

## The Wolf (*Canis lupus*) in Greenland: A Historical Review and Present Status

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**ABSTRACT.** In the past few decades, little information on the wolf (*Canis lupus*) in Greenland has been published. The decline of the species and its extirpation in the late 1930s from East Greenland is well documented. Since then, there has been a tendency for wolves sighted in the North and East Greenland National Park to be classified as temporary visitors wandering afar from adjacent Canada, with no prospect of survival in Greenland for anything but a short period. In view of the virtual absence of human population in this vast region, that assumption may not be accurate.

There is now abundant evidence to indicate that a renewed immigration and dispersal of wolves has been taking place during the last years, with a migration route from Ellesmere Island eastward across North Greenland into Peary Land, and then southward into the fjord region of central East Greenland. The wolf is reoccupying its former range and by the winter of 1983 wolves had reached the Scoresby Sund region — the species' southernmost territory of the 1930s.

Examination of the published records and all available unpublished data provides a historical picture of the status of the wolf in Greenland, from which some conclusions can be made regarding populations, pack size, migration routes, feeding habits and travelling distances.

**Key words:** wolf, *Canis lupus*, Greenland, history, distribution, migration, re-establishment, High Arctic

**RÉSUMÉ.** Peu d'information a été publiée au cours des dernières décennies sur le loup (*Canis lupus*) au Groenland. La diminution de l'espèce et son extirpation à la fin des années 1930 dans l'est du Groenland sont bien documentées. Depuis ce temps, les loups observés dans le nord et l'est du Parc national du Groenland ont surtout été classifiés comme des visiteurs voyageant loin du Canada adjacent, sans chance de survivance au Groenland sauf peut-être pour une courte période de temps. Vu l'absence presque totale de population humaine dans cette vaste région, cette supposition est peut-être fautive.

Des preuves abondantes signalent maintenant qu'il se produit depuis quelques années une immigration et une dispersion renouvelées de loups, suivant une voie de migration passant de l'île d'Ellesmere au nord du Groenland et jusqu'à la Terre de Peary, et ensuite vers le sud dans la région des fjords du centre de l'est du Groenland. Le loup est en train d'occuper à nouveau son territoire d'origine, de sorte qu'à l'hiver de 1983, des loups avaient atteint la région du détroit de Scoresby, qui composait la limite maximale sud de leur territoire des années 1930.

L'étude des dossiers publiés et de toutes les données disponibles non publiées présente un récit historique de l'état du loup au Groenland nous permettant de tirer certaines conclusions quant à la population, la taille des meutes, les voies de migration, les habitudes alimentaires et les distances parcourues.

**Mots clés:** loup, *Canis lupus*, Groenland, histoire, distribution, migration, rétablissement, nord de l'Arctique

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### INTRODUCTION

Today fully viable populations of the wolf (*Canis lupus*) are found only in Alaska, Canada and parts of the north-central U.S.A. (Minnesota) in the Nearctic region, and in Finland, the Soviet Union, Iran and Yugoslavia in the Palearctic region (Pulliainen, 1980; Mech, 1982). Originally, the wolf was distributed in suitable habitats throughout the northern hemisphere, but during the last century its range has decreased considerably, mainly due to persecution by man and various forms of habitat and prey destruction. In this respect, the history of the wolf in Greenland has been no exception.

Within the general pattern of decline there have been distinct periods of recovery in some regions. One of the most notable has been in western North America from the 1930s to the early 1950s, during which the wolf reclaimed substantial areas of its former range (Nowak, 1983). In this paper we document evidence that indicates a present-day wolf recovery in Greenland.

In the early part of this century, the wolf was not uncommon in North and East Greenland, and in the fjord region of central East Greenland it was persecuted by trappers (Manniche, 1910; Gjaever, 1930, 1939; Pedersen, 1934; Jennov, 1945). There is satisfactory documentation for the decline in the wolf population of East Greenland at the end of the 1930s, and by the early '40s the species was undoubtedly exterminated there. However,

the situation from North Greenland in the same period is uncertain due to the total absence of human occupation between the mid-1920s and the end of the 1940s.

Following World War II and the cessation of the Norwegian and Danish trapping and hunting activities, little or no attention was paid to the status of the wolf in Greenland, and for many years the species was regarded as extirpated. Thus, Johnsen (1953:108) concluded that "at present it is very questionable whether the Polar Wolf can be listed among the mammals of Greenland." The sporadic sightings in the decades since 1950 have been interpreted by zoologists as but stray animals incidentally reaching Greenland from the established wolf territories of adjacent northern Canada. Despite the increased numbers of documented sightings, the wolf has generally not been regarded as having real existence possibilities for a permanent repopulation of Greenland (Vibe, 1967, 1981). This conclusion has, however, been questioned (Dawes, 1978). The frequent sightings since 1978 in both North and East Greenland, including observations of packs, indicate that the wolf is reclaiming its former range of the 1930s.

This paper defines the present status of the wolf in Greenland and portrays the species' historical standing since the last century. Observations from a literature survey, as well as hitherto unpublished sightings, have been compiled into four maps that span the period 1871-1984. The region shown on the

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four maps includes the extensive North and East Greenland National Park (Fig. 1), which historically is the wolf's natural territory in Greenland. Also provided is a brief summary of the species' occurrence in western Greenland.

THE GREENLAND WOLF

The wolf, with its extensive circumpolar range, exhibits considerable morphological variation. In North America two main groups of wolves have been distinguished, *viz.*, the

“tundra wolves” and the “timber wolves” (Kelsall, 1968; Mech, 1970). Usually the former can be recognized by their generally lighter colour, more rounded ears and longer and more luxuriant fur. The Greenland wolf belongs to this group (Fig. 2). The present distribution area of tundra wolves extends from Greenland, westward across the Canadian Arctic Archipelago and the northern parts of the Canadian mainland west of Hudson Bay to the northern slopes of Alaska.

Taxonomists have split *Canis lupus* into a number of geographical races that have been summarized by Mech (1970).

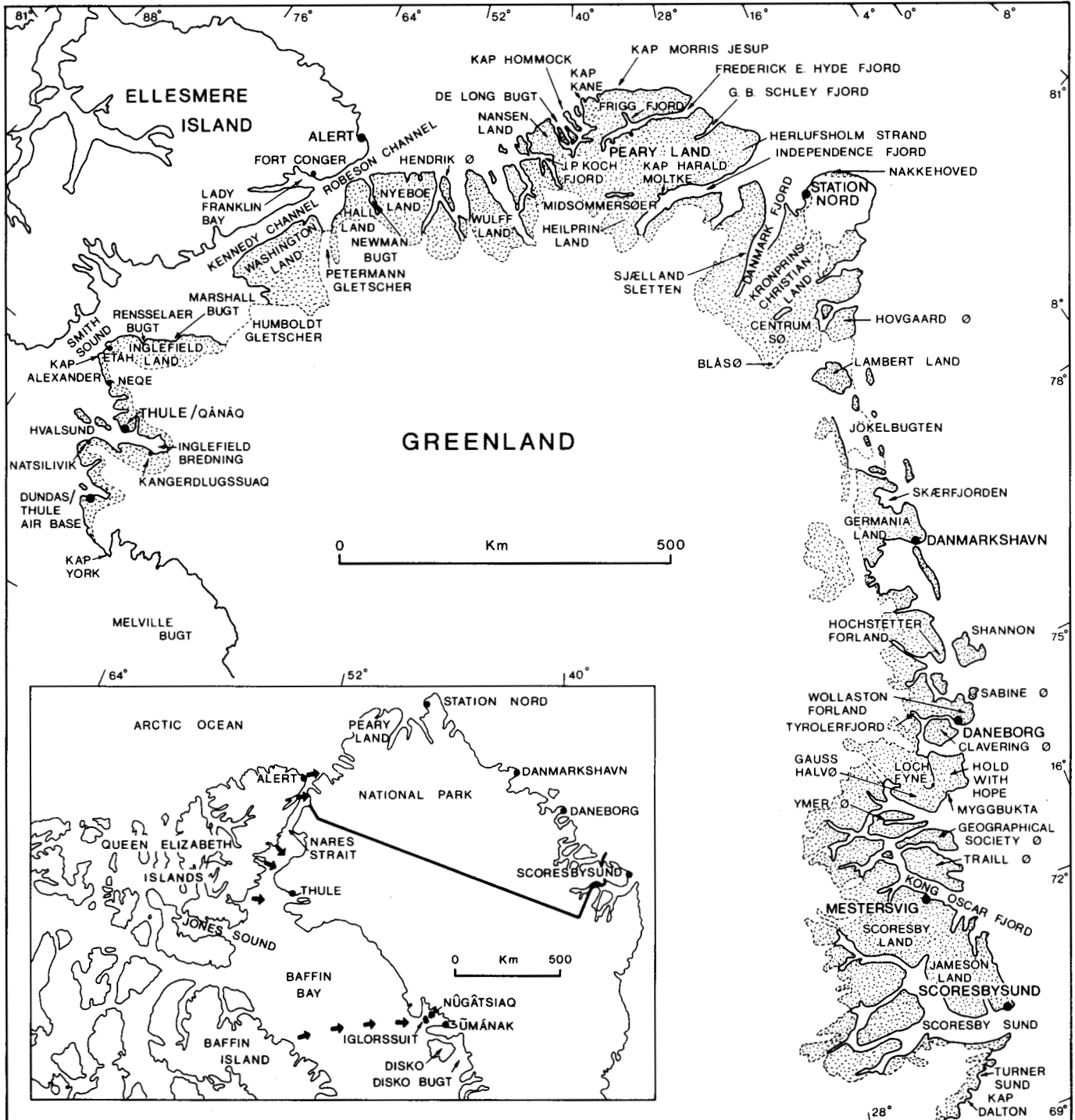


FIG. 1. Location map of Greenland and adjacent Canada showing on the inset map the three main migration routes taken by wolves into Greenland and the boundary of the North and East Greenland National Park.

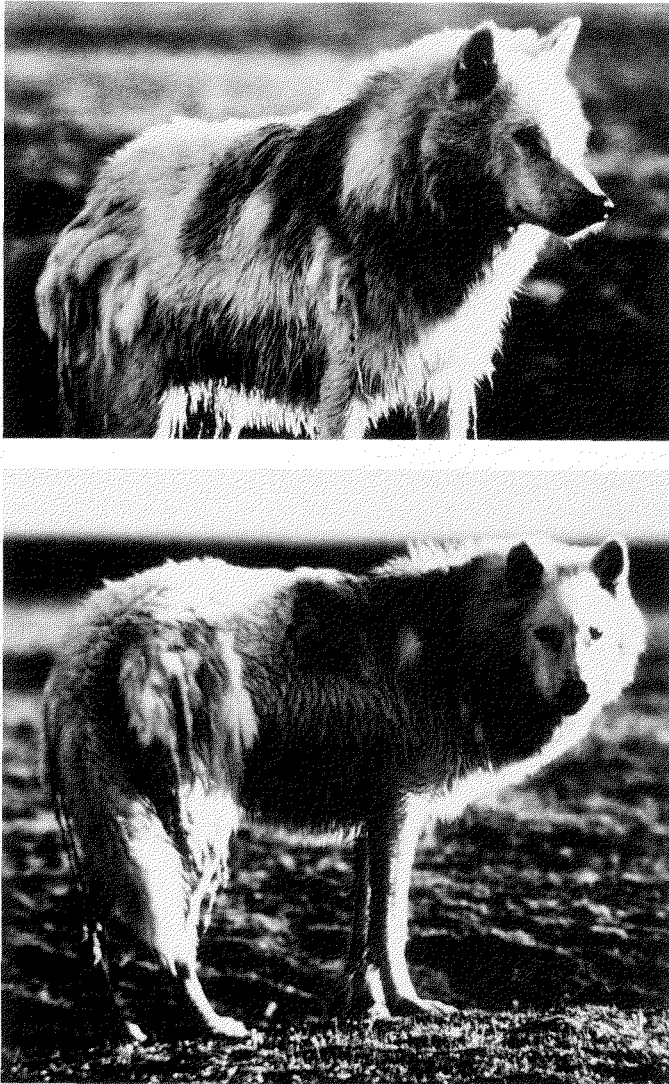


FIG. 2. Greenland wolf, photographed at Myggbukta, Hold with Hope, June 1982.

While there is general consensus that the morphological variation shown by wolves from various parts of their range may be classified at the subspecies level, there is considerable controversy about which morphological characteristics should be employed in taxonomic method, and hence also in the actual number of subspecies that may be distinguished. The situation

can be illustrated by the work of Hall and Kelson (1959), who recognize 24 subspecies of wolf in North America (including Greenland) — a classification upheld by Hall (1981) — while others, e.g., Kelsall (1968), Banfield (1974) and Nowak (1983) argue for a substantial reduction in the number of subspecies.

The controversy surrounding the systematics of the wolf can be specifically illustrated by the questionable separation of a Greenland subspecies, *Canis lupus orion* from *C. l. arctos* that occupies the Queen Elizabeth Islands in northern Canada (Fig. 1) (Pocock, 1935; Goldman, 1944). The wolf is fairly common in the Queen Elizabeth Islands, and on Ellesmere Island — the land closest to Greenland — packs of up to 20 animals have been recorded (Riewe, 1975; Grace, 1976). It is generally acknowledged that the Greenlandic wolves are migrants from Canada (Vibe, 1967), and the documented reports of wolves on the sea ice in both the northern and southern parts of Nares Strait suggest that migration is frequent and still persists (Dawes, 1978). It seems unlikely that the Greenland wolf has at any time developed subspecies characteristics distinct from its Canadian counterpart. Periods of population decline and extirpation in Greenland would be followed by invasion from the west, and the Greenland range would be re-established by “Canadian” wolves.

The problematic recognition of *C. l. orion* as an authentic Greenlandic subspecies apparently originates from the limited analytical data available from what is, and presumably always has been, a very small population. It should be stressed that no systematic quantitative data are available from populations of the Greenland wolf that can be adequately compared with the relevant data from North America. The sparse biometric data of Greenlandic wolves are presented in Table 1, and these depict a small- to medium-sized subspecies. However, it should be noted that the characteristic light weight of both males and females, as shown in Table 1, derives from only five animals killed in northeastern Greenland by the 1906-08 Danmark Expedition (Manniche, 1910). The low weight of these particular wolves probably reflects malnutrition in winter rather than a distinct morphological difference between a true Greenlandic subspecies and other High Arctic tundra wolves.

The Greenland wolf, according to Nowak (1983), was the predecessor of the present-day wolves that inhabit the Queen Elizabeth Islands. Nowak suggests that two disjunct wolf stocks evolved in the ice-free areas on the north side of the late Pleistocene (Wisconsin) ice sheet: one in the Peary Land refugium of North Greenland, the other in Alaska. Following ice regression, the Peary Land stock spread westward (and

TABLE 1. Weight (kg) and length (cm) of the Greenland wolf with comparative data from North America

Location	No.	Sex	Average	Min.	Max.	Reference
<b>Weight</b>						
E. Greenland	2	M	27	25	29	Manniche, 1910
	3	F	26	20.5	35	Manniche, 1910
N.W.T., Canada	18	M	44.5	41	52.5	Fuller and Novakowski, 1955
	21	F	38.5	32	50	Fuller and Novakowski, 1955
Jones Sound,	2	M	38.5	34	43	Riewe, 1975
N.W.T., Canada	2	F	24	23.5	25	Riewe, 1975
<b>Length</b>						
N.E. Greenland	4	M	155	148	165	Kolthoff, 1903; Manniche, 1910
	4	F	151	141	160	Pedersen, 1934
North America		M		152	198	Mech, 1970
		F		137	183	Mech, 1970

presumably also southward into East Greenland) across much of the Queen Elizabeth Islands, while the Alaskan population migrated to the east and south to give rise to the wolves of a "northern group" that occupy much of the mainland of Canada, including Baffin Island. The former wolves are referred by Nowak (1983) to *C. l. arctos*. Other wolf stocks, isolated south of the ice sheet, migrated northward to interact with the northern group.

Irrespective of whether this speculative evolution is correct, it seems reasonable with the current state of knowledge to refer the wolves of North and East Greenland (including those of the Thule district, see Fig. 1) to the same subspecies as that in the eastern Queen Elizabeth Islands, i.e., *C. l. arctos*. On the other hand, the wolves that periodically visit central West Greenland are almost certainly immigrants from Baffin Island, which, following current systematics, are referred to a separate subspecies, *C. l. manningi* (Hall, 1981; Nowak, 1983).

#### HUMAN GEOGRAPHY AND WOLF DATA

The North and East Greenland National Park is an ice-bound region having an ice-free area of approximately 350 000 km<sup>2</sup>. The park has no indigenous human population, and the only permanently manned outposts are the weather, airport and military stations, such as Station Nord, Danmarkshavn and Mestersvig, which today house a total of about 40 persons (Fig. 1). The nearest Greenlandic settlements are those in the Thule and Scoresbysund districts, and only hunting excursions from the latter area reach northward into the national park. The only normal out-of-summer visits to the park that extend to its western, northern and southern extremities are made by parties of the Sirius Sledge Patrol travelling from the headquarters at Daneborg in East Greenland.

The wolf data discussed in this paper should be viewed in the light of this geographical situation — a vast region having a very small, extremely localized permanent human population and a larger and more widespread, although still sparse, seasonal population. While several expeditions to North and East Greenland have been directed to surveys of terrestrial mammals, the wolf has not been the subject of any systematic survey. The observations synthesized in this paper include those recorded during various interdisciplinary scientific expeditions (mainly from published sources) and incidental (often unpublished) sightings made by expedition members or at manned outposts. Much of the unpublished data from the recent period, 1976-84, originates from observations in the archives of the Geological Survey of Greenland, the Sirius Sledge Patrol and other Danish state and private expeditions.

All wolf sightings, published or otherwise, known to the present authors are included in Figures 3, 4, 5 and 6. Wolf tracks are also included on all these maps, except Figure 6, but the map designation of the published record of tracks is not complete. Hence, in those cases where both tracks and animals are reported in the same locality and at the same general time, only the actual wolf sighting(s) has been included on the maps. Several unpublished records of animal tracks that cannot be confirmed have been omitted. For the period 1976-84 the numerous reports of tracks essentially endorse the distribution pattern depicted by the actual wolf sightings, and for the sake of clarity these have been omitted from Figure 6. Moreover, the sightings for the seven years of this period are designated on the map with the year of observation, so that some idea of the movement paths of wolves can be deduced.

In view of the geography of the region, the wolf distribution data shown in Figures 3, 4, 5 and 6 have some obvious shortcomings. On a regional scale, the information is clearly heterogeneous. Thus, large areas devoid of sightings or tracks may not necessarily indicate corresponding absence of the wolf throughout the given period, but rather the lack of any expedition activity. Likewise, the high density of sightings in a particular area may reflect the number or duration of expeditionary forces in the area, rather than define a discrete concentration or pocket of wolf habitation.

Nevertheless, despite these shortcomings, the data serve to illustrate some interesting trends in historical and present-day wolf populations. We draw some conclusions regarding population dynamics plus some characteristics of wolf biology in Greenland, such as pack size, feeding habits and movements.

#### HISTORICAL BACKGROUND

The concept of immigration of wolves into East Greenland from Ellesmere Island was proposed by Nathorst (1899) and is now generally accepted. Steensby (1910, 1916), based partly on the work of Nathorst, introduced the concept of "the musk-ox way" for the main migration route along which the early Eskimos passed eastward in pursuit of musk-ox (*Ovibos moschatus*). This route stretches to the north coast of Greenland from Ellesmere Island by way of the Robeson Channel and eastward along the wide E-W trending valley joining J.P. Koch Fjord and Independence Fjord, containing the lakes "Midsommersøer" (Fig. 1), and then southeastward following the Inland Ice into Kronprins Christian Land; from here it follows the east coast into central East Greenland. The authenticity of "the musk-ox way" has been confirmed by the work of Knuth (1967).

Like the Eskimo, the wolf probably followed this migration route, and like other terrestrial mammals, the species has most likely flourished in Greenland during certain periods. Migration patterns and population density have fluctuated in response to depredation by man, climatic conditions and ultimately prey availability (Vibe, 1967). Thus, the apparent immigration of wolves into Greenland during the last decades of the 19th century as suggested by Nathorst (1899) was probably only one among several pulses.

Finds of subfossil bone relics in Peary Land (E. Knuth, pers. comm.; Bennike, 1981) and Heilprin Land (Johnsen, 1953) and on the east coast in Germania Land (Manniche, 1910) indicate that the wolf was widespread at much earlier times. The Independence I Eskimo culture, the oldest known from North and East Greenland, dates back to 2500 B.C. (Knuth, 1981). Although no remnants of wolves have been found in ruins of this age or in the younger palaeo- or neo-Eskimo ruins, the presence of bones of musk-ox, hare and other animals, usually regarded as wolf prey (Knuth, 1952, 1967), suggests a habitat conducive to the existence of the wolf throughout at least the last 4000 years. Furthermore, in both North and East Greenland the most animal-conducive period was undoubtedly the postglacial climatic optimum between 8000 and 4000 years before present (Dansgaard *et al.*, 1971; Funder, 1978); and it is known that the caribou (*Rangifer tarandus*) — a renowned prey of the wolf — lived in North Greenland (Peary Land) some 8000 years ago (Knuth, 1983).

The date of the late 19th-century immigration cannot be accurately fixed. Few expeditions had penetrated so far north at that time and a small wolf population could easily have been

overlooked by the early explorers. However, in the west, two of the earliest expeditions, those led by E.K. Kane (1853-55) and C.F. Hall (1871-73), both sighted the wolf in Greenland (Kane, 1856; Davis, 1876; also Blake, 1874: Fig. 7); on the other hand, the expeditions led by K. Koldewey, 1869-70 (Koldewey, 1874:483), and C. Ryder, 1891-92 (Ryder, 1895), failed to record the species on the east coast. By the end of the century this situation had changed, and in 1899 Nathorst (1899, 1900) recorded several wolves, both male and female, in central East Greenland between 71° and 75° N.

#### DISTRIBUTION IN THE NATIONAL PARK

##### 1871-1909 (Fig. 3)

During the early geographical exploration of northern Greenland, the presence of the wolf was documented by several expeditions that reached the region by way of both the west and east coasts and across the Inland Ice. The first expedition along the west coast to reach 81°N — the western extremity of the National Park — was C.F. Hall's North Polar Expedition (1871-73). Wolf tracks were observed in October 1871 in the Newman Bugt area, in the following year tracks were seen in western Hall Land, and in April a single animal was sighted (Blake, 1874; Davis, 1876: Fig. 7). At this time the Greenland wolf population was probably very small, and it is noteworthy that G.S. Nares's British Arctic Expedition (1875-76) and A.W. Greely's United States Lady Franklin Bay Expedition (1881-84), both of which travelled widely in Greenland from winter quarters in Ellesmere Island, did not record evidence of the wolf. On the other hand, wolves were seen frequently in adjacent Ellesmere Island, less than 25 km from the Greenland coast (Feilden, in Nares, 1878; Greely, 1886). Of particular note is Greely's (1886:368) record of a pack of 18 wolves on the sea ice of Lady Franklin Bay in September 1881 and in the following year a pack of "a dozen" near Fort Conger, the expedition's wintering station. These early observations indicate a fairly large population in coastal Ellesmere Island but only rare animals in adjacent Greenland. This suggests that the Robeson Channel acted as a dispersal barrier across which migration was somewhat restricted.

Farther to the east, the first recorded evidence of the wolf was tracks and excrement at the head of Independence Fjord in 1892 and 1895 on R.E. Peary's two traverses of the Inland Ice (Astrup, 1895; Peary, 1898; Nathorst, 1899, 1900). Along the outer coast, Peary (1903, 1907) observed tracks during his sledge traverse in 1900, as did J.P. Koch in 1907 (Manniche, 1910) and Borup (1911) in 1909. The only record of a wolf killed in North Greenland during this period is that reported by Mikkelsen (1914), shot at Sjølland Sletten, Danmark Fjord, in September 1907.

The observation of wolf tracks in October 1907 in the area immediately south of Lambert Land (Manniche, 1910) provides an indication of the migration route southward from northern Greenland along the east coast. Jökølbugten, the ice-covered bay north of the 78° parallel, is extremely barren, characterized by large areas of floating glacier ice; ice-free areas are small, and there is no continuous land bridge joining the wider ice-free regions of the north and south. Consequently, it seems certain that this region has only supported wolves in transit — en route to the more hospitable fjord regions of central East Greenland.

Following its initial sighting in East Greenland by Nathorst (1899, 1900), the wolf was well established there during the first

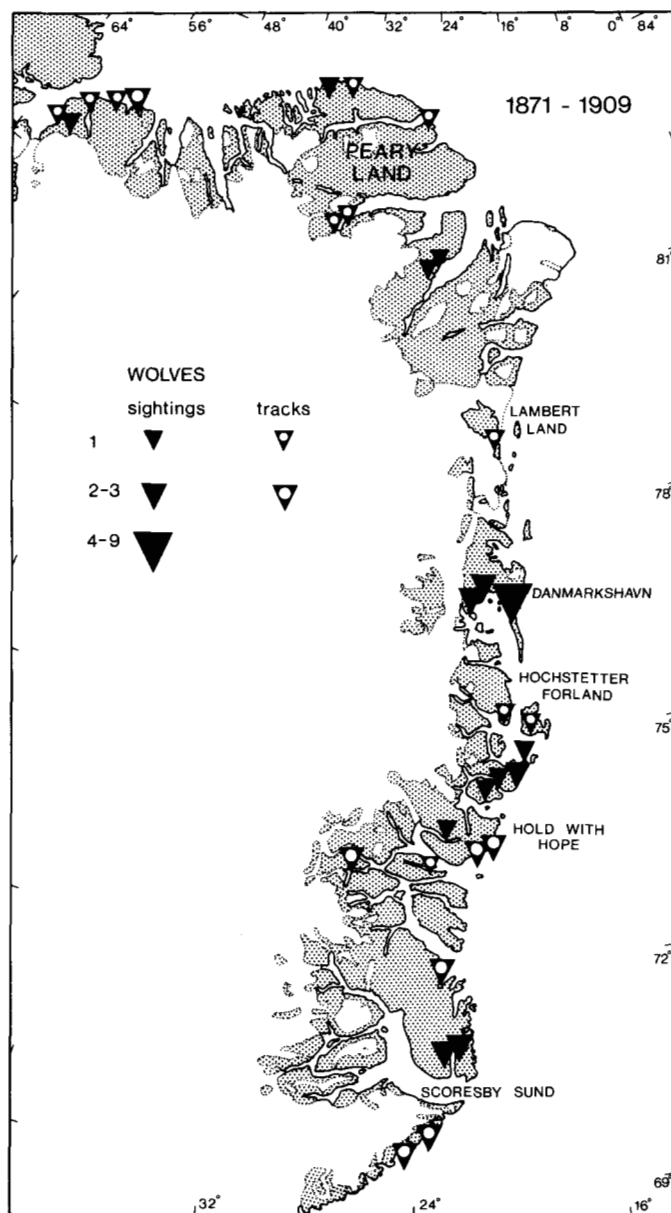


FIG. 3. Wolf sightings and tracks in North and East Greenland 1871-1909. Compiled from data in Blake (1874), Davis (1876), Astrup (1895), Peary (1898, 1907), Nathorst (1899, 1900), Winge (1902), Kolthoff (1903), Jensen (1904), Manniche (1910), Borup (1911), Mikkelsen (1914) and Giæver (1939).

decade of this century, with a distribution between Scoresby Sund and Germania Land (Winge, 1902; Kolthoff, 1901, 1903; Jensen, 1904; Manniche, 1910; Giæver, 1939). The size of the population seems to have been fairly limited, and no packs exceeding three animals were reported (Manniche, 1910). Tracks of wolves were found as far south as Kap Dalton and Turner Sund between 69° and 70°N (Winge, 1902; Jensen, 1904), but the most frequented areas appear to have been the forelands and low-lying valleys of Jameson Land, Hold with Hope, Wollaston Forland and Germania Land. Between 1899 and 1909 wolves were sighted on some 20 occasions and at least 11 animals were killed.

##### 1910-1939 (Fig. 4)

The establishment of the Thule trading station in 1910 led to increased Danish expeditionary activity in northernmost Green-



land; this provided a more detailed picture of the occurrence and distribution of the wolf. Between 1912 (First Thule Expedition) and 1923 (Bicentenary Jubilee Expedition) wolves were sighted at about 10 locations in the far north, and their tracks were noted in several places from Nyeboe Land in the west to the mouth of Independence Fjord in the east (Freuchen, 1915; Rasmussen, 1919, 1921, 1927; Koch, 1925, 1926; Elvin, 1934). Tracks were also noted in 1910 in the northeastern corner of Greenland at the head of Danmark Fjord (Mikkelsen, 1914). In 1921 wolves were seen regularly in the southern part of Peary Land; two wolves were shot, one at Kap Harald Moltke and the other on the north coast at Kap Morris Jesup, and the largest pack seen numbered three animals (Koch, 1926, 1940). Nothing is known about the status of the wolf in North Greenland for the later part of the period 1910-39, since, following Koch's observations in 1921, the region remained unvisited for the next 25 years.

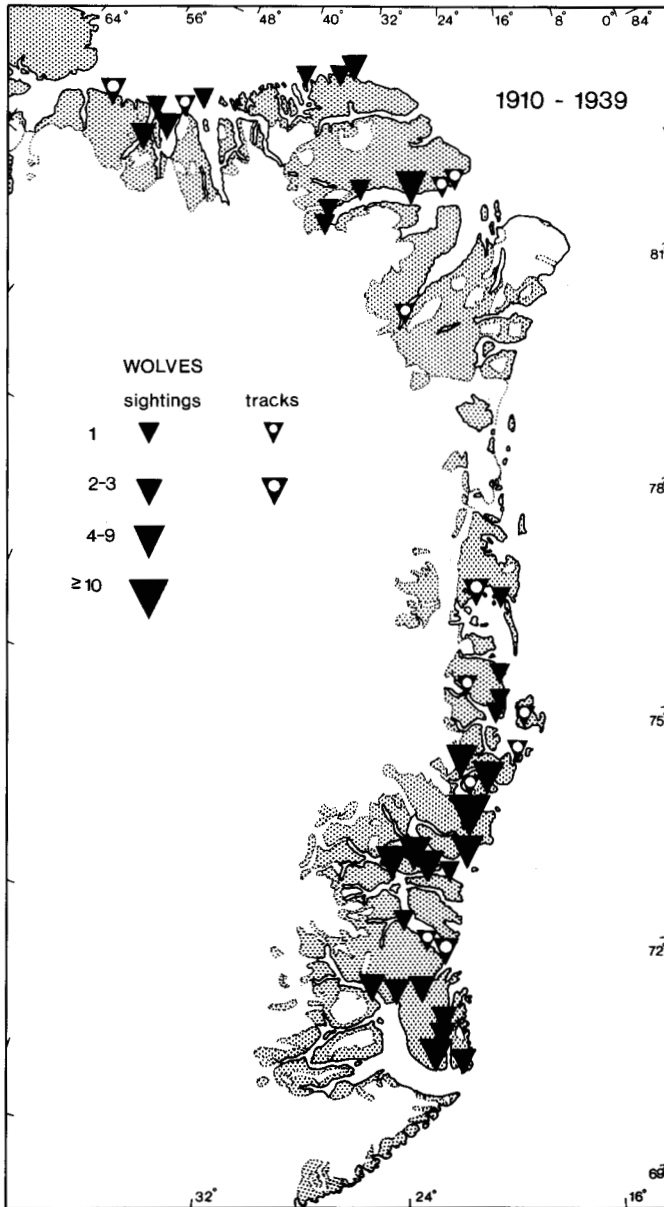


FIG. 4. Wolf sightings and tracks in North and East Greenland 1910-39. Compiled from data in Mikkelsen (1914), Freuchen (1915), Rasmussen (1919, 1927), Koch (1926, 1940), Pedersen (1926, 1930, 1934, 1942), Giæver (1930, 1939), Orvin (1931), Hvidberg (1932), Elvin (1934), Ingstad (1935), Munsterhjelm (1937), Devold (1940), Jennov (1945) and Sørensen (1959).

In East Greenland the period 1910-39 was marked by extensive expedition activity, mainly by Danish and Norwegian trappers who maintained a changing but permanent presence in the region, as well as by numerous scientific expeditions. This resulted in frequent encounters with wolves, and a fairly detailed picture can be gained of distribution and population density of wolves in the region 70-77°N.

Wolves, occasionally in packs up to four or more, were encountered repeatedly in the region between Scoresby Sund and Kong Oscar Fjord (Pedersen, 1926, 1930, 1934, 1942; Orvin, 1931; Ingstad, 1935; Munsterhjelm, 1937), but apparently the largest numbers occupied the region between Ymer Ø and Wollaston Forland (Giæver, 1930, 1939; Pedersen, 1934; Sørensen, 1959). Farther north, single animals were encountered on Hochstetter Forland and Germania Land, and in the latter area a pack of three animals, possibly a family, was seen on a number of occasions in the winter of 1932-33 (Pedersen, 1934; Jennov, 1945; H.V. Nielsen, pers. comm.). Tracks of mostly single wolves were observed between Sabine Ø and Germania Land (Mikkelsen, 1914; Hvidberg, 1932).

The hunting activity in East Greenland was organized by fur trading companies, and in the 1920s and 1930s a total of about 35 wolves are estimated to have been killed (Pedersen, 1926, 1934, 1963; Giæver, 1930, 1939; Devold, 1940; Jennov, 1945). In many cases the wolf was shot, but in some cases poison traps were used, and in one incident in 1930 8 wolves were killed by this method in Tyrolerfjorden (Giæver, 1930; Devold, 1940; Sørensen, 1959). This organized hunting took a heavy toll on the population, and it apparently was an important factor in the rapid decline of the wolf in East Greenland in the late 1930s (*cf.* Figs. 4 and 5), although, as pointed out by Vibe (1967), the long-term decline could possibly have been enhanced by a temporary decline in the availability of prey.

Between 1935 and 1939, only occasional sightings were made in East Greenland. Pedersen (1942) records evidence of wolf habitation in the Scoresby Sund region in the winter of 1935-36, and several wolves and tracks were observed in the Kong Oscar Fjord region in 1936-37 (Munsterhjelm, 1937). The "last" observations are the reports of fresh tracks from December 1939 in the Clavering Ø area (Sørensen, 1959). There can be little doubt that this drastic decrease in the number of sightings represents a true decline of the wolf population, and several expeditions wintering in central East Greenland in the late 1930s in renowned wolf territory failed to sight the animal. For example, a detailed diary of a Norwegian trapping expedition, wintering at Myggbukta area on Hold with Hope in 1938-39, does not mention any evidence of wolf habitation (Bang, 1944).

In summary, it seems reasonable to conclude that by 1940 the wolf had become extirpated from its former territory in East Greenland, and for several decades wolves were not observed in this region. It is possible that the wolf had also disappeared from North Greenland, although, as argued by Dawes (1978), the total lack of human activity in that area after 1921 makes this an assumption.

#### 1940-1975 (Fig. 5)

In North Greenland the status of the wolf was unknown from the early 1920s until the early 1950s. The only human presence in the region during this period was the Danish Peary Land Expedition (1947-50), which wintered near Independence Fjord. Apart from finds of a mandible in Heilprin Land and a cranium and excrement in southern Peary Land (Johnsen, 1953; E.

Knuth, pers. comm.), no evidence of the wolf was found, and this was readily cited to support the conclusion that the species had become extirpated from not only Peary Land but the whole of Greenland (Johnsen, 1953); this belief was generally upheld through the following years (Pedersen, 1963; Vibe, 1967, 1981; Gensbøl, 1969). However, this conclusion may not be accurate with respect to North Greenland, where wolf observations were actually made throughout the region despite the very limited expedition activity in the period 1950-75.

The first visits to North Greenland after the Danish Peary Land Expedition were the small summer geological parties in Kronprins Christian Land in 1952 and in northern Peary Land in 1953. Fränkl (1954, 1955) recorded evidence of wolves in both areas, including the sighting of a wolf near Kap Morris Jesup. In the 1960s and early 1970s members of the Sirius Sledge Patrol recorded fresh tracks in several areas of Peary Land, particularly

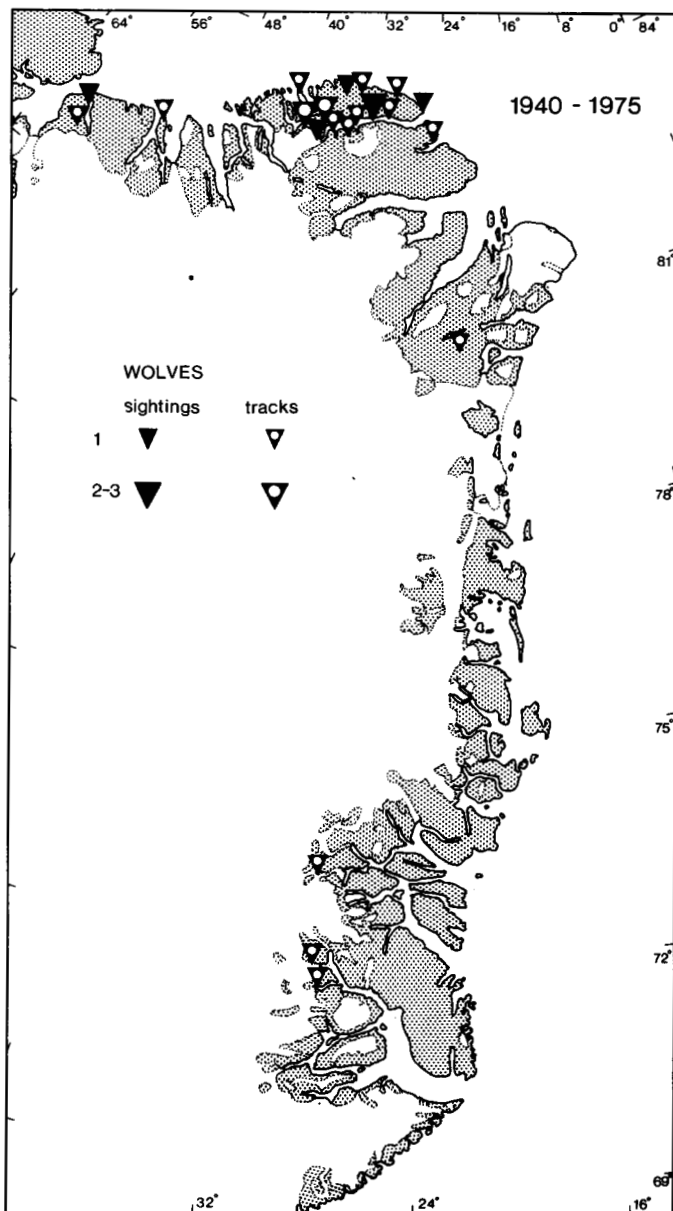


FIG. 5. Wolf sightings and tracks in North and East Greenland 1940-75. Compiled from data in Fränkl (1954, 1955), Haller (1956), Steck (1968), Grant (1972), Dawes (1978) and from J. Møhl and the Sirius Sledge Patrol (pers. comm.).

along the outer coast and in the inland region between De Long Bugt and Frederick E. Hyde Fjord (O. Andersen, Sirius Patrol, pers. comm.).

In 1965 and 1966, during summer visits to the Hall Land-Hendrik Ø region in the extreme west, several tracks were observed, and a wolf was seen on the sea ice of Robeson Channel close to the Greenland shore (Dawes, 1978; J. Møhl, pers. comm.). In 1969 the presence of several wolves in northern Peary Land was confirmed during a four-month expedition that recorded widespread tracks and several sightings, including a wolf pair and a "young" animal (Grant, 1972).

These numerous sightings suggest that the wolf may have gained a permanent foothold in North Greenland, where, despite the absence of caribou, certain areas (e.g., Peary Land) abounding in musk-ox, arctic hare (*Lepus arcticus*) and collared lemming (*Dicrostonyx groenlandicus*) could well support a small wolf population (Dawes, 1978). Many of the sightings come from the Frederick E. Hyde Fjord area; two prominent E-W valleys joining the inner reaches of De Long Bugt with Frederick E. Hyde Fjord apparently form important travelling routes for wolves reaching the east coast of Peary Land.

In contrast, no wolves were sighted in East Greenland between 1940 and 1975, in spite of a fairly extensive expeditionary activity throughout the region. For example, Lauge Koch's geological operations (1947-58) included overwintering parties until 1953, and the absence of sightings here is taken as an indication of the wolf's extirpation from East Greenland. However, there are three isolated observations of reputed wolf tracks made in 1951, 1957 and 1968 by geological teams working in the nunatak and the inner fjord terrain between 71°30'N and 73°30'N (Haller, 1956; E. Wenk, pers. comm.; Steck, 1968). The finding of a wolf skull (of uncertain age) in 1953 in the same region by E. Wenk (pers. comm.) is also worthy of note, since it indicates that the wolf has indeed at some time inhabited the high nunatak terrain (cf. Figs. 3, 4 and 5).

1976-1984 (Fig. 6)

The wolf observations of recent years demonstrate the dispersal route across North Greenland and southward into East Greenland and suggest the continuing influx of animals from Ellesmere Island. The first wolf encounters south of Peary Land in 40 years were in 1978, when two animals were observed in Danmark Fjord and southern Kronprins Christian Land on 22 April and again on 18 May (P. Schmidt Mikkelsen, Sirius Patrol, pers. comm.). The concurrent presence of wolves in Peary Land to the north was indicated by tracks in snow seen in the Frederick E. Hyde Fjord area in March (Sirius Patrol, pers. comm.) and in the G.B. Schley Fjord region in July (H. Andersson, pers. comm.).

In 1979 two wolves, believed to be the pair recorded the previous year, were seen twice at Danmarkshavn on 19 April and 9 June (B. Mogensen, pers. comm.; Hansen, 1979) and in March 1980 to the south at Loch Fyne (Sirius Patrol, pers. comm.). Later in 1980, in the period 24 April-6 November, two wolves were seen on five occasions between Hold with Hope and Hochstetter Forland (C. Birkebøll, Sirius Patrol, pers. comm.). Although it can never be ascertained, it is possible that all the above observations in East Greenland refer to the same pair of wolves.

The simultaneous occurrence of a small wolf population in North Greenland was confirmed by several sightings and tracks in Peary Land: along the north coast at Kap Morris Jesup, along

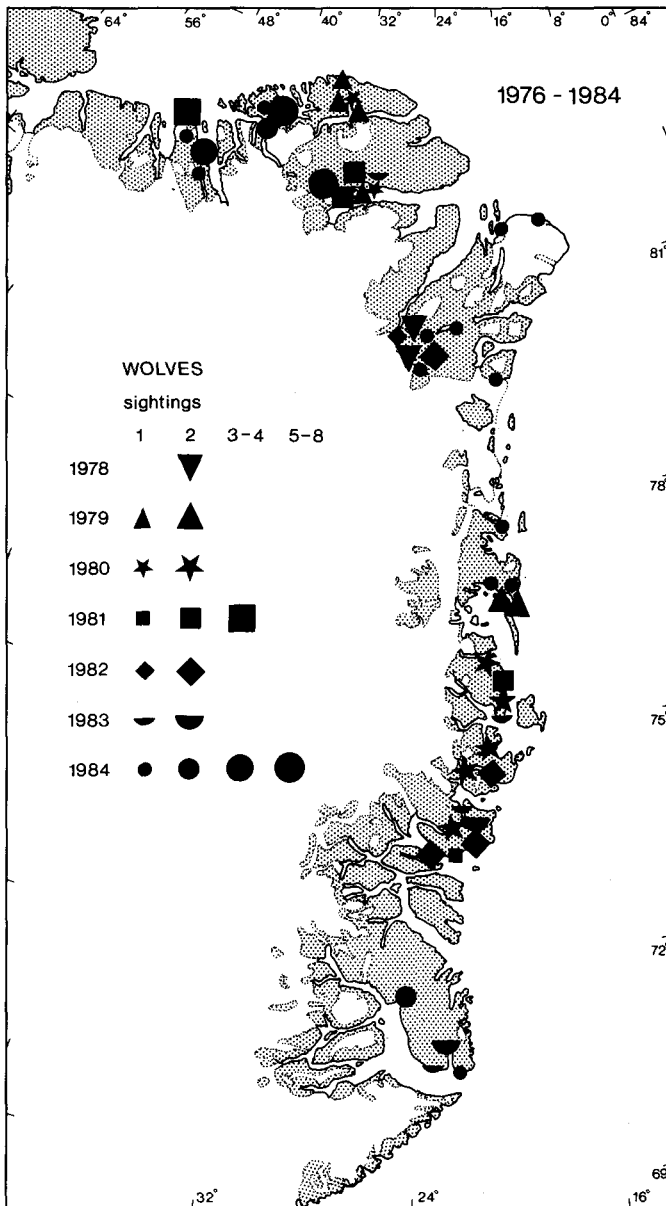


FIG. 6. Wolf sightings (only) in North and East Greenland 1976-84. Compiled from data supplied by J. Andersen, O. Bennike, C. Birkebøll, J.F. Clemmensen, K. Fischer, J.D. Friderichsen, E. Gade-Jørgensen, A.K. Higgins, K. Isler, F. Jensen, M. Jørgensen, E. Knuth, P.-H. Larsen, B. Mogensen, I. Parsons, the Sirius Sledge Patrol, M. Sønderholm, O. Sørensen, H. Thing (pers. comm.), and from Ericson and Elander (1983), Kunak (1984), Øland (1984).

Frederick E. Hyde Fjord and, in the south, at Independence Fjord. In 1979 three observations of at least two individual animals were made in August (A.K. Higgins, F. Jensen and E. Knuth, pers. comm.), and a track was observed on the sea ice in May as far west as De Long Bugt, near Kap Hummock (C. Vibe, pers. comm.). Again in July 1980, three observations of single animals were recorded (A.K. Higgins, E. Knuth, I. Parsons, pers. comm.), in addition to several reports of fresh tracks, for example at Frigg Fjord, Herlufsholm Strand and Kap Kane (O. Bennike, S. Funder, E. Knuth, I. Parsons, pers. comm.).

Much of the evidence for wolf habitation in North Greenland in the period 1978-80 was gathered during large-scale geological and geodetic expeditions that lasted for two months each summer. However, despite the absence of large-scale expedi-

tion activity in 1981 and 1982, wolves and their tracks were reported in both North and East Greenland. These reports suggest influx of wolves from the west, passage south near the Inland Ice margin in Kronprins Christian Land and along the east coast into the fjord region of central East Greenland. Hence, two wolves (possibly the "forerunners" of the main migration) were observed on Hochstetter Forland on 5 June 1981 (Sirius Patrol, pers. comm.), north-northwest of Daneborg on 11 June 1982 (O. Sørensen, Sirius Patrol, pers. comm.), at Myggbukta on Hold with Hope on several occasions 16-19 June 1982 (Ericson and Elander, 1983; Fig. 8) and on eastern Ymer Ø on 12 November 1982 (Sirius Patrol, pers. comm.). In addition a lone wolf was observed in southern Gauss Halvø in November 1981 (G. Andersen, pers. comm. to H. Thing).

In North Greenland a pack of four wolves was observed in northern Wulff Land on 18 March 1981 (Sirius Patrol, pers. comm.), possibly reflecting a fresh influx from Ellesmere Island, and two animals were seen twice at Kap Harald Moltke on 20 June and 12 July (E. Knuth, pers. comm.). In 1982 a pair of wolves was encountered in southern Kronprins Christian Land on 14 May and a third animal on 17 May (J.W. Andersen, Sirius Patrol, pers. comm.); these animals were presumably en route to the east coast.

In the last two years, 1983-84, renewed expedition activity has provided critical information confirming the wolf recovery and suggesting the continuing influx of the species from Canada. Most important data are the sightings of several packs, one of which comprised eight animals, and the dispersal of wolves for the first time since the 1930s into Jameson Land, the southern part of the wolf's former range.

In western North Greenland wolves were observed frequently in the period 23 June-18 August 1984 by the Geological Survey of Greenland's ground and air crews. Tracks in Nansen Land indicate the presence of at least one young animal in the wolf population (J.D. Friderichsen, pers. comm.). In eastern Wulff Land a pack of three wolves was observed on 13 July (O. Bennike, pers. comm.) and on 2 and 17 August sightings of a single wolf were made in central and northern Wulff Land (M. Sønderholm, P.-H. Larsen, pers. comm.). In southeastern Nansen Land in the low-lying fertile terrain between J.P. Koch Fjord and the inner part of De Long Bugt, lone wolves were observed on at least four occasions in July and August, as well as a wolf pair on 30 June and packs of five and two separate sightings of a pack of seven on 6, 1 and 9 July respectively (O. Bennike, J.D. Friderichsen, K. Isler, A.K. Higgins, pers. comm.).

Undoubtedly, many of the above sightings refer to the same individuals, and the packs of five and seven probably include the same animals. However, based on the observation dates and locations and on the general condition of the animals sighted, it is clear that several packs of two or more animals resided in the region during the summer. For example, it is noteworthy that the condition of the three wolves in the Wulff Land pack was considerably better than that of those animals constituting the pack of seven (O. Bennike, pers. comm.). It is concluded that at least twelve adult wolves were present during summer 1984 in the Wulff Land-Nansen Land region.

To the east in Peary Land the wolf's continuing presence is documented by tracks of at least two animals, observed on southern Herlufsholm Strand in August 1983 (O. Bennike, pers. comm.), while farther north in Frigg Fjord fresh tracks were observed in August 1984 in association with the track of a young

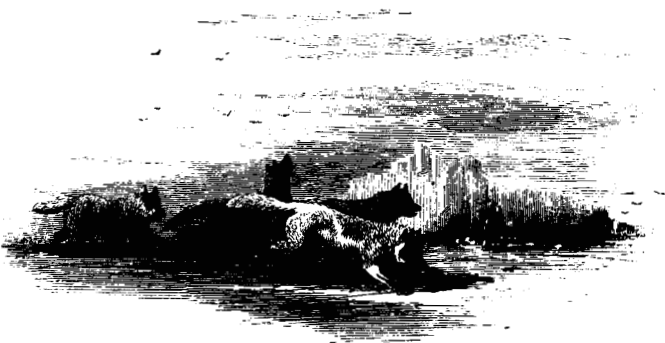


polar bear (E. Knuth, pers. comm.). In southern Peary Land a single wolf was observed at Kap Harald Moltke on 8 March 1983 (M. Vindbjerg, Sirius Patrol, pers. comm.), and in eastern Midsommersøer a pack of eight wolves was encountered by a Sirius sledge party on 3 March the following year (M. Jørgensen, Sirius Patrol, pers. comm.). It is likely that this pack contained the same animals as those in the Nansen Land pack mentioned above. The Midsommersøer valley across southern Peary Land linking J.P. Koch Fjord and Independence Fjord is a known animal migration route (part of "the musk-ox way"); fresh wolf tracks were observed throughout its 150 km length in the spring of 1983 and again in 1984 (M. Vindbjerg, M. Jørgensen, pers. comm.).

The use of Kronprins Christian Land as a transit area for wolf migration was also indicated in 1983 and 1984; in the spring and summer of both years tracks were observed in the Danmark Fjord-Centrum Sø-Blåsø area (P. Ancker, J.-F. Loubiere, Sirius Patrol, pers. comm.), and in the summer of 1984 fresh tracks, extremely abundant in Lambert Land, suggested the presence of at least a wolf pair (N.S. Preben-Andersen, pers. comm.). In addition, in 1984 four sightings of lone wolves were made in southern Kronprins Christian Land: at Centrum Sø on 25 April (G. Andersen, Sirius Patrol, pers. comm.), on southern Hovgaard Ø on 20 May (M. Jørgensen, pers. comm.) and at Blåsø and southwest of Centrum Sø on 3 and 8 August (E. Gade-Jørgensen, pers. comm.). Also from the northern coast in 1984 there are two sightings of single animals on 13 April at Station Nord by the station's personnel (J.F. Clemmensen, pers. comm.) and at Nakkehoved on 10 July (J. Andersen, pers. comm.).

Farther south, at the end of May 1984, a single wolf followed a Sirius sledge from north of Skærfjorden back to Danmarkshavn (M. Jørgensen, pers. comm.). This animal remained in the region; it was observed periodically from the beginning of June to mid-October at or in the vicinity of the Danmarkshavn station (K. Fischer, pers. comm.). This is probably the same animal as that seen by J. Andersen (pers. comm.) in August on the southern coast of Germania Land.

In the region between Shannon and Traill Ø there are several recent reports of tracks, including the trail of a pack of four animals seen in early June 1984 in southeastern Geographical Society Ø (C. Kempf, pers. comm.). The 1983 wolf sightings are: a single wolf on Hochstetter Forland in May (Sirius Patrol, pers. comm.), a lone male wolf at Loch Fyne in July (R. Burton, pers. comm. to H. Thing) and a wolf pair at Loch Fyne in August (O. Sørensen, pers. comm.).



ARCTIC WOLVES.

FIG. 7. "Arctic wolves" from Blake's (1874) report on C.F. Hall's United States North Polar Expedition 1871-73; the first expedition to record the wolf in Greenland north of 81°N.

A report by a local hunter of a wolf pair in the Scoresby Sund region in the winter of 1983 (Kunak, 1984) was followed by serious incidents from Jameson Land with sledge teams molested and dogs killed by wolf attack (Øland, 1984). On the basis of tracks in snow, A. Christensen (pers. comm.) reports that a wolf pair travelled south past Mestersvig on 15 April 1984; these could be the same animals as seen by Øland (pers. comm. to H. Thing) in May in western Jameson Land. In December at least one wolf was observed on the sea ice 1-2 km south of the settlement of Scoresbysund (O. Brønlund, pers. comm. to H. Thing). Single wolf tracks have been observed in spring and summer 1984 on both sides of Kong Oscar Fjord and in western Jameson Land (A. Christensen, R.E. Frandsen, pers. comm.; J. Madsen, C.R. Olesen, pers. comm. to H. Thing).

#### WOLVES IN WESTERN GREENLAND

The earliest written account of the presence of the wolf in western Greenland is found in the Danish document *Kongespejlet* (1843), written in about 1260, and this information has been substantiated in the field by the finding of a wolf cranium in the Norseman ruin, Nipaitsoq, in the Godthåb region at about 64°N (Møhl, 1982). Wolf bones and teeth, excavated from the Sarqaq (c. 1200 B.C.) and Dorset (c. 200 B.C.) ruins in the Disko Bugt and Godthåb regions respectively (J. Møhl, M. Meldgaard, pers. comm.; Vibe, 1967:156), indicate the long history of the wolf in western Greenland. During the last century, however, wolves were only occasionally encountered in the inhabited parts of the coast.

The occurrences are from two separate regions: the Umanak-Disko district in the south and, to the north of Melville Bugt, the Thule district, which in the north borders the National Park. The wolves in these regions are regarded as dispersing animals reaching the Greenland coast from Baffin Island and Ellesmere Island (Vibe, 1967) (see Fig. 1). Both districts support caribou in sheltered areas, but the presence of local hunting communities makes the lengthy survival of migrant wolves doubtful.

The two regions are separated by the 400 km long, glacier-filled coast of Melville Bugt, which forms a barrier to animal dispersal (Vibe, 1967). No archaeological or historical evidence exists for the presence of the wolf along this coast; the killing of a wolf northeast of Kap York in 1956 is the nearest documented sighting (Dawes, 1978). However, theoretically wolves may have wandered along this part of the Greenland coast in the past. In this respect it is noteworthy that Roby *et al.* (1984) conclude that at least one species, the caribou, managed to negotiate the formidable nunatak and ice terrain of Melville Bugt.

In the *Umanak-Disko region* two wolves were seen in the winter of 1868, and on 17 November one of these was shot near the settlement of Igdlorssuit (Fig. 1; Nathorst, 1899; Winge, 1902). Other observations in the region, including the sighting of a wolf pair in 1915 on the northeastern coast of Disko, have been summarized by Porsild (1916). The last authentic report was the encounter in 1978 when a male wolf was shot on 8 April, north of the settlement of Nûgâtsiaq (see Dawes, 1978:303).

In the *Thule district* wolves have been sighted between 75°30'N and 79°N, a region situated between Melville Bugt and Humboldt Gletscher; like Melville Bugt, the latter is a dispersal barrier restricting the migration of terrestrial wildlife. It is

noteworthy that the wolf has never been recorded in Washington Land (between Humboldt Gletscher and Petermann Gletscher — see Fig. 1), and it seems likely that little or no direct intercommunication occurs between the wolves in the Thule district and those in the National Park.

John Ross, the first European to visit the Thule district in 1818, remarked that the wolf was known to the Eskimo inhabitants of Kap York, as it had presumably been for centuries (Winge, 1902). The earliest documented sighting in the region was made on 14 October 1854 at the winter quarters of E.K. Kane's Second Grinnell Expedition (1853-55) at Rensselaer Bugt, Inglefield Land. However, several subsequent expeditions wintering in the region fail to mention the presence of the wolf (e.g., Hayes, 1867; Peary, 1898; Whitney, 1910), although it is clear that wolves were encountered occasionally by the Eskimos. Hence, Mylius-Erichsen and Moltke (1906:538) were able to quote incidents of wolves shot by Eskimos at the settlements of Neq̃, south of Kap Alexander, and at Natsilivik in Hvalsund (Fig. 1). Noteworthy observations were made by D.B. MacMillan's Crocker Land Expedition, which wintered at Etah 1913-17. Apart from a wolf shot at the door of the winter quarters in 1914, widespread and abundant tracks were recorded in Inglefield Land (MacMillan, 1918).

Apparently no wolves were observed by the several expeditions that wintered in the Thule district in the period 1930-50, e.g., Oxford University Ellesmere Land Expedition, 1934-35 (Shackleton, 1936), British Arctic Expedition, 1937 (Haig-Thomas, 1939), Danish Thule and Ellesmere Land Expedition, 1939-40 (Vibe, 1948), although reports about wolf encounters were related to these expeditions by the local Eskimos. Thus, Vibe (1948) notes wolf sightings at Kangerdlugssuaq at the head of Inglefield Bredning and later in 1937 at Marshall Bugt in Inglefield Land, while Haig-Thomas (1939), who travelled in both the Thule district and adjacent Ellesmere Island on two expeditions between 1935 and 1937, relates Eskimo thinking about the Greenland wolf's attitude toward humans compared to that of the wolves of Ellesmere Island.

Stories of more recent encounters are not uncommon among the Thule Eskimos, and several incidents in the region from Inglefield Land to Melville Bugt in the south in the period 1956-74 are reported by Dawes (1978). At present, no permanent Eskimo settlement occurs on Inglefield Land, and a small stock of caribou (*R. t. groenlandicus*) still exists there (Roby *et al.*, 1984). Eskimos reach this region on hunting excursions, and these parties are not unduly surprised to encounter the wolf, particularly in the central and eastern part of the area. Consequently, over the last decade several wolves have been shot (Innuterssuaq Uvdloriaq, Kangunaq Qissuq, K. Thomsen, pers. comm.). Despite the presence of caribou, it is hardly likely that the wolves have a permanent foothold in Inglefield Land; on the other hand, in view of the successful hunting activity it would seem that migration from adjacent Ellesmere Island must take place fairly frequently.

Little information is available on the travelling habits of wolves in the Smith Sound area, but it is known from Eskimo hunters that encounters with wolves on the Ellesmere Island side of the sound often lead to animals following sledges or sledge tracks back toward the Greenland coast (Vibe, 1948; Dawes, 1978). Vibe (1948) reports that this phenomenon is fairly common, and in one such incident in the 1930s a single wolf followed sledge tracks from Ellesmere Island all the way into Inglefield Bredning, a distance of over 300 km.

## HISTORY AND STATUS OF WOLF POPULATION

### *Distribution and Size*

Within historical time the wolf population in Greenland had its maximum distribution during the first decades of this century, ranging from south of Scoresby Sund up to the northern coast of Peary Land and westward to the Robeson Channel. This is almost matched by the present-day occurrence, although, as yet, the only sighting south of Jameson Land has been on the sea ice of Scoresby Sund. Past and present observations of wolves and tracks are concentrated in the prey-rich valleys and forelands, and this is particularly marked for the early parts of the century, with the concentration in the hunting districts in the fjord region of central East Greenland 70°-75°N.

The size of the former population can only be crudely surmised. Taking the total of 46 animals known to have been killed in East Greenland between 1900 and 1935 into consideration and assuming a slow immigration rate with no or only occasional reproduction (see below), it would seem that central East Greenland housed no more than 20-30 animals at any one time. The limited data available from North Greenland in the pre-war period and from the Thule district does not permit an accurate estimate of population density.

An estimate of the size of the present population can be gleaned from the 1984 data, which include sightings of several packs. The total minimum figure is about 20 animals. The summer data suggest a higher population in North Greenland, probably at least 15 animals, while in the same period at least 5 wolves resided in East Greenland. The wolf is regarded as evasive and shy and generally hard to observe (Mech, 1970). Based on the incidental observations of 1984 summer expeditions to only part of the National Park, we suggest that the current wolf population in Greenland must approach the numbers estimated during the "heyday" of the species in the early parts of this century.

### *Reproduction and Pack Size*

Wolf reproduction has never been documented in any part of Greenland, although there are reports of "young" animals from both North and East Greenland (Nathorst, 1899; Pedersen, 1934; Jennov, 1945; Grant, 1972; J.D. Friderichsen, pers. comm.). Pedersen (1934) concluded that reproduction did take place in East Greenland in the 1920s and 1930s; he argued, for example, that a cub observed with a female adult in the Scoresby Sund region must have been born locally rather than over 2000 km away in Canada. In the absence of specialized studies directed to wolf biology, it is impossible to rule out local reproduction. Given the collection of hitherto incidental data on the wolf, it is hardly likely that reproduction would in any case be detected. This is particularly true for North Greenland, where there is only periodic and seasonal human activity.

Packs of four or more animals have only been recorded a few times (Giæver, 1930; Devold, 1940; Sirius Patrol, O. Bennike, K. Isler, pers. comm.), and it is interesting that only about 17% of the observations from North and East Greenland refer to packs of more than two animals. It has been suggested that the average size of wolf packs in a given region is a reflection of the abundance of the species (Rausch, 1967). Whether a pack is composed of a family — adult animals and their young — or merely represents a band of individuals, large packs reflect a high population density, i.e., a high reproduction rate in the

case of the family or, conversely, many chance meetings of individual animals. On this basis the pack size recorded in Greenland suggests a relatively low population density and/or absence of or low rate of reproduction in the region.

For comparison, in the Jones Sound region of Arctic Canada (Fig. 1), 23% of the observations are of more than 2 animals, and packs of up to 24 animals have been noted (Riewe, 1975). In the more habitable and productive low arctic areas, e.g., Alaska, 52% of observations refer to wolf packs of more than 2, with the most common pack size being 5 or 6 animals (Rausch, in Mech, 1970).

#### Feeding Habits and Extirpation

The documented decline of the wolf population in East Greenland in the late 1930s was connected with organized hunting by the Danish and Norwegian trappers. It has been suggested that the decline and extirpation of the wolf had a natural cause, directly linked to the disappearance of the caribou from East Greenland at the turn of the century (Vibe, 1967). It is generally acknowledged that the wolf has a preference for large prey, although this statement may well be more relevant to the low and subarctic areas, where the hunting habits of the species have been most studied (Mech, 1970). In High Arctic regions, large prey are generally less abundant, and this, coupled with the fact that the wolves in the far north are organized in smaller packs, render such large prey as there are less accessible, and the reliance on smaller prey becomes essential.

This can be documented by the analyses of wolf excrement collected in regions supporting large prey. Hence, in a survey of 70 droppings from Ellesmere Island, a region supporting musk-ox and caribou, remnants of the arctic hare far prevailed over the larger prey; for example, 83% of the scats contained arctic hare, less than 20% contained musk-ox remains (Tener, 1954). In Greenland some information is available from areas supporting musk-ox; for example, Grant (1972) found a predominance of arctic hare and geese in material collected in northern Peary Land in 1969, while material collected in the same area in 1982 only contained remnants of small prey, such as hare, lemming and ptarmigan (*Lagopus mutus*). These data suggest that the wolves in Greenland, like their Ellesmere Island counterparts, prey upon any easily obtainable species; the hare, for example, forms an important food source.

The question of the effectiveness of wolves at slaying large prey, like musk-ox, has been the subject of much discussion (Pedersen, 1934; Jennov, 1945; Tener, 1954, 1965; Riewe, 1975; Gray, 1983). The unique defence formation of musk-ox herds is an effective combat mechanism against attack; however, when musk-ox herds stampede, opportunities are presented for wolves to isolate and attack individual animals (Gray, 1983). Eye-witness accounts of musk-ox killings are documented from the Queen Elizabeth Islands (e.g., Gray, 1970, 1983) and now from Greenland; two musk-ox calves were killed by a wolf pair on Hold with Hope in 1982 (Ericson and Elander, 1983; Fig. 8). However, the Greenland wolf is an opportunistic carnivore and there exists no evidence of an obligate dependence on a preferred single prey item — even in musk-ox rich territory.

In East Greenland the timing of the disappearance of the caribou and that of the wolf do not coincide, and it must be acknowledged that the wolf survived for 40 years in the region without the benefit of caribou as a food source. Although a temporary and concomitant low abundance of key prey items



FIG. 8. Two wolves attacking a musk-ox herd at Myggbukta, Hold with Hope, East Greenland, in 1982. One wolf has split the herd; the second (circled) descends the snow slope. Similar attacks in 1982 resulted in the killing of two musk-ox calves.

must have played some role in the livelihood and survival pattern of the wolf, it is concluded that the major cause of the disastrous decline of the species was the intense hunting persecution of the 1930s. Out of reach of this hunting activity, the wolf may well have survived in North Greenland, but due to the absence of human activity in the region in the 1930s and 1940s, and thus of records, this must remain a hypothesis.

It is generally acknowledged that in many regions the wolf's wanderings are closely associated with the movements of the caribou (Tener, 1960; Mech, 1970); in some cases re-establishment of former wolf ranges is due to a renewed caribou availability (Nowak, 1983). It should be stressed that the current wolf dispersal into Greenland is taking place from terrain supporting the caribou (*P.t. pearyi*) into a vast region devoid of this food source. The last caribou seen in Greenland north of the Humboldt Gletscher were three animals in Hall Land in 1921, individuals assumed to have crossed the Robeson Channel the same year (Koch, 1926). The only evidence for movement of caribou away from Ellesmere Island comes from Smith Sound, but here only occasional Peary caribou have reached Inglefield Land in the last century (Roby *et al.*, 1984).

#### Prey Potential

The North and East Greenland National Park is a rich wildlife reserve; hare, lemming, musk-ox and ptarmigan, as well as the arctic fox (*Alopex lagopus*), occur throughout the region now occupied by the wolf. In addition, seals are common in the fjords; evidence that the wolf preys on the seal is documented both from Greenland (e.g., Pedersen, 1934) and the Queen Elizabeth Islands (e.g., Riewe, 1975).

The only regional quantitative data available for a known prey of the wolf pertains to the musk-ox; 20 000 animals are estimated to exist in North and East Greenland (Nyebøe Land to Scoresby Sund), and with the favourable climatic conditions of the last two decades, the population in most areas shows stability or moderate growth (Thing *et al.*, 1984). Other land animals show a similar stability pattern (Vibe, 1981). The Greenland wolf, with its clear feeding preference for a variety of prey, appears, with the present wildlife status, to have an adequate food source available.

### *Migration Routes and Dispersal*

At present, North Greenland houses a small wolf population, but the region is also a corridor for wolves migrating from Ellesmere Island to East Greenland. In the east in Peary Land three main habitat areas are outlined, *viz.*, along the outer coast, in the inner reaches of De Long Bugt and along Frederick E. Hyde Fjord, and along the Midsommørsøer valley from J.P. Koch to Independence fjords. Migration and dispersal from Peary Land is taking place by way of southwestern Kronprins Christian Land, and the wolf is now repopulating its former territory in East Greenland. Since 1978 a handful of wolves has reoccupied the sheltered and relatively prey-rich fjord region of central East Greenland and a few have reached the southern limit of their former range of the 1930s.

### *Travelling Distances and Speeds*

Wolves are known to roam widely and at relatively fast travelling speeds (Mech, 1970). Long-range movements of wolves have hitherto been recorded by aerial and radio-tracking methods or by recapture of marked animals. Banfield (1953), from the Canadian mid-west, and Kuyt (1962), from the Northwest Territories, quote movements of up to 300 km, recorded by tagging and recapture. Burton (1973) cites an example from Alaska of a single animal that travelled over 1000 km in a six-week period, while Pulliainen (1965) puts the travelled distance of a wolf in Finland, apparently under the pressure of a chase, as high as 200 km a day. Based on data from the Isle Royale National Park, Lake Superior, Mech (1970) estimates an average normal rate of travel in subarctic areas at almost 60 km per day, a speed that includes hunting activity and rest.

The sudden arrival of wolves in East Greenland — the first in 40 years — along what is a relatively narrow, well-defined route provides an opportunity for the calculation of some travelling distances. Assuming that the wolves reaching the Scoresby Sund region in the fall of 1983 originated from North Greenland, their travelling distance must be considerably more than 1400 km, the great circle distance from southern Peary Land (e.g., Kap Harald Moltke) to Scoresby Sund. It is quite probable that the wolves now residing in the southern part of their range in Jameson Land are direct immigrants from Ellesmere Island, and in such a case their shortest travelling distance from the Robeson Channel area through southern Peary Land to southwestern Kronprins Christian Land and south to Scoresby Sund must have been well over 2000 km — probably considerably more. If it is further assumed that the sightings in East Greenland in the period 1978-80 all refer to the same pair of wolves, an idea of the natural southerly migration rate can be attained. Thus, with the available sighted locations between Peary Land and Hold with Hope of 80°N in 1978, 76°N in 1979, 74°N in 1980 (Fig. 6), the straight-line routes of the legs between the observed sites measure minimum distances of about 475 km for 1978-79 and about 350 km for 1979-80. In contrast, using Mech's 60 km per day travel estimate mentioned above, the journey from Peary Land to Hold with Hope could theoretically have been accomplished within a month.

### SURVIVAL PROSPECTS OF THE WOLF

The current distribution and population density of wildlife in the North and East Greenland National Park is sufficient for the survival of a small wolf population. Today wildlife in the

National Park is protected; legislation in 1974 defined that hunting, even by permanent residents, is illegal. While the complete control of all aspects concerning hunting and preservation in the National Park is impossible, e.g., lack of permanent "game wardens" makes the total enforcement of legislation difficult, the wolf would appear to have a good chance of survival. Rules now exist that safeguard against overexploitation by man — the main cause of the decline in the 1930s that led to extirpation from at least East Greenland. However, wolves reaching the southern part of the range in Jameson Land, south of the National Park border, are in immediate danger of elimination by the Scoresby Sund hunting communities. Øland (1984) reports recent attempts by hunters to kill wolves, while Kunak (1984) mentions the wolf as a coveted hunting prize.

Long-term survival possibilities of the wolf in the National Park are impossible to predict. Historical evidence shows that terrestrial animals in High Arctic regions undergo marked periodic fluctuations in response to variations in climatic conditions; in North and East Greenland the amount and duration of winter snowfall and the nature of the sea ice cover are critical factors (Vibe, 1967). The incoming of adverse climatic conditions and a severe deterioration of the habitat would alter the stability of the biological community, and the long-term livelihood and survival possibility of the wolf would be affected.

### NOTE ADDED IN PROOF

Our review of wolf data includes sightings up to December 1984; as discussed, reproduction has not been ascertained in Greenland but certainly cannot be ruled out. It is noteworthy that during the Geological Survey of Greenland's summer expedition in 1985 to western North Greenland, observations included sighting of wolf cubs. For example, on 21 July, K. Isler (pers. comm. to J.D. Friderichsen and A.K. Higgins) sighted a pack of four animals, one adult and three cubs, in Nansen Land, north of the low-lying valley linking J.P. Koch Fjord and De Long Bugt — an area known from the previous summer to support numerous wolves. This particular wolf family was observed several times during the rest of the summer (about one month) in the same general locality.

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