-haired "wool" dog kept exclusively for its thick soft hair. Some measures were reportedly taken to keep the two types from interbreeding. The wool dogs were apparently sheared, much like sheep, several times a year. In the early historic period (late 1700's/early 1800's), these dog-hair blankets were replaced as a favoured item by Hudson's Bay blankets and the weaving of dog-hair blankets was rather quickly abandoned. The impetus for keeping the "wool" dogs genetically isolated from the hunting dogs was soon lost and the wool dog as a separate type was considered extinct by about 1858 (Howay 1918). As far as is known, no "wool" dog specimens were ever deliberately acquired by museums or collectors (Gustafson 1980). Accordingly, the archaeological record is the only unbiased source of information about the indigenous dog populations of this area.

For no other North American aboriginal groups has this pattern of dog use been recorded (Allen 1920) and, if proven to be true, constitutes a unique situation. A wide range of sizes of dogs are definitely apparent in the archaeological sample from the central Northwest Coast: initial cranial/ mandibular measurements of typical "small" specimens are as small as the "Basketmaker Dogs" from the U.S. Southwest (Lawrence 1967), while measurements of some of the larger specimens are as large as Lawrence's "large Indian dog" (1968). Lawrence (1968) has presented evidence from Idaho that different sizes of dogs did exist side by side in primative aboriginal cultures and that this may be an old pattern, one not exclusive to the Pacific Northwest (see also Brothwell et. al. 1979). There is no indication however, that her samples represent the results of conscious selection (Darwin 1905) for genetically-distinct breeds. On the Northwest Coast, by contrast, the historic and ethnographic evidence suggests that the two types of dogs were deliberately maintained as separate populations, with explicit economic reasons for doing so, and thus may constitute true breeds.

Three previous osteometric studies are specific to central Northwest Coast prehistoric dogs, all attempting to find evidence of the two breed types (Digance 1986; Montgomery 1979; Gleeson 1970). All three are site-specific analyses and because of the small sample size of intact crania and post-cranial remains from the individual sites, rely almost exclusively on mandibular and/or carnassial tooth measurements in drawing their statistical conclusions. This methodology severely limits the usefulness of these studies in assessing the skeletal remains of dogs from other sites in the region where the two breeds are reported to occur.

In contrast to these previous

studies, this research intends to determine if the two described breeds existed and if so, to define them as completely as possible and delineate them in prehistoric time and space. To this end, the archaeological remains used are taken from a number of previously excavated sites within the region in an effort to increase the sample size of intact crania and post-cranial elements. DNA analysis of selected remains will be used to test for corroboration of osteometrically significant distinctions between breeds. Accelerated mass spectrometry (AMS) techniques will be used to date significant finds directly, thus eliminating reliance on associations with carbon-dated archaeological deposits.

The research is thus comprised of two parts: a classic osteometric multivariate analysis as suggested by Olsen (1985) of both cranial and post-cranial elements, and analysis of DNA extracted from the skeletal sample. The sample comprises cranial and post-cranial skeletal remains of adult dogs from 19 archaeological sites between Nanaimo on Vancouver Island and Cape Flattery, Washington, listed below. The archaeological deposits date from approximately 500 years ago to ca.4000 B.P.

Sites included in this study

DhRr 6 -Belcarra Park site,Vancouver N
DgRr 2 -St. Mungo Cannery site, Vancouver
DgRr 6 -Glenrose Cannery site, Vancouver
DgRs 2 -Tsawwassen Beach, Vancouver SW
DgRs 30-Beach Grove Golf Course Waterhazard, Vancouver SW
DgRr 1 -Crescent Beach, Vancouver SW
DiSc 1 -Little Qualicum Falls, Parksville District, Vancouver Island E
DhRx 16-Departure Bay, Nanaimo District, Vancouver Island E
DjSe 6 -Ships Point, Crofton District, Vancouver Island E
DfSf 13-Buckley Bay, Crofton District, Vancouver Island E
DfSf 14-Tsable River Bridge, Crofton District, Vancouver Island E
DiSe 7 -Deep Bay, Duncan District, Vancouver Island E
DcRt 15-Cadboro Bay, Victoria District, Vancouver Island S
DcRu 12-Maple Bank, Victoria District, Vancouver Island S
DfRu 13-Montague Harbour, Galiano Island, Gulf Islands District
DgRw 204-Rockshelter site, Gabriola Island, Gulf Islands District
DeRt 2 -Canal site, Pender Island, Gulf Islands District
45CA24 -Ozette Village site, Cape Flattery, WA, USA

DNA analysis techniques have advanced rapidly in recent years and methods of dealing with DNA that is in less than pristine condition are now available. DNA degrades relatively rapidly after death and only a small proportion of the original mass usually survives, but because there are thousands of mitochondria (the cell organelles involved in routine metabolic functions) in each cell the chances of some mitochondrial DNA (mtDNA) surviving are much better than for single-copy genomic material from the nucleus (Hagelberg & Clegg 1991). Molecules recovered from old blood, bone and dried tissue ("ancient" DNA) are generally fragmented into short segments. The

length of mtDNA fragments recoverable from ancient samples is somewhat critical to the investigation of genetic variation, since longer fragments are apt to contain more nucleotide variations than shorter ones (Brown & Brown 1992). Segments of mtDNA 300-400 base pairs long have been extracted from archaeological bone and historic skins (Horai et.al. 1991; Hagelberg et.al. 1991; Wayne & Jenks 1991), which should be adequate for the kind of analysis proposed for this study.

There are some distinct advantages to using mtDNA rather than nuclear DNA for studies of this type. Mitochondrial DNA analysis provides a unique opportunity to investigate the genetic history of individuals, populations of animals and species, due to the non-recombinant, maternal inheritance feature of mtDNA (Avise et.al. 1987). Direct nucleotide sequence analysis is a powerful technique that reveals the exact nucleotide composition of fragments of the mtDNA molecule. It requires relatively small amounts of the total complement of mtDNA and provides greater resolution (3-6 times) of genetic diversity than previously available techniques (Horai et. al. 1991). A relatively simple and fast method of direct sequence analysis has recently been developed whereby particular mtDNA segments are isolated from whole or partial mtDNA molecules with highly specific primers and then amplified (i.e. duplicated) using the polymerase chain reaction (PCR). Thus many exact copies of the targeted segment of the DNA is available for direct sequencing. This method has an advantage in that it is applicable both to intact mtDNA from fresh tissue samples and to the small amounts of short mtDNA segments found in old ("ancient") samples (e.g. bone, dried tissue, tissues preserved in alcohol, poorly or long-frozen tissue and blood), making it an analysis method of much broader application than other techniques (Kocher et.al. 1989). Automated sequence analysis of these mtDNA segments is a recent advancement in the technology that allows many samples to be analyzed with much less effort. Population studies based on genetic data are now possible and these automated sequencing machines are available to us at the University.

The genetic study will focus on the analysis of mtDNA from a variety of domestic dog breeds (*Canis familiaris*) and gray wolves (*Canis lupus*), from both contemporary and past populations. The skeletal collection of extinct prehistoric dogs from the Pacific Northwest Coast described above will be used as a specific example to test the resolution power of the technology to identify and characterize subgroups within species. Museum skeletal collections of other canids to be compared (wolves and coyotes) are also available for testing, as are veterinary collections of extant dog breeds.

The amount of material needed for mtDNA analysis of bone is relatively small. Roughly 1-2 grams of powdered bone appear to be sufficient. Hagelberg et. al. (1991) found a clear relationship between gross observable condition of archaeological bone, histological condition and the ability to extract amplifiable DNA: bone that appears to be well-preserved probably contains well-preserved DNA. It has been found that if collagen is still present in the bone, usable DNA should still exist as well (Tuross 1993). Testing for collagen, therefore, is a relatively cheap and easy way to determine if ancient bone samples are

suitable for more expensive DNA analysis.

The regional approach taken in this study of Northwest Coast indigenous dogs thus has an additional advantage: the different archaeological sites from which the samples are drawn provide for a variety of depositional conditions, some of which may preserve ancient DNA better than others. Overall, the use of central Northwest Coast prehistoric dogs as an application of ancient DNA technology has many advantages, the most important being the unique opportunity which it presents for comparing the results of DNA analysis and osteometric analysis under conditions favourable to both. However, the questions to be answered are difficult ones for both analysis techniques. Sexual dimorphism in dogs creates significant problems for the osteometric analysis, because it aims to identify breed distinctions based primarily on size and the sex of much of the sample cannot be determined. The extremely close genetic relationship of animals which differ at the breed level will necessitate extensive work to find an area of the genome which is characteristic for each group.

Until very recently, DNA analysis of archaeological bone has concentrated on perfecting extraction and interpretation techniques: it has not yet had wide use as a research tool in the solution of specific problems (Cherfas 1991). This project, which combines genetic analysis with multivariate osteometric analysis, has the potential to clearly demonstrate (finally!) whether two true breeds of dogs existed prehistorically on the central Northwest Coast and is an approach that could be used effectively for addressing systematic and taxonomic problems in other animal populations.

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FAUNAL PAPERS AT THE ESAF MEETING

Frances L. Stewart (McGill University and the University of New Brunswick, P.O. Box 4400, Fredericton, NB, E3B 5A3)

The 60th Annual Meeting of the Eastern States Archaeological Federation was held from October 28 to October 30 in Bangor, Maine. This regional society caters to both professional and amateur archaeologists in eastern Canada and the northeastern United States. Thirty-nine papers were presented in non-overlapping sessions and five of the presentations were in a zooarchaeology symposium.

After opening remarks by the ESAF president, Verna Cowin of the Carnegie Museum of Natural History (I am including affiliations because readers may want to contact some of the conference participants), the papers began with one by James B. Petersen and Brian S. Robinson, both from the University of Maine at Farmington, on "An Archaic and Woodland period fish weir in central Maine". This was an update of the paper given by these two at last May's CAA meeting. While there were no bones found, the weir was constructed to intercept fish, probably eels, shad, and/or salmon in the Kennebec River drainage. Dated on the basis of five radiocarbon dates from ca. 5080 to 1760 B.P., this

wooden weir was used by both Archaic and Middle Woodland peoples who sharpened and inserted the stakes into the river bottom in different ways. This appears to be the earliest weir found in North America and certainly is evidence of a long history for this fishing technique.

After the mid-morning break, I spoke about "Zooarchaeological studies through times and paradigms". Since most of the material in this paper was considered in greater detail in an article in the last issue of *Canadian Zooarchaeology* (1993:No.4:2-18), I will not repeat myself here. Other very interesting non-faunal papers were presented, including a number on material from Quebec, Ontario and the Maritimes.

Saturday afternoon was the highlight of the programme for zooarchaeologists. Then, five papers were included in the Zooarchaeology Symposium organized and chaired by Frank J. Dirrigl from the University of Connecticut. The first, "Methods of identifying cultural versus non-cultural bone and antler in the archaeological record" was a review of the taphonomic literature related to the topic by Pamela Crane and Kristin D. Sobolik who are both at the University of Maine at Orono. Similarly, Dirrigl reviewed the literature on bone preservation and argued for more precise recording of bone fragments in his "Quantification and taphonomic analysis of bone fragments recovered from archaeological sites." A very interesting methodological paper was David R. George's (University of Connecticut) "Microscopic identifications of bone fragments from archaeological sites: Problems and prospects". It was introduced with a discussion of the problems of using either NISPs or MNI when a sample consists of small calcined pieces lacking the macroscopic landmarks used for species identifications. Since most non-shell midden faunal samples in the northeast are of this sort, George's experiments with thin-sectioning were significant. They were also encouraging. Using thin sections of known mammalian species long bones, he has observed that the histomorphologies of the species are distinct, particularly in the patterns of their Haversian canal systems. While factors of individual age and low sample size testing to date suggest caution in accepting this method, it does look promising. For sites where the vast majority of the faunal remains are tiny previously unidentifiable pieces, this technique may be worth the time and expense involved in examining sectioned bones. George's paper was followed by one by Tonya Largy, of Harvard University, on "Animal remains from the statue of liberty and Ellis Island, New York" which were uncovered during repairs to the base of the statue. It was surprising to see an extensive oyster midden still intact in this highly developed area. The last faunal paper was by Arthur Spiess, of the Maine Historical Preservation Commission, on "Calcined bone and New England-Maritime prehistory". Spiess, using both calcined fragments and unburnt bones from the Late Ceramic Goddard Site, located on the coast of Maine, discussed differential preservation of burnt to non-burnt bone. As an aside, the Goddard Site is an interesting example of a large site which was carefully excavated and recorded for about 20 years by two dedicated amateurs whose hugh quantity of findings were

eventually donated to a museum.

In addition to the formal sessions which were all well-attended, the conference organizers, Michael Brigham and James Petersen, offered tours to Augusta to visit the Maine State Museum with its beautiful and informative, new exhibit on 12,000 years of prehistory in Maine and to Fort Western and its associated trading station or to the Abbe Museum in Bar Harbour and a shell midden. There was a hosted evening in the University of Maine's Hudson Museum and on another evening, David Sanger (University of Maine at Orono) provided an open house to view their new archaeological laboratories. There, a number of us interested in faunal material examined a problematic specimen, from a site in Maine, which we speculated might be a small piece of walrus tusk. Many participants were carrying archaeological materials with them to show to others for their opinions. This lab tour was followed by the traditional Canadian/American friendship party where Americans drink our beer.

In conclusion, the emphasis given to zooarchaeology and the very friendly atmosphere at this meeting make it one which zooarchaeologists working on eastern materials might choose to attend. I certainly will be interested in seeing what next year's program offers.

NOTE: I attended this conference while on a Social Sciences and Humanities doctoral fellowship and I thank the Canadian government for this support which I neglected to do in the acknowledgements to my article in the last issue of Canadian Zooarchaeology.

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Rothschild, Nan A., Balkwill, Darlene. 1993. The meaning of change in urban faunal deposits. Historical Archaeology 27(3):71-89.

CALL FOR CONTRIBUTIONS FOR:

ZOOARCHAEOLOGICAL ANALYSIS ON ONTARIO SITES: AN ANNOTATED BIBLIOGRAPHY

Work is currently underway to produce an annotated bibliography of faunal reports (including theses with a faunal focus) carried out for Ontario sites over the past 30 years or so. This project has been funded by the Ontario Heritage Foundation with a research grant to Dr. Howard Savage, Department of Anthropology, University of Toronto.

If you have on file any relevant, unpublished reports or theses which are **not** filed with the Faunal Archaeo-Osteology Laboratory at the University of Toronto, please write to the address below for the appropriate entry form and return as soon as possible. Final deadline for receipt of contributions is **17 July 1994.**

Planned as a Special Publication of the Ontario Archaeological Society, the bibliography is to be launched provincially at the Society's Annual Symposium in Toronto, October 1994, and nationally at the CAA's 1995 spring conference. It will be available on user-updatable disk and in hard copy. Please mark all correspondence **"BIBLIOGRAPHY".**

ALL QUERIES TO:
Janet C. Cooper, c/o Dr. Howard Savage,
Dept. of Anthropology,
University of Toronto
100 St. George Street
Toronto, Ontario, M5S 1A1
tel. (416) 978-5260

FORTHCOMING CONFERENCES/ CONFERENCES A VENIR

1994:

Canadian Archaeological Association.
27th Annual Meeting, 4-8 May 1994
Association canadienne d'archéologie.
27ième réunion annuelle, 4-8 Mai 1994
Edmonton, Alberta,
Hilton International Hotel
10235-101 Street, Edmonton, Alberta
Conference Coordinator: Jack Ives, Provincial Museum of Alberta, 12805-102 Avenue, Edmonton, (403) 453-9149, fax (403) 454-6629
Programme Chair: Raymond LeBlanc, (403) 492-5891, fax (403) 492-5273
NB: There is a faunal session from 9-12pm Thursday, May 5th
Ontario Archaeological Society.
Annual Symposium, Toronto, Ont. October, 1994. further details TBA

1995:

Hidden Dimensions: The Cultural Significance of Wetland Archaeology.
April or May 1995, University of British Columbia, Vancouver, B.C.
Programme Organizer: Kathryn Bernick, UBC Museum of Anthropology, 6393 N.W. Marine Dr., Vancouver, B.C. V6T 1Z2, (604) 822-6530, fax (604) 822-2974. E-mail stevenso@unixg.ubc.ca

REQUESTS, EXCHANGES, NOTICES/ DEMANDES, ECHANGES, AVIS

- Janet Cooper, who works with Dr. Howard Savage at U of T, is looking for seal information. She would like to know if there is any data available on the rate and pattern of epiphyseal union in pinnipeds, particularly for the appendicular skeleton (but not manus and pes), or any metric data which might be used on skeletal material recovered in an archaeological context. You can contact her c/o Dr. Howard Savage, Department of Anthropology, University of Toronto, 100 St.George St.,Toronto,Ont. M5S 1A1.

- Congratulations to Fran Stewart who has just received the first New Brunswick Women's Doctoral Scholarship. This scholarship is renewable for up to four years. Applicants must be female, a New Brunswick resident and in the first four years of a doctoral program. The scholarship is offered through the New Brunswick Department of Advanced Education and Labour.

- Annotated Bibliography and Catalogue of Vertebrate Paleopathology/Pathology. The co-editors of this ongoing project are now soliciting contributions. Major bibliographic sources have been surveyed. You input is needed in the following:
For the Introduction: Biographical data, personal anecdotes, as well as information leading to the whereabouts of any living relatives of Roy Lee Moodie.
For the Bibliography: The more obscure references, including passing remarks.
For Catalogue: Catalogued Museum specimens bearing paleopathologies. No domestic animals please.
For more information and forms: Mr. D. Tanke, Roy. Tyrell Mus., Box 7500, Drumheller, Alberta, Canada, T0J 0Y0

- Susan Crockford (see article p.15 for address) invites anyone working on domestic dogs to participate in a symposium at the fall 1994 ICAZ conference in Germany. Let her know as soon as possible if you are interested.