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Marine Mammals Inhabiting the Baffin Bay North Water in Winter

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ABSTRACT. Aerial surveys in March-April 1978 and March 1979 showed that some species of marine mammals overwinter in isolated areas of open water in the North Water in northern Baffin Bay. About 700 walruses and 37 bearded seals were seen, most over deep water (200-500 m) near SE Ellesmere Island in March 1979. Both species were much less common in 1978. Approximately 500 belugas were found in recurrent leads along the edge of the fast-ice in eastern Jones and Lancaster sounds and, to a lesser extent, in Smith Sound. Only 12 narwhals were seen. It has been concluded that the North Water is not a major overwintering area for marine mammals.

RÉSUMÉ. Les reconnaissances aériennes effectuées en mars et avril 1978 et en mars 1979 ont montré que quelques espèces de mammifères marins peuvent passer l'hiver dans les aires isolées des eaux libres dans les "Eaux du Nord", au nord de la baie de Baffin. En mars 1979, environ 700 morses et 37 phoques barbus ont été observés, la plupart à la surface des eaux profondes (200-500 m.), près de la partie sud-est de l'île Ellesmere. Ces deux espèces étaient moins fréquentes en 1978. Environ 500 bélougas furent découverts dans les fissures qui se forment périodiquement sur les bords de la banquise dans les parties orientales des détroits Jones et Lancaster, et á un moindre degré, dans le bras de mer Smith. Seulement 12 narvals furent apercus. Ainsi, les "Eaux du Nord" ne sont pas une aire majeure d'hivernage pour les mammifères marins.
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INTRODUCTION

In northernmost Baffin Bay, between NW Greenland and the islands of the Canadian High Arctic, isolated areas of open water persist throughout the winter. During spring and early summer the open water expands greatly as the pack-ice drifts southward. This "great open sea" or "North Water" was a haven for the 19th-century whalers who pursued the bowhead or Greenland right whale (*Balaena mysticetus*) northward in the spring through the treacherous pack-ice of southern Baffin Bay (Markham, 1874). Explorers who overwintered in the area (Kane, 1854; Hayes, 1867) noted the profound influence of the open water on the climate and the lives of the Thule Inuit of NW Greenland, who depended primarily on the sea for subsistence. The North Water continues to be the subject of oceanographic and climatological studies (Dunbar *et al.*, 1967; Dunbar and Dunbar, 1972), and satellite imagery has documented its extent and seasonality (Aber and Vowinckel, 1972).

Except for a few early anecdotes, little is known about the biological significance of the North Water during winter. Some workers have speculated that it is a winter refugium for beluga (white) whales, *Delphinapterus leucas*, and narwhals, *Monodon monoceros*, far to the north of the nearest areas of extensive open water (Sergeant and Hoek, 1974; Sergeant and Brodie, 1975; Mansfield *et al.*, 1975). The possibility of oil and gas exploration in northern Baffin Bay provided the

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incentive and funding to assess the significance of the North Water for marine mammals. In this paper we present the results of aerial surveys for marine mammals in the winters of 1978 and 1979. Observations of birds during these surveys are presented elsewhere (Renaud and Bradstreet, 1980.)

METHODS

Two aerial surveys were conducted over the North Water in 1978: 1448 linear km on 15-17 March and 1506 km on 18-20 April. Inclement weather in 1979 prevented a complete survey of the North Water, but 1158 linear km of surveys were flown. Place names referred to in the text are shown in Figure 1 and survey routes are shown in Figures 2 and 3.

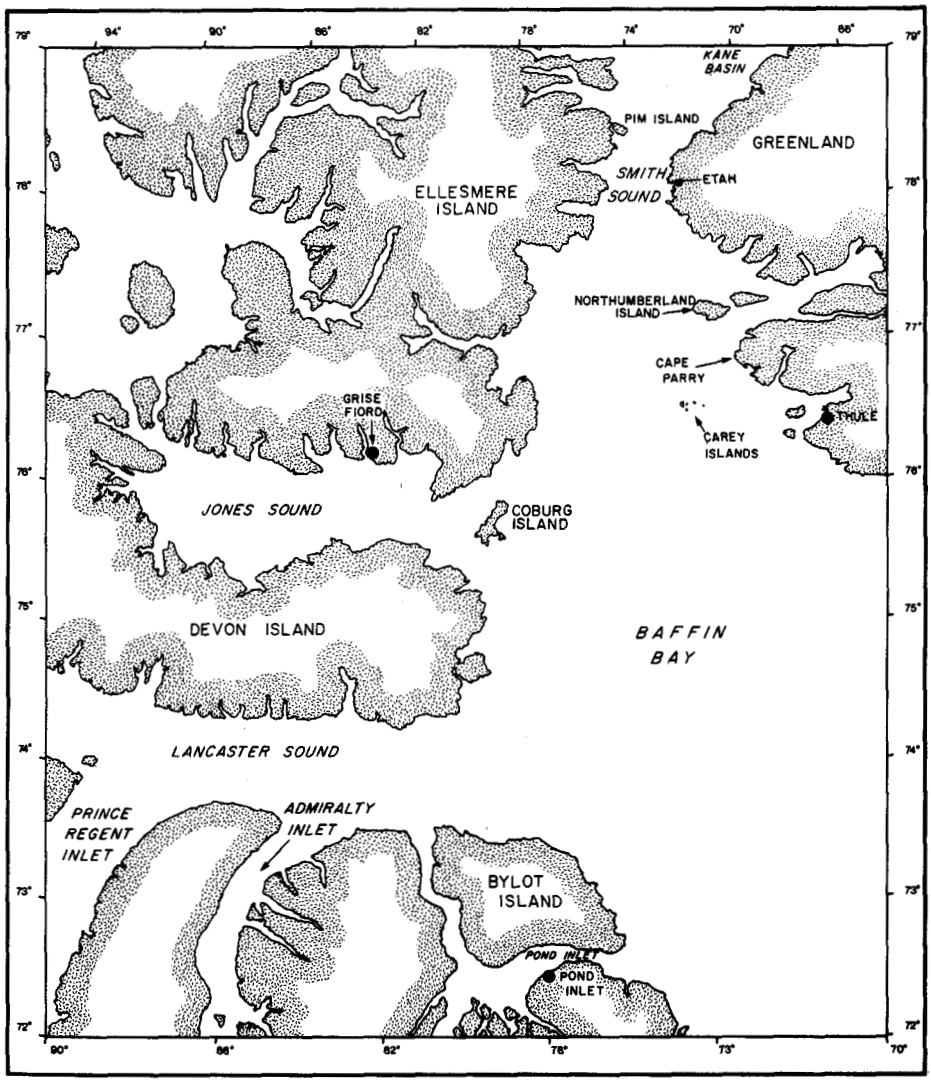

FIG. 1. Study area showing the place names mentioned in the text.

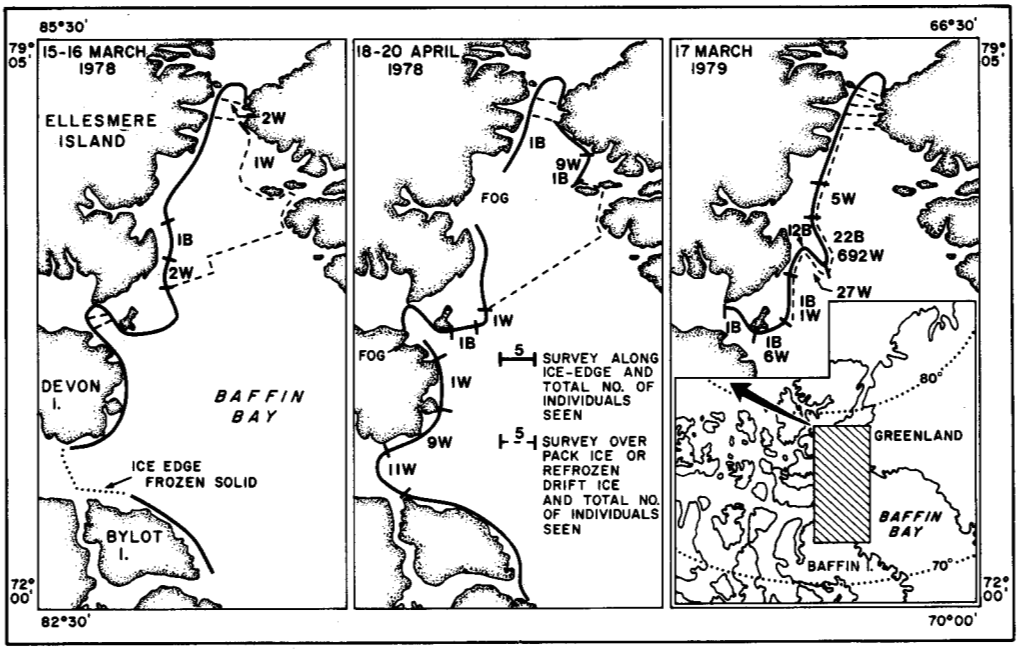

FIG. 2. Distribution of walruses (W) and bearded seals (B) in the North Water, late winter 1978 and 1979.

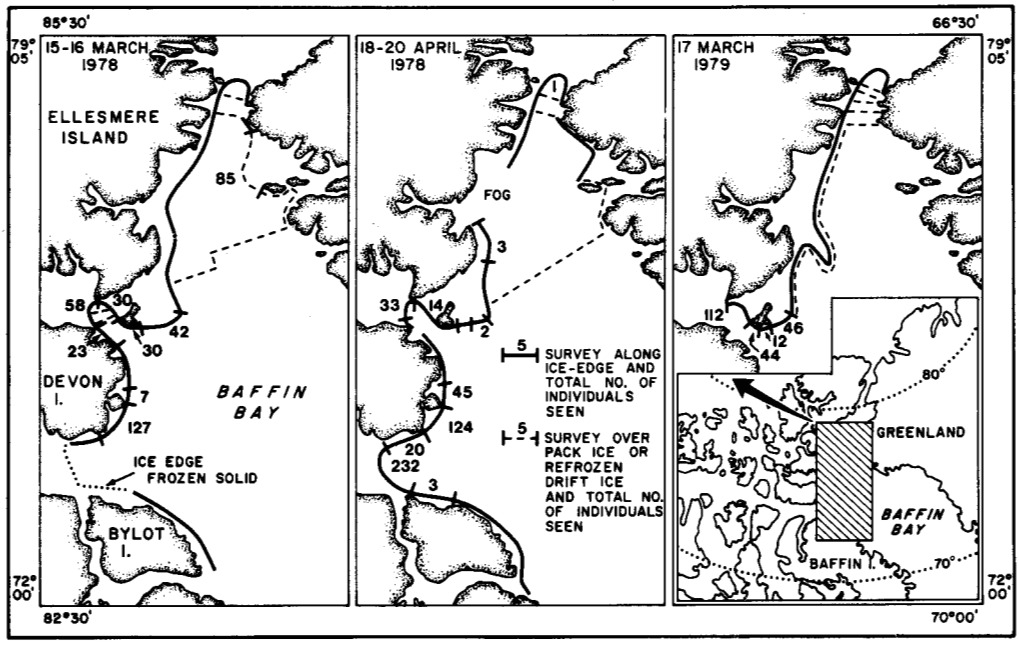

FIG. 3. Distribution of belugas in the North Water, late winter 1978 and 1979.

Surveys were conducted in a de Havilland Twin Otter, usually at altitude 100-200 m ASL and airspeed 200-220 km/h. Occasionally we flew at lower altitudes (about 50 m ASL) or airspeeds (185 km/h) when low cloud or fog was encountered, or when it was necessary to examine animals more closely. Two observers were present, one in the right front (co-pilot's) seat and another in the passenger area on either the right or left side depending on whether open water was present on one or both sides of the aircraft. Because open water was usually restricted to narrow leads (< 500 m wide) along the edge of the fast-ice, most surveys were flown about 50 m to the left of the lead with both observers seated on the right side of the aircraft. When wide leads were encountered, the aircraft was flown 500 m off the ice edge and the observers surveyed on both sides of the aircraft. Offshore transects over open water and pack ice were also flown with the observers surveying on both sides of the aircraft.

Observations of mammals, birds and ice conditions were dictated into tape recorders. Times of all observations were recorded and positions were fixed from landmarks and a Global Navigation System (GNS-500). For each individual or group of animals, the observer recorded the number of individuals, behaviour, and habitat. Whenever possible and appropriate, age, sex, direction of movement and reaction to aircraft were also recorded.

ICE CONDITIONS

In late winter, the west, east and north margins of the North Water are sharply defined by landfast ice-edges along the periphery of the eastern Canadian arctic archipelago and NW Greenland, and across Smith Sound (Figs. 4, 5). The southern limits of the North Water are defined more diffusely by the heavy pack-ice of Baffin Bay. Typically the North Water is most restricted in area during March and begins to enlarge in early spring as the pack-ice in Baffin Bay drifts to the south.

In March of 1978 and 1979, the extent of the North Water appeared typical (*cf.* Anon., 1970; Aber and Vowinckel, 1972; Lindsay, 1975), with the exception that Lancaster Sound was frozen solid to its eastern entrance. Usually Lancaster Sound is covered by pack-ice that remains in intermittent restricted motion throughout the winter (Anon., 1970). In both 1978 and 1979 Lancaster Sound remained frozen, with an ice-edge across its entrance, until July.

Calm cold conditions prevailed during the surveys in March 1978, and areas of open water were very restricted along the fast ice-edges and almost non-existent elsewhere (Fig. 6). At this time the most extensive open water (up to 500 m wide) occurred along the ice-edge across the mouth of Jones Sound. In Lancaser Sound open water was restricteed to intermittent narrow leads between the pack-ice and fast-ice along NE Bylot Island. Open water was less extensive than expected in Smith Sound; the area between the landfast ice-edge across the sound and the pack-ice to the south was covered by a continuous sheet of new ice. This was, no doubt, a temporary phenomenon attributable to the calm, cold conditions. The ice-edge along the coast of NW Greenland was less distinct than elsewhere, and much of the survey in this area was flown over pack-ice interspersed with narrow leads.

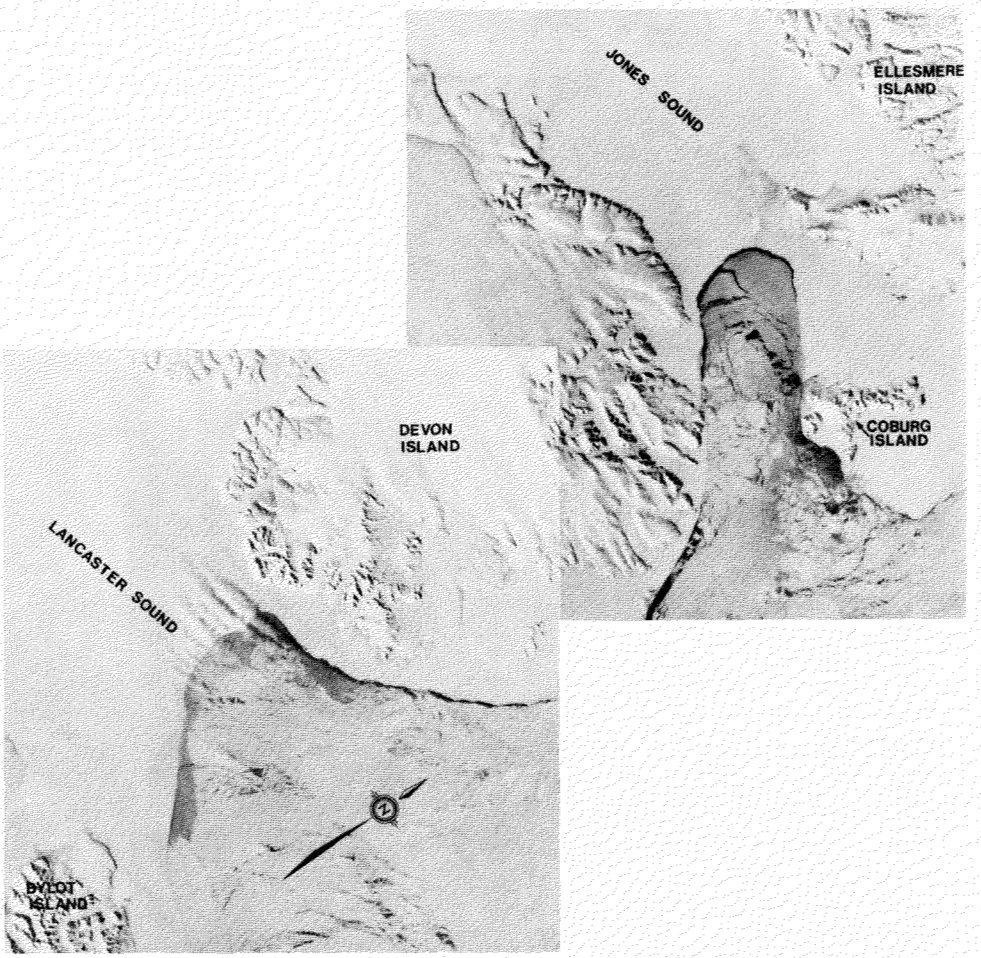

FIG. 4. Ice conditions in the vicinity of Jones and Lancaster sounds, 7 April 1978 (LANDSAT Imagery).

In March 1978, offshore Baffin Bay was almost entirely covered by pack-ice; open water was restricted to occasional cracks and narrow leads, particularly around the Carey Islands. Newly forming ice in most areas of open water in March 1978 appeared to be quickly consolidated into extensive thin ice that was more or less continuous with the pack-ice fields. The gradation of ice thickness is evident in LANDSAT imagery (Figs. 4, 5); however, it is often impossible to distinguish thin ice from open water on LANDSAT imagery, and consequently the open water appears more extensive than it really is.

By mid-April 1978, the leads along ice-edges had widened and the adjacent pack-ice was somewhat more dispersed than in March. A frozen lead that had extended across the entrance to Lancaster Sound in March had opened by April. Its western margin was the Lancaster Sound ice-edge, which persisted until mid-July.

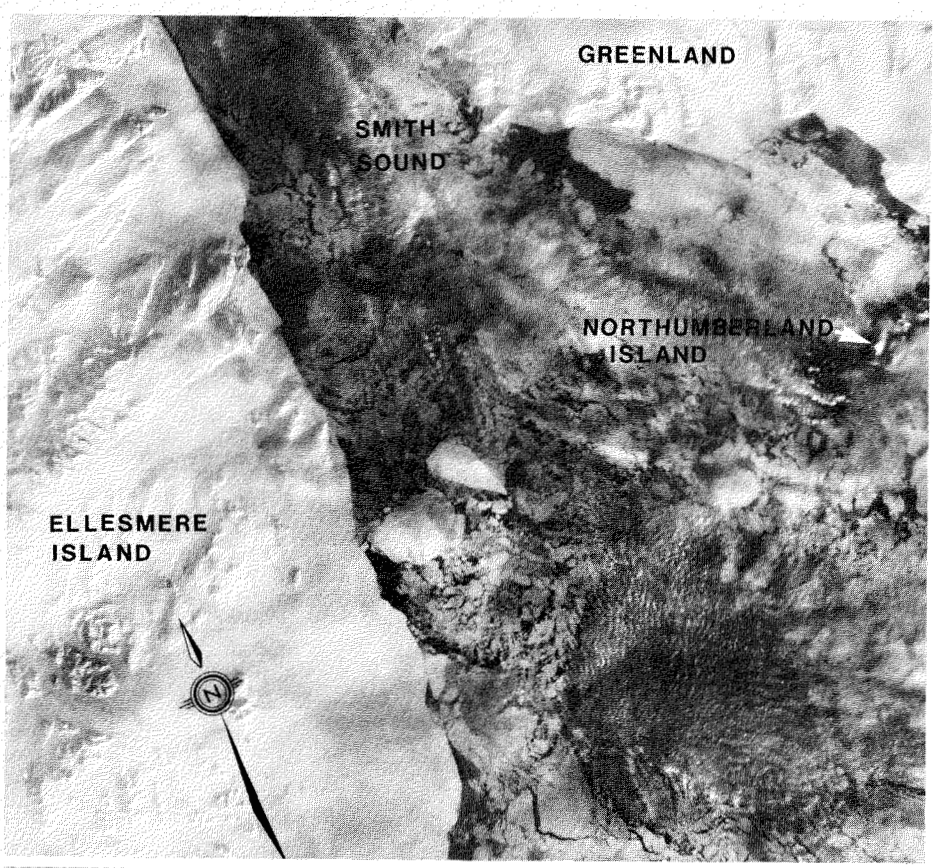

FIG. 5. Ice conditions in Smith Sound and northern Baffin Bay, 16 March 1978 (LANDSAT Imagery).

The positions of the ice-edges in March 1979 were similar to those in March 1978. However, the pack-ice was more dispersed in 1979, probably because of the extensive weather disturbances that also prevented completion of our surveys.

RESULTS AND DISCUSSION

Polar Bear

Stirling and Archibald (1977) suggested that polar bears (*Ursus maritimus*) tend to concentrate in areas of unstable ice where they can prey upon immature ringed seals. However, our limited evidence indicates that polar bears were not particularly concentrated along ice-edges bordering the North Water; few bears or bear tracks were seen during our surveys. Only four single adults were seen during the March 1978 survey and none were seen in April. Only one adult was seen during the March 1979 survey. All polar bears were seen along the edge of the fast-ice, and most (4 of 5) of these were along SE Ellesmere Island.

Ringed Seal

The ringed seal (*Phoca hispida*) is the most abundant marine mammal in the Arctic. During March and April, adults occupy areas of stable fast ice, which is

FIG. 6. A narrow intermittent lead along the east coast of Ellesmere Island, 17 March 1978. The consolidated pack-ice field of northern Baffin Bay is on the right side of the lead and the fast-ice is on the left.

critical for pupping, whereas subadults are thought to be excluded from prime breeding habitat and occupy areas of thin, unstable ice (McLaren, 1958a). Throughout the winter ringed seals are able to maintain breathing holes in solid ice and they are seldom seen before May and June when they begin to haul out on the ice near their holes (Finley, 1979).

Few ringed seals were observed during aerial surveys of the North Water. Four were observed in March and seven in April of 1978; only two were observed in March 1979. Most of these seals were swimming in narrow leads along the fast-ice, although in April 1978 four were observed hauled out on thin ice in Smith Sound. Some seal breathing holes were seen in thin ice.

Bearded Seal

During the winter, bearded seals (*Erignathus barbatus*) are mostly restricted to areas where ice cover is thin or broken. In addition, since bearded seals are normally bottom feeders, they must have access to relatively shallow areas where benthic prey is available (Vibe, 1950; Burns, 1967). Burns and Frost (1979) concluded that bearded seals in the Bering Sea were restricted primarily to waters of less than 100 m where they had access to drifting ice upon which they could haul out. Stirling *et al.* (1977) found that bearded seals preferred shallow areas (< 75 m) in the Beaufort Sea.

Few bearded seals were seen during the two surveys in 1978; only three were observed in March and eight (hauled out on the ice) in April. Seven of these seals were seen along the east coast of Ellesmere Island (Fig. 2).

During the 1979 survey along the east coast of Ellesmere Island a total of 37 bearded seals was seen (about 0.1/linear km, compared with 0.02/linear km in April 1978). At least 21 of these 37 bearded seals were in areas where water depths exceeded 500 m. The others were in areas where the average water depth exceeded 200 m. These depths are much greater than those where bearded seals have been found previously (*cf.* Stirling *et al.*, 1977; Burns and Frost, 1979), although little is known of the winter distribution of this species.

Bearded seals tend to be solitary throughout most of the year (Burns, 1967). Their clumped distribution off SE Ellesmere Island in March 1979, including at least four closely associated pairs, suggests the occurrence of breeding activities. However, conception does not occur until April or May (McLaren, 1958b; Burns, 1967).

Walrus

Walruses (*Odobenus rosmarus*) overwinter in areas with sufficient open water and productive bivalve communities in relatively shallow water. Kane (1892:348), who spent two winters (1853-1855) near the North Water, was "inclined to the opinion that walruses frequent the half broken ice margin throughout the year". Hayes (1867:245), who spent the winter of 1860-61 near Etah, NW Greenland, remarked that in February "The walrus had been very numerous in the open waters outside the harbour all through the winter, and their shrill cry could be heard at almost any time from the margin of the ice". Although some walruses overwinter in polynyas around NW Devon Island (Davis *et al.*, 1978; Kiliaan and Stirling, 1978) and off NW Greenland, the majority are thought to migrate to more southerly wintering grounds along the west Greenland coast (Freuchen, 1921; Vibe, 1950; Loughrey, 1959).

During aerial surveys, walruses on ice pans can be detected from a distance of several kilometres (Estes and Gilbert, 1978). In addition, their presence is often evident from faecal staining of ice pans or from distinctive patterns created when walruses surface through thin ice.

Few walruses or signs of walruses were seen during the surveys in 1978; five walruses were seen in March and 31 in April (Fig. 2). The majority of those seen in April were in the Lancaster Sound - SE Devon Island area, where none had been seen in March.

About 700 walruses were seen in March 1979; all were near SE Ellesmere Island where few walruses had been seen during March-April of 1978 (Fig. 2). The estimate of 700 walruses is approximate because most of these walruses were huddled closely together in groups as large as 45-50 individuals. Attempts at closer examination from 100 m ASL were abandoned because many walruses entered the water before they could be counted. It was rarely possible to determine sex or age, but at least two yearlings were seen, each in close

association with an adult. Most of the 700 walruses were hauled out along the edges of cracks and narrow leads in the pack-ice field close to the fast-ice edges.

Most of the 700 walruses seen in March 1979 were clumped in an area where water depths ranged from 200 to over 500 m. Extensive faecal staining on the ice suggested that they were able to forage in this area, although it is generally believed that walruses cannot feed at depths greater than 80 m and are, therefore, restricted in distribution to shallow waters (Vibe, 1950; Mansfield, 1973; Fay *et al.*, 1977). However, previous discussions of walrus distribution and diving capability have been circular in logic, because statements about diving capability have been based largely on distribution relative to water depth.

The occurrence of large numbers of walruses in the North Water in March 1979 and their virtual absence in early 1978 is not readily explained in the context of the considerable literature about walrus distribution and migrations in this area (*cf.* Freuchen, 1921; Vibe, 1950; 1967; Loughrey, 1959; Mansfield, 1958; 1966). Major wintering grounds formerly were considered to be on the west coast of Greenland between 66° and 69° (Freuchen, 1921) and along the south margin of the Davis Strait pack-ice (Loughrey, 1959; Vibe, 1967). Because of the great distance (about 1000 km) between summering and wintering areas, Freuchen (1921) and Vibe (1967) believed that the migration was not annual but continuous, and that walruses sought favourable ice conditions and foraging areas along the way. However, the Pacific walrus undertakes annual migrations that, in some cases, cover round-trip distances of at least 3200 km (Burns, 1965).

Beluga or White Whale

Belugas vacate their summering areas in the central Canadian High Arctic during September and October (Davis and Finley, 1979). Occasionally some are trapped during freeze-up and attempt (usually unsuccessfully) to maintain breathing holes in the ice (Hill, 1968; Freeman, 1968; Davis and Finley, 1979). However, most of the population of about 10 000 have moved eastward through Lancaster Sound by early October. It has been suggested that these belugas probably make only local migrations and overwinter in the North Water, thus isolating them from populations in west Greenland and southern Baffin Bay (Sergeant and Hoek, 1974; Sergeant and Brodie, 1975). However, this suggestion is unproven. Vibe (1950) suggested that small numbers of belugas may overwinter in the North Water, but he knew of only one winter record: on 6 February 1923, a herd of belugas was observed off Cape Parry (Nielsen, in Vibe, 1950).

We observed 402 belugas during the North Water survey in March 1978; most were in narrow leads along SE Devon Island (134 or 2.1/linear km) and along the Jones Sound ice-edge (183 or 1.8/linear km) (Fig. 3). North of 76°N, the only belugas observed were groups of 35 and 50 in heavy pack-ice near Northumberland Island close to where Nielsen (in Vibe, 1950) had seen a herd in the winter of 1923. The groups of belugas in Lancaster Sound, Jones Sound and Smith Sound appeared to be at least temporarily isolated from one another by extensive areas of impenetrable ice.

A herd of about 100 belugas was seen near Pim Island in Smith Sound on 5 April 1978 (Corp. T. Grant, R.C.M.P., pers. comm.). By mid-April the ice had begun to disperse somewhat and many belugas had moved southward to the entrance of Lancaster Sound (Fig. 3). On 18 April, 189 belugas (2.1/linear km) were seen along SE Devon Island and 232 (2.9/linear km) were seen along a newly formed lead across the mouth of Lancaster Sound. Most of the whales seen along SE Devon Island were moving southwest. When the Lancaster Sound ice-edge was resurveyed two days later, 303 belugas (3.8/linear km) were seen. We saw fewer belugas in and near Jones Sound in April (49) than in March (183), and we saw only four belugas in Baffin Bay north of 76°N during April.

An incomplete survey of the North Water on 17 March 1979 revealed a distribution of belugas similar to that during March 1978. All 214 belugas seen during March 1979 were in the vicinity of Jones Sound and Coburg Island (Fig. 3). The density there (1.6/linear km) was similar to that recorded there in March 1978 (1.8/km).

Most of the belugas observed during the March-April surveys were in narrow leads along the edge of the fast-ice. Their presence was usually evident from the distinctive patterns of breathing holes that they left in thin ice. In several instances belugas were observed beneath ice cupolas (Fig. 7).

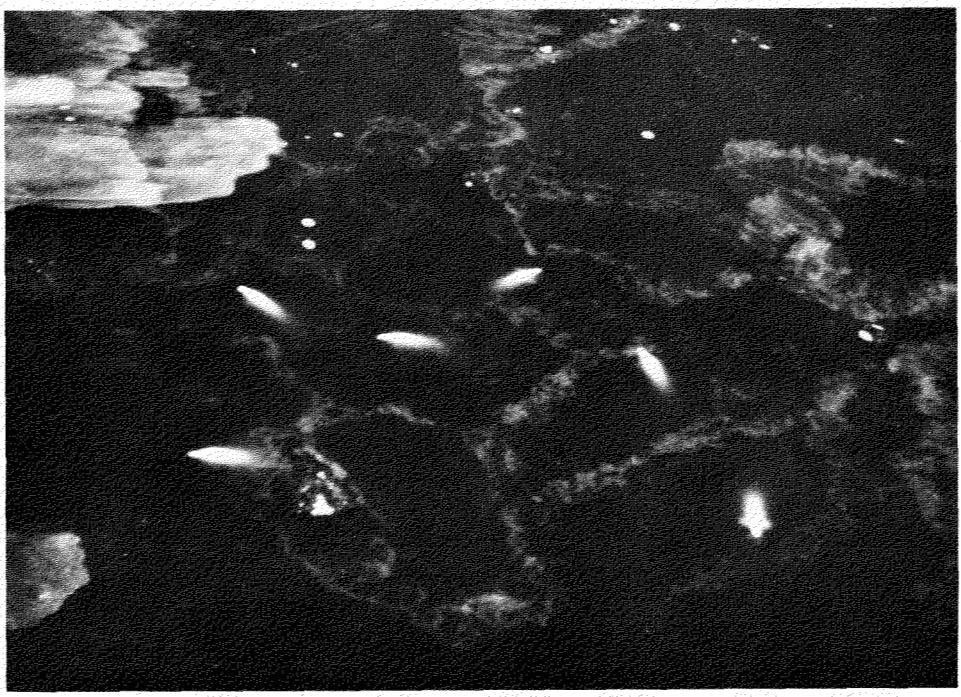

FIG. 7. Six adult belugas lie beneath a thin sheet of ice. The white spots are areas where exhaled air has been trapped beneath the ice. The light diffused patterns are thin sheets of ice that have rafted together.

Many of the groups of belugas along the Jones and Lancaster Sound ice-edges consisted of adults (presumably females) accompanied by immatures. Of 82 belugas classified as adults during the March 1978 survey of these areas, at least 38 were closely accompanied by immatures. Many of the other adults were near immatures but the degree of association was not clear. Of 232 belugas classified as adults during the April 1978 survey, at least 86 were in close association with immatures and many additional immatures were interspersed among the other adults (Table 1). Groups composed entirely of large adults were uncommon

Table 1. Age composition of belugas observed in Lancaster and Jones sounds during Northwater surveys in 1978 and 1979.

Survey Date	Adult		Immatures		Not Classified
	#	%	#	%	
March 1978	82	55	67	45	168
April 1978	232	66	120	34	126
March 1979	81	62	50	38	83

along the Jones and Lancaster Sound ice-edges, but the two groups (total of 85 belugas) observed on 16 March 1978 off NW Greenland consisted entirely of adults. In March 1979, only three all-adult groups (consisting of 4, 5 and 8 individuals) were positively identified. At least 45 of 81 other adult belugas were closely associated with immatures. Subjectively, the proportion of immature belugas and of adult-immature groups seemed high and the proportion of all-adult groups seemed low in relation to our unsystematic observations in the summering areas.

During the period of maximum ice cover, belugas overwintering in northern Baffin Bay appear to be restricted to isolated areas of open water along SE Devon Island, in eastern Jones Sound, and in Smith Sound. Overwintering belugas are apparently most numerous in Jones Sound and along SE Devon Island, which suggests that conditions for overwintering are more favourable or dependable here than in Smith Sound. The extensive formation of new ice that we observed in March of 1978 and 1979 along the Smith Sound ice-edge may preclude continuous occupation of this area by belugas during the winter. Because belugas were very conspicuous and restricted to narrow leads in March 1978, we believe that we detected most of the belugas in northern Baffin Bay. No belugas were observed during offshore transects over the pack-ice and there was no evidence of their conspicuous breathing holes in areas of thin ice. We estimate that about 500 belugas wintered in the North Water in 1978 and it appeared that similar numbers were present in 1979 although we were unable to complete the survey. Clearly, most of the eastern Arctic belugas do not overwin-

ter in the North Water. Vibe (1950) stated that belugas left the Thule area of NW Greenland when ice began to form in October and followed the coast south. These animals are thought to winter along the west coast of Greenland between Disko Bay (70°N) and 63°N (Vibe, 1967; Kapel, 1977).

Narwhal

Narwhals vacate their summering areas in the eastern and central Canadian High Arctic during September and October (Johnson *et al.*, 1976; Finley and Johnston, 1977). Kane (1892) considered their presence in the North Water during winter to be accidental; Inuit of Etah, NW Greenland, secured a young narwhal in the winter of 1854-55. Mansfield *et al.* (1975:1042) suggested, however, that narwhals "probably spend the winter in open water in Baffin Bay, especially in the 'North Water' . . .".

Only one small group of 12 narwhals was observed during the three March-April North Water surveys. They were along the east coast of Ellesmere Island near 78°N on 17 March 1979. The group consisted of seven adult females (one of which was accompanied by a small calf), two adult males, and two individuals of undetermined status.

THE NORTH WATER AS OVERWINTERING HABITAT

In mid-March of 1978, heavy pack-ice covered offshore areas of northern Baffin Bay and most leads had recently frozen over because of prevailing calm conditions. The action of winds and currents on the pack-ice of northern Baffin Bay produces narrow leads along landfast ice-edges at the northern perimeter of the pack-ice. Areas of open water appear to be found most consistently along SE Devon Island, in eastern Jones Sound and, less reliably, in Smith Sound (Figs. 4, 5). These areas of open water provide limited overwintering habitat for some species of marine mammals far to the north of their normal wintering ranges.

The ringed seal and its predator, the polar bear, are the only marine mammals that regularly occupy extensive areas of solid fast-ice. Other pinnipeds, notably the bearded seal and walrus, have only a limited capability to maintain breathing holes in solid ice, and therefore are restricted during the winter to areas where ice cover is (at most) thin or broken. Another factor believed to limit the winter distribution of walruses and bearded seals is their dependence on adequate and accessible benthic food resources. The combination of these factors may severely limit the potential winter range of these two species within the North Water. Most nearshore shallow water areas where benthic food would otherwise be accessible to walruses and bearded seals are covered by fast-ice in winter. Indeed, Burns and Frost (1979) attributed low numbers of bearded seals in the Beaufort Sea to the lack of shallow feeding areas, particularly in the winter when landfast ice extended beyond the continental shelf. Vibe (1950) noted that although the bearded seal was better able to maintain breathing holes than walruses, it was forced to leave coastal waters to winter near the ice-edge. Vibe observed that the bearded seal fed on arctic cod, *Boreogadus saida*, in areas where the water depths exceeded 100 m. Walruses only rarely feed on arctic cod (Mansfield, 1958) and occasionally they are known to feed on ringed seals (Vibe,

1950; Fay, 1960), but it is unlikely that these non-benthic types of food could support many walruses through the winter in the North Water.

Northern Baffin Bay can be an extremely harsh environment for overwintering whales; entrapment by ice is usually fatal. Whales are likely to avoid areas where potentially fatal ice conditions occur, even if these conditions occur only once every few years. Of the three cetaceans that often occur near ice, the narwhal, bowhead and beluga, the last appears to be best adapted for survival in the most restrictive of winter ice conditions.

The prime behavioural adaptations of belugas to ice are their ability to relocate annually those areas with ice conditions suitable for survival, and their ability to maintain holes in thin ice. The presence of belugas in certain areas of the North Water in winter is indicative of the dependence of certain ice conditions necessary for their survival. Such conditions must also exist in local areas of Hudson and James bays, where belugas also overwinter in restricted areas of open water isolated by extensive areas of heavy ice from the closest large areas of open water (Jonkel, 1969; Sergeant, 1973). Kleinenberg *et al.* (1964) reported that in the Soviet Arctic, belugas overwinter in severe ice conditions north to 82°N, particularly in areas of recurrent polynyas that are often hundreds of kilometres from extensive ice-free water.

Although some belugas do overwinter in isolated and restricted areas of open water, it appears that in the Canadian Arctic most belugas and narwhals undertake longer migrations to areas where ice conditions are not as severe. There is no evidence that the limited open water of the North Water supports more than a small percentage of the High Arctic population of belugas during late winter.

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