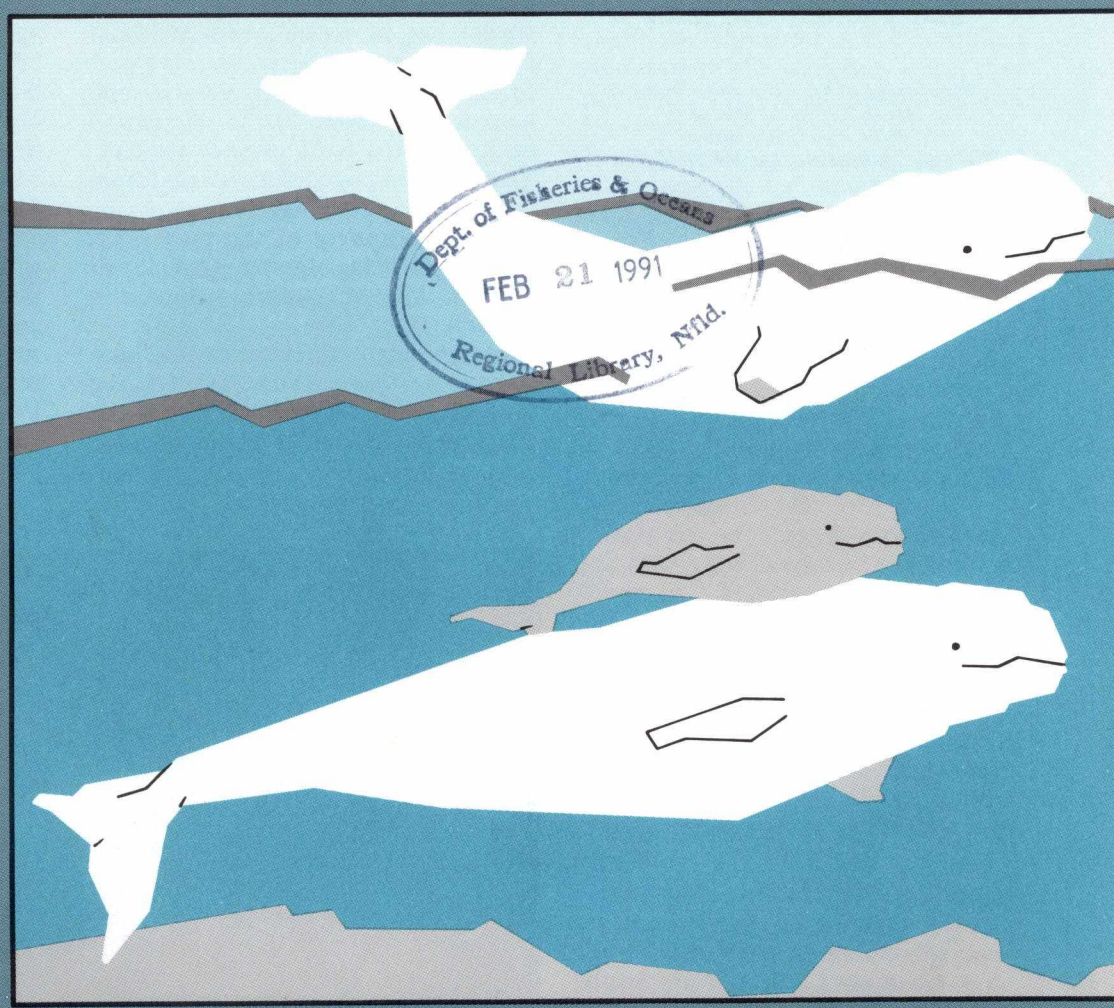
UNDERWATER WORLD



The Beluga

Fisheries and Oceans
Pêches et Océans
Canada

The Beluga

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Introduction

Belugas are an Arctic species. In their Arctic habitats, continuing subsistance harvests by the Inuit and future industrial development such as shipping and oil drilling can influence their well-being. There is a continuing need for careful management of belugas because their strong dependence in summer on specific nearshore habitats increases their vulnerability to human activity.

The beluga (also known as the white whale) has in recent years attracted public attention, especially with respect to problems of contamination and human disturbance to the population residing in the St. Lawrence Estuary. That remnant population, isolated from those in the Arctic and residing in the southern extremity of the range, has turned the beluga into a symbol for conservation of marine habitats in Canada.

More recently, attention has also been given to Arctic stocks because of public sensitivities in relation to the live capture program at Churchill, Manitoba, and because of the attribution by the Committee on the Status Endangered Wildlife in Canada (COSEWIC) of the endangered status to the Cumberland Sound and Ungava Bay beluga population and of the threatened status to the eastern Hudson Bay one.

Description

Belugas (Fig. 1) are classified as cetaceans of the suborder Odontocete which comprises whales having teeth instead of baleen. Along with narwhals, belugas belong to the family Monodontidae. As is characteristic of cetaceans, the beluga has a fusiform body, a horizontal caudal fin for propulsion and pectoral fins which act as rudders. The hydrodynamic form is enhanced by the absence of external appendages and organs. The ears consist of small openings on each side of the head, and the genitalia are contained in a ventral slit. The skin is smooth and hairless. As an odontocete, the nostrils open into a single blowhole located on the top of the head which has a prominent melon-shaped protruding

Fig. 1. Photo courtesy of Arctic Biological Station, DFO, Ste-Anne-de-Bellevue.

forehead characterizing the family Monodontidae. Like the narwhal, the cervical vertebrae are not fused, permitting great mobility of the head in a horizontal and vertical plane. Belugas show a remarkable agility in assuming various postures in water and when partially emerged.

The colour and the absence of a dorsal fin are the main distinguishing features as indicated in both the scientific name *Delphinapterus leucas*, literally "the white dolphin without a wing", and the common name "beluga" which in Russian means "the white one," or the English translation "the white whale." In reality, only adults are white; calves are born brown or dark grey and gradually pale to become totally white between 6 and 8 years of age.

Adult males (3.65 - 4.25 m and 450 - 1000 kg) are larger than females (3.05 - 3.65 m and 250 - 700 kg). Newborn calves measure about 1.5 m and weigh 50 - 80 kg at birth.

Distribution and Migration

Belugas are circumpolar in their distribution. They are found in Arctic and Subarctic waters along the northern coasts of Canada, Alaska, U.S.S.R., Norway and Greenland. It is estimated that between 40 000 and 60 000 belugas live in Canadian waters. These animals are distributed in the western Arctic (Beaufort Sea), the high Arctic (Lancaster Sound, Baffin Bay), eastern Arctic (Cumberland Sound and southeast Baffin, eastern and western Hudson Bay, James Bay and Ungava Bay) and in the St. Lawrence Estuary (Figure 2).

The various populations of belugas are distinguished on the basis of their summer distribution. In the eastern Arctic, it is not possible at present to demonstrate that the four summer populations are in fact genetically isolated, since they all winter in the Hudson Strait and/or Davis Strait and Baffin Bay area. The St. Lawrence population is considered to now be isolated from other populations of belugas even though it is thought that there was some exchange in the past when the distribution of the species was much wider.

In summer, belugas gather in specific estuaries and their adjacent waters. The summer habitat is characterized by the presence of shallow, brackish and relatively warm waters and sandy or muddy substrates.

The belugas' winter distribution remains poorly documented. They are dependent on areas of shifting ice where open water provides access to air. Such features are formed by a combination of currents and bottom topography creating open water, some, the polynias, recurring in the same areas year after year. Occasionally belugas may become entrapped when these features freeze and this can result in some mortality.

The location of their summer and winter habitats obliges belugas to migrate during the spring and autumn, over long distances (Fig. 3). For example, in the western Arctic, some belugas travel between the Beaufort Sea, where they live in the summer, to the Bering Sea in the winter; the distance covered is about 1200–1500 km. Belugas are not fast-swimming whales; their normal travelling speed is 9–10 km/h (6 knots).

Biology and Physiology

Sexual maturity occurs at 8 years of age in males and at approximately 5 years in females. Mating takes place in April–May. The mating system remains unknown but there are indications that males are polygamous, breeding with several females.

Gestation lasts for 14.5 months and births occur between the end of June to early August. The gestation period and the lactation period of some 18 months result in females only being able to produce young approximately every 3 years.

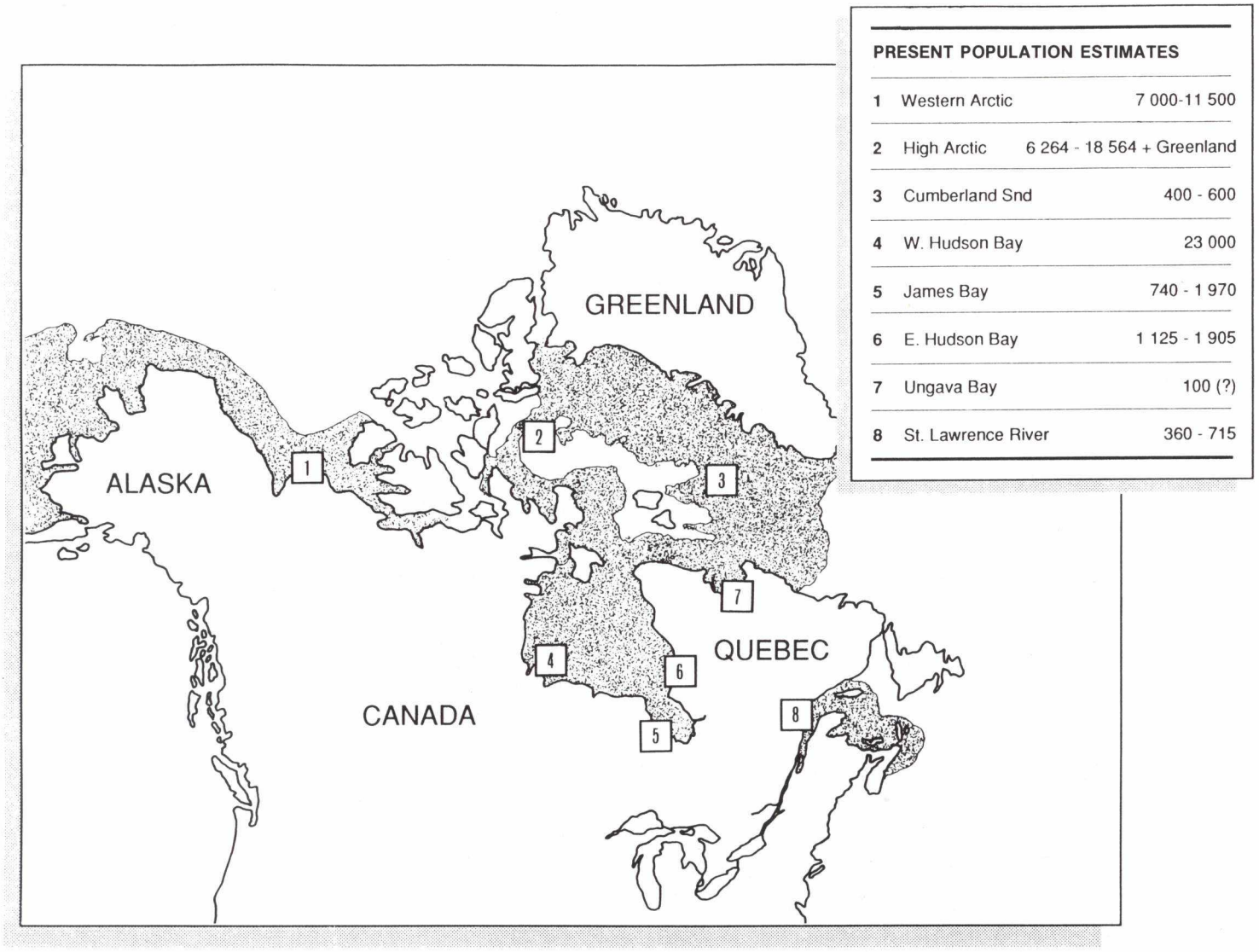
The fat-rich milk of the mother results in rapid growth of the young. Newborn calves are 33 - 46% of their mother's length; at 1 year they are 65%; at 2 years they are 73%; and by 5 years they have attained 88% of the adult length.

The beluga is an opportunistic feeder with a diverse diet. Food items vary according to seasonal availability and consist of many fish species such as capelin, Arctic cod and herring, but also invertebrates such as shrimp, squid and marine worms. As with most marine mammals there is a seasonality in the storage of blubber reserves. Their summer feeding activity is not well understood; during their estuarine aggregation they do not appear to feed at all, but their behaviour outside the estuaries is unknown. During the autumn, on their migration to the wintering areas, they and other marine mammals and seabirds feed heavily on schools of Arctic cod. This appears to be a very important time of the year for the accumulation of a thick layer of blubber, which acts both as an insulation and a large high-energy reserve.

Daily energy budgets of free-ranging belugas are not known. In captivity, average daily consumption of food is about 10–15 kg. Large numbers of belugas such as the 25 000 + wintering in Hudson Strait could have a major impact on the crustacean and fish populations.

Belugas are warm-blooded air-breathing animals adapted to life in cold (down to $-2°C$) Arctic waters. Common to all marine mammals, the blubber layer, 2.5 - 9.5 cm of fat lying immediately below the skin, provides an efficient insulator which helps to maintain an internal body temperature of approximately 37°C in ice-filled waters. This is a large amount of fat, at times making up almost 50% of the total body weight.

In order to feed successfully, belugas spend a significant amount of time underwater. Their normal diving capabilities are not well known but some belugas trained by the United States Navy have gone to depths of 600 m. Recent evidence from a wild free-ranging animal marked with a satellite transmitter has indicated dives to 300 m. Like other marine mammals, belugas have specific adaptations for diving.



PRESENT POPULATION ESTIMATES		
1	Western Arctic	7 000-11 500
2	High Arctic	6 264 - 18 564 + Greenland
3	Cumberland Snd	400 - 600
4	W. Hudson Bay	23 000
5	James Bay	740 - 1 970
6	E. Hudson Bay	1 125 - 1 905
7	Ungava Bay	100 (?)
8	St. Lawrence River	360 - 715

Fig. 2. Distribution of the beluga.

They contain twice as much blood as land animals of similar size, with blood cells holding a 10-fold greater amount of oxygen. The circulatory system is made up of a complex of valves and reservoirs which favours the oxygen-sensitive brain with fresh blood during lengthy dives. To withstand the tremendous pressures at depth, the thorax is collapsible because of the cartilaginous joints in the rib cage. Other adaptations related to diving include a lesser sensitivity to carbon dioxide build-up and a greater ability of their muscles to operate with depleted oxygen.

Ecology

Belugas have a well-developed sense of hearing and refined echolocation capabilities. They are also a very vocal species emitting not only echolocation clicks, but a wide variety of modulated whistles which probably serve in social communication. Their ability to discriminate using echolocation appears to be superior to the much studied oceanic bottlenose dolphin and is probably related to their navigation in ice-filled winter habitats and their utilization of shallow-water areas in the summer. Their refined sense of hearing probably also serves to protect them from such

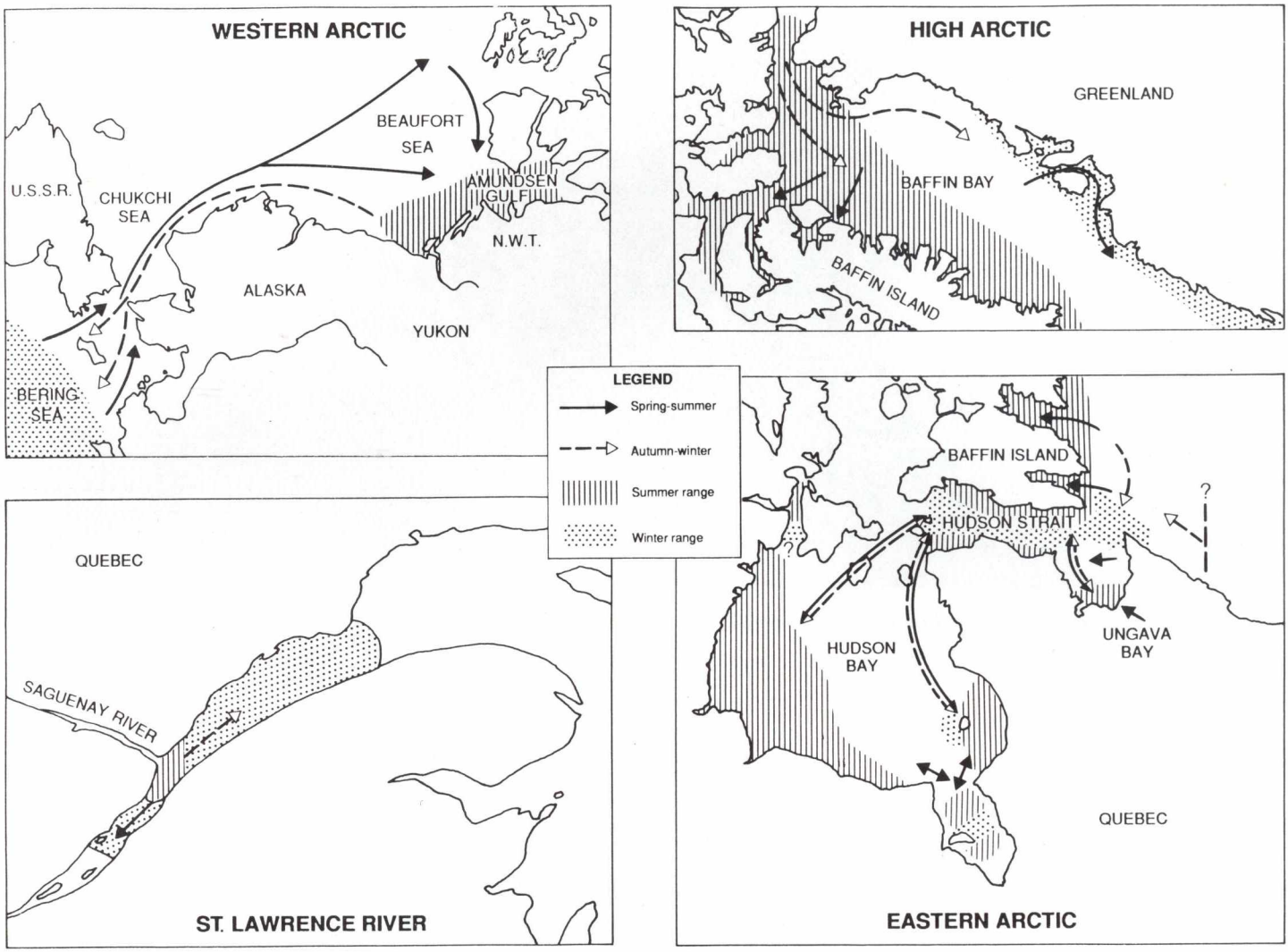


Fig. 3. Migration of the beluga.

predators as polar bears and killer whales.

Our knowledge of the ecology of belugas is largely restricted to the summer ice-free season when they aggregate in large numbers within certain river estuaries (Fig. 4). Belugas are philopatric, some identified individuals returning to the same estuaries year after year, even when they are frequently exposed to disturbance such as hunting.

Herds of belugas begin to arrive in the estuaries as soon as the ice permits their passage. At Cunningham Inlet (Somerset Island) where we have observed the estuary since 1979, whales arrive as the ice breaks in the second week of July and leave by mid-August. In eastern Hudson Bay, at the Nastapoka estuary, whales arrive as early as mid-June and remain in and around the estuary until early September. Most of the behaviours in estuaries are related to the nurturing of young calves and growth of new skin.

It appears that estuarine aggregations consist of a high proportion of females with newborn and juveniles (Fig. 6). Adult females with either newborn or yearling calves are often seen to be accompanied by juveniles which might serve as attendants. While the parental ties are not directly proven, it appears that such possible family units might be the nucleus of the beluga social structure.

Females spend much of their time in the quieter parts of the estuaries suckling their young. Newborn and yearling calves rarely leave the immediate vicinity of their mothers. Older age classes of grey calves form loose aggregations which engage in a variety of behaviours.

Fig. 4. Photo courtesy of Arctic Biological Station, DFO, Ste-Anne-de-Bellevue.

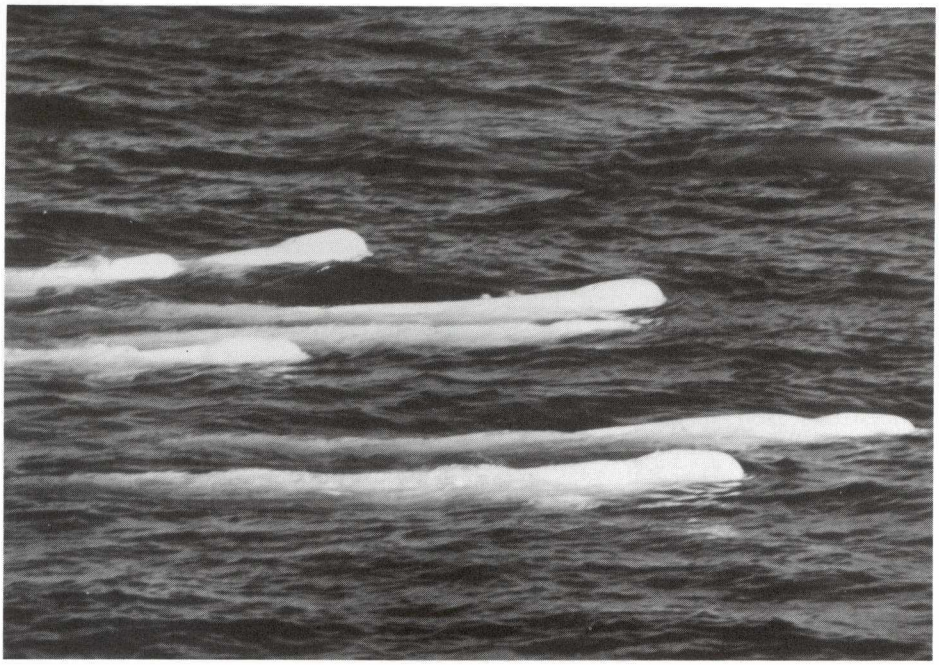


Fig. 5. Photo courtesy of Arctic Biological Station, DFO, Ste-Anne-de-Bellevue.

Fig. 6. Photo courtesy of Arctic Biological Station, DFO, Ste-Anne-de-Bellevue.

Pods of adult males, made up of 15–20 individuals, are seen in the larger estuaries, but usually remain apart from the others and are actively avoided by females with small calves.

In the early summer, whales in the estuary engage in activities which are directly related to changes in their skin. Individuals roll on the muddy or rocky bottoms at the mouth of river channels which have a strong current. They are actively abrading the skin surface, sometimes leaving strips of epidermis which have been cut off by the sharp limestone shale in the substrates. All age classes engage in this behaviour.

It has only been recently shown that belugas are subject to a seasonal epidermal moult which has not yet been as well-documented in other species of whales. Belugas have a very thick skin which is at least 10 times thicker than that of other dolphins and 100 times the thickness of the epidermal layer of terrestrial mammals. Their skin appears to be a very dynamic organ used for insulation, storage of high quantities of vitamin C and possibly protection from the abrasion caused by contact with ice. The high epidermal cell growth is seasonally related to their occupation of the warmer freshwater estuaries. These conditions facilitate the removal of dead skin and the rapid growth of new skin cells. The seasonal high levels of the hormone thyroxin in the blood suggest that this is a true moult.

Past and Present Exploitation

Marine mammals have been the basis of the Inuit economy for over 4000 years. They provide meat, fat, oil, leather, tools and material for fabrication of arts and crafts. With the development of the Thule culture, 800 - 1000 years ago, belugas became an important food species. The epidermal and dermal layers of the skin yield "muktuk," which is still highly prized as a food rich in vitamin C and high in energy content. The oil and meat of belugas is also consumed by people and their sled-dogs.

The hunts are often cooperative efforts involving several hunters and vessels and are conducted using harpoons and rifles. The boats used in the past were mainly kayaks. These have been replaced by motorized freighter canoes and larger fishing vessels up to 15 m in length.

The total number of belugas caught in the Canadian Arctic for subsistence purposes has varied between 700 and 1300 over the past 13 years (Fig. 7). The annual harvest fluctuates in response to weather, availability of other wildlife species and implementation of management measures.

Beginning in the middle of the eighteenth century, commercial whaling for belugas continued over a period of 200 years for certain populations in the eastern Arctic (Ungava Bay, eastern Hudson Bay) and over a period of 93 years for the St. Lawrence population. Commercial whaling was totally banned by the Canadian Government in 1972.

In the Arctic, belugas were generally caught for commercial purposes in entanglement nets or drive fisheries in shallow waters. In the St. Lawrence they were caught in weirs in the shallow areas

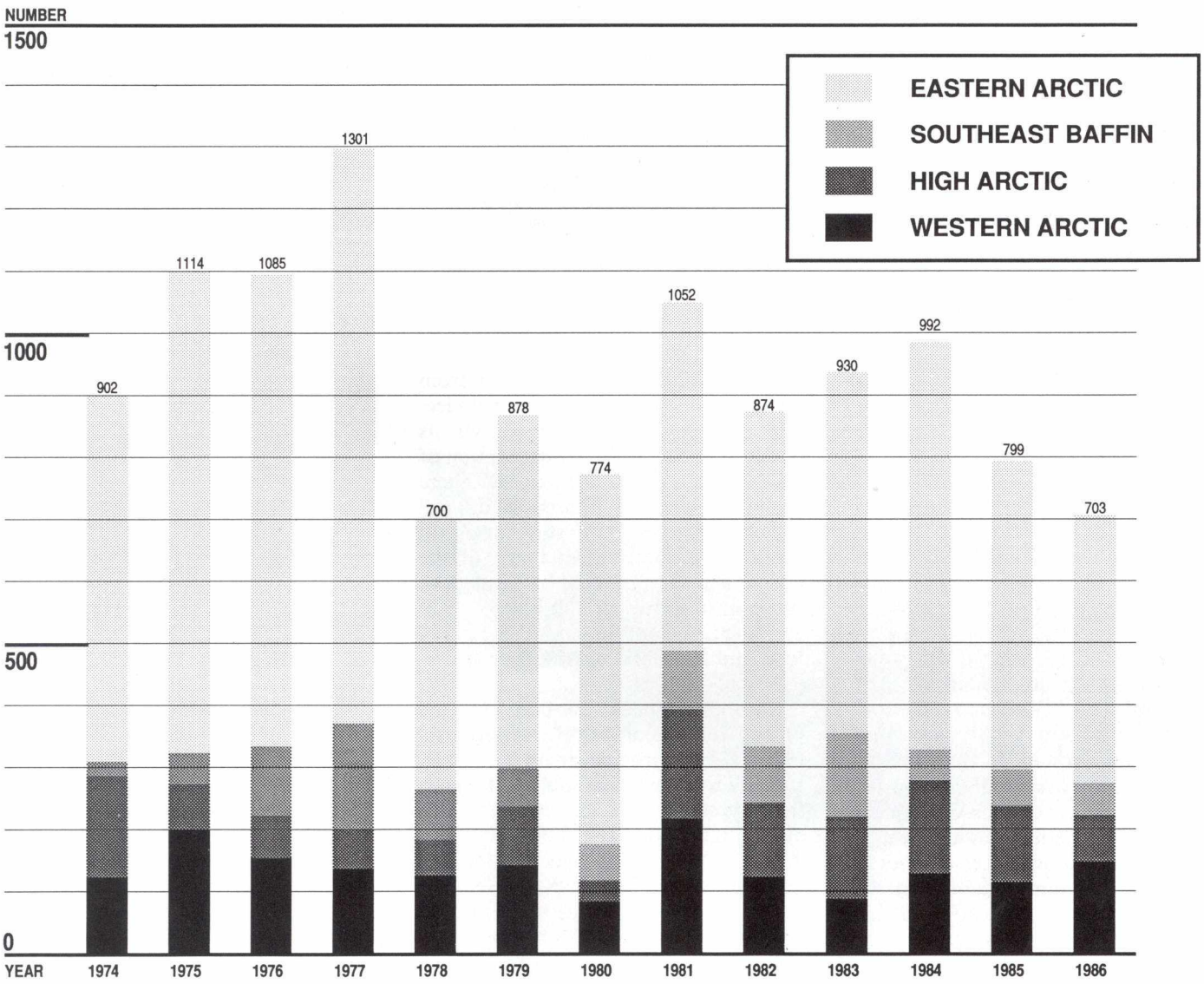


Fig. 7. Total number of belugas caught in the Canadian Arctic for subsistence purposes.

and by means of rifles and harpoons in the deeper areas.

The total cumulative numbers of beluga caught for commercial purposes, uncorrected for sunk animals, were about 11 000 in the high Arctic (from 1868 to 1898), 7000 off southeastern Baffin Island (from 1868 to 1939), 9000 in western Hudson Bay (from 1949 to 1970), 9900 in eastern Hudson Bay (from 1752 to 1916), 1200 in Hudson Strait (from 1909 to 1940), 1800 in Ungava Bay (from 1731 to 1938) and 14 500 in the St. Lawrence Estuary (from 1868 to 1960).

Because of their adaptation to shallow waters, belugas live well in captivity. In Canada, live belugas were taken from the St. Lawrence up to the beginning of the 1960s and from the western Hudson Bay population since 1967. The total known number of belugas captured in western Hudson Bay until 1990 is 61. The reasoning supporting the capture of live belugas for aquaria is based on public educational and research benefits.

The ban on commercial whaling, the intensification of conservation measures and the increase of public interest have lead to the development of a new non-consumptive use. Whale watching is attracting a large number of tourists in the St. Lawrence Estuary and an increasing number in the Arctic. In the St. Lawrence, however, belugas are excluded from whale watching activities as a special measure to limit disturbance. No guidelines have yet been established for Arctic whale watching ventures.

Management, Research and Conservation

There are concerns for the conservation of beluga stocks in Canada. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has analyzed the status of many of the Canadian beluga populations. Its conclusions were as follows: (1) St. Lawrence population, endangered (1983), current size 360 - 715; (2) Western Arctic population, healthy (1987), current size 7000 - 11 500; (3) Cumberland Sound population, endangered (1990) current size 400 - 600; (4) Ungava Bay population, endangered (1989–90), current size too low to estimate; (5) Eastern Hudson Bay population, threatened (1989–90), current size 1125 - 2905.

Most populations had been depleted by commercial exploitation in the past, some more so than others. At present, apart from subsistence hunting, other potential threats include habitat loss from shore development, degradation by toxic chemical contamination or hydrographic modifications (temperature, salinity, etc.) and disturbance by commercial shipping, ice breaking and whale watching activities.

Responsibility for beluga conservation, management and research, as for every other marine species in Canadian waters, belongs to the Department of Fisheries and Oceans of the Government of Canada. The Beluga Protection Regulations under the *Fisheries Act* are the legal basis upon which beluga management and conservation measures are enforced. In order to implement its mandate, the Department has developed a process based on scientific advice and consultation with resource users. Various committees are composed of native users, representatives from the whale watching industry and scientific experts.

Present management or conservation measures vary with the specific problems to be addressed. The conservation of the St. Lawrence beluga population is guided by an interdepartmental action plan. This plan includes measures to improve scientific knowledge, guidelines to control disturbance, steps to create a marine park and actions to control pollution by toxic chemical substances.

In the Arctic, wildlife management in general has to reconcile three main objectives: wildlife rehabilitation and conservation; ensurance of a continued

rational use of the resource; and respect of agreements defining native priority and hunting rights. The management tools commonly used for populations that are threatened or endangered include the creation of sanctuaries, the establishment of quotas, or when needed, the total closure of the hunt to restore the population. Regulations include rules about hunting equipment such as the calibre of rifle, use of edible parts, protection of the females accompanied by calves and prohibition of disturbance.

Information and education also constitute an important aspect of management, since conservation of renewable resources and their habitats is usually only achieved through the cooperation of all users.

The strong evidence that belugas return to certain Arctic summering areas and the mixing of contiguous summer groups in the winter necessitates further research on the identification of individual stocks. Current data based on genetic analyses support behavioral evidence indicating that stocks are defined by female assemblages in estuaries. Further genetic analyses can quantify the degree of isolation or separation of these stocks and the amount of inbreeding. Tagging of individuals in the estuaries will also reveal the routes and timing of migration. This will provide vital information about which stocks are being harvested by different hunting groups at different times of the year.

There is a strong requirement for more knowledge of the feeding ecology and annual energy budgets of all marine mammals. Belugas represent a significant proportion of the winter consumers in Hudson Strait. There, commercial operations such as large shrimp fisheries might lead to future conflicts. In the St. Lawrence, we should consider the effect of the competitive use of food species by the numerous marine mammal species and various fisheries on the resident belugas.

For free-ranging belugas, satellite tags which give information on location, swimming speed, dive frequency and depth will provide a wealth of information of feeding strategies and annual energy budgets. Identification of important feeding areas from these studies can then lead to meaningful research to evaluate the magnitude of the standing stock of fish and crustaceans used by the beluga populations.

Contaminants are the focus of much research in the St. Lawrence. Many industrial substances could have a negative impact on marine mammals. While direct links between various chemicals and changes in the St. Lawrence population have not been established there is certainly cause for concern and vigilance.

In the Arctic there is evidence of a significant decline in both PCBs and DDT in some marine mammals in the last 10 years. Yet, because of the high consumption of marine mammal's fat by native people, there is a concern about the effect of PCBs on human health. Inundations of large land areas by hydroelectric projects could also result in significant amounts of methylmercury being exported to the coastal marine environment.

Conventional population studies on belugas have been plagued with difficulties in attempting to estimate population size and birth and death rates. The precision achieved by the best aerial surveys to date is not sufficient to detect likely short-term changes in population size. Demographic studies based on age structure from dead animals in Inuit catches suffer from many biasing factors which obscure real mortality rates.

Future efforts in population assessment and dynamics will have to concentrate on the development of techniques based on the monitoring of live animals. Combined studies using satellite-marked animals and detailed aerial photography together with new genetic methods are the most promising future research directions.

Suggested Reading

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