9.0 MAMMALS

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Waters and/or ice habitats of the Hudson Bay marine ecosystem are used by at least five species of whales, by walruses, five species of hair seals, Arctic foxes, and polar bears. Among the whales, belugas, narwhals and bowheads are migratory Arctic species that frequent the region as ice conditions permit. Killer whales live at all latitudes and migrate into Hudson Bay in summer; the minke whale is a temperate-water species and rare summer visitor to the region. There are also reports of sperm whales and northern bottlenose whales in Hudson Bay but their occurence has not been confirmed and at best they are rare. Concentrations of belugas in the estuaries of the Nelson, Churchill, and Seal rivers in July and August are some of the largest known. Belugas are the only whales found commonly in James Bay and southeastern Hudson Bay. Walruses, ringed seals, bearded seals, and harbour seals are resident while harp and hooded seals are seasonal visitors to the region. Arctic foxes and polar bears frequent coastal areas in summer and ice habitats during other seasons.

Traditional subsistence harvests of marine mammals are important to the native cultures and economy of the region (see also Chapter 14). Commercial whaling, particularly for bowheads and belugas, was instrumental in the European exploration and development of the region and dates back to the late 1600's in northern Hudson Bay. Whales are no longer harvested commercially, but bowhead populations and the eastern Hudson Bay beluga stock have not recovered from past commercial harvests and remain depleted. European embargoes have nearly eliminated commercial sealing in the region (Stewart et al. 1986).

The vulnerability of marine mammals to contaminant loading and the effects of climate change, respectively, is discussed in Chapters 16 and 17. Because many marine mammals are upper level consumers, they are vulnerable to contaminant accumulation. The polar bear and other species that that rely on ice as a platform for feeding, moulting, movement, and/or breeding are vulnerable to climate driven changes in the ice environment of Hudson Bay and James Bay.

9.1 BELUGA *Delphinapterus leucas* (Pallas, 1776)

As its Latin name implies the beluga, or white whale, has no dorsal fin and is white in colour as an adult (Brodie 1989; Stewart and Stewart 1989). It has a circumpolar Arctic and Subarctic distribution, and occurs throughout Hudson Bay and James Bay, where it is the most common and abundant species of whale. Despite the fact that Europeans have harvested belugas from Hudson Bay since 1688 (Rich and Johnson 1957 in Reeves and Mitchell 1987), the species' seasonal movements and stock dynamics are not well understood. This makes it difficult to manage the ongoing subsistence harvests of these whales.

The persistent presence of belugas at specific estuaries, local population depletion, morphometrics, and the timing of movements all suggest that there are separate stocks of belugas summering in Ungava Bay, Foxe Basin, eastern Hudson Bay, and western Hudson Bay (Sergeant 1973, 1981; Finley et al. 1982). [Note: While these "stocks" have been delineated for the purpose of hunt management, they often represent the best current delineation of biological populations.] This is supported by the observation that belugas at the Nastapoka River

estuary show site tenacity during the summer and between years (Caron and Smith 1990). It is also supported by studies of molecular genetics which suggest that hunters in eastern Hudson Bay, Sanikiluaq and Kimmirut take animals from different stocks; that belugas summering in the Churchill River estuary may constitute another separate stock (de March and Postma 2003); and that there are differences between belugas summering in eastern and western Hudson Bay (Helbig et al. 1989; Brennin et al. 1997). Genetic information is not yet available from other major summer concentrations near the estuaries of the Seal, Nelson, Winisk, and Severn rivers, or from James Bay (de March and Postma 2003).

The hypothesis of geographical separation has been complicated by observations that belugas are distributed more or less continuously along the coasts of Hudson and James bays (Smith and Hammill 1986; Richard et al. 1990), and may winter together in Hudson Strait (Finley et al. 1982). Indeed, hunters in northern Quebec, northern Hudson Bay, and Arviat apparently take animals from a mixture of different stocks (de March and Postma 2003). Recent tagging studies have confirmed the exchange of animals among summering areas along the southwest coast of Hudson Bay, northern and central James Bay, and the Belchers (Richard and Orr 2003) (Figure 9-1).

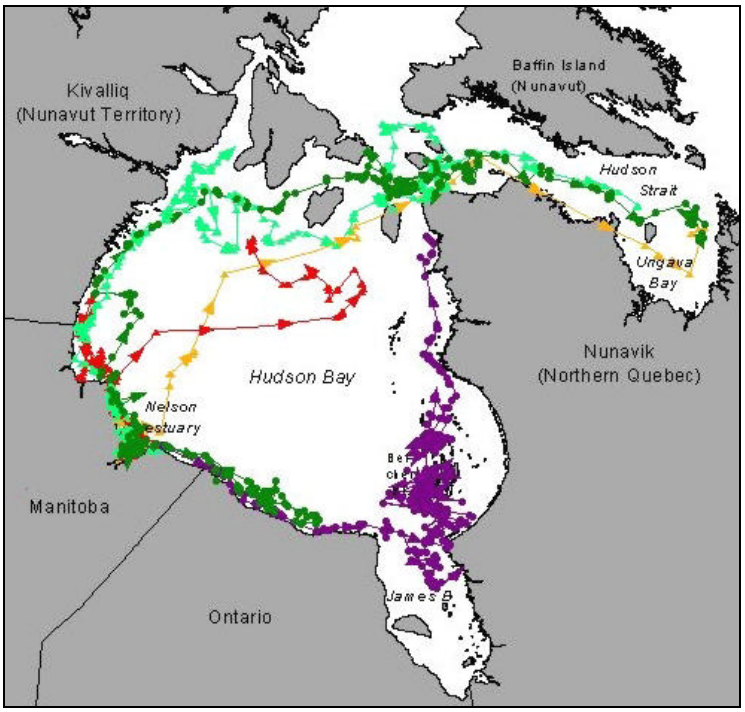

Figure 9-1. Seasonal movements of 5 belugas radio-tagged at the Nelson River estuary between 30 July and 5 August 2003 and followed until 27 November 2003 (Richard and Orr 2003). Arrows show direction of movement. Purple (?) and dark green (?) tracks were made by female belugas—a calf accompanied the former.

9.1.1 Distribution and Movements

The winter distribution and movements of belugas are limited by the presence of heavy pack ice or landfast ice where breathing holes cannot be maintained (Stewart and Stewart 1989). Of 5 animals tagged between 31July and 4 August 2003 at the Nelson River estuary, 3 travelled to eastern Hudson Strait and Ungava Bay by mid-November and the other two were travelling north in that general direction when the signals from their tags were lost in late October (red) and Late November (purple), respectively (Richard and Orr 2003). Aerial surveys of Hudson Strait, Ungava Bay, and northwest Hudson Bay in March have found belugas to be numerous in Hudson Strait and rare in Roes Welcome Sound and northern Hudson Bay (Finley et al. 1982; Richard et al. 1990). Together, these observations suggest that many of the belugas that summer in Hudson Bay and James Bay may winter in Hudson Strait. However, neither bay has been thoroughly surveyed in winter. There are scattered reports of belugas wintering at the floe edge in northern and western Hudson Bay (Sutton and Hamilton 1932; Doan and Douglas 1953; Sergeant 1973; Reeves and Mitchell 1989a; Richard 1993a; McDonald et al. 1997), in Roes Welcome Sound (Finley et al. 1982), in the Belcher Islands (Freeman 1967, 1968; McDonald et al. 1997), near Long Island (M.J. Dunbar, McGill Univ., Montreal, QC, pers comm. 1993), near Peawanuck (McDonald et al. 1997) and in recurring leads and tide cracks in James Bay (Jonkel 1969; Schwartz 1976; McDonald et al. 1997). Whether these whales are part of a resident population(s) or are just trapped individuals that would normally winter in Hudson Strait is not known, but traditional knowledge studies suggest that a significant number of belugas winter in James Bay by choice (McDonald et al. 1997).

The routes taken by belugas from wintering areas to summering areas in Hudson Bay and James Bay are not well known (Figure 9-2). Most knowledge of these routes comes from observations of the whale's arrival and departure times at traditional hunting areas, which are often near the coast (e.g., Finley et al. 1982; Reeves and Mitchell 1987; 1989a; McDonald et al. 1997). Ice leads can be important spring migration routes (Schwartz 1976; Stirling et al. 1981).

Figure 9-2. Spring and fall movements of belugas and seasonal concentration areas compiled from traditional (McDonald et al. 1997) and scientific (Finley et al. 1982; Richard et al. 1990; Gosselin et al. 2002; Richard and Orr 2003; P. Richard, DFO, Winnipeg, pers. comm.) sources. Map modified from McDonald et al. (1997:88).

Historical observations and traditional knowledge support the occurrence of a southward migration along the Quebec coast in spring and a return movement northward in the fall (Finley et al. 1982; Reeves and Mitchell 1987; McDonald et al. 1997). The earliest historical report of belugas at Akulivik was in April and the latest in October. To the south, at Petite rivière de la Baleine, Richmond Gulf (Lac Guillaume Delisle) and Grande rivière de la Baleine, they appear to have been uncommon before June and after mid-September. Inuit communities along the Quebec coast of Hudson Bay harvest most belugas from June through November (Finley et al. 1982; Lesage et al. 2001). Between 1990 and 2000, hunters from Kuujjuarapik, Umiujaq, and Inukjuaq killed most of their whales in July and August; hunters from Puvirnituk and Akulivik killed most of theirs in October; and those from Ivujivik killed most of theirs in June and October—not necessarily near the communities.

During the summer, belugas move along the Quebec coast of Hudson Bay but do not concentrate at the river mouths between Ivujivik and Inukjuak (M. Allard, Makavik Corp., Lachine, pers. comm.). An aerial survey of southeast Hudson Bay in 1985 found concentrations of belugas along the coast at Richmond Gulf, the estuaries of the Nastapoka River and Petite rivière de la Baleine, and offshore in the triangle formed by the Nastapoka River, the Belcher Islands, and Inukjuak (Smith and Hammill 1986). While whales were seen in the same general area during surveys conducted in 1993 (Kingsley 2000) and 2001 (Gosselin et al. 2002), fewer whales were seen offshore or in the estuaries. The highest herd counts in the Nastapoka River estuary in the summers of 1983 and 1984 by land-based observers were 245 and 260 whales, respectively (Caron and Smith 1990), but during tagging studies over a 3 week period in 1998 and a one month period in 1999 the maximum counts were less than 25 animals (Hammill and Doidge in Bourdages et al. 2002:11). Breton-Provencher (1979; Simard et al. 1980) also observed belugas along the southeast coast of Hudson Bay from Pointe Louis XIV to Richmond Gulf and in the Gulf itself. Historically, there were also large summer concentrations of belugas at Grande rivière de la Baleine (Reeves and Mitchell 1987, 1989b), but they have not been reported in recent years.

Studies of belugas radio-tagged at Petite rivière de la Baleine and the Nastapoka River have found that they remain offshore in eastern Hudson Bay, occasionally returning to the rivers, from August through late September (Smith 2000a). One animal, with a longer-lasting tag, was moving north past Puvirnituq when the signal was lost on 21 October. A female beluga with a calf was tagged at the Nelson River estuary in early August 2003. This animal moved to the Belchers in late August, remained there until mid-November, and then travelled north offshore the Quebec coast (Figure 9-1). It left the archipelago in mid-November and had reached the Kovik Bay (61°33' N, 77° 40' W) area when the signal was lost in late November.

Inuit in the Belcher Islands report that belugas arrive in spring both from the north and south (P. Kattuk, Mayor of Sanikiluaq, pers. comm.), suggesting that the whales either follow different routes from the north or that some of them winter south of the islands. Some of these whales, like the female and calf mentioned earlier, arrive at the Belchers via the Nelson River and northern James Bay (Richard and Orr 2003). It is not known whether whales summering in western Hudson Bay pass through southeast Hudson Bay or James Bay in spring.

There are historical reports of belugas occurring throughout James Bay and of their entering the shallow mouths of all the larger rivers along its coast (e.g., Trout Creek and the Attawapiskat, Moose, Albany, Hurricana, Trout, Pontax, Eastmain, and La Grande rivers; see review by Reeves and Mitchell 1987). In August 2001, they were distributed throughout the bay and quite numerous, particularly in the central area and along the Ontario coast north of 54°N (Gosselin et al. 2002). They feed at Hannah Bay and near Moose Factory in October and appear at Moose Factory and Attawapiskat as soon as there is open water in the spring (late March and April) (McDonald et al. 1997).

Belugas arrive at estuaries along the Ontario coast in early July (Johnston 1961; Richard et al. 1990). Cree have seen them in estuarine leads at Winisk and Ft. Severn earlier in the spring, before a shore lead has appeared, but this may not be a regular occurrence (Johnston 1961). During the summer, belugas move along the Ontario coast in small groups with concentrations entering the estuaries of larger rivers on the rising tide. Cree report that belugas begin to disappear from the Ontario coast about the end of August, moving off northward along

the coast. This observation is supported by tagging studies that followed eastward movements along the Ontario coast by 2 of 5 belugas tagged at the Nelson in early August 2003 (Richard and Orr 2003). By mid-August, one had moved east into James Bay; the other travelled to the Winisk area and returned to the Nelson by early September.

Belugas arrive at estuaries in Manitoba during or immediately after spring break-up (late May or early June in the Hayes and Nelson, mid to late June in the Churchill and Seal) and generally leave by late August or early September (Reeves and Mitchell 1989a). The largest single concentration of belugas in the world occurs in summer in the area of the Nelson River estuary, and there are smaller but still substantial concentrations of whales at the estuaries of the Churchill and Seal rivers (Richard et al. 1990). The population of belugas that summers in western Hudson Bay between Arviat, Nunavut and the Manitoba border was estimated to number over 23,000 animals in July 1987 (Richard et al. 1990). This estimate did not correct for submerged animals and is likely conservative. Belugas were present at least 160 km offshore from the mouth of the Nelson River and their densities were highest near the river mouth. Over the course of the summer some animals tagged at the Nelson range east into James Bay and north to the Belchers, while other remain close to the estuary or move west towards Churchill (Richard and Orr 2003). Belugas are present in the Churchill River estuary from mid-June until the end of August and their numbers are greatest from late July through mid-August (Bernhardt 1999a). Most whales leave the estuary and move northward along the Kivalliq coast in late August and early September when the weather begins to get stormy (Doan and Douglas 1953; Sergeant 1973, 1981; Watts and Draper 1988). Animals tagged at the Seal River have been recovered at Whale Cove and Repulse Bay (Sergeant 1973, 1981).

Many belugas move west along the south coast of Southampton Island in May and June (Eecherk in Finley et al. 1982) but relatively few are seen along the northwest coast of Hudson Bay until late summer. This suggests that most belugas moving south in the spring do so beyond view of the ice edge in western Hudson Bay. The southern Kivalliq communities hunt belugas earlier in the season (July-August) than do those to the north (August-September) (Gamble 1988; see also Chapter 14). This suggests there is a northward movement of belugas along that coast in late summer, and is supported by Inuit traditional knowledge (McDonald et al. 1997). Inuit have also observed an eastward movement of belugas south of Coral Harbour in September (Eecherk in Finley et al. 1982). Belugas are present in the Repulse Bay area during August and September (Gamble 1988).

In 2003, radio-tagging studies showed that some animals move north of Churchill later in the season, in mid-September or early October, and travelled offshore the Kivalliq coast or across central Hudson Bay (Figure 9-1). They passed south of Southampton Island or Coats Island in mid- to late October, and all three of the animals whose tags were still transmitting in November continued east, reached eastern Hudson Strait and northern Ungava Bay by late November. One of these tags was still operating in early January 2004, and transmitting the beluga's location near Cape Chidley (P. Richard, DFO, Winnipeg, pers. comm. 2004).

9.1.2 Biology

Belugas are well adapted for cold and ice. They have thick insulating blubber and skin, no dorsal fin, and are capable of breaking ice up to 20 cm thick with their melon or dorsal ridge to open breathing holes (Freeman 1968; Sergeant 1973; Finley and Renaud 1980; Mitchell and Reeves 1981). The beluga is not a fast swimmer, with maximum burst estimated at 20 $km \cdot h^{-1}$ and normal cruising speeds in the range of 6-9 $km \cdot h^{-1}$, but it is very agile in the water (Brodie 1989). Individuals can submerge for 15 to 20 minutes, swim 2 or 3 km underwater, and dive to depths of 647 m (Seaman and Burns 1981; Ridgeway et al. 1984; Reeves and Mitchell 1989b; Martin and Smith 1992). They can remain underwater for up to 42% of any 24 h period (Martin and Smith 1992). Their ability to remain submerged for long periods makes it difficult to estimate their numbers.

Aggregations of whales in the estuaries may be related to moulting or neonate survival. The animals generally ascend the estuaries with the rising tides and descend with the falling tides (Johnston 1961; Finley et al. 1982; Baker 1989). Active abrasion of skin surfaces softened by exposure to warm fresh water is thought to

accelerate the moult, which is linked to a seasonal endocrine cycle and, unlike other cetaceans, synchronized to meet the energetic demands imposed on the whales by their environment (St. Aubin and Geraci 1989; St. Aubin et al. 1990; Watt et al. 1991; Smith et al. 1992, 1994). The presence of many females with newborn calves suggests that estuaries are important in the reproductive scheme of the belugas (Finley et al. 1982). It may be related to predator avoidance by females with calves at a time when they cannot find refuge in ice from killer whales (P. Richard, DFO, Winnipeg, pers. comm. 2003).

At the Nastapoka River estuary the aggregation is composed mainly of adult nursing females and their calves and older female offspring (Smith et al. 1994). In the summer of 1984 the ratio of adult male to adult female belugas in the Nastapoka River estuary was estimated at 1:4.3 (Caron and Smith 1990). Judging from behavioural observations (T. Smith pers. comm. in St. Aubin and Geraci 1989) and examination of stomach contents, very little feeding activity occurs while whales are in the estuary. When disturbed by hunts or motor traffic the whales left the estuary for periods of 40 and 24 h respectively. Belugas communicate using a variety of sounds and have well-developed hearing and echolocation abilities (Stewart and Stewart 1989).

Animals that summer in western Hudson Bay are smaller than those in Cumberland Sound and the high Arctic, but not different from eastern Hudson Bay or Ungava Bay stocks (Sergeant and Brodie 1969; Finley et al. 1982; Doidge 1990; Stewart 1994). At Arviat, the mean lengths and weights of belugas aged 10 years or older were (Stewart and Walker 1987):

	n	Length (cm) ± SE	n	Weight (kg) ± SE
male	40	376.1 ± 17.4	39	679.4 ± 107.3
female	19	329.7 ± 20.1	18	488.7 ± 85.1

Assuming that belugas in western Hudson Bay deposit two dentine layers on their teeth annually (Brodie 1982), they may live at least 25 years (Sergeant 1973) while those in southeast Hudson Bay may live at least 33 years (Doidge 1990). The females reach sexual maturity at a mean age of 5 years and give birth to a single calf after a gestation period of about 14 months (Sergeant 1973). Breeding likely peaks in April or May (Richard 1993a), and calving takes place from May to early August--peaking in late May in northern Quebec and late June in western Hudson Bay (Reeves 1994). Calves are nursed for about 20 months and pregnancy occurs about once every 3 years. Newborn belugas are dark brown, grey brown, or blue grey and become progressively lighter in colour as they mature (Stewart and Stewart 1989).

Capelin, estuarine fishes, squid, decapod crustaceans, and annelid worms (*Nereis* sp.) are important food items for adult belugas summering in Hudson Bay (Sprules 1952; Doan and Douglas 1953; Breton-Provencher 1979; Simard et al. 1980; Watts and Draper 1986; McDonald et al. 1997). Belugas in the Belchers will also eat sculpins (P. Kattuk, Mayor of Sanikiluaq, pers. comm.), and young belugas that are just cutting teeth will eat *Nereis* sp. (Doan and Douglas 1953). While the capelin is an important food of belugas in southern Hudson Bay (Doan and Douglas 1953; Watts and Draper 1986) its' abundance varies from year to year (Sergeant 1973).

Predation by killer whales, hunting by man, and entrapment by ice are important causes of beluga mortality (Mitchell and Reeves 1981; Reeves and Mitchell 1988). Polar bears also prey on belugas to a limited extent (Freeman 1973; Smith 1985; Smith and Sjare 1990).

9.1.3 Population Status and Protection

Aerial systematic line transect surveys and coastal surveys were conducted in the summers of 1993 and 2001 to estimate the number of belugas at the surface in offshore areas of eastern Hudson Bay and James Bay (Table 9-1). The results of these surveys were analysed using both line transect and strip transect methods to facilitate comparison of the data among years, and with data from strip transect surveys that followed the same

tracks in 1985. From 1985 to 2001, the number of belugas summering in James Bay increased fourfold, while numbers in eastern Hudson Bay declined by almost half (Gosselin et al. 2002). These estimates did not correct for animals submerged beyond view and may be conservative. While the 2001 estimate for eastern Hudson Bay was similar to that from 1993, it would have been substantially lower (i.e., the line transect estimate would decrease from 1194 to 816) if a single group of 52 whales had not been seen on transect.

The apparent rate of increase in the James Bay beluga population cannot be explained on the basis of reproduction alone (Bourdages et al. 2002; Gosselin et al. 2002). It may reflect, at least in part, the fact that the 1985 survey (Table 9-1) was flown earlier in August, when a lot of ice still remained in northwest James Bay (Kingsley 2000). In 1993 and 2001 surveys, the highest densities of whales were seen in this area. Alternatively, there may have been immigration of animals from Hudson Bay. This latter hypothesis is supported by the timing of migration of the tagged female beluga into James Bay (Richard and Orr 2003) and the fact that people at Attawapiskat say that belugas are more numerous there in late August (P. Richard, DFO, Winnipeg, pers. comm.). This has important implications for population management and argues the need to improve understanding of the relationships between animals in these areas.

Table 9-1. Indices of abundance for beluga populations in eastern Hudson Bay and James Bay (from Gosselin et al. 2002).

Year	Abundance estimate				Original reference
	Eastern Hudson Bay		James Bay		
	Strip transect N (SE)	Line transect N (SE)	Strip transect N (SE)	Line transect N (SE)	
1985	1,442 (165)	2,089 [a]	1,213 (290)	1,842 [a]	Smith and Hammill 1986
1993	706 (205)	1,032 (421)	2,296 (566)	3,141 (787)	Kingsley 2000
2001	659 (263)	1,194 (507)	4,732 (712)	7,901 (1744)	Gosselin et al. 2002

a = Data collected in 1985 did not allow a line transect analysis, so the value is the product of the strip transect estimate and the mean ratio of line/strip transect estimates for the given stratum for the two following surveys.

The surveys indicate that the number of animals in eastern Hudson Bay has decreased both in offshore areas and in the estuaries since 1985. During this period there has also been a decline in the mean age of the catch, from a median of 13 years (n = 132, in 1980+1983-87) to a median of 8.7 years (n = 108; in 1993-01)(Lesage et al. 2001:25; DFO 2002a:6). Recent harvests are also characterized by an absence of older animals. In the 1980-87 the oldest animal harvested from Nunavik was 34 y; in 1993-99 the oldest animal harvested from eastern Hudson Bay was 18 y. These data, and the observation that fewer animals have been frequenting the Nastapoka River estuary in recent years relative to the 1980's and early 1990's, suggests that the population in eastern Hudson Bay continues to decline (Gosselin et al. 2002). The vulnerability of animals that summer in eastern Hudson Bay to harvest elsewhere is unknown but genetic studies suggest that hunters from Sanikiluaq and communities in Hudson Strait harvest some (de March and Postma 2003). If few of the animals harvested by Sanikiluaq (~13%) belong to the eastern Hudson Bay population, then few of those seen by aerial surveys around the Belchers are likely to belong to that population. This suggests that the eastern Hudson Bay beluga population may be smaller and more vulnerable than the aerial survey data suggest (Hammill 2001; Hammill et al. 2004). The 2001 management plan for the Northern Quebec (Nunavik) belugas recommended a limit of 30 on the annual harvest of belugas from eastern Hudson Bay (EHB) (DFO 2002a). DFO has cautioned that continuing current levels of harvesting (>140 EHB beluga killed in 2001 by communities in Hudson Bay and Hudson Strait) could cause this population to disappear within 10 to 15 years (Hammill 2001; Bourdages et al. 2002).

On 21 July 1987, DFO made an aerial reconnaissance survey of coastal waters from Kaskattama River, Manitoba to Cape Henrietta Maria, Ontario for belugas (Richard et al. 1990). Two transects were flown parallel to

the coast, one 3 km and the other 28 km off shore. Observers saw 1269 belugas on the first transect, of which 232 were concentrated at the Severn River estuary and 393 at the Winisk River estuary. Only 30 belugas were seen on the offshore transect.

The number of belugas in the area of the Nelson River estuary on 19 July 1987 was estimated from a systematic aerial visual and photographic survey at 19,500 (95% CI 14,200-26,800) animals (Richard et al. 1990). A survey of the Churchill River-Seal River area on 15 July 1987 produced a mean estimate of 5,600 belugas (95%CI 4,100-26,000). Tagging studies indicate that the whales can move between these estuaries in less than 5 days (Weaver in Richard et al. 1990), which raises the possibility some may have been double-counted. However, a survey of the two areas on consecutive days, 17 and 18 July 1987, yielded an estimate of 23,000 belugas (95% CI 14,200-26,800). The surveys on the 17th and 18th did not cover offshore areas of the Nelson River estuary that were covered on the 19th, and none of the estimates was adjusted to compensate for whales that were submerged beyond view. The beluga population in western Hudson Bay was thought to be stable at current levels of removal (Richard 1993). It has not been resurveyed since 1987.

Aerial reconnaissance surveys conducted in 1981 along the Kivalliq mainland coast north of the Manitoba border saw only 62 belugas in late July; when the area was resurveyed in August this number rose to 329, including a herd of 128 animals at the mouth of the Thlewiaza River (Richard et al. 1990). Small concentrations of belugas have also been observed at the mouths of the Tha-anne and Wilson rivers (Brack and MacIntosh 1963).

Systematic aerial visual and photographic surveys of belugas in Repulse Bay-Frozen Strait area of northern Hudson Bay in late July of 1982-84, yielded mean estimates of 700 (95%CI 200-3,300) to 1,000 (95%CI 621-1,627) whales (Richard et al. 1990). A herd of 143 belugas was seen south of the survey area on 23 July 1983 in the Canyon River estuary of south Southampton Island; another herd of 685 animals was seen at the head of East Bay on 17 August 1988. These observations suggest that a population of over 1000 animals summers in northern Hudson Bay. It is not known whether these whales represent a separate stock. Belugas were not seen during similar aerial surveys of Roes Welcome Sound in March 1982.

The beluga is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which allows regulated trade under permit (Stewart and Stewart 1989). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has designated the eastern Hudson Bay beluga population “Endangered”, and the western Hudson Bay population as “Special Concern” (Smith 2004): the former on the basis that it continues to decline and is likely to disappear at current hunting levels in less than 10 to 15 years; the latter on the basis that it has not been surveyed for 15 years, may consist of more than one population, and is subject to substantial removals by hunting. Shipping and hydroelectric projects may also pose threats to both populations. The effects of hunting and development on the beluga populations in Hudson Bay and James Bay are discussed in Chapters 14 and 15, respectively. There is a well-developed tourist industry in Churchill, and to a much lesser extent at communities and lodges along the Kivalliq coast, that caters to beluga whale-watchers.

9.2 NARWHAL *Monodon monoceros* Linnaeus, 1758

Narwhals are medium-sized toothed whales that lack a dorsal fin. They are about 1.60 m long at birth (80 kg). Males can grow to 5.40 m (~1935 kg) and females to 4.94 m (~1552 kg). Adult narwhals have only two teeth. In most males, the right tooth remains embedded in the skull and the left forms a magnificent spiral tusk that can extend straight forward over 3 m. In most females, both teeth remain embedded in the maxillae. Inuit use a variety of descriptive words in Inuktitut to identify narwhal. These include *tuugaalik* (with tusk), *qirniqtaq qilalugaq* (black whale), and a*llanguaq* (with black and white dots) (J. Kilabuk, Pangnirtung, pers. comm. 2002).

Narwhals inhabit Arctic waters and are seldom seen south of 61°N (Figure 9-3). They are common in the waters of Nunavut, west Greenland, and the European Arctic but rare in the East Siberian, Bering, Chukchi, and Beaufort seas. This distribution appears to be unchanged from historical reports.

Two populations of narwhals have been recognized for the purpose of hunt management in Canada (DFO 1998a+b). This tentative separation into Baffin Bay and Hudson Bay populations is based largely on summering distribution. It is supported by recent studies that found whales taken by Repulse Bay to have molecular genetics and organochlorine contaminant profiles that were distinct from those of animals harvested at several High Arctic locations (de March et al. 2003; de March and Stern 2003). Narwhals that summer in northwest Hudson Bay are believed to winter in eastern Hudson Strait (Richard 1991). They range over an area of roughly 250,000 km² (Stewart 2004a). Narwhals from the Baffin Bay population summer in the waters of West Greenland and the Canadian High Arctic and winter in Baffin Bay and Davis Strait (Koski and Davis 1994; Dietz et al. 2001; Heide-Jørgensen et al. 2003). The population affinity of animals that summer north of Baffin Bay and along the eastern and southern coasts of Baffin Island is unknown.

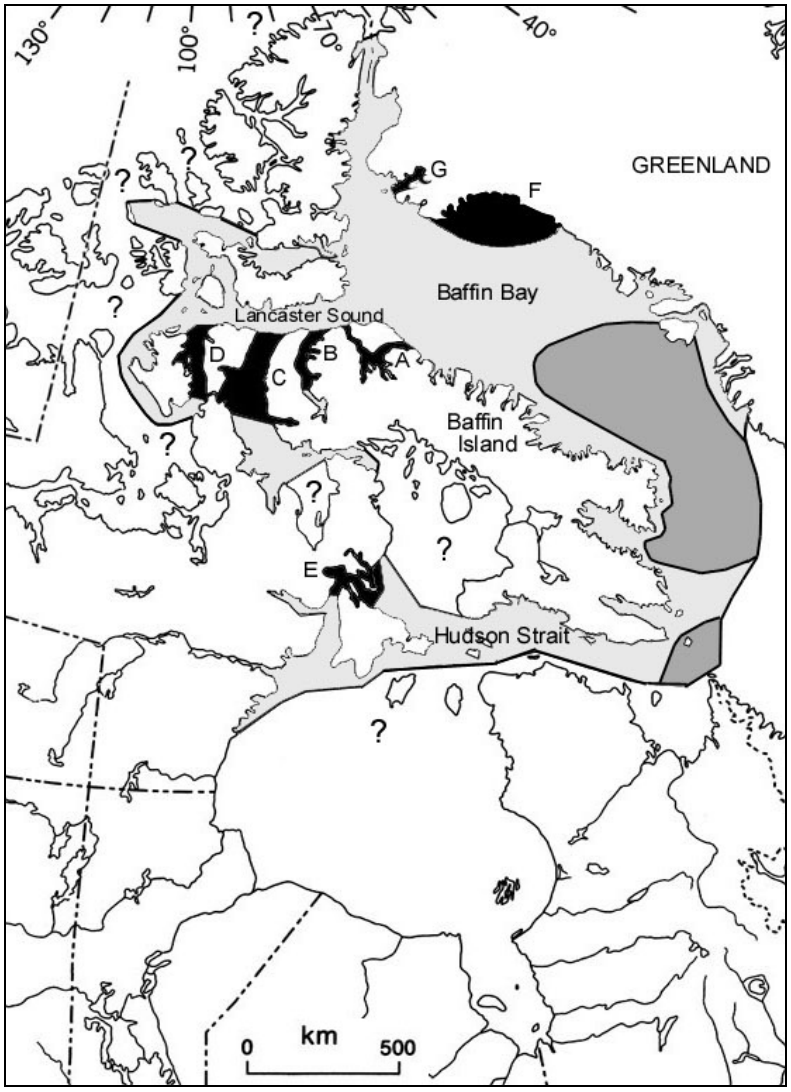

Figure 9-3. Distribution of narwhals in Canada (from Stewart 2004a). Summer concentrations in solid black include: A. Eclipse Sound/Navy Board Inlet, B. Admiralty Inlet, C. Prince Regent Inlet, D. Peel Sound, E. Foxe Channel, F. Melville Bay, and G. Inglefield Bredning. Wintering concentrations are shown in medium grey and known range in pale grey. Question marks indicate areas where the extent of the narwhal's distribution is uncertain.

9.2.1 Distribution and Movements

The summer range of the Hudson Bay narwhal population includes the waters surrounding Southampton Island, with the largest aggregations in Repulse Bay, Frozen Strait, western Foxe Channel and Lyon Inlet (Richard 1991; Gaston and Ouellet 1997; DFO 1998a; Gonzalez 2001; P. Richard, pers. comm. 2002). The area of these summering grounds is roughly 17,000 km² (Stewart 2004a). Whales from this population also summer, typically in smaller numbers, in Wager Bay and Duke of York Bay. There are no indications of large summer aggregations elsewhere in Hudson Bay or in James Bay, Hudson Strait or southern Foxe Basin. Sightings of narwhals to the south near Arviat and east near Cape Dorset are unusual and have been attributed to the presence of killer whales (*Orcinus orca*) (Higgins 1968; W. Angalik, pers comm. in Stewart et al. 1991). Thorough searches of the historical literature for the Quebec coast of Hudson Bay and James Bay have not found reports of narwhals (Reeves and Mitchell 1987), but three dead animals have been found along the Ontario coast of Hudson Bay (Johnston 1961).

Scientific studies have not identified any large-scale changes in the seasonal distribution of narwhals, but Inuit have observed local changes. Since the 1960s, narwhals have become less common near the hamlet of Repulse Bay. Hunters attribute this change to an increase in the number of people hunting and traveling with motorboats and snowmobiles near the community (Gonzalez 2001).

The seasonal movement patterns of the Hudson Bay narwhals are not well known. In the spring, they likely migrate westward from putative wintering grounds in eastern Hudson Strait (Richard 1991; Koski and Davis 1994), traveling offshore through Hudson Strait and Foxe Channel until they reach the floe edge east of Repulse Bay in late June (Gonzalez 2001). They move into their summering grounds in western Foxe Channel, Frozen Strait, Lyon Inlet and Repulse Bay as ice conditions permit and typically remain until late August or early September, when they travel southeastward out of the area through Frozen Strait, following the east coast of Southampton Island. Narwhals are seldom seen west of Southampton Island or along the west coast of Hudson Bay unless killer whales are present, but they are seen on occasion at the floe edge near Coral Harbour in late June or early July, and in late August or early September. Some animals also winter in open leads and polynyas of northern Hudson Bay and western Hudson Strait (Sutton and Hamilton 1932; Richard 1991).

Narwhals from the Hudson Bay population are not known to move north of Lyon Inlet (Richard 1991; Gonzalez 2001) but observations of whales passing east of Igloolik Island on their way north to Fury and Hecla Strait (Stewart et al. 1995), suggest that there may be some northward movement of narwhals into the region. It is also possible that these whales are resident in the region or are members of the Baffin Bay population returning northward. Tagging studies have not followed whales from the Hudson Bay population between their summer and winter habitats or whales from the Igloolik area to their wintering habitat.

The timing of narwhal migrations can vary by a month or more from year to year, depending upon ice conditions. They generally travel in groups (pods) of <10 animals that are dispersed during localized movements in summer, but gather into concentrations of many hundreds of animals during directed migrations in the spring and fall (Silverman 1979; Koski 1980a; Guinn and Stewart 1988; Cosens and Dueck 1991; Koski and Davis 1994; Richard et al. 1994). Most migratory movement takes place at the surface and their swimming speed averages 5.0 $km \cdot h^{-1}$ whether they are traveling horizontally or diving vertically (Heide-Jørgensen et al. 2001). Narwhals can reach peak speeds of 20 $km \cdot h^{-1}$ (Richard 2001).

9.2.2 Biology

Narwhals inhabit a vast area of the Arctic, but little is known of their actual habitat requirements. In summer, they prefer coastal areas that offer deep water and shelter from the wind (Finley 1976; Kingsley et al. 1994; Richard et al. 1994). During their fall migrations in the High Arctic, and later while wintering in the pack ice, narwhals prefer deep fjords and the continental slope, where depths range from 1000 to 1500 m and upwellings may increase biological productivity (Dietz and Heide-Jørgensen 1995; Dietz et al. 2001). They frequent heavy pack ice for much of the year and follow leads in the ice to their summering grounds. The quality of the ice habitat, particularly the presence of leads in fast ice and the density of broken pack ice, appears to influence habitat selection (Koski and Davis 1994). The ice may also provide refuge from predation by killer whales. Little is known of the physiological requirements of narwhals or of the species' ability to adapt to change in its environment (Stewart 2004a).

The vital rates of narwhals are uncertain because there is no accurate method to determine their ages. By analogy with belugas, females are believed to mature at 5 to 8 years and produce their first young at 7 to 13 years (Braham 1984; Kingsley 1989). Mating peaks in mid-April, and most calves are produced in July and August after a gestation period of 14 (Best and Fisher 1974) to 15.3 months (Hay 1984). However, there are few newborn calves at the Repulse Bay ice edge in July (Gonzalez 2001). While more frequent reproduction is possible, mature females produce a single calf about every three years on average until perhaps 23 years of age (Hay and Mansfield 1989; Kingsley 1989). Longevity may be about 50 years, but most animals probably do not reach the

age of 30. Generation times and net recruitment rates for narwhals are unknown. Rates of mortality from hunting and from predation by killer whales and polar bears are unknown.

The potential for large-scale mortality due to entrapment by ice or to disease is also unpredictable. Narwhals from the Hudson Bay population have been trapped by ice in Lyon Inlet (Degerbøl and Freuchen 1935), near White Island, and in Ross Bay (66°52'N, 85°00'W)(Gonzalez 2001). Few large entrapments have been reported from Canadian waters. When these entrapments occur early in the winter the mortality rate is likely high but the survival rate of animals trapped later in the season may be good, provided they are not hunted or found by bears. Little is known of the diseases of narwhals and their response to pathogens.

The rate of predation on narwhals by killer whales and polar bears is unknown but may be significant. Hunters in the Repulse Bay area see killer whales more frequently now than in the past and have expressed concern about their predation on narwhals (Gonzalez 2001). Killer whales may have driven narwhals close to Cape Dorset in the 1960s (Higgins 1968), south to Arviat in 1988 (W. Angalik, pers. comm. in Stewart et al. 1991), and into shallow water in the Repulse Bay area in 1999 (Gonzalez 2001). The latter resulted in an unusually large harvest of narwhals by Repulse Bay (see Tables 14-4 and 14-5). Killer whales also made hunting narwhals easier in the Repulse Bay area in 1998, and in the Lyon Inlet area in 2000. Their kill of narwhals during these high-harvest years is unknown but possibly significant.

Narwhals eat fishes and invertebrates (Degerbøl and Freuchen 1935; Vibe 1950; Finley and Gibb 1982; Neve 1995). The composition of their diet varies with season and location, likely in response to dietary preferences and the seasonal or geographical availability of prey species (Neve 1995). They appear to feed year-round but may increase their food intake prior to migration (Remnant and Thomas 1992; Stewart et al. 1995). Their primary summer foods in the Canadian Arctic are Arctic cod (*Boreogadus saida*), Greenland halibut (*Reinhardtius hippoglossoides*), squid (*Gonatus fabricii*), and decapod crustaceans (Finley and Gibb 1982; Hay 1984). Inuit hunters have also found Greenland cod (*Gadus ogac*) in narwhal stomachs (Stewart et al. 1995) and report that they eat Arctic charr (*Salvelinus alpinus*) (Remnant and Thomas 1992). Little is known about the interactions between narwhals and other species for food and habitat. Their preference for deepwater habitat effectively separates them from belugas for much of the summer.

Narwhals make a variety of sounds and are sensitive to underwater noise (Reeves 1977; Ford and Fisher 1978; Ford 1987; Miller et al. 1995). They can detect approaching ships at a distance of 80 km and show behavioural responses at distances of 55-40 km (Finley and Davis 1984; Miller and Davis 1984; Cosens and Dueck 1988, 1993; Finley et al. 1990). Inuit hunters have observed that narwhals are sensitive to, and avoid, noise from machines and explosions (Gonzalez 2001).

The narwhal's ability to dive deeply and remain under water for long periods enables them to move long distances under water to avoid hunters and to locate areas where they can surface to breathe. In the deep waters of Baffin Bay, narwhals dive to at least 1500 m and daily make dives to depths of over 500 m (Heide-Jørgensen and Dietz 1995; Heide-Jørgensen et al. 2002). They can remain under water for at least 26.2 minutes when foraging (Laidre et al. 2002) and up to 30 minutes when pursued by Inuit (Gonzalez 2001). Their diving behaviour makes it difficult to obtain accurate population estimates.

9.2.3 Population Status and Protection

A good estimate of the initial size of the Hudson Bay narwhal population cannot be generated from historical harvest data (Mitchell and Reeves 1981; Reeves 1992a). Estimates of current population size have been limited to methods that only estimate a portion of the population. Richard (1991) conducted systematic visual and photographic aerial surveys of narwhals in the Repulse Bay area between Roes Welcome Sound and Lyon Inlet, north of Southampton Island in March 1983 and July of 1982, 1983, and 1984. These surveys included the major known summering concentrations of the Hudson Bay narwhal population. The July 1984 photographic

survey was repeated in August 2000, with the addition of northern Lyon Inlet and Foxe Channel (P. Richard, DFO, Winnipeg, pers. comm. 2002). Without correcting the results of either survey for submerged animals, or the latter survey for persistent fog or animals that may have occupied Wager Bay (Gonzalez 2001), the narwhal population was estimated at 1355 (90%CI = 1000-1900) animals in 1984 and 1780 (90%CI = 1212-2492) animals in 2000. While the latter result is preliminary it suggests that the population did not decrease between surveys despite concern over heavy exploitation in 1999 (Stewart 2004a).

Narwhal populations in Canada may be limited by hunting, environmental contaminants (see Chapter 16), climate change, and industrial activities such as commercial fishing and vessel traffic (Stewart 2004a). The effects of climate change on ice habitats used by narwhals are uncertain, as is the species' capacity to adapt (see Chapter 17). The effects of the other factors are mitigated by the species' deepwater habits and widespread geographical distribution, much of which is outside normal hunting areas in offshore pack ice and in isolated areas of the Arctic. This remote distribution protects many narwhals from hunters as well as isolated oil spills or other events. However, under exceptional circumstances, such as large ice entrapments or when killer whales drive narwhals into shallow water, many animals can be taken at once from a single locality. Hunting probably represents the most consistent factor limiting the Hudson Bay narwhal population (see Chapter 14).

Protection for narwhals in Canada is limited to measures that manage the hunt, live capture, and movement of narwhal products (Stewart 2004a). The species is listed in Appendix II of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES). This designation is reserved for species that could be threatened with extinction if trade is not controlled and monitored. It means that a CITES export permit is required for narwhal products that cross international boundaries. In Canada, these permits are administered by DFO. In 1996, the International Union for the Conservation of Nature and Natural Resources (IUCN) assessed the population status of the narwhal (Hilton-Taylor 2000). It concluded that the threat of extinction could not be adequately assessed with the data available and listed narwhal in the data deficient (DD) category in *The 2000 IUCN Red List of Threatened Species.* In November 2004, the Committee on the Status of Endangered Wildife in Canada (COSEWIC) designated narwhals as a species of "Special concern", based on an updated review of their status (Stewart 2004a).

9.3 KILLER WHALE *Orcinus orca* (Linnaeus, 1758)

These powerful, fast-moving members of the dolphin family have distinctive black, white and grey markings and a tall, wide dorsal fin (Leatherwood and Reeves 1983; Heyning and Dahlheim 1988). They have a worldwide distribution limited only by ice cover, shortage of prey, and human predation. Killer whales are robust. Males generally attain a body length of 8.2 m and females 7.0 m (Mitchell 1975).

Little is known of their movements or biology in Hudson Bay and James Bay. They are seen infrequently and in small numbers in northern Hudson Bay and to the south along the Keewatin coast to Churchill and along the Quebec coast to Inukjuak in August and September (Doan and Douglas 1953; Sergeant 1968, 1986; Reeves and Mitchell 1988). Cree along the Ontario coast do not have a name for killer whale (Johnson 1961), suggesting that it is rare in James Bay and southern Hudson Bay.

Killer whales are top-level marine carnivores that eat fish, marine mammals, seabirds, and squid (Mitchell and Reeves 1982; Campbell et al. 1988; Heyning and Dahlheim 1988; Reeves and Mitchell 1988). When killer whales are nearby, belugas (W. Angalik, Arviat, pers. comm. 1989) and narwhals (Gonzalez 2001) hide in the shallows of estuaries or deep bays and seals leave the water (Johnson 1961), making them easy prey for hunters.

Killer whales are not hunted for food in the Hudson Bay area, but in August 1978, a killer whale that strayed into Baker Lake was killed by hunters offshore the community (S. MacDonald, Water Survey of Canada, Baker Lake, pers. comm. 1979; Sergeant 1986). COSEWIC is interested in the killer whale but does not consider the species to be of immediate concern (Campbell 1987).

9.4 BOWHEAD WHALE *Balaena mysticetus* Linnaeus, 1758

The bowhead or Greenland right whale is a large, slow-swimming Arctic baleen whale with a discontinuous circumpolar distribution (Leatherwood and Reeves 1983; Reeves and Leatherwood 1985). Based on the species' summer distribution there appear to be two stocks or populations in the eastern Canadian Arctic, one that summers in northern Hudson Bay and Foxe Basin and the other in Baffin Bay, Davis Strait and the waters of the Canadian High Arctic (Figure 9-4)(Cosens and Innes 2000). Genetic studies support the idea that the two stocks are distinct (Maiers et al. 1999). However, recent tagging and distribution studies that have demonstrated movement of animals between Prince Regent Sound and both Foxe Basin and Cumberland Sound suggest a single population (S. Cosens, DFO pers. comm.).

9.4.1 Distribution and Movements

The movements and biology of bowheads in Hudson Bay and James Bay are not well known. Some animals have been seen in mid-winter at the floe edge in western Hudson Bay, and off Mansel Island and some of the islands in southeast Hudson Bay (Low 1906). Whether these whales represent a resident, winter population or were simply trapped by ice is not known. Reeves et al. (1983) suggest that the entire summer population of bowhead is unlikely to winter in the bay. They may winter at the southern edge of the pack ice in Davis Strait (Low 1906; Mansfield 1985) or in Hudson Strait (McLaren and Davis 1981, 1983), particularly in highly productive areas of mixed arctic and subarctic water. In the spring, they follow the receding pack ice to seek out the most productive waters in which to feed (Figure 9-5). Inuit from Repulse Bay report that they are concentrated at the floe edge in June but disperse after breakup and then gather inshore in August (NWMB 2000).

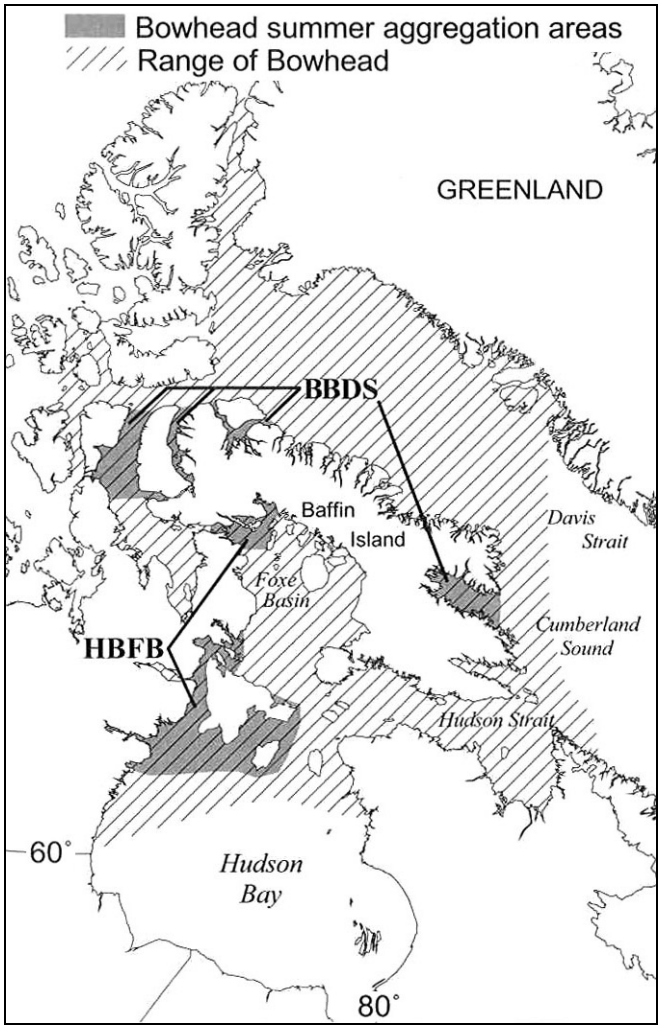

Figure 9-4. Ranges and summer aggregation areas of the two putative stocks of bowhead whales in eastern Canadian Arctic waters (modified from Reeves and Cosens 2003:284). BBDS = Baffin Bay-Davis Strait stock; HBFB = Hudson Bay-Foxe Basin stock).

Early whalers observed that bowheads were present in eastern Hudson Strait in April and May and in western Hudson Strait in late May (Wakeham 1898; Low 1906). They could be found along the floe edge in northwest Hudson Bay on both sides of the southern entrance to Roes Welcome Sound in June and early July, and moved northward as the ice cleared, through the Sound to Repulse Bay and later through Frozen Strait into Foxe Channel. Most commercial kills in the area south of Roes Welcome Sound were made in June and July, while those in Frozen Strait and Repulse Bay were made in August and September (Ross 1974; Reeves et al. 1983; Reeves and Cosens 2003). Whalers believed that the bowheads returned eastward through Hudson Strait in late autumn. There is good agreement between their observations and those reported by Inuit elders and hunters (NWMB 2000). The predictable cycle of occurrence strongly suggests that there is a seasonal migration of bowhead between Hudson and/or Davis Strait and Hudson Bay.

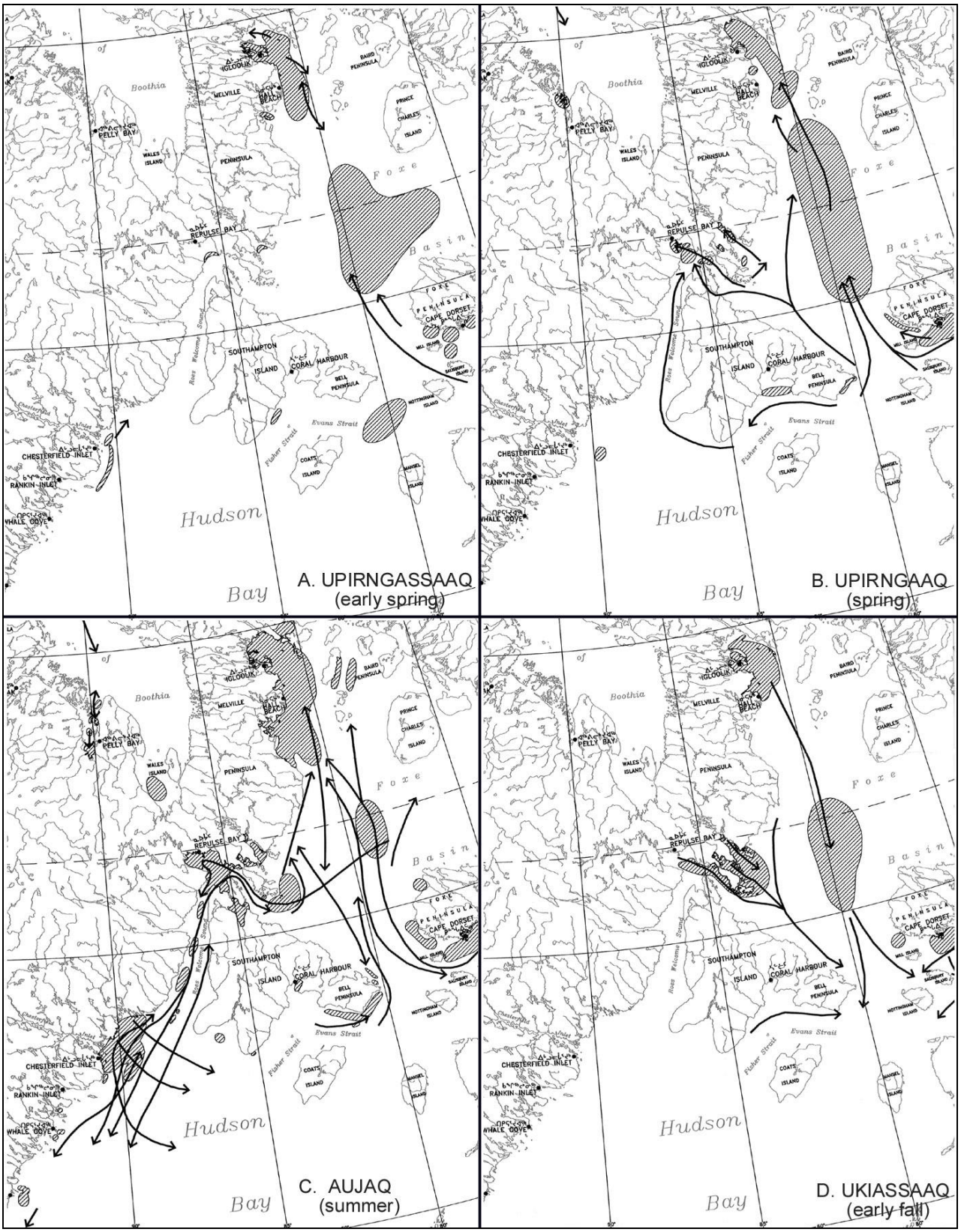

Figure 9-5. Inuit knowledge of the seasonal movements of bowheads in Hudson Bay and Foxe Basin from A. UPIRNGASSAAQ (early spring) to D. UKIASSAAQ (early fall) (adapted from NWMB 2000).

Historically, bowheads were concentrated in northwest Hudson Bay, between Marble Island and Frozen Strait (Ross 1974; Reeves et al. 1983; Reeves and Mitchell 1987). They were abundant in northwest Hudson Bay from mid-May through mid-September (Ross 1974; Reeves et al. 1983; Reeves and Cosens 2003). A favourite area for hunting them was the vicinity of Whale Point, north of the mouth of Chesterfield Inlet (Low 1906; Degerbøl and Freuchen 1935; Reeves et al. 1983). Bowheads are still seen in northwest Hudson Bay (Mansfield 1971; Cosens et al. 1997; Cosens and Innes 2000). They are not common to the south but have been seen at Arviat and in the Churchill River estuary in the 1980's (Watts 1988). Recent satellite telemetry studies have confirmed the movement of whales from Foxe Basin to Southampton Island in August (Dueck in Reeves and Cosens 2003).

The Ottawa Islands, in eastern Hudson Bay, may also have been an historical concentration area for bowheads (Degerbøl and Freuchen 1935). In 1912-13, the Scots whaler Active of Dundee took 6 whales and lost 4 in the Ottawas (Flaherty 1918; Newspaper Clipping in PAC, MG 29, A58, Vol 8., File 5 in Reeves and Mitchell 1987). Carcasses have also washed up on the beaches in the archipelago (Bell 1884; Flaherty 1918). They were, however, a novelty to local Inuit (Flaherty 1918). Manning (1976) saw a whale, or whales--presumably bowhead, blowing in the Ottawas in August 1971.

There are few confirmed reports of bowheads in James Bay and southeast Hudson Bay. On 24 August 1967, a large bowhead was seen at the surface 100 m offshore about 10 km south of Petite rivière de la Baleine (55°05'N, 76°52'W) (Fitzhugh in Reeves et al. 1983); a bowhead was seen northeast of Attawapiskat, James Bay, 1.6 km off Ekwan Point on 11 July 1978 (J. Crawford pers. comm. in Reeves et al. 1983); and, in 1981-2 residents of Kuujjuarapik purchased baleen on the Belcher Islands, probably from a bowhead--the whale was apparently killed in 1981 (C.A. Cote. pers. comm. in Reeves and Mitchell 1987).

9.4.2 Biology

Bowheads lack a dorsal fin and have an enormous head that can be up to one third of the total body length (Leatherwood and Reeves 1983). They exhale a characteristic V-shaped spout which is easily identified on a windless day, and seldom travel in groups of more than 6 animals. Individuals can grow to a length of about 20 m and a large animal may weigh 100 tonnes (Scoresby 1820; Nereini et al. 1984; Reeves and Leatherwood 1985). They have very thick, oil-rich blubber (up to 45 cm) that provides insulation from the cold Arctic water.

Age estimates based on aspartic acid racemization, which measures changes in the forms of aspartic acid in the eye lens over time, suggest that bowheads attain sexual maturity at about 25 years of age (age at length 12-13 m for males, 13-13.5 m for females) and may live over 200 years (George et al. 1999). Adult females are larger than males (Koski et al. 1993). Little is known of the species reproduction. Mating probably takes place in the spring, and calving from March through August of the following year--peaking in May. Calves are about 4.5 m long at birth and are usually born singly, although twins do occur (Nerini et al. 1984). The calving interval for the Hudson Bay/Foxe Basin population is unknown (DFO 1999a).

The Wager Bay-Marble Island area of northern Hudson Bay served as a nursery area for bowheads before commercial whaling reduced the population (Reeves and Cosens 2003), and photographic studies suggest that northern Foxe Basin currently is a nursery area (Cosens and Blouw 1999). Few whales now use the Wager Bay-Marble Island area (Reeves and Cosens 2003). It is not known whether this area was used by a separate stock that has not recovered from commercial whaling, or whether both were used by a single stock that has retreated northward. Females with calves were also taken historically in the Repulse Bay area (Reeves and Cosens 2003) and are still present (NWMB 2000).

Bowheads feed mainly by "skimming" small planktonic and benthic crustaceans from the water with their baleen (Lowry et al. 1978; Wursig et al. 1985), and often occur in areas where zooplankters, particularly calanoid copepods, are abundant relative to the surrounding waters (Scoresby 1820; Griffiths 1981). Feeding areas often correspond to oceanic fronts where temperature, turbidity, or current patterns suggest there is discontinuity or

mixing (Finley et al. 1983; Borstad 1985). Their predictable concentration in these feeding areas made bowheads very vulnerable to capture, and still leaves them susceptible to disturbance by humans. Bowheads have a complex vocal repertoire and are sensitive to noise disturbances (Finley 2001). Predation by killer whales and suffocation or starvation caused by ice entrapment, are likely the major causes of bowhead mortality in the eastern Canadian Arctic since the cessation of commercial whaling (Mitchell and Reeves 1982; Nerini et al. 1984; Reeves and Mitchell 1988; NWMB 2000; Finley 2001).

9.4.3 Population Status and Protection

Northwest Hudson Bay, from Whale Cove to north of Lyon Inlet, was surveyed systematically for bowheads between 12 and 17 August 1995 (Cosens and Innes 2000). A total of 15 whales were seen in Roes Welcome Sound, Repulse Bay, Frozen Strait and Duke of York Bay, too few to determine their density using line-transect methods, so an extrapolation was made from seven observations that had inclinometer readings. The number of animals at the surface was estimated at 75 (S.E. = 27.5; 95%CI 17-133). In 1994, systematic surveys of northern Foxe Basin on 11 and 15 August saw 47 and 53 whales, respectively, and estimated the number of bowheads at the surface in the area at 256 (S.E. = 31.5) and 284 (S.E. = 48.6), respectively (Cosens et al. 1997). None of these estimates was corrected for submerged animals or for animals missed by the observers, and all have wide uncertainty. Because they were not conducted in the same year and bowheads are large, mobile animals, it may not be reasonable to combine the population estimates from northwest Hudson Bay and northern Foxe Basin to provide an overall estimate of the population. Based on aerial surveys conducted in 2002-04, preliminary estimates suggest there may be more bowheads in the eastern Canadian Arctic than was previously thought (S. Cosens, DFO, Winnipeg, pers. comm. 2004).

Based on their survey estimates and a population reconstruction by Woodby and Botkin (1993), which estimated the size of the population prior to exploitation at 575 animals, DFO (1999a) has suggested that the Hudson Bay/Foxe Basin stock may have recovered to 50% of its former size. This estimate of recovery may be premature, as the population reconstruction did not consider the unexploited portion of the population in Foxe Basin (Finley 2001). However, the collective testimony of Inuit hunters and elders from Coral Harbour, Chesterfield Inlet, and Repulse Bay suggests that bowheads were more numerous in the 1990's than in the 1950's and 1960's (NWMB 2000).

The bowhead is protected from international trade by listing on CITES Appendix 1 (Mansfield 1985) and is listed as protected by the International Whaling Commission (IWC)(DFO 1999a). It is also considered by COSEWIC to be endangered in Canada (Mansfield 1985; Campbell 1987) and is listed as endangered on Schedule 2 of the Species at Risk Act (SARA). In 1979, the Government of Canada explicitly prohibited the killing of bowhead by any person without a licence from the Minister of Fisheries and Oceans (SQR/79-644, Canada Gazette Part II, Vol. 113, Extra, Sept. 7, 1979). Harvesting activities are discussed in Chapter 14.

9.5 OTHER WHALES

A live minke whale, *Balaenoptera acutorostrata*, was sighted at Button Bay, near Churchill, on 31 July 1990 (Pattie and Webber 1992). A minke whale carcass was found on the Ontario coast of James Bay, 12 km south of Lakitusaki River in June 1986 (Abraham and Lim 1990). It may be the same animal reported stranded on the "Ontario coast of southern Hudson Bay" by R.R. Campbell (pers. comm. 1988 in Reeves and Mitchell 1989a:3). Reports of sperm whale *Physeter catodon* and northern bottlenose whale *Hyperoodon ampullatus* in Hudson Bay have not been verified, and these species were either incorrectly identified or are exceedingly rare in the region (Reeves and Mitchell 1989a).

Degerbøl and Freuchen (1935) discussed the occurrence of baleen whales in Hudson Bay with many of the whalers who had hunted there for years--none of them had ever seen any baleen whale but the bowhead in Hudson Bay.

9.6 ARCTIC FOX *Vulpes lagopus* (Linnaeus, 1758)

Arctic foxes are distributed in coastal areas and on the larger islands of Hudson and James bays (Manning 1946, 1976; JBNQNHRC 1982, 1988; Berkes and Freeman 1986) and sometimes venture onto the sea ice in pursuit of food (Degerbøl and Freuchen 1935; Forsyth 1985). On the ice they follow polar bear to scavenge at their kills (Smith and Stirling 1975; Stirling and Archibald 1977), and dig into the nearshore snow lairs of ringed seal to prey on the seal pups (Smith 1976).

Arctic foxes also scavenge along the coasts in summer, eating stranded fish and marine mammals, ground-nesting birds, small mammals, and marine invertebrates (Sutton and Hamilton 1932; Forsyth 1985). Their mobility is remarkable. A white fox tagged on 8 August 1974 at Banks Island (74º14'N, 119º55'W) was recaptured about 1500 km away on 15 April 1975 near Repulse Bay (66º27'N, 84º24'W) (T. Strong, unpubl. data).

Fox trapping was an important aspect of the fur trade in Hudson Bay and James Bay and is still important to the regional economy (Degerbøl and Freuchen 1935; Schwartz 1976; Welland 1976; JBNQNHRC 1982, 1988; Gamble 1984, 1987a+b, 1988; OMNR 1985; Berkes and Freeman 1986). Inuit trappers harvest most of the Arctic fox taken in this region while Cree, who also harvest the species, trap far more coloured foxes.

9.7 POLAR BEAR *Ursus maritimus* Phipps, 1774

Polar bears have a circumpolar Arctic distribution with the most southerly populations occurring in James Bay and southern Hudson Bay (Stirling and Ramsay 1986). These large white bears are properly referred to as marine mammals because they spend much of the year on the sea ice (Urquhart and Schweinsburg 1984). Unlike most other bears they remain active in the winter.

The range of polar bear bears in Canada has been divided into 14 populations based on the bear's seasonal site fidelity to relatively local areas, natural obstacles, traditional knowledge, and management considerations (Figure 9-6) (Taylor and Lee 1995; Lunn et al. 1998, 2002a). Bears from 3 of these populations: Western Hudson Bay (WH), Southern Hudson Bay (SH), and Foxe Basin (FB) inhabit the Hudson Bay marine ecosystem. They move largely within the boundaries of their respective polar bear management zones. Tagged bears travel widely within these zones, but few travel between zones (Jonkel et al. 1976; Stirling et al. 1977; Vandal 1987; Vandal and Adams 1988, 1989; Taylor and Lee 1995). There is some mixing of the populations on the sea ice during the winter and spring. Genetically, bears from the three populations are more similar to one another than to bears in other areas but the degree of interbreeding between populations is unknown (Paetkau et al. 1999). Juvenile and subadult bears may be more likely to undertake long distance movements than adults (Stirling and Ramsay 1986). It is not known whether these movements are permanent emigrations.

9.7.1 Distribution and Movements

The most important factor affecting the seasonal distribution and movement of polar bears is the seasonal variation in sea ice conditions. The annual ice melt generally forces bears in Hudson Bay and James bay ashore from mid-July through late August, when they are at their maximum yearly weight from feeding on fat newly-weaned seals (Jonkel et al. 1976; Stirling et al. 1977; Stirling and Ramsay 1986; McDonald et al. 1997; Stirling et al. 1999; Stirling et al. 2004). They seem to come ashore in the same areas and show long-term site fidelity (Derocher and Stirling 1990b; Kolenosky et al. 1992; Stirling et al. 2004).

Over 80% of the Western Hudson Bay population is marked and there are extensive records on this population from mark-recapture studies and the return of tags from bears killed by Inuit hunters (Lunn et al. 2002a). In the fall there is a gradual movement of bears from this population along the south coast of Hudson Bay northward to the region north of Cape Churchill (Urquart and Schweinsburg 1984). There are notable congregations on the Fox Islands off Watson Point and the small islands near Cape Churchill where they gather to

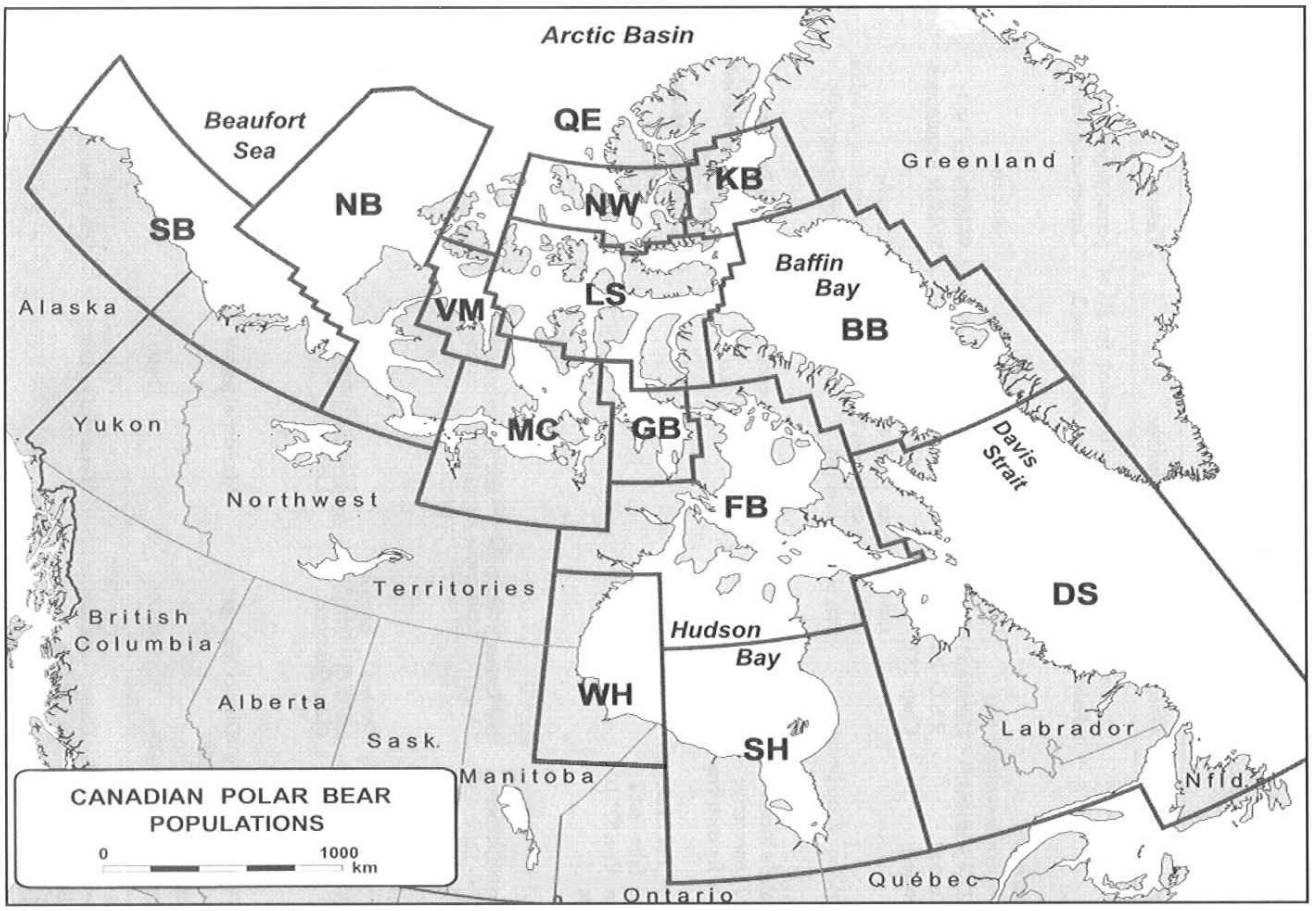

Figure 9-6. Management boundaries for Canadian polar bear populations as of 31 December 2000 (modified from Lunn et al. 1998). BB=Baffin Bay, DS=Davis Strait, FB=Foxe Basin, GB=Gulf of Boothia, KB=Kane Basin, LS=Lancaster Sound, MC=M'Clintock Channel, NB=Northern Beaufort Sea, NW=Norwegian Bay, QE=Queen Elizabeth Islands, SB=Southern Beaufort Sea, SH=Southern Hudson Bay, VM=Viscount Melville Sound, WH=Western Hudson Bay.

await the formation of new sea ice in November (see also Figure 5-5)(Stirling et al. 1977; Latour 1981; Derocher and Stirling 1990a,b). As soon as the ice conditions are suitable all but the pregnant females vacate their summer retreats and move offshore to resume hunting seals (Figure 9-7; Urquhart and Schweinsburg 1984). They remain on the ice throughout the winter, often hunting along leads and near the edges of land-fast ice where seals are most accessible (Jonkel et al. 1976). Variations in the annual pattern of leads and landfast ice strongly influence the distribution of bears throughout the winter. Some bears tagged in the Churchill region move northward along the Keewatin coast as far as Chesterfield Inlet (Stirling and Ramsay 1986; Stirling et al. 1999) and to Southampton Island, Ivujivik, and Inukjuak (Stirling et al. 1977). The movements of 41 adult female bears tagged at Churchill between 1991 and 1998, suggest that bears may concentrate in the area between Cape Churchill and Arviat (Figure 9-8; Derocher and Stirling 1990b; Stirling et al. 1999).

When the other bears move onto the ice in November the pregnant females remain on land to dig maternity dens in deep snowdrifts or in the earth (Stirling et al. 1977; Lynch 1993). The main maternity denning area for the population is south of Churchill in Wapusk National Park (Ramsay and Stirling 1990). Tree growth anomalies around and above den sites indicate that bears in Western Hudson Bay have shown site fidelity to maternity denning habitat south of Churchill for at least several hundred years (Scott and Stirling 2002). Some dens have been used for up to 29 years.

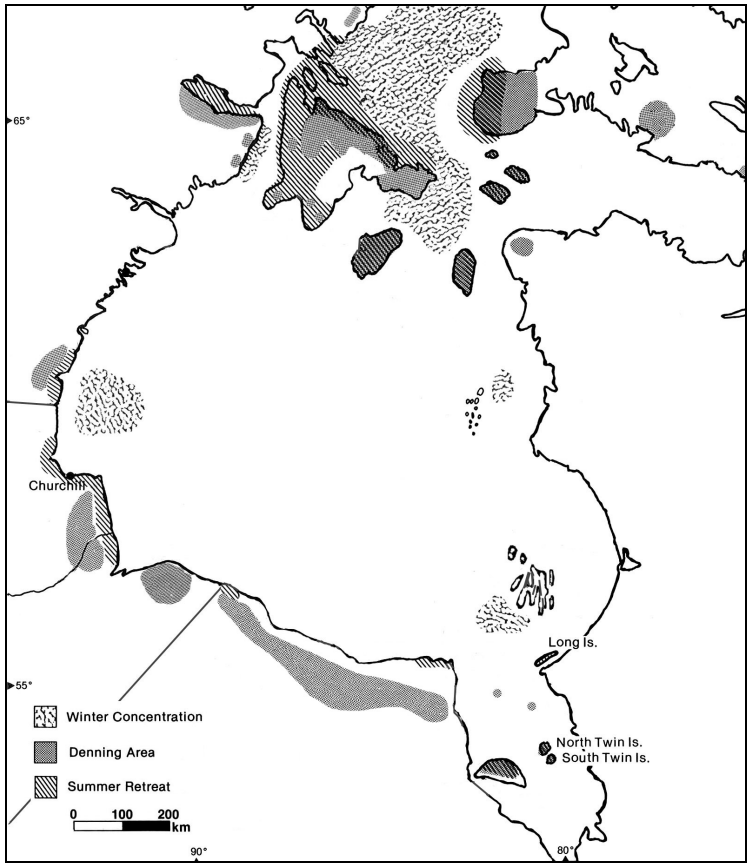

Figure 9-7. **Denning habitats, summer retreats, and winter concentration areas of polar bears in the Hudson Bay and James Bay areas. Composite based on Jonkel et al. 1976; Urquhart and Schweinsberg 1984; Kolenosky and Prevett 1983; OMNR 1985; Lynch 1993; McDonald et al. 1997.**

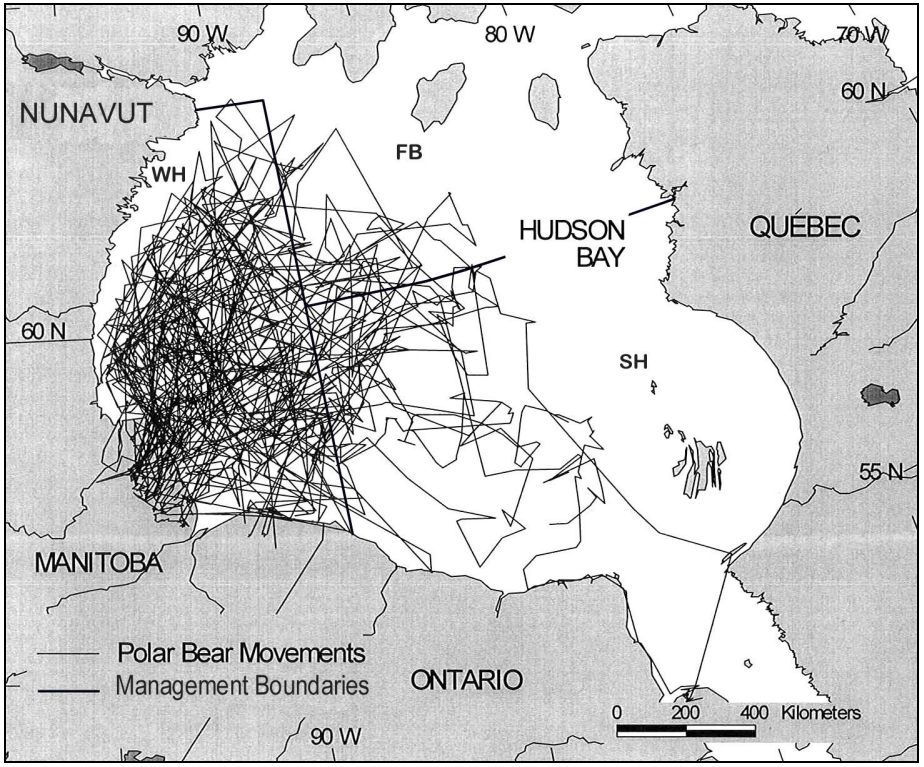

Figure 9-8. **Movements of 41 adult female polar bears tagged at Churchill through a total of 46 bear years, between 1991 and 1998 (modified from Stirling et al. 1999:298). Management boundaries for the Western Hudson Bay (WH) and Southern Hudson Bay (SH) populations, and part of the Foxe Basin (FB) population are shown.**

In late July and August, after the ice melts and the bears come ashore, the adult males tend to congregate on coastal capes and headlands, presumably to take advantage of the cooling onshore winds, while the family groups tend to move inland near the denning areas (Figure 9-7 and Figure 9-8; Stirling et al. 1977; Lunn and Stirling 1985; Derocher and Stirling 1990a,b; McDonald et al. 1997; Stirling et al. 2004). The daily movements of bears are less on land than on the ice (Derocher and Stirling 1990b). Radio-tracking collars are difficult to attach to male polar bears, so the seasonal movement patterns of female bears are better known. However, studies in the Beaufort Sea suggest that the distances moved by different age and sex classes of bears are similar during April through September (Armstrup et al. 2001).

Bears from the Southern Hudson Bay population (SH) spend their summers on the small islands in central and northern James Bay, on northern Akimiski Island, Long Island (Jonkel et al. 1976; McDonald et al. 1997), the outlying Belcher Islands, Twin Islands (Urquhart and Schweinsburg 1984; McDonald et al. 1997), and along the Ontario coast between Hook Point in James Bay and the Manitoba Border (Kolenosky and Prevett 1983; OMNR 1985). Akimiski Island is possibly the most southerly regular summering location used by polar bears in the world (Prevett and Kolenosky 1982). Between 1967 and 1980, late summer and fall counts found from 6 to 20 bears on the island, including females with cubs. Polar bears are rarely seen on the islands or mainland coast of southern James Bay (Jonkel et al. 1976; McDonald et al. 1997). Some animals may summer on islands adjacent to the Quebec coast.

Their seasonal pattern of onshore-offshore movements is similar to that of the Western Hudson Bay population, but the Southern Hudson Bay population appears to keep mainly to the James Bay-Hudson Bay Arc area (Jonkel et al. 1976; Kolenosky et al. 1992). Bears tagged near Cape Henrietta Maria have been recaptured north of the Belcher Islands, in northern James Bay, and to the west along the northern coast of Ontario. The area north of the Belcher islands is an extremely attractive habitat for male bears during the December to March period (Kolenosky et al. 1992).

Maternity denning areas have been confirmed southwest of Cape Henrietta Maria, on the Twin Islands, and on Akimiski Island (Doutt 1967; Jonkel et al. 1976; Stirling et al. 1977). The latter is the most southerly occurrence of reproducing polar bears in the world (Kolenosky and Prevett 1983). Maternity denning areas are suspected on the southwestern Belcher Islands, Nastapoka Island, and the Quebec mainland southeast of Cape Jones. In southern Hudson Bay and James Bay the physiological requirement of a female for a den may precede the development of suitable snow drifts in which a maternity den can be dug (Stirling and Ramsay 1986). Many bears dig earth dens initally and create snow dens similar to those in other areas of the Arctic later in the winter by burrowing into the overlying snowdrifts. They may leave the earth dens because of the need for adequate air exchange.

Coats and Mansel islands are important summer retreats for some bears from the Foxe Basin (FB) population that winter on the ice south of Southampton Island (Stirling et al. 1977; Kraft 1980; Crête et al. 1991; Gaston and Ouellet 1997). The coast of Wager Bay and the west and northeast coasts of Southampton Island are also important summer retreats for this population (Donaldson and Heard 1981; Furnell 1981). Denning is known or suspected near the south coast of Wager Bay, along the northeast coast of Southampton Island, on Mansel and Coats islands, and in northwest Quebec (Urqhart and Schweinsburg 1984). In winter, bears north of Southampton Island frequent the landfast ice along the southern half of Melville Peninsula. Polar bears move to and fro between eastern Southampton and northern Mansel islands and the northeastern coast of Labrador (Stirling and Killian 1980).

9.7.2 Biology

Polar bears live between 20 and 25 years (DeMaster and Stirling 1981). Adult male bears weigh 300 to 800 kg and are 200 to 250 cm in length from nose to tail; females are smaller, 150 to 300 kg and 180 to 200 cm.

Bears from the Southern Hudson Bay population are among the largest known (Kolenosky et al. 1989). During the period of ice cover the polar bears eat mostly ringed and bearded seals. Indeed, these seals make up an average of 96% of the diet of the Western Hudson Bay bears sampled (Iverson in Calvert et al. 2002). As top-level carnivores, they are susceptible to the accumulation of contaminants from their diet and vulnerable to changes in the availability of seals (see also Chapter 16). Bears using James Bay and Hudson Bay may be particularly vulnerable to the effects of changes in the duration and quality of the ice cover (Stirling and Derocher 1993; Stirling et al. 1999) (see also Chapter 17)

Polar bears in Hudson Bay and James Bay face a longer open water season and warmer summer than their counterparts in the High Arctic. This means that they must conserve their energy in summer to avoid starvation or overheating. Indeed, they spend most of their summer resting (Jonkel et al. 1976; Knudsen 1978). In 1969-70, bears on North Twin Island spent 86.8% of their time resting, 3.2% feeding, and the remainder travelling (Knudsen 1978). Their summer-autumn diet consisted primarily of geese (*Branta canadensis*) and crowberries (*Empetrum nigrum*). While their fat reserves will carry them through the summer (Lunn and Stirling 1985), polar bears will also eat a variety of small game, tundra berries and grasses, carrion, marine kelp and shellfish, stranded whales, garbage, and even members of their own species (Degerbøl and Freuchen 1935; Johnston 1961; Russell 1975; Jonkel et al. 1976; Miller and Wooldridge 1983; Lunn and Stenhouse 1985; Smith and Sjare 1990; Derocher et al. 1993; Smith and Hill 1996; Hobson and Sterling 1997; McDonald et al. 1997; Dyck and Daley 2002). Some bears in Wager Bay are able to catch seals during the open water season but this behaviour may be uncommon (Furnell and Oolooyuk 1980). Bears may occasionally kill walruses. The bears lose weight steadily from the time they come ashore until freeze-up in early November when they return to the sea ice to hunt (Stirling and Ramsey 1986).

Despite protracted periods away from the seals they depend upon for food, polar bears in Hudson Bay maintain a similar mean litter size to other bear populations (Derocher 1999) and reproduce more frequently (Ramsay and Stirling 1982; Kolenosky et al. 1992). The mean litter size for bears in Southern Hudson Bay is 2.04 (n = 161) and for bears in Western Hudson Bay is 1.84 (n = 274) (Derocher 1999). Females emerge with their cubs in late February to early April and return to the sea ice to feed (Jonkel et al. 1976; McDonald et al. 1997). While most polar bears wean their cubs after 2.5 years and have a 3-year breeding cycle, 40% of those in Hudson Bay wean their cubs after only 1.5 years and have a 2-year breeding cycle (Ramsay and Stirling 1982, 1986; see also Kolenosky et al. 1992). The litter size of females varies with age, increasing from maturity until 14 years of age and then decreasing (Derocher and Stirling 1994).

The higher reproductive rates in the Western Hudson Bay population have been associated with higher growth rates, but the reasons for the higher growth rates are unknown (Derocher and Stirling 1998). Female bears from this population breed for the first time between 3 and 5 years of age, and maintain high pregnancy rates from 5 to 20 years of age (Derocher et al. 1992). The average age at first breeding for female bears in western Hudson Bay is 4.1 years, by which time they have reached 97% of their asymptotic length, whereas females in other populations take between 4.5 and 5.5 years to attain the same proportion (Derocher and Stirling 1998). Breeding occurs in late March through May, but implantation of the fertilized egg may be delayed until between mid-September and mid-October; cubs are likely born from mid-November to mid-December (Derocher et al. 1992). Because female distributions on the ice are unpredictable males do not establish territories during the spring breeding season (Ramsay and Stirling 1986).

The use of earth dens by polar bears on the islands in James Bay and along the Manitoba and Ontario coasts of Hudson Bay is unique (Doutt 1967). The bears use two main types of summer dens, shallow depressions or pits and shallow burrows or dens (Doutt 1967; Jonkel et al. 1976). Pregnant females use most summer dens, although adult males occupy them occasionally in late summer and fall prior to freeze-up. The reasons for summer and fall use of earth dens are not fully understood. However, they are often dug down to permafrost, which keeps them cool and may help the bears avoid overheating, and they greatly reduce exposure

to insects (Stirling and Ramsay 1986). The bears, especially pregnant females, are extremely fat when they come ashore so that they may overheat easily in the relatively warm summer weather.

Hunting and aggressive interactions with other polar bears are likely the main causes of mortality among polar bears, although starvation and ice-related mortalities may also be significant—particularly among cubs (Urquart and Schweinsburg 1984; Derocher and Stirling 1996; Dyck and Daley 2002). Cub mortality is high between emergence in the spring and the following autumn, 0.99 cubs•litter^{-1} over the 25-week period (Derocher and Stirling 1996). Females that lose their litters will adopt orphaned cubs (Atkinson et al. 1996; Lunn et al. 2000).

These large predators are an important tourist attraction in Churchill, where tours are conducted to view them in fall before they return to the ice. Their seasonal presence is also an important aspect of Ontario's Polar Bear Provincial Park (OMNR 1980), and of the Churchill Wildlife Management Area (Teillet 1988).

9.7.3 Population Status and Protection

The International Agreement on the Conservation of Polar Bears and their Habitat, which was signed in Oslo, Norway in 1973, forms the action plan for polar bear management (Derocher et al. 1998). The IUCN/SSC Polar Bear Specialist Group (PBSG), which consists of research scientists from Canada, Denmark, Norway, USA, and the former USSR developed it. This group meets every 3-4 years to discuss and coordinate matters pertaining to the research and management of polar bears throughout their range (e.g., Derocher et al. 1998; Lunn et al. 2002b). The polar bear is listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). This designation is used for species that are not necessarily threatened with extinction but may become so unless trade in specimens is controlled. Consequently, there are international export restrictions on polar bear products. A federal permit is required if a bearskin is to be exported from the Province or Territory where it was killed.

In Canada, the polar bear is designated as a species of “Special Concern (formerly vulnerable)” by COSEWIC (Lunn et al. 2002a). This status was last examined and confirmed in November 2002. Species of special concern have characteristics that make them particularly sensitive to human activities or natural events that could lead to endangerment. Polar bears are listed as Special Concern under the Species at Risk Act (SARA), pending public consultation for addition to Schedule 1 (http://www.speciesatrisk.gc.ca). In January 1999, the Committee on the Status of Species at Risk in Ontario (COSSARO) listed the polar bear as ‘Vulnerable”.

Manitoba has legislated that the polar bear is a protected species (Lunn et al. 2002a; Scott and Stirling 2002). Preferred denning habitat of the Western Hudson Bay population is now contained largely within Wapusk National Park and the Cape Churchill Wildife Management Area. These WMAs have management plans under development that will control access to maternity denning areas and be beneficial for the survival of this population.

Recent estimates of the sizes, and assessments of the status, of the three polar bear populations found in Hudson Bay and James Bay are summarized in Table 9-2. Lunn et al. (1997) estimated the size of the Western Hudson Bay population in autumn 1995 at 1200 ± 250 animals using a mark-recapture study. The hunt sex ratio of 2 males: 1 female has resulted in a population composition that is 58% female and 42% male (Derocher et al. 1997). Southern Hudson Bay population, based on the resighting frequency (20%) of marked bears during late summer surveys, has been estimated at between 965 and 1095 animals, based on survey data from ca. 1990-96 (Calvert et al. 2002; see also Kolenosky et al. 1992). The current estimate of 2300 (SE = 350) bears in the Foxe Basin population was developed in 1996 from a mark-recapture program based on tetracycline biomarkers (Derocher et al. 1998).

Table 9-2. Current status of Hudson Bay polar bear populations (modified from Lunn et al. 2002a).

			5-year average (95-96 to 99-00)		
Population	**Estimate**	**Reliability[1]**	**Kill**	**% female**	**Sustainable harvest[2]**
Foxe Basin (FB)	2300	good	89.9	35.7	96.6
Southern Hudson Bay (SH)	1000	fair	45.4	36.2	41.4
Western Hudson Bay (WH)	1200	good	49.2	34.7	51.9

[1] Good = minimum capture bias, acceptable precision; fair = capture bias, precision uncertain.
2 Sustainable harvest is based on the populaiton estimate (N) for the area, estimated rates of birth and death, and the harvest sex ratio (Taylor et al. 1987): Sustainable harvest = (N x 0.015) / proportion of harvest that was female. The proportion of the harvest that was female is the greater of the actual value or 0.33.

Current harvests from the Western Hudson Bay and Southern Hudson Bay populations are believed to be sustainable (Lunn et al. 2002a). Aerial survey counts conducted annually from 1963 to 1996 show an increasing trend in the abundance of bears along the Ontario coast (Stirling et al. 2004). Similar surveys found bear abundance along the Manitoba coast to be increasing from 1963 to ca.1971, and stable from then until 1997. Past harvests reduced the Foxe Basin Population from about 3000 in the early 1970s to about 2300 (SE = 350) in 1996. The Nunavut harvest quotas have been revised to enable slow recovery of the population and co-management discussions with Quebec are ongoing.

Inuit observed an increase in the number of bears in southeast Hudson Bay between 1960 and 1990 (McDonald et al. 1997). They have also observed that polar bears throughout Hudson Bay show less fear of humans and dogs than in the past, and that those in the west and northwest are becoming increasingly aggressive and more dependent on foraging at dump-sites, camp sites, and meat caches.

9.8 ATLANTIC WALRUS *Odobenus rosmarus rosmarus*, Linnaeus, 1758

The walrus, called *aivik* in Inuktitut, is a large gregarious pinniped that is identifiable by its long canine teeth or tusks. It has a discontinuous Arctic and Subarctic distribution with distinct Atlantic and Pacific subspecies (Reeves 1978; Brenton 1979; Fay 1981, 1985). Some of the most southerly populations of Atlantic walrus are now found in southeast Hudson Bay and James Bay. Walruses are more common and abundant in northwest Hudson Bay, Hudson Strait and Foxe Basin (Richard and Campbell 1988; Mansfield and St. Aubin 1991).

Four distinct stocks of Atlantic walrus have been identified on the basis of distribution, genetic and lead isotope data in Canadian waters (Richard and Campbell 1988; Outridge and Stewart 1999; Stewart 2002; Outridge et al. 2003). Two of these, the South and East Hudson Bay Stock and the Hudson Bay-Davis Strait Stock, inhabit the Hudson Bay marine ecosystem (Figure 9-9). The former is distributed from the Ottawa Islands southward into western James Bay; the latter from Arviat north and east through Hudson Strait to Clyde River on the east coast of Baffin Island. These stocks may once have been contiguous and both may consist of sub-units that mix little or not at all. Within the South and East Hudson Bay Stock, the relationship between walruses in the Sleeper and Belcher archipelagos with those at Cape Henrietta Maria and inside James Bay is unknown. The Hudson Bay/Davis Strait Stock may consist of separate sub-stocks that inhabit northern Hudson Bay, Hudson Strait, and Davis Strait. Inuit have observed differences in body size and tusk length that are consistent with these separations, and further suggest that Chesterfield Inlet and Repulse Bay may not share the same walruses (Fleming and Newton 2003).

9.8.1 Distribution and Movements

In the absence of humans, Altantic walrus populations likely require large areas of shallow water (80 m or less) with bottom substrates that support a productive bivalve community, the reliable presence of open water over these feeding areas, and suitable ice or land nearby upon which to haul out (Davis et al. 1980). They are very

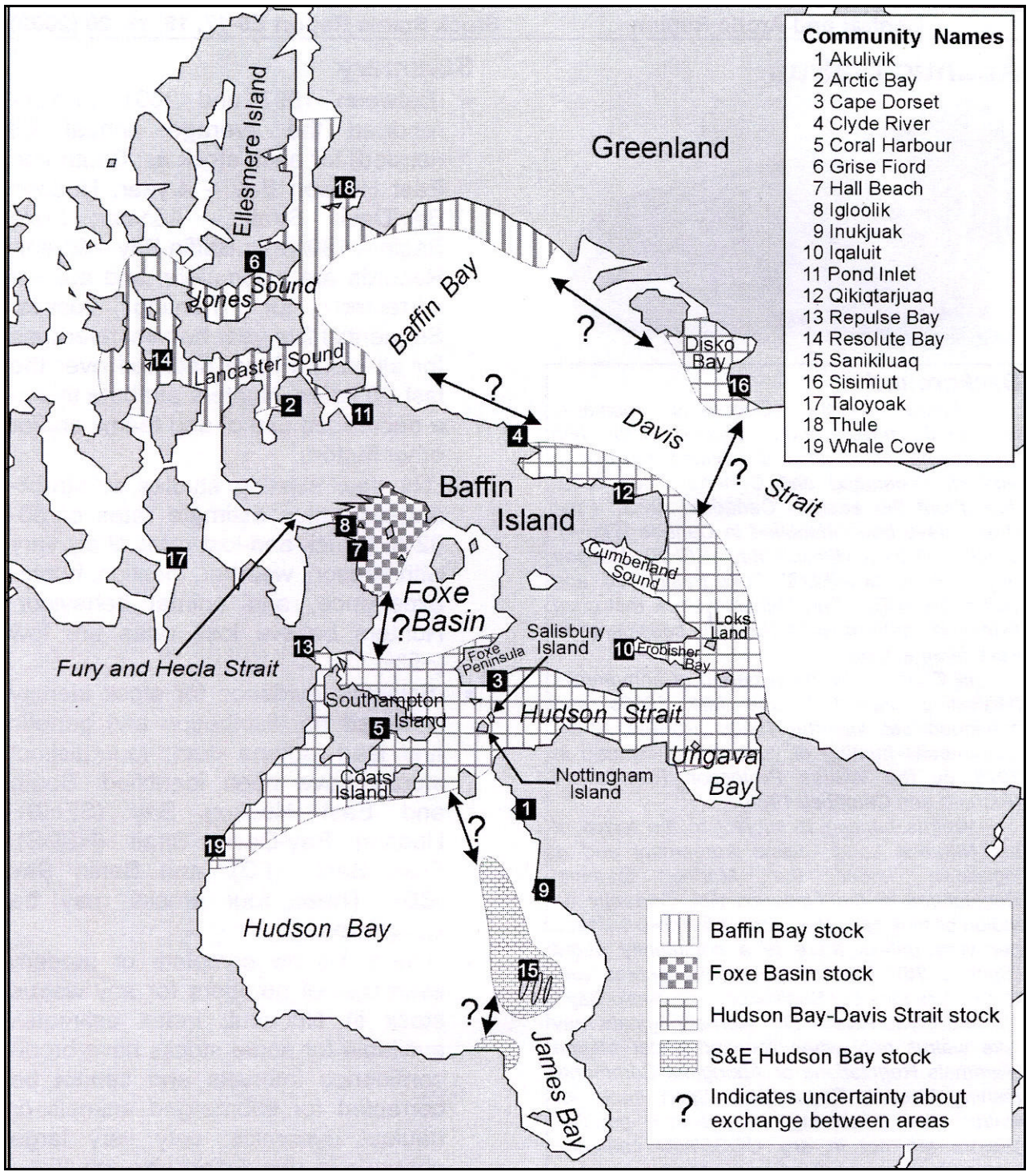

Figure 9-9. Map of the range and distribution of Atlantic walrus stocks in eastern Canadian waters (from DFO 2000).

gregarious and for most of the year are associated with moving pack-ice. In Hudson and James bays the scarcity of ice in summer and fall forces them to haul out on land where they tend to congregate in a few predictable locations (*uglit* or *ubliqvik* = resting place on land) (Mansfield 1973). Females with calves tend to be situated on the seaward side of the herd where protection from polar bear is greatest (Miller 1982; Miller and Boness 1983). *Uglit* are often situated on low, rocky shores with steep or shelving subtidal zones where the walruses have easy

access to the water for feeding and quick escape (Mansfield 1959; Miller and Boness 1983). They generally move to more sheltered areas when there are strong onshore winds and heavy seas (Mansfield 1959).

Inuit have contributed most knowledge of walruses in eastern Hudson Bay (e.g., Freeman 1964; Schwartz 1976; Reeves 1995a; Fleming and Newton 2003). In the northeast, walruses remain in the Ivujivik area year-round (Fleming and Newton 2003). *Akulik* and *Pilik* islands, which do not appear on maps, are important sites for these animals. In the early 1990s, Ivujivik hunters would go to *Akulik* when they did not see walruses elsewhere in winter. Walruses also winter in polynya kept open by strong currents around Nottingham Island and Salisbury islands, in Hudson Strait. They are seldom present in the Akulivik area in summer, but are seen there in the fall moving northward towards Hudson Strait (Fleming and Newton 2003). A single animal was harvested at Smith Island on the Quebec coast in 1989 (Olpinski 1990).

In southeast Hudson Bay, walruses were found, sometimes abundantly, in the Belcher, King George, and Sleeper islands (Flaherty 1918; Twomey 1939; May 1942; Manning 1946; Freeman 1964; Schwartz 1976). The species has not been common in recent years in the Belchers or along the east coast, and Inuit generally travel to the Sleepers Islands to hunt them in the fall. In 1993, however, walruses were re-occupying uglit in the North Belcher Islands and Inuit believed that local walrus population might be recovering (Z. Novalinga, Sanikiluaq Environmental Committee and P. Kattuk, Mayor of Sanikiluaq, pers. comm. 1993). There is a small population of walruses that summers on the Sleeper Islands (Loughrey 1959; Manning 1976; Olpinski 1990; Fleming and Newton 2003). They are on the floe ice in early summer (June and early July) and move ashore as the pack dissipates. Walruses are also present at the open floe edge west of the Sleeper Islands in winter (P. Kattuk, Mayor of Sanikiluaq and Z. Novalinga, Sanikiluaq Environmental Committee, pers. comm. 1993).

Walruses were once widely distributed in James Bay. In the east, they occurred south to the Paint Islands (Low 1906). They have not been seen near Chisasibi in recent years (Fleming and Newton 2003), but geographical names suggest that they may once have hauled out at "Walrus Point" and "Pte. du Morse" nearby. In the Wemindji area, at *Wiipichuutukuwiih*, walrus were once numerous and posed a hazard to paddlers. In 1992, willows covered the old depressions dug by walruses in the island's shoreline. Cree harvested walruses in the Wemindji-Waskaganish area until at least 1934. In the west, walruses occurred south to Attawapiskat (Fleming and Newton 2003). They were seen in the early 1960's on ice flows between Lakitusaki River (Lake River) and Bear Island (Johnson 1961), and in the 1970's at Ekwan Point (Fleming and Newton 2003). Residents of Attawapiskat noticed fewer walruses in their area in the early 1990's but report that they are present on the mainland between Akimiski Island and Ekwan River after spring breakup. They attribute this decrease to changes in the coastline resulting from postglacial uplift (Fleming and Newton 2003).

Walruses are present along the south coast of Hudson Bay west of James Bay. Shoals near Cape Henrietta Maria are an important haulout site for walruses between July and October (Clarke in Loughrey 1959; Johnson 1961; Abraham in Richard and Campbell 1988; C. Chenier, OMNR, Cochrane ON, pers. comm. 2003). In 1993, participants in the Hudson Bay Programme's Traditional Ecological Knowledge and Management Systems (TEKMS) study reported that there were lots of walruses in the Winisk (Peawanuck) area and that walruses had been seen in July in the Fort Severn area (Fleming and Newton 2003).

In western Hudson Bay, walruses have occurred south to Churchill and become increasingly numerous moving northward. They are rare at Churchill, where six were seen off the coast near Cape Churchill in October 1954 (Johnson in Loughrey 1959). They are seldom seen near Whale Cove but were numerous at islands near the community from 1942 to 1945 (Fleming and Newton 2003). Small groups of walruses are sometimes seen at the floe edge south to Whale Cove (Gamble 1988; Fleming and Newton 2003; H.E. Welch, DFO, Winnipeg, pers. comm. 1991). In 1993, participants in the TEKMS study said that walruses were more numerous in the Chesterfield Inlet area in the early 1990's than in the past (Fleming and Newton 2003). Walruses are absent near the community in summer, but do winter in the Chesterfield Inlet-Roes Welcome Sound area and are found on the other side of the inlet in the spring (Fleming and Newton 2003; H.E. Welch, DFO, Winnipeg, pers. comm. 1991).

They occur in Wager Bay when ice is minimal and Inuit indicate that they prefer areas with strong current. Walruses are common in the Repulse Bay area (Brice-Bennett 1976; Fleming and Newton 2003). They are seen less often when ice concentration remains high during the summer. The presence of walruses also depends on the strength of the current, which varies each summer. When the current is stronger walruses are sometimes only 40 miles away from Repulse Bay in the fall. They are sometimes seen at the floe edge in winter.

A relatively large walrus population summers immediately north of the study area in the Coats Island-Bencas Island-Evans Strait-Southampton Island area (Mansfield 1955, 1958; Loughrey 1959; Welland 1976; Orr and Rebizant 1987; Mansfield and St. Aubin 1991; P. Richard, DFO, Winnipeg, pers. comm. 2003). Walruses overwinter near the south coast of Southampton Island and between Nottingham and Salisbury islands (Orr and Rebizant 1987).

While walruses can travel long distances by swimming or by riding ice floes, their seasonal movements in Hudson Bay are poorly known. Inuit from Akulivik and Ivujivik have observed walruses moving northward from Hudson Bay into Hudson Strait in the fall (Figure 9-10; Reeves 1995a; Fleming and Newton 2003). However, there is no evidence for a concerted movement of walruses into or out of southeastern Hudson Bay. Instead, there are local seasonal movements between the rocky sites where they haul out during the ice-free period and

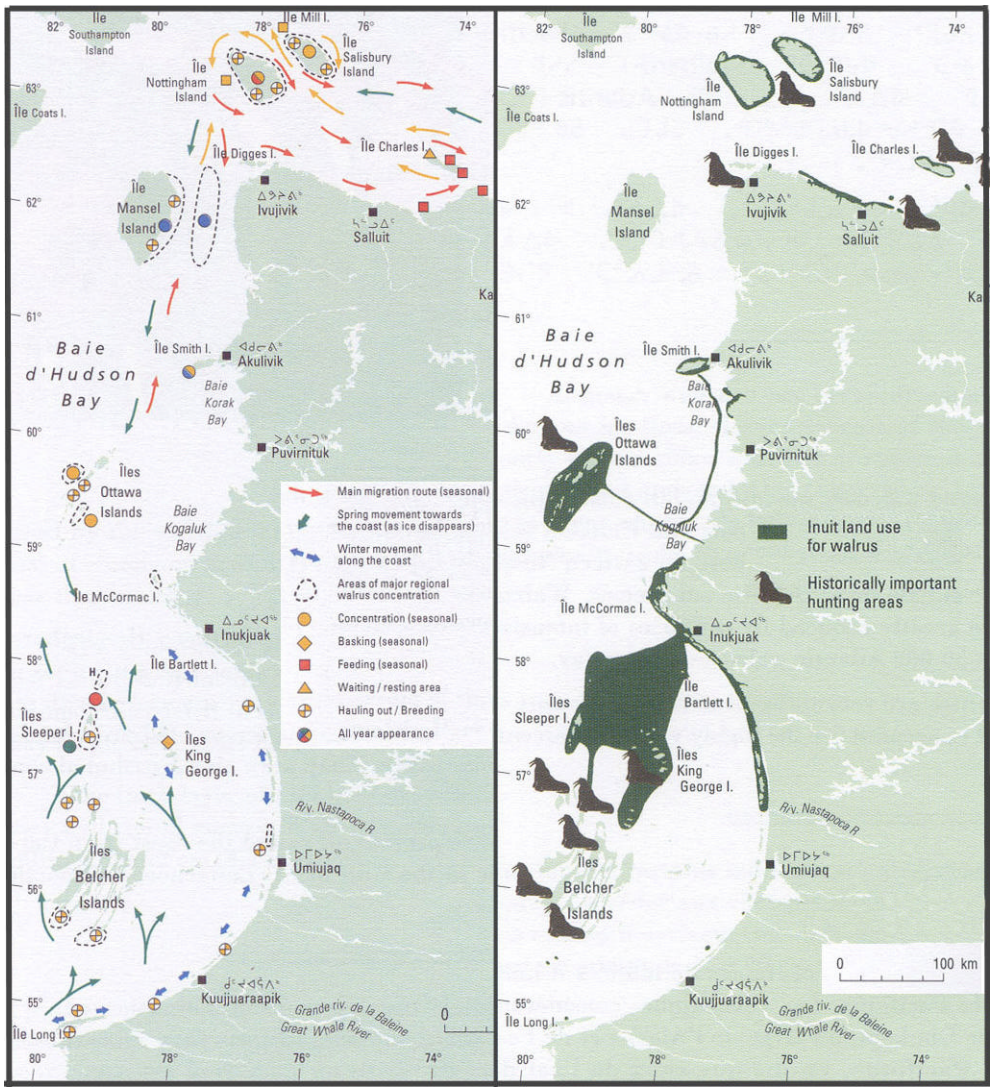

Figure 9-10. Inuit ecological knowledge (left) and regional land use and historical distribution (right) of walruses in south and east Hudson Bay (adapted from Reeves 1995a).

overwintering areas (Freeman 1964). In both the Belcher and Sleeper archipelagos, walruses stay at the floe edge during winter and move into the islands shortly after break up (Fleming and Newton 2003). Hunters report a seasonal movement of walruses around Coats, Walrus, and Southampton islands and between Foxe Peninsula and Nottingham and Salisbury islands (Orr and Rebizant 1987). They also describe a seasonal shoreward movement of walruses as ice conditions permit in the Repulse Bay and Coral Harbour areas in the fall (September) (Fleming and Newton 2003). On Akpatuqjuaq and Akpatuuraajuk islands (Mansel and Coats islands) walruses migrate to their uglit in springtime and disperse in the fall.

9.8.2 Biology

The biology of the walrus in the Hudson Bay ecosystem is poorly documented. Elsewhere, most walruses inhabit areas where water is less than 80 m to 100 m deep and they can dive to the bottom to feed (Vibe 1950; Fay 1985). Most feeding is done at depths of 10 to 80 m (Vibe 1950; Mansfiled 1958; Born et al. 2003) and some dives can take 24 minutes (Gjertz et al. 2001). Walruses are grazers rather than diggers, locating their benthic prey with their tusks and vibrissae and then rooting into the mud with their snout (Loughrey 1959; Fay 1981). Pelecypods, particularly *Mya truncata*, are their main prey, but many other invertebrates, fishes, the occasional seal, and even birds are also eaten (Degerbøl and Freuchen 1935; Vibe 1950; Mansfield 1958; Loughrey 1959; Fisher 1989; Reeves 1995a; Fleming and Newton 2003). In winter, walruses in the Repulse Bay area try to get close to the land for access to feeding areas (Fleming and Newton 2003).

Their low reproductive rate makes walruses vulnerable to over-harvesting and environmental perturbations. Walruses are polygynous and while males are gregarious out of the breeding season they compete intensely for the females during the mating season (Fay 1981; Sjare and Stirling 1996; Sjare et al. 2003). Mating occurs on the ice in mid-winter and as a result reproductive behavior is not well known (Fay 1985). Females mature between the ages of 5 and 10 years and give birth once every three years on average (Mansfield 1958; Born 1990; Garlich-Miller and Stewart 1999). Young are born in May or June, after a gestation period of 15 or 16 months, and suckle for up to 2 years (Fay 1985; Fisher and Stewart 1997). Calves moult in their first summer and during each summer thereafter (Mansfield 1958).

Male Atlantic walruses average 305 cm in length and have long, straight, stout ivory tusks; females average 250 cm in length and have smaller curved tusks (Mansfield 1958). Walruses may live 35 year and mature males can grow to over 1150 kg.

9.8.3 Population Status and Protection

As the number of whales in Hudson Bay dwindled towards the end of the last century whalers turned their efforts to harvesting other species, including large numbers of walruses (Low 1906; Degerbøl and Freuchen 1935). The large-scale commercial harvest and sport hunting of walruses was banned in Canada by an order in the Privy Council (P.C. 1036) in 1928 (see Mansfield 1973). There are no estimates of the level of exploitation, but the walrus population in the Canadian Eastern Arctic is apparently much reduced (Manning 1946; Schwartz 1976; Richard and Campbell 1988).

A comprehensive survey of walrus populations in Hudson Bay and James Bay has not been conducted. In the spring of 1955, a herd estimated at over 1000 animals was seen hauled out on the sandspit at Cape Henrietta Maria (Clarke in Loughrey 1959) and in September 1955, the captain of the Fort Severn saw a herd off the coast at Winisk (Loughrey 1959). Born et al. (1995), have questioned the accuracy of the former estimate, which was told to Clarke, and cautioned against its use in determining population trend. The Ontario Department of Natural Resources (DNR) has recorded opportunistic observations of walruses at shoals off the mouth of the "Brant River" since 1957 (C. Chenier, DNR, Cochrane, ON, pers. comm. 2003). Walruses have been seen on the shoals between July 20th and October 18th. The number of animals varies widely and no trend is apparent in the

population. High counts recorded by Ontario DNR have ranged from 310 on 5/10/78 (dd/mm/yy; J.P. Prevett), to 204 on 9/9/83 (K.F. Abraham), to 330 on 8/9/86 (K.F. Abraham), to about 221 in August 1999 (C. Chenier).

In the late 1930's, Twomey and Herrick (1942) saw and hunted a herd they estimated at over 400 animals in the northern Sleeper Islands. Since then only smaller herds have been reported form the region. On 4 August 1971, Manning (1976) saw 75 walruses near the south end of the Sleeper Islands, and the next day saw 25 off the west coast of Kidney Island, largest of the Sleeper Islands. A herd of about 30 animals was seen at the Sleepers in October 1996; nine of these animals were harvested (Brooke 1997). In the summer of 1993, a herd of about 30 animals was seen in the Belchers directly north of Sanikiluaq during an aerial survey (J. Desrosier, Quebec, QC, pers. comm. 2003). Hunters report that there are fewer walruses near the community and on neighbouring islands now, than in the past (DFO 2000).

In the early 1990's walrus were reportedly numerous along the Ontario coast of Hudson Bay west to the Winisk (Peawanuck) area, and have been seen in July in near Fort Severn (Fleming and Newton 2003). This coastline may provide a refuge for the population, since Cree hunters do not have a well-developed tradition of hunting walruses and take few animals (Johnston 1961).

Richard and Campbell (1988) and Born et al. (1995) estimated the size of this population at 410+ and 500? animals, respectively. Both of these estimates were tentative and based on a few sightings in a wide geographical area over a long period. Taking the largest direct counts of the past decade or so, as did Richard and Campbell (1988), yields an updated estimate of 270+ animals (Stewart 2004b). While this suggests a decline, data are too few to assess whether one has occurred.

Aerial survey counts of walruses in the northern Coats Island, Walrus Island and southeast Southampton Island area of northern Hudson Bay were conducted in July or August of 1954 (Loughrey 1959), 1961 (Mansfield 1962), 1976-77 (Mansfield and St. Aubin 1991) and 1988-90 (Richard 1993b). They produced maximum counts, respectively, of 2900 (Loughrey 1959: 80), 2650 (Mansfield 1959; 46), 2370 (Mansfield and St. Aubin 1991: 97), and 1376 (Richard 1993b: 7) walruses. These numbers are conservative, as they are not based on systematic surveys of the entire area and were not corrected for animals missed by the observers. While they suggest a declining trend, care must be taken in interpreting these data given differences in survey methods and ice coverage, and wide fluctuations in the numbers of animals hauled out at any particular time. Richard's (1993b) counts in 1988-90, for example, were above the average of the daily counts in 1976 and 1977. On Coats Island, Gaston and Ouelett (1997) counted about 600 animals at Cape Pembroke on 7 August 1992 and about 500 at Cape Prefontaine on 31 July 1995. Hunters from Coral Harbour have reported an increase in the number of walruses near their community over the past 10 years (DFO 2000).

Walruses were more common and numerous along the west coast of Hudson Bay between Arviat and Chesterfield Inlet in the past (Loughrey 1959; Born et al. 1995). They are now found mostly in the area north of Chesterfield Inlet. They have abandoned various *uglit* in western Hudson Bay but hauled out in small numbers in summer at Bibby Island (61°53'N, 93°05'W), Term Point (62°08'N, 92°28'W), Little Walrus Island (in Mistake Bay), Sentry Island (61°10'N, 93°51'W), Wag Island (63°23'N, 90°38'W), Marble Island (62°41'N, 91°08'W), and Fairway Island (63°15'N, 90°33') as recently as the 1950's (Low 1906; Degerbøl and Freuchen 1935; Loughrey 1959; Reeves 1978; Born et al. 1995; DFO 2000; Fleming and Newton 2003) (Figure 9-11). Small groups of walruses are sometimes seen at the floe edge south to Whale Cove (Gamble 1988; Fleming and Newton 2003). They are uncommon in the area but were numerous at islands near the community from 1942 to 1945 (Fleming and Newton 2003). Inuit report that walruses were more numerous in the Chesterfield Inlet area in the early 1990's than in the past (Fleming and Newton 2003). No counts are available for this region.

Inuit around Hudson Bay have linked the disappearance of walruses from traditional harvesting areas variously to poor and wasteful harvesting techniques, to harvest rates that are too low to stimulate an increase in the reproductive rate, and to natural shifts in the species' distribution (Fleming and Newton 2003). In the past,

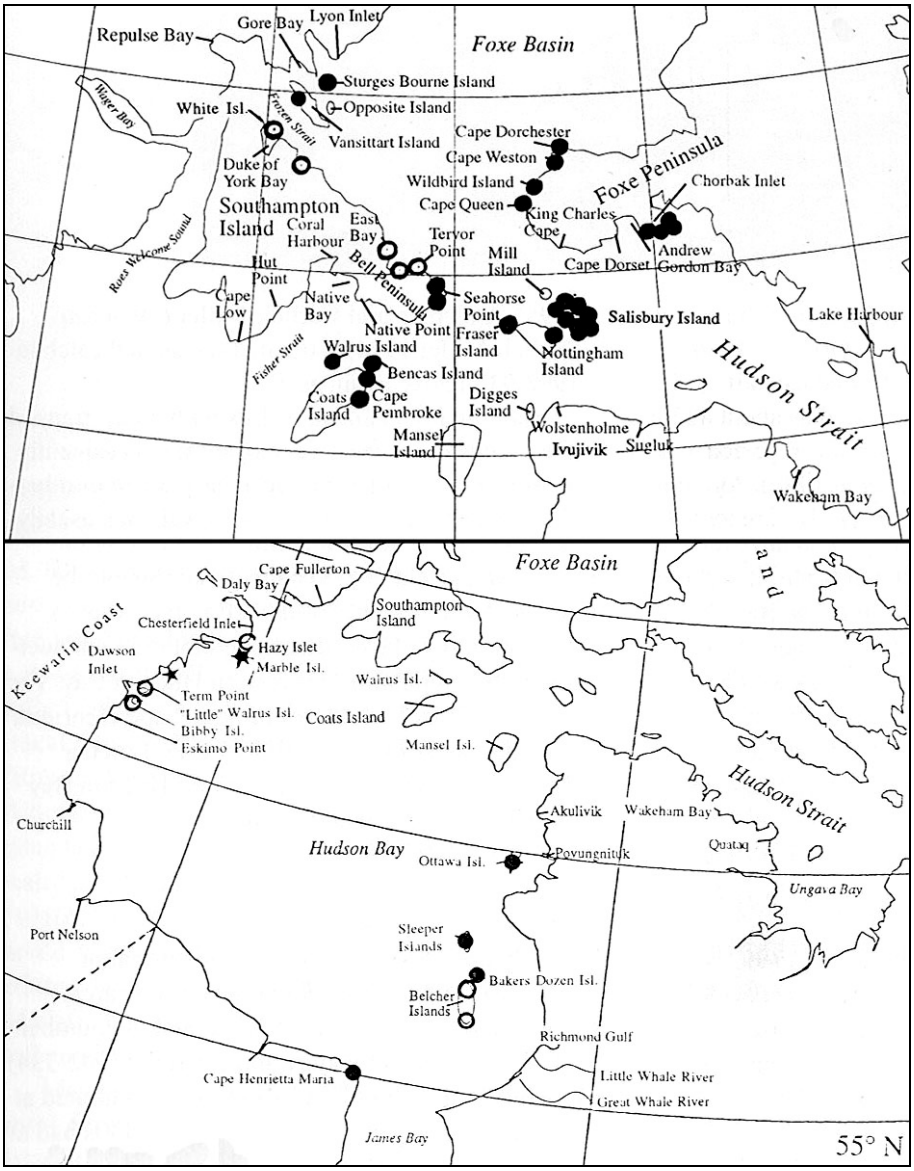

Figure 9-11. Locations of terrestrial haulouts (uglit) in northern Hudson Bay and Hudson Strait (top) and in southern, eastern, and northwestern Hudson Bay (bottom; adapted from Born et al. 1995). Legend: Black dots = haulouts still known or beleved to be used by walruses. Open circle = historical haulouts; present status unknown. Stars = Abandoned haulouts.

unregulated harvesting from motorboats disturbed animals at haulouts in the Belchers, Sleepers, and along the west coast of Hudson Bay, possibly with high mortality. Walrus remains were also discarded at the haulouts and, together with sinking losses, tainted both the haulouts and feeding grounds causing the walruses to leave the area. Inuit recognize the sensitivity of walruses to habitat disturbance and the mortality of other walruses in their traditional knowledge.

> *"When I was growing up, I remember, my father and the others used to say never try to kill a walrus where you think it will sink right into the feeding areas, or never cut up the walrus where they usually bask or rest. The elders used to say never to leave the guts near the islands where they bask. If you do that the walrus will move away from there."(Zach Novalinga, Sanikiluaq).*

In contrast, eastern Hudson Bay Inuit have suggested that population declines may be the result of too few walruses being killed for food to keep the reproductive rate high (Fleming and Newton 2003).

The disappearance of walruses from an area may not indicate a decline in the population but rather movements in search of richer feeding grounds or better haulouts (Fleming and Newton 2003). Likewise, their occupation of sites where they were seldom seen in the past, such as *ullikuluk* near Coral Harbour in 1993, does not necessarily indicate an increase in population. Changes in the coastline have made some island haulouts in the Winisk area part of the mainland coast, reducing their use by walruses. Declining use of habitat in the Attawapiskat area has also been attributed to coastal changes but increased boat traffic may also be a contributing factor.

COSEWIC has not assigned a status to Atlantic walrus populations in Hudson Bay and James Bay (Richard and Campbell 1988) but a status update is ongoing (Stewart 2004b). Careful population management involving native harvesters is required for conservation of the existing populations (see also Chapter 14). The Atlantic walrus is listed on Appendix III of the Convention on International Trade in Endangered Species (CITES).

9.9 BEARDED SEAL *Erignathus barbatus* (Erxleben, 1777)

The bearded or squareflipper seal is a large, solitary seal with a continuous circumpolar distribution in Arctic and Subarctic waters (McLaren 1958a; Mansfield 1967a; Burns 1981; Cleator 1996). The species is distributed widely in Hudson Bay and James Bay, where it is resident year-round. Individuals can be distinguished from other Arctic seals by the absence of color patterns on the body, presence of long white whiskers, square foreflippers, and habit of swimming at the surface with their back out of the water. They are much less abundant than the ringed seal, and may be limited by dependance on areas of high benthic productivity for food (Mansfield et al. 1975).

9.9.1 Distribution and Movements

Bearded seals prefer areas of moving pack ice and open water where the water depth is less than 150 to 200 m, but they sometimes maintain breathing holes in landfast ice or occupy deeper areas (McLaren 1958a; Mansfield 1967a; Smith 1981; Cleator 1996). They are relatively sedentary but may move between coastal and offshore areas in response to ice changing conditions. They typically occur alone or in small groups and their distribution is patchy and has relatively low density. Aggregations of bearded seals are most likely during the winter months prior to breakup and during early summer when the availability of ice pans for haulout is limited. During the open water period they will enter estuaries and haul out on land, sometimes in the company of harbour seals (Remnant 1997; Bernhardt 1999a, 2000a).

9.9.2 Biology

Bearded seals generally grow to an average of 2.1 to 2.4 m in length and can weight over 350 kg (Burns 1981; Smith 1981; Cleator 1996). Smith (1981) found that females mature between age 4+ and 7 years and that most reproduce annually, while McLaren (1958a) found that they mature at age 6+ years and breed biennially. Breeding likely occurs between mid-April and late May, and implantation is delayed about two months (Smith 1981). The single pups are born on the ice in April or May and abandoned after 12 to 18 days of nursing (Mansfield 1967a; Burns 1981; Smith 1981). They can swim immediately after being born and begin to feed independently immediately after weaning. These seals can live about 31 years (Benjaminson 1973), and a 25 year-old female was taken at the Belchers (Smith 1981).

The most important food items of bearded seals in the Belcher Islands are decapod crustaceans, pelecypod molluscs and fish, mainly Arctic cod (*Boreogadus saida*) (Smith 1981). Prey selection may be based on prey availability, so their diet may vary within a relatively small area and over a short period (Antonelis et al. 1993). Their long whiskers, or vibrissae, are sensitive to touch and are used to locate benthic prey. Hunting and predation by polar bears are likely the main causes of mortality among bearded seals, which are stalked when they haul out on the ice to nap (Sutton and Hamilton 1932; Stirling and Archibald 1977). Bearded seals are

uncommon in areas frequented by walruses, suggesting that there is either inter-specific competition for benthic prey or predation by walruses (Cleator and Stirling 1990).

The bearded seal is one of the least visible of the Canadian Arctic phocid seals, but is the most actively vocal, with a varied underwater repertoire (Smith 1981; Cleator et al. 1989; Terhune 1999). The frequency-modulated sounds are often heard where no bearded seals are observed (Smith 1981).

9.9.3 Population Status and Protection

McLaren (1962) estimated the bearded seal population of the Belcher Islands at 13,050 animals. This estimate was not based on systematic survey data. Smith (1975) and Simard et al. (1980) saw few bearded seals during their late May surveys of southeast Hudson Bay and James Bay for ringed seal. Aerial systematic strip transect surveys have been conducted for these species in western Hudson Bay. The areas surveyed in 7-14 June 1994 and 1-4 June 1995 extended north from the Nelson River estuary to Rankin Inlet and offshore to 90º W longitude (Lunn et al. 1997). In 1994, the bearded seal population was estimated at 12,290 (SE = 2520) with a density of 0.122 seals·km² of ice; in 1995, it was estimated at 1,980 (SE = 560) with a density of 0.024 seals·km² of ice. The widely different estimates may be related to differences in the timing of the surveys. Additional survey work was conducted in 1997, 1999, and 2000 (Calvert et al. 2002) but the results are not yet available (N. CWS, Edmonton, pers. comm. 2004).

The species has not been assigned a status under the CITES or by COSEWIC (Cleator 1996).

9.10 HARBOUR SEAL *Phoca vitulina* Linnaeus, 1758

The harbour seal is distributed along the entire length of Canada's east and west coasts and is widely distributed in the eastern Canadian Arctic and Subarctic (Mansfield 1967a+b; Bigg 1981). Small, local populations occur sporadically around the coasts of Hudson and James Bay, and there are resident populations in some fresh water drainages of the Hudson Bay watershed. The adults tend to be sedentary, and inhabit areas that have open water year-round. They tend to be solitary in the water but form small groups when hauled out on rocky shores.

9.10.1 Distribution and Movements

There are small resident populations of harbour seals along the coasts of Hudson Bay and James Bay in isolated localities where tidal rips, swift current, and river outflows keep small areas ice free throughout the winter--many of these areas are estuaries (Doutt 1942; Mansfield 1967a+b; Welland 1976). Some harbour seals also inhabit the floe edge in winter (Welland 1976). Seals that winter in fresh water in the Lacs des Loups Marins area take advantage of open water but may also use under-ice shoreline shelters caused by lowered water levels (Smith and Horonowitsch 1987). These areas may provide important resting sites for seals and protect them from low temperatures and predators.

Harbour seals like fresh water and have also been found well inland in summer in Ennedai Lake (Mansfield 1967b) and the Thleiwaza River system in Nunavut (Beck et al. 1970). Seals, probably harbour seal, also occur in Manitoba's Seal River system inland to Stony Lake and are common in Shethanei Lake (G. Dodds, Parks Planning Consultant, Winnipeg, pers. comm. 1991). Baker (1989) observed harbour seals in the Nelson River estuary from 5 July to 6 October when observations ended. They are also common in the Churchill River, from the estuary to the upper end of Long Island, 55 km upstream from the river mouth (Remnant 1997). They are present in fresh water immediately upstream of the water level enhancement weir from mid-May through at least mid-October (Remnant 1997; Bernhardt 1999, 2000). There are resident harbour seal populations in the Upper and Lower Seal Lakes on the Nastapoka River (Doutt 1942; Power and Gregoire 1978) and in Kasegalik Lake on Flaherty Island in the Belchers (Freeman 1964; Manning 1976).

There is no evidence for migrations of harbour seals from the Atlantic into the Hudson Bay, or for migrations of animals from the Seal Lakes in Quebec to or from the sea (Mansfield 1967b). Seals apparently occupy Lower Seal Lake year-round, wintering near rapids at the mouth of the outlet (Doutt 1954), and have modified the lake's fish community through their predations (Power and Gregoire 1978). Mansfield (1967b) suggests that watersheds may have been a favoured summer resort for wandering young harbour seals, a few of which may have remained in the Upper and Lower Seal Lakes. With the advent of the high-powered rifle the coastal harbour seals may have been heavily exploited, resulting in the virtual isolation of the lake seals.

In the Belchers, harbour seals do ascend the Kasegalik River in summer (Freeman 1964). Their favorite haulouts include small rocky outcrops in Kasegalik Lake, islets in the Kasegalik River, and some deep inlets on the southwest coast. "Kasegalik" means the place of harbour seals (Manning 1946).

Based on their jaw measurements and dark pelage, Doutt (1942) suggested that the seals in Upper and Lower Seal Lakes represent a distinct subspecies, *P. v. mellonae*, which had developed since the lakes were isolated by post-glacial emergence. Mansfield (1967b) believed this to be unlikely, since there is overlap in the jaw measurements with the other subspecies *P. v. concolor*, dark pelage is common among Arctic harbour seals, and there are a number of routes by which the seals might have entered the lakes in recent years. However, molecular genetic differences suggest that the two subspecies may be reproductively isolated (Smith and Lavigne 1994).

9.10.2 Biology

Adult harbour seals of both sexes average about 150 cm in length and 90 kg in weight (Mansfield 1967a). They are bluish-grey on the back and belly with a faint pattern of white markings. In the Arctic, the females mature at age 2 to 5 years and breed annually, giving birth to a single pup, on land, in late June or July (Bigg 1969, 1981). Twomey and Herrick (1942) found afterbirth on a rock at Kasegalik Lake on Flaherty Island. The presence of current year pups at the Churchill River estuary in the fall of 1996, suggests that pupping also occurs in the Churchill area (Remnant 1997). Pups are precocious in their swimming habits since they must often take to the water before the next tide covers their birthplace (Mansfield 1967a). They are abandoned after a lactation period of 2 to 6 weeks and can live for 30 years (Bigg 1981). Young harbour seals can undertake migrations of 1,475 km (Beck 1983) and for this reason the species is also known as the ranger seals.

Little is known of the Arctic marine diet of the harbour seal, but elsewhere it preys upon a wide variety of inshore fishes, squids, and crustaceans (Bonner 1979; Bigg 1981). The species will eat lake trout and whitefish when in freshwater (Beck et al. 1970). Dodds (pers. comm.) observed seals, probably harbour seals, catching Arctic grayling in rapids on the Seal River. Eagles and foxes prey upon newborn seals, while sharks, killer whales, polar bears, and walruses prey upon the adults (Bonner 1979). Harvesting is likely one of the greatest causes of mortality among these seals (see also Chapter 14).

Blasting activities during construction of the weir across the Churchill River caused harbour seals to leave their haulouts and enter the water (Bernhardt 1999a). It did not displace them permanently from the haulouts; they would swim in the area and sometimes hauled out again within 5 minute of the blast. They appeared to habituate to the frequent airboat traffic on the river but would enter the water if a boat stopped nearby and haul out again when it left. They would approach to within 50 m of construction personnel working on the weir. Inundation of their pre-project haulout about 500 m upstream of the weir, caused the seals to relocate to another haulout in the reach of river within 1 km downstream (Bernhardt 2000a).

While little is known of harbour seals in Hudson Bay and James Bay, the University of Alberta and Canadian Wildife Service are currently studying the biology of the species in the Churchill area (W. Bernhardt, North/South Cons. Inc., Winnipeg, pers. comm. 2004).

9.10.3 Population Status and Protection

The number of harbour seals in Hudson Bay and James Bay has not been estimated. Use of the Churchill River estuary by harbour seals was studied during the summers of 1996 through 1999 to assess possible effects of the Lower Churchill River Water Level Enhancement Weir Project (Remnant 1997; Bernhardt 1999a, 2000a). In 1999, up to 21 seals, mostly harbour but some bearded, were hauled out at once; these numbers fluctuated on a daily and seasonal basis.

Estimates of the freshwater harbour seal population in the Lacs des Loups Marins area are imprecise and range from 100 to 600 animals (Smith 1996, 1997).

COSEWIC designated the Atlantic subspecies of the harbour seal *P. v. concolor* as data deficient (formerly indeterminate) in April 1999; on the basis that insufficient information was available to determine the status (Baird 2001). The Lacs des Loups Marins subspecies *P. v. mellonae* was designated special concern (formerly vulnerable) in April 1996, on the basis of its limited range and low numbers which make it vulnerable to human impact and natural catastrophic events (Smith 1997). Freshwater seals north of the 55th parallel are listed as protected species under the James Bay and Northern Quebec Agreement; however, this protection does not have the force of law (Gunn in Smith 1996).

Harbour seals are not listed under CITES, so international trade in products from the species is not monitored or regulated (Baird 2001). The IUCN has designated the species as “insufficiently known”, meaning that it is “suspected but not definitely known to be endangered, vulnerable, or rare due to a lack of reliable information”

9.11 RINGED SEAL *Phoca hispida* (Schreber, 1775)

These small seals have a wide distribution in seasonally and permanently ice-covered waters of the Northern Hemisphere (Frost and Lowry 1981). The ringed seal is the most common and abundant species of seal in Hudson Bay and James Bay, where it is resident year-round (Smith 1975; Sergeant 1986).

9.11.1 Distribution and Movements

Ringed seals occur in water of virtually any depth and their distributions likely are driven primarily by food availability and ice conditions (Reeves 2001). During the winter, adult ringed seals generally occupy stable landfast ice where they maintain a number of breathing holes by abrading the ice with the claws of their fore flippers, and build subnivean lairs in which to haul out and/or pup (McLaren 1958b; Frost and Lowry 1981; Smith 1987; Smith et al. 1991). The ability to maintain holes through the ice throughout the winter enables them to occupy large areas of the Arctic that are inaccessible to other marine mammals except during the summer (Davis et al. 1980). In spring, the highest densities of breeding adults occur on stable landfast ice in areas with good snow cover, whereas non-breeders occur at the floe edge or in the moving pack ice (Smith 1975; Holst et al. 1999). Jonkel (in Smith 1975) found significant numbers of ringed seals in the very centre of Hudson Bay in March 1972.

In their breeding habitat ringed seals are strongly territorial (Smith 1987). They can often be seen in spring when they come out onto the ice beside their breathing holes to bask in the sun and moult their hair coat (Mansfield 1967a; Manning 1976). During the open water season seals of all ages are found nearshore (Frost and Lowry 1981). They tend to be solitary except during the moulting season (Stirling and Calvert 1979).

Little progress has been made in identifying stocks of ringed seals, and the patterns of movement and degree of genetic interchange between areas are not well known (Frost and Lowry 1981; Reeves 2001). While the species is generally assumed to be sedentary, individuals will move over 1300 km in a season (Smith 1987;

Teilmann et al. 1999). General mass movements have not been documented in Hudson Bay and James Bay but seasonal changes in distribution related to the presence and quality of ice are likely.

9.11.2 Biology

Adult ringed seals average 125 cm in length and 65 kg, and are identifiable by characteristic ring-shaped color patterns on their body fur (Stirling and Calvert 1979). The average lifespan is probably between 15 and 20 years (Frost and Lowry 1981) but individuals may live to age 43 years (McLaren 1958b). Females first become pregnant between the age of 4 and 7 years and generally breed annually (Frost and Lowry 1981; Holst et al. 1999). Breeding takes place in mid to late May, and implantation is delayed for about 3 months (Reeves 2001). Pups are born singly in snow lairs between late February and early April, and the nursing period is partly dependant on ice stability (Figure 9-12; Cleator 2001; Reeves 2001). Pups in subnivean birth or haul-out lairs with thin snow roofs are more vulnerable to predators than those in lairs with thick ones (Smith and Stirling 1975). In the drift ice of the Sea of Okhotsk pups only nurse for about 3 weeks (Fedoseev 1975) while in the more stable ice areas they typically nurse for 5 to 7 weeks (Frost and Lowry 1981). During the nursing period pups double in weight and shed their wooly white coats. They are abandoned at ice break-up (McLaren 1958b; Frost and Lowry 1979).

Prior to the 1990's, recruitment rates of ringed seals in western Hudson Bay appeared to be related to the timing of spring breakup, which was correlated with the North Atlantic Oscillation (Ferguson et al. 2005) (see also Section 4.1.4). Studies in 1990-2001 suggest that decreased snow depth--particularly below 32 cm, possibly influenced by the timing of spring breakup, has had a detrimental affect on ringed seal recruitment in western Hudson Bay (Ferguson et al. 2005).

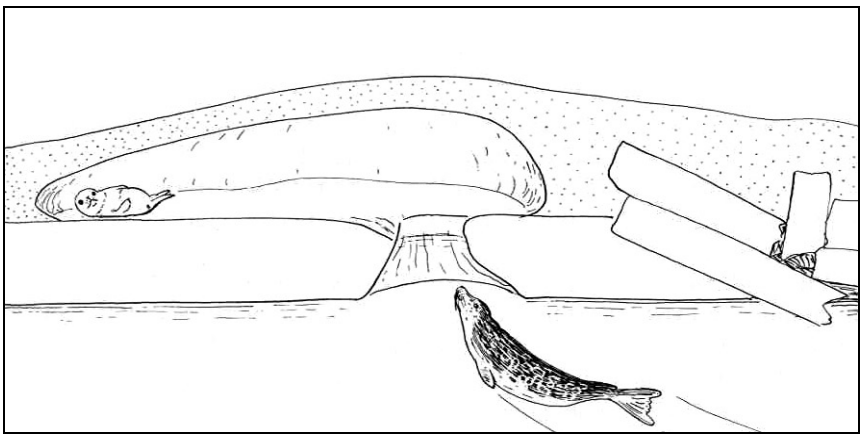

Figure 9-12. Ringed seal birth lair (from Mansfield 1968:380).

While ovulation rates among ringed seals sampled near Arviat in 1990-91 and 1991-92 were high, 100% and 83% respectively, the pregnancy rates were relatively low, 61% and 48% respectively (Holst et al. 1999). The reasons for these relatively low reproductive rates are unknown but poor feeding conditions may be a factor. Studies of the food habits of ringed seals in the Arviat area are ongoing (Calvert et al. 2002).

Ringed seals are adaptable in their feeding habits and eat a variety of pelagic, nectonic, and benthic invertebrates and fishes--particularly the amphipod *Themisto libellula* (synonym *Parathemisto libellula*), the mysid *Mysis oculata*, Arctic cod (*Boreogadus saida*), and sculpins (McLaren 1958b; Smith 1987; Weslawski et al. 1994; Cleator 2001). Unlike bearded seals they seldom eat burrowing invertebrates. In winter they take more benthic prey whereas during ice-breakup and in open water they take more pelagic prey (Weslawski et al. 1994). This may be a reflection of the seasonality of the pelagic invertebrate community. McLaren (1958b) observed a seal near Churchill diving to a depth of 26 to 28 m to feed on benthic decapods. Individuals can dive to a depth of at least 340 m (Innes in Reeves 2001:26). They can remain submerged for well over 20 minutes and dives to 250 m are not uncommon (Teilmann et al. 1999).

Polar bears are the main predators on ringed seals (Russell 1975; Stirling and Archibald 1977; Furnell and Oolooyiuk 1980; Smith 1980) but Arctic foxes are also important predators on newborn seals (Smith 1976,1987).

There is incidental predation by killer whales (Reeves and Mitchell 1988) and walruses (Vibe 1950; Mansfield 1958; Loughrey 1959). Hunting is also a major cause of mortality among ringed seals (see Chapter 14).

9.11.3 Population Status and Protection

Estimates of ringed seal populations are based mainly on aerial surveys conducted during the peak haulout and moulting period from late May to early July. Smith (1975) conducted an aerial survey of Hudson Bay between the 13th and 20th of June 1974. He saw an average of 1.48 seals·km^{-2} in the shorefast ice between Churchill and Chesterfield Inlet, 0.37 seals•km^2 in offshore areas containing consolidated pack made up of large ice pans, and 0.11 seals·km^{-2} for other offshore areas with greater amounts of broken ice and open water. Very low population densities of seals, 0.12 seals·km^{-2} near shore and 0.21 seals·km^{-2} offshore, were observed between Winisk and Churchill. Ice in this area was apparently unstable and unsuitable for haul-out or breeding. These densities do not account for seals that were under the ice. By doubling the observed densities to account for seals that were under the ice and multiplying each by the area of that ice type in Hudson Bay, he estimated that there were 455,000 ringed seals in Hudson Bay--including Roes Welcome Sound and waters south of a line between Seahorse Point and Cape Wolstenholme but not including James Bay. McLaren's (1958b) estimate of 218,300 ringed seals in roughly the same area did not account for seals in the offshore ice.

Smith (1975) found very low densities of ringed seals, 0.12-0.24 seals·km^{-2}, during a similar aerial survey of James Bay. This survey was conducted on 26 and 27 May 1974, when ice breakup was well advanced. Rather than use these densities, which he believed would underestimate the population, Smith (1975) extrapolated densities derived for the nearshore and offshore ice types in Hudson Bay to estimate a population of 61,000 ringed seals in James Bay.

Southeast Hudson Bay provides good ringed seal habitat since it has a large area of stable landfast and offshore ice in winter (see also Figure 5-6). The area between Long Island and Petite rivière de la Baleine was surveyed for ringed seals and their breeding lairs between the 20th and 30th of May 1978 (Simard et al. 1980). This aerial systematic strip-transect survey extended 40 km offshore and encompassed an area of 10,000 km^2. The area's ringed seal population was estimated at between 14,400 and 21,400 animals. Breeding lairs were common between Grande rivière de la Baleine and Petite rivière de la Baleine. Little is known of seals in Richmond Gulf, but Richard Couture (pers. comm.) saw breeding lairs and very many ringed seals during a low helicopter flight over the gulf in April.

Aerial systematic strip transect surveys have been conducted for ringed seals in western Hudson Bay. The areas surveyed in 7-14 June 1994 and 1-4 June 1995 extended north from the Nelson River estuary to Rankin Inlet and offshore to 90º W longitude (Lunn et al. 1997). In 1994, the number of seals hauled out on the ice in this area was estimated at 38,340 (SE = 3640) with a density of 0.381 seals·km^{-2} of ice; in 1995, it was estimated at 140,880 (SE = 8100) with a density of 1.690 seals·km^{-2} of ice. The widely different estimates may be related to differences in the timing of the surveys. These estimates are likely conservative because they are based on the number of seals hauled out on the ice and were not corrected for seals that were submerged. The total population of the area may be twice as large (Sterling and Øritsland 1995). Additional survey work was conducted in 1997, 1999, and 2000 (Calvert et al. 2002) but the results are not yet available (N. Lunn, CWS, Edmonton, pers. comm. 2004).

The species has not been assigned a status under the CITES or by COSEWIC (Cleator 1996).

9.12 HARP SEAL *Phoca groenlandica* (Erxleben, 1777)

The harp seal is common in the north Atlantic and adjacent Arctic regions from about 90^o east to 90^o west longitude (Ronald and Healey 1981; Lavigne and Kovacs 1988). In early May, large herds of harp seals begin their northward migration from whelping and moulting grounds in the Gulf of St. Lawrence and off the southeastern

coast of Labrador to summering areas in the eastern Canadian Arctic and off west Greenland (Sergeant 1965). While most continue northward into Lancaster Sound and Baffin Bay, some enter Hudson Strait and move westward into Foxe Basin and Hudson Bay (Mansfield 1967a). They are common in Hudson Strait before the shore ice leaves in spring, rare in summer, and common again in autumn after the shore ice forms (Low 1906).

Migrants are present in Hudson Bay from ice break-up in early June until just before freeze-up in early October (Sutton and Hamilton 1932; Mansfield 1968; Gamble 1984, 1987a+b, 1988). They occur south to Arviat in the west (Gamble 1984, 1987a+b, 1988) and Chisassibi in the east (Sergeant 1986), and are present during the open water season in the Belchers (Freeman 1964, 1967; Mansfield 1967a, 1970). Manning (1946) saw groups of six harp seals outside Inukjuak in mid-late July and at Gilmour Island, in the Ottawa Islands, in late August. Freeman (1964) reported that harp seals might pass offshore the Belcher Islands in the fall. In 1975, Cree from Chisasibi killed a small number of juvenile (young-of-the-year) seals, probably at Cape Jones (Sergeant 1976, 1986). The species is less common in Hudson Bay and James Bay than ringed or bearded seal, but may have been more numerous and widespread in the past (Bell 1884). As recently as the early 1970's harp seal were rare along the Kivalliq coast south of Rankin Inlet (R.E.A. Stewart, DFO, Winnipeg, pers. comm.). With the Atlantic population on the increase (Roff and Bowen 1986) the species may be re-occupying its former range. Hunters at Coral Harbour reported harvesting harp seals in January and February of 1984 (Gamble 1987a), suggesting that some may overwinter in the region.

These seals can grow to about 163 cm in length and 135 kg in weight (Mansfield 1967a), and live 30 years (Sergeant 1976). They have silver pelage with dark spots that fade with age to eventually give way to a dark saddle along the flanks and over the back, accompanied by a black face (Mansfield 1967a). Males are generally more boldly marked and may be darker all over at about 4 years, including being completely black (Stewart 1983). Females mature between 4 and 7 years of age (Sergeant 1976) and bear one pup annually thereafter (King 1964). Adults eat a variety of pelagic fish and pelagic and benthic Crustacea, and smaller amounts of benthic fish (Sergeant 1973). Their major cause of mortality is likely hunting by man (Davis et al. 1980) (see Chapter 14).

The number of harp seals using Hudson Bay and James Bay is unknown. The species does not have a CITES or COSEWIC designation, so there is no monitoring or restriction in the international trade in products from the species. Marine Mammal Export permits are, however, required from DFO to export seal parts from Nunavut.

9.13 HOODED SEAL *Cystophora cristata* (Erxleben, 1777)

The hooded seal is a rare summer visitor to Hudson Bay and perhaps James Bay. A single male was reported at the mouth of the Kaskattama River, Manitoba, in the fall of 1955 (Mansfield 1968), and Captain Ferris of the HBC ship Fort Garry shot what was probably a hooded seal on the ice of Cape Henrietta Maria sometime in the 1940's or 50's (Johnson 1961).

Hooded seals are generally found in Arctic and Subarctic regions of the North Atlantic (Reeves and Ling 1981; Kovacs and Lavigne 1986). They tend to occur farther offshore and occupy deeper water than harp seal, and to prefer thick drifting ice to fast ice (Sergeant 1974; Lavigne and Kovacs 1988). Adult males have an average standard length of 2.5 m and body mass of about 300 kg. They inflate their proboscis (hood) and extrude their nasal septum during threat displays. Females are smaller at 2.2 m and 160 kg and only have tiny hoods.

Hooded seals migrate northward from their wintering areas in the North Atlantic into Foxe Basin in July and return southward in September (Koski 1980; T. Qillaq, Clyde River, pers. comm. 1985). Presumably those in Hudson Bay and James Bay follow a similar schedule.

The species was examined by COSEWIC in April 1986 and designated “Not at Risk”. It has not been assigned a status designation under CITES.

9.14 SUMMARY

The extreme southerly presence of Arctic marine mammals is characteristic of the Hudson Bay marine ecosystem. Walruses, ringed seals, bearded seals, and harbour seals are resident in the waters year-round, while Arctic foxes and polar bears frequent coastal areas in summer and ice habitats during other seasons. The quality, extent and duration of the sea ice cover are vitally important determinants of their seasonal distributions, movements, and reproductive success. Heavy pack ice and landfast ice limit which species can survive and where they winter and reproduce. Some walruses remain at the ice edge or in the pack ice over the winter, while others move northeast into Hudson Strait. The duration of ice cover determines how long polar bears can hunt seals and whether seals can successfully reproduce and moult. While polar bears and Arctic foxes use these ice environments as a platform upon which to travel and hunt seals, the other species must maintain access to the surface to breathe.

The resident seal species move on or offshore to access seasonally preferred ice habitats. Ringed seals, and occasional bearded seals, are the only animals that can maintain breathing holes through the mature landfast ice. They use it as a stable platform upon which to haul out, build birth lairs, pup, and moult. They also inhabit consolidated and open pack ice, as do bearded seals and walruses. Harbour seals frequent areas where currents maintain open water year-round, typically in freshwater or estuarine rapids or small coastal polynyas or at the ice edge. Their reliance on ice makes ringed and bearded seals, polar bears, and walruses vulnerable to changes in the ice environment of Hudson Bay and James Bay (see also Chapter 5 and Chapter 17).

Harp and hooded seals and five species of whales are seasonal visitors that move into the region as ice conditions permit in the spring. The beluga, narwhal and bowhead are migratory Arctic whales that winter mostly in the pack ice of Hudson or Davis straits. They follow ice leads or penetrate the pack as it dissipates and are typically the first to arrive in spring and last to leave in the fall. Belugas are the only whales found commonly in James Bay and southeastern Hudson Bay, while narwhals and bowheads remain mostly in northwestern Hudson Bay. Harp and hooded seals that winter in the North Atlantic arrive a bit later in the season, once most of the pack ice has dissipated, and leave earlier in the fall. Killer whales live at all latitudes and migrate into Hudson Bay in summer; the minke whale is a temperate-water species and rare summer visitor. There are also reports of sperm whales and northern bottlenose whales in Hudson Bay but their occurrence has not been confirmed and at best they are rare.

The timing of these seasonal movements can vary by a month or so from year to year, depending upon ice conditions. Most movement data, polar bears excepted, comes from observations of species' arrival and departure times at harvesting locations. Since most harvesting is done near the coast, offshore movements are virtually unknown. The seasonal movements and population dynamics of polar bears are better known. Long-term radio tracking studies of polar bears, particularly in western Hudson Bay, have identified distinct Southern Hudson Bay, Western Hudson Bay, and Foxe Basin populations. Bears from each of these areas show fidelity to maternity denning and summering areas but mix on the ice of central Hudson Bay in winter.

Polar bears in Hudson Bay and James Bay face a longer open water season and warmer summer than their counterparts in the High Arctic. They must conserve their energy to avoid starvation or overheating, and lose weight steadily from the time they come ashore until freeze-up in early November when they return to the sea ice to hunt. Despite the protracted periods of starvation these bears maintain a similar mean litter size to other polar bear populations and reproduce more frequently. The mean litter size for bears in Southern Hudson Bay is 2.04 (n = 161) and for bears in Western Hudson Bay is 1.84 (n = 274). Females emerge with their cubs in late February to mid-March and return to the sea ice to feed. While most polar bears wean their cubs after 2.5 years and have a 3-year breeding cycle, 40% of those in Hudson Bay wean their cubs after only 1.5 years and have a 2-year breeding cycle. The higher reproductive rates in the Western Hudson Bay population have been associated with higher growth rates, but the reasons for the higher growth rates are unknown.

The whale species and the walrus all have relatively low reproductive rates, producing a single calf about every three years on average over their reproductive life. The rate of calf mortality is relatively low as the females feed and protect their young for the first several years of their lives. The vital rates of narwhals are uncertain because there is no accurate method to determine their ages. The seal species have a greater reproductive potential since they can reproduce annually. However, this potential is not always met; the actual pregnancy rate among ringed seals in western Hudson Bay can be 48-61%. The rate of mortality among seal pups is high, as they are eaten by polar bears and Arctic foxes, and weaned and abandoned after a period of weeks or a few months.

The whales, most seals, and perhaps walruses can dive to the bottom to feed throughout James Bay and most, if not all, of Hudson Bay. However, little is known of these species' diets or energetics in the region. As top-level carnivores, polar bears are particularly susceptible to the accumulation of contaminants from their diet and vulnerable to changes in the availability of seals (see also Chapter 16). Arctic foxes scavenge polar bear kills and prey upon ringed seal pups.

Various populations of walruses and whales have been identified for management purposes in Hudson Bay and James Bay on the basis of seasonal distribution, genetics, contaminant loads or other factors. Some of these populations are shared with communities on Hudson Strait, Foxe Basin, Davis Strait, or the Atlantic coast. The genetic interchange among populations, within and outside the region, is unknown. Two putative walrus populations have been identified in the region, one in South and East Hudson Bay and the other in Hudson Bay-Davis Strait. Narwhals from the Hudson Bay population and bowheads from the Hudson Bay-Foxe Basin population summer in northwest Hudson Bay, and may mix with other populations on their wintering grounds in Davis Strait. The largest summering concentration of belugas in the world occurs in the Nelson River estuary area, and there are smaller concentrations at the estuaries of the Seal, Churchill, Winisk, Severn, and Nastapoka rivers. Use of these estuaries by belugas may be related to neonate survival and/or moulting. Belugas in eastern and Western Hudson Bay are treated as separate populations.

Estimates of marine mammal populations in the region, based on systematic aerial surveys or counts at walrus haulouts, likely are conservative as they have not been corrected for animals submerged beyond view, and all but the polar bears can hold their breath for over 20 minutes (Table 9-1). The number of belugas summering in James Bay may have increased fourfold between 1985 and 2001, while numbers in eastern Hudson Bay declined by almost half. The increase in James Bay cannot be explained by reproduction alone, other contributing factors may include survey timing and immigration from Hudson Bay. The latter has important implications for population management and argues the need to improve understanding of the relationships between animals in these areas. In eastern Hudson Bay, the decline in numbers of belugas, offshore and at estuaries was accompanied by a decrease in the mean age of the catch. DFO has cautioned that continuing current levels of harvesting (>140 EHB beluga killed in 2001 by communities in Hudson Bay and Hudson Strait) could cause this population to disappear within 10 to 15 years.

There is little scientific or traditional information to indicate large changes in the region's other marine mammal populations over the past 20-50 years, but scientific survey information is very limited. The bowhead population remains severely depleted by commercial whaling that ended a century ago, and the historical range of walruses in James Bay and western Hudson Bay is much reduced. Hunting and disturbances caused by motorboats and snowmobiles may be causing narwhals and walruses to avoid areas near the communities.

The Committee on the Status of Endangered Wildife in Canada (COSEWIC) has designated bowhead and the eastern Hudson Bay belugas "**Endangered**"; the Lac des Loups Marins subspecies of harbour seal, polar bear, narwhal, western Hudson Bay beluga population as "**Special Concern** (formerly Vulnerable)"; the hooded seal as "**Not at Risk"**; and the Atlantic subspecies of the harbour seal as "**Data Deficient**". An update of the status of Atlantic walrus populations in Canada is ongoing. The Committee on the International Trade in Endangered Species (CITES) has listed bowhead under Appendix I, which protects them from international trade.

Belugas, narwhals and polar bears are listed under Appendix II, which is reserved for species that could be threatened with extinction if trade is not controlled and monitored, and Atlantic walrus are listed under Appendix III. A CITES export permit is required to transport products from these species across international boundaries. Marine Mammal Export permits are required from DFO to export marine mammal products from Nunavut. Harvesting levels are discussed in Chapter 14.

Table 9-3. Population estimates of marine mammals in areas of Hudson Bay and James Bay.

Species	Area	Survey dates	Population estimate[a]	Reference
Beluga	James Bay	1985	1,842 [b]	Smith and Hammill 1986
		1993	3,141 (SE = 787)	Kingsley 2000
		2001	7,901 (SE = 1744)	Gosselin et al. 2002
	eastern Hudson Bay	1985	2,089 [b]	Smith and Hammill 1986
		1993	1,032 (SE = 421)	Kingsley 2000
		2001	1,194 (SE = 507)	Gosselin et al. 2002
	southwest Hudson Bay (Nelson, Churchill and Seal river estuaries)	17-18 July 1987	23,000 belugas (95% CI 14,200-26,800)	Richard et al. 1990
	northwest Hudson Bay (Repulse Bay, Frozen Strait)	late July 1982-84	mean estimates of 700 (95%CI 200-3,300) to 1,000 (95%CI 621-1,627)	Richard et al. 1990
Narwhal	northwest Hudson Bay (Repulse Bay area)	July 1984	1355 (90%CI = 1000-1900)	Richard 1991
		August 2000	1780 (90%CI = 1212-2492)	Richard pers. comm. 2002
Bowhead	northwest Hudson Bay (Whale Cove to north of Lyon Inlet)	12-17 August 1995	75 (S.E. = 27.5; 95%CI 17-133)	Cosens and Innes 2000
Polar bear	western Hudson Bay (WH)	1995	1200 (95%CI = 950-1450)	Lunn et al. 1997a
	southern Hudson Bay (SH)	1996	1000 (965-1095)	Calvert et al. 2002
	Foxe Basin (FB)	ca. 1996	2300 (SE = 350)	Derocher et al. 1998
Walrus	northern Hudson Bay	26 August 1977	2370 (haulout surveys)	Mansfield and St. Aubin 1991
	Coats Island	August 1990	1376 (direct count)	Richard 1993b
	Nottingham Island	August 1990	461 (direct count)	Richard 1993b
	Cape Henrietta Maria	August 1999	221 (direct count)	C. Chenier, OMNR, Cochrane ON, pers. comm. 2003
Bearded seal	western Hudson Bay, Nelson River estuary north to Rankin Inlet and offshore to 90º W longitude	7-14 June 1994	12,290 (SE = 2520); 0.122 seals•km^{-2} of ice	Lunn et al. 1997b
Ringed seal	Hudson Bay, not including James Bay	13-20 June 1974	227,500[c];	Smith 1975
	James Bay		30,500 (extrapolated from Hudson Bay data)	Smith 1975
	western Hudson Bay, Nelson River estuary north to Rankin Inlet and offshore to 90º W longitude	1-4 June 1995	140,880 (SE = 8100); 1.690 seals•km^{-2} of ice	Lunn et al. 1997b
	southeast Hudson Bay, coastal waters between Long Point and Petite riviere de la Baleine extending 40 km offshore	20-30 May 1978	14400-21400, 1.44 to 2.14 seals•km^{-2} of ice	Simard et al. 1980

[a] = estimates were not corrected for seals in the water or whales submerged beyond view.
[b] = Data collected in 1985 did not allow a line transect analysis, so the value is the product of the strip transect estimate and the mean ratio of line/strip transect estimates for the given stratum for the two following surveys.
[c] = 1.48 seals•km^{-2} of landfast ice between Churchill and Chesterfield Inlet, 0.37 seals•km^{-2} of offshore consolidated pack ice, 0.11 seals•km^{-2} of broken ice and open water