

Paleoeskimo Dogs of the Eastern Arctic

DARCY F. MOREY¹ and KIM AARIS-SØRENSEN²

(Received 28 June 2000; accepted in revised form 11 June 2001)

ABSTRACT. Sled or pack dogs have been perceived as an integral part of traditional life in the Eastern Arctic. This perception stems from our knowledge of the lifeway of recent Thule and modern Inuit peoples, among whom dog sledding has often been an important means of transportation. In contrast, the archaeological record of preceding Paleoeskimo peoples indicates that dogs were sparse at most, and probably locally absent for substantial periods. This pattern is real, not an artifact of taphonomic biases or difficulties in distinguishing dog from wolf remains. Analysis of securely documented dog remains from Paleoeskimo sites in Greenland and Canada underscores the sporadic presence of only small numbers of dogs, at least some of which were eaten. This pattern should be expected. Dogs did not, and could not, assume a conspicuous role in North American Arctic human ecology outside the context of several key features of technology and subsistence production associated with Thule peoples.

Key words: Thule, Dorset, Inuit, zooarchaeology, dog, sled, transportation, economics, Greenland, eastern Arctic

RÉSUMÉ. On a toujours considéré les chiens de traîneau ou chiens de somme comme faisant partie intégrante de la vie traditionnelle dans l'Arctique oriental. Cette perception vient de nos connaissances sur le mode de vie des derniers Thulés et des Inuits modernes, chez qui le traîneau à chiens a souvent représenté un mode de transport majeur. En revanche, les données archéologiques des peuples paléoesquimaux qui ont précédé Thulés et Inuits révèlent que les chiens étaient tout au plus clairsemés, et probablement absents localement pendant de longues périodes. Cette répartition est bien réelle et n'est pas le produit de distorsions taphonomiques ou de difficultés à faire la distinction entre les restes du chien et ceux du loup. L'analyse de restes canins proprement documentés trouvés sur des sites paléoesquimaux au Groenland et au Canada souligne la présence sporadique de chiens en nombre toujours restreint, dont au moins quelques-uns étaient mangés. Cette répartition n'est pas surprenante, les chiens n'assumant pas – et ne pouvant assumer – un rôle évident dans l'écologie humaine de l'Arctique nord-américain en dehors du contexte de diverses caractéristiques clés de la technologie et de la production de subsistance associées aux Thulés.

Mots clés: Thulé, Dorset, Inuit, zooarchéologie, chien, traîneau, transport, science économique, Groenland, Arctique oriental

Traduit pour la revue *Arctic* par Nésida Loyer.

INTRODUCTION

Twenty years ago, archaeologist Lewis Binford introduced an influential article with an anecdote that inspired the title's opening phrase, "Willow smoke and dogs' tails" (Binford, 1980). According to Binford, an old Eskimo man summed up his life in the Arctic with those words, because half of Eskimo life was spent amidst willow smoke rising from campfires, the other half watching dogs' tails waving as the animals pulled a sled or carried packs across the landscape. We are concerned here with the latter image, for which Binford's anecdote underscores the enduring perception of dogs as a central characteristic of traditional life in the Arctic. In the pages of this journal, for example, Arnold (1979:265) suggested that archaeological data from earliest times would eventually show that domestic dogs were "an integral part of cultural adaptation to the arctic."

Our goal in this report is to describe evidence for the abundance and use of Arctic dogs (*Canis lupus familiaris*) in prehistory. Our focus is the Eastern Arctic (Fig. 1), and

especially Greenland, partly because it is the region with which we have greatest familiarity. In addition, as the recipient of late human population movements into initially uninhabited lands some 4500 years ago (see Maxwell, 1985), the Eastern Arctic provides an ideal setting for exploring the requirements of human existence (see Fig. 2). We emphasize that the apparent ubiquity of dogs among Arctic peoples is a phenomenon of the past thousand years or so, and it cannot be regarded as a central feature of traditional life. In fact, when one considers the overall archaeological record, it would be a surprise to find that dogs regularly played a significant role prior to about one thousand years ago.

THE HISTORICAL PERSPECTIVE

The perception of dogs as a central feature of life in the Arctic has a clear and obvious foundation. For example, ethnographic summaries of North American Arctic peoples

¹ Department of Anthropology, 622 Fraser Hall, University of Kansas, Lawrence, Kansas 66045-0221, U.S.A.; dmorey@lark.cc.ukans.edu

² Zoological Museum, University of Copenhagen, Universitetsparken 15, 2100 Copenhagen Ø, Denmark

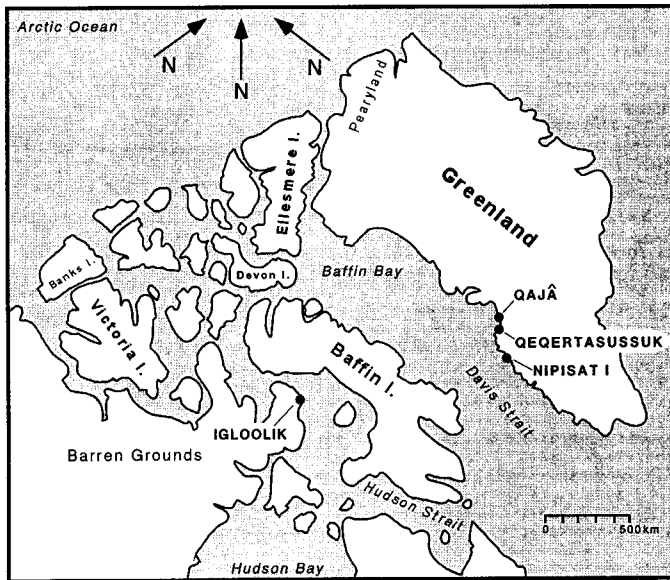


FIG. 1. General map of the Eastern Arctic region, showing approximate locations of Qaja, Qeqertasussuk, Nipisat I, and Igloolik, the four principal Paleoeskimo sites discussed in the text.

in *Arctic*, volume 5 of the *Handbook of North American Indians* series (Damas, 1984a), make repeated reference to the role of dogs in transportation and other tasks among different groups. Even within the narrow slice of time afforded by only two or three centuries of historic contact, however, one finds considerable variation, both temporal and geographic, in the use and abundance of dogs. Among the Polar Eskimo of the Thule District, for example, the dog sled was the most important means of transportation, used up to ten months of the year (Gilberg, 1984). Likewise, in the northern coastal areas of west Greenland, dog sleds averaging perhaps seven animals per team were commonplace, and under favourable conditions they could pull up to 75 kg per day (Kleivan, 1984). In contrast, within the vast Central Eskimo region, dog sled teams of substantial size were common only in Canada's Igloolik region of Foxe Basin and northern Baffin Island (see Mary-Rousselière, 1984), with no more than one to three dogs per hunter common throughout the rest of the region (Damas, 1984b). Among the Copper and Caribou Eskimo, real teams may have been virtually unknown until the introduction of rifles and the historic period trapping economy (Arima, 1984; Damas, 1984c). On southern Baffin Island, Kemp (1984) reported that during the early 20th century, dog traction was based on 2–6 dogs per person in the Hudson Strait and Cumberland Sound regions, but as many as 6–12 dogs along Davis Strait. Dogs were regularly used in hunting tasks by different peoples, and absent enough dogs to form teams, or during summer, they were frequently used as individual pack animals.

While dogs have obviously been useful to many northern peoples, and even essential in certain contexts, they come with a liability: they require maintenance. This simple fact, along with environmental variation that constrains transportation modes, surely underlies much observed

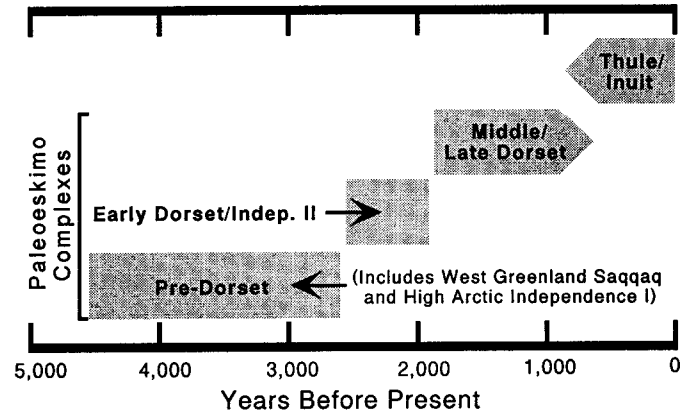


FIG. 2. Simplified chronology of major archaeological complexes of the Eastern Arctic.

variability in the propensity of different Arctic peoples to sustain large numbers of the animals. From five recent (1920s and 1930s) Siberian Eskimo communities where dog sledding was a central feature of life, Krupnik (1993) presents data showing that of the total food supply generated annually, the amount (estimated in kilocalories) consumed by dogs ranged from 20% to nearly 35%, and averaged about 28%. Clearly the food needed by dog sled teams poses a major and continuous production requirement. Consequently, the viability of team sledding will depend on other aspects of a people's technological, organizational, and production strategy. Even without team sledding, however, dogs maintained for any purpose will be in direct competition with humans for food, an individual adult animal requiring about 400 kg of meat and fat per year (Saladin d'Anglure, 1984). In times of plenty, this requirement might pose little problem, but life in the Arctic is not always dependably bountiful. Thus, wide variation in the abundance of dogs, and even in their presence versus absence, should be an expected feature of northern life.

FROM HISTORY TO PREHISTORY: THULE PEOPLES

The familiar dog sled of recent Inuit peoples was evidently not a regular factor in Arctic life in North America until little more than 1000 years ago. Its routine use coincides with, or slightly predates, the emergence of classic Thule culture along the northern coastal regions of the western Arctic (Ackerman, 1984; Dumond, 1984; Park, 1987). Within 100–200 years, Thule peoples spread eastward through the Canadian Arctic and into Greenland, and the different Inuit groups encountered by European explorers almost certainly are descended from these recent Thule migrants (summary in Maxwell, 1985).

The success of the Thule diaspora, including the apparent competitive advantage of Thule peoples over preceding populations, was undoubtedly based on numerous technological traits and organizational characteristics, with high mobility and transportation efficiency likely among

the most important. For example, Therkel Mathiassen, who defined and named the Thule culture, identified dog sleds, umiaks, and kayaks as key Thule traits (Mathiassen, 1927). Two of these, dog sleds and umiaks, are still unknown from the Paleoeskimo record in North America. Moreover, while Mathiassen's original description of Thule culture and its development has been refined considerably over the years (Gulløv, 1997), recent summaries also emphasize the importance of Thule transportation capabilities, including dog sleds (e.g., Maxwell, 1985; Condon, 1996; McGhee, 1996). Such emphasis is clearly appropriate and is rooted in the precolonial (before A.D. 1721—see Gulløv, 1997) and early colonial archaeological record itself. Eastern Arctic Thule sites, at least in all but the southernmost reaches, routinely yield not only numerous bones of dogs, but also sled parts and other associated material remains, including trace buckles and whip shanks (e.g., Mathiassen, 1930, 1931, 1933, 1934; Larsen, 1934; Glob, 1935; Schledermann, 1975; Taylor and McGhee, 1979; McGhee, 1984). Moreover, the skeletal remains themselves sometimes exhibit trauma-induced pathologies consistent with the animals' having been disciplined as part of their management in teams (Park, 1987; Morey, 1992a), a predictable pattern based on historical observations (e.g., Freuchen, 1935; see also Park, 1987).

PRIOR TO THULE: THE PALEOESKIMO CULTURES

The Dorset Culture

The near-ubiquity of dog remains, sled parts, and associated accoutrements from Eastern Arctic Thule sites stands in sharp contrast to the virtual absence of evidence for dogs from the preceding Dorset culture (e.g., Rowley, 1940, Maxwell, 1984, 1985; Dumond, 1987; McGhee, 1996). At present, the only well-documented case is a single skull from early Dorset deposits (ca. 2200 B.P.) at the Nanook site, in the Lake Harbour District of Baffin Island (Cleland, 1973). Mary-Rousselière (1976) mentions two dog bones from a Late Dorset house at the multicomponent (Dorset, Thule) Nunguvik site on Baffin Island, but he suspects the specimens are intrusive. References to other "sporadic evidence" (Maxwell, 1984:364) or a few large canid bones from Dorset settlements that "appear to come from wolf-like dogs" (McGhee, 1996:145) are equivocal at best.

The virtual invisibility of dogs in the Dorset record could be due to several circumstances. First, as implied by McGhee above, the difficulty of distinguishing dog from wolf (*Canis lupus*) remains in Arctic contexts may be impeding our ability to recognize the animals. Elsewhere, for example, McGhee characterizes canid bones from the Gull Cliff (pre-Dorset) component at Port Refuge, Devon Island, as falling in the size range of modern Eskimo dogs or Arctic wolves, but adds: "there is no indication as to which species they represent" (McGhee, 1979:93). Similarly,

other reports list occasional specimens from large Dorset assemblages as "dog/wolf" (Schledermann, 1990:182, 216; Murray, 1996:77–78; Nagy, 1997:123) or "large canid" (Helmer, 1981).

To be sure, there are archaeological contexts in North America where the distinction between dogs and wolves regularly poses difficulties (e.g., Morey, 1986). As Park (1987) pointed out, however, taxonomic identification should not usually be a major problem in Arctic contexts. Arctic dogs are systematically smaller than the different northern wolf subspecies, and in our experience the morphological traits that characterize dogs (Olsen, 1985; Morey, 1992b, 1994; Clutton-Brock, 1995) are routinely pronounced in Arctic populations (see below). There will always be occasional specimens that pose problems, but we suspect that at least some "wolf-like dog" remains can be securely resolved, and if they really are wolf-like in size, it is because they are from wolves.

It is also possible that nothing more than a limited zooarchaeological data base, compounded by poor organic preservation at many Paleoeskimo sites (summary in Darwent, 1994), underlies the virtual invisibility of dogs from Dorset contexts. However, literally tens of thousands of animal bones have now been analyzed from Dorset contexts across the Eastern Arctic, and the absence of dogs continues to be the rule (Darwent, 1995; Appelt, 1998; Bendix, 1998, 1999). At this point, the simplest explanation for the Dorset pattern is that Dorset peoples did not have dogs, excepting an occasional animal whose presence implies no more than idiosyncratic circumstances at a specific point in time (e.g., Maxwell, 1985). Dogs were certainly part of the general Eastern Arctic scene for the past 4000 years (see below), and Dorset people undoubtedly had periodic access to them through contacts with other groups. But current evidence indicates that dogs played no systematic role in Dorset life, and they usually were absent.

Earlier Paleoeskimos

The near-absence of dogs from Dorset contexts also contrasts, much less dramatically, with the record of preceding peoples, among whom at least some dogs can be clearly documented. As recently as 20 years ago, however, the presence of pre-Dorset Paleoeskimo dogs from the Eastern Arctic was far from certain. For example, Arnold (1979, 1981) reported three canid vertebrae from the Lagoon site on Banks Island. On the basis of osteophytic development and abnormally compressed spinous processes, he suggested that they came from a pack dog, the pathologies having developed in response to the stress of carrying an individual load. This suggestion is certainly plausible, and major osteoarthritic pathologies of the postcranial skeleton are well documented among sled dogs maintained by the British Antarctic Survey (Bellars, 1969; Bellars and Godsall, 1969). Snyder (1995) has described comparable pathologies on vertebrae from the late

prehistoric Sommers and post-contact period Larson sites in the Northern Plains of North America, contexts where ethnohistoric accounts clearly document the use of dogs for pulling loads by travois (see Snyder, 1995). At the same time, it is worth bearing in mind that degenerative pathologies in the vertebral column are a routine phenomenon among both wild and domestic canids that have never served as draft animals (e.g., Cross, 1940; Harris, 1977; Palmer, 1993).

Other Canadian pre-Dorset contexts have also yielded suggestive but inconclusive evidence of dogs. For example, several Paleoeskimo contexts from Devon Island have yielded large canid remains that are described as *possibly* dog (McCartney, 1989; Helmer, 1991; see also McGhee, 1979), including a mandible for which the morphological description sounds compelling (McCartney, 1989). From his pioneering work in the High Arctic, in this case northernmost Ellesmere Island, Eigil Knuth (1967:32) reported that “one diggit [sic] bone of domesticated dog (*Canis familiaris*) was collected from an Independence I ruin.” Knuth further noted that this single bone constituted the only evidence of dogs among either Independence I or II peoples. We have not seen this specimen, and a recent systematic examination of faunal remains from over thirty Independence I and II localities in the High Arctic, many with well-preserved bone assemblages, has failed to yield any other large canid bones (Darwent, 1999).

There is no reason to question that all ancient Arctic peoples had periodic access to dogs, or that the concept of dog traction, along with the technological skills to implement it, was part of their repertoire. For example, Pitul’ko and Kasparov (1996) report evidence of both dogs and a possibly associated sled runner from the Siberian High Arctic as early as 8000 years ago. But the importance of dogs at different times and places, or even their presence versus absence, must be evaluated empirically.

PALEOESKIMO DOGS FROM GREENLAND AND BAFFIN ISLAND

Figure 1 shows the approximate locations of Qeqertasussuk, Qajâ, and Nipisat 1, three Paleoeskimo sites in west Greenland that have yielded dog remains. Qeqertasussuk and Qajâ are located along the east and south portions of Disko Bay, while Nipisat 1 is several hundred kilometres to the south, in the Sisimiut District. These important sites are notable for excellent organic preservation in the context of long sequences of Paleoeskimo occupations, characteristics that prompted extensive, multi-year field research programs at Qeqertasussuk and Nipisat 1, along with smaller-scale investigations at Qajâ (Meldgaard, 1983; Møhl, 1986; Grønnow, 1988, 1990, 1994; Grønnow and Meldgaard, 1988; Kramer, 1996; Møbjerg, 1998). Paleoeskimo dog remains are confined to portions of the deposits representing the Saqqaq culture, a Greenland variant of the

Arctic Small Tool tradition (see Fitzhugh, 1984), which in this region includes a time span of ca. 4500–2700 B.P., or slightly later (Møbjerg, 1998; all site dates summarized below are based on calibrated ¹⁴C determinations, as reported in cited sources). In all, there are 79 specimens, 41 from Qeqertasussuk, 21 from Qajâ, and 17 from Nipisat 1.

In addition to these Greenland localities, four postcranial specimens from Jørgen Meldgaard’s 1957 investigations at Igloolik, an island just north of Canada’s Melville Peninsula (Fig. 1; see Meldgaard, 1960a, b; Møhl, 1997), are associated with a Paleoeskimo settlement and are clearly from domestic dogs. These specimens were recovered from the Káleruserk locality (Parry Hill), from about 50 m elevation. From the same locality, a mandible fragment from 50 m elevation and a nearly complete cranium with an associated partial mandible, from ca. 47 m elevation, are probably wolf. Meldgaard’s work at Igloolik, including the vertebrate assemblage that was recovered, has never been fully described, and we include here the four dog specimens from those collections simply to establish their presence. Further, we assume that these remains are pre-Dorset in age because of their general association with deposits that have been dated to the early fourth millennium B.P. (Meldgaard, 1960a).

Taxonomy: Dog or Wolf?

The Greenland wolf has always been a sporadic and uncommon animal whose presence represents movements of Canadian animals across ice-bound seas in winter (Vibe, 1981; Dawes et al., 1986). Archaeological and historical evidence indicates, however, that wolves were present in west Greenland at least occasionally during pre-colonial times (Vibe, 1967; Møhl, 1982; Dawes et al., 1986). West Greenland wolves would almost certainly represent immigrants from Baffin Island, assigned to the subspecies *Canis lupus manningi* (Dawes et al., 1986). More northerly populations in the Thule District and into northeast Greenland would be derived from *Canis lupus arctos* populations of Canada’s eastern Queen Elizabeth Islands (Nowak, 1983; Dawes et al., 1986). The relevance of the distinction between *C.l. manningi* and *C.l. arctos* is that the former is unusually small for an Arctic wolf (see Goldman, 1944), and thus special care should be exercised in evaluating canid remains from areas where local wolves would be expected to originate from Baffin Island.

Figure 3 provides three bivariate plots of selected measurements on specimens from the Paleoeskimo sites, recent Greenland sled dogs and wolves, and Thule Period dog remains from various locations in Greenland. All measurements (Table 1) were recorded by D. Morey (except the Igloolik tibia, recorded by K. Aaris-Sørensen), and all specimens are from the collections of the Zoological Museum, University of Copenhagen. These measurements are part of a larger database of observations on over 2000 canid bone specimens, mostly archaeological dogs, from

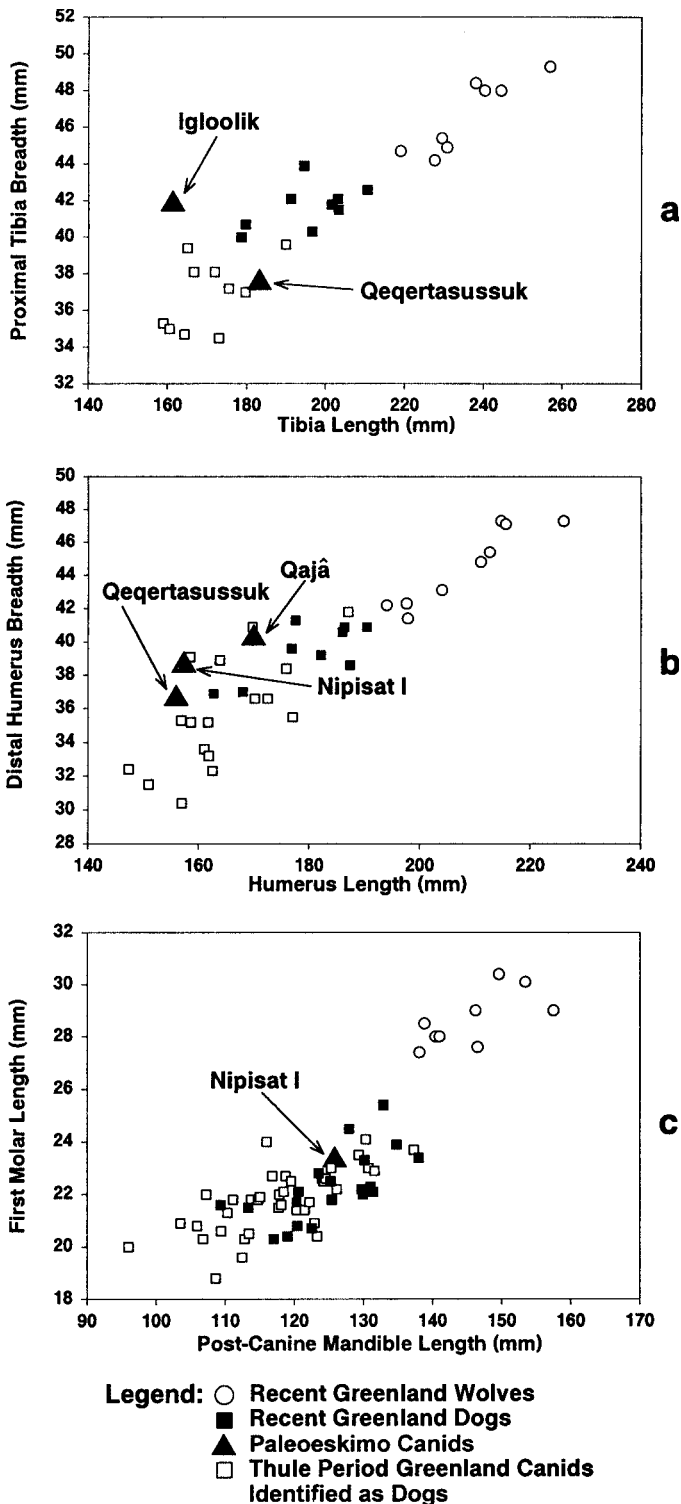


FIG. 3. Bivariate plots of selected measurements on Paleoeskimo dog skeletal specimens and corresponding measurements on recent Greenland wolves, recent Greenland sled dogs, and Thule period canids from Greenland, identified as dogs. Specimens used for 3a and 3b represent all presently available measurements from this database. On 3c, the Thule Greenland dog sample represents every fourth specimen from that series, selected from a file listed alphabetically by site name. This subset was arbitrarily extracted solely to preserve clarity of the plot. Summary statistics on Table 1 represent this subset.

all over Greenland (Morey, 1997). In all plots, the recent wolf specimens are, with one exception, from northern

Greenland or Ellesmere Island, and thus represent *C.l. arctos*. One male specimen from the Umanak Fjord area of west Greenland is almost certainly an immigrant from Baffin Island. All measurements are on adults.

Figure 3a compares intact tibiae from Qeqertasussuk and Igloolik with recent and Thule period specimens. The Qeqertasussuk specimen falls within the range of the dogs; it is more than 35 mm shorter than the two shortest wolf tibiae (219.3 mm, 227.6 mm). The crania from these two wolves, both females, have condylobasal lengths (see von den Driesch, 1976) of 219.5 mm, and 215.8 mm, respectively, slightly shorter than figures summarized by Goldman (1944) for several *C.l. manningi* specimens, which average 227.5 mm for two males and 224.3 mm for three females. The Igloolik tibia is even shorter, while exhibiting an unusually broad proximal epiphysis.

Figure 3b compares three humeri from Paleoeskimo sites with recent and Thule period specimens. In this case, the two smallest wolves have humerus lengths of 194 mm and 197.6 mm, 24.1 mm greater than the longest of the three Paleoeskimo specimens (Qajâ, 169.9 mm—see also Møhl, 1986). Distal humerus breadths for the wolves are 42.2 mm and 42.3 mm, respectively, compared to a greatest Paleoeskimo specimen breadth of 40.2 mm (Qajâ). The similarity in breadth highlights that the diaphyses in the wolf specimens are proportionally longer, a routine pattern that characterizes wolf limbs in relation to morphologically generalized dogs.

Finally, Figure 3c compares the Nipisat 1 mandible length and first molar (carnassial) length with reference specimens (see also Gotfredsen, 1996). All dogs form a cluster distinct from the wolves, with lack of overlap stemming from the proportionally more massive teeth of the wolves, another systematic difference between the two species (Morey, 1992b). There is no reason to suspect that *C.l. manningi* would complicate this clear distinction. First-molar lengths summarized by Goldman (1944) for this subspecies average 27.9 mm for two males and 27.3 mm for three females: modest lengths for wolves, but significantly greater than those of any reference dogs.

Beyond the specimens highlighted above, all others present convincing size and morphological matches with reference dogs, and they are not consistent with any wolves we have seen. In addition, many specimens were clearly part of articulated series from single individuals. For example, the Qeqertasussuk left tibia highlighted in Figure 3a was articulated in situ with a femur and innominate. A complete series of left tarsals and metatarsals refit mechanically (Lyman, 1994) and are part of the same limb unit. Likewise, most of the Qajâ series is attributable to a single subadult individual, though this series does not include the adult humerus from Figure 3b. The subadult specimens are sufficiently mature, however, to determine that their adult size would have fallen well short of wolf size. Identification of the highly fragmented Nipisat 1 series also relies on qualitative considerations, but we regard the identifications as secure.

TABLE 1. Inventory of identified dog bones from four Paleoeskimo sites in the Eastern Arctic.

Qeqertasussuk	Qajâ	Nipisat 1	Igloolik
Mandible–right corpus ¹	Humerus–left complete	Mandible–left complete	Ulna–right, nearly complete
Mandible–left corpus ¹	Humerus–right complete	Mandible–right complete	Femur–left distal
Tooth: Lower Canine–right complete	Innominate–left ilium/ischium ¹	Tooth: Lower Canine–right complete	Tibia–left complete
Humerus–right diaphysis	Femur–left complete ¹	Tooth: Lower Canine–left complete	Fibula–left complete
Humerus–right diaphysis ¹	Tibia–left complete ¹	Tooth: Upper Canine–left complete	
Humerus–right complete ¹	Astragalus–right complete	Tooth: Lower Incisor 2–left complete	
Humerus–left complete	Calcaneum–left complete ¹	Tooth: Lower Incisor 3–right complete	
Ulna–left complete	Vertebra: Cervical–complete ¹	Tooth: Upper Molar 2–left complete	
Radius–left complete	Vertebra: Cervical–complete	Vertebrae: Axis, anterior	
Metacarpal 2–left complete	Vertebra: Thoracic–complete ¹	Humerus–right complete	
Metacarpal 3–left proximal	Vertebra: Thoracic–superior	Humerus–left distal	
Innominate–left complete	Vertebra: Lumbar–complete ¹	Ulna–left proximal	
Innominate–right ilium	Vertebra: Sacral–complete ¹	Tibia–left proximal	
Femur–left complete	Ribs 1 to 3–left complete ¹	Tibia–left diaphysis	
Tibia–left complete	Rib–left complete ¹	Fibula–left diaphysis	
Tibia–right distal	Rib–left complete ¹	Vertebra: Axis–complete	
Tibia–left distal ¹	Rib–left complete ¹		
Tibia–left diaphysis	Rib–right complete ¹		
Fibula–left complete	Rib–right proximal ¹		
Astragalus–left complete			
Calcaneum–left complete			
Tarsals 1 to 4–left complete			
Tarsal Central–left complete			
Metatarsals 1 to 5–left complete			
Metatarsals 3 to 4–right proximal			
Phalange 1–unsided complete			
Vertebra: Thoracic–superior ¹			
Vertebra: Thoracic–superior ¹			
Rib–left complete			
Rib–left complete			
Rib–left proximal			
Rib–left diaphysis			
Rib–right proximal			
Total: 41 (MNI = 3)	Total: 21 (MNI = 2)	Total: 17 (MNI = 3) ²	Total: 4 (MNI = 1)

¹ Indicates that a juvenile individual is represented.

² Gotfredsen (1998) reports 25 rather than 17 specimens because her inventory individually counts several conjoining fragments of single bones (recent or post-depositional breaks).

Abundance of Dogs

The vertebrate assemblages from Qeqertasussuk, Qajâ, and Nipisat 1 include many bones of seal (*Phocidae*), waterfowl, and, in the case of Nipisat 1, caribou (*Rangifer tarandus*) (Møhl, 1986; Grønnow, 1994; Gotfredsen, 1998). The purely osteological criteria within each site indicate that the 79 dog bones represent a minimum (MNI) of eight individuals, recovered from among literally tens of thousands of well-preserved animal bones that occur throughout the stratigraphic sequences. At Qeqertasussuk, for example, the 41 dog bones (MNI = 3) have been identified from among over 100 000 examined vertebrate specimens (Grønnow, 1994; Meldgaard, 1995). The 21 Qajâ dog bones (MNI = 2) come from an assemblage of over 15 000 vertebrate specimens identified to species, along with 44 000 specimens inventoried as seal bones but not returned from the field (Møhl, 1986). Finally, the 17 Nipisat 1 dog bones (MNI = 3) come from an assemblage of over 65 000 examined vertebrate specimens, of which more than 27 000 were identified to family, genus, or species (Gotfredsen, 1998). The 24 dog bones reported by Gotfredsen were later

reduced to the 17 reported here by piecing together some of the fragments. The bone sample from Nipisat 1 is derived from nine different stratigraphic levels, and only two of them contained recognizable dog bones. In level 6, only one dog bone was found among 41 925 vertebrate specimens, which included 22 778 mammals (cf. Gotfredsen, 1998). Analogous comparisons are not available for Igloolik.

Equally compelling is the fact that the dog remains are not scattered continuously throughout the deposits at these sites. For example, although Saqqaq deposits at Qajâ span about 900 years, from ca. 3600 to 2700 B.P. (Meldgaard, 1983; Grønnow, 1994), the dog bones occur only in the earliest occupation levels (Møhl, 1986). Similarly, Qeqertasussuk spans a period of about 800 years, from ca. 3900 to 3100 B.P. (Grønnow, 1994), but at least 33 of the 41 dog bones are from the earlier deposits that encompass the first four to five centuries of occupation, while only a few are more recent (Morten Meldgaard, pers. comm. 2000). In contrast, Nipisat 1 may span nearly 1500 years, from ca. 4000 to 2500 B.P. (Møbjerg, 1998), but the dog bones are confined to the most *recent* occupations, between

TABLE 2. Summary of dog bones with cut marks from Qeqertasussuk and Qajâ.

Specimen	Element	Location	Description
Qeqertasussak 1983/70-1	Innominate ¹	ischim, acetabular branch	10–11 major scores, and several less conspicuous, oriented perpendicular to long axis; series begins ca. 4 mm; below tuber ischii, terminates ca. 7 mm; below acetabular rim; marks 2–4 mm long, relatively wide and deep
1983/70-2	Femur ¹	Area 1: proximal diaphysis, lateral face	four principal marks, 4–6 mm long, beginning ca. 25 mm below inferior margin of trochanter major; angled down ca 45 dg or more in relation to long axis of bone
		Area 2: mid-diaphysis, posterior face	eight scores angled down sharply, 4–8 mm long
		Area 3: proximal, posterior face	two short scores, ca. 2 mm long, across long axis of bone, just below trochanter major
1983/70-3	Tibia	mid-diaphysis, lateral face	four well demarcated scores, 16–20 mm long, angled sharply down, sub-parallel to long axis of bone
1983/70-18	Tibia	diaphysis, lateral face	faint double score across lateral face, ca. 30 mm above distal epiphysis
1983/70-13	Rib	proximal diaphysis, anterior face	three short, thick scores, ca. 12–14 mm below rib head
1983/70-14	Rib	near distal end	several short, deep scores roughly perpendicular to long axis of bone
983/70-29	Thoracic Vertebra	spinous process, lateral face	two clear scores on left side, roughly perpendicular to axis
Qajâ 1982/350-2	Humerus ¹	distal epiphysis, medial face	two relatively long (ca. 5 mm) and several shorter, fainter scores just above medial ligament of elbow joint
1982/350-3	Femur	diaphysis, medial-posterior face	probable faint scores just below proximal epiphysis; root etching/surface deterioration make identification uncertain

¹ Indicates illustrated specimen; see Figures 4–6.

ca. 3000 and 2500 B.P. (Gotfredsen, 1998). Some gnawing marks on caribou bones from older deposits are attributed to dogs (Gotfredsen, 1998), but in the absence of direct evidence, this interpretation is problematical because damage caused by dogs is difficult to distinguish from that caused by wolves and foxes (Noe-Nygaard, 1989).

In short, dog remains occur at these sites neither commonly nor consistently, and we argue that the archaeological visibility of the animals is extraordinarily low. At each site, several centuries are represented during which little or no evidence of dogs can be gleaned. Considering the nature of the samples under consideration, we presently interpret that pattern in the simplest terms: the people responsible for these presumably seasonal occupations were only occasionally accompanied by one or a few dogs.

Economic Use

The dog remains from these sites are not accompanied by any recognizable sled parts or artifacts that might be associated with sleds; nor has any evidence of dog sledding been found at any Saqqaq site (Gotfredsen, 1996). It should be emphasized that this absence of evidence includes Qeqertasussuk, a context with such extraordinary preservation that the excavated inventory contains numerous wooden artifacts, including hand tools and fragments of a kayak-like vessel frame, along with pieces of animal skin, sinew thread, baleen thong knots, and a variety of plant and insect parts (Böcher and Fredskild, 1993; Grønnow, 1994).

It is of course reasonable to speculate that the Paleoeskimo dogs were used in hunting, or perhaps as individual pack animals (Grønnow and Meldgaard, 1988; Gotfredsen, 1996). Regarding the latter possibility, the Qajâ series includes a single subadult lumbar vertebra that exhibits an abnormally shortened, flattened spinous process. This pathology, like the similar pathologies found on Paleoeskimo canid vertebrae from Banks Island in Canada (Arnold, 1979), could signify that the animal carried a pack during its brief life.

The clearest evidence of economic use of these dogs is in the form of cut marks inflicted by tools (see Guilday et al., 1962; Binford, 1981; Noe-Nygaard, 1989). Table 2 summarizes these cases, and Figures 4–6 provide examples. The first three specimens from Qeqertasussuk, an innominate, a femur, and a tibia, are all from the same individual, thus providing an unusual glimpse of how an entire limb was processed. The scores on innominate 1983/70–1 (Fig. 4) are multiple, wide, and deep, and they cut across the axis of the bone, a pattern consistent with disarticulation of the hind leg from the pelvis (Binford, 1981; Noe-Nygaard, 1989). The accompanying femur (specimen 1983/70–2; Fig. 5) bears three bundles of cut marks, two of which contain narrow, long, well-demarcated scores oriented 45° to nearly parallel to the long axis of the bone, patterns most consistent with filleting meat from the bone (Binford, 1981; Noe-Nygaard, 1989). Similarly, the articulating tibia (1983/70–3) exhibits four long scores angled sharply down with respect to the long axis of the bone. It would appear that the left leg of this animal was



FIG. 4. Most of the ischium portion of a dog innominate from Qeqertasussuk, specimen 1983/70-1, with acetabulum at bottom. Arrows indicate most conspicuous sets of cut marks on the acetabular branch. Photo: Geert Brovad.

removed, and flesh was subsequently carved from around the intact bones.

Elsewhere, Qeqertasussuk rib 1983/70-13 and thoracic vertebra 1983/70-29 exhibit marks that are consistent with filleting the tenderloin from the vertebral column (Binford, 1981; Noe-Nygaard, 1989), while rib 1983/70-14 may reflect dismemberment (Noe-Nygaard, 1989). The clearly marked Qajâ specimen, humerus 1982/350-2 (Fig. 6), most likely indicates disarticulation at the elbow joint or filleting of meat along the forelimb (Binford, 1981; Noe-Nygaard, 1989). No cut marks were observed on the Nipisat 1 specimens, but bone preservation there is the poorest of the three Greenland sites, with exterior surfaces often degraded.

Cut marks resulting from different activities can occur in the same position, and it should be noted that the interpretive models cited above (Binford, 1981; Noe-Nygaard, 1989) concern butchery of large ungulates (caribou, *Rangifer tarandus*, and red deer, *Cervus elaphus*, respectively). As Snyder (1991) has pointed out, however, the anatomical similarity of canids to such ungulates can



FIG. 5. Proximal end of a dog femur from Qeqertasussuk, specimen 1983/70-2, showing cut-marked Area 1 (see Table 3) on the lateral face. Arrows highlight the two most conspicuous of four clear marks. Photo: Geert Brovad.



FIG. 6. Distal end of a dog humerus from Qajâ, specimen 1982/350-2, highlighting the most conspicuous cut mark (arrow) on the medial face. Photo: Geert Brovad.

TABLE 3. Selected measurements (mm) on dog bones from Qeqertasussuk, Qajâ, Nipisat 1, and Igloodik, compared to means from samples of modern Greenland wolves, Greenland Thule Period dogs, and recent Greenland sled dogs. All specimens are adults, and sexes are mixed.

	Archaeological Specimens: Individual Measurements							Reference Series: Means (SD)		
	Qeqertasussuk			Qajâ	Nipisat1	Igloodik	Modern Wolves	Thule Dogs	Recent Sled Dogs	
	35	2	3	2	1	8	1			
Mandible:								n = 9	n = 38	n = 20
Length: from posterior canine (5)					125.8			145.7 (6.8)	117.8 (8.7)	125.1 (7.4)
Tooth row length: from posterior canine (7)					83.2			98.8 (3.8)	79.9 (5.7)	82.8 (4.7)
Corpus height at M1 (19)					27.4			32.4 (2.0)	26.5 (1.9)	28.6 (2.2)
Carnassial (M1) crown length (13a)					23.3			28.7 (1.1)	21.8 (1.2)	22.3 (1.3)
Carnassial (M1) crown breadth (13b)					9.6			11.4 (0.5)	9.0 (0.7)	9.4 (.7)
Humerus:								n = 9	n = 15–17	n = 9
Greatest length from the caput (GLC)	155.9			169.9		157.3		208.1 (10.5)	164.2 (10.0)	179.7 (9.4)
Depth of proximal end (Dp)	44.9			45.6		45.6		54.4 (1.1)	44.4 (3.2)	49.0 (0.6)
Breadth of the distal end (Bd)	36.6			40.2		38.6		44.5 (2.4)	35.7 (3.3)	39.4 (1.7)
Smallest breadth of diaphysis (SD)	14.1			15.1		13.4		15.3 (0.3)	13.7 (1.3)	15.4 (0.3)
Femur:								n = 9	n = 12–13	n = 9
Greatest length from the caput (GLC)		187.6						226.0 (9.5)	(180.7) (12.0)	201.2 (10.4)
Breadth of proximal end (Bp)		40.5						52.0 (2.6)	41.3 (2.8)	46.2 (2.1)
Breadth of the distal end (Bd)		35.4						43.2 (2.2)	34.0 (2.6)	39.8 (1.5)
Smallest breadth of diaphysis (SD)		13.9						15.2 (0.7)	13.2 (0.8)	15.6 (0.8)
Tibia:								n = 0	n = 10–11	n = 9
Greatest length (GL)			183.3			161.3		237.1 (11.7)	170.2 (9.1)	195.5 (10.8)
Breadth of the proximal end (Bp)			37.5			41.8		46.7 (1.9)	36.9 (1.9)	41.7 (1.2)
Breadth of the distal end (Bd)			23.9			25.8		28.5 (1.6)	24.0 (1.6)	27.0 (1.1)
Smallest breadth of diaphysis (SD)			13.2			14.1		14.9 (0.7)	12.8 (1.3)	14.3 (0.6)

be expected to channel butchering activities along similar pathways, thus yielding similar archaeological traces. We concur, and conclude that the inferences suggested above constitute well-founded probabilities. As a group, this cut-marked set of dog bones implies primarily butchering and processing for food. There are no marks that would clearly suggest skinning for the pelt, such as might occur at the distal limb extremities (Snyder, 1991, 1995).

That some of these animals apparently were eaten does not imply that dogs regularly served as dietary fare, or in any other capacity. When surveying the quantity and diversity of animal remains at sites such as Qeqertasussuk, it is easy to forget that the many occupational events represented must surely have included at least some occasions when Saqqaq hunters experienced limited or delayed success in their quest for food. An occasional dog, maintained because conditions had been favourable to that point, may have provided a handy and expendable backup food source while more standard fare was being sought.

OVERVIEW OF PALEOESKIMO DOGS

We argue, on empirical grounds, that pre-Thule peoples in the Eastern Arctic had dogs only sporadically, and at most in small numbers. Moreover, the marginal presence of dogs is not confined to Dorset peoples, but characterizes all pre-Thule peoples, although the animals may have been sparsest during Dorset times. We also argue that this pattern should be expected. Dogs did not emerge as a central feature of Arctic life until team sledding became

important, and team sledding became important only in the context of a lifeway centered heavily on maximization of multi-seasonal group mobility and efficient response to different resource targets over extensive territory. From Mathiassen (1927) to Maxwell (1985), these are recognized as the distinctive characteristics of the Thule lifeway, unmatched by their predecessors. Dogs may have been hitched to sleds occasionally among pre-Thule peoples (e.g., McGhee, 1996), but this practice and its accompanying technology had little chance to take hold outside of a broader organizational and productive strategy that systematically allowed the benefits of maintaining the animals to outweigh the costs. This package included the umiak, a vessel capable of accommodating substantial numbers of dogs alongside people when travel was by open sea. Thus, the practice of dog traction arose intermittently throughout North American Arctic prehistory, but was favoured in an evolutionary sense, and thus rendered a selective advantage to both canids and humans, only as part of the historically contingent circumstances posed by the emergent Thule lifeway. Prior to this process, dogs remained a minor and intermittent component of human ecology in the North American Arctic.

This scenario is at odds with certain elements of conventional interpretation. For example, Knuth (1966/67:201, 1967:50) portrays life among the Paleoeskimo pioneers of the High Arctic, the Independence I and II complex hunters of the “musk-ox way” (Knuth 1966/67) in northern Canada and Greenland. Knuth’s account posits a life during winter’s dark period consisting of several months of semi-hibernation passed in a kind of torpor, with people

using fuel to thaw only enough food and ice to maintain metabolism while inactive. This reconstruction envisions Independence people “retreating into their dreams for several months a year,” nurturing a “way of life that was as rich in the imagination as it was poor in material comforts” (McGhee, 1996:65).

While this dark period reconstruction seems to us both physiologically and psychologically unrealistic, it is at least reasonable to infer that mobility was markedly compromised during this season. Thus, regardless of the literal accuracy of Knuth’s portrayal of winter life, intriguing questions arise concerning the dogs that are sometimes depicted as an integral part of life. How and where did the animals pass winter’s dark period? Would dogs not occasionally have expired during these times, with their carcasses sometimes put to use in ways that would have resulted in archaeological evidence that they were regularly present? Our point in raising these questions is not to suggest that Independence peoples absolutely never had dogs. We would be surprised, however, to find evidence that they routinely did, and note that there is no archaeological evidence to support an assumption that dogs were a regular part of Paleoeskimo life.

Likewise, there is no need to generate a special explanation for the virtual absence of evidence for dogs from Dorset contexts, a pattern that is often regarded as one of several remarkable oddities associated with these people (e.g., Maxwell, 1985; Dumond, 1987; McGhee, 1996). Given overall limitations to their mobility and associated subsistence production, we find nothing odd about the Dorset pattern.

Finally, if the arguments advanced here are correct in general, they lead to several expectations regarding the occasional Paleoeskimo dogs that are encountered archaeologically. For example, we predict that they will turn out, on average, to be larger or stouter (or both) than Thule sled dogs. This pattern is suggested by data summarized here (Fig. 3, Table 1), although it remains to be rigorously evaluated. We have not yet attempted systematically, for example, to distinguish geographic variation from temporal variation. We anticipate this pattern because of the differing ecological circumstances of pre-Thule versus Thule dogs. Beyond possessing basic good health and conformation, sled dogs are under selective pressure primarily for behavioural traits that are conducive to management within coordinated teams. Size and strength per se are not at a premium, and in fact large sled dogs (over 25 kg) typically have less endurance because of their reduced capacity to dissipate heat efficiently (Coppinger and Schneider, 1995). Figure 3 and Table 1 also suggest that the modern Greenland sled dogs are larger than Thule dogs. If this pattern holds under closer scrutiny, we suspect it is because (1) most of the recent dogs are from northern and eastern Greenland, where heat retention is potentially advantageous, and (2) dog sledding is no longer the vital component of life that it was for the immediate predecessors of Inuit peoples in many parts of Greenland. Phrased

differently, current selective pressures on the dogs do not replicate pre-colonial circumstances.

In contrast, if pre-Thule dogs were used as pack animals, the viability of these animals may have hinged more on their individual capacity to endure heavy loads, working with people whose overland (and ice) travel expectations were more modest than those of later Thule peoples. Size and strength would have played a greater role in shaping the selective regime in this sparse population. These predictions are largely speculative, and we offer them simply to emphasize that an ephemeral presence for pre-Thule dogs does not render them uninteresting or unworthy of further investigation. To the contrary: from a theoretical perspective, tracking the evolution of the canid-human domestic relationship in the Eastern Arctic becomes an even more intriguing challenge.

CONCLUSION

From a traditional standpoint, dogs just seem to make sense in the Arctic (e.g., Dumond, 1987). They can provide important services as draft animals, hunting aides, raw material for tools and clothing, and, at least in a pinch, a source of food. Bolstered by the compelling record of dogs as a key component of life among many recent Inuit and Thule groups, the fact of their occasional occurrence among some Paleoeskimos underlies reconstructions that depict the animals as routinely present and important. Moreover, it is easy to appreciate why some archaeologists have expected to find evidence that dogs played an integral role prior to Thule times. Thule people, with their dog teams (and boats), apparently moved from Alaska to Greenland in little more than a century. Several thousand years earlier, pre-Dorset Paleoeskimos probably traversed the same tract in little more time than it took the Thule people. Thus, it has seemed reasonable to expect that similar aids to mobility were part of the Paleoeskimo colonization of the Eastern Arctic as well. In the end, however, this expectation reflects errant preconceptions about the requirements of life in the Arctic, for the archaeological record increasingly indicates that Paleoeskimos colonized and lived in the remotest corners of this region with little or no help from dogs. Moreover, considering the maintenance demands of dogs, we believe, in contrast to Arnold (1979), McGhee (1996), and others, that the scarcity or periodic absence of dogs in Paleoeskimo times should be expected. Indeed, we would be surprised if future discoveries reveal that these early peoples of the Eastern Arctic ever maintained the animals consistently or in substantial numbers.

ACKNOWLEDGEMENTS

We are grateful to the American-Scandinavian Foundation, the Wenner-Gren Foundation for Anthropological Research, Denmark’s Commission for Scientific Research in Greenland, and the University

of Kansas General Research Fund for supporting this research through grants to D. Morey. Space and logistical support for the analysis of dog remains from Greenland has been provided by the Zoological Museum, University of Copenhagen, and we especially thank Knud Rosenlund, Jeppe Møhl, Morten Meldgaard, Georg Nyegaard, and Gitte Gotfredsen for their help on different fronts. Geert Brovad provided the photographs. Finally, our warm thanks go to Jørgen Meldgaard, Morten Meldgaard, Bjarne Grønnow, Gitte Gotfredsen, and Chris Darwent, who provided invaluable assistance during the preparation of this paper.

REFERENCES

- ACKERMAN, R.E. 1984. Prehistory of the Asian Eskimo zone. In: Damas, D., ed. *Arctic. Handbook of North American Indians*, Vol. 5. Washington, D.C.: Smithsonian Institution. 106–118.
- APPELT, M. 1998. Late and Terminal Dorset at the gateway to Greenland: Field campaigns 1996–1997. Paper presented at the 6th Arctic Archaeology Conference, 30–31 October, Fayetteville, Arkansas.
- ARIMA, E.Y. 1984. Caribou Eskimo. In: Damas, D., ed. *Arctic. Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 447–462.
- ARNOLD, C.D. 1979. Possible evidence of domestic dog in a Paleoeskimo context. *Arctic* 32:263–265.
- . 1981. The Lagoon site (OjR1-3): Implications for Paleoeskimo interactions. Mercury Series, Archaeological Survey of Canada Paper No. 107. Ottawa: National Museum of Man.
- BELLARS, A.R.M. 1969. Veterinary studies on the British Antarctic Survey's sledge dogs: I. Survey of diseases and accidents. *British Antarctic Survey Bulletin* 21:1–18.
- BELLARS, A.R.M., and GODSALL, M.F. 1969. Veterinary studies on the British Antarctic Survey's sledge dogs: II. Occupational osteoarthritis. *British Antarctic Survey Bulletin* 22:15–38.
- BENDIX, B. 1998. Appendix 2: Quaternary zoology. In: Arneborg, J., and Gulløv, H.C., eds. *Man, culture and environment in ancient Greenland: Report on a research programme*. Copenhagen: The Danish National Museum and Danish Polar Center. 188–190.
- . 1999. Late Dorset faunal remains from sites at Hatherton Bay, Thule District, Greenland. Unpubl. Master's thesis, Zoological Museum, University of Copenhagen, Denmark.
- BINFORD, L.R. 1980. Willow smoke and dogs' tails: Hunter-gatherer settlement systems and archaeological site formation. *American Antiquity* 45:4–20.
- . 1981. *Bones: Ancient men and modern myths*. New York: Academic Press.
- BÖCHER, J., and FREDSKILD, B. 1993. Plant and arthropod remains from the Palaeo-Eskimo site on Qeqertasussuk, west Greenland. *Meddelelser om Grønland, Geoscience* 30.
- CLELAND, C.E. 1973. Appendix I: Notes on the dog skull from Nanook component 2. In: Maxwell, M.S. *Archaeology of the Lake Harbour District, Baffin Island*. Mercury Series, Archaeological Survey of Canada Paper 6. Ottawa: National Museum of Man. 353–356.
- CLUTTON-BROCK, J. 1995. Origins of the dog: Domestication and early history. In: Serpell, J., ed. *The domestic dog: Its evolution, behaviour and interactions with people*. Cambridge: Cambridge University Press. 7–20.
- CONDON, R.G. 1996. *The northern Copper Inuit: A history*. Norman: University of Oklahoma Press.
- COPPINGER, R., and SCHNEIDER, R. 1995. Evolution of working dogs. In: Serpell, J., ed. *The domestic dog: Its evolution, behaviour and interactions with people*. Cambridge: Cambridge University Press. 21–47.
- CROSS, E.C. 1940. Arthritis among wolves. *Canadian Field-Naturalist* 54:2–4.
- DAMAS, D., ed. 1984a. *Arctic. Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution.
- . 1984b. Central Eskimo: Introduction. In: Damas, D., ed. *Arctic. Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 391–396.
- . 1984c. Copper Eskimo. In: Damas, D., ed. *Arctic. Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 397–414.
- DARWENT, C.M. 1994. Zooarchaeological analysis in the Canadian Arctic. *Canadian Zooarchaeology* 5:2–15.
- . 1995. Late Dorset faunal remains from the Tasiarulik site, Little Cornwallis Island, central high Arctic, Canada. Unpubl. M.A. thesis, Department of Archaeology, Simon Fraser University, Vancouver, British Columbia.
- . 1999. Interpreting the subsistence of the first high Arctic occupants. In: *On being first: Cultural and environmental consequences of first peopling*. In: Gillespie, J., Tupaka, S., and de Mille, C., eds. *Proceedings of the 31st Annual Chacmool Conference*. Calgary, Alberta: The Archaeological Association of the University of Calgary. 391–407.
- DAWES, P.R., ELANDER, M., and ERICSON, M. 1986. The wolf (*Canis lupus*) in Greenland: A historical review and present status. *Arctic* 39:119–132.
- DUMOND, D. 1984. Prehistory of the Bering Sea region. In: Damas, D., ed. *Arctic. Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 94–105.
- . 1987. *The Eskimos and Aleuts*. 2nd ed. London: Thames and Hudson.
- FITZHUGH, W.H. 1984. Paleoeskimo cultures of Greenland. In: Damas, D., ed. *Arctic. Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 528–539.
- FREUCHEN, P. 1935. Part II. Field notes and biological observations. In: *Report of the Fifth Thule Expedition 1921–1924*, Vol. 2 (4–5). Copenhagen: Gyldendal. 68–278.
- GILBERG, R. 1984. Polar Eskimo. In: Damas, D., ed. *Arctic. Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 577–594.
- GLOB, P.V. 1935. Eskimo settlements in Kempe Fjord and King Oscar Fjord. *Meddelelser om Grønland* 102(2).
- GOLDMAN, E.A. 1944. Part II: The classification of wolves. In: Young, S.P., and Goldman, E.A. *The wolves of North America*. Washington D.C.: The American Wildlife Institute. 389–636.
- GOTFREDSEN, A.B. 1996. The fauna from the Saqqaq site of Nipisat 1, Sisimiut District, West Greenland: Preliminary results. In: Grønnow, B., and Pind, J., eds. *The Paleo-Eskimo cultures of*

- Greenland: New perspectives in Greenlandic archaeology. Copenhagen: The Danish Polar Center. 97–110.
- . 1998. The faunal material of the Saqqaq site Nipisat 1, Sisimiut District, west Greenland. In: Arneborg, J., and Gulløv, H.C., eds. *Man, culture and environment in ancient Greenland*. Copenhagen: The Danish Polar Center. 124–132.
- GRØNNOW, B. 1988. Nye perspektiver i Saqqaq-forskningen: En orientering om de tværfaglige undersøgelser på bopladsen Qeqertasussuk, Christianshåb Kommune. In: Møbjerg, T., Grønnow, B., and Schultz-Lorentzen, H., eds. *Palaeoeskimoisk forskning i Grønland*. Aarhus: Aarhus Universitetsforlag. 21–38.
- . 1990. Prehistory in permafrost: Investigations at the Saqqaq site, Qeqertasussuk, Disco Bay, West Greenland. *Journal of Danish Archaeology* 27:24–39.
- . 1994. Qeqertasussuk—The archaeology of a frozen Saqqaq site in Disko Bugt, west Greenland. In: Morrison, D., and Pilon, J., eds. *Threads of Arctic prehistory: Papers in honor of William E. Taylor, Jr.* Archaeological Survey of Canada Paper 149. Hull, Quebec: Canadian Museum of Civilization, Mercury Series. 197–238.
- GRØNNOW, B., and MELDGAARD, M. 1988. Boplads i dybfrost. *Naturens Verden* 1988:409–440.
- GUILDAY, J.E., PARMALEE, P.W., and TANNER, D. 1962. Aboriginal butchering techniques at the Eschelman site, Lancaster County, Pennsylvania. *Pennsylvania Archaeologist* 33:2: 59–83.
- GULLØV, H.C. 1997. From Middle Ages to colonial time: Archaeological and ethnohistorical studies of the Thule culture in south west Greenland 1300–1800 AD. *Meddelelser om Grønland, Man & Society* 23.
- HARRIS, S. 1977. Spinal arthritis (*Spondylosis deformans*) in the red fox *Vulpes vulpes* with some methodology of relevance to zooarchaeology. *Journal of Archaeological Science* 4: 183–195.
- HELMER, J.W. 1981. Climate change and Dorset culture change in the Crozier Strait region, N.W.T.: A test of the hypothesis. Unpubl. Ph.D. dissertation, Department of Archaeology, University of Calgary, Alberta.
- . 1991. The Palaeo-Eskimo prehistory of the north Devon lowlands. *Arctic* 44:301–317.
- KEMP, W.B. 1984. Baffinland Eskimo. In: Damas, D., ed. *Arctic Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 463–475.
- KLEIVAN, I. 1984. West Greenland before 1950. In: Damas, D., ed. *Arctic Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 595–621.
- KNUTH, E. 1966/67. The ruins of the musk-ox way. *Folk* 8–9:191–219.
- . 1967. Archaeology of the musk-ox way. *Contributions du Centre d'Études Arctiques et Finno-Scandinaves* No. 5. Paris: École Pratique Des Hautes Études–Sorbonne.
- KRAMER, F.E. 1996. Akia and Nipisat 1: Two Saqqaq sites in Sisimiut District, west Greenland. In: Grønnow, B., and Pind, J., eds. *The Paleo-Eskimo cultures of Greenland: New perspectives in Greenlandic archaeology*. Copenhagen: The Danish Polar Center. 65–96.
- KRUPNIK, I. 1993. *Arctic adaptations*. Hanover, New Hampshire: Dartmouth College, University of Press of New England.
- LARSEN, H. 1934. Dødemandsbugten: An Eskimo settlement on Clavering Island. *Meddelelser om Grønland* 102(1).
- LYMAN, R.L. 1994. *Vertebrate taphonomy*. Cambridge: Cambridge University Press.
- MARY-ROUSSELIÈRE, G. 1976. The Paleoeskimo in northern Baffinland. In: Maxwell, M.S., ed. *Eastern Arctic prehistory: Paleoeskimo problems*. Society for American Archaeology, *Memoir* 31. 40–57.
- . 1984. Iglulik. In: Damas, D., ed. *Arctic Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 431–446.
- MATHIASSEN, T. 1927. Archaeology of the Central Eskimos, the Thule culture and its position within the Eskimo culture. Report of the Fifth Thule Expedition, 1921–1924, Vol. 4. Copenhagen: Gyldendal.
- . 1930. Inugsuk, A mediaeval Eskimo settlement in Upernivik District, west Greenland. *Meddelelser om Grønland* 77(4).
- . 1931. Ancient Eskimo settlements in the Kangamiut area. *Meddelelser om Grønland* 91(1).
- . 1933. Prehistory of the Angmagssalik Eskimos. *Meddelelser om Grønland* 92(4).
- . 1934. Contributions to the archaeology of Disko Bay. *Meddelelser om Grønland* 93(2).
- MAXWELL, M.S. 1984. Pre-Dorset and Dorset prehistory of Canada. In: Damas, D., ed. *Arctic Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 359–368.
- . 1985. *Prehistory of the eastern Arctic*. Orlando: Academic Press.
- McCARTNEY, P.H. 1989. Paleoeskimo subsistence and settlement in the high Arctic. Unpubl. Ph.D. dissertation, Department of Archaeology, University of Calgary, Alberta.
- McGHEE, R. 1979. The Paleoeskimo occupations at Port Refuge, high Arctic Canada. Mercury Series, Archaeological Survey of Canada Paper 92. Ottawa: National Museum of Man.
- . 1984. The Thule village at Brooman Point, high Arctic Canada. Mercury Series, Archaeological Survey of Canada Paper 125. Ottawa: National Museum of Man.
- . 1996. *Ancient people of the Arctic*. Vancouver: UBC Press.
- MELDGAARD, J. 1960a. Prehistoric culture sequences in the Eastern Arctic as elucidated by stratified sites at Igloolik. In: Wallace, A.F.C., ed. *Men and cultures: Selected papers of the Fifth International Congress of Anthropological and Ethnological Sciences*. Philadelphia: University of Pennsylvania Press. 588–595.
- . 1960b. Origin and evolution of Eskimo cultures in the Eastern Arctic. *Canadian Geographical Journal* 60:64–75.
- . 1983. Qajã, en køkkenmødding i dybfrost: Feltrapport fra arbejdsmarken i Grønland. Copenhagen: Nationalmuseets Arbejdsmark 1983:83–96.
- MELDGAARD, M. 1995. Resource pulses in a marine environment: A case study from Disko Bugt, west Greenland. In: Fischer, A., ed. *Man and sea in the Mesolithic: Coastal settlement above and below present sea level*. Oxbow Monograph 13. Oxford: Oxbow Books. 361–368.

- MOREY, D.F. 1986. Studies on Amerindian dogs: Taxonomic analysis of canid crania from the Northern Plains. *Journal of Archaeological Science* 13:119–145.
- . 1992a. Economic use of domestic dogs in the Arctic: A zooarchaeological view from Greenland. Paper presented at the Society for American Archaeology Meetings, 8–12 April, Pittsburgh, Pennsylvania.
- . 1992b. Size, shape, and development in the evolution of the domestic dog. *Journal of Archaeological Science* 19: 181–204.
- . 1994. The early evolution of the domestic dog. *American Scientist* 82:336–347.
- . 1997. Analysis of archaeological dog remains from Greenland: A progress report. Report submitted to the Commission for Scientific Research in Greenland, Danish Polar Center, Copenhagen.
- MURRAY, M.S. 1996. Economic change in the Palaeoeskimo prehistory of the Foxe Basin, N.W.T. Unpubl. Ph.D. dissertation, Department of Anthropology, McMaster University, Hamilton, Ontario.
- MØBJERG, T. 1998. The Saqqaq culture in the Sisimiut municipality elucidated by the two sites Nipisat and Asummiut. In: Arneborg, J., and Gulløv, H.C., eds. *Man, culture and environment in ancient Greenland*. Copenhagen: The Danish Polar Center. 98–118.
- MØHL, J. 1982. Ressourceudnyttelse fra Norrøne og Eskimoiske affaldslag belyst gennem knoglematerialet. *Grønland* 1982 (8–9):286–295.
- . 1986. Dog remains from a Paleoeskimo settlement in west Greenland. *Arctic Anthropology* 23(1-2):81–89.
- . 1997. Greenland—A Quaternary zoological view. In: Gilberg, R., and Gulløv, H.C., eds. *Fifty years of Arctic research: Anthropological studies from Greenland to Siberia*. Copenhagen: Publications of the National Museum of Denmark, Ethnographical Series, Vol. 18. 237–242.
- NAGY, M.I. 1997. Palaeoeskimo cultural transition: A case study from Ivujivik, Eastern Arctic. Unpubl. Ph.D. dissertation, Department of Anthropology, University of Alberta, Edmonton.
- NOE-NYGAARD, N. 1989. Man-made trace fossils on bones. *Human Evolution* 4:461–491.
- NOWAK, R.M. 1983. A perspective on the taxonomy of wolves in North America. In: Carbyn, L.N., ed. *Wolves in Canada and Alaska: Their status, biology, and management*. Edmonton, Alberta: Canadian Wildlife Service, Report Series No. 45. 10–19.
- OLSEN, S.J. 1985. *Origins of the domestic dog*. Tucson: University of Arizona Press.
- PALMER, N. 1993. Bones and joints. In: Jubb, K.V.F., Kennedy, P.C., and Palmer, N., eds. *Pathology of domestic animals*. Vol. 1, 4th ed. New York: Academic Press. 181 p.
- PARK, R.W. 1987. Dog remains from Devon Island, N.W.T.: Archaeological and osteological evidence for domestic dog use in the Thule culture. *Arctic* 40:184–190.
- PITUL'KO, V.V., and KASPAROV, A.K. 1996. Ancient Arctic hunters: Material culture and survival strategy. *Arctic Anthropology* 33:1–36.
- ROWLEY, G. 1940. The Dorset culture of the Eastern Arctic. *American Anthropologist* 42:490–499.
- SALADIND'ANGLURE, B. 1984. Inuit of Quebec. In: Damas, D., ed. *Arctic. Handbook of North American Indians*, Vol. 5. Washington D.C.: Smithsonian Institution. 476–507.
- SCHLEDERMANN, P. 1975. Thule Eskimo prehistory of Cumberland Sound, Baffin Island, Canada. Mercury Series, Archaeological Survey of Canada Paper 38. Ottawa: National Museum of Man.
- . 1990. *Crossroads to Greenland: 3000 years of prehistory in the eastern high Arctic*. Calgary: The Arctic Institute of North America, Komatik Series No. 2.
- SNYDER, L.M. 1991. Barking mutton: Ethnohistoric, ethnographic, archaeological, and nutritional evidence pertaining to the dog as a Native American food resource on the Plains. In: Purdue, J.R., Klippel, W.E., and Styles, B.W., eds. *Beamers, bobwhites, and blue-points: Tributes to the career of Paul W. Parmalee*. Springfield: Illinois State Museum Scientific Papers, Vol. 23. 359–378.
- . 1995. Assessing the role of the domestic dog as a Native American food resource in the Middle Missouri Subarea A.D. 1000–1840. Unpubl. Ph.D. dissertation, Department of Anthropology, University of Tennessee, Knoxville.
- TAYLOR, W.E., Jr., and MCGHEE, R. 1979. Archaeological material from Creswell Bay, N.W.T., Canada. Mercury Series, Archaeological Survey of Canada Paper No. 85. Ottawa: National Museum of Man.
- VIBE, C. 1967. Arctic animals in relation to climatic fluctuations. *Meddelelser om Grønland* 170(5).
- . 1981. Pattedyr (Mammalia). In: Salmonsens, F., ed. *Grønlands fauna*. Copenhagen: Gyldendal. 363–459.
- VON DEN DRIESCH, A. 1976. A guide to the measurement of animal bones from archaeological sites. Harvard University, Peabody Museum of Archaeology and Ethnology, Bulletin 1