WINTER OBSERVATIONS ON BELUGA (*DELPHINAPTERUS LEUCAS*) IN JONES SOUND, N.W.T.

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On November 25, 1966, two hunters searching for seal breathing holes in the sea ice near the mouth of Starnes Fiord, S. Ellesmere Island, N.W.T., found an area of open water where a large number of beluga (*Delphinapterus leucas* Pallas) were apparently trapped. About 600 yards distant they discovered a second similar opening in the sea ice, and within two weeks of this a third was discovered equidistant from the others.

This was the first wintering of whales witnessed by any of the residents of Grise Fiord, a small community of eighty Eskimos who formerly had lived at various locations in eastern Hudson Bay, northern and eastern Baffin Island, Foxe Basin and Smith Sound. During the winter months following the discovery of these whales, hunters from Grise Fiord, approximately twenty-five miles distant, periodically hunted whales at these breathing places. In view of the seeming rarity of such winterings in the high latitudes, this report comprises those observations the writer was able to obtain during the course of five visits to the breathing holes.

Formation and Maintenance of Breathing Holes

The winter 1966-67 was unusual at Grise Fiord because of light winds and sparse snowfall. Weather conditions in Jones Sound are remarkably local however, and the preceeding statement principally applies to the region extending about thirty miles east and west of the community. Strong local winds, especially from the heads of fiords or down glaciers, can be experienced at any time.

Hunters believe that the usual strong winds blowing from the head of Starnes Fiord prevented this body of water from freezing during early October, a time when calm conditions prevailed and sea ice formed outside of the fiord. A sudden period of calm during this time, when temperatures rarely rose above 5°F and reached −5° most nights, would enable Starnes Fiord (an area of about 100 square miles) to freeze over rapidly, trapping any whales still in the Fiord. A 25-30 mile belt of winter ice, without leads or cracks would effectively prevent the trapped whales from reaching the open waters of Jones Sound.

Later examination of ice conditions in Starnes Fiord and the region surrounding the area where the whale holes occurred confirmed the hunters' opinions as to the conditions of the ice at the time of freeze-up.

When the holes were first located, the largest measured approximately thirty by ten feet; the other two holes were smaller, the smallest being circular, with a diameter of about eight feet. The edges had been built up by spray and waves generated by movement of the whales in the openings.

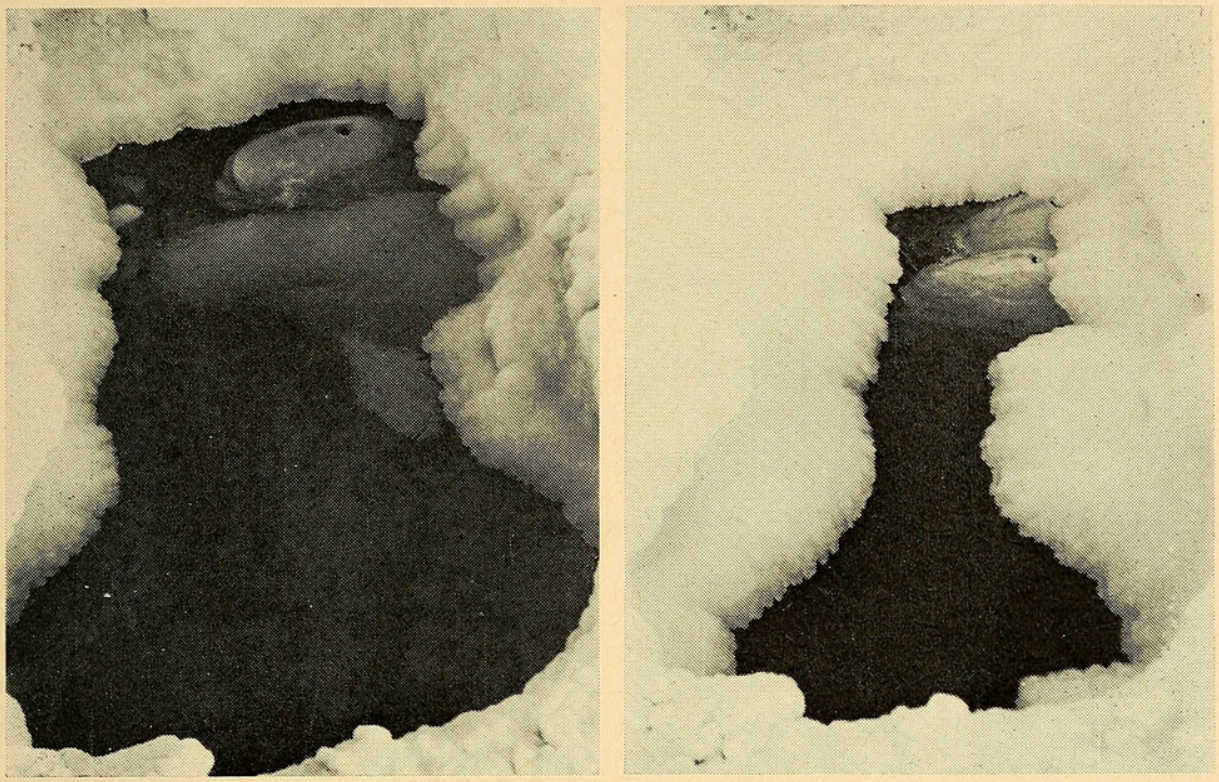

FIGURE 1. Beluga surfacing to breathe. Photographs taken on April 1 and 2, 1967, indicate the extent of ice-formation in the breathing hole during a 24 hour period.

The smallest hole was abandoned for a few hours during the night of November 28, following disturbance due to hunting. The next morning it had frozen over to a depth of about 3 inches, and was never re-opened. Hunters believe the whales can break new ice up to an inch thick using their heads, but that ice of a greater thickness and hardness than newly formed sea-ice would prove too difficult. At this time, night temperatures averaged −30°F, with day temperatures only a few degrees higher; it required eight to ten hours for an inch of new ice to form on holes in the sea ice.

The two remaining breathing holes became progressively smaller in area as the sides were built up by spray. By mid-December both holes had domed roofs of ice covering them, with a single elongate slit in the roof of the smaller of the two holes, and two elongate slits about one and two feet long in the centre of the other roof; these slits were parallel to the long axes of the holes.

At the end of December a heavy storm drifted and compacted considerable snow on the sea ice in this region. It seemed very probable that the holes would be completely drifted over with closure of the small holes. The hunters were certain, however, that the whales would be able to prevent the sealing of the ice-lined dome covering the breathing holes by the heat of their breathing immediately below the single short slits in the centres of the roofs.

On December 29 hunters removed the ice roof from each hole, exposing an area approximately six feet by three feet. When they returned to the site January 6 both roof domes had reformed.

TABLE 1. — Beluga lengths from hunting returns, Grise Fiord and Starnes Fiord, N.W.T.

Lengths	September 1–25, 1965		September 1–7, 1966		December 28, 1966 – March 31, 1967	
	Males	Females	Males	Females	Males	Females
5′ – 6′11″	1	1	1	1	0*	0*
7′ – 8′11″	2	1	1	6	0	0
9′ – 10′11″	6	3	7	7	3	0
11′ – 12′11″	1	8	2	10	5	11
13′ – 14′11″	4	0	5	1	2	2
15′	5	0	2	0	0	0
	19	13	18	25	10	13

*Two whales in this size class are not included as the sex was not observed (November 1966).

The second breathing hole was abandoned January 25; temperatures at this time were –40°F, and the number of whales surviving was estimated to be 25-30, from the original number of approximately 150.

The last whale-hunting at the breathing hole occurred April 2; on this occasion approximately 15-20 whales remained at a hole measuring approximately six feet by three feet, with a roof of compacted snow and ice having no opening at the centre. On April 5 hunters discovered the whales had left the breathing hole, which was now being kept open by ringed seal (*Pusa hispida*); the hunters presumed the whales were attempting to reach open water twenty miles distant. There were no pressure or tide cracks open in the immediate vicinity, and they considered the whales were in some way able to utilize seal breathing holes in the course of their journey to the open water.

NUMBER AND COMPOSITION OF WHALES

We estimated 150-200 whales initially frequented the three breathing holes; after removal of approximately 50 whales by mid-December numbers seemed scarcely diminished. By early January, however, following removal of between eighty and ninety whales by hunting, an estimated 30-40 survived, suggesting a slight dying-off independent of hunting mortalities.

No consistent account of size or sex distribution of whales was made. There were more young adults (light grey, 10-13 feet in length) than both juveniles (dark grey, 5-9½ feet) and fully adult whales (white, 12½ feet and above). The largest male measured 13′9″ and the largest female 13′8″ in a small sample of 25 whales.

Because of selective hunting during the winter, the size-frequencies shown in Table 1 are not representative of the trapped population. Bias is introduced because hunters preferred small whales due to ease of handling and quality of the skin (a northern delicacy).

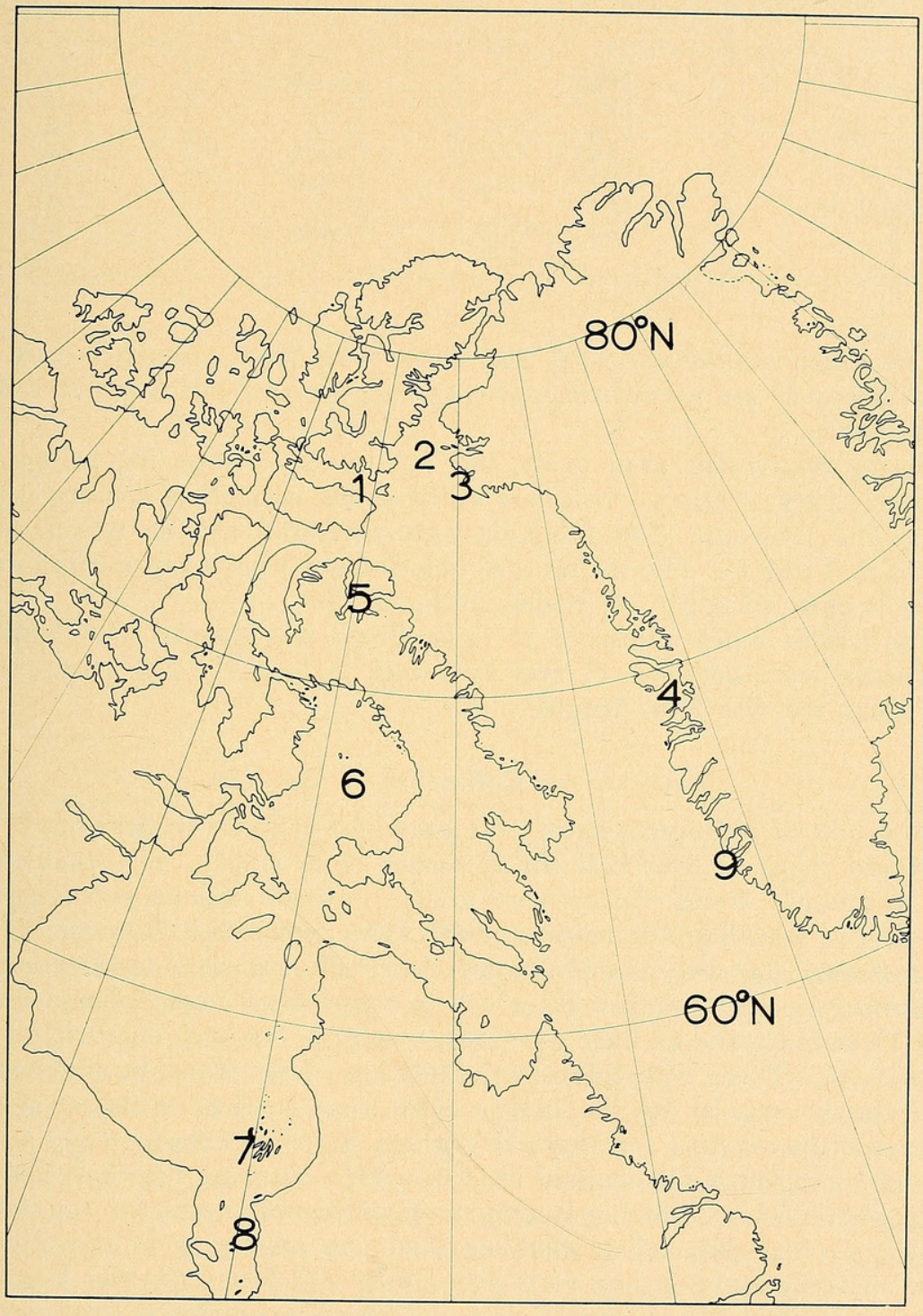

FIGURE 2. The Eastern Arctic. 1. Jones Sound; 2. Smith Sound; 3. Thule; 4. Disko Bay; 5. Navy Board and Milne Inlets; 6. Foxe Basin; 7. Belcher Islands; 8. James Bay; 9. Godthaab.

TABLE 2. — Liver weights, winter-killed beluga, Starnes Fiord N.W.T.

Date	Body length	Sex	Liver weight (Pounds)
Jan. 6	11′10″	Female	27
,,	13′3″	Male	40
Jan. 25	12′6″	Male	24
,,	12′4″	Female	40
,,	12′2″	Female	33
March 31	12′2″	Male	21
,,	12′2″	Male	20½

Two small individuals 5-5½ feet long, with fresh umbilical scars killed on November 29 are noteworthy, as they indicate that births occur well into the fall season.

During September most years, but not in 1967, when the beluga failed to appear, thirty or forty whales are killed in the immediate vicinity of Grise Fiord. The 1965 and 1966 fall kills were measured by the writer and are included in Table 1. The sex ratio of ninety-eight whales represented in these samples is close to unity (47 males, 51 females).

The largest whale measured at Grise Fiord was a male 17′4″ length; six other males were between 15 and 15½ feet in length. The largest female whale measured was 13′8″ length.

FEEDING AND CONDITION OF WHALES

Stomachs of forty-six whales were examined at intervals between November 25 and April 1; over half the stomachs were empty, or contained only water or mucus. Food remains were always in small amount, averaging about a half-litre of semi-liquid remains in most cases. Polar cod (*Boreogadus saida*) and crustacea (*Boreomysis nobilis*) were virtually the only food species.

Blubber thickness ranged from one to two inches measured mid-dorsally, in late December, and as little as one-half inch to one and one-half inches in late January. There was differential depletion of fat from the blubber layer over different regions of the body. The most marked withdrawal of fat occurred in the cervical and thoracic regions, where in extreme cases a fibrous layer containing little fat overlaid the ribs. However, even in these extremely emaciated individuals, blubber thickness remained near normal in the peduncle region, with an intermediate blubber thickness occurring in the abdominal region. For example, in one very thin female (13 feet six inches length) the blubber and fibrous layer extending from the scapular region to immediately posterior to the genital opening weighed 62 pounds (on one side of the body only), whereas blubber and fibrous layer covering the much less extensive peduncle region weighed 35 pounds on one side of the body.

Small liver size likewise reflected the nutritional stress of these winter whales; for comparison with the data presented below (Table 2), the liver of a summer caught whale (male, 10 feet length) weighed 29 pounds.

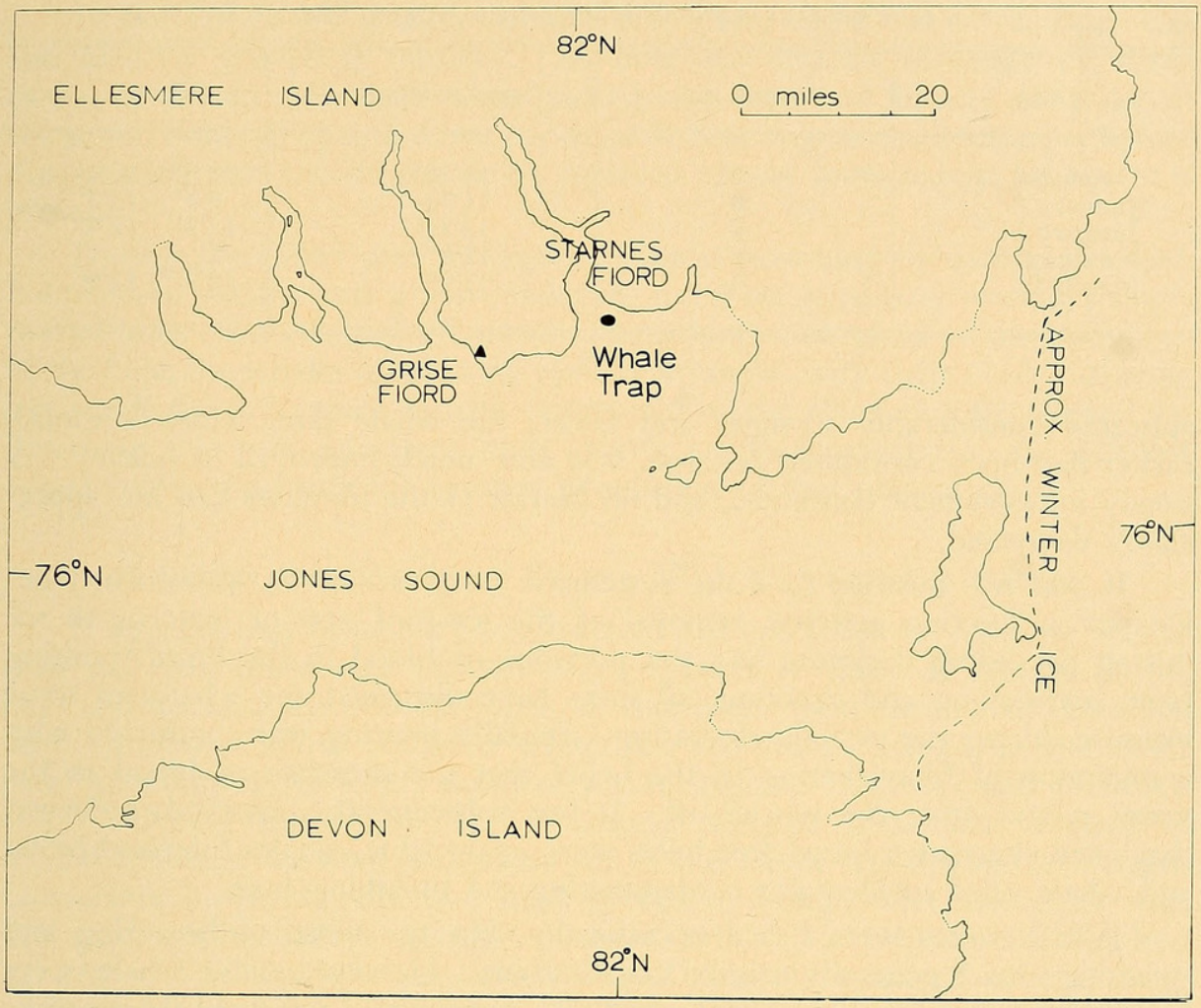

FIGURE 3. The Jones Sound Region.

BEHAVIOURAL AND PHYSIOLOGICAL OBSERVATIONS

On November 28-29 ten females 12 feet and over in length were examined; none were pregnant, and six had a small quantity of either green-coloured milk or a clear fluid present in the mammary glands. On December 27-29 five females were examined and found to be not pregnant; on this date no liquid could be expressed from the mammary glands, though of seven females examined during January, February and March, one did have a small quantity of clear fluid in the mammae. None of the twenty-one females, judged from size, colour and ability to lactate as being sexually mature, were pregnant.

Despite the fact that smaller individuals were selectively hunted, the differential survival of larger individuals was apparent once numbers were reduced. By mid-January small individuals had virtually disappeared from the group of trapped whales remaining. A small number of measurements from landed whales indicates this trend (Table 3).

Observations on leanness and swimming behaviour gave the definite impression that the whales were steadily weakening from the time of first sighting (November 25) until the end of January, when about 20-30 whales survived at a single breathing hole. On February 20, however, the surviving whales

TABLE 3. — Lengths of winter-killed beluga, Starnes Fiord N.W.T.

Date	Sample size	Average length	Range
December 28.	7	11′3½″	10 0″ – 12′1″
January 7.	8	11′9½″	9′9″ – 13′3″
January 24.	4	12′3½″	12′2″ – 12′6″
February 21.	1	13′8″	
March 31.	3	12′8″	12′2″ – 13′9″

appeared considerably stronger and fatter; the whale skin, which a month earlier had been considered tasteless, was now much improved in quality. A steady improvement continued, and on March 31 the numbers had not appreciably decreased.

It was not possible to make systematic observations on undisturbed behaviour as hunting activity, removal of the ice-roof, use of lanterns to see during prevailing darkness, and the presence of blood in the holes resulting from harpooning and shooting, all must have disturbed the whales in some measure during the periods of visiting. Initially hunting was conducted with a minimum of blood-letting in the belief that the presence of blood in the water would drive the whales off. It was subsequently observed, however, that once alternative blood-free holes were unavailable, whales tolerated blood and whale offal accidentally contaminating the breathing hole.

Whale noises were heard occasionally, but the noise of breathing and splashing sounds generally masked vocalizations. However, while whales were being withdrawn from the water other whales generally refrained from breaking surface and were observed swimming back and forth beneath the open water. On one occasion as a large whale was being hauled from the water tail-first, several other whales crowded around the head of the dying whale and considerable shrill vocalization was clearly heard. This continued until the whale disappeared from the edge of the breathing hole, out of sight of the whales remaining in the water, whereupon there was immediate silence and dispersal of the assembled whales. Despite its actual ineffectiveness in this case such behaviour can be classed as 'succorant' (Scott 1958).

The manner in which whales surfaced varied both according to the structure of the ice hole and the number of whales present. During November the large numbers of whales surfaced for purposes of breathing in two different ways. At the two large rectangular holes a succession of whales, perhaps 30-40 in number, would break surface, blow and inspire, then dive, all in similar fashion to that observed in open water conditions during migration when whales swim near the surface. This same school would reappear perhaps half a dozen times in rapid succession so that the water surface during these few minutes was constantly broken by the heads and backs of moving whales. A few minutes calm would follow, then another group of whales appeared and behaved similarly. It was possible to recognize individuals by head scars.

In November one smaller circular hole about eight feet in diameter was also used by groups of whales. This hole was entered vertically by about twelve or fifteen individuals, close packed with head and flippers rising out of the water, bobbing up and down for three or four respiratory exchanges before disappearing into the depths to be replaced almost immediately by the next group.

During December and subsequent months breathing behaviour changed. Numbers of whales were greatly reduced, and those remaining were at a single roofed hole. On removal of the roof, breathing took place at the periphery of the hole, the whales often being radially arranged with their heads surfacing just inside the hole, more usually at one end of the elongate hole (Figure 1). Breathing was now associated with greatly reduced movement, the noise of actual ventilation being the greatest proportion of that generated.

A LITERATURE SURVEY OF BELUGA WINTERINGS IN THE ARCTIC

It appears that beluga are encountered far less frequently during winter than narwhal (*Monodon monoceros*). Apparently narwhal remain in the bays and fiords as the new ice forms, so that entrapment may occur if sudden calm conditions allow extensive winter ice formation; beluga on the other hand generally move south ahead of ice formation(Degerbøl and Freuchen 1935). During the winter 1914-5 unusual weather conditions resulted in several thousand narwhal being trapped in the Disko Bay region of western Greenland; however, only two small groups of beluga were associated with this mass occurrence of narwhal (Porsild 1918). In 1943 several hundred narwhal and beluga in approximately equal numbers wintered off the north of Disko Island (Vibe 1950). In north Greenland it appears as though wintering beluga are rare: Holtved (1967) mentions a group of eighty and another unspecified number in the Smith Sound region. It seems probable that beluga winter more especially in the Disko Bay region of western Greenland (Vibe 1967) and until recently at least, habitually in the Godthaab Fiord region (Moeller 1964). In recent years the wintering distribution of beluga appears to have altered, and a more northerly or westerly winter distribution is posited (Vibe 1967).

In the 1940's, a large number of female and young beluga, together with a few old males, were trapped one winter in the Navy Board Inlet region, and in 1958 three individuals were trapped in Milne Inlet: these cases are the only ones known to experienced hunters from northern Baffin Island (Markusie and Ningyok, pers. comm.). During the spring 1957 about 100 beluga were found near Blacklead Island in Cumberland Sound (RCMP Game Report, Pangnirtung).

Beluga are sometimes taken in late winter by northern Alaska hunters in the Wainwright area (Nelson 1966); informants confirm that this also occurs in the Barrow region (Antonio Weber, pers. comm.). However, these Alaskan records may refer to early spring arrivals, rather than true wintering groups, that become trapped when leads freeze over or disappear with shifting ice. A true wintering occurred in the Eskimo Lakes, Mackenzie Delta region

during 1966-7, when approximately fifty beluga trapped in the fall persisted in freshwater lakes until January (Hill 1967).

Beluga are sometimes trapped by winter ice in the complex fiords of the Belcher Island archipelago, in southern Hudson Bay: three were located by hunters in January 1961, and one harpooned at a breathing hole five years earlier. Similar occasional winterings are reported from eastern James Bay (Freeman, field notes).

ASSOCIATION OF BELUGA AND OTHER SPECIES

On February 21, 1967, a large ringed seal was taken at the whale breathing hole; at this time about 25-30 beluga were present.

One year-old ringed seal was observed in the breathing hole April 1; it was shot the following day as it entered a den situated about 75 feet from the breathing hole where 15-20 whales still survived.

The whales were absent when the hole was next visited, April 5, but the continued presence of water in the hole suggested it was in use as a seal breathing hole. A ringed seal was in fact taken from the hole April 26.

It appears that when narwhal and beluga occur together at a breathing hole, the species surface separately to breathe (Vibe 1950).

DISCUSSION AND CONCLUSION

Perhaps the most significant feature of this winter occurrence of beluga was the continuing survival of adults during several months of restricted feeding, and despite the iceing-over of the breathing hole which allowed only a small air space for breathing exchange.

Predictably, small individuals were less capable of withstanding the continued metabolic stress than the larger whales. To what extent the reduction in numbers due to hunting aided the survival of remaining whales cannot be evaluated. Whales, and in particular beluga are very sensitive to stress (Norris 1966), and intermittent periods of human interference, at approximately ten or twelve day intervals, must have added to the stress otherwise resulting from the restrictive situation.

That the poor feeding conditions occasioned stress can hardly be doubted. Diminishing blubber reserves not only affect thermoregulation through a decrease in insulatory material and, in time, shortage of fuel, but result in loss of buoyancy and probably an adverse body-fluid balance.Lilly (1966) states that whales maintain water balance through both metabolic water production and directly from their food; with restricted food intake, dehydration becomes a real threat.

The flaccid condition and reduced weight of livers, as well as the general appearance of the whales (see below) was taken as an indication of the poor nutritional state of the animals. I think the absence of pregnant cows in a sample of twenty-one mature females probably indicates loss of fetuses due to chronic metabolic stress.

The skin did not change in appearance during the five months of observation; there was none of the roughening or sloughing-off that has been observed in poorly-fed captive beluga (Ray 1966). Perhaps the small amounts of living food available to these trapped beluga supplied critical amounts of essential nutrients not available to captive animals. Despite the normal appearance of the skin surface during December, however, a marked loss of flavour occurred; the characteristic taste returned in March when the whales were visibly improved in condition.

The appearance of some whales in December and January suggested extreme emaciation: a hollow between the head and trunk and longitudinal folds along the ventral surface of the body were marked features. Fat reserves were depleted unevenly, the peduncle keeping normal fat thickness when the thorax had lost its fat reserves. This uneveness suggests the importance of the flukes, both as the means of propulsion, and in thermoregulation where the continued functioning of the counter-current heat exchange mechanism requires insulation of venous blood from low ambient temperatures (Scholander 1958).

The presence of new-born calves in this trapped population indicates a breeding season for the species extending from March (Degerbøl and Freuchen 1935) until November.

In a recent review of epimeletic (care-giving) behavior in whales (Caldwell and Caldwell 1966) abundant examples of succorant behavior in four Odontocete families were cited, but no evidence of this behavior was obtained for the Monodontidae. This present paper reports the first observation of succorant behavior in the cetacean family Monodontidae.

ACKNOWLEDGEMENTS

These observations were made during field studies carried out at Grise Fiord N.W.T. under the sponsorship of the Northern Co-ordination and Research Centre, Ottawa. Thanks are due also to Dr. D. E. Sergeant and Dr. W. O. Pruitt Jr. for helpful comments, and Dr. E. H. Grainger for identification of *Boreomysis*.

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Accepted April 15, 1968