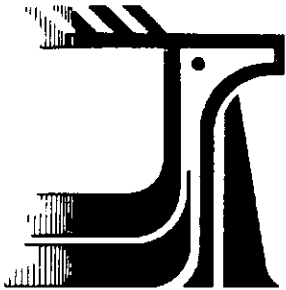


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**STATUS REPORT ON THE BELUGA (WHITE WHALE)
(EASTERN HIGH ARCTIC\BAFFIN BAY POPULATION)
DELPHINAPTERUS LEUCAS
IN CANADA**

BY

D.W. DOIDGE

AND

K.J. FINLEY

**STATUS ASSIGNED IN 1992
VULNERABLE**

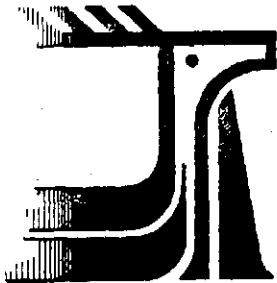
REASON: POPULATION WHICH WAS FORMERLY SECURE IS AT RISK DUE TO OVER-EXPLOITATION.

OCCURRENCE: BAFFIN BAY

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**STATUS REPORT ON THE BELUGA (WHITE WHALE)
(EASTERN HIGH ARCTIC\BAFFIN BAY POPULATION)
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IN CANADA**

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STATUS ASSIGNED IN 1992

VULNERABLE

Status of the Baffin Bay Population of Beluga, *Delphinapterus leucas*

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Doidge, D.W., and K.J. Finley. 1993. Status of the Baffin Bay Population of Beluga, *Delphinapterus leucas*. A report submitted to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Canadian Wildlife Service, Ottawa, Ontario.

In summer, Belugas of the Canadian eastern high arctic are found in the waters of the central archipelago. Large numbers, up to 5000, frequent the estuaries of Somerset Island. Belugas migrate through Lancaster Sound in the fall to over-winter in Baffin Bay and Davis Strait. Estuaries are considered critical habitat for Belugas because of their repeated seasonal occupation.

Disturbance by man is caused by vessel traffic, in particular ice-breakers evoke a fleeing response at distances greater than 35 km. Development of hydrocarbon resources carries the inherent risk of oil spills to which Belugas are moderately susceptible. Belugas are hunted for subsistence purposes by the Inuit of Canada and Greenland. No quotas regulate catch size in either country. Migration patterns indicate a single stock, but differences in contaminant levels of Canadian and Greenlandic Belugas suggest stock separation. From a population of approximately 12 000, on average 50 Belugas are harvested in the Canadian high arctic and 700 in Greenlandic waters annually, which raises concern that exploitation exceeds production. Current population levels indicate that Baffin Bay Belugas are not rare or endangered, but management issues need to be addressed through co-operation between native hunters and government authorities. Because demographic parameters are poorly

known (especially catch sizes in West Greenland), and Belugas are susceptible to over-harvesting, the Baffin Bay stock of Belugas should be considered vulnerable until better information on population trend is available.

En été les bélugas de l'est du Grand Nord canadien fréquentent les eaux de l'archipel central. Un grand nombre soit jusqu'à 5000 bêtes, visitent les estuaires de l'île Somerset. À l'automne, ils empruntent le détroit de Lancaster pour migrer vers la baie Baffin et le détroit de Davis pour y passer l'hiver. Les estuaires sont considérés comme des habitats critiques étant donné que l'espèce les fréquente de façon répétée en saison. Le trafic maritime, en particulier les brise-glace qui provoquent chez le béluga une réaction de fuite même à des distances supérieures à 35 km, est une source de perturbations. L'exploitation de combustibles fossiles signifie qu'il y a un risque de déversements d'hydrocarbures auxquels il est modérément susceptible. Les Inuits canadiens et groenlandais le chassent à des fins alimentaires sans être soumis à un contingent. Les données sur les régimes migratoires révèlent l'existence d'un seul stock, mais des différences des teneurs en éléments polluants chez les bélugas des eaux canadiennes et groenlandaises portent à croire à l'existence de deux stocks. En moyenne, 50 individus d'une population d'environ 12 000 bêtes sont capturés chaque année dans le Grand Nord canadien, et 700 dans les eaux groenlandaises. Ce niveau d'exploitation est une source de préoccupations car il peut être supérieur au taux de recrutement. Les effectifs actuels révèlent que les bélugas du détroit de Lancaster ne sont ni rares ni menacés de disparition, mais certains aspects de la gestion devraient être étudiés dans le cadre d'un effort de coopération entre les chasseurs autochtones et les autorités gouvernementales. Étant donné que l'on connaît mal les paramètres démographiques (surtout le niveau des captures au Groenland ouest) et que l'espèce est susceptible à la surexploitation, on devrait considérer le stock de béluga du détroit de Lancaster comme vulnérable jusqu'à ce que des données plus complètes sur les tendances démographiques soient disponibles.

Key Words: Cetacea, Odontoceti, Monodontidae, *Delphinapterus leucas*, Beluga, White Whale, *béluga*, *marsouin blanc*, Baffin Bay, endangered species.

The Beluga, *Delphinapterus leucas* (Pallas, 1776), a White Whale (Figure 1) without a fin, derives its common name from the Russian word for white. However, in the Soviet Union this name refers to the White Sturgeon, *Acipenser huso*; *belukha* being the name of the White Whale. Other common names are White Whale (English), *marsouin blanc* or *béluga* (French), *qilaluga* (Inuttitut), *qilaluaq qaqortoq* (Greenlandic), *weisswal* (German), *hvidhval*, *hvidfisk* (Danish) and *mjaldur* (Icelandic) [M.P. Heidi-Jorgensen, Greenland Fisheries Research Institute, Copenhagen, Denmark; personal communication; Brodie 1989].

The asymptotic length of Belugas from West Greenland is 386 cm for females and 483 cm for males. These animals can weigh up to 1200 kg (Heide-Jorgensen and Teilmann, In Press). The skin of Belugas changes from the slate grey to brown of neonates to a dark grey or blue that progressively lightens with age to white, leaving only the trailing edges of the flippers and flukes dark in most animals (Vladykov 1944; Kleinenberg et al 1969; Brodie 1971; Sergeant 1973). Sexual maturity has been correlated with the onset of white coloration in some populations, but this does not apply universally (Doidge 1990a).

Based on ear bone morphology, Kasuya (1973) proposed an affinity between the Beluga, and the Irrawaddy River Dolphin *Orcaella brevirostris*, leading others (Barnes 1976; Gaskin 1982; Barnes et al. 1985) to expand the Family Monodontidae to include *Orcaella*. Using immunological and enzyme electrophoresis procedures, Lint et al. (1990) found a close relationship between *Delphinapterus leucas* and *Monodon monoceros* (Narwhal) to the exclusion of other species and concluded that *Orcaella* was definitely not a member of Monodontidae.

Belugas are capable of diving to 647 m and remaining submerged for at least 16 minutes (Ridgway et al. 1984). They feed on a variety of fish and

invertebrates of benthic and pelagic origin. In Canadian arctic waters, Arctic Cod (*Boreogadus saida*) and Greenland Halibut (*Reinhardtius hippoglossoides*) are important prey (Davis et al. 1980; Bradstreet et al. 1986). On the wintering grounds in Disko Bay, Belugas feed on redfish (*Sebastes* spp.) and Greenland Halibut (Heidi-Jorgensen and Teilmann, In Press).

Distribution

The distribution of Belugas is characterised by a disjunct circumpolar range with distinct concentrations that occupy traditional, non-overlapping summering areas (IWC 1980). In summer, Belugas in the eastern Canadian high Arctic occur in Barrow Strait, Prince Regent Inlet, Peel Sound and Jones Sound. These whales are isolated from western Arctic Belugas by a longitudinal gap (approximately 100 to 120°W) in the western Arctic islands (Finley et al. 1987), and by nearly 2000 km from the nearest summer concentration of Belugas in Cumberland Sound, S.E. Baffin Island (Brodie 1971). The Belugas that summer in the eastern Canadian high Arctic appear to winter off the West Greenland coast (Figure 1), therefore we refer to them as the Baffin Bay population.

Belugas concentrate in traditional summer estuaries, particularly those of Somerset Island, from mid-July to mid-August (Heyland 1974; Sergeant and Brodie 1975; Finley 1976; Smith et al. 1985). Estuarine concentrations of Belugas occur at Creswell Bay, Cunningham Inlet, Elwin Bay and Garnier Bay on Somerset Island, Maxwell Bay on Devon Island and Brodeur River and Cape Kater on the Brodeur Peninsula, Baffin Island (ibid.). In late summer, Belugas disperse southward through Peel Sound as far as northern Franklin Strait and estuarine concentrations have been observed around southeastern Prince of Wales Island (Cunningham Bay) in late August (Finley and Johnston 1977). Belugas do not usually penetrate much further west than western Barrow Strait.

In September, Belugas exit Lancaster Sound and move northeastward toward Greenland (LGL 1983). Catch statistics indicate a southward migration along

the West Greenland coast to wintering grounds south of Disko Island (Degerbol and Neilsen 1930; Vibe 1950; Kapel 1977). As many as 500 Belugas overwinter in flaw leads in the northern periphery of the "Northwater" (Finley and Renaud 1980). Aerial surveys have identified overwintering grounds of Belugas in Davis Strait off southwest Greenland (67° to 70°N) where the majority of whales occurred in pack-ice within 50 km of the coast (McLaren and Davis 1981, 1983; Heidi-Jorgensen et al. 1992). None was observed in the open water along the coast south of 67°N, but catch statistics (Kapel 1977) show that in some years, e.g. 1967 to 1974, Belugas occur as far south as 63°N, along the advancing pack-ice edge. Based on his review of the history of the distribution of Beluga in West Greenland waters, Heidi-Jorgensen (1992) concluded that Beluga no longer winter south of 65°N. A large geographic gap separates the Davis Strait wintering grounds from the apparent wintering grounds in Hudson Strait of Belugas from Hudson Bay and Cumberland Sound (Finley et al. 1982).

A few Belugas are sometimes caught during the summer in the northernmost districts of Greenland: Upernavik and Avanersauq, but no surveys have been conducted to determine the size of this summer population (Heide-Jorgensen 1990). No estuarine concentrations are known to occur along the West Greenland coast and the population there in summer is considered small (Reeves and Mitchell 1987). It is unclear what the relationship is between the Greenlandic and Canadian summering groups or between the Northwater and Davis Strait wintering groups of whales. Because these seasonal ranges are connected by the migration route (see below), there is no reason to suspect that these groups are segregated during the breeding season in spring.

Based on differences in body size, Sergeant and Brodie (1969) proposed discrete populations of Belugas in the eastern Arctic. Although the sample size from Ellesmere Island was very small, Sergeant and Brodie (1969) suggested that they were transitional in size between Canadian and the larger Belugas found in West Greenland. In a re-analysis of the data, Doidge (1990b) showed the difference in body size between Beluga populations was not as great

as previously thought.

Migration

A few hundred Belugas overwinter in flow leads at the entrances of Lancaster and Jones Sounds (Finley and Renaud 1980), but the bulk of the migrants from wintering grounds in Davis Strait do not arrive in the Baffin Bay "Northwater" until late June (LGL 1983). Belugas cross Baffin Bay north of 76°N, then move southward along ice edges to the entrance of Lancaster Sound. In most years, when not covered by fast-ice, the peak migration of Belugas through Lancaster Sound occurs between mid-June and mid-July. Whales follow the south coast of Devon Island westward toward their summering grounds (Johnson et al. 1976; LGL 1983). In years when the entrance to Lancaster Sound is obstructed by ice into July, large numbers of Belugas congregate along the ice-edge. In such ice-barrier years, Belugas may cross Lancaster Sound along the ice-edge to the northern Baffin coast (LGL 1983; Finley et al. 1990).

Belugas are virtually absent from Lancaster Sound from late July to early September. The autumn migration of Belugas out of Lancaster Sound is rapid; the bulk of the population passes eastward in large herds in mid-September (LGL 1983). Most whales follow a narrow corridor along the south coast of Devon Island, then head north, crossing Jones Sound to southeastern Ellesmere Island (LGL 1983). Belugas are present in the Thule district, NW Greenland in October (Vibe 1950) and catch statistics from Melville Bay (72° to 75°N) show that Belugas pass there during October and November (Kapel 1977). No southern migration of Belugas occurs along the northeast coast of Baffin Island (Koski and Davis 1979). This pattern of beluga migration appears unchanged from that of the 19th century (Reeves and Mitchell 1987).

Protection

National

Canada: In Canada, beluga protection regulations are issued under the

Fisheries Act of 1867 since 1949. Reeves and Mitchell (1989) review the history of this legislation and its subsequent amendments. These regulations have been modified over the years, primarily in response to commercial and native hunting pressure in Hudson Bay and Cumberland Sound. In recent years, quotas have been set for harvests in northern Quebec and southeastern Baffin Island. No restrictions apply to the aboriginal take of Baffin Bay Belugas in Canada provided they are used for subsistence purposes. In 1966, a substitution to the Fisheries Act disallowed the sale or barter of beluga products, but a 1967 amendment then allowed residents to sell beluga parts or carcasses to a whale factory that was operating at the time in Hudson Bay. Commencing in 1980, Indians and Inuit within the NWT were permitted to trade or barter beluga products if the transactions were recorded. Also in 1980, restrictions were placed on hunting methods: hunters must be equipped with a boat, harpoon and float and rifles larger than 0.22 calibre; calves and females with calves were fully protected and non-native residents required licenses to hunt Belugas.

On February 4, 1993, the Beluga Protection Regulations were revoked by the Government of Canada and replaced by the Marine Mammal Regulations, effective February 24, 1993 (Canada Gazette, 24/2/93, SOR/DORS 93-56). In the NWT, only the native persons can hunt Belugas or trade in their products. No quotas apply to beluga hunting in the Canadian high arctic, but the killing of calves (animals less than 2 m in length) or an adult accompanied by a calf is prohibited. The revised regulations delete the restrictions on calibre and specific instead a minimum muzzle energy of 1500 foot-pounds and use of full metal-jacketed bullets. A shotgun with rifled slugs may be used if the muzzle energy exceeds 1500 foot-pounds. No person is allowed to disturb Belugas unless hunting for them.

Belugas are susceptible to disturbance and over-exploitation when occupying estuaries (Caron and Smith 1990), yet no legislation specifically protects such habitat in the high Arctic.

Greenland: In West Greenland, beluga hunting is regulated by various local rules, some following traditional practices (Dahl 1990), but harvest size is not limited (Heide-Jorgensen 1990).

International

Until 1992, no agreements existed for the international management or protection of the Baffin Bay population of Belugas that is evidently shared by Canadian and Greenlandic Inuit. In 1979, the Scientific Committee of the International Whaling Commission (IWC) recommended the development of cooperative international research programs between countries sharing common stocks of beluga whales. Noting the high catches of Belugas in West Greenland, the IWC Sub-Committee on Small Cetaceans urgently recommended that Canada and Denmark initiate studies on this population. In 1980, the Sub-Committee recommended that management of Belugas be initiated, but no action was taken by the Commission (IWC 1980). In 1981, Canada withdrew from the IWC. Dialogue between Greenland and Canada continued and in 1992 the Canada-Greenland Joint Commission for the Conservation and Management of Narwhals and Belugas was formed.

International trade in Beluga Whales, their parts and derivatives is regulated under Appendix II of the Convention on International Trade in Endangered species of Wild Fauna and Flora (CITES). This listing requires the prior grant of a CITES export permit from the country of origin before export may occur.

Population Size and Trend

The first, crude population estimate of 10 000 was based on the number of Belugas seen during aerial reconnaissance at the major estuaries of the high arctic islands (Sergeant and Brodie 1975). Finley (1976) estimated that in late July of 1975, at least 5000 Belugas were in the estuaries of Somerset Island. Based on strip-transect surveys, he estimated another 2700 were in the offshore waters of Barrow Strait. These surveys did not include the

offshore summer range of Prince Regent Inlet. Using the results of extensive systematic surveys flown in July 1981, Smith et al. (1985) estimated 4200 to 16 500 Belugas occurred in the offshore waters of Somerset Island with an additional 2064 animals in estuaries. The clumped distribution of Belugas and the degree of survey coverage led to the wide confidence intervals associated with this estimate. These figures should be considered minimal since they are uncorrected for submerged animals (Smith et al. 1985) and surveys did not cover potential summering areas in Peel Sound, Jones sound or West Greenland (Heide-Jorgensen 1990). In 1984 and 1985, several hundred Beluga were sighted during aerial surveys in Peel Sound (P. Richard, Department of Fisheries and Oceans, Winnipeg, Manitoba; personal communication). Recent satellite tagging of Belugas indicates that, when offshore, they can spend a large portion of the time submerged and thus undetectable by aerial reconnaissance (Martin and Smith 1992).

Aerial photographic surveys of the major estuarine concentrations of Belugas provide the most accurate assessment of that portion of the population inhabiting coastal waters. Unlike most subarctic estuaries used by Belugas, high Arctic estuaries have transparent waters in which submerged whales can be easily seen and photographed (Heyland 1974). Although beluga numbers in estuaries can fluctuate from day to day (Finley 1976; Hay and McClung 1976), shore-based observations indicate that during August the numbers of whales in the major estuaries are fairly consistent. Belugas in the major estuaries on 2 and 3 August, 1973 numbered 8900; half of these being in the estuaries of Somerset Island (Sergeant 1979). Peak numbers are usually higher at Creswell Bay (3000 to 5000) compared to Cunningham Inlet (1000 to 2000) (Heyland 1974; Finley 1976; Sergeant 1979).

During autumn, Belugas migrate in large herds out of Lancaster Sound along the south coast of Devon Island (Finley and Johnston 1977; Koski and Davis 1979). Because the migration is rapid, unidirectional, and follows a narrow corridor along the coast, autumn surveys of this area likely provide the best estimates of population size. Koski and Davis (1979) estimated that

10 250 to 12 000 Belugas moved past Cape Warrender during September, 1979, with a peak passage between 14 and 18 September.

Concern has been expressed that this population is declining due to excessive hunting by Greenlandic and Canadian Inuit (Reeves and Mitchell 1987; Heide-Jorgensen 1990). The abundance index, derived from aerial surveys flown over the wintering grounds in 1990 and 1991, has declined significantly ($p = 0.13$) from that calculated from similar surveys in 1981 and 1982 (Heide-Jorgensen et al. 1992). Although the 13% probability level is higher than that normally used in statistical practice, the repercussions of Type II statistical error to management decisions justifies the concern over population trend.

Harvest Methods

Historically, Belugas were hunted for subsistence by the Inuit using harpoon and kayak in Canada (Kemper 1980) and Greenland (Kristiansen and Henningsen 1964). Between 1874 and 1898, Scottish whalers operated a drive fishery at Elwin Bay, Somerset Island, where they killed an estimated 10 985 Belugas (Reeves and Mitchell 1987).

In Canada, Belugas are now hunted from motor boats. Whales are usually herded into shallow water and shot, and may be harpooned (Kemper 1980, Doidge and Finley personal observations). In West Greenland, Belugas are caught by drive fisheries at Upernavik, by nets or are pursued and shot and/or harpooned (Heide-Jorgensen 1990). Motor boats are banned for whale hunting purposes in some areas (Heide-Jorgensen 1990).

Catch Size

Canada

Baffin Bay Belugas are hunted by Canadian Inuit from settlements that border the summer range and migration routes. Strong (1989) summarized government records of catches of beluga for these settlements for the period 1955 to 1987 (Table 1). Harvest surveys in these communities between 1979 and

1983 (Finley and Miller 1980; Donaldson 1988) show good agreement on catch size and indicate the harvest has been less than 50 Belugas annually. A declining trend is seen in the number caught over the last three decades, but the proportional catch between the settlements remains the same. The communities of Grise Fiord, Resolute Bay and Creswell Bay account for the majority of the catch. Pond Inlet and Arctic Bay, situated on the south side of Lancaster Sound, are not on the main migration route so catches there are lower (Kemp et al. 1977). Kuuganayuk, the outpost camp at Creswell Bay, is situated near a major estuarine concentration of Belugas, but due to the small number of people who had been living there this settlement harvested few Belugas (Kemp et al. 1977). In the fall of 1991, the Inuit family, which had been living there permanently, moved to Resolute Bay (Welch 1993). Typically, most whales are taken at Resolute Bay during the autumn migration from mid-August to early September. Hunters at Grise Fiord anticipate the arrival of Belugas for early September (Riewe 1977; Bradstreet et al. 1986; Donaldson 1988). In winter, Inuit occasionally discover Belugas entrapped by ice, whereupon the whales are usually harvested (Freeman 1968).

Annual variations in ice conditions causes major fluctuations the number of Belugas caught by Canadian Inuit communities. For example, no Belugas appeared at Grise Fiord between 1969 and 1972 owing to heavy ice conditions (Riewe 1977). Furthermore, the presence of concentrations of Arctic Cod near communities can attract Belugas and influence harvest size, as was the case at Resolute Bay in 1976 (Bradstreet et al. 1986).

Greenland

In contrast to the small harvests in the Canadian high Arctic, the reported annual harvest of the communities in West Greenland averaged 700 Belugas (range 216 to 1874) during the period 1954 to 1987 (Table 2). Heide-Jorgensen (1990) cautioned that the Greenlandic statistics are incomplete, particularly in recent years when several Greenlandic settlements stopped reporting their catches. He suggested that 500 to 1000 Belugas are

taken annually in Greenland. Applying an estimated loss rate of 25% to catches in Canada and West Greenland, Heide-Jorgensen (1990) suggested the total removal due to hunting was, at least, 875 to 1500 Belugas annually.

The catch record in Greenland is occasionally punctuated by large catches of Belugas at "savssats" or ice-entrapments on the wintering grounds, in particular Disko Bay (Porsild 1918). The highest catch from a savssat is estimated at 1326.

Loss Rates

Unlike the situation with most other hunted populations of beluga in Canada, most of the beluga catch from the Baffin Bay population are not taken at the summer concentrations at estuaries, but during the autumn migration. As Belugas migrate along the coast they are intercepted and driven into shore. Therefore, loss rates from other Canadian hunts (e.g. Fraker 1980) are not applicable to the Baffin Bay population. The portion of Belugas that are lost due to sinking or that die later from bullet wounds is not known.

Statistics on loss rates from various types of Narwhal hunting (Finley et al. 1980; Finley and Miller 1980; Weaver and Walker 1988) are not applicable to Beluga hunts because Belugas tend to sink more readily than Narwhals when shot (Finley, personal observation). However, most Belugas are taken in shallow water so loss rates are likely lower than the 30 to 60% reported for Narwhal hunts.

The killing power of rifles used in Beluga hunts is more related to bullet jacket type than calibre (Doidge, personal observation). Many bullet types and calbres are used. Soft-point ammunition, regardless of calibre, expands and has its energy absorbed in the blubber layer. Bullets may become encapsulated in the blubber (Doidge, personal observation) indicating that wounding does not always result in death. The associated mortality rate however, remains unknown.

Habitat

Estuaries are presumed to be critical habitat for Belugas based on their repeated seasonal occupation (Finley 1982). Site fidelity in spite of harassment (Finley et al. 1982; Caron 1987; Caron and Smith 1990), thermal benefits of warm estuarine waters to the young (Sergeant 1973; Sergeant and Brodie 1975; Breton-Provencher 1979) and all age classes (Fraker et al. 1979), physiological factors such as the moulting of skin (Finley et al. 1982; St. Aubin and Geraci 1989), and the predictably ice-free habitat offered by estuaries in spring (Breton-Provencher 1979) are considered as the reasons estuaries are important habitat for Belugas.

The function of estuaries as calving grounds suggested by Sergeant (1973), was dismissed by Caron (1987) since her observations over two summers in eastern Hudson Bay did not show a pronounced seasonal increase in the number of neonates. However, at Creswell Bay in early August Finley (1976) documented a marked increase in the number of neonates present. Calves may be born outside estuaries then later congregate within them.

The thermal benefit of estuaries is directly proportional to the temperature gradient between the environment and the body of the whale. Beluga body temperatures are in the region of 35°C. In summer, stream channel temperatures at Cunningham Inlet approach 8°C (Hay and McClung 1976) whereas surface waters in Barrow Strait are 0 to 2°C, so estuaries confer some thermal advantage, especially to young. Doidge (1990c) found that the young of Narwhal and Beluga possess similar insulation, yet only Beluga have an estuarine habit. The Inuit belief that warm, flowing, fresh water and sand banks on which to rub enhances the moulting process has been shown to have a physiological basis (St. Aubin and Geraci 1989).

The feeding habitat of Lancaster Sound Belugas is not well known. Recently, Belugas tagged with satellite transmitters were found to dive into, and presumably be feeding in deep holes (350 m) in Barrow Strait (Martin and Smith 1992). Pits on the seafloor, found in Baffin Island Fjords at depths of 40 to 326 m, are believed to have been made by Narwhals or Belugas foraging

for food (Hein and Syvitski 1989). Groups of Belugas, thought to be feeding on concentrations of Arctic Cod, have been observed in September along the southeast coasts of Devon and Ellesmere Islands (Bradstreet et al. 1986).

The majority of Belugas overwinter in the waters of Davis Strait, but some occupy the flow leads at the eastern entrances to Lancaster and Jones Sounds (Finley and Renaud 1980).

General Biology

Reproductive Capability

Vital rates are usually determined on an age-specific basis by examining a large number of reproductive tracts from harvested animals. For the Lancaster Sound population and other Beluga populations, vital rates are poorly known and are likely to remain so in Canada, given the small harvest available for scientific examination. The harvest at Grise Fiord has been examined, but is biased by hunter selection of grey (young) animals (R.E.A. Stewart; Department of fisheries and Oceans, Winnipeg, Manitoba; personal communication) which further reduces the sample size of mature animals. The small sample size ($n < 500$) associated with studies of Beluga demography (Brodie 1971; Sergeant 1973; Braham 1984; Burns and Seaman 1985; Doidge 1990a) prevents useful comparisons between Beluga populations, and are not precise enough to detect changes in population status (Doidge 1990a,d). The general range of these values though, is useful in assessing the relative importance of demographic parameters in the growth of Beluga populations, but are not precise enough to derive meaningful estimates of rate of increase.

Breeding Cycle

Heidi-Jorgensen and Teilmann (In Press) examined the reproductive cycle of 167 female and 205 male Belugas harvested in West Greenland during 1985 to 1992. Males were found to attain sexual maturity at age 6 to 7 years and females at age 4 to 7 years. Tooth wear, which prevents the estimation of true age for some samples, may have biased these estimates of age-at-maturity

downwards (Heidi-Jorgensen and Teilmann, In Press). Implantation occurs in May with a single calf being born the following April or May. Neonatal Belugas have been observed between March (Degerbol and Freuchen 1935; Heidi-Jorgensen and Teilmann, In Press) and late November (Freeman 1968). Others report a more limited period of births from the end of May (Cosens and Dueck 1990) until August (Braham 1984; Greendale and Greendale-Brousseau 1976; Hay and McClung 1976).

The ratios of pregnant and lactating animals in harvests elsewhere (Kleinenberg et al. 1969; Burns and Seaman 1985; Sergeant 1973; Doidge 1990a,d) indicate that the breeding cycle is 3 years in Hudson Bay and the Russian Far East, but may be 2 years in the Russian North (Doidge 1990a). The duration of gestation is 12 to 14.5 months (Laws 1959; Sergeant 1962, 1973; Kleinenberg et al. 1969; Brodie 1971; Doidge 1990a), including an average overlap of pregnancy and lactation of 0.3 years (Doidge 1990a). Based on the ratio of lactating to pregnant animals in the harvest, the duration of lactation ranges from 1.4 to 2.6 years in the Russian North and 2.0 to 2.7 years in Hudson Bay (Doidge 1990a). Harvest bias between lactating and pregnant animals directly affects these estimates.

Heidi-Jorgensen and Teilmann (In Press) argue that fetal growth rates in Beluga warrant closer attention. The 330 day duration of gestation that they calculated for West Greenland animals is shorter than that found elsewhere.

Sex Ratio

Freeman (1968) found a 1:1 sex ratio in a sample of 98 Belugas from Grise Fiord. Similarly, the 381 Belugas examined by Heidi-Jorgensen and Teilmann (In Press) had an overall sex ratio of unity. Differences between the sex ratios of Belugas harvested at Disko Bay (18 females:43 males) and Upernavik (169 females:117 males) indicate segregation of sexes among groups does occur (Heidi-Jorgensen and Teilmann, In Press).

Population Age and Length Frequencies

The sample sizes of length frequency data from harvests at Grise Fiord (Freeman 1968), Creswell Bay (Finley 1976) and West Greenland (Heidi-Jorgensen and Teilmann, In Press) are too small to be used in detailed demographic analyses. Comparison of length frequencies from aerial photographs of high Arctic surveys with those of other stocks may yield some useful demographic information, but are likely to be limited by their short time series.

Theoretical, stable age and length distributions, based on survivorship and fecundity data from relatively small sample sizes from sites other than the high Arctic predict that young of the year comprise about 10% of the population at the end of the birth pulse (Burns and Seaman 1985; Béland et al. 1988; Doidge 1990a). During aerial surveys of Creswell Bay, Finley (1976) found the proportion of neonatal Belugas in the herd peaked at 12% in August, a figure similar to Sergeant's (1973) estimate of crude birth rate of 12.0 to 12.5%. In aerial photographs taken at Cunningham Inlet on 30 July 1973, 17.9% of the 1614 Belugas were classified as neonates (Heyland 1974).

Age and length distributions of Belugas harvested in West Greenland differ by site and season (Heidi-Jorgensen and Teilmann, In Press). The age distribution of animals caught in Disko Bay during spring contains older animals and shows no clear mode. The distribution of ages in the autumn harvest at Upernavik shows a clear mode at age 3 years for both sexes, but lacks the older ages found in the Disko Bay distribution.

Population Growth Rate

Based on the stabilization of catch-effort and modal length of males during the commercial harvest of Belugas in western Hudson Bay, Sergeant (1981) considered a catch of up to 5% of the population to be sustainable. From simulation models, Béland et al. (1988) concluded the potential for growth of Beluga populations was 2 to 3% or less. The actual rate may lie within these limits, but both estimates are imprecise because they are based either on crude estimates of population size or have been calculated using

incorrect assumptions about mortality rates (Doidge 1990a). While the 2.5% rate of population increase used by the Department of Fisheries and Oceans' Arctic Fisheries Scientific Advisory Committee (DFO 1990) might be based on the correct mathematics, the estimates of the demographic parameters used in the calculations do not support such precise estimates of growth rate that are likely to be stock specific.

Research and Management

The primary management question is whether the Lancaster Sound population of beluga can sustain the current combined harvest by Canadian and Greenlandic Inuit. Heide-Jorgensen (1990) summarised the management situation in Greenland:

"Our present knowledge about the size and biology of small cetaceans in Greenland is insufficient for proper management of the resource".

In particular, he states:

"lack of precise data on catches of white whales... makes it impossible to evaluate what the presumed changes in hunting patterns might have been on populations".

The question of whether or not the beluga population which summers in the Canadian high Arctic is shared by the two countries awaits definitive evidence from mark-recapture or genetic studies, but present knowledge of migratory patterns indicates the resource is shared. Efforts, therefore, should be concentrated on determining the most critical issues: the size of the population and catch.

Systematic strip-transect aerial surveys are considered the most effective means of censusing beluga populations (Heide-Jorgensen 1990; Smith et al. 1985). However, Smith et al. (1985) question the cost effectiveness of large scale systematic surveys of the summering range of Baffin Bay Belugas. Because of the present trend in government spending, the series of surveys required to detect a trend in population number are unlikely to be conducted. Aerial photographic surveys, in combination with shore-based observations

along the autumn migration corridor of the south coast of Devon Island (Koski and Davis 1979), likely provide the best estimate of population size at the least cost.

Until better estimates from aerial surveys become available, and satellite telemetry reveals the proportion of whales missed by these surveys, a conservative estimate of population size, based on surface counts, is 12 000 animals. The estimated catch of 600 to 1000 indicates that 3 to 8% (depending on if corrections for submerged animals are made) of the population is harvested annually. The current exploitation rate is viewed as exceeding safe levels (IWC 1980; Reeves and Mitchell 1987; Heide-Jorgensen 1990). Since the values of vital rates are poorly known (Doidge 1990a), arguments concerning estimates of sustainable yield (eg. Béland et al. 1988; AFSAC in DFO 1990) become mathematical exercises that are counterproductive to wise management. The data base simply does not exist for such estimates and their application in management serves only to reduce what little confidence the resource users place in such "scientific" arguments concerning allowable catch. Now the issue must not centre on catch exceeding production since neither of these parameters is known with any certainty, but rather efforts should be channelled towards ascertaining stock identity, population and catches size, loss rates and improving estimates of vital rates (especially juvenile mortality). Proper management will depend entirely on the willingness of hunters to cooperate with resource managers (Heide-Jorgensen 1990) and vice-versa, as has been shown in the successful co-management of polar bear stocks.

Behaviour/Adaptability

Belugas are a gregarious species, often forming large herds during migration or when gathered at certain estuaries in summer. They are found primarily in coastal waters, although much of their winter range is in deep offshore waters where pack-ice is present (Finley et al. 1980, 1990). Their preference for shallow waters may have evolved in response to Killer Whale

(*Orinus orca*) predation, a behaviour that is used to advantage by modern Inuit hunters who often drive Belugas into shallow water where capture is easier (Finley et al. 1990).

Belugas have a wide range of calls (Sjare and Smith 1986a). They possess a sophisticated echolocation system that they use to forage and navigate (Au et al. 1987; Turl et al. 1987). To some extent, their acoustic system is adapted to high levels of ambient noise, but high levels of artificial noise may interfere with their acoustic discrimination. Belugas in Lancaster Sound are sensitive to vessel noise, reacting to ships approaching at distances of 35 to 50 km (Finley et al. 1990). The sensitivity of Baffin Bay Belugas may be explained by their low exposure to vessel traffic in the past. Other populations of Belugas, such as that in the St. Lawrence River, appear to tolerate vessel activity (Finley 1990).

Most Beluga populations show strong site fidelity to estuaries (Caron and Smith 1990). Whatever benefits estuaries bestow, the repeated occupation of estuaries suggests that estuaries are critical habitat for Beluga (Finley 1982). In eastern Hudson Bay, the decline of some estuarine populations while adjacent ones remain stable, suggests that Belugas do not appear to switch to other similar habitat in spite of harassment from hunters and vessel traffic (Caron and Smith 1990; Finley 1990).

Limiting Factors

The response of beluga populations to exploitation is inherently limited by their slow rate of reproduction. They mature at 5 to 6 years of age, are long lived (30+ years), but produce few young annually (1 per 2 to 3 years) (Brodie 1971; Sergeant 1973; Burns and Seaman 1985; Doidge 1990a). Mortality factors include predation and ice-entrapment.

Besides man, two other predators of Belugas, Killer Whales and Polar Bears (*Urus maritimus*), are thought to have insignificant effect on Beluga populations (Davis et al. 1980). Some aspects of Beluga behaviour appear to have evolved in response to predation by Killer Whales (Finley et al. 1990).

However, few Killer Whales have been observed on the summer range of Belugas leading Davis et al. (1980) to suggest that predation by Killer Whales is not high. Belugas are vulnerable to Polar Bear predation when trapped by ice (Kleinenberg et al. 1969; Freeman 1973; Lowry et al. 1987), but have also been taken by bears in open water (Smith 1985).

Ice-entrapments or "savsatts" are infrequent events, but can result in large scale mortality of Belugas, particularly if the entrapments are found by hunters (Porsild 1918; Freeman 1968; Kapel 1973). The occurrence of savsatts is a well known phenomenon in West Greenland, particularly in Disko Bay which periodically freezes over rapidly, trapping large numbers of Narwhals and Beluga (Porsild 1918). These savsatts may be only short-term entrapments from which the whales later escape.

The habit of Belugas to continue to congregate in estuaries despite harassment from vessel traffic and hunting, makes them susceptible to over-hunting (Finley et al. 1980; Caron and Smith 1990). In the Canadian high Arctic, hunting at estuaries has been limited to Creswell Bay, Somerset Island. The small, subsistence harvest there does not threaten the stock.

As with many Arctic, marine mammal populations, the availability of food ultimately controls population size. Knowledge of the feeding ecology and energy budget of Belugas is limited. In late summer, Belugas feed heavily on Arctic cod. An overlap in diet between Belugas, the growing population of Harp Seals (*Phoca groenlandica*) and other piscivores may lead to increased competition for food between these species (Finley et al. 1990). In addition, Greenland's major fishing grounds, and an international shrimp fishery developing in Davis Strait include the winter range of Belugas. Thus, the carrying capacity of both summer and winter feeding habitats may be decreasing.

Environmental Factors

PCBs

Studies of organochlorine pollutants in beluga whales show that the

Arctic is no longer a pristine environment. Blubber samples from juvenile Belugas (8 males, 7 females) from Grise Fiord contained 2 to 3 ug/g wet weight (ppm) PCBs, 1 to 3 ug/g DDT, 2 to 4 ug/g toxaphene and 1 to 2 ug/g chlordanes residues (Muir 1990). Compared to the high levels reported for St. Lawrence River Belugas, these high Arctic samples contained 25 times less PCBs, 20 to 30 times less DDT, 6 times less toxaphene, but only 3 times less chlordanes (Muir 1990).

Oil

The exploitation of oil reserves in the deep water of Lancaster Sound poses the risk of a large scale oil spill. The utilization of coastal shallows, estuaries, bays and ice-edges make Belugas vulnerable to oil spills because their ability to avoid slicks would be reduced in such enclosed areas (Wursig 1990). In a qualitative assessment of vulnerability to oil, Wursig (1990) rates Belugas in the mid-range because: (1) their diet includes both animals that concentrate hydrocarbons (benthos) and those that eliminate them (fish and crustacea), (2) belugas show a degree of adaptation to stress and (3) the size of the population is moderate.

Heavy Metals

The level of heavy metal contamination has been examined in Belugas from West Greenland (n=41, Hansen et al. 1990) and from Grise Fiord (n=16+, Wagemann et al. 1990). The range of ages of the whales sampled were similar; West Greenland: 0 to 14 yrs, Grise Fiord: 1 to 21 yrs. When adjusted for moisture content, the maximum contamination levels in muscle tissue from West Greenland were 1.2 times that of cadmium and selenium, and 1.3 times that of mercury in the Grise Fiord animals. In kidney tissue, these factors were 1.2, 1.4 and 2.1 for cadmium, selenium and mercury respectively. Maximum levels in liver tissue from West Greenland were 5.5 those from Grise Fiord for selenium and 4.2 times those for mercury. Conversely, cadmium levels in liver from Grise Fiord were 1.9 times those of West Greenland. This large difference in

contaminant levels in liver implies at least some spatial separation between beluga from West Greenland and Grise Fiord.

At both sites, the maximum level of mercury in muscle exceeded that recommended for human consumption (0.5ppm) by Health and Welfare Canada.

Noise

The acoustic system of the beluga is adapted for communication, navigation and foraging in ice-covered waters. Belugas apparently use passive listening to low-level, low-frequency ambient sounds of moving and solid ice to obtain information critical to their survival (Sjare and Smith 1986a, 1986b; Finley et al. 1990). Although adapted to dealing with high levels of ambient noise, their acoustic system may be susceptible to interference from noises produced by ice-breakers or other large vessels (Mansfield 1983; Cosens and Dueck 1990). Near Inuit settlements, Belugas are subjected to noise from outboard motors, which have increased both in size and number during the past two decades (Riewe and Amsden 1979).

Special Significance of the Species

The beluga is one of three species of whale in Canadian Arctic waters; the others are the Narwhal, and the Bowhead Whale, *Balaena mysticetus*. The publicity associated with the high PCB levels in Belugas in the St. Lawrence River has made this species a symbol of marine conservation and habitat protection. Belugas are of special significance to the Inuit who regard Beluga hunting part of an important cultural tradition. Beluga muktuk is considered a local delicacy. Well managed stocks of white whales provide a renewable resource of lipid, protein and vitamins (Sergeant and Brodie 1975).

International Trade

The Convention on International Trade in Endangered Species of Flora and Fauna (CITES) dictates that permits are required for the international trade of beluga products, but the trade is not restricted (Reeves and Mitchell

1989). No international trade exists in beluga products. In Canada, live capture of Belugas for public display is centred at Churchill, Manitoba (Sergeant and Brodie 1975). These animals are not part of the high Arctic stock. In December 1992, the Minister of the Department of Fisheries and Oceans announced a ban on the live capture of Beluga Whales for export.

National Trade

National trade in muktuk is limited by law to sale between Indians, Inuit or beneficiaries of land claim settlements in the Yukon, NWT, Quebec and Newfoundland (Marine Mammal Regulations 1993).

Evaluation

Available information on catch size (particularly that in West Greenland) relative to population size, raises concern that Baffin Bay Belugas are being exploited at a rate exceeding productivity. There are, however, uncertainties in both indices of catch and population size that must be urgently addressed.

Migration patterns indicate a single stock, but differences in contaminant levels between Canadian and Greenlandic Belugas raise the question of stock discreteness. This question should be resolved.

Commercial fisheries development in Davis Strait and increasing interspecific competition for food may be degrading the carrying capacity of the summer and winter range of Belugas. Although international and cross-cultural communication has been initiated, conservation strategies for this population cannot be implemented until resource users at the community level agree that management measures are in their own self interest.

Estimates of population size indicate that the species is not rare or endangered, but there are sufficient concerns to warrant close attention to the population's trend. On this basis, we consider the population to be vulnerable.

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Table 1. Summary of reported catches of Belugas in the eastern high Arctic
 (Source: Strong 1989).

Year	GF	RB	CB	AB	PI	Total
1955	14	.	.	.	.	14
56	6	.	77	.	2	85
57	15	.	94	.	.	109
58	5	.	92	.	.	97
59	25	.	98	.	26	149
60	35	.	46	.	.	81
61	10	.	26	.	.	36
62	75	.	3	.	.	78
63	83	.	3	.	.	86
64	20	.	16	16	1	53
65	48	.	.	1	.	49
66	118	.	.	2	1	121
67	0	.	.	1	.	1
68	0	.	.	.	.	0
69	.	.	.	.	.	.
70	0	.	.	.	.	0
71	.	36	.	.	.	36
72	.	.	.	.	.	.
73	20	42	.	3	5	70
74	6	16	.	2	0	24
75	10	11	14	.	.	35

Table 1 cont'd.

Year	GF	RB	CB	AB	PI	Total
76	15	11	.	.	.	26
77	11	17	.	0	0	28
78	15	1	1	0	0	17
79	12	6	.	31	2	51
80	16	.	.	0	0	16
81	47	8	.	0	0	55
82	6	8	0	2	0	16
83	6	18	.	0	1	25
84	21	1	12	13	0	47
85	6	6	8	1	0	21
86	0	1	5	0	0	6
87	25	0	0	0	9	34

GF - Grise Fiord RB - Resolute Bay

CB - Creswell Bay AB - Arctic Bay

PI - Pond Inlet.

Table 2. Summary of estimated catches of Belugas in West Greenland reported to the IWC.

YEAR	DISTRICT												
	TH	UP	UM	JA	CH	GD	EG	KA	HO	SU	GT	FR	TOTAL
1954	.	16	61	1326	69	241	88	50	23	.	.	.	1874
55	.	10	3	39	13	75	107	41	11	1	.	.	300
56	.	9	8	89	2	75	155	52	29	5	.	.	424
57	.	6	11	191	8	66	96	30	95	.	.	.	503
58	.	3	4	50	5	8	90	29	35	1	.	.	225
59	.	12	12	48	5	46	112	32	42	.	.	.	309
60	.	13	6	52	17	37	55	18	17	.	1	.	216
61	32	15	6	11	3	75	125	5	47	1	11	1	332
62	85	9	7	52	12	42	57	23	23	8	11	.	329
63	75	18	12	25	5	22	36	5	8	12	11	.	229
64	125	4	6	57	4	38	55	12	8	4	18	.	331
65	150	20	33	102	44	28	27	13	24	18	9	.	468
66	.	25	88	76	34	132	135	21	24	13	12	1	561
67	.	34	66	90	72	37	140	30	76	47	4	.	596
68	.	97	65	490	105	160	160	98	46	38	.	.	1259
69	.	111	36	357	119	89	83	13	100	40	30	.	978
70	17	334	6	656	127	212	113	25	10	24	.	.	1524
71	2	238	3	82	25	97	96	28	123	4	41	.	739
72	.	293	25	116	39	78	107	22	135	11	14	1	841
73	.	262	33	205	35	81	217	43	121	.	70	.	1067
74	21	195	13	290	65	22	116	13	135	8	25	2	905
75	3	150	19	49	56	92	53	18	130	4	33	.	607
76	13	77	12	50	104	721	73	5	72	.	48	.	1175
77	14	240	49	50	58	217	32	22	43	13	65	.	803
78	20	104	44	100	131	106	109	6	77	5	17	.	719

Table 2 cont'd.

DISTRICT													YEAR
79	25	250	22	100	95	98	85	1	35	12	18	.	741
80	30	191	100	100	110	44	148	10	109	45	1	.	888
81	76	343	95	83	115	60	66	16	62	23	78	.	1017
82	127	329	17	80	120	48	55	10	95	13	0	0	894
83	53	233	19	50	50	47	37	10	99	2	1	0	601
84	21	333	15	120	38	111	67	16	25	16	1	0	763
85	190	188	6	50	0	46	55	26	25	17	8	0	611
86	.	240	4	78	.	.	36	.	0	2	0	.	360
87	.	550	13	.	.	.	29	.	0	8	6	.n	606

Districts:

TH - Thule, UP - Upernavik, UM - Umanaq, JA - Jakobshavn,
 CH - Christianshab, GD - Godhavn, EG - Egedesminde, KA -
 Kangaatsiaq,
 HO - Holsteinborg, SU - Sukkertoppen, GT - Gothab, Fr -
 Frederikshab

Sources: Born (1986, 1987), Kapel (1977, 1983, 1985),
 Kapel and Larsen (1984)

Caption to Figures

Figure 1. Beluga Whale, *Delphinapterus leucas*.

Figure 2. Distribution and migration routes of Baffin Bay
Belugas.

SHAPE OF BLOW	DORSAL FIN	FLUKES ON DIVE
	