APPENDIX 8A-2

MARINE MAMMAL BASELINE

MARY RIVER PROJECT

Environmental Field Studies

MARINE MAMMAL BASELINE

2007-2010

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EXECUTIVE SUMMARY

INTRODUCTION

This environmental baseline report on marine mammals has been prepared in support of an Environmental Impact Statement (EIS) for Baffinland's Mary River Project (the Project). The baseline report includes a review of scientific information of marine mammal species that occur in the Project regional study area (RSA) and those species that occur along the shipping routes outside the RSA. In addition, traditional knowledge collected during Project-specific Inuit Qaujimajatuqangit (IQ) studies and other sources of IQ are provided. Aerial surveys were conducted in support of the Mary River Project periodically during 2006, 2007, and 2008 to document the distribution and abundance of marine mammals in the vicinity of the Milne Inlet and Steensby Inlet port sites and along potential shipping routes. The results of these surveys are presented here.

Twenty-two marine mammal species are known or expected to occur in the RSA and along the proposed shipping routes in Baffin Bay and Davis Strait (see Table 2.1). Species accounts are provided for all species. However, emphasis is placed on the species that regularly occur in the RSA. Only one mysticete or baleen whale species, the bowhead whale (*Balaena mysticetus*), occurs regularly in the RSA. Narwhal (*Monodon monoceros*) and beluga (*Delphinapterus leucas*) are abundant in the RSA; other odontocetes that occur (albeit in low numbers) in the RSA include killer whales (*Orcinus orca*) and northern bottlenose whales (*Hyperoodon ampullatus*). Pinniped species that occur regularly in the RSA include ringed seal (*Pusa hispida*), bearded seal (*Erignathus barbatus*), harp seal (*Pagophilus groenlandicus*), and walrus (*Odobenus rosmarus*). Polar bears (*Ursus maritimus*) also occur throughout the RSA.

BOWHEAD WHALE

The bowhead whale is one of only three whales that spend their entire lives in the Arctic. It occurs seasonally along both shipping routes and is typically found singly or in small groups. Bowheads are adapted to living in areas of heavy unconsolidated ice cover during winter, can navigate extensive distances under ice, and are capable of breaking up to 20 cm of ice to breathe (George et al. 1989). Feeding and calving usually takes place in nearshore, sheltered, shallow waters in summer. During open-water periods bowhead distribution is likely driven by the distribution of prey species (Thomas 1999). Bowheads are baleen whales (filter feeders), eating pelagic crustaceans (primarily copepods and euphausiids) and epibenthic invertebrates (Lowry 1993). Because invertebrate distributions are often subject to changing physical and chemical conditions, characteristics such as water temperature, salinity, nutrient availability, ocean currents, and marine water upwelling can indirectly affect bowhead distribution (Mackas et al. 1985; Castel and Veiga 1990). Traditionally, bowheads have been observed feeding along the floe edge and their presence is often dependent on the tides.

Bowheads are highly vocal animals, though call type and regularity can vary significantly with season (Tervo et al. 2009). Mating can occur throughout the year, though most conceptions occur during late winter or early spring (Koski et al. 1993). Gestation lasts 12 to 16 months, and single calves are born during spring migration (Nerini et al. 1984; Koski et al. 1993).

There are four recognized bowhead stocks, one of which (the Eastern Canada-West Greenland stock) occurs in the RSA. This stock ranges throughout the eastern and central northern Arctic and from northern Baffin Bay to Hudson Strait (Heide-Jørgensen et al. 2006). Bowhead whales in Davis Strait and Baffin Bay were commercially overexploited in the late 1800s and early 1900s, reduced from an estimated 11,800 whales to perhaps as low as 1000 (Woodby and Botkin 1993). This stock, however, has shown significant recovery in recent decades (Heide-Jørgensen et al. 2006) and might now number >14,000, although this number has been questioned and an estimate of ~6,500 has been made at the Scientific Committee of the International Whaling Commission (IWC 2009). The Eastern Canada-West Greenland stock is listed as Special Concern by COSEWIC (2010) and is under consideration for listing under the *Species At Risk Act* (SARA).

Milne Port and Shipping Route

Along the proposed northern shipping route, bowheads occur during summer and fall. Some bowhead whales summer along the east coast of Baffin Island, and others move westward through Lancaster Sound during June and July to feed and nurse calves in inlets and channels in the Canadian Arctic Archipelago. Milne Inlet, Eclipse Sound, and to a lesser extent Koluktoo Bay are used by bowhead whales during the open-water season. Mothers and calves tend to arrive later in the season. IQ suggests that the number of bowheads using Eclipse Sound appears to be increasing in recent years. Moderate numbers of bowhead whales were sighted in Eclipse Sound during 2007 and 2008 August-September aerial surveys; overall bowhead whale density ranged from 0.02 to 0.29/100 km^2. Fall migrations to wintering grounds begin in September and occur over the next few months. It is thought that fall migrants wintering in Davis Strait follow the east coast of Baffin Island south to wintering areas, whereas whales that winter along the west coast of Greenland might cross north Baffin Bay and then move south.

Steensby Port and Shipping Route

The number of bowheads in the Foxe Basin-Hudson Bay region is estimated to be approximately 2,125 animals (Heide-Jørgensen et al. 2006). Bowheads congregate to feed and nurse calves in spring and summer around Southampton Island, along the western Hudson Bay coast, and in a relatively small area in northern Foxe Basin between Igloolik and Fury and Hecla Strait. Bowhead whales north of Igloolik in summer are primarily juveniles and females with newborn calves, suggesting that this location is a nursing area (Cosens and Blouw 1999). The area has been identified as potentially the only bowhead nursery area in the Canadian Arctic (Stephenson and Hartwig 2010) and is considered a potential Area of Interest for a Marine Protected Area.

IQ indicates that bowheads observed near Hall Beach in spring migrate there from southern Foxe Basin. Migrations are not well-documented, though most movement is thought to take place through the western and central portion of Foxe Basin and might be influenced by ice cover. During summer, this species tends to select areas of high ice cover (Ferguson et al. 2010), presumably to reduce the risk of predation by killer whales. Northern Hudson Bay, Foxe Basin, and Admiralty Inlet have been identified as summering areas, with whales moving farther into inlets and bays as the ice breaks up.

During aerial surveys of Foxe Basin in fall 2006, small numbers of bowheads were observed in northwest Foxe Basin, with uncorrected density estimates of 0.4-0.5/100 km^2. Bowheads were also observed in northwest Foxe Basin in September and October 2008, with density estimates of 0.4 and 0.1/100 km^2, respectively. Bowheads were not observed in Steensby Inlet during aerial surveys in 2006 or 2008.

Hudson Strait has been identified as a primary wintering area (late December to late March) for bowhead whales (COSEWIC 2009; Ferguson et al. 2010). IQ suggests that they are not particularly numerous in Hudson Strait, although it is thought that the corridor is used extensively for migration. Bowheads begin winter migrations in October as the sea ice begins to form, heading south toward northeastern Hudson Bay and Hudson Strait. In 1981, ~1,349 bowheads were estimated to occur in Hudson Strait (Koski et al. 2006). During the 2008 aerial surveys, bowheads were observed in Hudson Strait in both April and August, with uncorrected density estimates of 0.1/100 km^2 in both months.

BELUGA WHALE

The beluga whale has a circumpolar distribution and occurs seasonally along both shipping routes. It isan opportunistic feeder, consuming a wide array of fish and invertebrates. Mating is thought to peak before mid-April, though little is known about mating behaviour. Calving begins during spring migration and extends into early summer.Calving occurs in offshore areas during late spring migration (COSEWIC 2004a). IQ suggests, however, that newborn calves have been observed along the floe edge in June, July, August, and September (Stewart 2001). Calving is believed to occur in bays, inlets, and the mouths of rivers (Stewart 2001). Grise Fiord hunters also reported beluga giving birth along the floe edge in October and February (Stewart 2001).

Beluga whales occupy different habitats during different times of the year. During early spring, the concentrate along ice edges as the fast ice breaks up, following leads into still ice-covered areas near their summering locations (Stirling 1980). During summer, they are typically found along coastlines in shallow waters, often frequenting and concentrating in river estuaries or glacier fronts (Sergeant 1973; Michaud et al. 1990; Smith and Martin 1994; Lydersen et al. 2001). Beginning in mid-August, beluga move away from nearshore habitats and appear to make long journeys to deep-water areas where they spend several weeks diving to the seafloor, presumably to feed on deep-water fish (Smith and Martin 1994; Richard et al. 2001b). Throughout winter, they tend to be found in areas of loose pack ice or polynyas.

Four of the seven recognized beluga populations in Canada occur in the RSA, including the Eastern High Arctic-Baffin Bay, Western Hudson Bay, Eastern Hudson Bay population, and Ungava Bay populations. The Eastern High Arctic-Baffin Bay and the Western Hudson Bay populations are listed as Special Concern, and the Eastern Hudson Bay and Ungava Bay populations are listed as Endangered by COSEWIC (COSEWIC 2010). All four subpopulations are under consideration for listing under SARA. The most recent abundance estimate for the Eastern High Arctic Baffin Bay population is 21,213 (Innes et al. 2002), whereas the estimate for the component occurring in winter in West Greenland is 10,595 (Heide-Jørgensen et al. 2010). The most recent population estimate for the Western Hudson Bay population is 57,300 (Richard 2005). The Eastern Hudson Bay population has declined from 3,849 in 1985 to 2,453 in 2001 (Bourdages et al. 2002).

Some IQ suggests that although the current size of beluga populations varies from year to year, numbers generally remain the same. However, IQ from other sources suggests that current beluga populations are substantially smaller than they were five decades ago.

Milne Port and Shipping Route

The Eastern High Arctic-Baffin Bay population summers in the Canadian Arctic archipelago and winters in the loose pack ice of two distinct areas; along the west coast of Greenland and in the North Water Polynya in northern Baffin Bay. It has been suggested that these represent two distinct populations, though considerable uncertainty exists with regard to abundance, distribution, and summering habitat (Thomsen 1993; de March et al. 2002; Heide-Jørgenson et al. 2003b; COSEWIC 2004a). Belugas are taken in summer at Creswell Bay and Grise Fiord with a very limited harvest at Pond Inlet during the spring, A more substantial hunttakes place along the west coast of Greenland during fall and winter.

Belugas from the very small population wintering in the North Water enter Lancaster Sound in late April or early May (Finley and Renaud 1980). The main population that wintered off west Greenland migrates north along the coast of Melville Bay and crosses the north end of Baffin Bay before entering Lancaster Sound from the north with peak movements occurring in late June to July depending on ice conditions (Koski and Davis 1979; Remnant and Thomas 1992; Stewart et al. 1995; Stewart 2001). Belugas are only common along the south shore of Lancaster Sound in years when there is a fast-ice edge across the east end of the sound that prevents the whales from moving through to the summering areas. In other years, only a small number of animals move into areas inland of Bylot Island. IQ indicates that small numbers of belugas are common in waters near Pond Inlet in spring, summer, and fall (Remnant and Thomas 1992). Belugas have been observed mating in May and July at the Admiralty Inlet floe edge. IQ indicates that Koluktoo Bay and the southern portion of Milne and Navy Board inlets could be calving areas. Other mating and calving areas identified include along the floe edge at Pond Inlet and Navy Board Inlet, offshore areas in Lancaster Sound and Baffin Bay, and in Eclipse Sound.

Eastward fall migrations begin in September, and are concentrated almost exclusively along the southern coast of Devon Island. In August and September 2007, belugas were observed in Eclipse Sound and White Bay during aerial surveys, with density estimates of 0.1 and 0.3/100 km^2, respectively. In August and September 2008, small numbers of belugas were observed in Eclipse Sound, Eskimo Inlet, Koluktoo Bay, Milne Inlet, and White Bay with density estimates ranging from 0.1 and 8.3/100 km^2, depending on location and day. The highest densities were observed in White Bay.

Steensby Port and Shipping Route

All four populations of beluga in the RSA are known or expected to occur along or in the vicinity of the southern shipping route. Beluga from the Eastern High Arctic Baffin Bay population enter into northern Foxe Basin during spring and remain in the general area of eastern Fury and Hecla Strait throughout the summer. These beluga typically remain in shallower waters where feeding is thought to occur.

The Western Hudson Bay and Eastern Hudson Bay populations occur in the southern shipping route waters from late October through April when the whales are on their wintering grounds, and during fall migrations from summering areas in late September and October. Beluga whales from both populations may occur in the vicinity of Igloolik, Hall Beach, and likely Steensby Inlet during July to early September.

IQ indicates that belugas are not expected in Igloolik until late August or early September, and sometimes as late as December. Some Igloolik Elders believe that belugas have been arriving in the area much later than usual in recent years, suggesting that northern migrations might be taking place later in the season.

The summer distribution of the Western Hudson Bay beluga population centres along the Manitoba coastline, with large aggregations occurring in the Seal, Churchill, and Nelson rivers. The wintering location of this population has not been confirmed; however it is thought to be in Hudson Strait and off the coast of Labrador (Richard et al. 1990; Richard 1993; Richard and Orr 2003, 2005). Spring migration to summering areas occurs during late April to May (Sergeant 1973). The majority of animals likely follow the eastern coast of Hudson Bay south to the Belcher Islands, and then across through the pack ice to the Manitoba coast in late May and early June (COSEWIC 2004a). A small number of belugas move westward toward Southampton Island.

The very small (possibly extirpated) Ungava Bay beluga population occurs year-round in the RSA. It is unclear if the few whales that have been seen in the summer in southern Ungava Bay are remnants of the Ungava Bay beluga population or belong to another population.

Based on aerial survey results, beluga whales were widespread in Foxe Basin and Hudson Strait during the months with survey effort (April to October) but abundance varied with location and month. In Hudson Strait, observed densities in 2008 decreased from 3.0/100 km^2 in April to 0/100 km^2 in October. In northwest Foxe Basin, beluga densities were lower in April and June, increasing in August, and the highest density was observed in September (1/100 km^2). In Steensby Inlet, beluga were observed most frequently in September (1/100 km^2), with no sightings in April, June, and August, and one sighting in October. With the exception of August, beluga whales were consistently observed in small numbers during spring and fall in northeast Foxe Basin. In southern Foxe Basin, they were observed in low numbers in spring and summer.

NARWHAL

The narwhal inhabits deep arctic waters of Baffin Bay, the eastern Canadian Arctic, and the Greenland Sea (Reeves et al. 2002). It is seldom found south of 61°N (COSEWIC 2004). The diet of the narwhal is thought to be similar to that of the beluga, consisting primarily of small cod, flatfish such as Greenland halibut, squid, and other small fish and invertebrates. Though little information is available with respect to reproduction, gestation is thought to be between 14 and 15 months (COSEWIC 2004b). Calving generally occurs in July and August, though it can take place as early as late May (Mansfield et al. 1975; Cosens and Dueck 1990; Gonzalez 2001). Some hunters believe that narwhals mate at any time of the year, whereas others believe it to occur only in spring, summer, or fall (Remnant and Thomas 1992; Stewart et al. 1995; Stewart 2001).

Narwhals tend to prefer coastal areas that provide deep water and protection from the wind during summer (Kingsley et al. 1994; Koski and Davis 1994; Richard et al. 1994) and appear to favour deep fjords and the continental sloper, in areas where water depths are 1000 to 1500 m and marine water upwelling increases biological productivity (Dietz and Heide-Jørgenson 1995; Dietz et al. 2001). During winter, narwhals are widely distributed in heavy pack ice in offshore Baffin Bay (Koski and Davis 1979).

Narwhals are highly social animals and usually travel in small groups (Strong 1988). They have been observed in groups of hundreds or thousands during migration, and concentrations usually occur along fast-ice edges (Strong 1988).

Based largely on summer distributions, two tentative populations of narwhal occur in Canadian waters; the Hudson Bay population (Richard 1991) and the Baffin Bay population (Koski and Davis 1994; Dietz et al. 2001, Richard et al. 2010; Heide-Jørgenson et al. 2003a; Laidre and Heide-Jørgenson 2005). Many Inuit believe that at least two different narwhal stocks exist in the Arctic. However, narwhals are currently assessed as a single population in the eastern Arctic (COSEWIC 2004b). This population is under consideration for listing under SARA and is listed as Special Concern by COSEWIC (2010). Narwhal abundance in the Canadian High Arctic is estimated in excess of 63,000 narwhals (NAMMCO 2010b).

Milne Port and Shipping Route

Narwhals occur throughout the northern shipping route year-round but are found in the RSA primarily during the open-water period. Those that winter in Baffin Bay typically summer in the eastern Canadian Arctic, moving to summering areas in Melville Bay, Eclipse Sound, Smith Sound, and beyond Lancaster Sound. Important summering areas identified within Baffin Bay include Eclipse Sound, Inglefield Bredning, and Smith Sound-Kane Basin (Koski and Davis 1994). IQ indicates that within the Project RSA narwhals concentrate in Admiralty Inlet, Milne Inlet, Eclipse Sound, Koluktoo Bay, Tremblay Sound, Tay Sound, Creswell Bay, Pond Inlet, Navy Board Inlet, and Admiralty Inlet in the summer. The Lancaster Sound complex, including Navy Board and Pond Inlets, has been identified as one of the most productive in the Arctic (Stephenson and Hartwig 2010).

Recent estimates indicate that 20,211 narwhals summer in the Eclipse Sound area (NAMMCO 2010b). Survey results from the late 1980s and early 1990s indicated that the summer distribution of narwhals within Eclipse Sound, Milne Inlet, Koluktoo Bay, and Tremblay Sound is driven by the presence and distribution of ice and by the presence of killer whales (Kingsley et al. 1994).

Narwhals begin to migrate out of their summering areas in groups of a few hundred to several thousand just before freeze-up begins in late September (Koski and Davis 1994). Those summering near Somerset Island enter Baffin Bay north of Bylot Island in mid- to late October (Heide-Jørgenson et al. 2003c), whereas the population summering in Pond Inlet begins migrating down the east coast of Baffin Island in late September (Dietz et al. 2001). Narwhals generally arrive in their wintering areas in November (Heide-Jørgenson et al. 2003c). The Baffin Bay narwhal population winters at two discrete areas with the vast majority in the pack ice in central Baffin Bay (Koski and Davis 1979; Heide-Jørgenson et al. 1993; Koski and Davis 1994; Heide-Jørgenson et al. 2002a; Laidre et al. 2004), and small numbers in the North Water polynya at the north end of Baffin Bay (Richard et al. 1998a).

Considerable aerial survey effort was focused on Eclipse Sound and Milne Inlet and nearby bays and inlets during the open-water periods of 2006, 2007, and 2008 as part of the Project's baseline data collection program. Narwhals were present in Eclipse Sound, Milne Inlet, and Koluktoo Bay throughout the survey period in 2007 and 2008 (~late July to mid-September). Numbers of narwhals observed during a typical survey often numbered in the thousands.

Maximum uncorrected densities were recorded in Koluktoo Bay (176/100 km^2) in the first half of August 2007 and in Milne Inlet during the later part of August 2007 (305/100 km^2). Narwhals were also frequently seen in Tremblay Sound and White Bay in high density, reaching a maximum of 760/100 km^2 in White Bay in August 2008. Aerial surveys documented fine-scale movements of large groups of narwhal between various areas of Eclipse Sound and surrounding fjords. Narwhal densities increased from August through September in Eclipse Sound with corresponding decreases in density in Milne Inlet and surrounding bays and inlets.

Steensby Port and Shipping Route

A much smaller number of narwhal inhabit waters along the southern shipping route. The Hudson Bay population was estimated to be 1,780 in 2000 (COSEWIC 2004b), though it could be as many as 3,500 during summer (COSEWIC 2004b).

The timing and routes of migration used by the Hudson Bay narwhal population are less well understood than those of the Baffin Bay population. This population is thought to winter in eastern Hudson Strait (Richard 1991; Koski and Davis 1994), and move toward summering areas located primarily in the Repulse Bay area north of Southampton Island during late June (Gonzalez 2001). Small numbers might move north toward Fury and Hecla Strait, in the vicinity of Igloolik (Stewart et al. 1995). IQ indicates that narwhals from the Gulf of Boothia and from Hudson Strait arrive in the Igloolik area at different times and that narwhal abundance in northern Foxe Basin is irregular; whales might be observed one year, but not the next. Fall migrations to Hudson Strait begin in late August or early September, depending on ice conditions. A small number of narwhals that winter in Baffin Bay are thought to move through Fury and Hecla Strait into northern Foxe Basin during spring migrations in April and May (Brody 1976; Stewart et al. 1995).

Aerial surveys in 2008 confirmed that narwhal occur in relatively low numbers in Foxe Basin. There was one sighting of seven narwhals in northeast Foxe Basin in April 2008 and five narwhals were sighted in Foxe Basin in June 2008; there were no sightings in Steensby Inlet. Narwhals were most abundant in Hudson Strait during April and June surveys when 22 (density of 0.63/100 km^2) and 29 individuals (density of 0.8/100 km^2) were recorded, respectively. They were observed in moderate densities (0.55/100 km^2) there in September, and were absent in October.

WALRUS

The walrus has a discontinuous circumpolar distribution and some are migratory, moving south as the ice advances in fall and north as it recedes in spring (Fay 1981). It winters along the west coast of Greenland, in the North Water and other polynyas.In Foxe Basin, walruses winter along the floe edge along the north side of Rowley Island and south to the Melville Peninsula (COSEWIC 2006b).

Little information is available with respect to walruses breeding and calving in Canadian waters. However, in northwest Greenland, pups are born from early April to mid July, with peak whelping in late May and early June (Born 1990; COSEWIC 2006c). Lactation generally lasts from 25 to 27 months (Fisher and Stewart 1997).

Calves are able to nurse in the water and accompany females into the water when they forage (Loughrey 1959; Miller and Boness 1983; Kovacs and Lavigne 1992). IQ suggests that walruses are highly territorial and will aggressively defend their territories against any perceived threat; they have been observed to challenge ships passing into their territory. Walruses are primarily benthic feeders on bivalve molluscs and other invertebrates, and are generally confined to shallow waters up to 100 m deep (Vibe 1950; Outridge et al. 2003; NAMMCO 2005b; 2006).

Four extant stocks occur in Canadian waters; however, these stocks can be further subdivided based on genetic, isotopic, body size, and distributional differences (Stewart 2002). Three of the four identified stocks occur within the confines of the RSA; the Baffin Bay (High Arctic) population, the Foxe Basin population, and the North Hudson Bay-Davis Strait population (COSEWIC 2006c). IQ suggests that different populations can be distinguished based on physical differences such as colouration, tusk size, firmness of liver, taste, skin toughness, and smell. These differences are believed to be associated with differences in diet.

The Canadian walrus population has no status under SARA and is listed as Special Concern by COSEWIC (2006b). Despite the lack of abundance data, shifts in walrus distribution, abandonment of main haul-out sites and increased areas over which hunters must now travel to access walrus suggest that most stocks are declining (Stewart 2002).

Milne Port and Shipping Route

The Baffin Bay walrus population is estimated to be between 1,700 and 3,000 (Born et al. 1995; DFO 2002), with summering populations in Kane Basin, Buchanan and Princess Marie bays, Jones Sound, eastern Ellesmere Island, and the Lancaster Sound-Barrow Strait area (Born et al. 1995).

Walruses along the northern shipping route winter in the North Water and other polynyas among the Canadian Arctic islands; they inhabiti northwest Baffin Bay north from Pond Inlet to Kane Basin, Lancaster Sound, Barrow Strait, and Jones Sound. They are also distributed along the west coast of Greenland. Walrus move westward along the southern coast of Devon Island during spring to summering areas in the Canadian Arctic islands. Only a few individuals are now observed among the inlets and fjords south of Bylot Island. IQ indicates that calving locations existed in Admiralty Inlet, near the outlet of Navy Board Inlet, and off the north coast of Bylot Island.

It is thought that timing and route of the fall return migration is primarily driven by ice conditions, and likely follows the same route used during spring migrations. Aerial surveys in the vicinity of Eclipse Sound in 2007 and 2008 recorded two walruses: one in Eclipse Sound and one in Milne Inlet.

Steensby Port and Shipping Route

Walruses are considerably more abundant along the southern shipping route. They are year-round residents in northern Foxe Basin, overwintering in small polynyas and shore-lead systems near the outlet of Fury and Hecla Strait, east of Hall Beach, and among the islands (Rowley, Koch, and the Spicer islands) farther east of Hall Beach and south of Steensby Inlet. Their distribution appears to be driven by ice and open-water conditions during winter. During the open-water period, they haul out onto beaches and coasts among the islands south of Steensby Inlet and onto drifting pans of ice.

Walruses have been observed well within Steensby Inlet during late summer, but the degree to which they use the inlet, or whether they haul out anywhere in the inlet, is not known. Foxe Basin accommodates the largest concentration of walruses in Canada (Stephenson and Hartwig 2010). IQ indicates that the main calving area in Foxe Basin is in waters in the northwestern portion of the basin. The Foxe Basin walrus population is estimated to be approximately 5,500 (Born et al. 1995), though this estimate is relatively uncertain.

Walruses were abundant in the northern Foxe Basin portion of the aerial survey route in 2006. They were observed in pack ice or open water. The highest densities were 15/100 km^2 in northwest Foxe Basin in June, and 4.3/100 km^2 in Steensby Inlet in September. This trend was also observed in 2008; on average, walrus densities in northwest Foxe Basin were about seven times higher than those observed in northeast Foxe Basin or southern Foxe Basin. During the aerial surveys, two terrestrial walrus haul-out sites were observed, one at Manning Islands (mid-way between Hall Beach and Spicer Islands) and the other at Bushnan Rock (a small sandy islet west of the gap between Rowley and Koch Islands). Walrus densities in Hudson Strait (0.1/100 km^2) were lower than any observed in Foxe Basin. The low abundance of walruses in the area between northern Hudson Bay and southern Foxe Basin appears to be primarily caused by a lack of islands that can be used as haul-outs (Stephenson and Hartwig 2010). IQ indicates that walruses occur along the north shore of Hudson Strait and concentrate in the vicinity of Cape Dorset.

RINGED SEAL

The ringed seal is an important component of the Arctic marine system, both as main prey of polar bears, and as a major consumer of marine fish and invertebrates (Lowry et al. 1980; Smith 1987). It occurs year-round along both proposed shipping routes and in the vicinity of both proposed port sites and it was formerly a major traditional food source for the Inuit.

Ringed seals establish a series of breathing holes and subnivean lairs, with many of these structures created shortly after fall freeze-up. Birth lairs are constructed on the landfast ice in mid-March (Smith et al. 1991) and pups are born in April. Pups are nursed for 38 to 44 days (Smith et al. 1991) and rely on their white fur, high metabolic rates, and the birth lair for protection from the cold while building an adequate layer of blubber. Landfast ice is preferred for breeding rather than pack ice (McLaren 1958; Kelly 1988). IQ also suggests that ringed seal dens will not be constructed on moving pack ice in areas of strong ocean currents. The population of ringed seals in the Canadian Arctic is estimated to be at least a few million (Reeves 1998). Canadian populations are not listed under SARA and are listed by COSEWIC as Not At Risk.

Milne Port and Shipping Route

Ringed seals are common throughout Baffin Bay (McLaren and Davis 1982) as well as along the length of West Greenland (Vibe 1950; McLaren and Davis 1982). During winter and spring, ringed seals concentrate on stable shorefast ice, though in areas where fast ice is limited, as in Baffin Bay, increased numbers might occupy offshore pack ice (Burns 1970; Stirling et al. 1982; Finley et al. 1983). As ice breaks up during summer, they disperse as solitary animals or small groups throughout open-water areas

(Moulton and Lawson 2002; Williams et al. 2004) or to coastal areas (MacLaren 1958; Smith 1973; 1987; MacLaren and Davis 1982; Harwood and Stirling 1992).

Though ringed seals were originally thought to remain in the same general region throughout the year (MacLaren 1958), recent evidence suggests that some members of the population, particularly juveniles, might undertake extensive seasonal movements (Smith 1987; Heide-Jørgenson et al. 1992; Teilmann et al. 1999; Harwood and Smith 2003). IQ indicates some seasonal movements, mostly in response to changes in distribution of sea ice. A general pattern of movement into inlets and bays as landfast ice forms in the fall has been observed. In the spring, ringed seals often follow the ice into offshore areas as it breaks up, returning again in the fall to bays and inlets as new ice forms.

Ringed seals are abundant along the proposed northern shipping route, occurring throughout Baffin Bay and Davis Strait, Eclipse Sound, Koluktoo Bay, and Navy Board and Pond inlets. IQ indicates that large concentrations of ringed seals hauled out on the ice in many areas of Eclipse Sound. In June 2006, observed uncorrected density estimates for ringed seals in Eclipse Sound, Koluktoo Bay, Milne Inlet, and Navy Board Inlet were 41.4, 25.6, 37.6, and 39.2/100 km^2, respectively. In June 2007, density estimates for Milne Inlet and Koluktoo Bay were 29.9 and 18/100 km^2, respectively, whereas in 2008, estimates were 127.1 and 216.1/km^2, respectively.

Steensby Port and Shipping Route

Ringed seals are abundant along the proposed southern shipping route, occurring throughout Foxe Basin, including the landfast ice of Steensby Inlet and Hudson Strait. Southern Steensby Inlet, Igloolik, Hall Beach, Murray Maxwell Bay, and Rowley Island into Fury and Hecla Strait have been mentioned as important hunting and/or pupping areas. IQ suggests that most ringed seal denning in northern Foxe Basin occurs in fast ice, but that some denning and pupping can occur in moving pack ice in southern Foxe Basin and in the western part of Fury and Hecla Strait.

Ringed seals were present in all surveyed areas of Foxe Basin and Hudson Strait from April to October, and most sightings occurred during June and to a lesser extent August, when they were easily observed basking on pack ice. Aerial surveys in 2006, 2007, and 2008 indicated that the density of seals basking on sea ice in Steensby Inlet was 20, 157, and 71/km^2, respectively. The density of ringed seal in Murray Maxwell Bay, and the fast ice between Igloolik and Hall Beach in June 2008 was 126/100 km^2 and 51.3/100 km^2, respectively.

BEARDED SEALS

The bearded seal has a patchy circumpolar distribution as far north as 85ºN (Burns 1981). Canadian populations are not listed under SARA and are listed as Data Deficient by COSEWIC (2010). There is no reliable abundance estimate for bearded seals in Canadian waters; Cleator (1996), however, suggested an estimate of >190,000. Bearded seals typically occur alone or in small groups. Whelping occurs between late April and early May, and pups are typically born on pack ice where they are weaned after 12 to 18 days. Bearded seals eat a wide variety of foods and are generally considered to be benthic feeders that prey on an array of benthic invertebrates and fish, although pelagic fish are also taken (Lowry et al. 1980; Finley and Evans 1983; Antonelis 1994).

The bearded seal's distribution is largely determined by the presence of shallow water (Burns 1981; Kingsley 1986; Harwood et al. 2005). Bearded seals usually move into areas of open water <200 m deep when the pack ice retreats, although some associate with ice year-round (Burns and Frost 1979). They are seldom found in fast-ice areas, but are widely dispersed in open-water areas of pack ice where leads and cracks are frequent, and where ice pans are sufficient for haul-out sites (McLaren and Davis 1982).

Bearded seals are considered common in the RSA (Cleator 1996; Kovacs 2002). IQ indicates that pupping occurs throughout this region, as well as along the northern coast of Bylot Island. Bearded seals were observed in small numbers during springtime seal surveys in Eclipse Sound and Milne Inlet in 2007 and 2008.

The moving pack ice of northern Foxe Basin supports substantial numbers of bearded seals and is thought to be an area of high density for bearded seals (Beckett et al. 2008). During aerial surveys in support of the Project, bearded seals were present in all areas of Foxe Basin and Hudson Strait, and most sightings occurred from April to August 2008 when they were easily observed basking on sea ice. During aerial surveys in June 2008, most bearded seals were sighted near the mouth of Steensby Inlet; densities were lower in northwest Foxe Basin, northeast Foxe Basin, southern Foxe Basin, and Hudson Strait.

HARP SEALS

The harp seal occurs in the northern Atlantic and Arctic oceans below 84ºN (Ronald and Healy 1981; Riedman 1990). Three geographically distinct populations occur in the North Atlantic Basin (McLaren and Davis 1982), only one of which occurs in the RSA, the Northwest Atlantic population. It is the largest population, including a total of ~5.9 million animals (ICES 2005). This population spends the summer off west Greenland and in the Canadian Arctic (NAMMCO 2001). Canadian populations of the harp seal are not listed under SARA or by COSEWIC (2010).

Harp seal whelping occurs from late February to mid March (Jefferson et al. 2008), on the local first-year ice or landfast ice (APP 1982) offshore Newfoundland and Labrador and in the Gulf of St. Lawrence. Lactation lasts ~12 days (Kovacs and Lavigne 1986; Lydersen and Kovacs 1996; Oftedal et al. 1996). Mating usually takes place in late March or early April, after pups have weaned and before the moult in April and May (King 1983).

Harp seals enter Lancaster Sound in July and August (Johnson et al. 1976; Greendale and Brousseau-Greendale 1976; APP 1982) via migration routes along the fast-ice edge off east Baffin Island (Koski and Davis 1979) or across Baffin Bay from Greenland (Degerbøl and Freuchen 1935; Sergeant 1965). Harp seals enter Pond Inlet and Navy board Inlet at the end of July (Miller 1955). Harp seals concentrate at the mouth of Navy Board Inlet and occasionally in Eclipse Sound throughout August and September (Miller 1955; Beckett et al. 2008). The number of adult seals entering Lancaster Sound and Eclipse Sound varies annually (Greendale and Brousseau-Greendale 1976; Johnson et al. 1976; Riewe 1977, APP 1982). The September exodus from Lancaster Sound proceeds along the south and east coasts of Devon, into Jones Sound, and then along the south coast of Ellesmere Island, and across Smith Sound to Greenland. Others migrate south along the east coast of Baffin Island

(Koski and Davis 1979, 1980; APP 1982). By October, most seals have left the Canadian High Arctic and Greenland waters.

Harp seals were sighted in relatively high numbers during aerial surveys in Eclipse Sound and Milne Inlet, from 30 August to 18 September 2007. Harp seals were seen frequently in large groups of 10 to 50, and in one case 400, and most sightings were in Eclipse Sound.

Smaller numbers of harp seals also move westward into Hudson Bay and Foxe Basin during early summer. Some animals move south occasionally as far south as the Belcher Islands near James Bay (Sergeant 1986). Others head west across northern Hudson Bay toward Southampton Island and disperse along the west coast of the bay and into Foxe Basin (Sergeant 1986). There were relatively few sightings of harp seals in Hudson Strait during aerial surveys in 2008.

POLAR BEAR

The polar bear has a circumpolar distribution and occurs in relatively low densities throughout most of the ice-covered areas in the RSA. It tends to be more abundant along shore-lead systems and polynyas during winter, where less-consolidated ice cover provides habitat for prey species (Stirling and McEwan 1975; Stirling and Smith 1975; Smith 1980; Stirling et al. 1993; Stirling 1997). Non-pregnant females, juveniles, and adult males remain active on the pack ice throughout the year, often moving considerable distances with the ice (Garner et al. 1994; Amstrup et al. 2000; Peacock et al. 2008, 2009). The distribution and population size of polar bears is likely regulated by the extent of sea ice and the distribution and numbers of their primary prey, the ringed seal (Stirling and Øritsland 1995; V. Sahanatien, pers. comm.). IQ indicates that polar bears also prey on walrus and whales.

Female polar bears give birth to 1-3 cubs every 3 to 4 years (Stirling et al. 1975; Lentfer et al. 1980; Jefferson et al. 1993). Mating occurs from April to June, and females give birth the following December or January (Harington 1968; Jefferson et al. 1993) in maternity dens, which are excavated in accumulations of snow on stable parts of landfast ice, offshore pack ice, and most often on land within 50 km of the coast (Harington 1968; Stirling et al. 1984; Ramsay and Stirling 1990; Stirling and Andriashek 1992; Amstrup and Gardner 1994). Denning sites in Foxe Basin occur inland (V. Sahanatien, pers. comm.). Dens are created in the fall and bears leave their dens in April. Cubs remain with their mothers for 1.4 to 3.4 years (Stirling et al. 1975; Ramsay and Stirling 1988; Derocher et al. 1993).

The global polar bear population is estimated at 22,000 to 25,000, of which at least 15,500 occur in Canada or in subpopulations shared with Canada (COSEWIC 2008). Three subpopulations of polar bears occur in the RSA: Foxe Basin, Baffin Bay, and Davis Strait. Between 1994 and 1997, the Baffin Bay polar bear subpopulation was estimated to be 2,074 (Taylor et al. 2005). The Davis Strait subpopulation was estimated at 2,100 (Peacock et al. 2006 in COSEWIC 2008). From 1989–1994 2,197 polar bears were estimated in the Foxe Basin population (Taylor et al. 2006). The preliminary estimate for the Foxe Basin population in 2009–2010 is 2,850 (S. Stapleton, pers. comm.). The polar bear was listed as a species of Special Concern under SARA in October 2011; it is listed as Special Concern by COSEWIC (2008).

Milne Port and Shipping Route

Along the northern shipping route, polar bears are distributed throughout Baffin Bay, Lancaster Sound, and along coastal areas. Polar bears from the Baffin Bay subpopulation occupy drifting pack ice and landfast ice between Baffin Island and west Greenland during winter, but can concentrate along the Lancaster Sound fast-ice edge (Koski 1980; Ferguson et al. 2000; Ferguson et al. 2001). Bears are also concentrated along landfast ice edges across Pond and Navy Board inlets during spring. Bylot Island and coastal Baffin Island are used as summer retreats when sea ice melts and also provide denning habitat for pregnant females. The Davis Strait subpopulation occurs in the Labrador Sea, eastern Hudson Strait, Davis Strait south of Cape Dyer, and an undetermined portion of southwest Greenland (Stirling and Kiliaam 1980; Stirling et al. 1980; Taylor and Lee 1995). Polar bears are harvested domestically as well as during commercial spring sport hunt based out of Pond Inlet.

Small numbers of polar bears (six in total) were observed during the open-water season in Milne Inlet, Eclipse Sound, and Eskimo Inlet during aerial surveys in 2007 and 2008. Polar bears were also observed in low numbers on landfast ice in Milne Inlet, Koluktoo Bay, and Navy Board Inlet in June 2006.

Steensby Port and Shipping Route

Polar bears from the Foxe Basin subpopulation range over Foxe Basin, northern Hudson Bay, and western Hudson Strait during winter. They are forced ashore during the open-water period. Based on harvest records from 1970–2011 and recent aerial surveys during late summer, polar bears are concentrated in Central Foxe Basin (eastern Southampton Island and Vansittart Island, White Island, and adjacent islands) as well as northern Foxe Basin (Rowley Island, Koch Island, and the Spicer Islands). Fewer bears are found on the east side of Foxe Basin, and along the south shore of Hudson Strait (Peacock et al. 2008, 2009; Stapleton and Garshelis 2010). IQ indicates that polar bears are more concentrated in northern Foxe Basin and through Fury and Hecla Strait into the Gulf of Boothia. Polar bear denning locations have been identified in Grant Study Bay, Murray Maxwell Bay, on South Spicer Island, on Southhampton Island, Nottingham Island, on Foxe Peninsula, on Rowley and Koch Islands, and on the north shore of Hudson Strait (Nunavut Planning Commission 2011; V. Sahanatien, pers. comm.). Hall Beach Elders indicated that the southeastern portion of Steensby Inlet provides good denning habitat. Polar bears are hunted by the communities of Hall Beach and Igloolik.

Non-pregnant females, juveniles, and adult males move in the RSA throughout the year and home ranges vary seasonnally (Peacock et al. 2008, 2009). Seasonal areas of high utilization by female polar bears in Foxe Basin and Hudson Strait remain generally stable across years (V. Sahanatien, pers. comm.). Areas of high utilization occur along the southern shipping route in central and south Foxe Basin in the spring and fall, and in southern Foxe Basin and Hudson Strait in winter (V. Sahanatien, unpub. data).

During aerial surveys for the Project, small numbers of polar bears were observed on landfast ice, pack ice, terrestrial areas, and in open-water areas primarily in northern Foxe Basin but also in Hudson Strait. Polar bears were most frequently observed in September and October along the shorelines of Steensby Inlet and Foxe Basin including Koch, Rowley, and Bray islands. During the aerial surveys with ice cover, highest polar bear densities were observed in northwest Foxe Basin (0.5/100 km^2).

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ABBREVIATIONS

AI .... Areas of Interest
COSEWIC .... Committee on the Status of Endangered Wildlife in Canada
CSAS .... Canadian Science Advisory Secretariat
DFO .... Fisheries and Oceans Canada
EBSA .... Ecologically and Biologically Significant Area
EIS .... Environmental Impact Statement
IQ .... Inuit Qaujimajatuqangit
ITK .... Inuit Tapirisat Kanatami
IUCN .... Union for the Conservation of Nature
IWC .... International Whaling Commission
TK .... Traditional Knowledge
LGL .... LGL Environmental Research Associates
LSA .... local study area
MPA .... Marine Protected Area
Mt/a .... million tonne-per-annum
NIRB .... Nunavut Impact Review Board
NSC .... North/South Consultants Inc.
NWT .... Northwest Territories
RSA .... regional study area
SARA .... *Species At Risk Act*
SSC .... Species Specialist Committee
the Project .... Mary River Project

1.0 INTRODUCTION

The Mary River Project (the Project) is a proposed iron ore mine and associated facilities located on North Baffin Island, in the Qikiqtani Region of Nunavut (see Figure 1.1). The Project involves construction, operation, closure, and reclamation of a 21 million tonne-per-annum (Mt/a) open pit mine that will operate for 21 years. The high-grade iron ore to be mined is suitable for international shipment after crushing and screening with no secondary processing or concentrating required. Three Mt/a of iron ore will be transported via an upgraded existing road to Milne Inlet where it will be stockpiled for shipment during the open-water season. A railway system will transport an additional 18 Mt/a of ore from the mine area to an all-season deep-water port and ship-loading facility at Steensby Port, where the ore will be loaded into ore carriers for overseas shipment through Foxe Basin. A dedicated fleet of cape-sized ice-breaking ore carriers and some non-icebreaking ore carriers and conventional ships will be used during the open-water season to ship the iron ore to markets.

This environmental baseline study report has been prepared in support of an Environmental Impact Statement (EIS) for the Project, to be submitted by Baffinland Iron Mines Corporation (Baffinland) to the Nunavut Impact Review Board (NIRB).

1.1 STUDY AREAS

Project interaction with the marine environment and marine mammals will occur through the proposed development and operation of ports at Milne and Steensby inlets, and through shipping activities.

1.1.1. Port Site Descriptions

Milne Port

Milne Port lies on the northern side of Baffin Island, at the southern terminus of Milne Inlet (see Figure 1.1). Ships using Milne Port would access Lancaster Sound from the North Atlantic via Davis Strait and Baffin Bay. From Lancaster Sound, access to Milne Inlet is through Pond Inlet into Eclipse Sound, or perhaps via Navy Board Inlet and south through Eclipse Sound and Milne Inlet.

The Milne Port area is a narrow fjord, characterized by deep water and high surrounding headlands. All marine waters inland of Lancaster Sound are covered by fast ice through much of the year. Port operation and shipping activity at Milne Port would occur from approximately August through October. Marine mammal field investigations related to development of Milne Port were focused on Eclipse Sound and Milne Inlet.

Steensby Port

Steensby Port lies in Steensby Inlet, located on the south side of Baffin Island and at the northern end of Foxe Basin (see Figure 1.1). Ships would access Steensby Port from the North Atlantic via Hudson Strait and Foxe Basin.

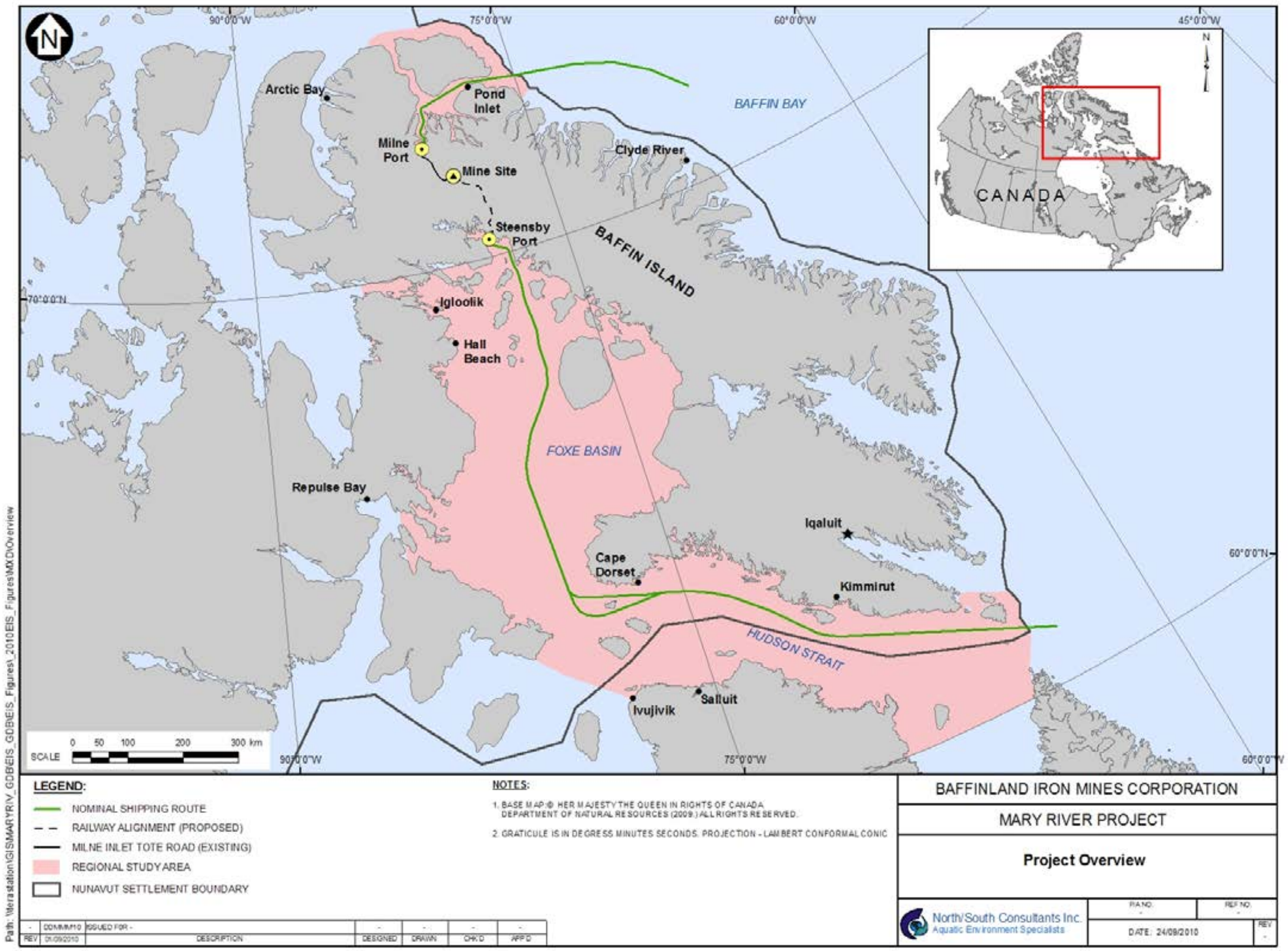

Figure 1.1 Location of the Mary River Mine Site, Proposed Port Sites at Steensby and Milne Inlets, and Nominal Shipping Routes

Steensby Inlet is a wide bay, characterized by shallow water and gentle terrestrial relief around most of its perimeter. Shipping from Steensby Port would occur year-round. The shipping route from the North Atlantic to Steensby Inlet is covered with pack ice through much of the year, and Steensby Inlet is covered by fast ice from December through July.

1.1.2 LSA and RSA

The local study area (LSA) refers to the area that includes the shipping corridor and a 50-km buffer on either side. For the southern route, this would include all of Steensby Inlet, the central part of Foxe Basin, and the northern and central parts of Hudson Strait. For the northern route, this would include the southern half of Navy Board Inlet, Eclipse Sound, and all inlets and sounds south of it, Pond Inlet, and the water inside the Nunavut Settlement Area Boundary from Cape Walter Bathurst, Bylot Island, to Cape Jameson, Baffin Island. The regional study area (RSA) for the southern route includes all of Foxe Basin and Hudson Strait to the Nunavut Settlement Area Boundary, and for the northern route includes the LSA plus the rest of Navy Board Inlet and waters surrounding Bylot Island out to the Nunavut Settlement Area Boundary (see Figure 1.1).

1.2 OVERVIEW OF BASELINE FIELD STUDIES

Marine mammal baseline studies were conducted by LGL Environmental Research Associates (LGL) and by North/South Consultants Inc. (NSC) to document the abundance and distribution of marine mammals in the vicinity of Milne and Steensby ports, as well as along proposed shipping routes. Aerial surveys were conducted annually in 2006, 2007, and 2008 (see Section 4).

1.3 OVERVIEW OF REPORT

This report presents:

- A comprehensive review of available scientific information specific to marine mammal species occurring in the Project RSA or along either proposed shipping routes for the Project that might lie outside the RSA. This includes published scientific literature, grey literature, and information from ongoing research programs (see Section 2).
- A summary of Inuit Traditional Knowledge (TK) information collected during the Inuit Qaujimajatuqangit (IQ) conducted for the Project, as well as through other initiatives. Information relevant to marine mammals in the Project RSA is summarized in Section 3.
- An overview of methods and results of marine mammal aerial surveys conducted for the Project from 2006 to 2008 (see Section 4).

2.0 LITERATURE REVIEW

Marine mammal baseline information was obtained from a review of published and unpublished literature, including articles in scientific journals, Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessment and update status reports, Canadian Science Advisory Secretariat (CSAS) reports, reports to the International Whaling Commission (IWC), and North Atlantic Marine Mammal Commission reports.

2.1 SPECIES AT RISK

The federal *Species at Risk Act* (SARA) was assented in December 2002 with certain provisions coming into force in June 2003 (e.g., independent assessments of species by COSEWIC) and June 2004 (e.g., prohibitions against harming or harassing listed endangered or threatened species or damaging or destroying their critical habitat). Once listed under SARA, a population of a marine species will be afforded additional protection through the federal *Fisheries Act*. Under SARA, a management plan must be developed for this population (GoC 2010).

For the status of marine mammals that occur in the RSA under SARA, COSEWIC, and the International Union for the Conservation of Nature (IUCN), see Table 2.1. Under SARA, one population is listed as Endangered (blue whale), two are listed as Special Concern (fin whale, polar bear), and eight populations are under consideration for listing under SARA (bowhead whale, narwhal, four beluga populations, harbour porpoise, and walrus; Table 2.1).

COSEWIC considers two species to be Endangered (blue whale, EHB and Ungava populations of beluga) and eight species as Special Concern (bowhead whale, fin whale, beluga, narwhal, killer whale, harbour porpoise, walrus, and polar bear; Table 2.1). The other species are either not listed by COSEWIC or are considered to be Not at Risk or Data Deficient (COSEWIC 2010).

2.2 PROTECTED AREAS AND KEY HABITAT SITES

A number of locations along the proposed northern and southern shipping routes are important for marine mammals. The Lancaster Sound complex, including Navy Board and Pond Inlets, has been identified as having seasonally high numbers of most marine mammals and is identified as one of the most productive in the Arctic (Stephenson and Hartwig 2010). The waters of Milne Inlet and Eclipse Sound are used by bowhead whales and by narwhals during the open-water season. Beluga and killer whales are also occasionally present. Ringed seals use the area for pupping, nursing, and moulting from mid-March to mid-June. Bearded seals and harp seals are also present in the area. A large population of polar bears relies on the ringed seals in the fast ice adjacent to the North Water Polynya over the winter and spring (Stirling et al. 1981; Finley et al. 1983). Polar bears use the northern coast of Bylot Island for maternity denning and as a summer retreat (Schweinsburg et al. 1982).

Table 2.1 Status and Regional Distribution of Marine Mammal Species in the Project RSA and in Baffin Bay and Davis Strait

Species	Status			Region		
	SARA[1,5]	COSEWIC[2]	IUCN[3]	Eclipse Sound, Navy Board Inlet, Pond Inlet	Baffin Bay, Davis Strait	Foxe Basin, Hudson Strait
BALEEN WHALES (MYSTICETES)						
Bowhead whale	UC	SC	LC	present	present	present
Humpback whale	NS	NAR	LC	absent	present	absent
Minke whale	NS	NAR	LC	absent	present	absent
Sei whale	NS	DD	EN	absent	uncommon	absent
Fin whale	Sc1:SC	SC	EN	absent	common	absent
Blue whale	Sc1:EN	EN	EN	absent	uncommon	absent
TOOTHED WHALES (ODONTOCETES)						
Sperm whale	NS	NAR/CWS: 3	VU	absent	common	absent
Northern bottlenose whale	NS	NAR	DD	absent	present	present
Beluga	UC	EN,SC [4]	NT	abundant	abundant	abundant
Narwhal	UC	SC	NT	abundant	abundant	abundant
White-beaked dolphin	NS	NAR	LC	absent	present	absent
Atlantic white-sided dolphin	NS	NAR	LC	absent	uncommon	absent
Killer whale	NS	SC	DD	uncommon	uncommon	uncommon
Long-finned pilot whale	NS	NAR	DD	absent	present	absent
Harbour porpoise	UC	SC	LC	absent	present	absent
SEALS AND WALRUS (PINNIPEDS)						
Walrus	UC	SC/CWS: 1	DD	common	present	common
Bearded seal	NS	DD	LC	abundant	Abundant	abundant
Harbour seal	NS	NAR	LC	uncommon	present	uncommon
Ringed seal	NS	NAR/CWS: 2	LC	abundant	abundant	abundant
Harp seal	NS	CWS: 3	LC	abundant	abundant	common
Hooded seal	NS	NAR/CWS: 3	VU	absent	present	absent
BEARS (URSIDS)						
Polar bear	Sc1:SC	SC	VU	present	present	present

NOTES:

1. *SPECIES AT RISK ACT*: NS = NO STATUS (GOC 2009); UC = UNDER CONSIDERATION; SC = SPECIAL CONCERN; T = THREATENED; EN = ENDANGERED; Sc1 = SCHEDULE 1
2. COMMITTEE ON THE STATUS OF ENDANGERED WILDLIFE IN CANADA (COSEWIC 2010): NAR = NOT AT RISK; DD = DATA DEFICIENT; SC = SPECIAL CONCERN; T = THREATENED; EN = ENDANGERED; NL = NOT LISTED; CWS= CANDIDATE WILDLIFE SPECIES PRIORITY LIST FOR ASSESSMENT : 1=HIGH PRIORITY, 2=MID-PRIORITY, 3=LOW PRIORITY.
3. INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN 2010): EN = ENDANGERED; VU = VULNERABLE; NT=NEAR THREATENED; LC = LEAST CONCERN; DD = DATA DEFICIENT. CLASSIFICATIONS ARE FROM THE 2010 IUCN RED LIST OF THREATENED SPECIES.
4. EN: UNGAVA BAY AND EASTERN HUDSON BAY POPULATIONS, SC: WESTERN HUDSON BAY AND EASTERN HIGH ARCTIC-BAFFIN BAY POPULATIONS
5. THE SPECIES AT RISK REGISTRY WAS REVIEWED AND THERE ARE NO RECOVERY STRATEGY AND ACTION PLANS AVAILABLE FOR ENDANGERED MARINE MAMMAL SPECIES. THERE ARE NO MANAGEMENT PLANS ON THAT WEBSITE FOR SPECIAL CONCERN SPECIES.

To the south, bowhead whale, beluga, narwhal, and occasionally killer whales move into Foxe Basin during the open-water period. Bowhead whales in Foxe Basin congregate in an area north of Igloolik, near the entrance to Fury and Hecla Straits. The area has been identified as potentially the only bowhead nursery area in the Canadian Arctic (Stephenson and Hartwig 2010).

During periods of ice cover ringed seals and polar bears are common throughout the region, frequenting areas of landfast and pack ice. Polar bears have also been observed at coastal and inland locations during the open-water period. Bearded seal populations are concentrated along cracks and leads in the sea ice, along with walrus to the south throughout Foxe Basin and along the landfast ice edge at the entrance to Steensby Inlet. The area accommodates the largest concentration of walrus in Canada (Stephenson and Hartwig 2010).

Hudson Strait (including Akpatok, Salisbury, and Nottingham islands) is an important overwintering area for many marine mammals including narwhal, beluga, and walrus. It is a highly productive area and the ice edge through strait is likely an important habitat for numerous species (Stephenson and Hartwig 2010).

Based on results from a recent satellite telemetry study, Hudson Strait has been identified (CSAS 2008) as a potentially important overwintering habitat (late December to late March) for bowhead whales (see Figure 2.1). Northern Foxe Basin has also been identified as an important calving area and shelter for neonate and juvenile bowhead whales from late May to late July. The CSAS (2008) has recommended that these areas be considered in the assessment of critical habitat for bowhead whale under SARA.

A review of marine mammal species distribution and abundance during winter also identified five winter open-water refugia that are considered particularly important habitats for marine mammals (Heide-Jørgensen and Laidre 2004). One of those is located in the RSA: South Baffin Island (see Figure 2.2).

DFO (2010) identified three potential Areas of Interest (AI) for their Marine Protected Area (MPA) process in the eastern Arctic, two of which overlap with the Project RSA (Igloolik and Southampton Island, Figure 2.3). Recently, science advice was sought on the selection of Ecologically and Biologically Significant Areas (EBSA) in the Igloolik/Foxe Basin region, a key step in the process of creating an MPA (DFO 2010).

The original Igloolik AI being considered for EBSAs was broadened to include all of northern Foxe Basin south to 68°N. Part of the rationale for this expansion was to include the proposed southern shipping routes associated with the Mary River Project (DFO 2010). Based on the current state of knowledge or Northern Foxe Basin, and following community consultations with Igloolik and Hall Beach, three EBSAs were identified: Fury and Hecla Strait, Igloolik, and Rowley Island (see Figure 2.4). The Rowley Island extension following Igloolik community meetings overlaps with the LSA. The main features of the EBSA designation for the Rowley Island area include walrus aggregation, migratory path for bowhead whales, narwhals, beluga, and killer whales and a sea ice edge.

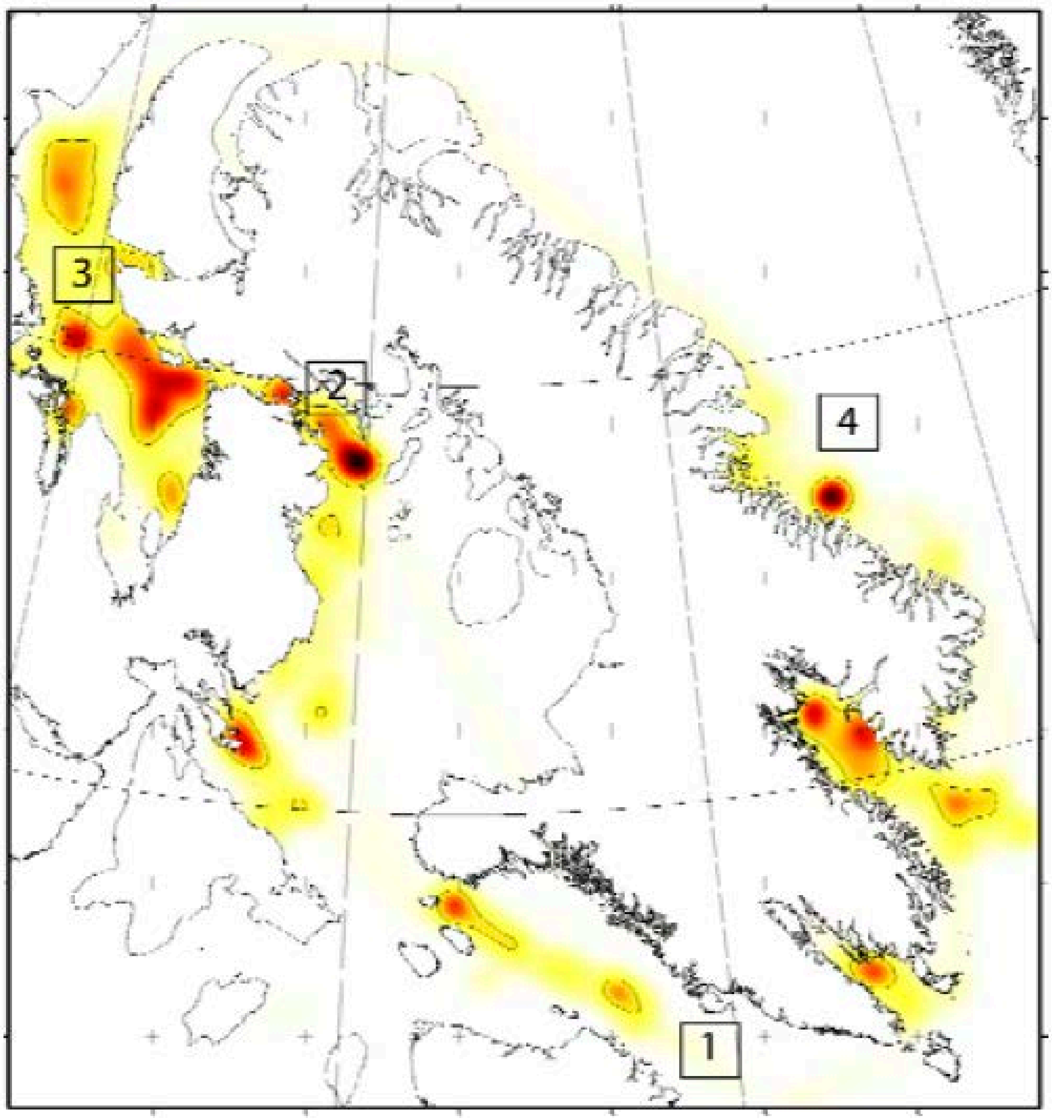

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Figure 2.1 Potentially Important Bowhead Whale Habitat Identified to Date by the Canadian Science Advisory Secretariat (Source: CSAS 2008)

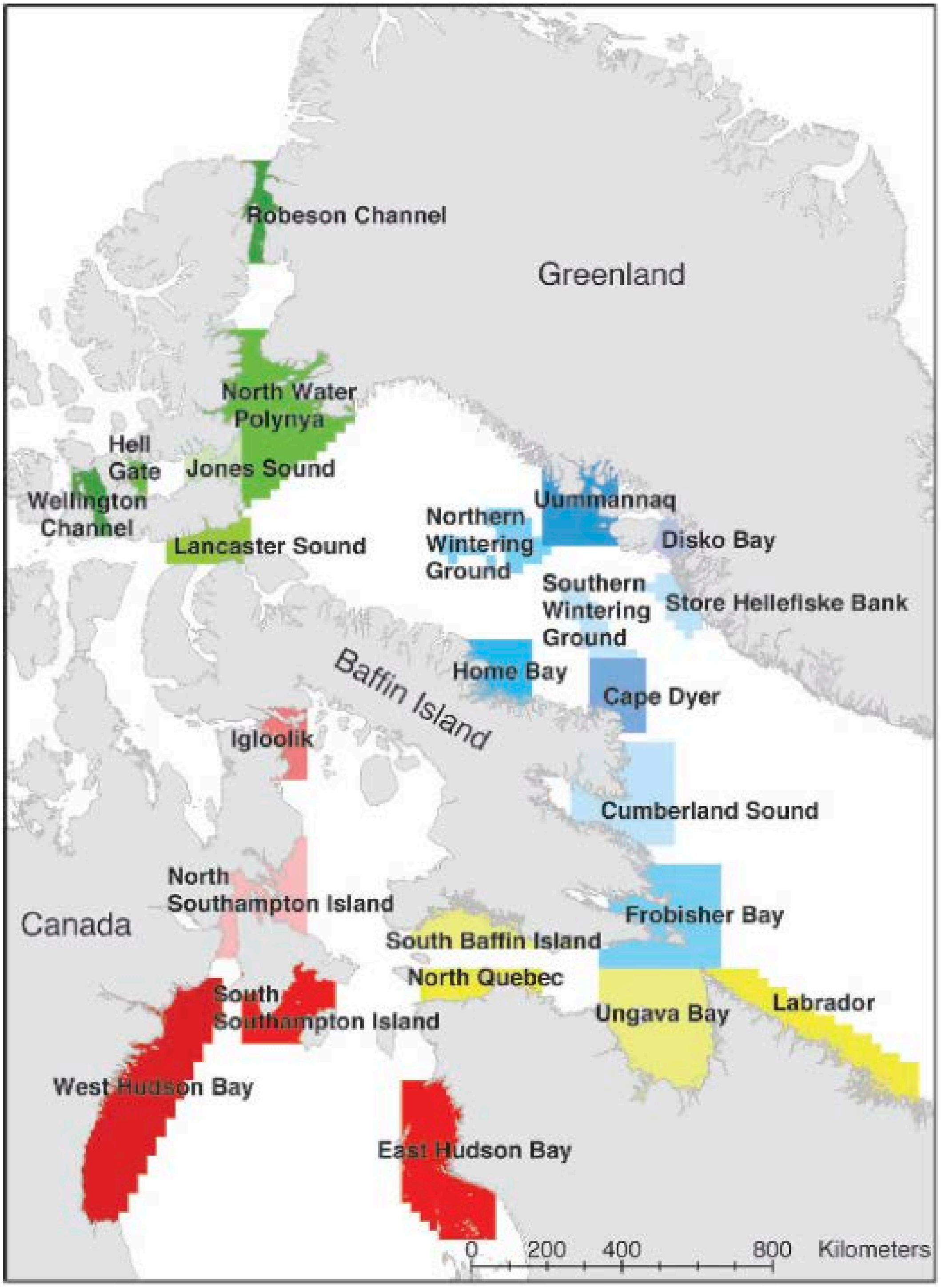

Figure 2.2 Winter Open-Water Refugia Considered Important for Marine Mammals and Birds (from Heide-Jørgensen and Laidre 2004)

Figure 2.3 General Areas of Interest Originally Identified as Potential Areas for Development of MPAs in the Eastern Arctic (Source: DFO 2010)

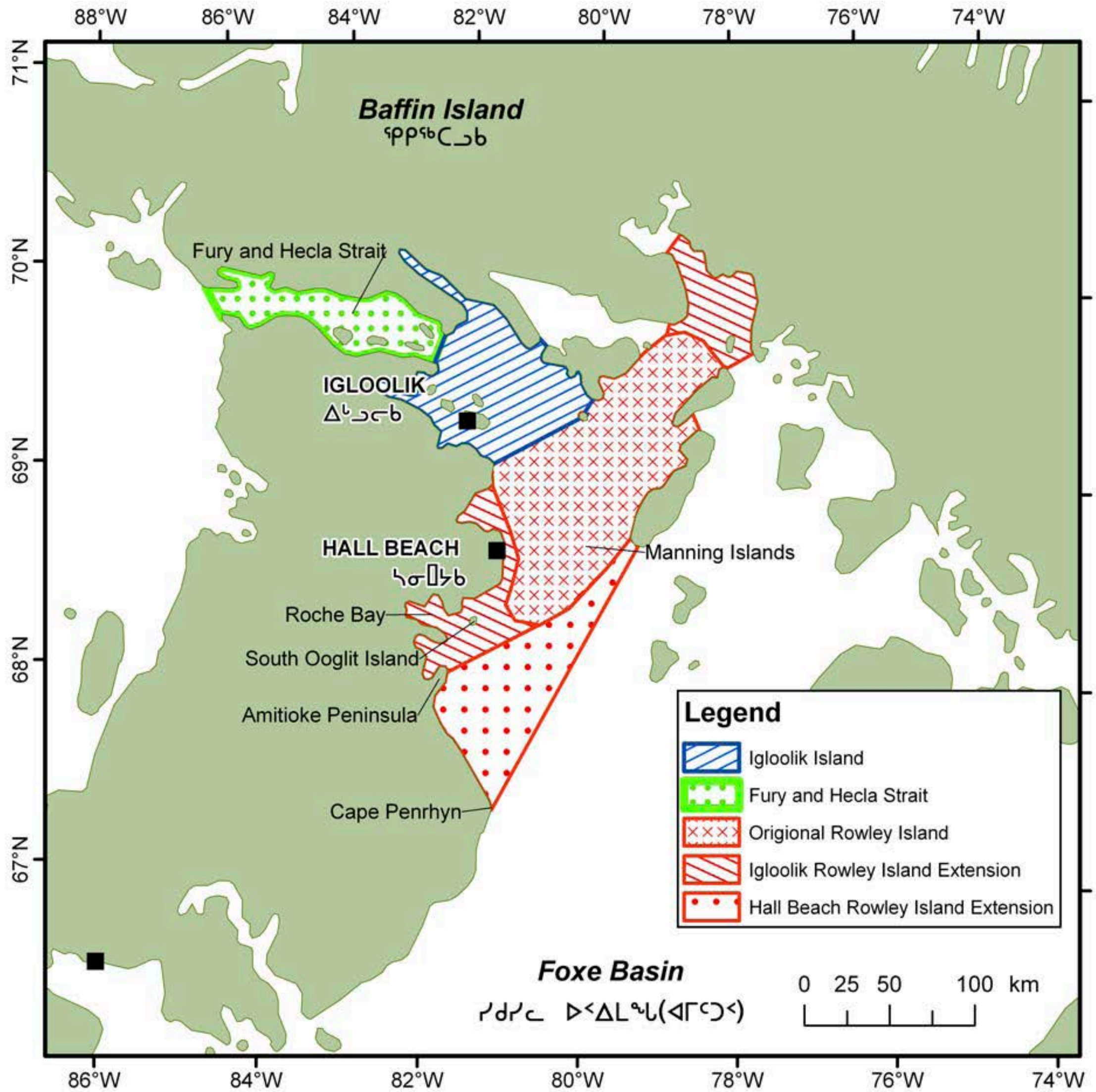

Figure 2.4 Northern Foxe Basin Draft EBSA Map from Scientific Meetings and Recommendations from Igloolik and Hall Beach Community Meetings

An EBSA or areas within an EBSA will not necessarily become an MPA, however, the ecological and biological criteria for the establishment of MPAs is similar to EBSA criteria and an MPA may be created within an identified EBSA (DFO 2010). Protective measures following the establishment of MPAs can vary; some MPAs might be “no take” zones that prohibit most or all human activities, whereas others may be zoned to allow different types of use in different areas.

2.3 SPECIES ACCOUNTS

Twenty-two marine mammal species might occur or are known to occur in the RSA or in Baffin Bay or Davis Strait, through which Project vessels will transit (see Table 2.1). The species include six baleen whale species (mysticetes), nine toothed whales (odontocetes), six seal species, including walrus (pinnipeds), and polar bear. Of the 22 species, only a few are known to regularly occur in the RSA and LSA: the bowhead whale, beluga, narwhal, northern bottlenose whale, killer whale, ringed seal, harp seal, bearded seal, walrus, and polar bear. The other species occur only in Baffin Bay or Davis Strait. The following sections describe the marine mammals in the RSA, focused on population size and status, general biology, and geographical and seasonal distributions in the RSA. Species with COSEWIC designation and those that are of importance for Inuit life are emphasized.

2.3.1 Bowhead Whale (Balaena mysticetus)

Population Status and Abundance

The bowhead whale is one of only three whales that spend their entire lives in the Arctic. There are four (until recently five) recognized stocks of bowhead whales—two are found in the North Pacific Ocean (Bering Chukchi Beaufort and Okhotsk stocks) and two in the North Atlantic Ocean (Eastern Canada-West Greenland and Spitzbergen stocks) (Heide-Jørgensen et al. 2006). One stock is found in the RSA, the Eastern Canada-West Greenland stock, which ranges throughout the eastern and central northern Arctic (Davis and Koski 1980; Finley 2001), and from northern Baffin Bay to Hudson Strait (e.g., Heide-Jørgensen et al. 2006). A recent satellite tracking study of bowhead whales in west Greenland and the eastern Canadian Arctic suggests that both areas consist of a single stock, and that Hudson Strait is an important wintering area for that population (Heide-Jørgensen et al. 2006). The stock is listed as Special Concern by COSEWIC (2010) and is under consideration for listing under SARA. The species is listed as Least Concern on the IUCN Red List of Threatened Species (IUCN 2010).

Commercial whaling in the early 1900s was responsible for significantly depleting bowhead whale stocks in the eastern Canadian Arctic (Nunavut Wildlife Management Board 2000). The pre-exploitation population of bowhead whales in Davis Strait and Baffin Bay is estimated to have been at least 11,800 whales. Commercial whaling activities might have reduced this population to perhaps 1,000 (Woodby and Botkin 1993).

Bowhead whales have shown significant recovery in recent decades (Heide-Jørgensen et al. 2007). Based on surveys of Hudson Strait and the West Greenland coast in March 1981 and 1982, correcting for whales outside the survey area and an assumed population growth rate of 3.4% per year (George et al. 2004), Koski et al. (2006) derived a projected population estimate of 3,633 (95% CI =1,382–9,550) for the overall eastern bowhead whale population in 2004. The corrected abundance estimate for Hudson Strait in March 1981 was 1,349 (95% CI 402-4,529). Dueck et al. (2008) estimated the Eastern Canada-West Greenland bowhead population at 14,400. Heide-Jørgensen et al. (2008a) proposed revised estimates of 14,196 and 2,125 for bowhead whales in Baffin Bay-Davis Strait and Foxe Basin-Hudson Bay, respectively.

General Biology

Bowhead whales are adapted to living in areas characterized by heavy unconsolidated ice cover during winter. They are capable of breaking up to 20 cm of ice to breathe, and can navigate extensive distances under ice (George et al. 1989). Bowheads are highly vocal, and it has been suggested that vocalizations are used for communication within groups, to monitor changes in ice conditions, and to aid in navigation beneath the ice (Würsig and Clark 1993; George et al. 1989). The call rates and call type diversity appear to be higher during winter months than during spring months (Tervo et al. 2009). During open-water periods, their distribution is likely driven by the distribution of prey (Thomas 1999). Bowheads are baleen whales (i.e., are filter feeders) and eat pelagic crustacean zooplankton (mostly copepods and euphausiids) and epibenthic invertebrates (Lowry 1993). In turn, the distribution of invertebrates in the water column can be affected by physical and chemical oceanographic factors such as water temperature, salinity, nutrient availability, oceanic currents, and marine water upwelling (Mackas et al. 1985; Castel and Veiga 1990).

Mating can occur throughout the year, but most conceptions occur during late winter or early spring (Koski et al. 1993). Gestation is 12 to 16 months, and single calves are born during the spring migration (Nerini et al. 1984; Koski et al. 1993).

Geographic and Seasonal Distribution

Members of the Eastern Canada-West Greenland population range from the mouths of Cumberland Sound and Frobisher Bay, Hudson Strait, and northeastern Hudson Bay in winter (COSEWIC 2009; Ferguson et al. 2010; Figure 2.5). Bowhead whales also winter among open leads and loose pack ice along the west coast of Greenland, in and near Disko Bay (Finley 1990, 2001; Heide-Jørgensen and Finley 1991, Reeves and Heide-Jørgensen 1996; Koski et al. 2006; Heide-Jørgensen et al. 2007). It is thought that some bowhead whales may also winter in the loose pack ice and polynyas of central Davis Strait and southern Baffin Bay (Finley 2001). Sea ice selection varies seasonally with bowhead whales selecting low ice coverage, thin ice, and small floe areas close to the maximum ice extent during winter months (Ferguson et al. 2010). This presumably enables bowhead whales to remain in ice while reducing the risk of ice entrapments.

In spring and summer, bowhead whales occur in northwestern Hudson Bay (around Repulse Bay and Frozen Strait) and in northern and northwestern Foxe Basin (near Igloolik; COSEWIC 2009; Ferguson et al. 2010; Figure 2.5). Bowheads also migrate north along the west coast of Greenland and then west across Baffin Bay (Davis and Koski 1980; Finley 1990, 2001; Heide-Jørgensen et al. 2003c; Figure 2.5). Bowheads wintering in the pack ice in southern Davis Strait are thought to move north along the eastern coast of Baffin Island (Davis and Koski 1980; Kilabuk 1998). Bowheads are present off West Greenland in March, and feed in the rich waters around Disko Bay into May. Very few calves or juvenile whales are observed in Disko Bay, although >80% of the bowheads in Disko Bay in spring are female (Laidre et al. 2007; Heide-Jørgensen et al. 2008b). Meanwhile, the females represent ~50% of the individuals in the eastern Canadian Arctic (Heide-Jørgensen et al. 2008b). Bowheads leave Disko Bay in mid-May and travel north and across Baffin Bay to Bylot Island in about 10 days (Heide-Jørgensen et al. 2003a). Approximately half the Eastern Canada-West Greenland bowhead population summers in the bays and passages of the north-central and northeastern Canadian arctic archipelago during August and September (Davis and Koski 1980; Koski and Davis 1980), and the remainder summer in a number of areas in Baffin Bay. Whales tagged in Disko Bay summered in June-August offshore along the coast of Baffin Island, south of Bylot Island. Isabella Bay is an important late-summer concentration area for bowheads, most of which are adults (Finley 1990).

Foxe Basin is the main nursing ground for cow-calf pairs using the Hudson Bay region (Higdon and Ferguson 2010). Calves and juveniles comprised 79 to 97% of the summer population in northern Foxe Basin during aerial photography surveys from 1996 to 1998 (Cosens and Blouw 2003). Bowhead whales travel to the Gulf of Boothia and Prince Regent Inlet from Foxe Basin and Lancaster Sound in the summer and depart in the fall (COSEWIC 2009; Ferguson et al. 2010). In contrast to winter months, bowhead whales tend to select high ice coverage, thick ice, and large floe areas during summer months (Ferguson et al. 2010). This presumably reduces the risk of predation from killer whales in productive feeding areas. Based on satellite tracking and other studies, bowheads appear to return to the same feeding areas from year to year (Koski et al. 1988; Heide-Jørgensen et al. 2006; Laidre et al. 2007), but at times they will travel long distances from these normal feeding areas, presumably in search of food when the usual feeding areas do not have abundant food (see Quakenbush et al. 2009). Whereas populations show high site fidelity at specific locations, individuals apparently show limited annual site fidelity to specific localities (Heide-Jørgensen et al. 2008b).

Summer aerial surveys in 1978 and 1979 recorded bowheads in the Baffin Bay pack ice off Bylot Island but none in Jones Sound, the southeast Ellesmere Island region, or northern Baffin Bay (Koski and Davis 1979, 1980). Bowheads were present in the mouth of Lancaster Sound in June and July, but not in August or September (APP 1982). Some individuals nurse calves in inlets and sounds within the Canadian arctic archipelago during June and July (Kilabuk 1998).

The use of Eclipse Sound by bowhead whales apparently varies on short and long time scales. Cosens et al. (2005) observed several bowheads along the west shore of the sound during aerial surveys in August 2002, but observed no bowheads on a replicate survey on the same day or when the surveys were repeated in 2004.

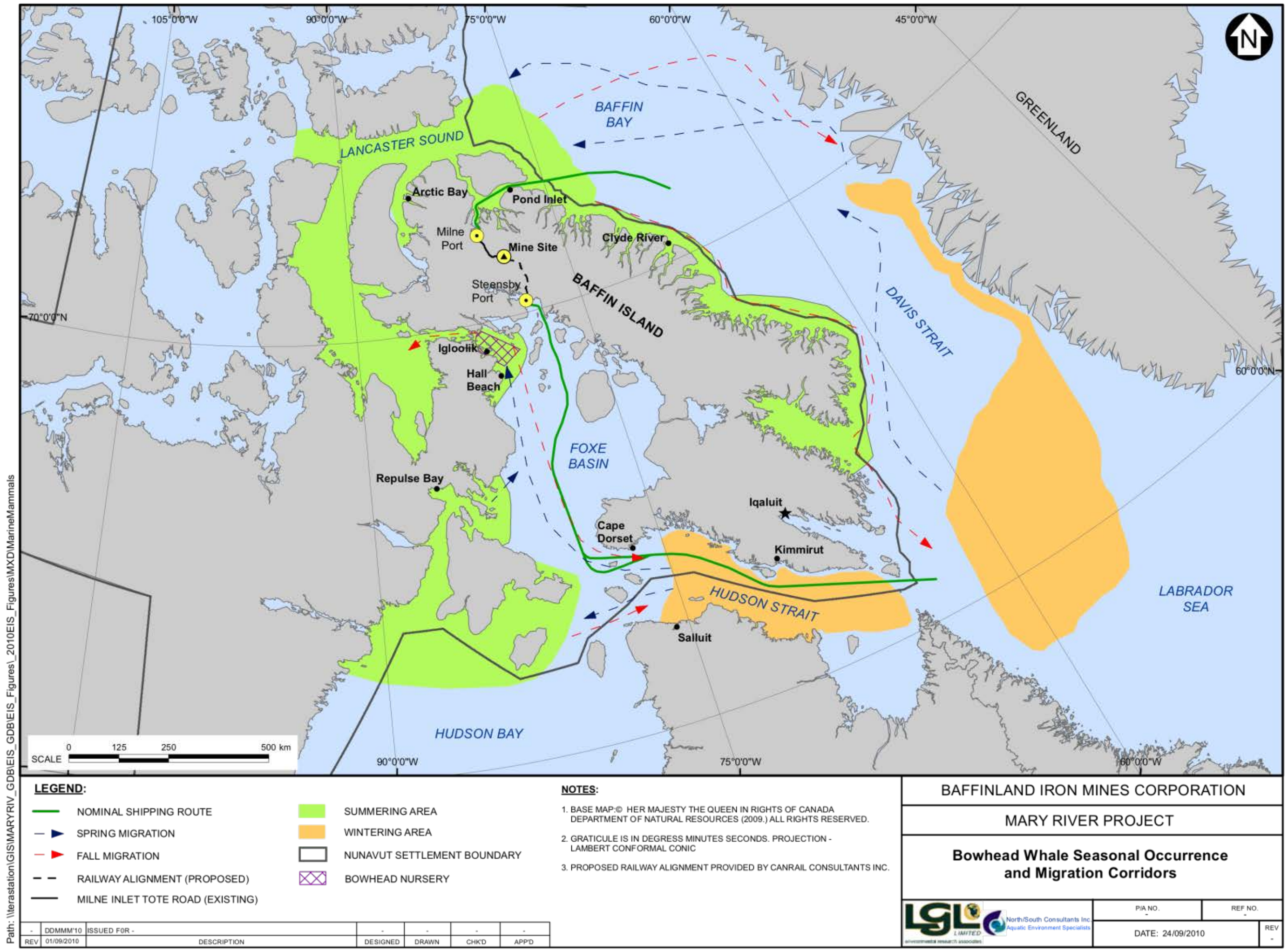

Figure 2.5 Seasonal Occurrence and Migration Corridors for the Eastern Canada-West Greenland Bowhead Whale Stock (After COSEWIC 2009 and Stephenson et al. 2010)

Fall migration begins in mid-September, but most bowheads leave north Baffin Bay in early October. Fall migration is almost entirely coastal, and occurs quite rapidly (APP 1982). In 1978, shore-based observers at Cape Adair on northeast Baffin Island observed 43 bowheads passing between 13 September and 7 October, with most passing between 1 and 7 October (Koski and Davis 1979). In 1979, an estimated 92 bowheads passed Cape Adair between 28 September and 16 October, with peak numbers passing about 1 October (Koski and Davis 1980). These observations concur with recent satellite tracking of a bowhead that left Lancaster Sound on 7 October and moved rapidly southward along the east coast of Baffin Island, reaching the southeast corner of Baffin Island by 31 October (Heide-Jørgensen et al. 2006). Bowheads using Isabella Bay on the east coast of Baffin Island are thought to vacate the area by late October (Finley 1990).

2.3.2 Humpback Whale (Megaptera novaeangliae)

Population Status and Abundance

The humpback whale is found throughout all the world's oceans (Clapham 2002). The species is not listed under SARA and is listed as Not At Risk by COSEWIC (2010) and Least Concern on the IUCN Red List of Threatened Species (IUCN 2010). Commercial whaling has taken its toll on humpback whale populations. Complete protection since 1964 has failed to bring up today's stocks higher than 10% of their pre-exploitation level. Using photo identification data from the feeding and breeding areas, Smith et al. (1999) calculated an abundance estimate of 10,600 (95% CI ± 9300-12,100) for all humpback whales in the North Atlantic Ocean.

General Biology

Humpback whale average group size ranges between 1.4 and 2.1 (Christensen et al. 1992; Øien 1990), but in their breeding and feeding ranges, they can occur in groups of up to 15 (Leatherwood and Reeves 1983). Whitehead et al. (1998) reported a mean group size of 1.47 for humpback whales seen off Nova Scotia.

Geographic and Seasonal Distribution

Although this species is considered to be a mainly coastal species, it often traverses deep pelagic areas while migrating. Its migrations between high-latitude summering grounds and low-latitude wintering grounds are reasonably well known (Winn and Reichley 1985). Humpback distribution in the Davis Strait is concentrated over offshore banks between 61ºN and 66ºN in summer (Perkins et al. 1982; Larsen and Hammond 2004), although small numbers have been found as far north as Umanak district, at 71ºN (Kapel 1979). A feeding aggregation of humpback whales occurs along the south coast of West Greenland, where they are relatively common between July and November (Mosbech et al. 2004). Based on photo-identification surveys, ~360 humpback whales occur in the western Greenland summer aggregation (Larsen and Hammond 2004).

Humpback whales have not been reported in the RSA.

2.3.3 Common Minke Whale (Balaenoptera acutorostrata)

Population Status and Abundance

The minke whale has a cosmopolitan distribution that spans ice-free latitudes (Stewart and Leatherwood 1985). It is not listed under SARA. It is listed as Not at Risk by COSEWIC (2010) and as Least Concern on the IUCN Red List of Threatened Species (IUCN 2010). Because of its small size, the minke whale was not targeted by the whaling industry until the larger baleen whale stocks were successively depleted (Perrin and Brownell 2002). As a result, minke whale stocks are in better condition than those of the larger baleen whales. The IWC recognizes four stocks of minke whales in the North Atlantic Ocean: Northeast Atlantic, Central North Atlantic, West Greenland, and Canadian East Coast. The west Greenland minke whale population was estimated at 3,474 (Reilly et al. 2008).

General Biology

The minke whale is relatively solitary, usually seen individually or in groups of two or three, but can occur in large aggregations of up to 100 at high latitudes where food resources are concentrated (Perrin and Brownell 2002). The small size, inconspicuous blows, and brief surfacing times of minke whales mean that they are easily overlooked in heavy sea states, although they are known to approach vessels in some circumstances (Stewart and Leatherwood 1985).

Geographic and Seasonal Distribution

Minke whales are found throughout most of the North Atlantic Ocean, but generally occur in coastal and shelf areas (NAMMCO 2003). In spring and summer, they are distributed along the west coast of Greenland at least as far north as 72ºN (Mosbech et al. 2004), but most sightings are from Davis Strait between 64ºN and 69ºN (Larsen et al. 1989; Kapel and Larsen 1982; Larsen and Kapel 1982; Kapel 1984). Small numbers have been taken in Davis Strait in May, but most do not arrive until June (Kapel 1977). Norway hunted minke whales in West Greenland waters until 1985, taking 52 to 75 per year. Greenland took 180 to 268 per year during that time, and has continued a subsistence hunt of ~100 per year (NAMMCO 2003).

Minke whales are rare in the RSA. The only reported sighting to our knowledge is one minke whale sighted in Hudson Strait during the mid-September 2008 aerial survey (see Section 4.3.2).

2.3.4 Sei Whale (*Balaenoptera borealis*)

Population Status and Abundance

The sei whale has a cosmopolitan distribution, with a marked preference for temperate oceanic waters (Gambell 1985a). It has no status under SARA, is listed as Data Deficient by COSEWIC (2010), and is listed as Endangered on the IUCN Red List of Threatened Species (IUCN 2010). Sei whale populations were depleted by whaling, and their current status is generally uncertain (Horwood 1987). The global population is thought to be ~80,000 (Horwood 2002).

No recent abundance estimates are available for the western North Atlantic Ocean. The North Atlantic population was thought to be ~4,000 in the 1990s (Perry et al. 1999).

General Biology

The sei whale is a pelagic species (Harwood and Wilson 2001) and usually occurs alone or in small groups. Its blow is not as high as those of blue and fin whales, and it tends to make only shallow dives and surfaces relatively frequently.

Geographic and Seasonal Distribution

Sei whales are thought to migrate between summer feeding areas at high latitudes and wintering areas at low latitudes (Jonsgård 1966; Jonsgård and Darling 1977). They are known to occur only in very small numbers off the west coast of Greenland between 64ºN and 67ºN from July to September (Kapel 1979). Sei whale occurrence in the Davis Strait-Baffin Bay area might be related to occasional influxes of warmer water from the Irminger Current (Kapel 1985).

Sei whales have not been reported in the RSA.

2.3.5 Fin Whale (*Balaenoptera physalus*)

Population Status and Abundance

The fin whale is widely distributed in all the world's oceans (Gambell 1985b), but typically occurs in temperate and polar regions from 20° to 70° north and south of the equator (Perry et al. 1999). It is listed as Special Concern under Schedule 1 of SARA and by COSEWIC (2010), and is listed as Endangered on the IUCN Red List of Threatened Species (IUCN 2010).

As many as seven small independent stocks are recognized in the North Atlantic population, but the subdivision has been questioned and it has been suggested that there is only one stock (Gambell 1985b). The animals found in the study area might be part of a putative West Greenland stock, but there is no evidence that this stock is separate from the East Greenland-Iceland stock (Donovan 1991). Aerial surveys in 1987 and 1989 estimated the population of fin whales along the coast of West Greenland at 1,046 (NAMMCO 2005a). The West Greenland stock was estimated at 3,200 in 2005 (IWC 2010).

General Biology

The fin whale is sometimes observed alone or in pairs, but on feeding grounds, groups of up to 20 are more common (Gambell 1985b). The diving behaviour of fin whales in the western North Atlantic was reviewed by Stone et al. (1992) with the objective of evaluating the likelihood of detection by aerial and shipboard surveys. Fin whales in their study area blew about 50 times/h and the average dive time was about three minutes. As fin whales do not usually remain submerged for long periods, have tall blows, have a conspicuous surfacing profile, and often occur in groups of several animals, they are less likely to be overlooked than most other species.

Geographic and Seasonal Distribution

Fin whales occur in coastal, shelf, and oceanic waters. Stone et al. (1992) suggested that fin whales tend to follow steep slope contours, either because they detect them readily, or because biological productivity is high along steep contours because of tidal mixing and perhaps current mixing.

Fin whales are commonly found off the west Greenland coast, especially in Davis Strait from June to October (Mosbech et al. 2004; Sergeant 1977). Norwegian vessels operating in Baffin Bay and Davis Strait in the early 1980s found fin whales as far north as 71ºN, but most sightings were from 64ºN to 69ºN (Larsen 1981; Kapel and Larsen 1982). The main migration route is thought to follow the western edge of the Greenland fishing banks (APP 1982). It is not clear where they spend the winter, but a preliminary analysis of whale calls recorded from moored hydrophones found high numbers of fin whale calls in Davis Strait during winter (NAMMCO 2010a).

Fin whales have not been reported in the RSA.

2.3.6 Blue Whale (*Balaenoptera musculus*)

Population Status and Abundance

The blue whale is widely distributed throughout the world's oceans, occurring in pelagic, continental shelf, and inshore waters (Leatherwood and Reeves 1983). It is listed as Endangered under Schedule 1 of SARA, by COSEWIC (2010), and on the IUCN Red List of Threatened Species (IUCN 2010). All blue whale populations have been exploited commercially, and many have been severely depleted as a result. The worldwide population has been estimated at 15,000, with 10,000 in the Southern Hemisphere (Gambell 1976), 3,500 in the North Pacific Ocean, and up to 1,400 in the North Atlantic Ocean (NMFS 1998).

General Biology

Blue whales usually occur alone or in small groups (Leatherwood and Reeves 1983; Palacios 1999). Sigurjónsson et al. (1989, 1991) reported average group sizes of 1.6 and 1.4, respectively, in Icelandic waters and in Faeroese and adjacent waters, and Whitehead et al. (1998) reported an average group size of 1.4 off the coast of Nova Scotia. Blue whales have a tall and conspicuous blow, and can lift their flukes clear of the surface before a deep dive. Dives can last 10 to 30 minutes and are usually separated by a series of 10 to 20 shallow dives. Swimming speed has been estimated as 2 to 6.5 km/h while feeding and 5 to 33 km/h while travelling (Yochem and Leatherwood 1985).

Geographic and seasonal distribution

Blue whale summer distribution in the western North Atlantic extends from the Scotian Shelf to the Davis Strait. A few blue whales are present along the West Greenland coast from June to October (Mosbech et al. 2004), but most sightings are from the south end of Davis Strait up to ~66.5ºN (Kapel and Larsen 1982; Larsen et al. 1989; Sears and Larsen 2002).

The whales in Davis Strait are part of the stock that occurs in eastern Canadian waters. A blue whale photographed in the St. Lawrence estuary was later found in Davis Strait (Sears and Larsen 2002).

Blue whales have not been reported in the RSA.

2.3.7 Sperm Whale (*Physeter macrocephalus*)

Population Status and Abundance

The sperm whale is the largest of the toothed whales, with an extensive worldwide distribution (Rice 1989). The species has no status under SARA and is listed as Not at Risk under COSEWIC (2010). It is a low-priority wildlife species candidate for assessment by the COSEWIC Species Specialist Committee (SSC) (COSEWIC 2010), and is listed as Vulnerable on the IUCN Red List of Threatened Species (IUCN 2010). The global population size has been estimated at ~360,000 (CV = 0.36; Whitehead 2002). There is no evidence of population increase since the end of large-scale whaling in 1980, and there is concern that populations are continuing to decline in some areas (Taylor et al. 2008a).

General Biology

Sperm whales are generally distributed over large areas that have high secondary productivity and steep underwater topography (Jacquet and Whitehead 1996). Mean group sizes of sperm whales are 20 to 30 (Whitehead 2003), and typical social unit sizes range from 3 to 24 (Christal et al. 1998). They routinely dive to depths of hundreds of metres (Rice 1989), and can dive as deep as ~2 km (and possibly deeper on rare occasions) for periods of over 1 h; however, most of their foraging occurs at depths of ~300 to 800 m for 30 to 45 minutes (Whitehead 2003). They are capable of remaining submerged for longer than two hours, but most dives probably last 30 minutes or less (Rice 1989).

Geographic and Seasonal Distribution

Female and juvenile sperm whales generally occur only in tropical and subtropical waters, whereas males are wider ranging, occurring in higher latitudes as far as the edges of the polar pack ice (Rice 1989; Harwood and Wilson 2001; Waring et al. 2001). Most information on sperm whale distribution in Davis Strait is for Greenland waters only. Male sperm whales arrive off south Greenland in April, and by June have reached their northernmost limit of 68°N in Davis Strait. They can be found off the west coast of Greenland from May to October (Kapel 1979), and migrate south again starting in early fall. There are sightings of single sperm whales at ~67 to 68.75°N along the coast in 1977, 1979, and 1980 (Kapel 1979; Larsen 1981; Kapel and Larsen 1982), but most are sighted between 61 and 66°N (Kapel 1979; Larsen et al. 1989).

Sperm whales have not been reported in the RSA.

2.3.8 Northern Bottlenose Whale (*Hyperoodon ampullatus*)

Population Status and Abundance

The northern bottlenose whale is found exclusively in the North Atlantic Ocean, mainly in cold temperate, subarctic, and polar waters (Reeves et al. 1993, 2002). In the offshore waters of Atlantic Canada, there are two known centres of abundance of northern bottlenose whales—on the edge of the Scotian Shelf and in Davis Strait. Genetic analysis suggests that the two aggregations are differentiated and should be considered separate stocks (Dalebout et al. 2001). The northern bottlenose whale has no status under SARA, and is listed as Not at Risk by COSEWIC (2010). It is listed as Vulnerable on the IUCN Red List of Threatened Species (IUCN 2010)

The Scotian Shelf population was estimated to contain about 163 (Whitehead and Wimmer 2005). There is no estimate for the Davis Strait population. Most subpopulations of the species are probably still depleted because of large kills in the past—over 65,000 animals were killed in a multinational hunt that operated in the North Atlantic from ~1850 to the early 1970s (Mitchell 1977; Reeves et al. 1993).

General Biology

Northern bottlenose whales are often seen in pairs or in groups of 4 to 10 (Reeves et al. 1993). These whales are unusual in that they often approach vessels that are stopped or moving slowly, and can stay around for an hour or more (Reeves et al. 1993). Observed dive durations were 1 to 80 minutes, with 48% lasting less than 10 minutes and 11% lasting more than 1 h (Reeves et al. 1993). Routine dives can be to depths of 800 m or more with maximum dive depths of at least 1,500 m (Reeves et al. 2002). They prefer waters more than 1,000 m deep in areas with steep underwater topography (Reeves et al. 1993; Whitehead et al. 1996).

Geographic and Seasonal Distribution

Of two areas of concentration in the northwest Atlantic Ocean, one is in the study area: Davis Strait off northern Labrador (Whitehead et al. 1996; Mead 1989; Reeves et al. 1993). In winter and spring, northern bottlenose whales concentrate along the 1000 m depth contour (the edge of the pack ice) from the northern tip of Labrador to the middle of Davis Strait, and in summer and fall, they concentrate off the north coast of Labrador and off Hall Peninsula, between Frobisher Bay and Cumberland Sound (Reeves et al. 1993). Bottlenose whales also occur off the Nuuk and Maniitsoq districts of western Greenland, at ~64 to 66°N (Kapel 1979; Reeves et al. 1993).

The range of the northern bottlenose whale includes the eastern end of the southern RSA.

2.3.9 Beluga Whale (*Delphinapterus leucas*)

Population Status and Abundance

The beluga has a northern circumpolar distribution, ranging south into the subarctic. Four of the seven recognized beluga populations in Canada occur in the RSA. These include the Eastern High Arctic–Baffin Bay population, the Western Hudson Bay population, the Eastern Hudson Bay population, and the Ungava Bay population (see Figure 2.6).

The Eastern High Arctic Baffin Bay and the Western Hudson Bay populations are listed as Special Concern, and the Eastern Hudson Bay and Ungava Bay populations are listed as Endangered by COSEWIC (COSEWIC 2010). All four populations are under consideration for listing under SARA. The IUCN Red List of Threatened Species considers the beluga whale Near Threatened (IUCN 2010).

Movement patterns and genetic evidence suggest that the Eastern High Arctic Baffin Bay population occupies two distinct winter habitats, the North Water and the West Greenland coast. It might in fact comprise two populations, the West Greenland population and the North Water population, although considerable uncertainty remains about the abundance and distribution of the two populations (Thomsen 1993; de March et al. 2002; Heide-Jørgensen et al. 2003b; COSEWIC 2004a). It is unclear how or if those populations also occupy separate habitat in their summering areas in the Canadian High Arctic (COSEWIC 2004a).

The most recent abundance estimate for the Eastern High Arctic Baffin Bay population, corrected for submerged animals, is 21,213 (95% CI = 10,985-32,619; Innes et al. 2002). That estimate is based on aerial and photographic surveys of Prince Regent Inlet, Barrow Strait, and Peel Sound during summer 1996. Based on aerial winter surveys in 2006 and 2008, the population estimate for beluga in West Greenland is 10,595 (95% CI = 4,904-24,650; Heide-Jørgensen et al. 2010).

The most recent Western Hudson Bay population abundance estimate, based on summer aerial surveys in 2004, is 57,300 (95% CI = 37,700–87,100; Richard 2005).

The Eastern Hudson Bay population has declined from 3,849 in 1985 to 2,453 in 2001 (Bourdages et al. (2002). Doidge et al. (2002) reported that many of the river mouths historically frequented by beluga during summer are no longer used, likely because of declining numbers attributable to overharvesting, as well as motorboat traffic and commercial shipping (McDonald et al. 2002; COSEWIC 2004a). There is some speculation that harvest levels could cause this population to be extirpated within the next decade (COSEWIC 2004a). The eastern Hudson Bay population could be divided to include a distinct James Bay population (Petersen et al. 2010). Abundance estimates for James Bay beluga range from 1,842 in 1985 to 7,901 in 2001 (Gosselin et al. 2002).

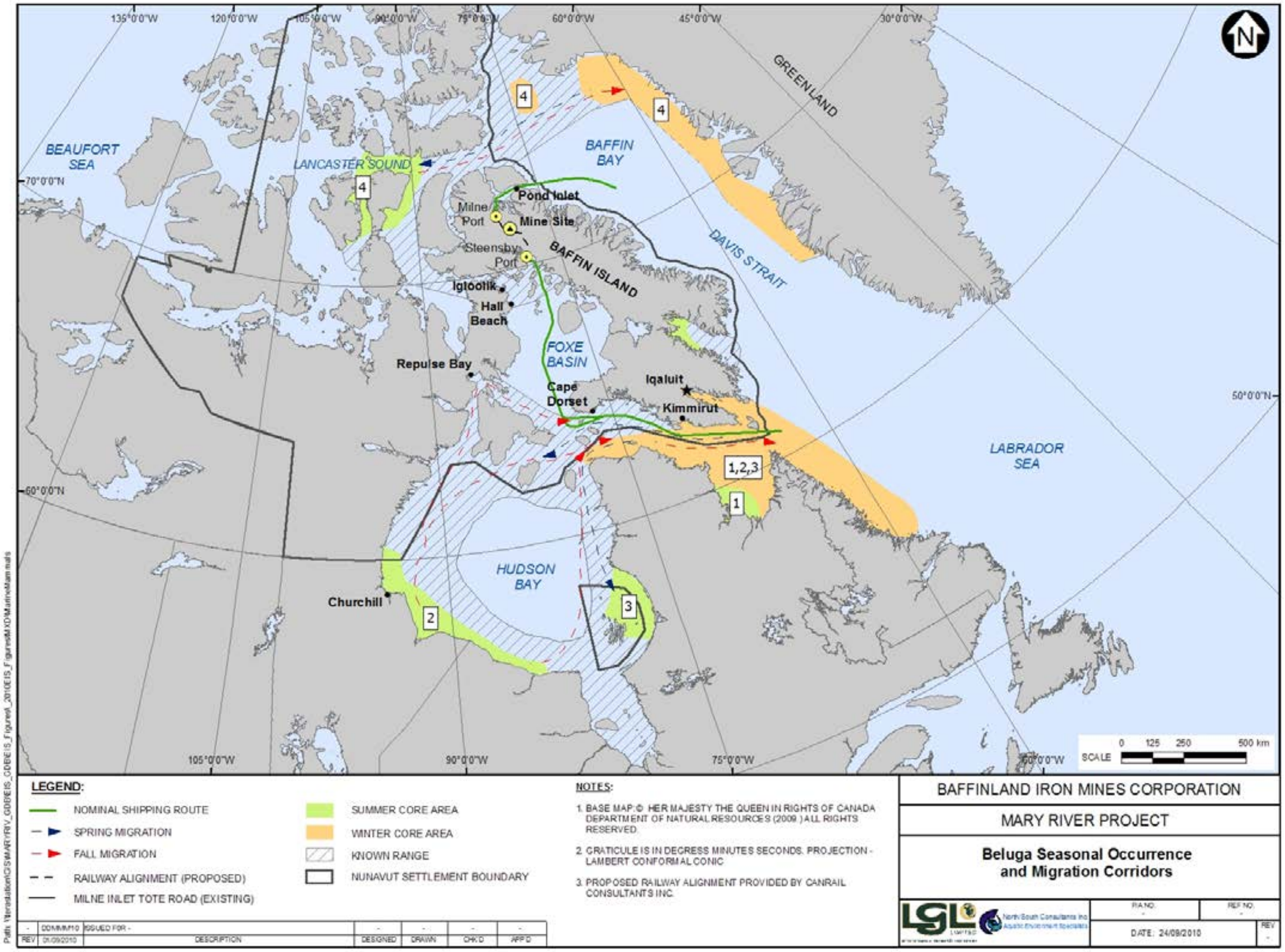

Figure 2.6 Seasonal Occurrence and Migration Corridors for the Ungava Bay (1), Western Hudson Bay (2), Eastern Hudson Bay (3), and Eastern High Arctic–Baffin Bay (4) Beluga Populations (After COSEWIC 2004a)

The Ungava Bay population has been decimated by commercial and subsistence hunting, and has been reduced to undetectably low levels or has been extirpated (Kingsley 2000; Gosselin et al. 2002; COSEWIC 2004a). Beluga whales now are only rarely observed at river mouths where they were historically concentrated (Lee et al. 2002). Ungava Bay beluga are thought to winter in northern Ungava Bay or Hudson Strait, where they mix with beluga from other populations (de March and Postma 2003).

General Biology

Mating is thought to peak before mid-April, but little is known of mating behaviour. Calves have already been born when whales begin to arrive at summering areas, suggesting that calving occurs in offshore areas during late spring migration (COSEWIC 2004a). Some information suggests that a limited amount of calving might also occur near estuaries and bays (Remnant and Thomas 1992). Beluga whales are opportunistic feeders, consuming a wide array of fish and invertebrates.

Data acquired from satellite-linked time depth recorders deployed on beluga whales captured in the Mackenzie River Delta, NWT, showed that when the animals moved far offshore, they frequently dove to depths of 400 to 600 m (Richard et al. 1997). Those dives typically ranged from 10 to 20 minutes in duration, with horizontal movement at the sea floor, separated by surfacing periods of 5 to 8 minutes in duration. Beluga whales in the Canadian High Arctic also dive deep (350 m), presumably for benthic foraging (Martin and Smith 1992, 1999).

Geographic and Seasonal Distribution

Beluga whales occupy different habitats during different times of the year. During early spring, beluga concentrate along ice edges as the fast ice breaks up, following leads into still ice-covered areas near their summering locations (Stirling 1980). During summer, they are typically found along coastlines in shallow waters, often frequenting and concentrating in particular river estuaries or glacier fronts (Sergeant 1973; Michaud et al. 1990; Smith and Martin 1994; Lydersen et al. 2001). Beginning in mid-August, beluga move away from nearshore habitat and appear to make long journeys to deepwater areas where they spend several weeks diving to the seafloor, presumably to feed on deepwater fish (Smith and Martin 1994;, Richard et al. 2001b). Throughout winter, they tend to be found in areas of loose pack ice or polynyas, preferring ice cover of 4/10 to 8/10 (Koski and Davis 1979; Finley and Renaud 1980; COSEWIC 2004a).

Eastern High Arctic Baffin Bay Population - Beluga of the Eastern High Arctic Baffin Bay population summer in the Canadian arctic archipelago and winter in loose pack ice along the west coast of Greenland south of Disko Island (Davis and Finley 1979; McLaren and Davis 1983) and in the North Water Polynya in northern Baffin Bay (Finley and Renaud 1980; Richard et al. 1998a, 2001a; Heide-Jørgensen et al. 2003b; Figure 2.6). Beluga from the smaller population wintering in the North Water begin entering Lancaster Sound in late April or early May (Finley and Renaud 1980) with peak movements occurring in late June to July, depending on ice conditions (Koski and Davis 1979; Remnant and Thomas 1992; Stewart et al. 1995; Stewart 2001).

Beluga whales wintering off the west coast of Greenland generally occupy similar geographic areas between years. They are usually found within 50 km of the west Greenland coast in large numbers (Heide-Jørgensen et al. 1996; Heide-Jørgensen and Aquarone 2002). Most recently, aerial surveys reported increased distribution westward, likely resulting from reduced sea ice coverage or early annual ice recession (Heide-Jørgensen et al. 2010). The peak movement of Greenland wintering animals occurs later than the North Water animals, in late June and July (Davis and Finley 1979; Koski et al. 2002).

Summering areas are concentrated in the waters around Somerset Island (see Figure 2.6; Remnant and Thomas 1992; COSEWIC 2004a), although a small number of whales occasionally move into Eclipse Sound and the Milne Inlet area, apparently to feed and calve (Remnant and Thomas 1992). Eastward fall migrations begin in September, and are concentrated almost exclusively along the southern coast of Devon Island.

Beluga migrate rapidly out of the central High Arctic in mid- to late September, mostly close along the south coast of Devon Island (see Figure 2.6; Davis and Finley 1979; Koski and Davis 1979, 1980; Heide-Jørgensen et al. 2003b). Most of the population passes through Lancaster Sound in less than a week (Koski et al. 2002). The whales then turn north along the eastern coast of Devon Island; some enter Jones Sound, and others swim directly on to southeastern Ellesmere Island and northern Baffin Bay (Koski et al. 2002). Eastern Devon Island and Jones Sound are important fall feeding areas, and beluga concentrate along the shores and bays feeding on arctic cod (Richard et al. 1998b). Tagged whales arrived in Jones Sound and northern Baffin Bay from late September to early October. Seventeen of 20 tagged individuals travelled to the North Water and were recorded there until the last of the tags ceased transmitting, from mid-October to late November, and three continued on to coastal waters off southwestern Greenland (Richard et al. 2001a; Heide-Jørgensen et al. 2003b). In West Greenland, beluga winter along the coast from 67°N to 69°N, particularly in the fjords of Nuuk and Maniitsoq districts; most whales are found within 50 km of the coast (Heide-Jørgensen et al. 1993; Heide-Jørgensen and Reeves 1996). These whales usually leave the fjords in May but some remain until June or July. They return to the area in late October (Heide-Jørgensen et al. 1994).

Western Hudson Bay Population - The summer distribution of the Western Hudson Bay beluga population centres along the Manitoba coastline, with large aggregations occurring in the Seal, Churchill, and Nelson rivers (see Figure 2.6). Aerial surveys and satellite-linked radio telemetry are currently being conducted to help provide an understanding of how flow regulation might affect beluga use of the Nelson River estuary (Bernhardt 2004; Richard and Orr 2003, 2005).

The wintering location of Western Hudson Bay beluga has not been confirmed; they are thought to winter in Hudson Strait (Richard et al. 1990; Richard 1993; Richard and Orr 2003, 2005) and off the coast of Labrador (Brice-Bennet 1978, Martin et al. 2001). Spring migration to summering areas occurs during late April–May (Sergeant 1973). The majority of animals are thought to follow the eastern coast of Hudson Bay south to the Belcher Islands, and then across through the pack ice to arrive along the Manitoba coast in late May and early June (COSEWIC 2004a). A small number of beluga whales move westward toward Southampton Island. Beluga generally remain in the Nelson, Churchill, and Seal estuaries along the coast until late July, when numbers peak.

In September, beluga begin a northward migration along the coast toward Southampton Island (Sergeant 1973). Most beluga tagged with satellite linked radio transmitters in the Nelson River estuary migrated up the western Hudson Bay coast during late September–early October and reached Hudson Strait by late October–early November, where they remained until their tags ceased to function (Richard and Orr 2003, 2005). A smaller number of tagged whales also moved up the eastern coast of Hudson Bay (Richard and Orr 2003, 2005).

Eastern Hudson Bay Population - Spring migration routes have not been directly documented, but it is presumed that beluga move from wintering areas south along the eastern Hudson Bay coastline to summering areas inshore and offshore areas of the Nastapoka Arc (see Figure 2.6; COSEWIC 2004a). The summer distribution is concentrated at the Nastapoka and Great Whale estuaries, and occupied a coastal area that extended from Kujjuarapik to Inukjuak (Caron and Smith 1990;, Doidge 1994; Kingsley 2000; Doidge and Lesage 2001; Gosselin et al. 2002). The distribution extends offshore to the Belcher Islands (Smith and Hammill 1986; Kingsley 2000; Gosselin et al. 2002).

The eastern Hudson Bay and presumably James Bay beluga move from summering areas toward wintering grounds during early October. The population is thought to winter primarily in Hudson Strait, though some individuals have been found as far east as northern Labrador during winter and spring (Kingsley et al. 2001, Lewis et al. 2003). Seven beluga whales satellite tagged in July 2002 left eastern Hudson Bay by October and moved into Ungava Bay and Hudson Strait where they remained until the tags stopped in December (Lewis et al. 2003).

Ungava Bay Population - Historically, the Ungava Bay beluga were distributed in Ungava Bay near the Mucalic, George, and Whale river estuaries during summer (see Figure 2.6; COSEWIC 2004a). Beluga now are only rarely observed at river mouths and the population might be extirpated (Lee et al. 2002; COSEWIC 2004a). There is little information on the seasonal movements of the Ungava Bay beluga population. Some beluga from other populations are thought to winter in Hudson Strait and Davis Strait; the degree of mixing with Ungava Bay beluga is unknown (de March and Postma 2003).

2.3.10 Narwhal (Monodon monoceros)

Population Status and Abundance

The narwhal occurs in deep arctic waters, primarily in Baffin Bay, the eastern Canadian Arctic, and the Greenland Sea (Reeves et al. 2002). It is seldom found south of 61º N (COSEWIC 2004b). Based largely on summer distributions, two tentative populations of narwhal occur in Canadian waters (see Figure 2.7; DFO 1998a, 1998b): the Hudson Bay population (Richard 1991) and the Baffin Bay population (Koski and Davis 1994; Dietz et al. 2001; Richard et al. 2010; Heide-Jørgensen et al. 2003a; Laidre and Heide-Jørgensen 2005). Although physical and behavioural observations suggest that different narwhal populations could occur in the north Baffin region (Remnant and Thomas 1992; Stewart et al. 1995; Dietz et al. 2001; Laidre and Heide-Jørgensen 2005), genetic analyses have not provided consistent differences that could help delineate populations (de March et al. 2003). Currently, narwhals in the eastern Arctic are assessed as a single population (COSEWIC 2004b).

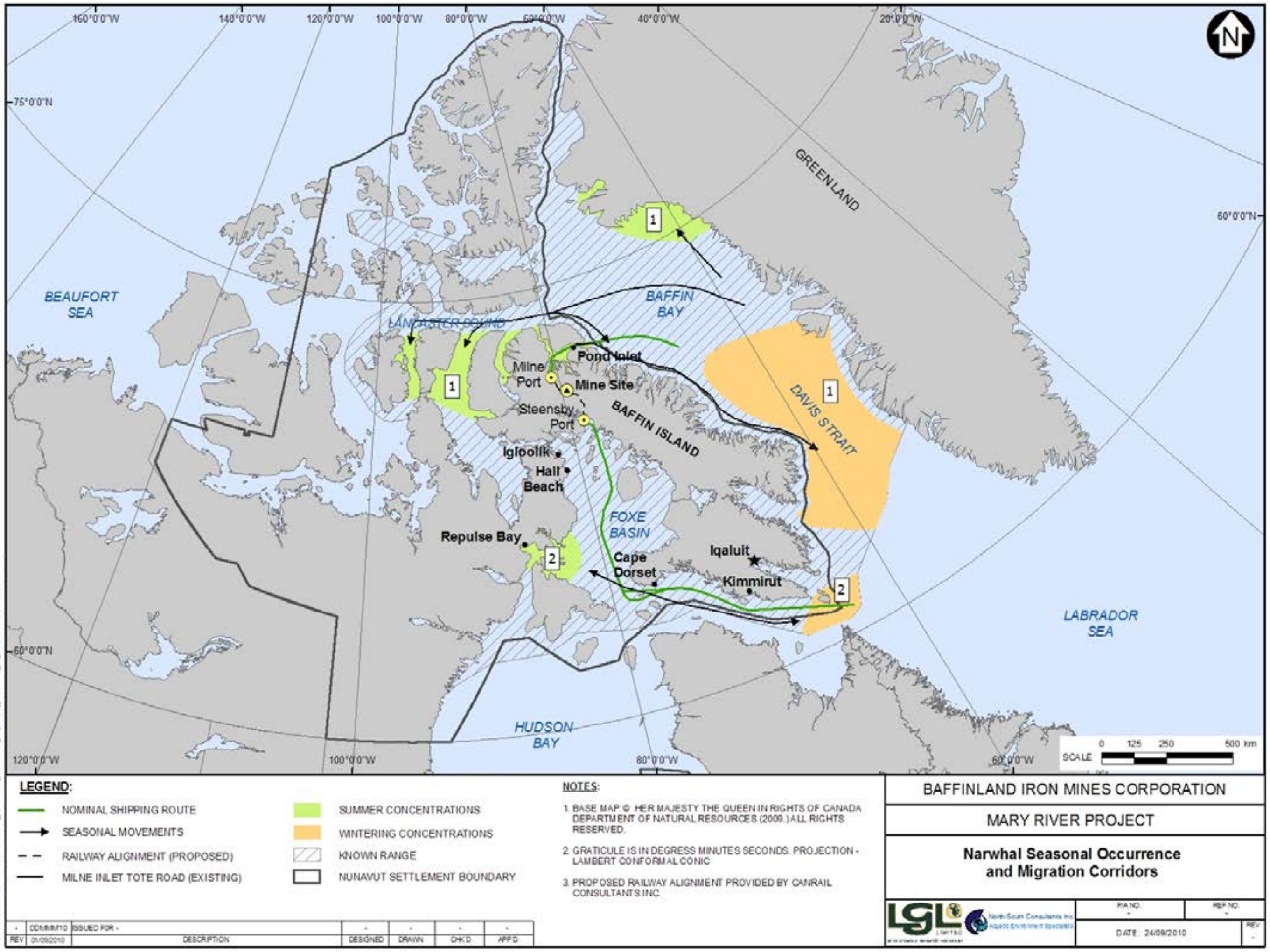

Figure 2.7 Seasonal Occurrence and Migration Corridors for the Baffin Bay (1) and Hudson Bay (2) Narwhal Populations

The narwhal is under consideration for listing under SARA, but is listed as Special Concern by COSEWIC (2010). It is listed as Near Threatened on the IUCN Red List of Threatened Species (IUCN 2010).

An estimated 34,363 (± SE 8282) narwhals were present in offshore areas of Baffin Bay from May to July 1979 (Koski and Davis 1994). This survey did not account for submerged animals and did not cover eastern Baffin Bay or the Smith Sound Kane Basin area. Most narwhals that winter in Baffin Bay summer in the eastern Canadian Arctic. Innes et al. (2002) provided an estimate of 45,358 (95% CI = 23,397 to 87,932) for the population summering around Somerset Island. That estimate was based on 1996 surveys of western Lancaster Sound, Barrow Strait, Prince Regent Inlet, and Peel Sound, thus did not include all areas in the Canadian High Arctic where narwhals are known to concentrate (e.g., Gulf of Boothia, Admiralty Inlet, and Eclipse Sound). A recent reanalysis of 2002 to 2004 summer aerial surveys of narwhals in the Canadian High Arctic resulted in estimates of 27,662 for the Prince Regent and Gulf of Boothia area, 20,211 for the Eclipse Sound area, 10,078 for the East Baffin Island fjord areas, and 5,361 for Admiralty Inlet (this latter estimate is thought to be negatively biased) for a total estimate in excess of 63,000 narwhals (NAMMCO 2010b).

Kingsley et al. (1994) reported on replicate aerial surveys of narwhal at the Eclipse Sound summering area from 1987 to 1993. The number of narwhals observed per survey ranged up to more than 600 animals. However, the estimate was not corrected for submerged animals and considering narwhal diving behaviour, it is likely that more than 1500 narwhal could have been present (Kingsley et al. 1994). The distribution of narwhal in Eclipse Sound, Milne Inlet, Koluktoo Bay, and Tremblay Sound during summer appeared to be driven by the presence and distribution of ice and by the presence of killer whales (Kingsley et al. 1994).

The putative Hudson Bay narwhal population was estimated at 1,780 (90% CI = 1,212 to 2,492) in 2000 (COSEWIC 2004b). This estimate was higher than the previous estimate of 1,355 (90% CI = 1,000 to 1,900) from 1984 (COSEWIC 2004b). Considering that neither estimate was corrected for submerged individuals or weather conditions, and that only the 2000 estimate also included northern Lyon Inlet and Foxe Channel, it is possible that the Hudson Bay population could number ~3,500 narwhals during summer (COSEWIC 2004b).

General Biology

Gestation period is thought to be 14 to 15 months (COSEWIC 2004b), and narwhal calving generally takes place takes during July and August, although it can occur as early as late May (Mansfield et al. 1975; Cosens and Dueck 1990; Gonzalez 2001). Based on the racemisation of L-aspartic acid to D-aspartic acid in the nucleus of the eye lens, ~20% of the 75 sampled narwhals in West Greenland were estimated to be older than 50 years, and a maximum age of 115 ± 10 years was calculated for a female (Garde et al. 2007).

Narwhals are social and are usually seen in small groups (Strong 1988). They can be encountered in groups of up to hundreds during migration, and concentrations occur along some fast-ice edges (Strong 1988). Observations from Bruce Head, at the mouth of Koluktoo Bay, indicated that narwhals travelled in clusters that averaged 3.5 (range: 1 to 25), and that they entered the bay in larger clusters than when they exited (Marcoux et al. 2009).

They tend to prefer coastal areas that provide deep water and protection from the wind during summer (Kingsley et al. 1994; Koski and Davis 1994; Richard et al. 1994), and appear to favour deep fjords and the continental slope during winter, in areas where water depths are 1000 to 1500 m and marine water upwelling increases biological productivity and, consequently, the abundance of squid and flatfish (turbot, Greenland halibut) on which they feed (Dietz and Heide-Jørgensen 1995; Dietz et al. 2001). The maximum recoded dive depth and dive duration were 546 m and 24.8 minutes, based on satellite tags placed on three juvenile narwhals off northeast Svalbard, Norway, in August 1998 (Lydersen et al. 2007).

Geographic and Seasonal Distribution

The distribution of ice and open water (leads in fast ice and density of pack ice) is an important habitat feature that affects narwhal migration patterns and winter distribution (Koski and Davis 1994; Laidre et al. 2004). Narwhals make annual movements between summering and wintering areas, the timing of which can vary considerably, depending on ice conditions. Although the timing of their movements is variable, narwhal show high levels of site fidelity, annually returning to well-defined summering and wintering areas (Laidre et al. 2004).

Narwhals occur in the RSA throughout the year, occupying southern Baffin Bay and northern Davis Strait in the winter, and moving north to summering areas in Melville Bay, Eclipse Sound, Smith Sound, and beyond Lancaster Sound (see Figure 2.7). Important summering areas in Baffin Bay include Eclipse Sound, Inglefield Bredning, and Smith Sound-Kane Basin (Koski and Davis 1994). Greenland halibut and redfish remains were found in stomachs of narwhals captured in Pond Inlet in the early summer season (Finn and Gibb 1982 in Richard et al. 1994). Satellite tracking studies of narwhals summering in Tremblay Sound and Melville Bay have shown that summering narwhals remain in a relatively small area during August (Dietz and Heide-Jørgensen 1995; Dietz et al. 2001).

Narwhals begin migrating out of their summering areas in groups of a few hundred to several thousand just before freezeup begins in late September (Koski and Davis 1994). Those summering near Somerset Island enter Baffin Bay north of Bylot Island in mid- to late October (Heide-Jørgensen et al. 2003c). The subpopulation that summers in Pond Inlet starts migrating down the east coast of Baffin Island in late September (Dietz et al. 2001). By mid- to late October, narwhals leave Melville Bay and migrate southward along the west coast of Greenland in water depths of 500 to 1000 m (Dietz and Heide-Jørgensen 1995). Narwhals generally arrive in their wintering areas in November (Heide-Jørgensen et al. 2003c).

Narwhals winter in heavy pack ice with 90 to 99% ice cover (Koski and Davis 1994). The Baffin Bay narwhal population winters at two discrete areas in the pack ice in central Baffin Bay (see Figure 2.7; Heide-Jørgensen et al. 1993; Koski and Davis 1994; Heide-Jørgensen et al. 2002a; Laidre et al. 2004), and in polynyas at the north end of Baffin Bay (Richard et al. 1998a). During early April and May, narwhal wintering in Davis Strait and southern Baffin Bay follow the east coast of Baffin Island north to Lancaster Sound, where they move westward as ice conditions permit (usually late June and July) to summering areas in Barrow Strait, Peel Sound, Prince Regent Inlet, Admiralty Inlet, and Eclipse Sound (see Figure 2.7; Read and Stephansson 1976; Cosens and Dueck 1991; Remnant and Thomas 1992; Kingsley et al. 1994; Koski and Davis 1994; Richard et al. 1994).

A small number of these whales might move through Fury and Hecla Strait into northern Foxe Basin (see Figure 2.7; Brody 1976; Stewart et al. 1995), and concentrations also occur at Melville and Inglefield bays in west Greenland (Heide-Jørgensen 1994). Recent satellite tracking studies of 21 narwhals tagged in Admiralty Inlet in 2003 and 2004 have shown that the summer distribution pattern of whales from Admiralty Inlet differs from that shown in previous tracking studies from Somerset Island, Eclipse Sound, and Melville Bay (Dietz et al. 2008). Narwhals summering in Admiralty Inlet tend to migrate into Lancaster Sound two weeks after, and out of Lancaster Sound two weeks before, narwhals summering around Eclipse Sound. Whereas the winter range of narwhals from Admiralty Inlet did overlap with that of animals from Melville Bay and Eclipse Sound in central southern Baffin Bay and northern Davis Strait, it did not overlap with the more northerly winter range of narwhals from Somerset Island (Dietz et al. 2008).

The timing and routes used by Hudson Bay narwhals during spring and fall migrations are less well-understood. They are thought to winter in eastern Hudson Strait (Richard 1991; Koski and Davis 1994), and move toward summering areas, located primarily in the Repulse Bay area north of Southampton Island, during late June (see Figure 2.7; Gonzalez 2001). Most individuals remain in the vicinity of northern Southampton Island, including Repulse Bay, Frozen Strait, western Foxe Channel, and Lyon Inlet (Richard 1991; DFO 1998a; Gonzalez 2001), and some might move north toward Fury and Hecla Strait, in the vicinity of Igloolik (Stewart et al. 1995). Fall migrations to Hudson Strait begin in late August or early September, depending on ice conditions (Richard 1991; Gonzalez 2001).

Recent tracking studies examining the movements of nine narwhals equipped with satellite-linked tracking devices (five in August 2006 and four in August 2007) in the vicinity of Repulse Bay (Westdal et al. 2010). The tagged narwhals used the same migration route in both years. Animals started moving out of Repulse Bay and Lyon Inlet in September and were transmitting off the northeast coast of Southampton Island by early November. They then travelled into Hudson Strait, passing north of Nottingham Island, but on both sides of Salisbury Island and Mills Island, through Foxe Channel before arriving at their wintering grounds by late December (Westdal et al. 2010). Two transmitters from 2006 were still transmitting in May 2007 when the animals began migrating back into Hudson Strait (Westdal et al. 2010).

2.3.11 White-Beaked Dolphin (*Lagenorhynchus albirostris*)

Population Status and Abundance

The white-beaked dolphin is not listed under SARA, is listed as Not at Risk by COSEWIC (2010), and is listed as Least Concern on the IUCN Red List of Threatened Species (IUCN 2010). It is found in cold temperate and subarctic waters in the North Atlantic (Reeves et al. 1999a).

Populations in the eastern and western North Atlantic appear to be distinct (Kinze 2002). There are few estimates of abundance, but there could be a hundred thousand or more throughout their range (Reeves et al. 1999a). The white-beaked dolphin is less abundant in the western North Atlantic Ocean than in the eastern portion of their range, with the greatest abundance occurring off Labrador and southwest Greenland (Kinze 2002).

General Biology

White-beaked dolphins typically form groups of 5 to 50, but group sizes can range up to several hundred (Reeves et al. 1999a; Kinze 2002). White-beaked dolphins are known to be active bow riders (Reeves et al. 2002).

Geographic and Seasonal Distribution

White-beaked dolphins are found primarily in shelf waters (Reeves et al. 2002). In spring, white-beaked dolphins move northward toward south Greenland and into Davis Strait, where they remain for the summer; starting in autumn and as late as November, they move southward again (APP 1982).

White-beaked dolphins have not been reported in the RSA.

2.3.12 Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*)

Population Status and Abundance

The Atlantic white-sided dolphin is not listed under SARA and is listed as Not at Risk by COSEWIC (2010). It is listed as Least Concern on the IUCN Red List of Threatened Species (IUCN 2010). It occurs in temperate and subarctic portions of the North Atlantic Ocean, where it is quite abundant (Reeves et al. 1999b). It typically occurs in areas with high seabed relief, and along deep oceanic and continental shelf waters 400 to 1000 m deep. The total population of Atlantic white-sided dolphins in the North Atlantic could be as high as a few hundred thousand (Reeves et al. 1999b).

General Biology

The Atlantic white-sided dolphin is gregarious, commonly seen in groups of 50 to 60, and occasionally seen in groups numbering hundreds (Reeves et al. 1999b). There is some sex and age segregation among groups (Jefferson et al. 1993). Whitehead et al. (1998) reported a mean group size of 8.8 off Nova Scotia.

Geographic and Seasonal Distribution

The Atlantic white-sided dolphin occurs in temperate and subarctic waters of the North Atlantic Ocean as far north as southern Greenland and possibly Davis Strait (APP 1982; Reeves et al. 2002). The species ranges to its northern limits during the warmer months (Reeves et al. 2002). References to this species in Davis Strait are poorly documented (Gaskin 1992 in Reeves et al. 1999b).

Off West Greenland, it has been reported near Nuuk, and possibly also occurs as far north as Uummannaq, although the same local name is applied to this species and the white-beaked dolphin (Reeves et al. 1999b).

Atlantic white-sided dolphins have not been reported in the RSA.

2.3.13 Killer Whale (*Orcinus orca*)

Population Status and Abundance

The killer whale is cosmopolitan and globally fairly abundant; it has been observed in all oceans of the world (Ford 2002). Killer whales off eastern Canada are not listed under SARA and are listed as Special Concern by COSEWIC (2010). The species is listed as Data Deficient on the IUCN Red List of Threatened Species (IUCN 2010). Worldwide, there is a minimum population estimate of 50,000 (Forney and Wade 2007). There are no population estimates or data to differentiate among stocks of killer whales in the northwest Atlantic Ocean or Canadian Arctic. At least 15 sightings of groups comprising more than 40 killer whales have been reported in the Canadian Arctic (Higdon 2007).

General Biology

Killer whales are sexually dimorphic. Adult males are larger than females and are easily identified by their large dorsal fin (Baird 2001). Calving in western Canada occurs year-round, but might be more concentrated between during spring and fall. Gestation lasts 12 to 17 months, and weaning is thought to occur at a relatively young age (1 to 2 years). Females calve every 2 to 12 years with a mean of about 5 years between viable offspring (Olesiuk et al. 1990).

Killer whales in the Pacific Northwest are segregated socially, genetically, and ecologically into three distinct groups: residents, transients, and offshore animals. It is unknown if killer whales in the Canadian Arctic can be classified into similar ecotypes (Higdon 2007). Group sizes of resident pods are 5 to 50, whereas transient pods number 1 to 7 (Bigg et al. 1987). Killer whales prey on a wide range of animals, including squid, fish, and a wide array of marine mammals (Baird 2001). Killer whales in the Arctic feed primarily on a variety of marine mammals including narwhal, beluga, bowheads, and seals (Higdon 2007).

Geographic and Seasonal Distribution

The killer whale ranges from the Atlantic Ocean up into Davis Strait as far north as Lancaster Sound, and there are a few known areas where killer whales are regularly sighted: in Cumberland Sound, Lancaster Sound, and Pond Inlet (Baird 2001). Killer whales are uncommon in northern Baffin Bay and Lancaster Sound from August to October (Koski and Davis 1979). They are found only rarely along or within pack ice (Reeves et al. 2002), so they probably remain in northern areas until forced south by pack ice formation (APP 1982).

Sightings of killer whales in the Canadian Arctic have been reported throughout the year with the majority (87%) occurring during summer (Higdon 2007). Regular occurrences of killer whales have been reported in Pond Inlet in spring, summer, and fall, with most sightings (n=24) reported during July–August (Higdon 2007). Winter sightings have been reported for Disko Bay (Higdon 2007).

Killer whales are relatively recent arrivals to the Hudson Bay area. Some 29 sightings have been reported between 1900 and 1990 in the Hudson Bay complex, which includes Hudson Strait, Hudson Bay, Foxe Basin, and eastern Hudson Bay. Small numbers of killer whales are occasionally reported near Igloolik (Higdon 2007). Since 1990, 45 sightings have been recorded in the area (Higdon 2007).

The increase in sightings might be attributable in part to climate induced reductions in the duration and extent of sea ice cover in the area (COSEWIC 2008). It has been suggested that their distribution and movement patterns in polar areas might be limited by the presence of pack ice in the winter months (Reeves and Mitchell 1988), but more recently, killer whales have been observed well within Antarctic sea ice during winter (Gill and Thiele 1997). There is no direct evidence to show that arctic killer whales make seasonal migrations in response to changing ice conditions (Baird 2001; Higdon 2007).

2.3.14 Long-finned Pilot Whale (*Globicephala melas*)

Population Status and Abundance

The long-finned pilot whale is not listed under SARA, is listed as Not at Risk by COSEWIC (2010), and is listed as Data Deficient on the IUCN Red List of Threatened Species (IUCN 2010). It is abundant throughout the North Atlantic Ocean as far north as 70°N (Bernard and Reilly 1999), with some evidence of segregation between the west and east (Bloch and Lastein 1993). Minimum population estimates include at least 10,000 in the western North Atlantic (Reeves et al. 2002) and 6,731 to 19,603 off eastern Newfoundland and Labrador (Hay 1982). In comparison, there are an estimated 778,000 long-finned pilot whales in the eastern North Atlantic Ocean (Buckland et al. 1993).

General Biology

Pilot whales are very social; they are rarely seen travelling alone and are usually seen in groups of 20 to 90. Long-finned pilot whales sighted off southwestern Greenland have been seen singly or in groups up to thousands of individuals, with average group sizes of 8 to 50 (Abend and Smith 1999). Whitehead et al. (1998) reported an average group size of 11.4 for 54 sightings off Nova Scotia. Heide-Jørgensen et al. (2002) found that pilot whales outfitted with time-depth recorders dove to depths of up to 828 m, although most of their time was spent above 7 m.

Geographic and Seasonal Distribution

The long-finned pilot whale is found in the deeper waters of the Labrador Sea and up into Davis Strait as far as ~67°N in West Greenland waters, south of Disko Island (Abend and Smith 1999).

Concentrations occur around 62°N and 65°N, with all sightings occurring along the outer slopes of the fishing banks (Larsen et al. 1989), but they are not generally abundant in West Greenland waters (Abend and Smith 1999). Historically they have been recorded in Baffin Bay only during warm-temperature periods. Historic whaling data show that most were caught during June to September (Abend and Smith 1999). In May, they have been seen along the pack ice edge in Davis Strait, and in June and July, they have been recorded north of 64°N in Davis Strait (APP 1982).

Pilot whales have not been recorded in the RSA.

2.3.15 Harbour Porpoise (*Phocoena phocoena*)

Population Status and Abundance

The harbour porpoise inhabits shallow, coastal waters in temperate, subarctic, and arctic regions in the northern Hemisphere (Read 1999). The harbour porpoise is under consideration for listing under SARA, and is listed as Special Concern by COSEWIC (2010). It is listed as Least Concern on the IUCN Red List of Threatened Species (IUCN 2010). There are three subpopulations of harbour porpoise in Canadian waters—the Newfoundland-Labrador subpopulation is the one that occurs in the RSA. There is another subpopulation off West Greenland (Lockyer et al. 2001). There is no estimate of abundance for the Newfoundland-Labrador subpopulation (COSEWIC 2006a).

General Biology

Harbour porpoises tend to avoid vessels (Reeves et al. 2002). They are usually seen in small groups of one to three, often including at least one calf; occasionally they form much larger groups (Bjørge and Tolley 2002). They dive to depths of at least 220 m and stay submerged for more than five minutes (Harwood and Wilson 2001).

Geographic and Seasonal Distribution

The harbour porpoise can be found as far north as Cape Aston (70°N) off Baffin Island (COSEWIC 2006a) and up to Cape York (~76°N) off the west coast of Greenland (Read et al. 1997). In Greenland, it is most abundant during May to November, with a peak calving season at the beginning of July (Teilmann and Dietz 1998). They mainly inhabit inshore waters such as bays and harbours, but can occur up to 100 km offshore (Lear and Christensen 1975). During one survey of the 1000-m contour line in Davis Strait to the mouth of Hudson Strait in August, few (13 sightings of one to five animals) were sighted at 58 to 61°N (H. Whitehead, pers. comm. in COSEWIC 2006a). They are probably most common in the Bay of Fundy and southwest Greenland from 65 to 67°N (Kapel 1977).

The range of the harbour porpoise includes the eastern end of the southern RSA.

2.3.16 Atlantic Walrus (*Odobenus rosmarus*)

Population Status and Abundance

Atlantic walrus have a discontinuous circumpolar distribution, occurring from the northeastern coastal waters of Canada and Greenland to the Western Kara Sea, including Svalbard and Franz Josef Land. Stewart (2002) described four extant stocks that occur in Canadian waters, but also suggested that these stocks can be further divided on the basis of genetic, isotope, body size differences, and distributions of animals. Three of these stocks occur in the RSA: the Baffin Bay (High Arctic) population, the Foxe Basin population, and the North Hudson Bay Davis Strait population (COSEWIC 2006c). The Baffin Bay (High Arctic) population is shared by Canada and Greenland, and there could also be exchange between the Northern Hudson Bay Davis Strait and Central West Greenland populations (COSEWIC 2006b). The Canadian walrus population has no status under SARA. It is listed as Special Concern by COSEWIC and is listed as high priority candidate wildlife species for assessment by the SSC (COSEWIC 2010). The species is listed as Data Deficient on the IUCN Red List of Threatened Species (IUCN 2010).

Recent tagging data and other information indicate that some finer discrimination of walrus populations could be required. Stewart (2008) suggests that the Baffin Bay (High Arctic) population could be considered to be three stocks: Baffin Bay, west Jones Sound, and Penny Strait-Lancaster Sound stocks. All three of these stocks will be discussed as a single population here because of a lack of information specific to the three individual stocks. Born et al. (1995) and DFO (2002) suggested that the Baffin Bay (High Arctic) population size are 1,700 to 2,000 and as many as 3,000, respectively, with summering populations numbering 100 in Kane Basin, 300 in Buchanan and Princess Marie bays on Ellesmere Island, 300 to 600 in Jones Sound and along eastern Ellesmere Island, and 1,000 in the Lancaster Sound Barrow Strait area (Born et al. 1995).

The Foxe Basin population might also comprise two stocks, based on recent Pb isotope ratios and the distribution of harvest sites: North Foxe Basin and Central Foxe Basin (Stewart 2008). The Foxe Basin stocks will be discussed as a single population here because of a lack of information specific to the two individual stocks. The best available population estimate for the Foxe Basin population is 5,500 (Born et al. 1995). This estimate, however, has wide uncertainty limits.

Born et al. (1995) estimated the size of the North Hudson Bay Davis Strait population at 6,000. This estimate, however, was based on few sightings in a wide geographical area over a long period and also has a high uncertainty (COSEWIC 2006b).

Despite the paucity of abundance and trend data, shifts in walrus distribution, abandonment of main haul-out sites, and increased areas over which hunters must now travel to access walrus suggest that most stocks are declining (Stewart 2002).

General Biology

In the Qaanaaq area (formerly Thule) of northwest Greenland, calves are born from early April to mid July, with peak whelping in late May and early June (Born 1990, COSEWIC 2006c). Lactation lasts up to 25 to 27 months (Fisher and Stewart 1997). Calves are able to nurse in the water and accompany females into the water when they forage (Kovacs and Lavigne 1992; Loughrey 1959; Miller and Boness 1983).

Geographic and Seasonal Distribution

Walruses are associated with moving pack ice over shallow waters of the arctic coast for much of the year (McLaren and Davis 1982; King 1983). When ice is lacking in summer and fall, they congregate and haul out on land at sites that are often situated on low, rocky shores with steep or shelving subtidal zones where animals have easy access to the water (Mansfield 1959; Salter 1979; Miller and Boness 1983). Walruses are primarily benthic feeders, and are generally confined to shallow coastal waters 80 to 100 m deep where they forage on bivalve molluscs and other invertebrates (Vibe 1950; Outridge et al. 2003; NAMMCO 2005b, 2006).

The Baffin Bay (High Arctic) population inhabits northwest Baffin Bay north from Pond Inlet to Kane Basin, and extends into Lancaster Sound, Barrow Strait, and Jones Sound in the Canadian Arctic Archipelago (see Figure 2.8; Vibe 1967; Davis et al. 1978; DFO 2002; COSEWIC 2006b). Its distribution along the west coast of Greenland extends south to the Sisimiut Region at ~67ºN (Richard and Campbell 1988; Born et al. 1995; COSEWIC 2006b). The Foxe Basin population inhabits the relatively shallow waters of northern Foxe Basin throughout the year (COSEWIC 2006b). The North Hudson Bay Davis Strait population extends north from northern Labrador to Clyde River on the east coast of Baffin Island (Richard and Campbell 1988; Born et al. 1995; Stewart 2002). It extends west past Southampton Island, into northern Hudson Bay, and into southern Foxe Basin (Born et al. 1995).

Walruses are migratory; they move south as the ice advances in fall and north as it recedes in spring (Fay 1981). Walruses winter in the offshore pack ice of Davis Strait and along the west Greenland coast primarily at 66 to 69ºN (Vibe 1967; Davis et al. 1980; APP 1982; McLaren and Davis 1982), the North Water Polynya and the polynya off eastern Devon Island, off northern Labrador (Loughrey 1959; Boles et al. 1980), and in Foxe Basin ranging from the floe edge along the north side of Rowley Island heading south to about 67.5ºN, parallel to the Melville Peninsula (COSEWIC 2006b).

In May and June, walruses begin to move to summering areas in the Canadian Arctic Archipelago (Davis et al. 1978), possibly the west coast of Greenland around Disko Island and the Thule District (Mansfield 1973), the east coast of Baffin Island from Cape Dyer north to ~67ºN (Mallory and Fontaine 2004), Cumberland Sound (Haller et al. 1967; Mallory and Fontaine 2004), and the coast of Hall Peninsula on southeast Baffin Island (Meldrum 1975; MMI 1979). By late July or early August, most are at their summering areas (Gunn 1949; Lawrie 1950; Finley et al. 1974). Fall migration from summering areas is determined by ice conditions. No data are available, but it is thought that routes taken during autumn migration retrace those of the spring migration (APP 1982).

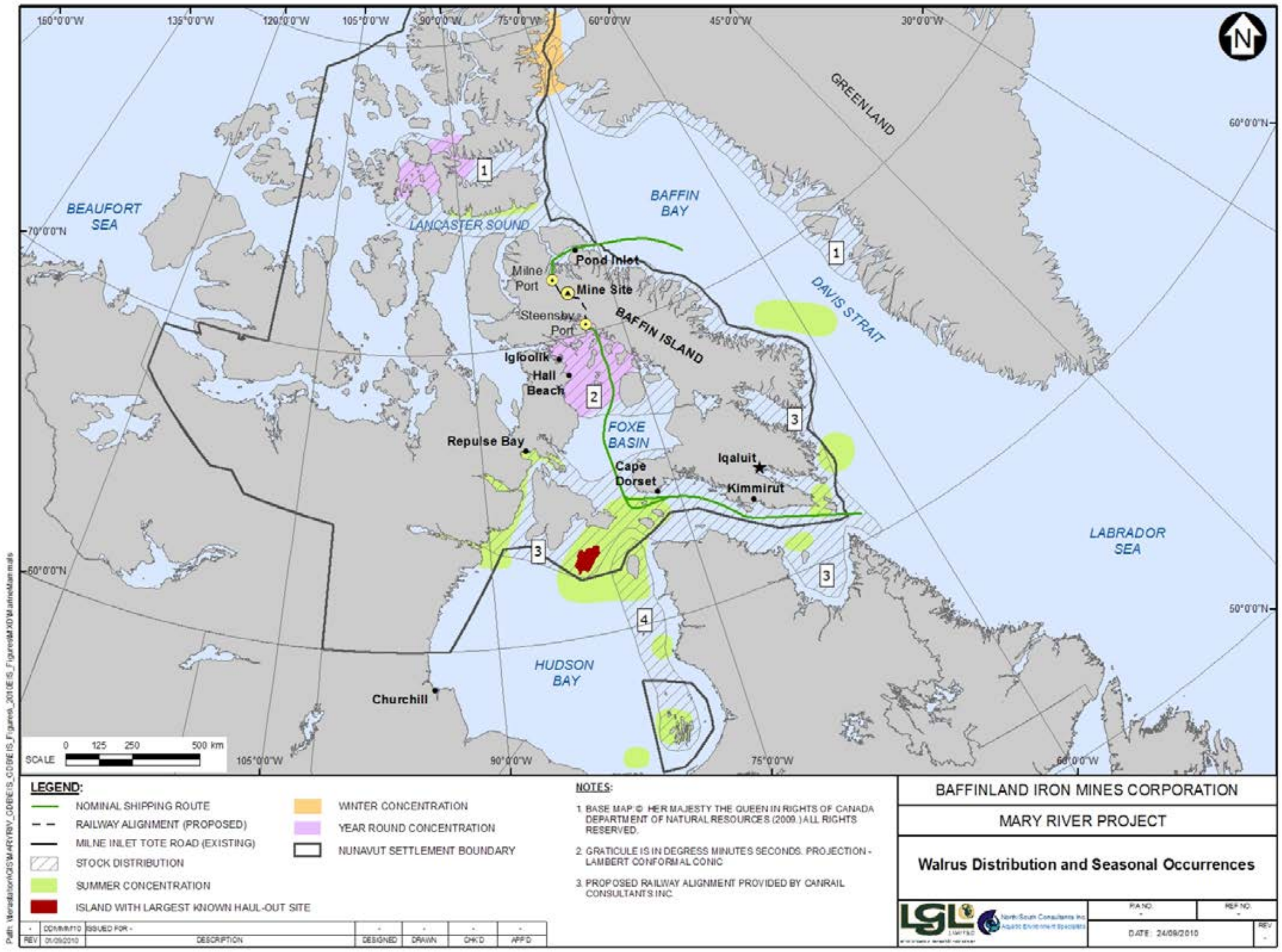

Figure 2.8 Distribution of Putative Walrus Stocks: Baffin Bay (High Arctic) (1), Foxe Basin (2), Northern Hudson Bay Davis Strait (3), and South and East Hudson Bay (4) (after Born et al. 1995; NAMMCO 1995; COSEWIC 2006b; Beckett et al. 2008)

Walrus are year-round residents in Foxe Basin. They are thought to undergo north-south movements in the basin (Davis et al. 1980; Anderson and Garlich-Miller 1994), perhaps in response to ice conditions, and move from summering areas around Jens Munk, Koch, Rowley, and the Spicer islands into Foxe Channel during winter (Orr et al. 1986). In recent decades, there has been an eastward shift in walrus summering areas away from the west side of northern Foxe Basin (Brody 1976; Anderson and Garlich-Miller 1994). The shift might be in response to hunting pressure from Igloolik and Hall Beach, or because of a decline in population size or habitat (Stewart 2002). The absence of walrus in the area between northern Hudson Bay and southern Foxe Basin appears to be primarily caused by a lack of islands that can be used as haul-outs (Stephenson and Hartwig 2010).

Although walrus are known to move into Steensby Inlet, the extent to which habitat within Steensby Inlet is used is not known. During the open-water period, they haul out onto beaches and coasts among the islands south of Steensby Inlet and onto drifting pans of ice.

2.3.17 Bearded Seal (*Erignathus barbatus*)

Population Status and Abundance

The bearded seal has a patchy circumpolar distribution as far north as 85ºN (Burns 1981). Canadian populations are not listed under SARA and are listed as Data Deficient by COSEWIC (2010). The species is listed as Least Concern on the IUCN Red List of Threatened Species (IUCN 2010). The global bearded seal population is estimated to be >500,000 (Riedman 1990). Discrete populations of bearded seals have not been delineated in Canadian waters, but strong site fidelity to breeding sites is thought to occur (Cleator et al. 1989). Davis et al. (2008) reported overall limited gene flow among bearded seal populations in the Atlantic, although no significant differentiation was found between walrus sampled in Qaanaaq and the Labrador Sea. Though there is no reliable abundance estimate for bearded seals in Canadian waters, Cleator (1996) suggested an estimate of >190,000.

General Biology

Bearded seals typically occur alone or in small groups. Whelping occurs between late April and early May, and pups are typically born on unstable pack ice where they are weaned after 12 to 18 days.

Bearded seals eat a wide variety of foods and are generally considered to be benthic feeders that prey on an array of benthic invertebrates and fish, although pelagic fish are also taken (Lowry et al. 1980; Finley and Evans 1983; Antonelis 1994). Bearded seals are highly vocal, and males use underwater vocalizations to establish breeding territories and advertise breeding condition (Stirling et al. 1983; Cleator et al. 1989).

Geographic and Seasonal Distribution

The bearded seal's distribution is largely determined by the presence of shallow water (Burns 1981; Kingsley 1986; Harwood et al. 2005). Bearded seals usually move into areas of open water <200 m deep when the pack ice retreats, although some associate with ice year-round (Burns and Frost 1979). They are rarely found in fast-ice areas, but are widely dispersed in open-water areas of pack ice where leads and cracks are frequent, and where ice pans are sufficient for haul-out sites (McLaren and Davis 1982).

In southern Baffin Bay and Davis Strait, bearded seals are found north of Cape Dyer, with peak densities at 68 to 69ºN. Bearded seals were widespread in March and April in both the close and open pack ice in southern Baffin Bay, Davis Strait, and the Labrador Sea (McLaren and Davis 1982). Koski (1980) reported bearded seals to be widespread at low densities in May to July 1979 in the offshore pack ice of Baffin Bay (Koski and Davis 1979). Small numbers might overwinter in polynyas along the ice edge off southeast Ellesmere Island (Finley and Renaud 1980), and the Qaanaaq area of northwest Greenland (Vibe 1950). Farther south, bearded seals have also wintered on the landfast and pack ice off north and central Labrador (Schwartz 1977; Boles et al. 1980; APP 1982). When the pack ice begins to disintegrate, they move almost exclusively along coasts, into shallow (<200 m), open-water areas (APP 1982; Harwood et al. 2005; cf. Johnson et al. 1976; Koski and Davis 1980).

Although they are regarded as common along the northwestern coast of Greenland, north of Cape York, they are rare in Melville Bay (Vibe 1950) but somewhat more common to the south (Kapel 1975; APP 1982). Bearded seals have also been identified on pack ice far offshore in central and western Davis Strait and the Labrador Sea, areas where water depths greatly exceed 200 m (McLaren and Davis 1982).

Bearded seals are common in the RSA. Large numbers of bearded seals occur in around northeastern Baffin Island and in Lancaster Sound (see Figure 2.9; Cleator 1996; Kovacs 2002). The many polynyas of northern Foxe Basin support several colonies of bearded seals. In particular, Northern Foxe Basin is an area of high (or likely high) density for bearded seals (see Figure 2.9; Beckett et al. 2008).

2.3.18 Harbour Seal (*Phoca vitulina*)

Population Status and Abundance

The harbour seal occurs between ~30ºN and 80ºN along the east coast of North America (Burns 2002). It is not listed under SARA, is considered Not at Risk by COSEWIC (2010), and is listed as Least Concern on the IUCN Red List of Threatened Species (IUCN 2010). In 1993, there were an estimated 40,000 to 100,000 in the western Atlantic Ocean, of which 30,000 to 40,000 were in Canadian waters (Burns 2002).

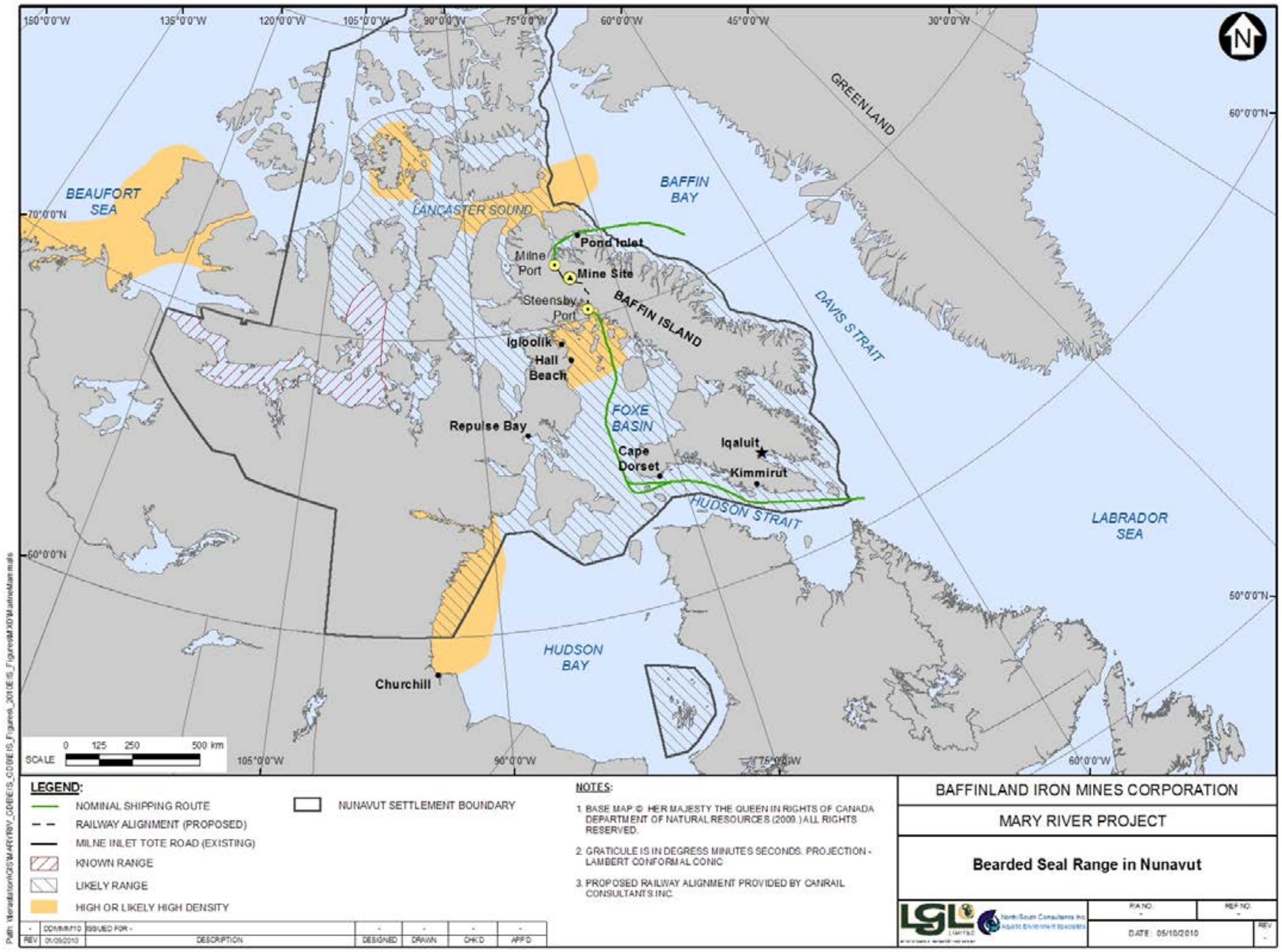

Figure 2.9 Bearded Seal Distribution and Relative Density in Nunavut (Source: Beckett et al. 2008)

General Biology

Whelping occurs in late May with lactation lasting ~4 weeks (Boulva and McLaren 1979; Härkönen and Heide-Jørgensen 1990). Adults are relatively sedentary throughout the year, whereas subadults and pups have longer-range movements (Bonner and Witthames 1974; APP 1982).

Geographic and Seasonal Distribution

The harbour seal occurs only in small numbers along the coasts of eastern Baffin Island as far north as 76ºN (Mansfield 1967; APP 1982). Harbour seals have also been recorded occasionally around Pond Inlet (Tuck 1957; Bissett 1967) and along eastern Ellesmere Island (Mansfield 1967; Smith and Taylor 1977). They are more common along the coast of Labrador and farther south (Mansfield 1967; Boulva and McLaren 1979). Although there are few winter records and the extent of movement is unknown, adults have been found to overwinter in areas of open water (Mansfield 1967; Boulva and McLaren 1979) and return to their bays and inlets when the ice breaks up in April and May (APP 1982). During the summer and autumn, they spend the majority of time hauled out on beaches (APP 1982). Harbour seals usually forage <50 km from their haul-out sites (Thompson 1993), although tagged seals have been found to disperse farther (Bjørge et al. 1995, 2002).

2.3.19 Ringed Seal (*Pusa hispida*)

Population Status and Abundance

The ringed seal is an important element of the arctic marine ecosystem, both as a main prey of polar bears, and as a major consumer of marine fish and invertebrates (Lowry et al. 1980; Smith 1987). Canadian populations are not listed under SARA and are listed as Not at Risk by COSEWIC (2010). They are listed as mid priority candidate wildlife species for assessment by the SSC (COSEWIC 2010). The species is listed as Least Concern on the IUCN Red List of Threatened Species (IUCN 2010). The population of ringed seals in the Canadian Arctic is estimated to be at least a few million (Reeves 1998) to as many as 6 to 7 million (Stirling and Calvert 1979). The NAMMCO scientific committee estimated the abundance of ringed seals in northeastern Canada and West Greenland at 1.3 million based on habitat suitability (NAMMCO 2010c). An estimated 150,000 to 200,000 occupy the pack ice in central and southern Baffin Bay (Koski 1980; Finley et al. 1982), and 50,000 inhabit the fast ice along southeast Baffin Island north of 70ºN (MMI 1979; Koski 1980).

Population structures of ringed seals across the Canadian Arctic are poorly understood in general, and no investigations of population structure specific to Baffin Bay (Teilmann and Kapel 1998) or Foxe Basin have been done. However, movements of tagged seals between west Greenland and Baffin Island suggest that seals on both sides of Baffin Bay might be part of the same population (Teilmann et al. 1999; Born et al. 2002).

General Biology

Ringed seals do not haul out on land, but haul out on sea ice to moult and rest. They also give birth to young on the ice, in subnivean (below snow on ice) lairs. Breeding or birth lairs are constructed in mid-March at the earliest (Smith et al. 1991). Ringed seals prefer to breed on landfast ice (McLaren 1958; Smith and Hammill 1981; Kelly 1988), but they also breed in pack ice (Finley et al. 1983; Kelly 1988; Koski and Davis 1979; McLaren and Davis 1982). Ringed seal pups are born in the birth lairs in April. They nurse for 38 to 44 days (Smith et al. 1991). Newborn pups do not have a layer of blubber to protect them from the cold. They rely on their white fur, high metabolic rates, and the birth lair for protection from the cold. Newborn pups can and do enter the water to escape predation, but they must return to the birth lair to prevent hypothermia (Smith et al. 1991). Pups are subject to intense predation by foxes and polar bears (Smith 1976; Kingsley 1990). In some areas, mortality from fox predation can be as high as 40% (Smith 1976).

From summer to early spring, ringed seals spend most of the time in the water feeding. During the open-water period, time at the surface is 12 to 130 seconds, and dive times are 18 to 720 seconds (Mansfield 1970).

Geographic and Seasonal Distribution

Ringed seals are common throughout Baffin Bay (McLaren and Davis 1982) and they are also common along the length of West Greenland, especially in Melville Bay (Vibe 1950; McLaren and Davis 1982). During winter and spring, ringed seals concentrate on stable shorefast ice. However, in areas where fast ice is limited, such as Baffin Bay, numbers of seals occupying the offshore pack ice can exceed those on fast ice (Burns 1970; Stirling et al. 1982; Finley et al. 1983). As ice breaks up during summer, they disperse as solitary animals or small groups throughout open-water areas (Moulton and Lawson 2002; Williams et al. 2004, Kelly et al. 2010) or to coastal areas (MacLaren 1958; Smith 1973, 1987; McLaren and Davis 1982; Harwood and Stirling 1992). Ringed seals also frequent polynyas, but are not dependent on them because they can maintain breathing holes in the ice.

Ringed seals are abundant in the LSA and RSA. Waters inland of Bylot Island provide important habitat during winter for pupping, mating, and moulting (see Figure 2.10; Beckett et al. 2008). Ringed seals also occur throughout Foxe Basin, Hudson Bay, and Hudson Strait (see Figure 2.8). An ongoing satellite-tagging study found ringed seals using northwest Foxe Basin, particularly east of Rowley Island and into Fury and Hecla Strait (Luque 2010).

Ringed seals originally were thought to remain in the same general region throughout the year, perhaps making smaller-scale movements in response to ice formation and breakup (MacLaren 1958). Subsequent studies have shown that age segregation can occur during different seasons, and that members of some populations, usually juveniles, can make extensive seasonal movements (Smith 1987; Heide-Jørgenson et al. 1992; Teilmann et al. 1999; Harwood and Smith 2003). Satellite-linked radio telemetry has shown that there is some movement by seals between the Thule area of west Greenland and Lancaster Sound, but the extent to which this occurs is not known (Born et al. 2002).

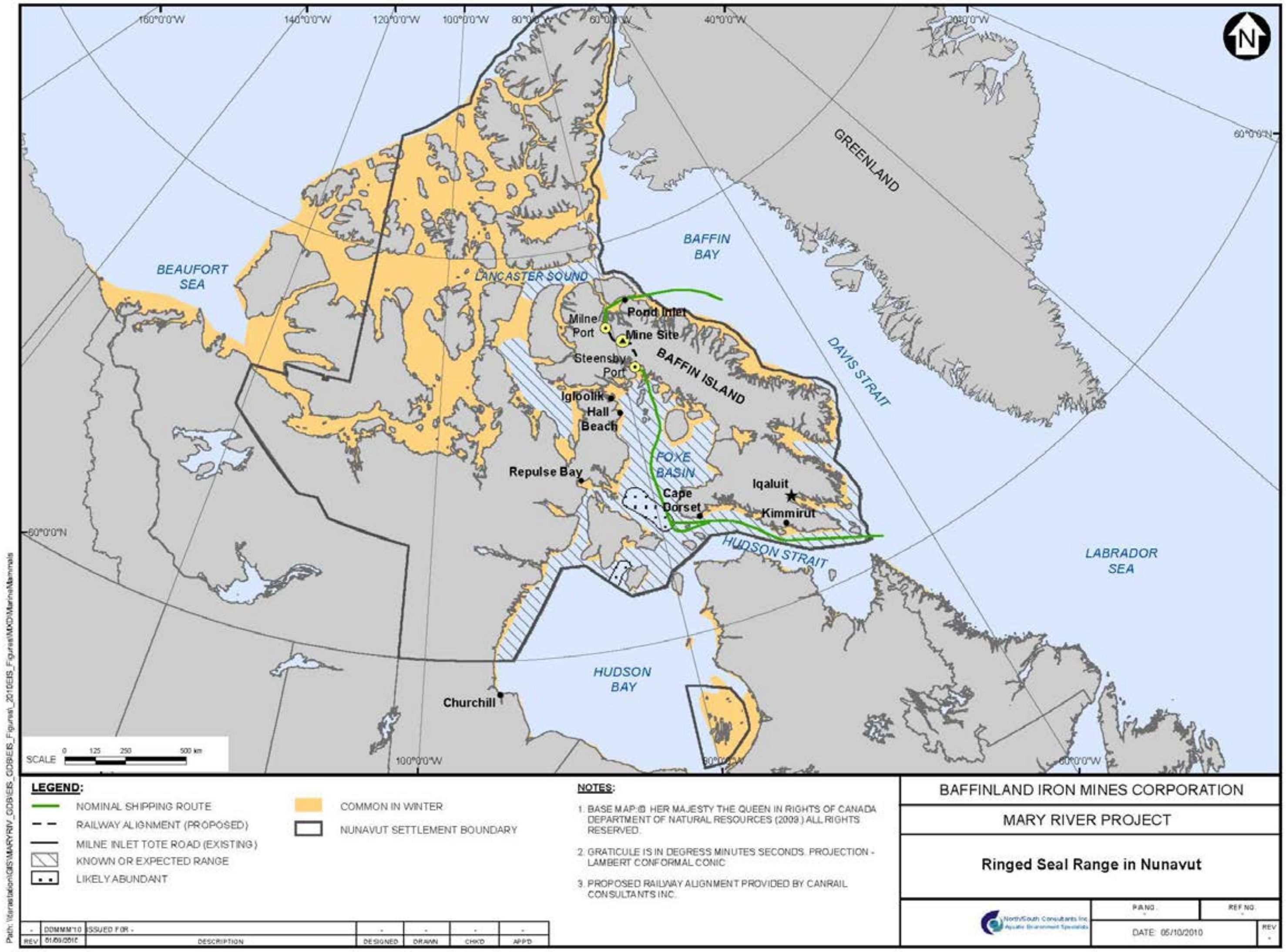

Figure 2.10 Ringed Seal Distribution and Relative Density in Nunavut (Source: Beckett et al. 2008; Stephenson et al. 2010)

2.3.20 Harp Seal (*Pagophilus groenlandicus*)

Population Status and Abundance

Harp seals occur in the northern Atlantic and Arctic oceans below 84ºN (Ronald and Healy 1981; Riedman 1990). Three geographically distinct populations occur in the North Atlantic Basin (McLaren and Davis 1982), only one of which occurs in the study area, the Northwest Atlantic population. It is the largest population, located off Newfoundland and Labrador and in the Gulf of St. Lawrence, including a total of ~5.9 million animals (SE ± 747,000) with an annual production of 991,400 pups (SE ± 58,200; ICES 2005). This population spends the summer off west Greenland and in the Canadian Arctic (NAMMCO 2001). Canadian populations of the harp seal are not listed under SARA or by COSEWIC (2010). It is a low-priority wildlife species candidate for assessment by the SSC (COSEWIC 2010). The species is listed as Least Concern on the IUCN Red List of Threatened Species (IUCN 2010).

General Biology

Harp seal whelping occurs from late February to mid-March (Jefferson et al. 2008), on the local first-year ice or landfast ice (APP 1982), and lactation lasts ~12 days (Kovacs and Lavigne 1986; Lydersen and Kovacs 1996; Oftedal et al. 1996). Females remain with their young for the first two to three weeks of life, until they are able to swim (Kovacs and Lavinge 1986). Mating usually takes place in late March or early April, after pups have weaned and before the moult in April and May (King 1983).

Harp seals dive for an average of 16 minutes (Jefferson et al. 2008) and, whereas most foraging dives occur at depths of 90 m or less (Reeves et al. 2002) dives have been recorded to a maximum depth of 370 m (Jefferson et al. 2008).

Geographic and Seasonal Distribution

In late January and February, adult harp seals move as far north as 54ºN, inside the pack, from their wintering areas along the north and east coasts of Newfoundland (APP 1982). In these northern waters, seals whelp over several hundred square kilometres throughout the pack ice (Bergflødt 1977; APP 1982; McLaren and Davis 1982). Some individual harp seals have been reported to occur throughout the edge of the pack ice north to ~63ºN in February and March (MAL 1977; MMI 1979; McLaren and Davis 1982). An area in southern Davis Strait has been identified as an important whelping patch for harp seals (see Figure 2.11; Stephenson and Hartwig 2010).

Harp seals arrive along the southwest coast of Greenland in late May and June (APP 1982). Most young-of-the-year and subadults spend the summer in inshore areas between Disko Bay and Upernavik (Sergeant 1976a), whereas adults continue up the west Greenland coast, reaching as far north as the Qaanaaq area in June and July (Vibe 1950; Sergeant 1965; APP 1982).

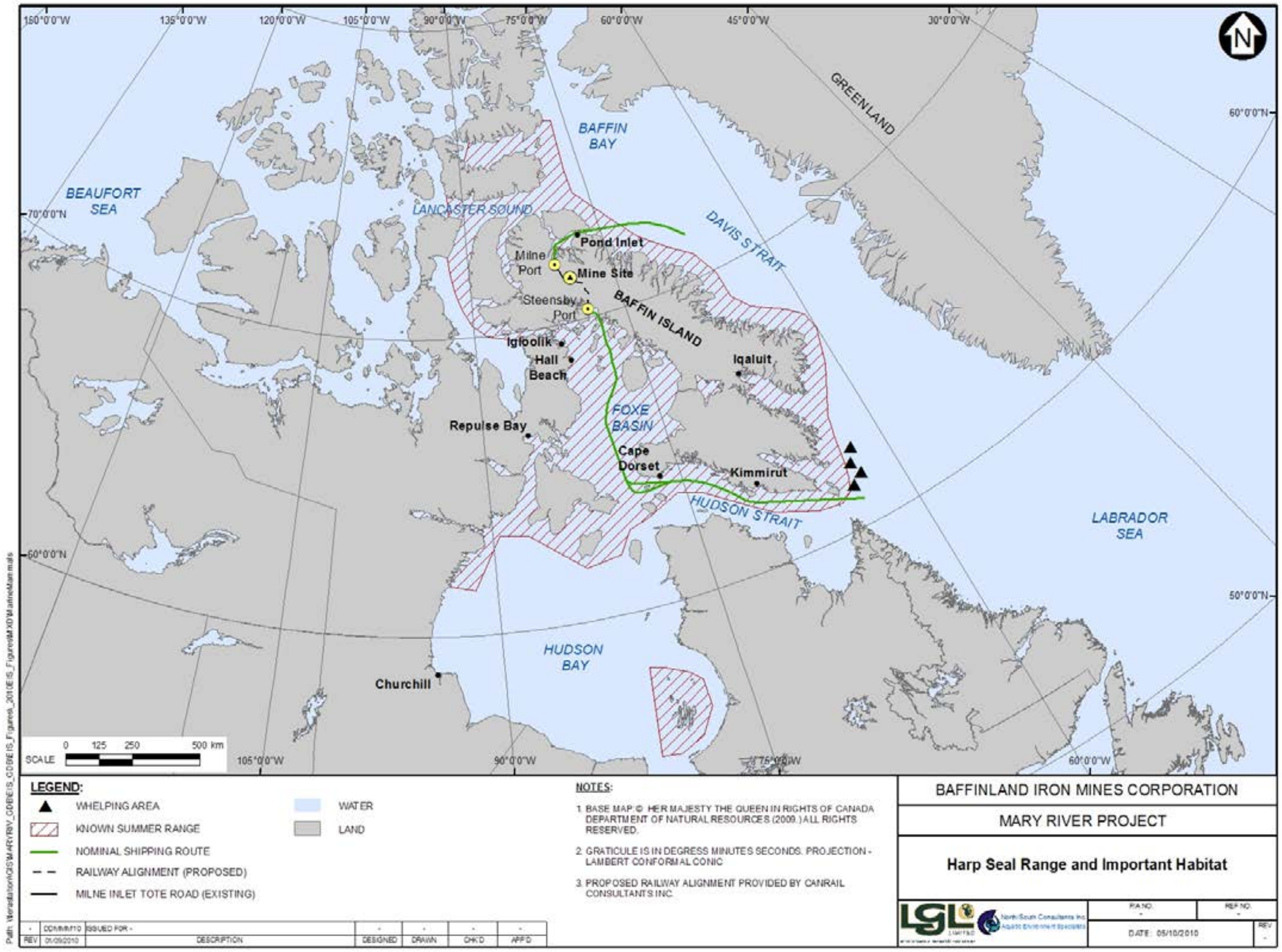

Figure 2.11 Seasonal Distribution of Harp Seals in Nunavut (Source: Beckett et al. 2008)

Harp seals enter Lancaster Sound in July and August (Johnson et al. 1976; Greendale and Brousseau-Greendale 1976; APP 1982) via mig¬ration routes along the fast-ice edge off east Baffin Island (Koski and Davis 1979) or across Baffin Bay from Greenland (Degerbøl and Freuchen 1935; Sergeant 1965). Harp seals enter Pond Inlet and Navy board Inlet at the end of July (Miller 1955). Harp seals concentrate at the mouth of Navy Board Inlet and occasionally in Eclipse Sound throughout August and September (Miller 1955; Beckett et al. 2008). The number of adult seals entering Lancaster and Eclipse Sound varies annually (Greendale and Brousseau-Greendale 1976; Johnson et al. 1976; Riewe 1977, APP 1982). Tuck (1957) estimated that 150,000 harp seals moved west past Cape Hay, Bylot Island, in late June to August 1957, but Greendale and Brousseau-Greendale (1976) counted only 16,000 passing the same area in mid-June to July 1976. Koski (1980) estimated that ~4,000 animals were in Barrow Strait east of 94ºW in late August and early September 1979, and were offshore, often in small schools, and associated with pan ice (APP 1982).

The September exodus from Lancaster Sound proceeds along the north coasts of Devon and Ellesmere islands, and then either across Smith Sound to Greenland, or along the east coast of Baffin Island (Koski and Davis 1979, 1980; APP 1982). By October, most seals have left the Canadian High Arctic and Green¬land waters, although small numbers might remain near the southwest Greenland coast until March (Anderson 1934; Sergeant 1965; Evans 1968; APP 1982; McLaren and Davis 1982).

Smaller numbers of harp seals also move westward into Hudson Bay and Fox Basin during spring. Some animals move south along the east coast of Hudson Bay, reaching Southampton Island and occasionally as far south as the Belcher Islands near James Bay (Sergeant 1986). Others head west across northern Hudson Bay and disperse along the west coast of the bay and Foxe Basin (Sergeant 1986).

By January, most adults have arrived at their wintering areas east and north of Newfoundland, although subadults can take several months longer or overwinter in Davis Strait (Fisher 1955; Sergeant 1965; IOL et al. 1978; APP 1982; McLaren and Davis 1982). Some harp seals overwinter in Cumberland Sound, or remain until mid-January (Haller et al. 1967), whereas others remain along the Greenland coast until February (Kapel 1975). During the winter, harp seals can be present as far north as the pack ice edge in southwest Davis Strait (MAL 1977).

2.3.21 Hooded Seal (*Cystophora cristata*)

Population Status and Abundance

The hooded seal is not listed under SARA and is listed as Not at Risk by COSEWIC (2010). It is a low-priority wildlife species candidate for assessment by the SSC (COSEWIC 2010). The species is listed as Vulnerable on the IUCN Red List of Threatened Species (IUCN 2010). It is limited to arctic and subarctic North Atlantic Ocean waters, usually south of 85ºN (Reeves and Ling 1981). The global population of hooded seals is estimated at 300,000 to 600,000 (Kovacs and Lavigne 1986).

There are four known whelping areas of the hooded seal, one of which is in the study area. That whelping patch forms between 62ºN and 64ºN in Davis Strait along the eastern border of the pack ice, which varies annually with the position of the ice edge across the Strait (APP 1982). The total population size of this whelping patch is estimated at 34,000 to 42,000 (MMI 1979), with a breeding population of ~20,000 to 30,000, including 10,000 to 20,000 whelping adults (APP 1982).

General Biology

Hooded seals are solitary animals (McLaren and Davis 1982). Little breeding data exist for the Gulf of St. Lawrence and Davis Strait populations; however, the timing of whelping and breeding is believed to be similar to that of the “Front” east of northern Newfoundland and southern Labrador (cf. Sergeant 1976b). Whelping occurs in late March (Bergflødt 1977) with lactation lasting ~4 days (Atkinson 1997). Females remain with their young for about one week (range of 3 to 8 days; Bergflødt 1977; APP 1982), whereas the pups remain on the pack ice for 7 to 12 days after birth (Bergflødt 1977; APP 1982). Mating usually takes place in February, after pups have weaned and before the moult in April (King 1983).

Hooded seals are generally associated with ice. They are typically found drifting in offshore pack ice ranging from 25 to 99% ice cover (McLaren and Davis 1982), and females are known to pup in loose aggregations on the pack ice (Bergflødt 1977; Thompson et al. 1998). Hooded seals typically dive to depths of 100 to 600 m for 5 to 15 minutes to forage (Folkow and Blix 1995; Folkow et al. 1996).

Geographic and Seasonal Distribution

The hooded seal is a highly migratory species. In February, hooded seals begin to assemble for breeding (APP 1982). By March, the seals establish two main whelping areas in the western North Atlantic Ocean; they are found along the pack ice edge in Davis Strait, and on the pack ice at the “Front” east of northern Newfoundland and southern Labrador (Sergeant 1976b; McLaren and Davis 1982).

In early April, hooded seals begin their northward migration to Davis Strait and the coastal waters of southwest and central Greenland (Rasmussen 1960; Mansfield 1967; Kapel 1975; cf. Sergeant 1976b; APP 1982; McLaren and Davis 1982). Some animals remain off southern and southwestern Greenland during the moulting period (Rasmussen 1960; Kapel 1975; APP 1982), whereas others proceed to Denmark Strait, or move across Baffin Bay. Others turn north after reaching the west Greenland coast and move to northwest Greenland (Vibe 1950), but are rare north of there (APP 1982).

The route of the northward migration of hooded seals is poorly known, but it is believed to follow the edge of the offshore pack ice (IOL et al. 1978; APP 1982), or along the east side of Baffin Island from Davis Strait (APP 1982). Movement off south Greenland peaks in May and early June (Kapel 1975).

From June to August, adults disperse widely from the Denmark Strait (King 1983), travelling around the southern tip of Greenland, then northward along the west coast; small numbers of animals appear in Lancaster Sound and northwest Baffin Bay during July and August. Hooded seals are occasionally sighted along the northeast coast of Bylot Island during fall; they are rare in Eclipse Sound (Koski and Davis 1979). Hooded seals remain in northwest Baffin Bay until October (Koski and Davis 1979; Koski 1980).

Although few data are available, southward migration is presumed to retrace the routes used during northward movement (Mansfield 1967). Southward migration along the Labrador coast has been observed in late September, with occasional hooded seals seen in eastern Lancaster Sound during early winter (Rasmussen 1960; Johnson et al. 1976).

The range of the hooded seal includes the eastern end of the southern RSA and eastern and northern Bylot Island in the northern RSA.

2.3.22 Polar Bear (*Ursus maritimus*)

Population Status and Abundance

The polar bear has a circumpolar distribution throughout the northern hemisphere and occurs in relatively low densities throughout most ice-covered areas as far north as 88°N (DeMaster and Stirling 1981; Durner and Amstrup 1995). The southern limit of its distribution varies annually depending on the distribution of the seasonal pack ice during winter (Stirling 1988). The global polar bear population is estimated at 22,000 to 25,000, of which at least 15,500 are in Canada or in subpopulations shared with Canada (COSEWIC 2008). The polar bear was elevated to a species of Special Concern under SARA in October 2011;it is listed as Special Concern by COSEWIC (2008), and it is listed as Vulnerable on the IUCN Red List of Threatened Species (IUCN 2010).

There are currently 18 subpopulations of polar bears recognized worldwide (not including the Queen Elizabeth and Arctic Basin “catch all” populations), 13 of which range partially or entirely within Canada (Lunn et al. 2002; COSEWIC 2008). Of those, three occur in the RSA: the Foxe Basin, Baffin Bay, and Davis Strait subpopulations (see Figure 2.12). Individuals from a fourth subpopulation, the Lancaster Sound, have the potential to overlap with the RSA. Satellite-tagging studies suggest significant movement within and between subpopulations (Gardner et al. 1990; Amstrup 1995; Durner and Amstrup 1995; Sahanatien and Derocher 2010). Females from Foxe Basin moved into adjacent polar bear subpopulation management zones (Western Hudson Bay, Gulf of Boothia, and Davis Strait) and returned to Foxe Basin during satellite-tagging studies in 2007–2010. Site fidelity was observed in several bears that returned to or near the area of first capture in Foxe Basin (Figure 2.13; Peacock et al. 2009; Sahanatien and Derocher 2010).

Abundance and trends vary substantially between subpopulations, with population declines attributable to overharvesting and climate change. The mean population size of the Foxe Basin subpopulation from 1989 to 1994 was estimated at 2,197 (SE = 349) based on mark-recapture estimate using tetracycline as a biomarker (Taylor et al. 2006). The preliminary revised population estimate for the subpopulation is 2,850 (95% CI = 2100–3200), based on 2009–2010 aerial surveys conducted by the Government of Nunavut (S. Stapleton, U. of Minnesota, pers. comm.). Mark-recapture analysis of the Baffin Bay polar bear subpopulation from 1994 to 1997 estimated the abundance at 2,074 ± 266, including 1,017 ± 192 females and 1057 ± 124 males (Taylor et al. 2005). It is likely that the current hunting level will continue to deplete the population (COSEWIC 2008). Mark-recapture sampling of the Davis Strait subpopulation that began in 2005 estimated a population of 2,100 after two years of sampling (Peacock et al. 2006 in COSEWIC 2008).

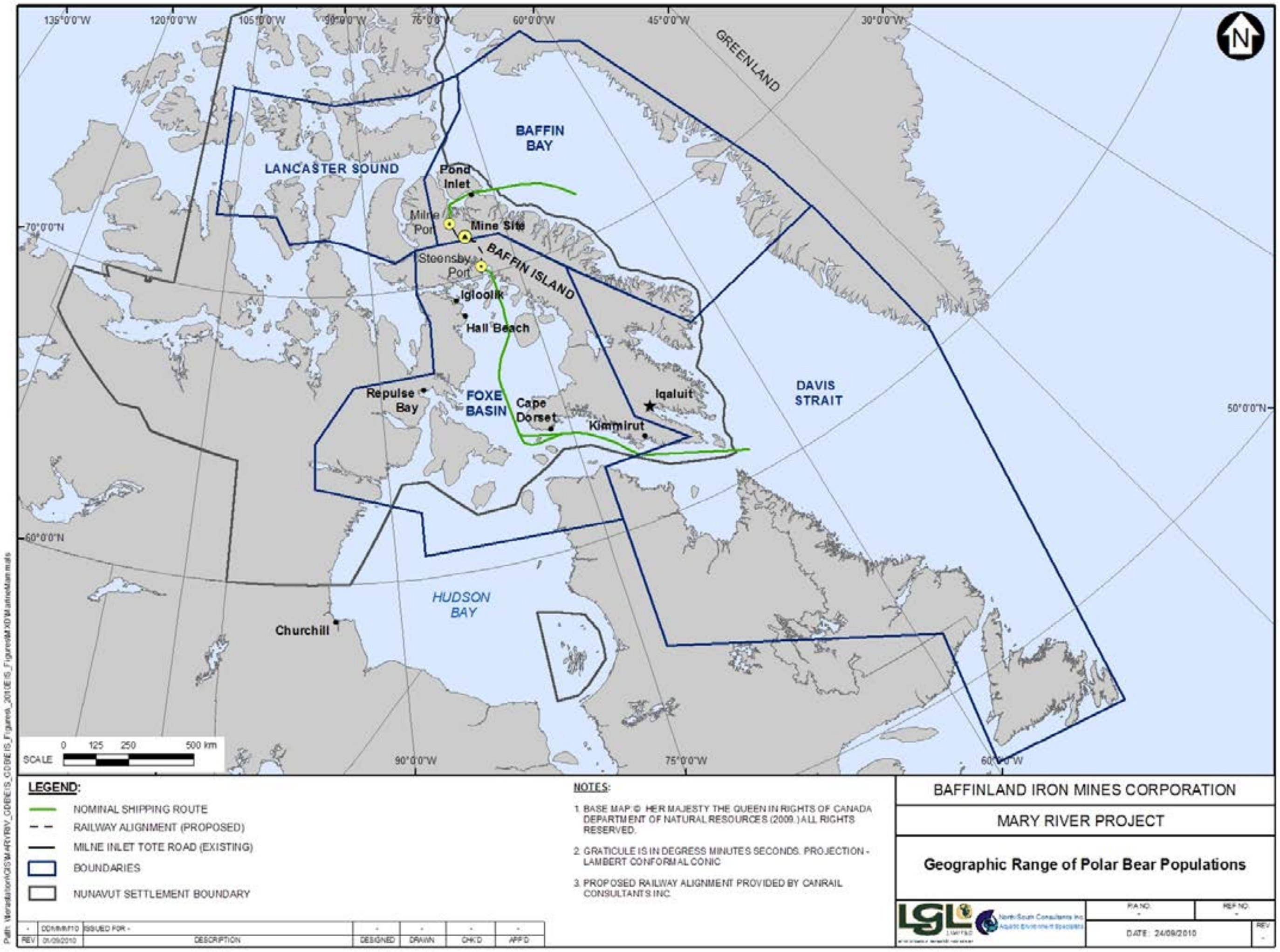

Figure 2.12 Geographic Range of Polar Bear Populations (Names In Blue Font) in Nunavut (Source: Modified from COSEWIC 2008 and Lunn et al. 2002)

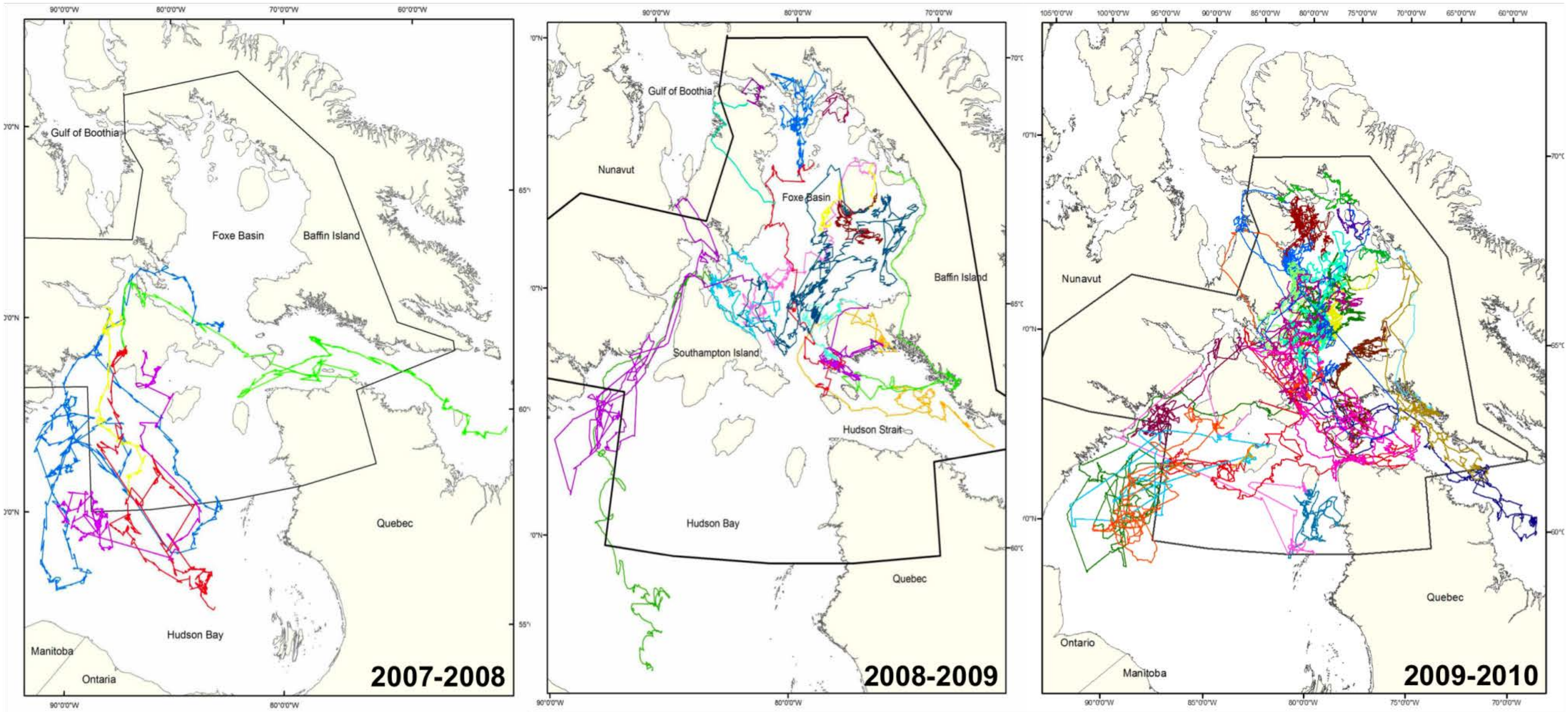

Figure 2.13 Annual movements of satellite collared female polar bears, Foxe Basin 2007–2010. (Source: Peacock et al. 2009; Sahanatien and Derocher 2010).

The trend in abundance is unknown, however, the increased length of the open-water season is of concern in the area (COSEWIC 2008). Mark-recapture analysis of the Lancaster Sound subpopulation based on data from 1995 to 1997 estimated the abundance at 2,541 ± 391 (Taylor et al. 2008). The population trend is uncertain (COSEWIC 2008).

General Biology

Females give birth to 1 to 3 cubs (mean 1.7; Stirling et al. 1975) at an average interval of 3 to 4 years (mean 3.6; Lentfer et al. 1980; Jefferson et al. 1993). Mean litter size for cubs of the year was 1.49 in Davis Strait for 2005–2009 (Peacock 2009), and 1.63, 1.64, and 1.53 in Foxe Basin for 2008, 2009 and 2010 respectively (Peacock et al. 2009). Mating occurs from April to June, and females give birth the following December or January (Harington 1968; Jefferson et al. 1993) in maternity dens, which are excavated in accumulations of snow on stable parts of landfast ice, offshore pack ice, and most often on land within ~50 km of the coast (Harington 1968; Stirling et al. 1984; Ramsay and Stirling 1990; Stirling and Andriashek 1992; Amstrup and Gardner 1994). Cubs remain with their mothers 1.4 to 3.4 years (Stirling et al. 1975; Ramsay and Stirling 1988; Derocher et al. 1993).

Polar bears feed primarily on ringed seals (Stirling and Archibald 1977), but also feed on bearded seals (Stirling and McEwan 1975), walruses (Calvert and Stirling 1990), other marine mammals (Stirling and Archibald 1977; Smith 1980), arctic cod, geese and their eggs, and reindeer (Smith 1985; Jefferson et al. 1993; Smith and Hill 1996; Derocher et al. 2000). The distribution and population size of polar bears are thought to be regulated by the distribution and numbers of ringed seals (Stirling and Øritsland 1995).

Geographic and Seasonal Distribution

Polar bears have a circumpolar distribution, the seasonal extent of which is largely determined by the distribution and extent of sea ice. They occur throughout the arctic basin, but tend to be more abundant along shore lead systems and polynyas during winter, where less-consolidated ice cover provides habitat for young ringed seals and other marine mammals (Stirling and McEwan 1975; Stirling and Smith 1975; Smith 1980; Stirling et al. 1993; Stirling 1997; Amstrup et al. 2000).

Over most of their range, pregnant females den on land within close proximity of the coast during winter (Ramsay and Stirling 1990; Stirling and Andriashek 1992; Richardson et al. 2005), although denning can occur on drifting pack ice in some areas (Amstrup and Gardner 1994). Preferred denning sites in Foxe Basin occur inland, generally in hilly terrain where snow can form deep drifts (V. Sahanatien, U. of Alberta, pers. comm.).

Non-pregnant females, juveniles, and adult males remain active on the pack ice throughout the year, often moving considerable distances with the ice (Garner et al. 1994; Amstrup et al. 2000). In Hudson Strait, the annual distance traveled for satellite-tagged female polar bears ranged from 547 to 4,935 km in 1991–1998 (Parks et al. 2006). The annual distance traveled for Foxe Basin female polar bears ranged from 3,254 to 7,064 km in 2007–2009 (Peacock et al. 2008).

In some areas, such as Hudson Bay or parts of the High Arctic and eastern Baffin Island, the sea ice completely melts during summer and bears are forced ashore to wait until ice reforms in the fall (Schweinsburg and Lee 1982; Derocher and Stirling 1990; Ferguson et al. 1997; Lunn et al. 1997). Sea ice is the platform from which polar bears hunt ringed seals and bearded seals, their primary food source. Consequently, large-scale changes in ice regime attributable to climatic warming or other causes can reduce a bear’s opportunity to access food and can have negative effects on individuals and populations (Stirling and Derocher 1993; Stirling et al. 1999). Decreased survival and natality, and declines in body condition of polar bears in southern and western Hudson Bay have been attributed to climate change (Stirling et al. 1999, Derocher et al. 2004, Stirling et al. 2004, Obbard et al. 2007). Polar bear sea ice habitat trends (1979-2008) were analyzed using microwave satellite imagery in Foxe Basin, Hudson Strait and Hudson Bay. In all regions, preferred habitat declined during freeze up (November-December), spring (April-May), and break-up (June-July), and sea ice season length decreased. Hudson Strait also lost preferred sea ice habitat during the winter months (Sahanatien and Derocher 2011).

Polar bears are common in the RSA and through most of the Canadian Arctic Archipelago. Polar bears from the Foxe Basin population range over Foxe Basin, northern Hudson Bay, and western Hudson Strait during winter (COSEWIC 2008). They are forced ashore during the open-water period.

Polar bear distribution in Foxe Basin and Hudson Strait during late summer is clumped. Based on aerial surveys conducted in 2007–2010, higher concentrations of bears occur in Central Foxe Basin (eastern Southampton Island and Vansittart Island, White Island, and adjacent islands) as well as northern Foxe Basin (Rowley Island, Koch Island, and the Spicer Islands). Fewer bears are found between Igloolik and Hall Beach, on the east side of Foxe Basin, and along the south shore of Hudson Strait (Peacock et al. 2008, 2009; Stapleton and Garshelis 2010; Figure 2.14). The low occurrence of polar bears on the east side of Foxe Basin may be related to the sea ice regime (V. Sahanatien, U. of Alberta, pers. comm.). Polar bear harvest locations for 1970–2011 are generally consistent with the distribution reported during aerial surveys in 2007–2010, with higher catch concentrations reported in Southhampton Island, Repulse Bay, and along the north shore of Hudson Bay. One notable exception is the area between Hall Beach and at the entrance to Fury and Hecla Strait where abundant harvest records are reported for the period 1980–2011 (Figure 2.15).

Polar bear denning locations have been identified in Grant Study Bay, Murray Maxwell Bay, on South Spicer Island, on Southhampton Island, Nottingham Island, on Foxe Peninsula, on Rowley and Koch Islands, and on the north shore of Hudson Strait (Figure 2.15; Nunavut Planning Commission 2011; V. Sahanatien, U. of Alberta, pers. comm.).

Non-pregnant females, juveniles, and adult males move in the RSA throughout the year. Home ranges of female polar bear vary seasonnally; they are largest during freeze-up and break-up, smaller during winter and smallest during the open-water season (Peacock et al. 2008, 2009). Male polar bear home range follow the same pattern, however the mean size of male home range are much smaller than for females (Peacock et al. 2009). Polar bears used very little landfast ice during their movements. Habitat of >90% ice concentration is used most frequently through the year. Large (>2 km in diameter) ice floes are used most often, except during freeze up in October and November when smaller ice floes (<500 m in diameter) are used (Peacock et al. 2009). Areas of high utilization by female polar bears in Foxe Basin and Hudson Strait remain generally stable across years (V. Sahanatien, U. of Alberta, pers. comm.). High utilization areas occur along the southern shipping route, particularly in central and south Foxe Basin during freeze-up and break-up, and in southern Foxe Basin and Hudson Strait in winter (Figure 2.16).

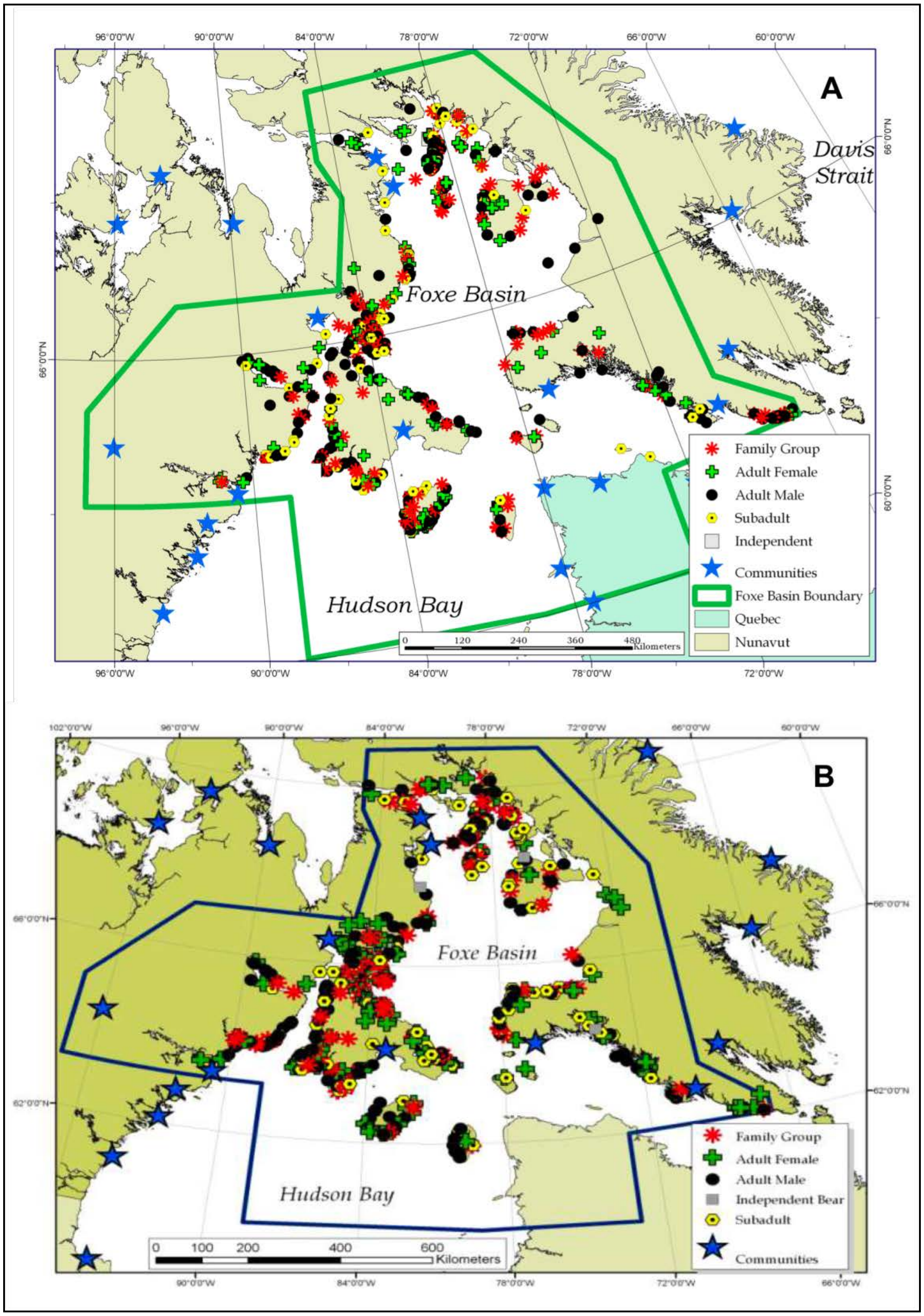

Figure 2.14 Distribution of Polar Bear Sightings Populations during aerial surveys in A) August–Setember 2009, and B) August–October 2010 (Source: Peacock et al. 2009; Stapleton and Garshelis 2010).

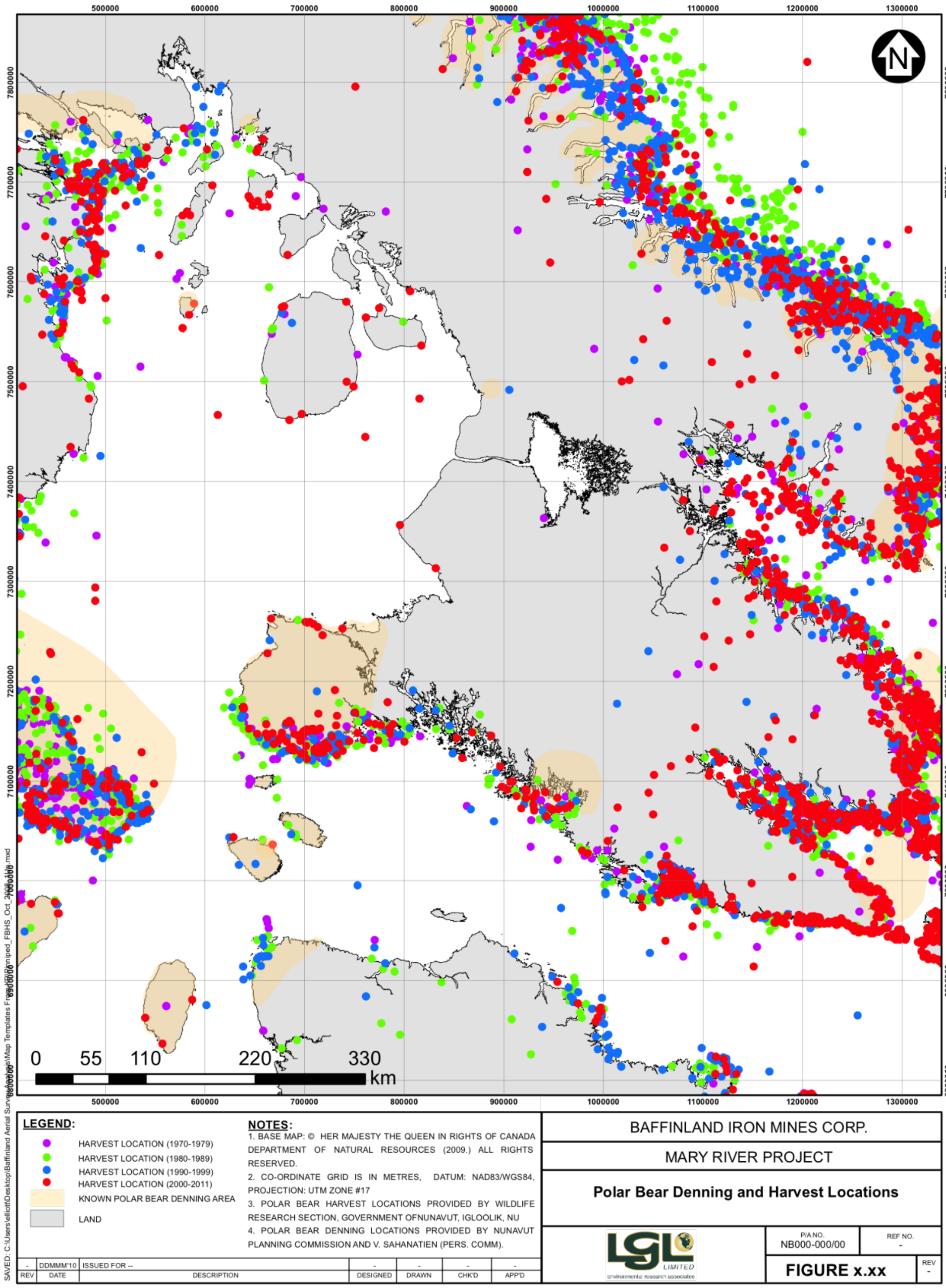

Figure 2.15 Polar Bear harvest locations for 1970–2011 and known denning areas (Source: A. Coxon, Government of Nunavut, unpub. data; V. Sahanatien, U. of Alberta, unpub. Data; Nunavut Planning Commission 2011).

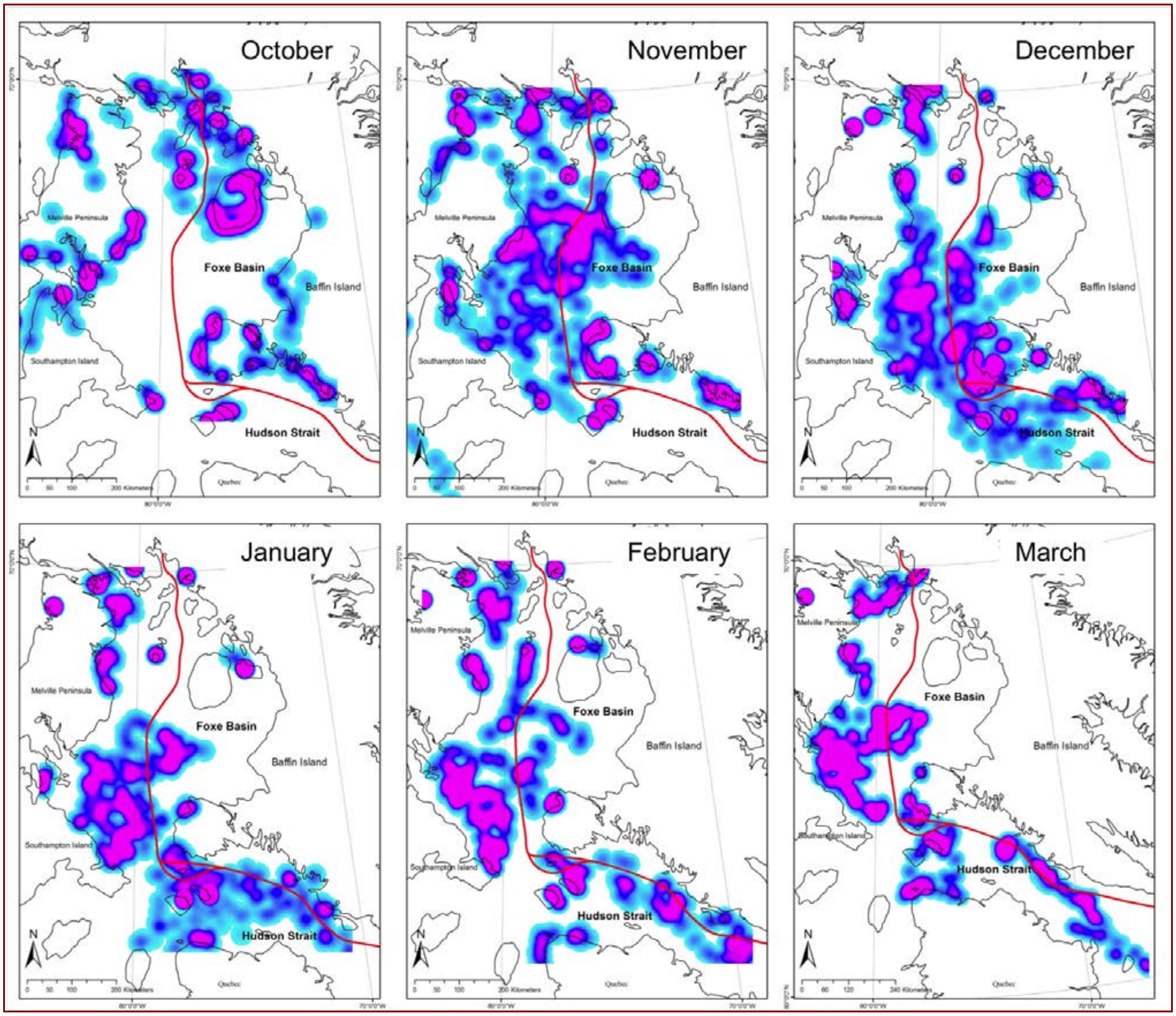

Figure 2.16. Monthly utilization distribution of satellite collared female polar bears, Foxe Basin Polar Bear Project, 2007-2011. Pink = highest density; Dark Blue = medium density; Light Blue = light density; White = no polar bear locations. Red Line = Proposed Shipping Route. (Source : Sahanatien, U. of Alberta, unpub. data.)

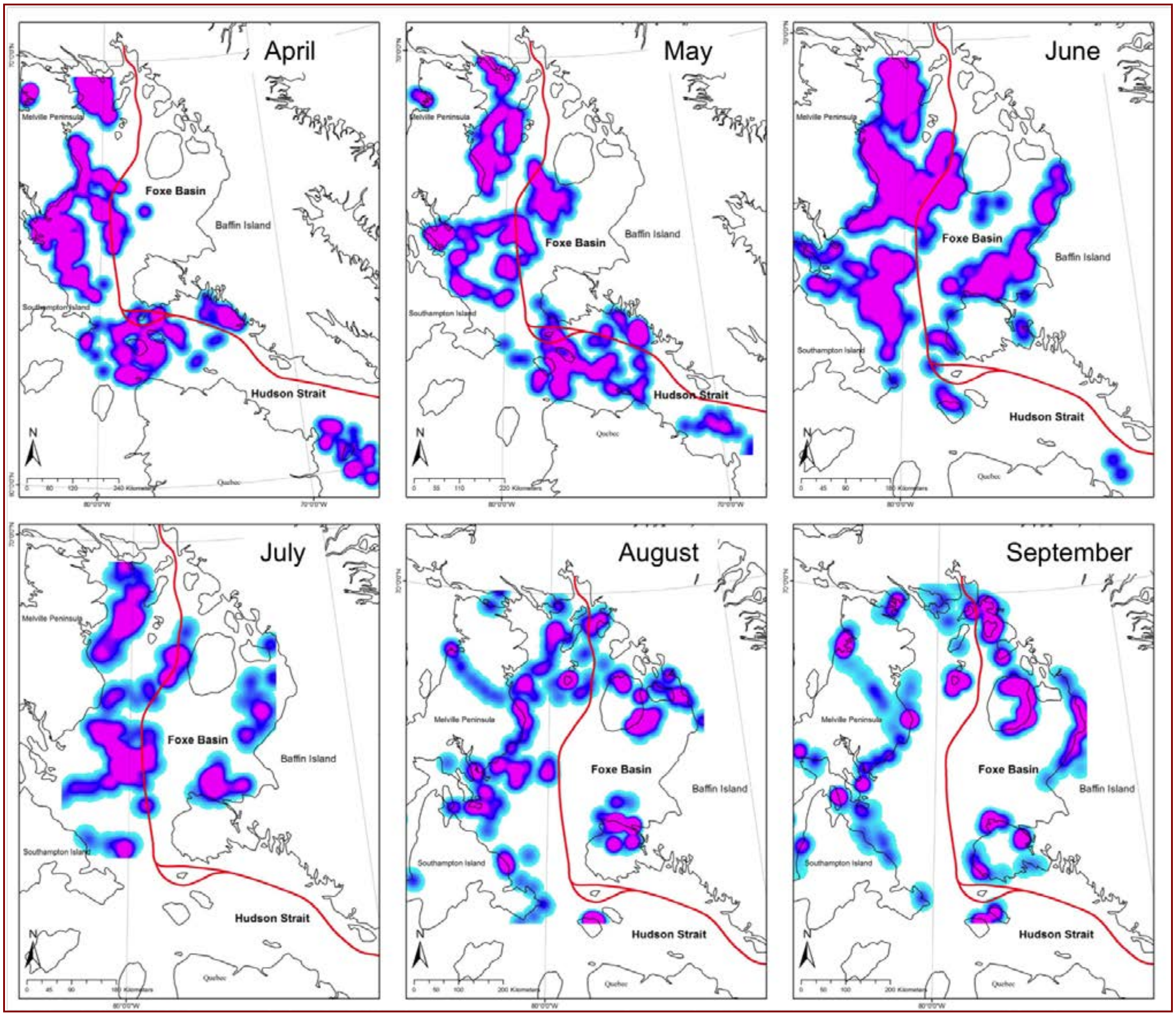

Figure 2.16. con't. Monthly utilization distribution of satellite collared female polar bears, Foxe Basin Polar Bear Project, 2007-2011. Pink = highest density; Dark Blue = medium density; Light Blue = light density; White = no polar bear locations. Red Line = Proposed Shipping Route. (Source : V. Sahanatien, U. of Alberta, unpub. data.)

Polar bears from the Baffin Bay population occupy drifting pack ice and landfast ice between Baffin Island and west Greenland during winter, but can be concentrated along the Lancaster Sound fast-ice edge (Koski 1980; Ferguson et al. 2000; Ferguson et al. 2001). Bears are also concentrated along landfast ice edges across Pond Inlet and Navy Board Inlet during spring. During the open-water period in September–October, bears are forced ashore by the absence of ice (Taylor and Lee 1995). Most bears spend this period on Bylot and Baffin islands (Lunn et al. 2002). Denning activity by pregnant females is concentrated along the north coast of Bylot Island and coastal Baffin Island in the vicinity of Pond and Navy Board inlets. Only males and subadults are found in offshore waters; females with young were rarely seen in the pack ice (APP 1982). Polar bears also frequent fast-ice edges in this area (APP 1982).

The Davis Strait subpopulation occurs in the Labrador Sea, eastern Hudson Strait, Davis Strait south of Cape Dyer, and an undetermined portion of southwest Greenland (Stirling and Kiliaan 1980; Stirling et al. 1980; Taylor and Lee 1995).

Polar bears from the Lancaster Sound subpopulation tend to occupy the central and eastern part of their range during winter, but move westward during spring to summer on multi-year pack ice in eastern Viscount Melville Sound (Schweinsburg et al. 1982).

3.0 INUIT QAUJIMAJATUQANGIT (IQ) STUDIES

Community-based research programs to support the Mary River Project were initiated in 2006 and continued through 2010. The primary objectives of the IQ study were to:

- obtain local knowledge of wildlife, land use, and areas of cultural value
- identify potential Project interactions with the above
- support Project decision-making and environmental assessment of the Project

2.3.23 This section synthesizes IQ knowledge pertaining to marine mammals. Where available, IQ knowledge collected during the Mary River studies were augmented by additional IQ information collected from other published literature.

3.1 IQ STUDY METHODS

Data were collected for the Mary River IQ studies through:

- working group meetings
- individual interviews with community Elders
- Topic-specific workshops in a number of communities

Working groups established in Arctic Bay, Pond Inlet, Igloolik, Hall Beach and Clyde River were designed to provide a representative cross-section of people in the community with respect to sex, age, lifestyle, and occupation. Data were collected during discussions held at working group meetings. IQ interviews targeted Elders within each community who were identified by that communities' working group as being key knowledge holders. Interviews were conducted by individuals from the respective communities that were trained in the collection of IQ data. Topic-specific workshops were held in several communities to verify results from working group discussions and IQ interviews, as well as to provide opportunity for community members not participating in the working groups or individual interviews an opportunity to contribute their knowledge. A comprehensive description of methods used during the Mary River IQ studies is provided in Knight Piésold (2010).

IQ information pertinent to marine mammals was collected during workshops in Hall Beach, Igloolik, Pond Inlet, Kimmirut, and Cape Dorset, and through individual interviews with Elders in Arctic Bay, Igloolik, and Pond Inlet. Information collected pertained specifically to:

- bowhead
- narwhal
- beluga
- killer whales
- ringed seal
- bearded seal
- harp seal
- walrus
- polar bear

IQ observations described the seasonal distribution and abundance of marine mammals, trends in animal abundance, identified important areas for feeding and reproduction, and indicated areas of importance to Inuit for harvesting activities. As well, participants were asked to share their observations of marine mammal reactions to ship traffic and other forms of disturbance.

Data specific to marine mammals collected during the IQ study are summarized in the following sections by population status and abundance, general biology, and geographic and seasonal distribution. Although the section does not explicitly describe Inuit resource use, local observations that were likely made during resource use activities are included. Most of the information presented here was collected during community-based research for the Mary River Project and is not referenced. Any information derived from other IQ studies is specifically referenced.

3.2 SPECIES-SPECIFIC INFORMATION COLLECTED DURING IQ STUDIES

3.2.1 Bowhead Whale

Population Status and Abundance

Since commercial whaling has ended, bowhead have been relatively scarce in the Baffin Island area, although recent accounts suggest that bowhead sightings are becoming more frequent in areas along Baffin Island. IQ obtained in the Nunavut Wildlife Management Board (2000) indicated that since the 1960’s, most communities within the Baffin region (including Igloolik, Hall Beach, Pond Inlet, and Arctic Bay) have reported an increase of bowhead whale sightings. Increasing bowhead observations are thought by most to be the result of increasing populations; however, it has been suggested that changes in their distribution may be the cause.

Inuit Elders throughout the Arctic have reported that bowhead whales are difficult to see unless travelling in large groups. As a result, they may occur more frequently than previously reported by local communities. Annual variations in bowhead abundance and distribution are believed to be directly related to food availability (Nunavut Wildlife Management Board 2000).

General Biology

During spring and summer, bowheads often gather at locations where their food supply is most abundant and remain there as long as they are not disturbed (Nunavut Wildlife Management Board 2000). They are usually observed feeding along the floe edge, although their presence is often dependent on the tides.

Little IQ is available with respect to bowhead mating and reproduction. They are believed to give birth in the summer. However, calving may take place earlier in the year as females have occasionally been observed with calves on arrival in the spring. IQ from the Nunavut Wildlife Management Board (2000) indicated that several activities, including feeding, mating, and calving, takes place in nearshore, sheltered, shallow waters in summer.

The Inuit recognize eight different age categories of bowhead whales; 1) arvaaraq or newborn calf; 2) arvaaq or an older calf still being nursed; 3) ingutuq or a one- to two-year-old travelling with or without their mother; 4) aktuarjuk (mikinisaarjuk) or juvenile/immature that is not full-grown but mid-sized; 5) arvaaralik (arvaalik) or adult female with a calf; 6) tiggalluk or a medium-sized male; 7) akturjuaq (aktualuk) or large adult male; and 8) arviq (aktut) or adult, full-grown bowhead with white patches and spots (Nunavut Wildlife Management Board 2000).

The only known predators of bowhead whales are man and killer whales. Dead bowheads found by Inuit frequently have teeth marks corresponding to killer whale attacks.

Geographic and Seasonal Distribution

In the North Baffin region, Elders reported that bowhead move offshore between Baffin Island and Greenland during winter, although a few whales remain scattered in open water along the coast. They arrive in the North Baffin area in late spring and summer, waiting along the floe edge until ice break-up allows access to summer feeding areas in inlets, bays, and fjords. Bowheads without calves are usually the first to arrive, in spring, often as solitary animals or in pairs. Mothers with calves tend to arrive later in the season. Bowheads are believed to return to the same summering areas year after year. Reported summering areas include Pond Inlet, Navy Board Inlet, Eclipse Sound, Milne Inlet, Lancaster Sound, Cumberland Sound, and Admiralty Inlet (see Figure 3.1). Some bowheads also move from northern waters through Hudson Strait into Foxe Basin to summer. Bowhead whales summering in Foxe Basin tend to concentrate in an area to the north and east of Igloolik, near the outlet of Fury and Hecla Strait. (see Figure 3.2). They are not particularly numerous within Hudson Strait, although it is thought that the corridor is used extensively for migration (see Figure 3.2). The area north of Igloolik has been identified as an important bowhead nursing area. The majority of bowheads leave their summering areas in September, but some animals may remain in the area until October when sea ice begins to form.

3.2.2 Narwhal

Population Status and Abundance

Many Inuit believe that at least two different narwhal stocks exist in the Arctic. For example, hunters in Grise Fjord believe that narwhals in Jones Sound represent a separate stock from those in the Pond Inlet/Arctic Bay area because of their behavioural differences (Stewart 2001). Others believe that stocks can be differentiated by size and/or other physiological differences.

Whereas some Inuit believe that narwhal populations have remained stable, others suspect that these and other marine mammal species are decreasing over time. Arctic Bay residents believe that fewer narwhal have been observed around the community since 1992 (Remnant and Thomas 1992). Similarly, fewer narwhal are observed now in the south end of Admiralty Inlet as compared to the 1950’s. Inuit hunters interviewed by Remnant and Thomas (1992) indicated that narwhal abundance fluctuates annually and is part of a natural cycle. Although year-to-year variation was thought to exist in terms of distribution, many hunters interviewed by Stewart (2001) believed that the narwhal population as a whole was increasing.

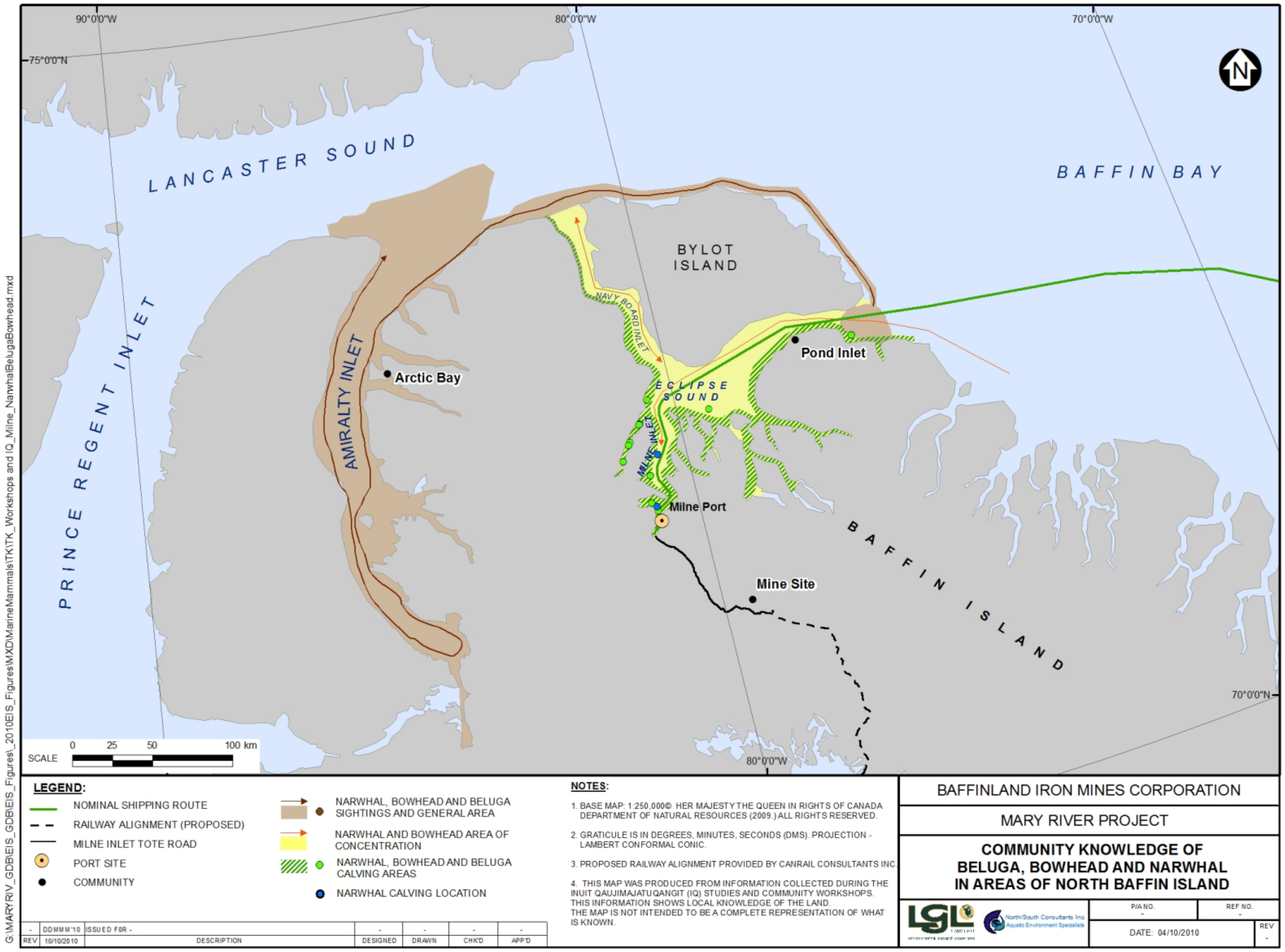

Figure 3.1 Community Knowledge of Beluga, Bowhead, and Narwhal in Areas of North Baffin Island

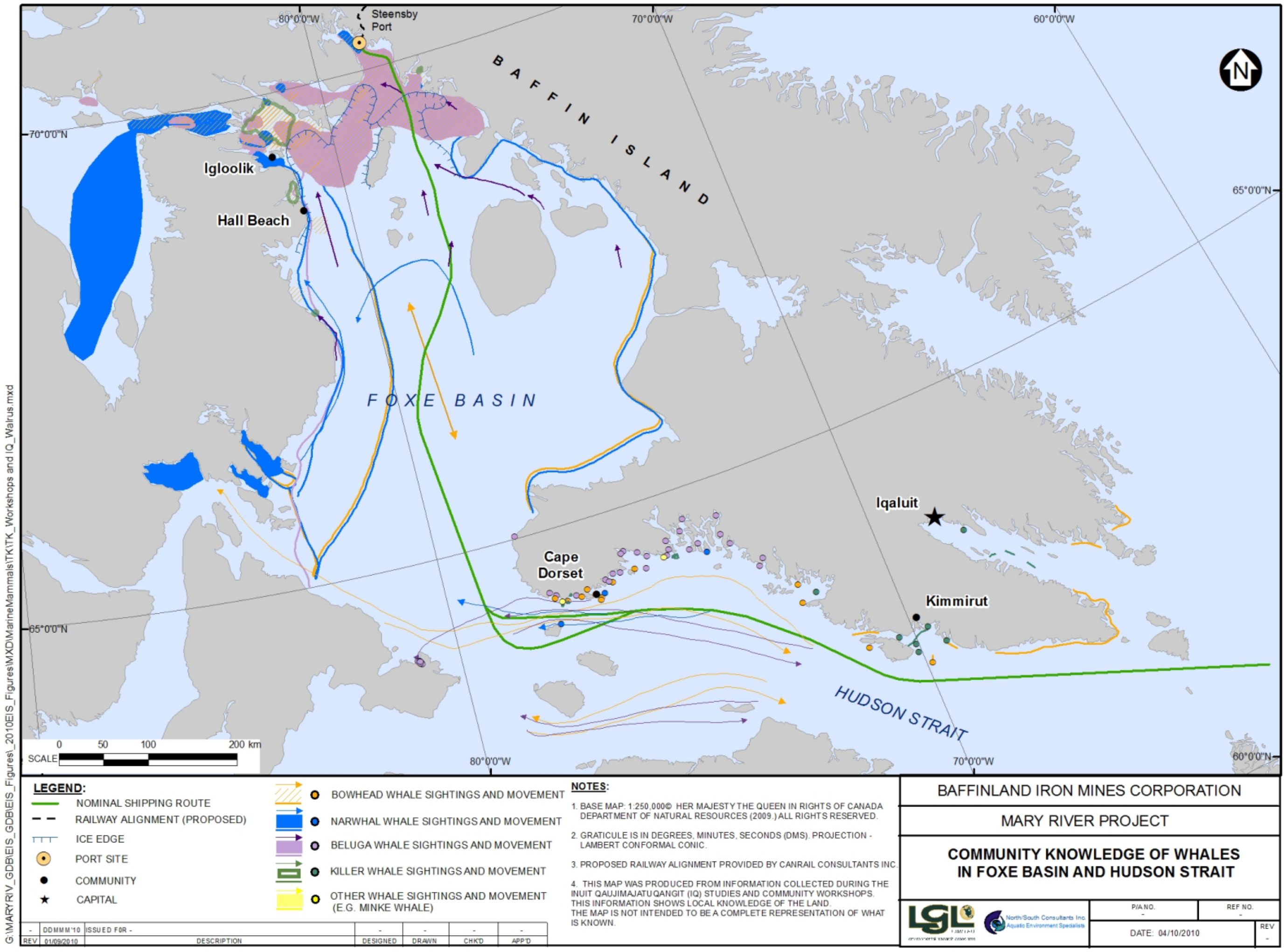

Figure 3.2 Community Knowledge of Whales in Foxe Basin and Hudson Strait

General Biology

Narwhal feed primarily on Arctic cod, Greenland halibut, Arctic char, and occasionally krill. IQ reported by Remnant and Thomas (1992) and Stewart (2001) described other food items such as Greenland cod, herring, sculpin, squid, shrimp, and plankton. Some hunters suggested that narwhal diet changes with season (Stewart 2001). Most believed that narwhal feed year-round, although others indicated that feeding did not take place during migration (Remnant and Thomas 1992). Narwhal are thought to increase their food intake before the fall migration (Remnant and Thomas 1992), likely done to increase fat stores for winter. One individual indicated that narwhal do not feed in the presence of predators such as killer whales.

Although many Elders have observed no discernable physiological differences between narwhal, IQ exists for the presence of two body types: a larger, dark-coloured form with longer tusks, and a smaller, light-coloured form with smaller tusks. These forms are not believed to be indicative of stock differences because both exist within the same pods (Remnant and Thomas 1992; Stewart 2001).

Some hunters believe that narwhal mate at any time of the year, whereas others believe it to occur only in spring, summer, or fall (Remnant and Thomas 1992; Stewart et al. 1995; Stewart 2001). Pond Inlet hunters reported that mating activity occurs in areas off the northern coast of Bylot Island or at the mouths of Navy board and Pond inlets at the floe edge. Eclipse Sound, Tremblay Sound, Milne Inlet, and Koluktoo Bay have also been reported as mating areas (Remnant and Thomas 1992). Some of the Arctic Bay hunters cited in Remnant and Thomas (1992) and Stewart (2001) believed that narwhal mated only in Admiralty Inlet. Narwhals have been observed mating in June at the Admiralty Inlet floe edge and in August in western Admiralty Inlet (Stewart 2001). Calving areas were reported to be widely distributed within the inlet.

Length of gestation period was generally unknown, although some people indicated a period of less than one year (Remnant and Thomas 1992). Calving begins in early August when there is floating ice; however, some Elders believed that it could begin as early as May. Other IQ studies have been less specific in terms of calving, indicating that, depending on the individual or community interviewed, calving may occur; 1) at any time of the year; 2) during spring and summer; or 3) from July to September (Remnant and Thomas 1992; Stewart 2001).

Many hunters interviewed by Remnant and Thomas (1992) noted that the birthing process did not occur in one day, and may require up to two weeks. Females are thought to give birth every other year; however, because mothers are often seen with a yearling and a newborn calf, some Inuit believe that females produce one calf every year (Thomas 1992; Stewart 2001).

Calving generally occurs near the floe edge while the whales are migrating north. Females often continue travelling during the calving process. IQ in Remnant and Thomas (1992) indicated that calving can take place within inlets, bays, fjords, sounds, mouths of rivers, and the open water at the floe edge, and some individuals suggested that calving took place anywhere. In the vicinity of the community of Pond Inlet, calving is known to occur in Pond Inlet, Navy Board Inlet, Eclipse Sound, Milne Inlet, and Koluktoo Bay (see Figure 3.1).

Besides Inuit, killer whales prey on narwhal and have been observed successfully feeding on them. Polar bears and sharks may also prey opportunistically on narwhal, as unsuccessful attacks by both species have been reported (Stewart 2001).

Geographic and Seasonal Distribution

In the North Baffin region, Elders reported that narwhal spend the winter in Baffin Bay, although some animals may winter along the floe edges at Pond Inlet and Navy Board Inlet. IQ indicates that within the Project RSA they concentrate in Admiralty Inlet, Milne Inlet, Eclipse Sound, Koluktoo Bay, Tremblay Sound, Tay Sound, Creswell Bay, Pond Inlet, Navy Board Inlet, and Admiralty Inlet in the summer (see Figure 3.1). Spring movements from wintering areas may begin as early as March, when narwhal move north along the east coast of Baffin Island toward Lancaster Sound (see Figure 3.3). As the sea ice breaks, narwhal move westward into the Arctic Archipelago and to summering areas in fjords and inlets such as Eclipse Sound and Milne Inlet (see Figure 3.4). While waiting for the ice to break, narwhal concentrate along flow edges at Pond Inlet, Navy Board Inlet, Lancaster Sound and Admiralty Inlet. Fall movement patterns are the reverse of spring movements: narwhal generally leave summering areas in fjords such as Eclipse Sound in mid- to late September, returning south along the east coast of Baffin Island to wintering areas (see Figure 3.5).

To the south, smaller numbers of narwhal move west through Hudson Strait toward Repulse Bay and then north along the west coast of Foxe Basin toward Igloolik during spring (see Figure 3.3). Small numbers of narwhal also enter northern Foxe Basin through Fury and Hecla Strait from Gulf of Boothia (see Figure 3.3). Whales from the Gulf of Boothia and from Hudson Strait arrive in the Igloolik area at different times. During fall, narwhal in Foxe Basin return to wintering areas via the same route that they arrived. Narwhal abundance in northern Foxe Basin is irregular; the whales may be observed one year, but not the next.

Some changes in narwhal distribution have been observed since the 1970’s. For example, IQ reported by Stewart (2001) indicated that until the 1970’s, narwhal in Clyde River were predominantly fall migrants. Since that time, the whales have begun staying from spring to fall. Hunters believe that there are more narwhal in the area now than there were 20 to 30 years ago.

3.2.3 Beluga Whale

Population Status and Abundance

Beluga are an important resource for the Inuit. Traditionally, this species was considered to be abundant throughout the Arctic. Elders recalled that the population size of beluga whales continued to shrink years after commercial hunts had ceased (The Southeast Baffin Beluga Management Committee 1998). Today, beluga whale populations are believed to be recovering and continue to represent an important seasonal resource for local communities.

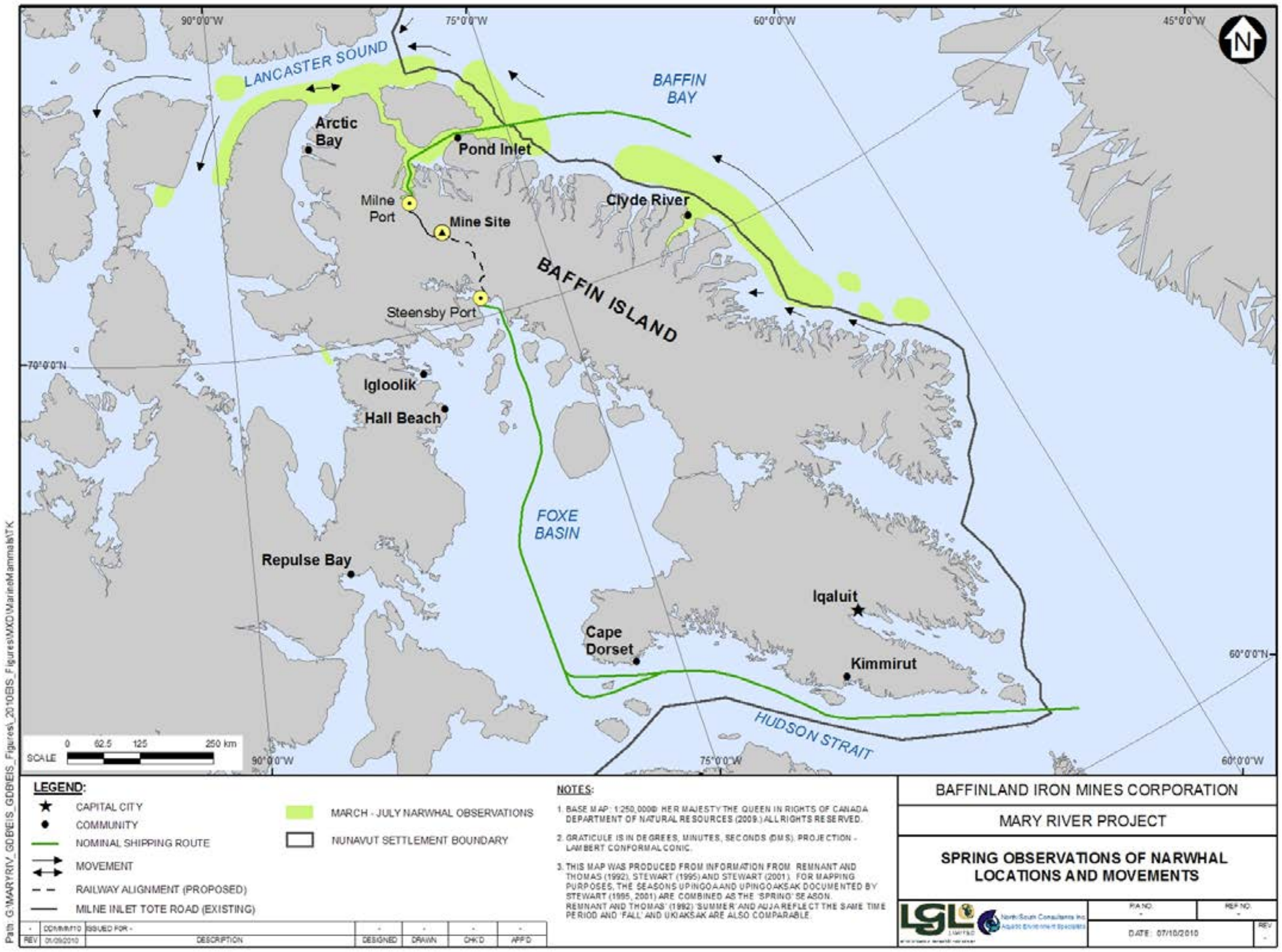

Figure 3.3 **Spring Observations of Narwhal Locations and Movement Patterns (Source: Remnant and Thomas 1992; Stewart et al. 1995; Stewart 2001)**

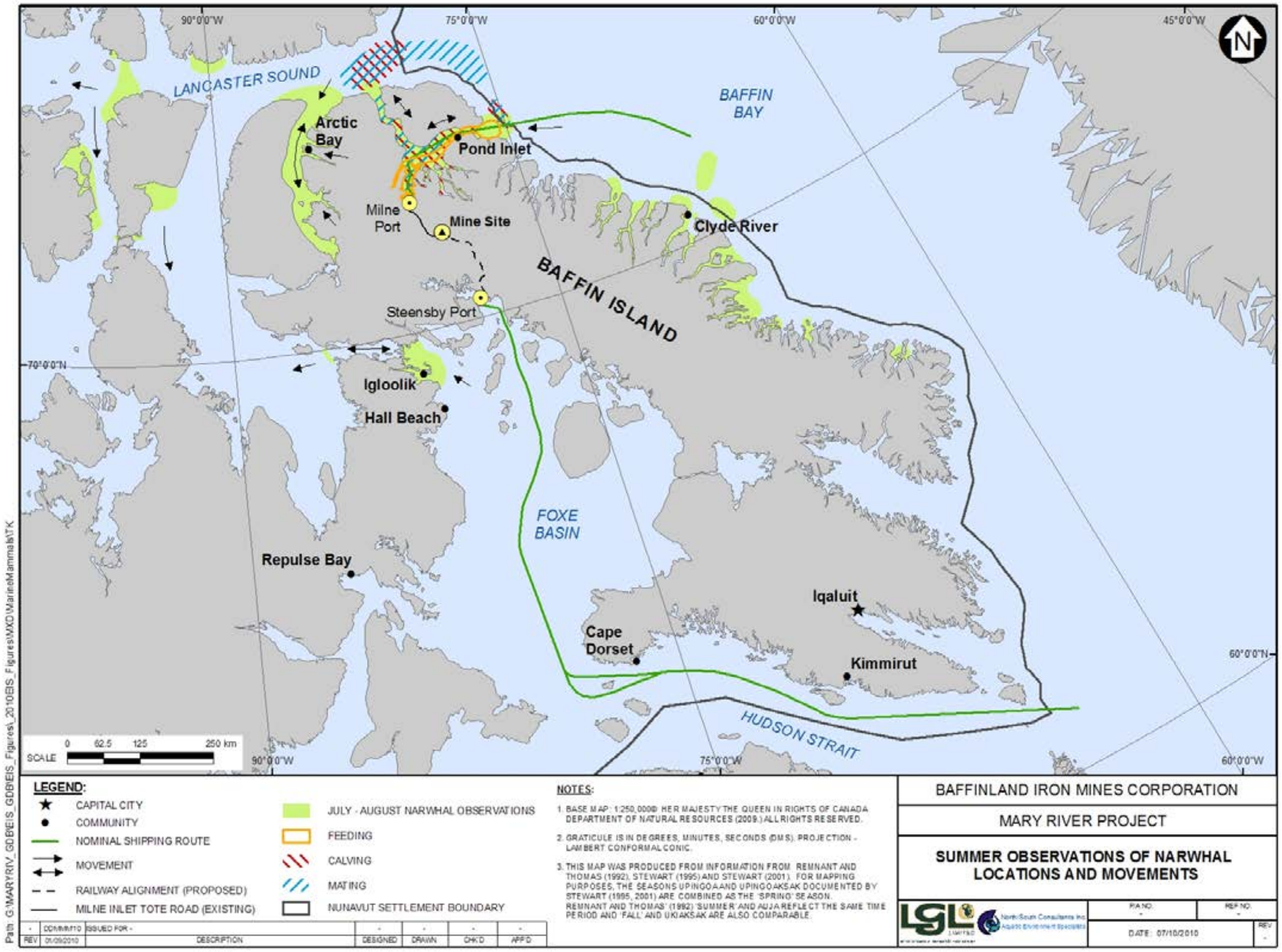

Figure 3.4 Summer Observations of Narwhal Locations and Movement Patterns (Source: Remnant and Thomas 1992; Stewart et al. 1995; Stewart 2001)

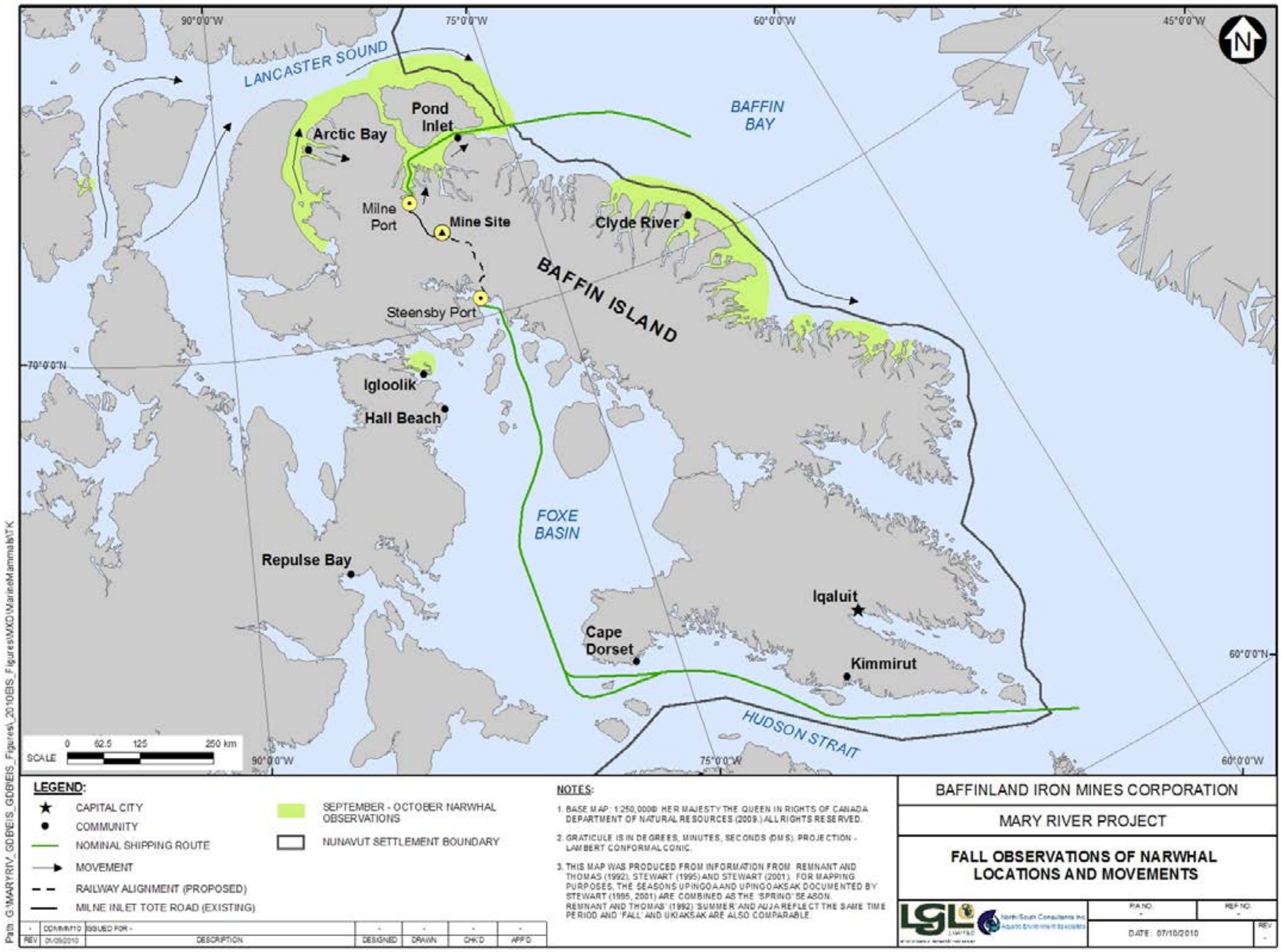

Figure 3.5 Fall Observations of Narwhal Locations and Movement Patterns (Source: Remnant and Thomas 1992; Stewart et al. 1995; Stewart 2001)

Some IQ suggests that although the current size of beluga populations might vary from year to year, numbers generally remain the same (Remnant and Thomas 1992). However, IQ from other sources suggests that current beluga populations are substantially smaller than they were five decades ago (The Southeast Baffin Beluga Management Committee 1998). Community members have reported both a decrease in number and a delayed return of beluga in the fall since the 1980's. The majority of the whales that return in the fall are now females with young and juveniles, as the number of males decreased in the mid-1900's and have yet to recover (The Southeast Baffin Beluga Management Committee 1998). Some hunters believe that current declines in beluga abundance are the result of decreases in food availability, primarily schools of small fish such as cod.

General Biology

Beluga feed on Arctic cod, actively following schools along the coast and in deeper waters offshore. Other prey species identified in beluga diets include Arctic char, halibut (primarily Greenland halibut), sculpin, eelpout, capelin, Greenland cod, and shrimp (Remnant and Thomas 1992; The Southeast Baffin Beluga Management Committee 1998; Stewart 2001). Important feeding areas identified in Remnant and Thomas (1992) were Koluktoo Bay, the southern half of Milne and Navy Board inlets, and a large expanse of open water off the coast of Bylot Island.

Whereas some hunters assumed that beluga feed year-round, many believe that the whales do not feed during migrations (Remnant and Thomas 1992). Some Inuit have suggested that beluga whales are generally fatter when they arrive in the spring than when leaving in the fall after birthing and/or molting (Southeast Baffin Beluga Management Committee 1998; Stewart 2001).

Evidence for the existence of different populations comes from physical differences observed by hunters in each community. For example, beluga observed at the Cumberland Sound floe edge in the spring are generally smaller than those that summer at Clearwater Fjord, near the head of Cumberland Sound.

Only white belugas are believed to breed, as grey whales are juveniles that have not yet matured (Remnant and Thomas 1992; Stewart 2001). However, some hunters in Grise Fiord reported that grey whales will give birth on occasion (Stewart 2001). Belugas typically have one calf at a time and are thought to reproduce each year (Stewart 2001). Some Inuit suggest that gestation is less than one year (Remnant and Thomas 1992). Near Pond Inlet, breeding is believed to take place in August when floating ice is present. Beluga have been observed mating in May and July at the Admiralty Inlet floe edge (Stewart 2001). Other mating and calving areas that have been identified include along the floe edge at Pond Inlet and Navy Board Inlet, offshore areas in Lancaster Sound and Baffin Bay, and within Eclipse Sound and Milne Inlet (see Figure 3. and Figure 3.5). Calving is believed to occur within bays, inlets, and the mouths of rivers, and newborn calves have been observed along the floe edge in June, July, August, and September (Stewart 2001). Grise Fiord hunters also reported beluga giving birth along the floe edge in October and February (Stewart 2001).

Polar bears have been observed preying on beluga. Bears will grab beluga as they come up for air, pulling them out of the water and onto the ice.

Geographic and Seasonal Distribution

Beluga occur throughout the eastern Arctic, and tend to concentrate in certain areas, including Baffin Bay, Eclipse Sound, Milne Inlet, Koluktoo Bay, Navy Board Inlet, Pond Inlet, Admiralty Inlet, Koluktoo Bay, Cumberland Sound, Frobisher Bay, Foxe Basin, Hudson Strait, Fury and Hecla Strait, and near Clyde River (see Figure 3.1 and Figure 3.6 to Figure 3.8).

Interviews with Elders indicated that small numbers of beluga are common in waters near Pond Inlet (see Figure 3.1). They are present in spring, summer, and fall (Remnant and Thomas 1992), and are widely distributed (Stewart 2001). The first appearance of beluga in Arctic Bay (northern coast of Baffin Island) may occur as early as March and as late as June (see Figure 3.6). Although some beluga move into Pond and Navy Board inlets in the spring as the ice breaks up, the majority of beluga present at the mouths are thought to migrate farther north and west (see Figure 3.6; Remnant and Thomas 1992). Many of these move into Admiralty Inlet and others continue west into Barrow Strait (see Figure 3.6 and Figure 3.7) Beluga are believed to remain and feed in these areas during summer (Remnant and Thomas 1992). One hunter suggested that beluga enter Navy Board Inlet only to avoid killer whales (Remnant and Thomas 1992). Fall migration back to wintering areas generally occurs in September and October (see Figure 3.8), and coincides with ice formation in the inshore waters.

To the south, beluga migrate west through Hudson Strait from wintering areas to the east and move into northern Foxe Basin, following the east and west coast of the basin (see Figure 3.6). Summering areas include the bays and inlets along the coast of northern Foxe Basin (see Figure 3.7). Beluga whales are not expected in Igloolik until late August or early September, and sometimes as late as December (see Figure 3.8). Some Igloolik Elders believe that beluga have been arriving in the area much later than usual in recent years, suggesting that northern migrations may be taking place later in the season. Elders interviewed in the Southeast Baffin Beluga Management Committee (1998) also observed that beluga were returning through Hudson Strait much later in the fall now, closer to freeze-up. Fall movement is from Foxe Basin eastward through Hudson Strait to wintering areas (see Figure 3.8). Wintering areas were not clearly identified, although it was indicated that beluga congregate near the mouth of Frobisher Bay in winter (The Southeast Baffin Beluga Management Committee 1998).

Community members have observed the same individuals year after year, suggesting that certain individuals and populations show a high rate of fidelity to particular locations (The Southeast Baffin Beluga Management Committee 1998).

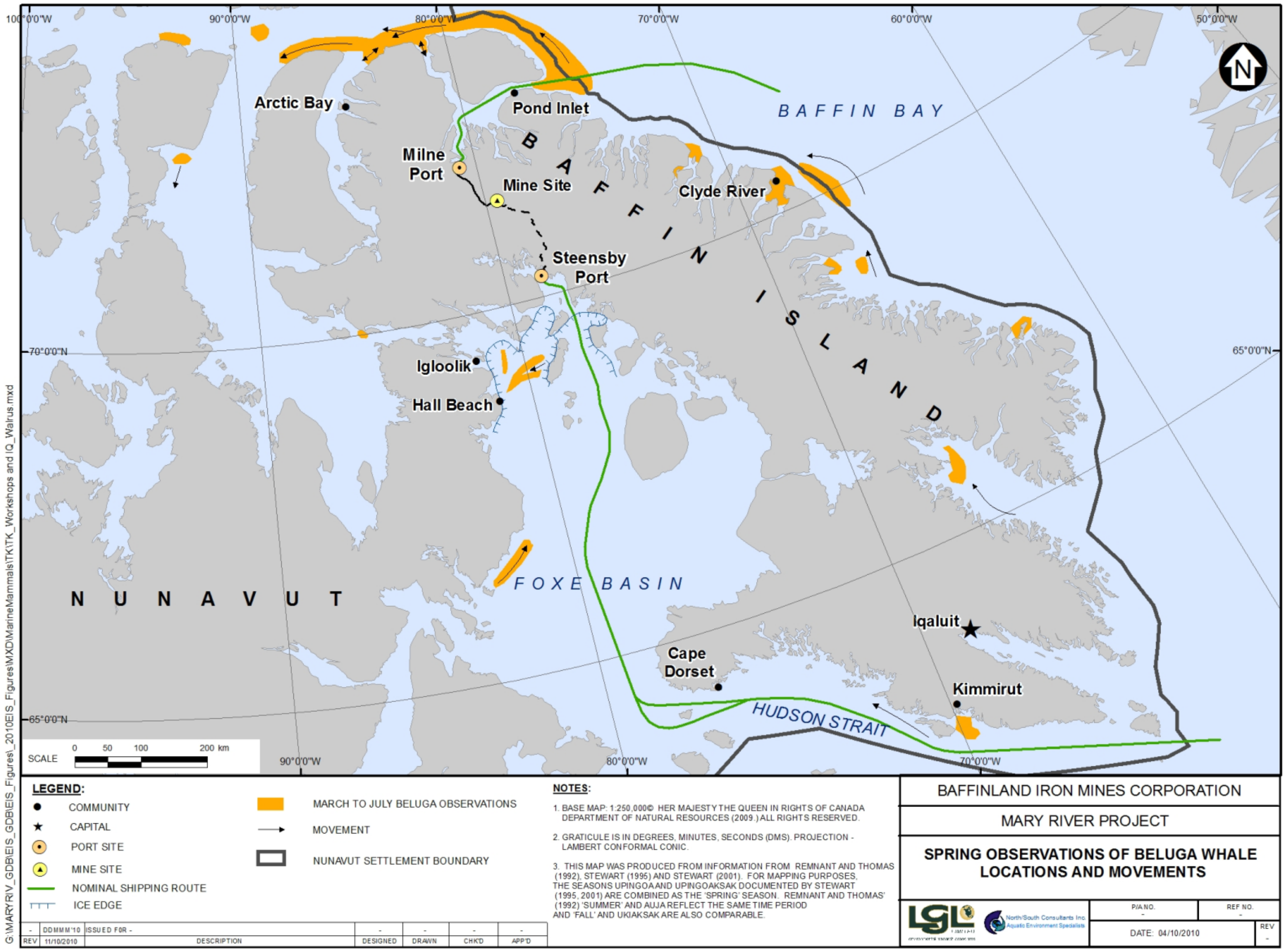

Figure 3.6 Spring Observations of Beluga Locations and Movement Patterns (Source: Remnant and Thomas 1992; Stewart et al. 1995; Stewart 2001)

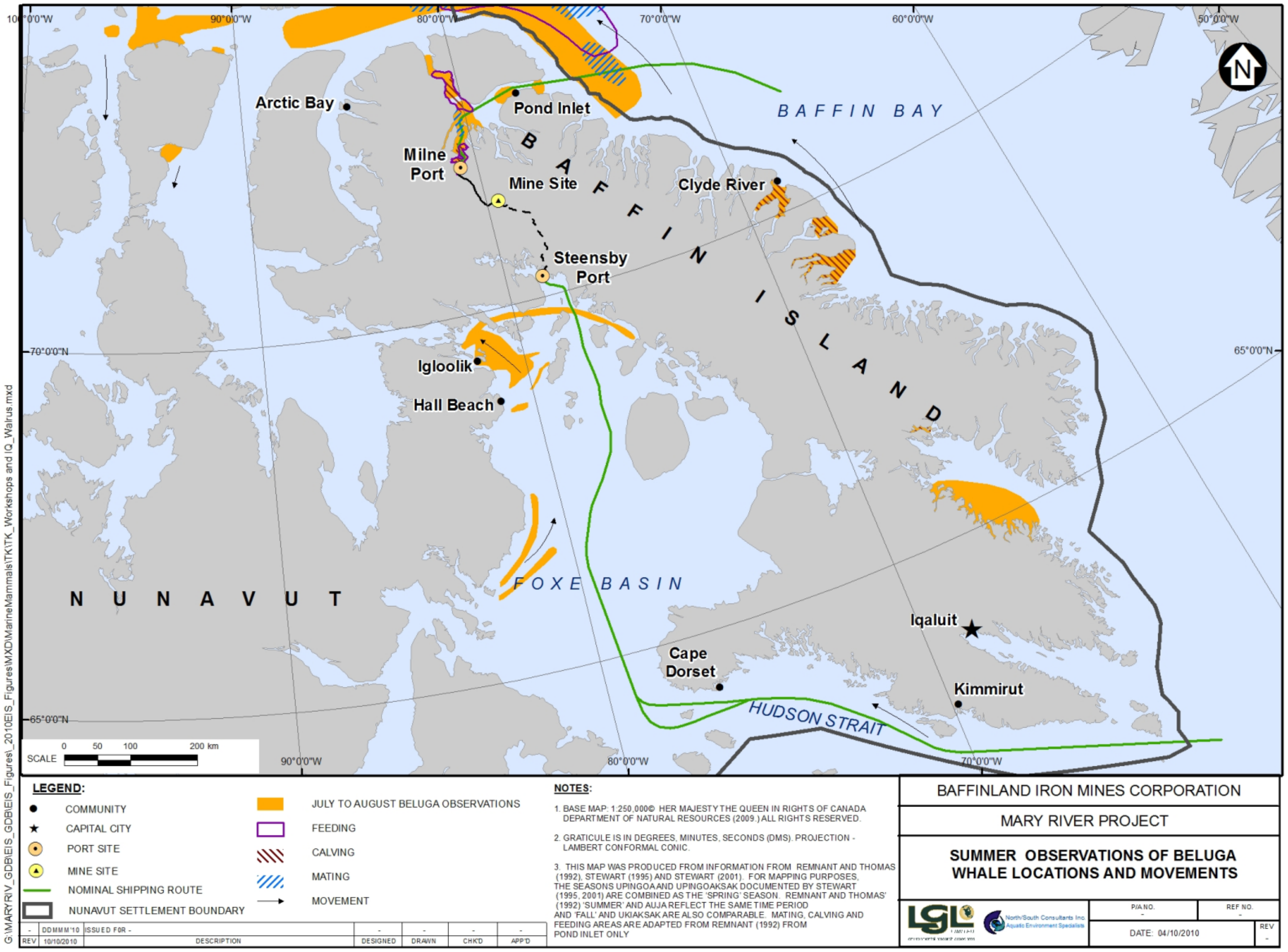

Figure 3.7 **Summer Observations of Beluga Locations and Movement Patterns (Source: Remnant and Thomas 1992; Stewart et al. 1995; Stewart 2001)**

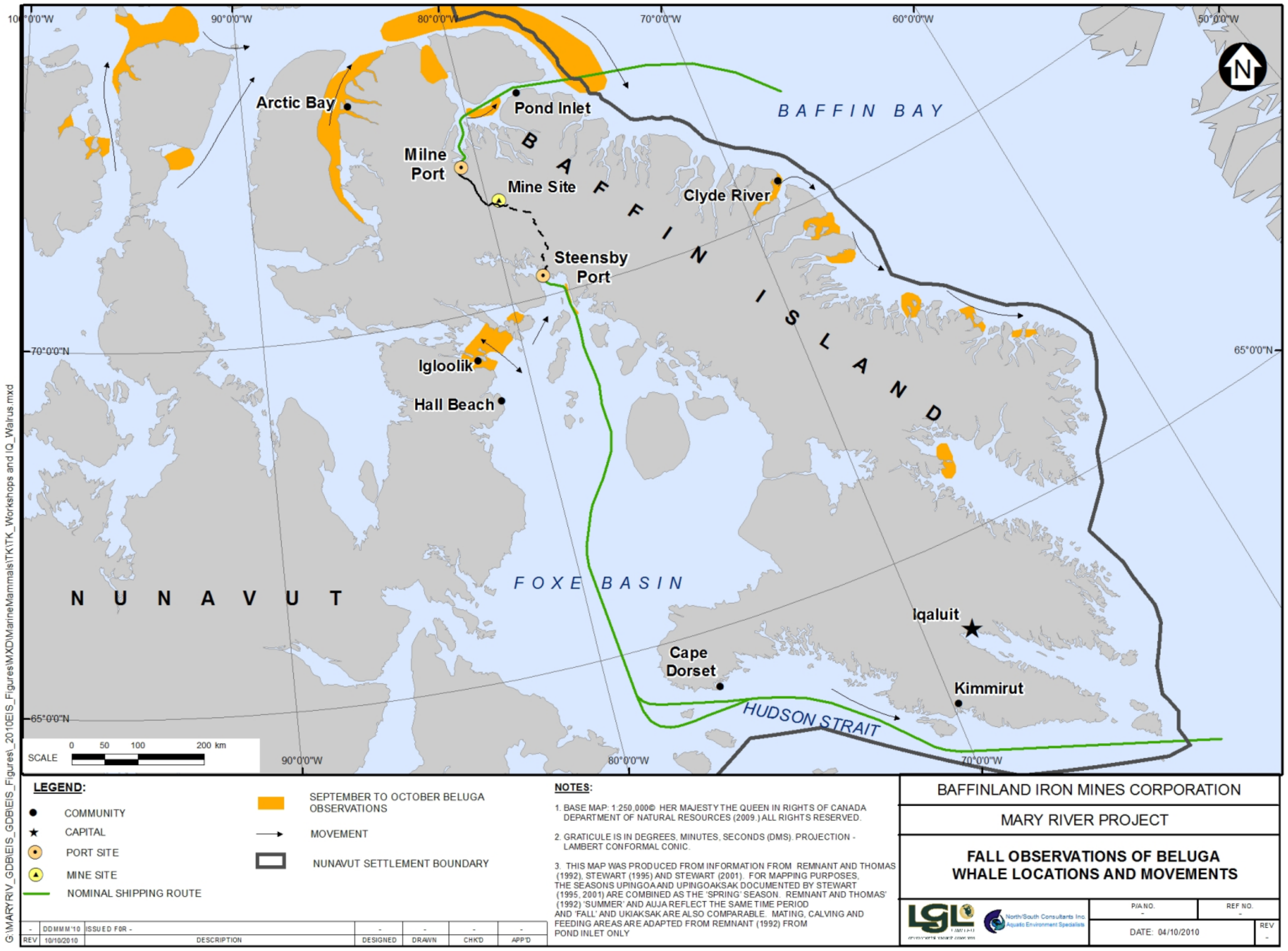

Figure 3.8 Fall Observations of Beluga Locations and Movement Patterns (Source: Remnant and Thomas 1992; Stewart et al. 1995; Stewart 2001)

3.2.4 Killer Whale

Population Status and Abundance

Only a small amount of IQ regarding killer whales has been recorded. However, it was noted by many Inuit that the presence of killer whales in the Arctic has been increasing. Elders in Pond Inlet have indicated that pod size of killer whales has increased significantly in recent years.

General Biology

Killer whales often hunt seals, narwhal, beluga, bowhead and fish in open water. It is thought that when they detect prey, the killer whales begin to emit high-pitched sounds and calls. When other marine mammals hear the calls, they flee into shallow water, where it is easier for the predators to capture them.

Little information regarding killer whale reproduction was recorded during the IQ study, but it was indicated that some calving occurred near Pond and Milne inlets (see Figure 3.9).

As a result of the increasing presence of killer whales in the Arctic, some Inuit have noted a decrease in other marine mammal species in some areas. For example, Elders in Igloolik indicated that seals in one offshore area near their community had disappeared because of predation by killer whales.

Geographic and Seasonal Distribution

Killer whales presence and distribution in the Arctic is sporadic but has been increasing. Accounts of killer whales hunting seals and other marine mammals in both Steensby and Milne inlets are becoming more common, particularly from communities such as Igloolik and Pond Inlet. Killer whales are frequently observed in and around Eclipse Sound (see Figure 3.9). Killer whales have also been observed recently in Murray Maxwell Bay, near Hall Beach, and near Repulse Bay (see Figure 3.5).

3.2.5 Ringed Seal

Population Status and Abundance

Ringed seals occur throughout most of the Arctic and are year-round residents in the regions around Baffin Island. Little IQ regarding changes in ringed seal abundance has been collected.

General Biology

The ringed seal diet consists primarily of fish such as Arctic cod, but also includes other animals such as clams and mussels. Ringed seal pupping starts in April, but most pups are born in May. Single pups are born in snow dens that the female excavates into snowdrifts on the ice. Most pupping occurs in bays and inlets where landfast ice forms, but some pupping might also occur in areas of moving pack ice. Pregnant ringed seals frequently occur along the floe edge, in close proximity to dens excavated in areas of landfast ice.

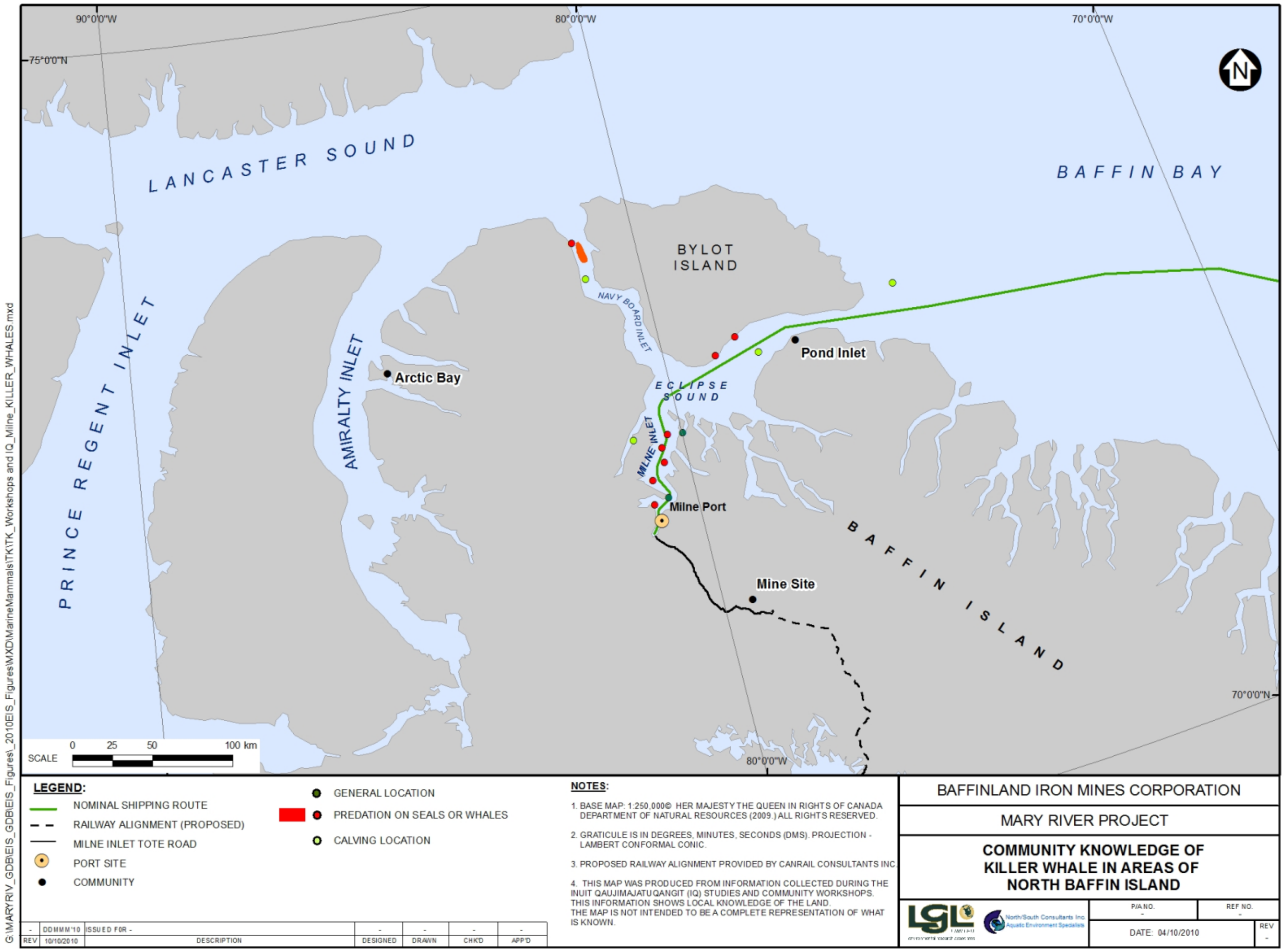

Figure 3.9 Community Knowledge of Killer Whales in Areas of North Baffin Island

The presence of sufficient snow cover on the ice is of primary importance when selecting denning locations. IQ also suggests that ringed seal dens will not be constructed on moving pack ice in areas of strong ocean currents because the ice will pile up on itself, crushing the dens. Most denning in the north Baffin region is thought to occur in areas of landfast ice such as Eclipse Sound or Admiralty Inlet (see Figure 3.10). Ringed seal are common in northwestern Foxe Basin, particularly in Gifford fjord and Fury and Hecla Straits (Anon 2008). Inuit in Igloolik and Hall Beach suggest that most ringed seal denning in northern Foxe Basin occurs in fast ice, but suggest that some denning and pupping may occur in moving pack ice in southern Foxe Basin and in the western part of Fury and Hecla Strait (see Figure 3.11).

Large concentrations of ringed seals hauled out on the ice have been observed in many areas of Eclipse Sound in the north Baffin area, in Murray Maxwell Bay and the southeastern portion of Steensby Inlet in northern Foxe Basin, and at the western part of Fury and Hecla Strait (see Figure 3.10 and Figure 3.11).

IQ indicates that ringed seals are distributed throughout the pack ice as well as landfast ice areas. Seals that occur in the pack ice are generally considered to be smaller than seals found in areas of landfast ice, and are less fat.

Geographic and Seasonal Distribution

Ringed seals are widely distributed throughout the Arctic, concentrating in areas of landfast ice but also occurring throughout areas of moving pack ice. IQ suggests ringed seals so not undergo large-scale seasonal migrations in large numbers. Some seasonal movements have been observed, mostly in response to changes in distribution of sea ice. A general pattern of movement into inlets and bays as landfast ice forms in the fall has been observed. In the spring, ringed seals often follow the ice into offshore areas as it breaks up, returning again in the fall to bays and inlets as new ice forms.

3.2.6 Bearded Seal

Population Status and Abundance

Bearded seals occur throughout most of the Arctic in low numbers relative to walrus and ringed seals. Limited IQ has been collected regarding the overall abundance of bearded seals, but some community Elders in the Baffin region have observed a decrease in bearded seal abundance since the advent of firearms and motorized transportation. In contrast, one Elder noted that bearded seals were rare near Pond Inlet in the past, but are now more frequently observed. Hunters from Cape Dorset also suggested an increase in the abundance of bearded seals.

General Biology

Bearded seals are benthic feeders, with diets similar to that of walrus. IQ indicates that sculpin and other fish may also be important in the diet.. Mating is believed to occur in the pack ice and not on landfast ice. Pups are born on the moving pack ice, usually along the floe edge in areas of shallow water.

Pupping occurs between March and May depending on location, and juveniles inhabit the floe areas well into June. Bearded seals give birth in April along the southern part Steensby Inlet.

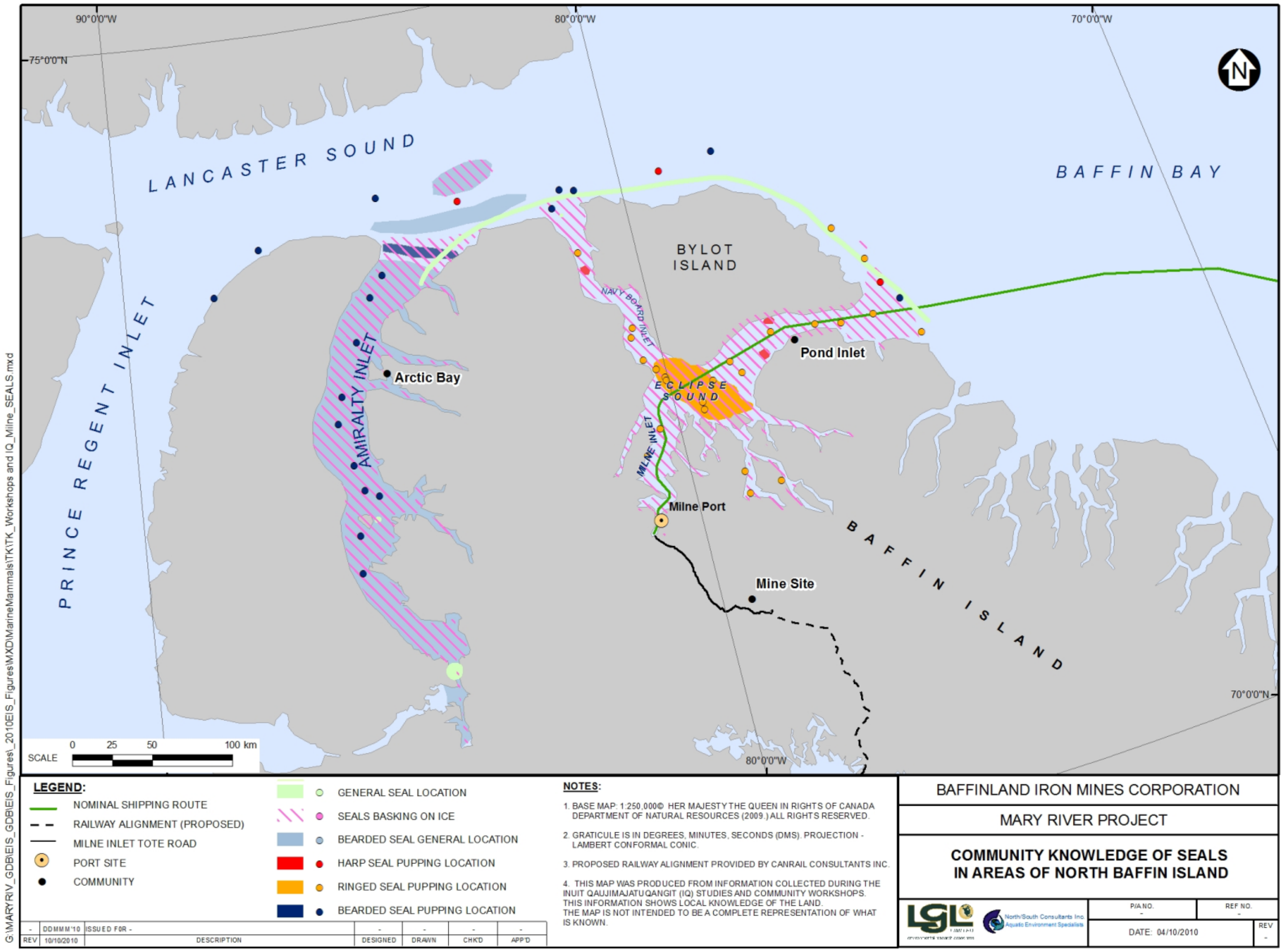

Figure 3.10 Community Knowledge of Seals in Areas of North Baffin Island

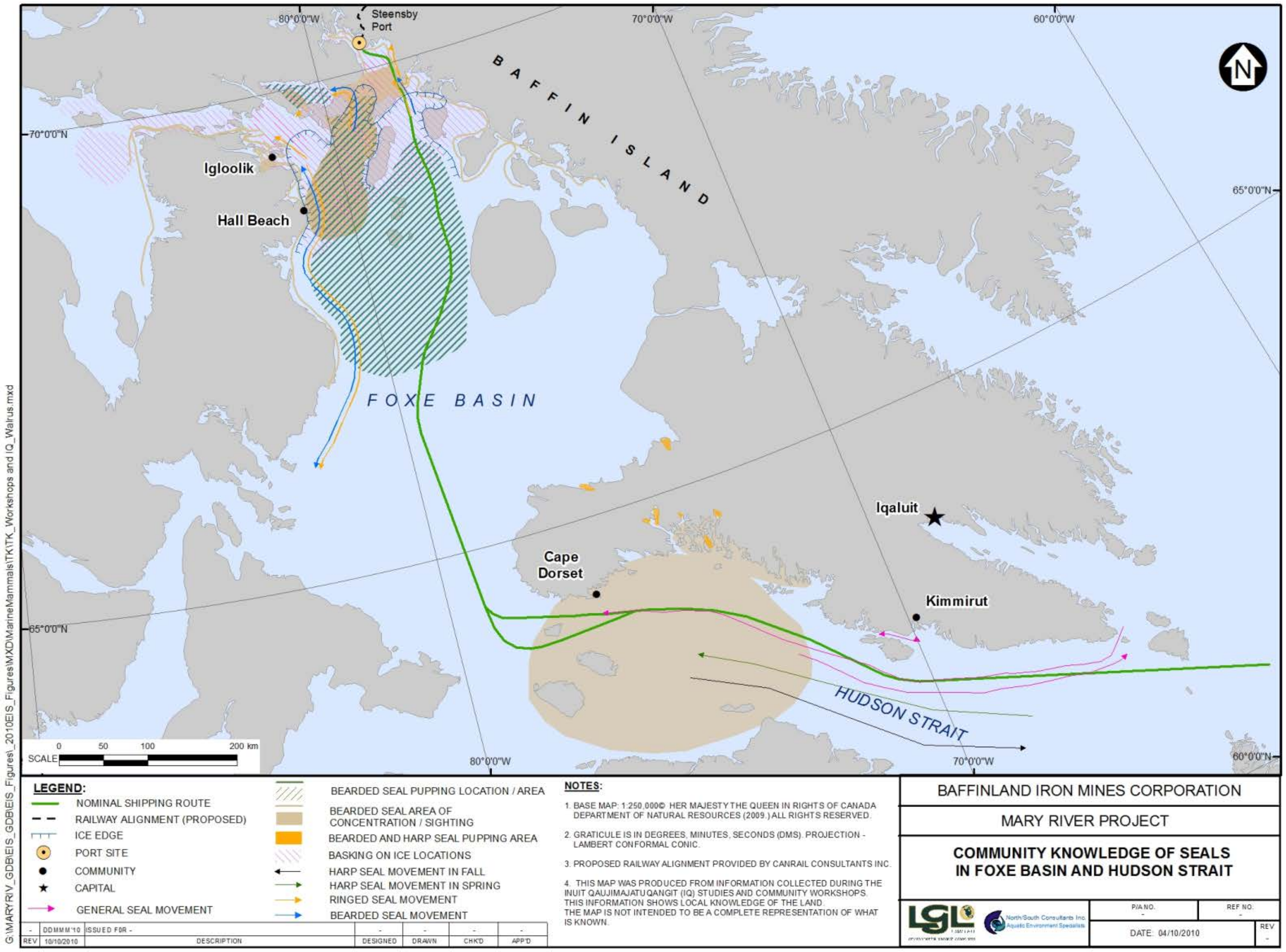

Figure 3.11 Community Knowledge of Seals in Foxe Basin and Hudson Strait

Bearded seals begin shedding their winter coats in spring, and haul out on the sea ice to bask during this period. Basking behaviour is common during the summer, and one Elder noted that bearded seals tend to bask in the sun immediately after eating. Bearded seals occasionally maintain breathing holes through the ice, despite the presence of open water close by.

Geographic and Seasonal Distribution

Bearded seals inhabit inlets and nearshore areas along the floe edge. Elders from Arctic Bay speculated that this behaviour is attributable to hunting pressure by killer whales. This species has a strong affinity for ice, preferring to haul up onto ice as long as it is present. Bearded seals generally prefer to haul up onto moving multi-year ice rather than moving inland to haul out on beaches or shoals. Seasonal movements occur in response to the formation and breakup of sea ice. Bearded seals move into inlets and bays to feed during open-water periods, and return to areas offshore of the floe edge once landfast ice has formed in fall. Coastal movements also occur throughout the open-water period; Inuit in Cape Dorset and Kimmirut reported westward movements through Hudson Strait during spring and eastward movements during fall.

In the north Baffin region, bearded seals are abundant throughout Admiralty Inlet and along the northwest coast of Baffin Island (see Figure 3.10). Pupping occurs throughout this region, as well as along the northern coast of Bylot Island.

To the south, bearded seals occur throughout northwestern Foxe Basin, year-round, and pupping takes place throughout most of its range (Anon 2008; see Figure 3.11). Near Igloolik, bearded seal numbers are greatest in June. Bearded seals undergo seasonal migrations from nearshore areas to open water in the fall. They return in the spring when the ice begins to retreat to breed and give birth. Bearded seal distribution appears to be limited by the presence of floe ice, although the animals tend to concentrate in certain areas during times of breeding when their mating calls can be heard.

3.2.7 Harp Seal

Population Status and Abundance

Little IQ related to population status and abundance of harp seal is available. This species is generally considered of low abundance compared to other seal species in the region, with sporadic sightings in both north and south Baffin.

General Biology

IQ with respect to the life history, reproduction, and diet of harp seals is limited. Although it is thought that harp seals give birth in the spring, exact times were unknown. Pupping locations were also generally unknown, though some Inuit suggested that limited pupping may occur in Pond Inlet and Navy Board Inlet (see Figure 3.10).

Geographic and Seasonal Distribution

Harp seals have been observed in both the north and south Baffin regions, usually in late summer or fall. They undergo seasonal migrations into the Lancaster Sound, Eclipse Sound, and Admiralty Inlet areas, arriving after the sea ice has broken in summer and leaving as new ice forms (see Figure 3.10). Seasonal migrations also occur through Hudson Strait and into Foxe Basin during spring, followed by a return migration in the fall (see Figure 3.11). Harp seal are not considered abundant in Foxe Basin. They are found primarily between Igloolik and the Peninsula of Melville North (Anon 2008).

3.2.8 Walrus

Population Status and Abundance

Walrus populations are believed to be decreasing throughout the Arctic. Whereas some Inuit believe that the decline is part of a natural cycle dependent on climatic conditions, others believe it is attributable to anthropogenic affects such as motorized boats, ecotourism, and sport hunting. As a result of population declines, walrus exist in smaller numbers now than in the past.

General Biology

Walrus are a highly vocal animal, and IQ indicates that male, female, and juvenile walrus can be differentiated based on distinctive calls. Different populations can also be distinguished based on physical differences such as colouration, tusk size, firmness of liver, taste, skin toughness, and smell. These differences are believed to be associated with differences in diet. Walrus feed on animals living on the seafloor, primarily on clams and mussels. Krill, eels, kettlefish, and other small fish were also identified as walrus diet items. Some adult walrus also occasionally kill and eat seals. Small differences in diet are believed to exist between populations.

Walrus are aggressive and unafraid of most large predators such as killer whales. They are highly territorial and will aggressively defend their territories against any perceived threat. For example, walrus have been observed to challenge ships passing into their territory. Older walrus defend their territory most aggressively, whereas younger animals are believed to have better hearing and as a result, act as “lookouts” for danger.

Walrus calves are born between March and July, depending on location. Ice conditions are important for calving, and calves are typically born along the floe edge or on moving pack ice. In the North Baffin area, calving locations were identified in Admiralty Inlet, near the outlet of Navy Board Inlet, and off the north coast of Bylot Island (see Figure 3.12). In Foxe Basin, the main calving area identified was in waters in the north western portion of the basin (see Figure 3.13).

Geographic and Seasonal Distribution

Walrus generally occur in shallow waters, where they can easily access their food. Small numbers of walrus occur near the mouth of Navy Board Inlet and in Lancaster Sound to the west of Admiralty Inlet (see Figure 3.12). Larger numbers of walrus occur in northern Foxe Basin and concentrate among the islands and in coastal areas (see Figure 3.13). Walrus also occur along the north coast of Hudson Strait and concentrate in the vicinity of Cape Dorset (see Figure 3.13).

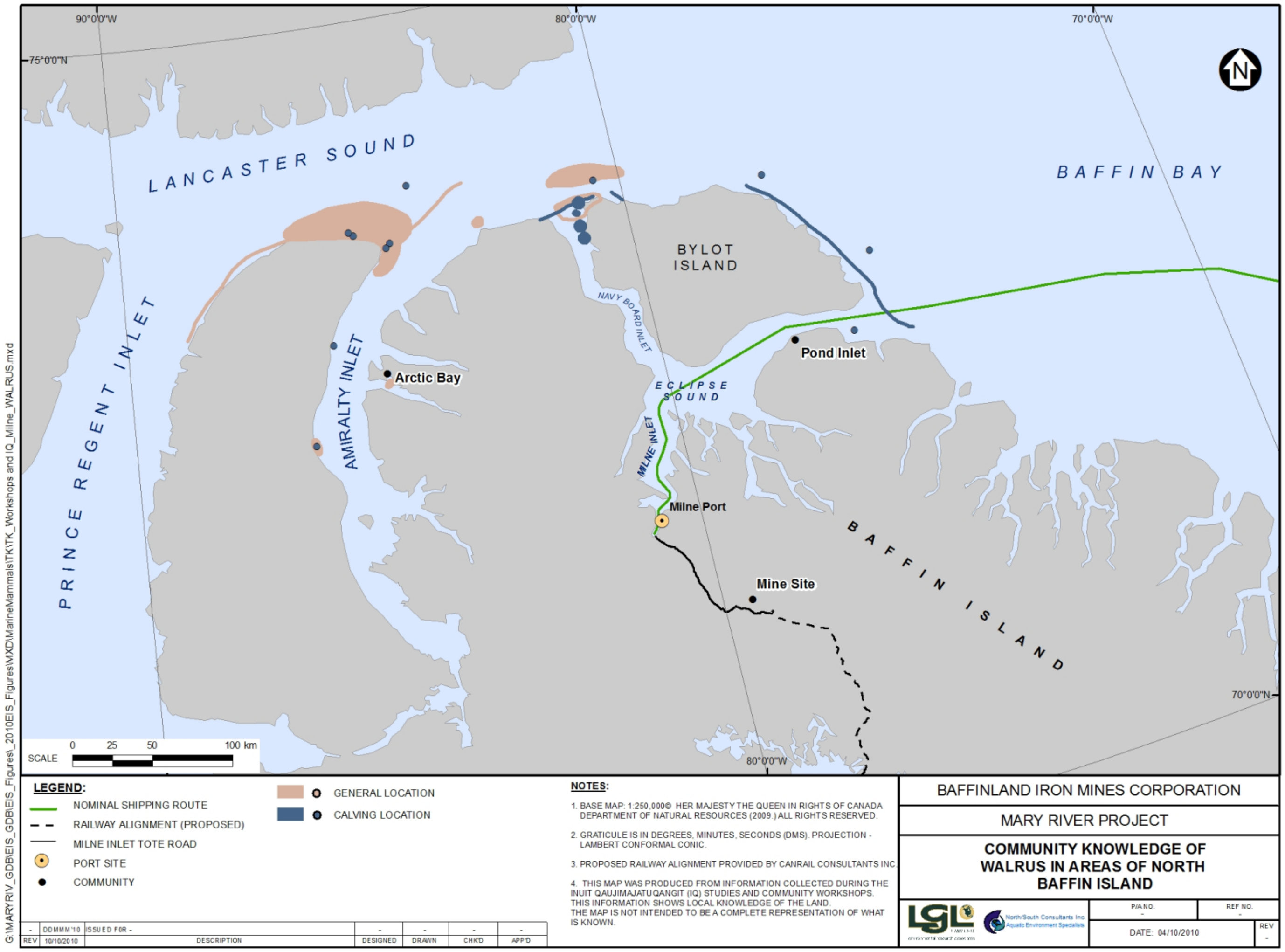

Figure 3.12 Community Knowledge of Walrus in Areas of North Baffin Island

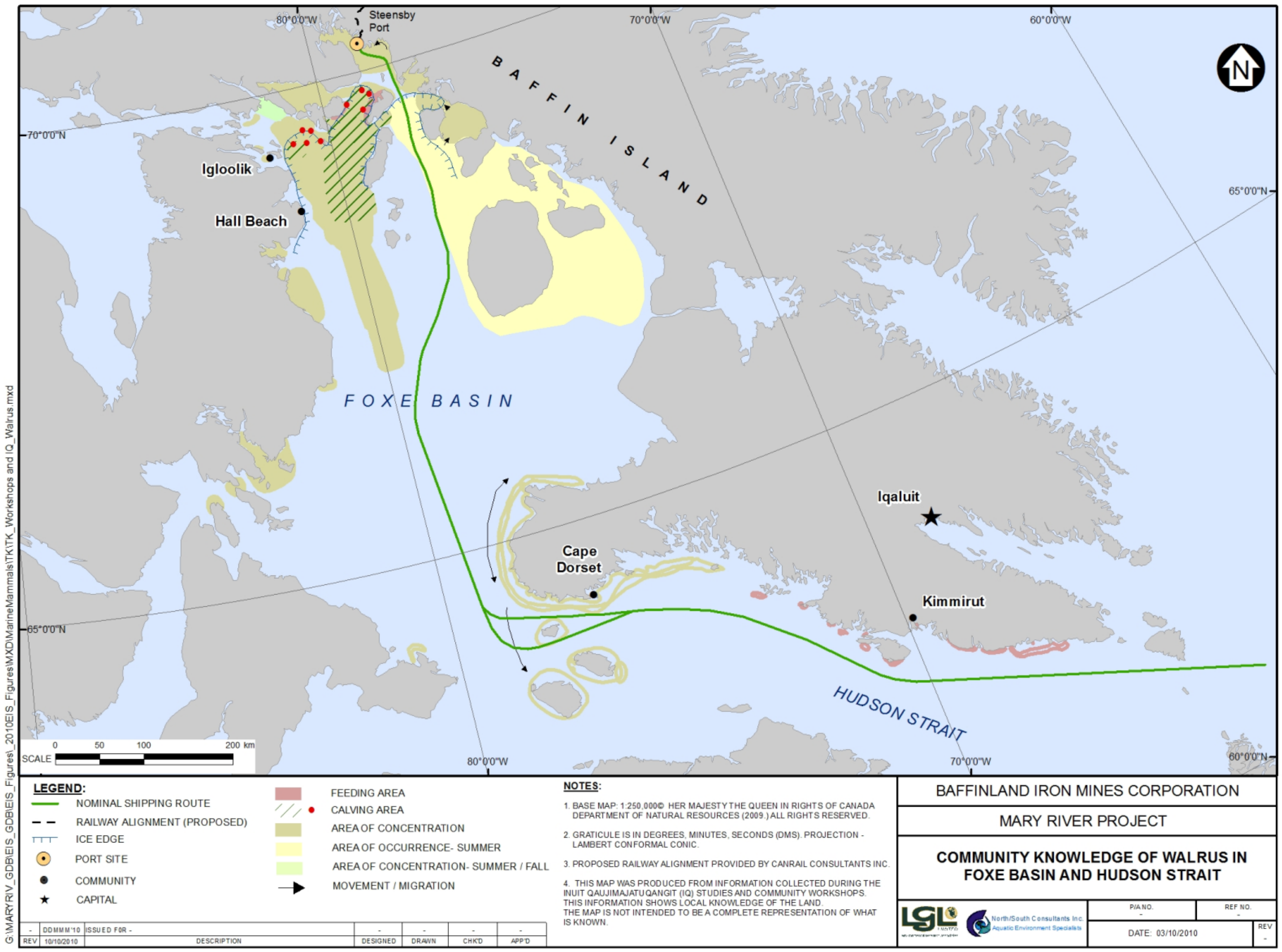

Figure 3.13 Community Knowledge of Walrus in Foxe Basin and Hudson Strait

Walrus are year-round residents, shifting their distribution locally in response to ice conditions. Elders indicate that the area east of Rowley Island is the preferred birthing area if ideal conditions are met. If not, walrus will travel to other birthing areas west of Rowley and Spicer Islands (S. Frame, DFO, pers. comm.). During winter, walrus occur among the pack ice and along the floe edge. In northern Foxe Basin, walrus tend to move into bays and inlets as the sea ice breaks up during spring and then back to offshore areas as ice forms in the fall. Near Cape Dorset, walrus winter along the north shore of Hudson Strait, but move to islands in the middle of the strait during open-water periods. Localized coastal movements also occur.

Although large migratory movements by large numbers of animals are not thought to occur, Inuit in Kimmirut and Cape Dorset suggest that a small number of animals might move between the Cape Dorset area and northern Foxe Basin.

3.2.9 Polar Bear

Population Status and Abundance

Whereas little reference to discrete populations of polar bears was made, most Inuit agree that the number of polar bears has increased since the 1960's. In the past, polar bears were found only by the floe edge, but currently they are more widely dispersed and frequently enter Inuit camps and communities. This increase in the number of bears has been attributed to a decrease in multi-year ice and a decreased fear of humans and dogs. Most Elders believe that bear numbers have increased as a result of government-imposed hunting quotas. One Elder suggested that it is the female bear population that is increasing as regulations only permit the hunting of male bears.

General Biology

IQ knowledge indicates that polar bears prey primarily on seals. They hunt seals on the sea ice, usually along floe edges or cracks in the ice where the ice is rough and contains more snow. Polar bears are also known to prey on walrus and whales, sometimes travelling back and forth along cracks in the ice waiting for whales to surface. Additionally, polar bears have been known to feed on eider ducks and their eggs, fish in riverine environments, caribou, some types of vegetation (leaves, berries, seaweed), all which are consumed when food is scarce. Before entering their dens, bears are believed to eat moss to block their bowels during hibernation.

Most IQ indicates that polar bears begin building dens in the fall, in deep snow, on the side of hills or cliffs. Some Elders believe that only full-grown males and pregnant females maintain dens, although others believe that all polar bears hibernate in dens during winter. Bears will constantly dig out the den during hibernation to easily break out in the spring. This is done as snow accumulates through the winter. Most Elders agree that polar bears leave their dens in April, but suggest that males and young bears may leave their dens in March. It appears as though the timing for leaving dens corresponds to the appearance of seal pups. It was noted that a female bear may return to her den to provide shelter for her cubs during blizzards.

Most denning occurs on land. In the North Baffin region, denning is known to occur on Bylot Island near Navy Board Inlet and along the coasts of Admiralty Inlet (see Figure 3.14).

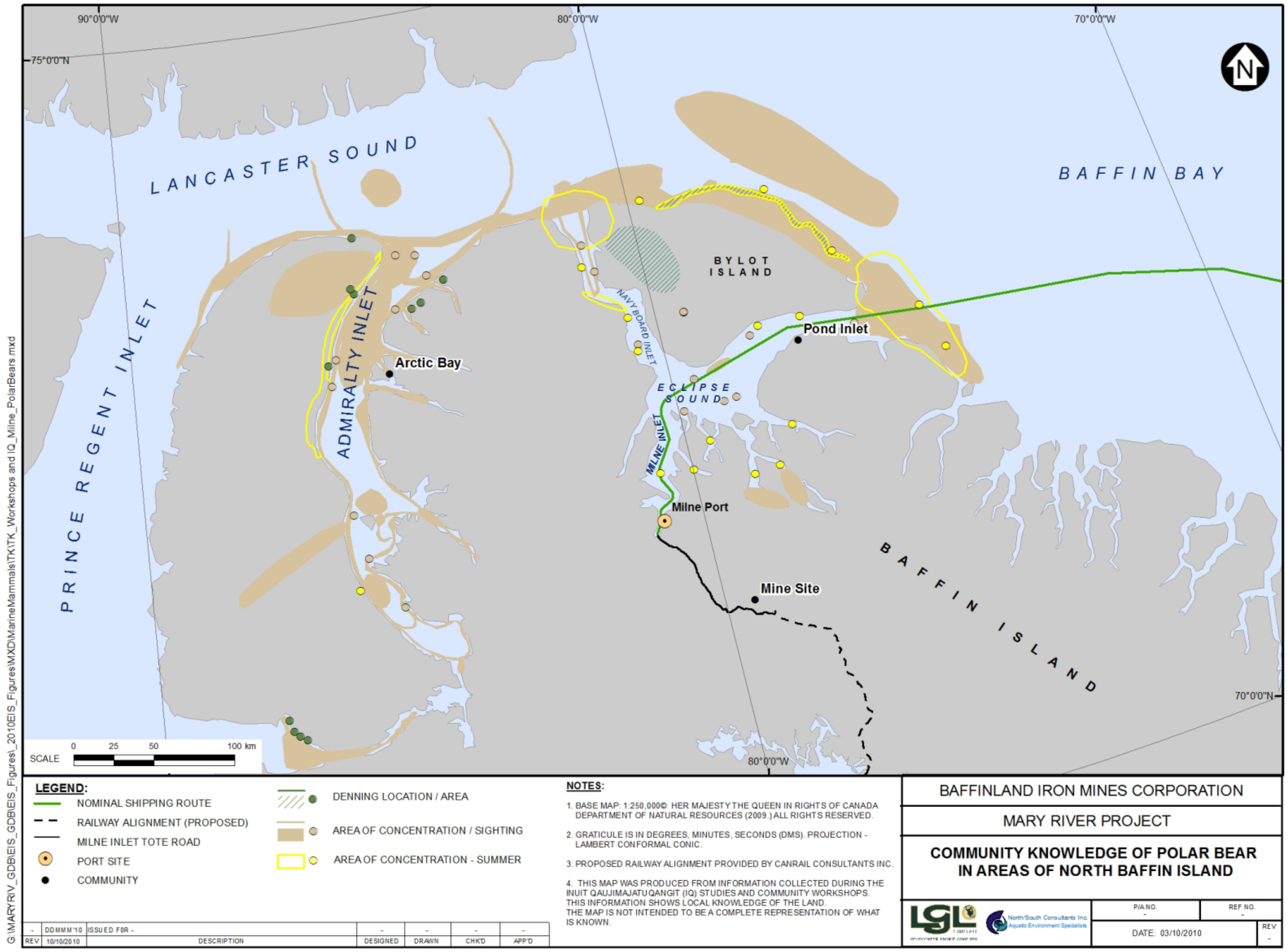

Figure 3.14 Community Knowledge of Polar Bears in Areas of North Baffin Island

To the south, polar bears den on islands in northern Foxe Basin and in the Gulf of Boothia, as well as in areas inland of Cape Dorset (see Figure 3.15). According to Hall Beach Elders, the flat western portion of Steensby Inlet contains few places appropriate for denning, although the steeper terrain and greater snow depth in the southeastern part provides suitable den habitat.

In fall (October/November), female bears typically give birth to one or two cubs (rarely three) inside a den excavated in the snow, and remain there throughout the winter (from October/November to April). The cubs are nursed all winter inside the den. Some Inuit believe that if a bear gives birth early on the sea ice, it will carry the cub in its mouth and immediately travel inland to make a den. It was suggested that increasing numbers of polar bears are causing the population to use less appropriate habitat (with less snow) to build dens.

Geographic and Seasonal Distribution

Polar bears usually inhabit sea ice, where they hunt seals. Identified areas of bear concentration along the northern shipping route include northwest Baffin Bay along the coast of Baffin and Bylot islands, and throughout Admiralty Inlet (see Figure 3.14). To the south, polar bears are distributed throughout Foxe Basin and Hudson Strait, but are more concentrated in northern Foxe Basin and through Fury and Hecla Strait into the Gulf of Boothia (see Figure 3.15). Polar bears are reported as being widely distributed from south of Hall Beach to north of Igloolik and east to the coast of Baffin Island (Anon. 2008). Elders in Igloolik indicated that bears travel to Foxe Basin on ice flows through Fury and Hecla Strait in the spring (see Figure 3.15).

In summer, when the ice has disappeared, the bears move onto land. They typically move along the shorelines, although some have been observed farther inland. The large islands in northern Foxe Basin are known areas of polar bear concentration during summer. IQ indicates that bears have become more visible in the summer and are more widely distributed.

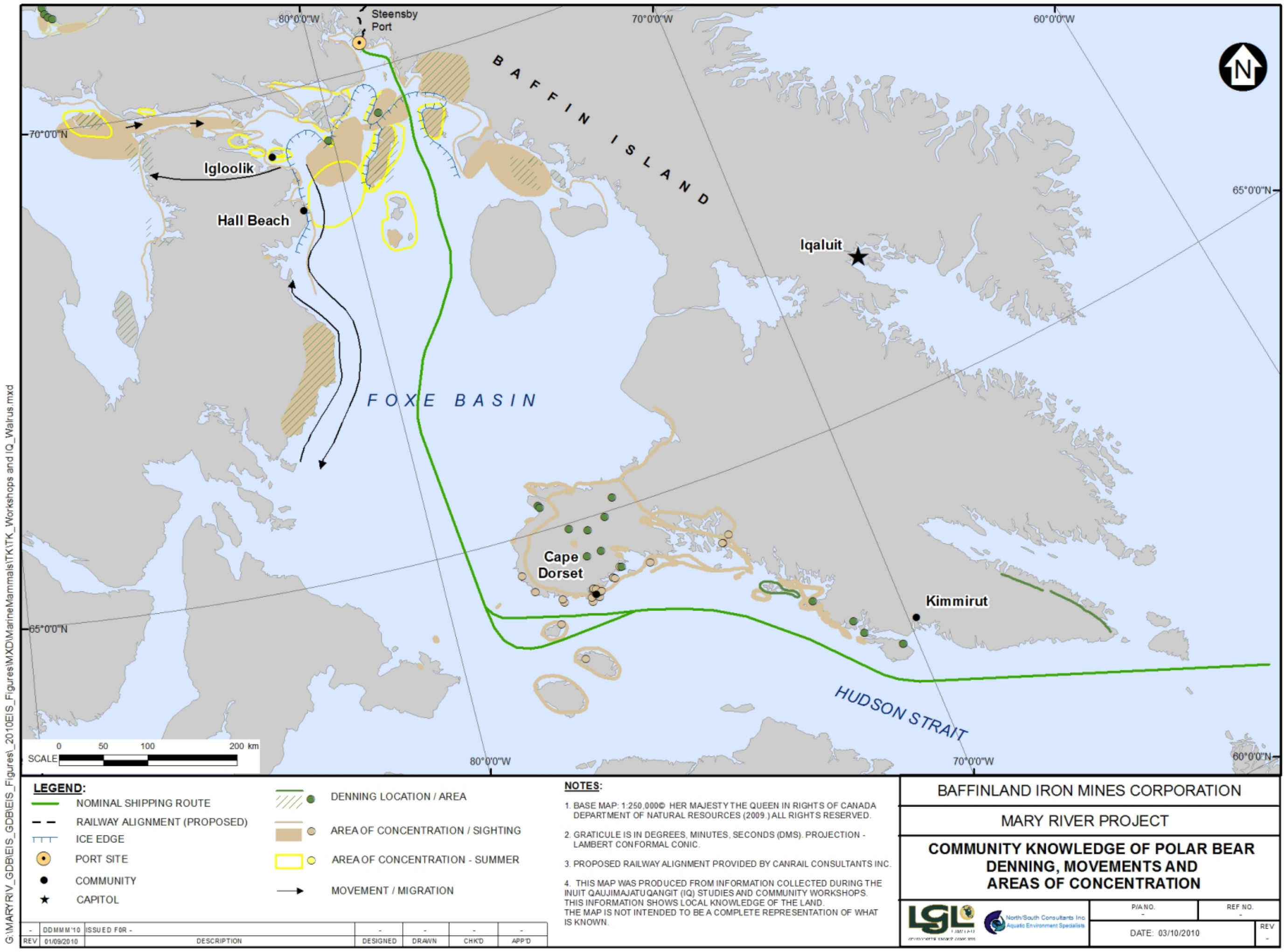

Figure 3.15 Community Knowledge of Polar Bears in Foxe Basin and Hudson Strait

4.0 PROJECT-SPECIFIC FIELD INVESTIGATIONS

Aerial surveys were conducted periodically during 2006, 2007, and 2008 to document the distribution and abundance of marine mammals (and seabirds) in the vicinity of the Milne Inlet and Steensby Inlet port sites and along potential shipping routes for the proposed Mary River Project. The following sections present methodologies and discuss results of marine mammal observations during the aerial surveys. The seabird baseline report provides the methods and results of the seabird aerial surveys.

4.1 SURVEY METHODS

Two types of aerial surveys were conducted: ringed seal surveys of landfast ice during spring and “marine mammal” surveys primarily targeting cetaceans, which were mostly conducted during the open-water season. Both ringed seal and marine mammal aerial surveys were conducted at the Milne Inlet Port and shipping route and the Steensby Inlet Port and shipping route. Survey methods and analysis procedures are detailed below and Table 4.1 summarizes key survey information.

4.1.1 Ringed Seal Surveys

4.1.1.1 Survey Design

Most quantitative surveys of ringed seal abundance and distribution, including this study, are conducted during late spring, when large numbers of moulting seals haul out on the landfast ice and hence, are available to be counted by aerial surveyors. Seal surveys over the landfast ice of Milne Inlet and Steensby Inlet were conducted in June 2006, 2007, and 2008. In June 2006, additional survey coverage of the shipping route into Milne Inlet, i.e., Eclipse Sound and Navy Board Inlet was acquired (see Appendix 3, Figure A3.1). Likewise, survey coverage included northern Foxe Basin in June 2006 (see Appendix 3, Figure A3.2).

In Milne Inlet, survey design (orientation and spacing of survey transects) differed during 2006 vs. 2007 and 2008. During 2007 and 2008, single transects were surveyed in the middle of the narrow southern section of Milne Inlet and in a loop around Koluktoo Bay (see Appendix 3, Figure A3.1). North of Koluktoo Bay, where Milne Inlet widens, parallel east-west transects spaced at 4-km intervals were surveyed to provide ~25% survey coverage of the area. In 2006, survey design was recognizance in nature, and covered a larger area than subsequent years. As such, single transects extending the length of Milne Inlet, Navy Board Inlet, and Eclipse Sound were surveyed in that year.

In Steensby Inlet, survey design also differed in 2006 vs. 2007 and 2008. In 2007 and 2008, parallel east-west transects spaced nominally at 4-km intervals were surveyed to once again provide ~25% coverage of the area (see Appendix 3, Figure A3.2). As the survey approached the ice floe edge in the southern portion of the survey area, length and orientation of transects were adjusted to ensure accurate coverage of the region around the floe edge. In 2006, parallel east-west transects were spaced farther apart at 10 km vs. the nominal 4-km spacing in 2007 and 2008.

Table 4.1 Summary of Ringed Seal and Marine Mammal Aerial Survey Field Procedures and Coverage - 2006, 2007, and 2008

Survey Period	Study Area	Aircraft	Altitude (m)	Speed (km/h)	Total Transect Width (m)	Total Area Surveyed (km^2)	Linear Distance Surveyed (km)
RINGED SEAL SURVEYS							
Milne Inlet Port and Shipping Route							
Jun 2006	Eclipse Sound, Navy Board and Milne Inlet	Dornier 228	152	315	800	1,140	1,425
Jun 2007	Milne Inlet	Eurocopter A Star	152	220	800	476	595
Jun 2008 [1]	Milne Inlet	Twin Otter DHC-6	91	220	594	151	255
Steensby Port and Shipping Route							
Jun 2006	Steensby Inlet, Northern Foxe Basin	Dornier 228	152	315	800	1,058	1,323
Jun 2007	Steensby Inlet	Eurocopter A Star	152	220	800	389	486
Jun 2008 [2]	Steensby Inlet	Twin Otter DHC-6	91	220	594	384	646
MARINE MAMMAL SURVEYS							
Milne Inlet Port and Shipping Route							
Late Jul, Aug, Sep 2007	Eclipse Sound, Milne Inlet	Shorts Skyvan or Twin Otter DHC-6	305	220	1,986	32,044	16,135
Aug, Sep 2008	Eclipse Sound, Milne Inlet	Twin Otter DHC-6	305	220	1,986	24,567	12,370
Steensby Port and Shipping Route							
Aug, Sep 2006	Steensby Inlet, Northern Foxe Basin	Shorts Skyvan	305	315	1,986	4,361	2,196
Apr, Jun, Aug, Sep, Oct 2008	Steensby Inlet, Foxe Basin, Hudson Strait	Twin Otter DHC-6	152	220	994	31,362	31,551
Aug, Sep, Oct 2008	Shoreline Northern Foxe Basin [3]	Twin Otter DHC-6	91	220	594	1,854	3,121

NOTES:

1. Conducted on 17 June from 1343 h to 1507 h; 100% ice cover; sightability conditions were primarily (89%) good with cloud cover (91% overcast, 9% clear)
2. Conducted on 14 and 15 June. 14 June from 1519 h to 1659 h; 100% ice cover; sightability conditions were primarily (78%) excellent with 20-100% cloud cover. 15 June from 1051 h to 1240 h; primarily 100% ice cover (4% of effort with 85% ice cover); sightability conditions were primarily (96%) excellent with 5-50% cloud cover.
3. These aerial surveys were targeting birds.

4.1.1.2 Survey and Data Recording Procedures

Strip transect methodology was used, which has been standard for previous aerial surveys of ringed seals. Two primary observers occupied seats on opposite sides of the aircraft in each survey year. Survey procedures varied in 2006 and 2007 vs. 2008. In 2006 and 2007, surveys were conducted from a fixed-wing aircraft (Dornier 228) and a helicopter (Eurocopter A Star), at an altitude of 150 m above sea level (asl) and a ground speed of 315 km/h (in 2006) and 220 km/h (in 2007). The survey strip width was 400 m on each side of the aircraft, offset 100 m from the centreline of the aircraft. In 2008, a fixed-wing aircraft, a Twin Otter (DHC-6) was used and surveys were conducted at an altitude of 91 m asl and at a ground speed of 220 km/h. The survey strip width was 297 m on each side of the aircraft, offset 69 m from the centreline of the Twin Otter.

In 2006 and 2007, pre-determined transects and routes were constructed in a mapping software package (Oziexplorer; Brisbane, Australia; www.oziexplorer.com) and uploaded onto the GPS navigation system onboard the helicopter. Observers situated on either side of the aircraft recorded the number of seals observed within the survey strip ("on transect") and also those observed outside the strip ("off transect"). A timing device emitted an audible signal every 30 seconds to notify observers it was time to record data. During each 30 seconds interval, all observed seals (on and off transect) were identified and counted. Behavioural, species, sex/age, group size, and habitat (i.e., whether a seal was hauled out at a hole or crack) information was also recorded whenever possible. Seals passing below the flight path of the aircraft were identified and counted by the pilot sitting in the front right seat. These sightings were recorded as off-transect observations. Constant communication was maintained between the pilot and dedicated observers to ensure seal counts were not duplicated. Track logs from the aircrafts navigation system, as well as those collected using a hand held GPS, provided a detailed record of aircraft speed and flight path. GPS waypoints indicated the onset and completion of each transect. Weather conditions were recorded for each transect.

In 2008, for each seal sighting by a primary observer, the observer dictated onto audiotape the species, number, and habitat (hole or crack) of the seal(s) and noted whether the sighting was on or off the transect strip. Environmental parameters were recorded at the start of each transect. At the end of each two-minute (~7.4-km) period along a transect, the two primary observers each dictated onto audiotape the time, visibility, ice cover, ice deformation, melt water, sun glare, and overall sightability conditions (subjectively classified as excellent, good, moderately impaired, severely impaired, or impossible). A timer, initialized at the start of each transect, provided an audible signal at two-minute intervals. Two GPS receivers were used to record the track log of every survey flight.

Incidental sightings of other marine mammal species were also recorded during each ringed seal survey.

4.1.2 Marine Mammal Surveys

4.1.2.1 Survey Design

"Marine mammal" surveys, which targeted cetaceans and to a lesser extent polar bears, walrus, and seals, were conducted primarily during the open-water season. Surveys of Milne Inlet and Eclipse Sound in late July, August and September 2007 and August and September 2008 were designed to sample the larger open-water areas of the shipping route as well as Eskimo Inlet, Koluktoo Bay, Tay Sound, Tremblay Sound, and White Bay (see Appendix 3, Figure A3.1). The survey objectives were to document the daily and seasonal distribution of narwhal and other marine mammals summering in the area, and to attempt to document the responses of narwhal to ship movements to the Milne Inlet Port Site.

Steensby Inlet was surveyed in August and September 2006 along a series of transects oriented east—west and reconnaissance transects of the northern portion of Foxe Basin were also surveyed at this time (see Appendix 3, Figure A3.2).

Foxe Basin and Hudson Strait were surveyed in 2008 to provide information on marine mammal distribution and abundance during spring (April, June), summer (August, September), and fall (October) along the proposed shipping route. Survey effort during 2008 focused on Steensby Inlet and northern Foxe Basin, and along the northern half of Hudson Strait extending from Cape Dorset eastward to Resolution Island (see Appendix 3, Figure A3.2). Survey flights in northern Foxe Basin and Steensby Inlet followed east-west transects, whereas those in Hudson Strait followed a north-south zigzag pattern, which was based on a similar design used by DFO for bowhead surveys in the area. The broad-scale, zigzag surveys were planned to assess marine mammal distribution within areas adjacent to the proposed shipping route (including a western shipping route option that was dropped from consideration in 2008).

The vast area of Foxe Basin precluded extensively surveying the entire shipping route through the area. The areas surveyed were targeted because of their importance to marine mammals, proximity to Inuit communities that rely on marine mammals, and anticipated Project interaction with marine wildlife in those areas.

4.1.2.2 Survey and Data Recording Procedures

Survey and data recording procedures for the marine mammal surveys differed in 2006 vs. 2007 and 2008. During the open-water period in 2006, marine mammal surveys over Steensby Inlet and northern Foxe Basin were conducted from a fixed-wing aircraft (Shorts Skyvan) at an altitude of 305 m asl and a ground speed of 315 km/h. The survey strip width was 993 m on each side of the aircraft, offset by 230 m from the centreline of the aircraft. Two primary observers conducted the survey in 2006. In 2007 and 2008, marine mammal surveys over open-water in Milne Inlet and Eclipse Sound were conducted from a fixed-wing aircraft (Twin Otter DHC-6 or Short Skyvan) at an altitude of 305 m asl and at a ground speed of 222 km/h (see Table 4.1). The survey strip width was 993 m on each side of the aircraft, offset by 230 m from the centreline of the aircraft.

During surveys of Steensby Inlet, Foxe Basin, and Hudson Strait in spring, summer, and fall 2008, survey altitude was 152 m asl and transect strip width was 497 m on each side of the aircraft. During the shoreline surveys of Steensby Inlet and an adjacent area of northern Foxe Basin in August, September and October 2008, the survey altitude was 91 m to allow observers to focus survey effort on seabird observations. Marine mammals sightings were also recorded in a transect strip width of 297 m on each side of the aircraft during the bird surveys. Depending on survey location, two (Eclipse Sound, Milne Inlet) or four (Steensby Inlet, Foxe Basin, and Hudson Strait) primary observers were present on every flight and secondary observers were present when available.

During the 2006 marine mammal surveys, observers manually recorded the species and number of individuals observed, activity, heading, swimming speed category, whether the sightings was within or outside the target transect width, and the inclinometer reading of the sighting. The inclinometer reading was recorded when the animal’s location was perpendicular to the path of the aircraft, allowing calculation of lateral distance from the aircraft trackline. GPS waypoints were collected to provide location and time of each mammal sighting. Observations on sightablity were recorded during each flight.

In 2007 and 2008, when a marine mammal was sighted, observers dictated into their audio recorder the time, species, number of individuals, sighting cue, age class (when determinable), activity, heading, swimming speed category, whether it was within or outside the target transect width, and the inclinometer reading of the sighting. The inclinometer reading was recorded when the animal’s location was perpendicular to the path of the aircraft, allowing calculation of lateral distance from the aircraft trackline. In addition to marine mammal sightings, each observer recorded the time, sightability (subjectively classified as excellent, good, moderately impaired, seriously impaired, or impossible), sea conditions (Beaufort wind force), ice cover, ice type, and sun glare at two-minute intervals along transects, and at the end of each transect. A timer produced an audible signal at two-minute intervals. Environmental parameters were also recorded at the start and end of each transect. Two GPS receivers were used to record the track log of every survey flight.

4.1.3 Data Analysis Procedures

All data were transcribed by each observer onto standard coding sheets after each flight and were keypunched into electronic databases after the fieldwork was completed. The data were error checked for valid codes, valid code sequences, and by test plots of sightings after they were geo-coded. The observer data were geo-coded using the shared time reference between the observer data and the flight tracklines recorded by the GPS receiver(s).

The sightings and the survey tracklines were uploaded into a GIS database (MapInfo 10.0 and ArcGIS 9.3) that allowed maps to be produced and geographical analyses to be completed.

Marine mammal densities were calculated by dividing the number of individuals sighted by the marine area (excluding survey track over offshore islands) surveyed (i.e., transect length x transect strip width). Densities are expressed as number of individuals per 100 km^2. Only sightings that were on-transect and made during acceptable environmental conditions were used. Environmental conditions that were deemed unacceptable and hence, excluded from analyses included survey effort when overall sightability was rated as impossible or severe. Density estimates were not corrected for detection or availability biases.

4.2 SURVEY EFFORT

4.2.1 Eclipse Sound and Milne Inlet

Aerial surveys to document the distribution and abundance of marine mammals in Eclipse Sound and Milne Inlet were conducted annually from 2006 to 2008 (see Table 4.1). For the number of survey flights and length of each flight, see Appendix 2.

Ringed seal surveys were conducted in Eclipse Sound and Milne Inlet in June of 2006, 2007, and 2008. The 2006 survey was reconnaissance in nature and covered Milne Inlet, Eclipse Sound, Navy Board Inlet and Pond Inlet in low survey coverage. Approximately 1425 km were flown resulting in about 1440 km^2 of surveyed area (see Table 4.1). Ringed seal surveys in 2007 and 2008 focused on Milne Inlet and Koluktoo Bay. Although fewer kilometres were flown (594 km in 2007 and 155 km in 2008) and a smaller area was surveyed (475 km^2 in 2007 and 255 km^2 in 2008, Table 4.1), greater survey coverage was provided (~25% of the overall area in Milne Inlet and Koluktoo Bay).

Marine mammal survey effort in Eclipse Sound and Milne Inlet during 2007 and 2008 was considerable to document changes in narwhal distribution and abundance in relation to ship transits into Milne Inlet. Areas surveyed also included Eclipse Sound, Koluktoo Bay, Tremblay Sound, White Bay, Tay Sound and Navy Board Inlet. In total, 20 flights and 16,135 km were flown during 2007 and 15 flights and 12,370 were flown in 2008 (see Table 4.1).

4.2.2 Foxe Basin and Hudson Strait

Aerial surveys to document the distribution and abundance of marine mammals in Steensby Inlet and northern Foxe Basin were conducted annually from 2006 to 2008 (see Table 4.1). Survey area was expanded in 2008 to include Hudson Strait. For the number of survey flights and length of each flight, see Appendix 2.

Ringed seal surveys were flown over Steensby Inlet in June of 2006, 2007, and 2008. The 2006 survey covered 1323 linear km and surveyed 1058 km^2 (Table 4.1). The 2007 survey was restricted to Steensby Inlet and included 486 km of flight and covered 389 km^2 of area (see Table 4.1). The 2008 survey in Steensby Inlet was flown at a lower altitude, covered more linear kilometres, but surveyed a comparable area as in 2007. A total of 646 km were flown and 384 km^2 were surveyed (see Table 4.1).

Marine mammal surveys were flown over Steensby Inlet and northern Foxe Basin in August and September 2006 and 2007. A total of 2196 km were flown and 4385 km^2 were surveyed in 2006, and 3506 km were flown and 6964 km^2 in 2007 (see Table 4.1).

In 2008, surveys were flown from April–October over Steensby Inlet, Foxe Basin, and Hudson Strait. Two different types of surveys were conducted. Broad-scale, zig-zag surveys were flown in April, June, August, September, and October. These surveys had a total effort of 31,551 km and 150 h, and covered 31,362 km^2. In August, September, and October, low altitude seabird and marine mammal surveys of nearshore areas of northern Foxe Basin and Steensby Inlet including offshore islands (Bray, Rowley, and Koch Islands) were conducted. These surveys included 3,121 km and 15 hours of survey effort, and covered 1,854 km^2 (see Table 4.1)

4.3 MARINE MAMMAL SPECIES DIVERSITY, DISTRIBUTION, AND DENSITY

4.3.1 Eclipse Sound and Milne Inlet

During 2006, 2007 and 2008 aerial surveys in Eclipse Sound and its bays and inlets, bowhead, beluga, narwhal, killer whale, walrus, bearded seal, ringed seal, harp seal, and polar bears were sighted. Narwhal was the most abundant marine mammal sighted in the area (see Table 4.2 and Table 4.3). Few pinnipeds were sighted apart from the harp seal in 2007. High-level aerial surveys can detect only a small fraction of pinnipeds in the water except for the largest species (e.g., walrus) and when large groups of harp seals are present.

4.3.1.1 Narwhal

Narwhals move into the fjords and bays of Eclipse Sound in July when the sea ice begins melting and shore leads form. Narwhals were present in Eclipse Sound, Milne Inlet, and Koluktoo Bay when aerial surveys were initiated in both years (29 July 2007 and 4 Aug 2008), and were still present when the surveys ended (18 Sept 2007 and 9 Sept 2008) (see Table 4.2 and Table 4.3, and Figure 4.1). Numbers seen on a typical aerial survey were often in the thousands. Other locations where narwhal were frequently sighted are Tremblay Sound and White Bay; Eskimo Inlet and Tay Sound were locations where narwhal were sighted on one or two surveys each year (see Table 4.2 and Table 4.3, Figure 4.1 and Figure 4.2, and Appendix 4).

Surveys in 2007 and 2008 documented fine-scale movement of large groups of narwhals between the various areas of Eclipse Sound and the fjords around it, both from day to day and on a longer interval. Examples of daily differences in distributions are between 7 and 8 August 2007 and between 25 and 26 September 2008 (see Figure 4.2). On a longer interval, their distribution apparently shifts from throughout the entire survey area in early August to Milne Inlet and other bays and sounds in late August, and from there to Eclipse Sound in mid September (see Figure 4.3 and Figure 4.4, which show all sightings over two-week periods). In 2007, the survey period extended far enough into September to cover the period when narwhals vacated Milne Inlet and Koluktoo Bay, both areas that contained high concentrations of narwhals in 2007 and 2008 (see Figure 4.3 and Figure 4.4). Beginning 8 September 2007, no narwhals or very few narwhals were seen in Koluktoo Bay, and no narwhals were seen in Milne Inlet between 10 September and18 September, the last survey day in 2007. On 18 September, large numbers of narwhals were again seen in northern Milne Inlet and there was one sighting in Koluktoo Bay (see Figure 4.1 and Appendix 4).

Table 4.2 Density (#/100 km^2) of Marine Mammals in Eclipse Sound and Vicinity - August and September 2007

Species	Period	Area														All Areas	
		Eclipse Sound		Eskimo Inlet		Koluktoo Bay		Milne Inlet		Tay Sound		Tremblay Sound		White Bay			
		Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.
Bowhead Whale	Aug1	0.1	4	0	0	0.8	9	0.2	8	0	0	0.2	1	0	0	0.2	22
	Aug2	0.6	5	0	0	0	0	0.2	2	0	0	0	0	0	0	0.3	7
	Sep1	0.0	1	0	0	0.1	1	0.2	5	0	0	0.2	1	0	0	0.1	8
	Sep 2	0.1	1	0	0	0	0	0	0	0	0	0	0	0	0	0.0	1
	All	0.1	11	0	0	0.4	10	0.2	15	0	0	0.1	2	0	0	0.1	38
Beluga	Aug1	0.0	1	0	0	0	0	0	0	0	0	0	0	0	0	0.0	1
	Aug2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sep1	0	0	0	0	0	0	0	0	0	0	0	0	0.3	2	0.0	2
	Sep2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	All	0.0	1	0	0	0	0	0	0	0	0	0	0	0.2	2	0.0	3
Narwhal	Aug1	10.9	542	35.6	36	305.4	3520	84.3	3731	21.8	53	204.6	1200	223.3	479	81.6	9,561
	Aug2	4.9	44	30.4	15	15.9	35	175.6	1709	0	0	103.6	163	267.2	311	92.8	2,277
	Sep1	55.1	3349	0	0	27.8	264	37.6	1184	0	0	89.0	532	56.4	326	47.8	5,655
	Sep2	60.3	1035	0	0	0.4	1	11.1	117	0	0	0	0	0	0	34.8	1,153
	All	36.4	4970	14.8	51	149.9	3820	70.3	6741	7.9	53	131.8	1895	108.1	1116	63.6	18,646
Killer Whale	Aug1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Aug2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sep1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sep2	0.2	3	0	0	0	0	0	0	0	0	0	0	0	0	0.1	3
	All	0.0	3	0	0	0	0	0	0	0	0	0	0	0	0	0.0	3
Walrus	Aug1	0.0	1	0	0	0	0	0.0	1	0	0	0	0	0	0	0.0	2
	Aug2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sep1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sep2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	All	0.0	1	0	0	0	0	0.0	1	0	0	0	0	0	0	0.0	2
Bearded Seal	Aug1	-	2	-	0	-	1	-	1	-	0	-	2	-	0	-	6
	Aug2	-	3	-	0	-	0	-	1	-	0	-	0	-	0	-	4
	Sep1	-	0	-	0	-	0	-	0	-	0	-	1	-	1	-	2
	Sep2	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0
	All	-	5	-	0	-	1	-	2	-	0	-	3	-	1	-	12
Ringed Seal	Aug1	-	2	-	0	-	0	-	1	-	0	-	0	-	0	-	3
	Aug2	-	2	-	0	-	0	-	1	-	0	-	0	-	1	-	4
	Sep1	-	1	-	2	-	8	-	12	-	0	-	1	-	0	-	24
	Sep2	-	0	-	0	-	0	-	1	-	0	-	0	-	0	-	1
	All	-	5	-	2	-	8	-	15	-	0	-	1	-	1	-	32
Harp Seal	Aug1	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0
	Aug2	-	150	-	0	-	0	-	58	-	0	-	20	-	0	-	228
	Sep1	-	1100	-	5	-	14	-	22	-	0	-	64	-	57	-	1,262
	Sep2	-	66	-	0	-	0	-	5	-	0	-	0	-	0	-	71
	All	-	1316	-	5	-	14	-	85	-	0	-	84	-	57	-	1,561
Polar Bear	Aug1	0	0	0	0	0	0	0.0	1	0	0	0	0	0	0	0.0	1
	Aug2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sep1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sep2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	All	0	0	0	0	0	0	0.0	1	0	0	0	0	0	0	0.0	1

NOTES:

1. CELLS WITH - INDICATE SPECIES DENSITIES THAT CANNOT BE RELIABLY ESTIMATED BECAUSE OF SPECIES SIZE AND SURVEY CONDTIONS.
2. NB INDICATES THE NUMBER OF SIGHTINGS THAT ARE ON-TRANSECT AND DURING ACCEPTABLE ENVIRONMENTAL CONDITIONS AND USED IN DENSITY CALCULATIONS
3. DENSITY OF 0.0 IS EQUIVALENT TO A VALUE BETWEEN >0 AND <0.05.

Table 4.3 Density (#/100 km2) of Marine Mammals in Eclipse Sound and Vicinity - August and September 2008

Species	Period	Area														All Areas	
		Eclipse Sound		Eskimo Inlet		Koluktoo Bay		Milne Inlet		Tay Sound		Tremblay Sound		White Bay			
		Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.
Bowhead Whale	Aug1	0.1	3	0	0	0	0	0.3	6	0	0	0	0	0	0	0.2	9
	Aug2	0	0	0	0	0.1	1	0.0	1	0	0	0	0	0	0	0.0	2
	Sep1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	All	0.0	3	0	0	0.0	1	0.1	7	0	0	0	0	0	0	0.1	11
Beluga	Aug1	0	0	0	0	0	0	0.7	13	0	0	0	0	8.3	15	0.5	28
	Aug2	0	0	0.7	1	0.2	3	0.2	9	0	0	0	0	3.7	14	0.2	27
	Sep1	0.1	2	0	0	0.4	2	0	0	0	0	0	0	0	0	0.1	4
	All	0.0	2	0.4	1	0.2	5	0.3	22	0	0	0	0	4.4	29	0.3	59
Narwhal	Aug1	28.3	610	0	0	117.8	694	25.4	478	0	0	146.5	325	759.6	1,372	67.0	3,479
	Aug2	6.5	288	87.0	124	157.4	1,922	151.0	6,069	6.1	37	6.4	27	103.5	387	76.2	8,855
	Sep1	31.4	749	0	0	14.5	71	0.1	1	0	0	0	0	3.6	4	16.9	825
	All	18.4	1647	48.1	124	116.9	2,687	86.4	6,548	4.6	37	48.2	352	264.6	1,763	60.7	13,159
Bearded Seal	Aug1	-	3	-	0	-	0	-	3	-	1	-	0	-	0	-	7
	Aug2	-	7	-	0	-	2	-	2	-	1	-	0	-	2	-	15
	Sep1	-	2	-	0	-	0	-	0	-	0	-	0	-	0	-	2
	All	-	12	-	0	-	2	-	5	-	2	-	0	-	2	-	24
Ringed Seal	Aug1	-	0	-	0	-	0	-	1	-	0	-	0	-	1	-	2
	Aug2	-	5	-	3	-	1	-	2	-	1	-	15	-	1	-	28
	Sep1	-	3	-	0	-	0	-	0	-	0	-	0	-	0	-	3
	All	-	8	-	3	-	1	-	3	-	1	-	15	-	2	-	33
Harp Seal	Aug1	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0
	Aug2	-	15	-	0	-	0	-	0	-	0	-	0	-	0	-	15
	Sep1	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0
	All	-	15	-	0	-	0	-	0	-	0	-	0	-	0	-	15
Polar Bear	Aug1	0	0	0	0	0	0	0.1	2	0	0	0	0	0	0	0.0	2
	Aug2	0.0	1	0	0	0	0	0	0	0	0	0	0	0	0	0.0	1
	Sep1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	All	0.0	1	0	0	0	0	0.0	2	0	0	0	0	0	0	0.0	3

NOTES:
1. CELLS WITH - INDICATE SPECIES DENSITIES THAT CANNOT BE RELIABLY ESTIMATED BECAUSE OF SPECIES SIZE AND SURVEY CONDTIONS.
2. NO. INDICATE THE NUMBER OF SIGHTINGS THAT ARE ON-TRANSECT AND DURING ACCEPTABLE ENVIRONMENTAL CONDITIONS USED IN DENSITY CALCULATION
3. DENSITY SHOWN AS 0.0 IS EQUIVALENT TO A VALUE BETWEEN >0 AND <0.05.

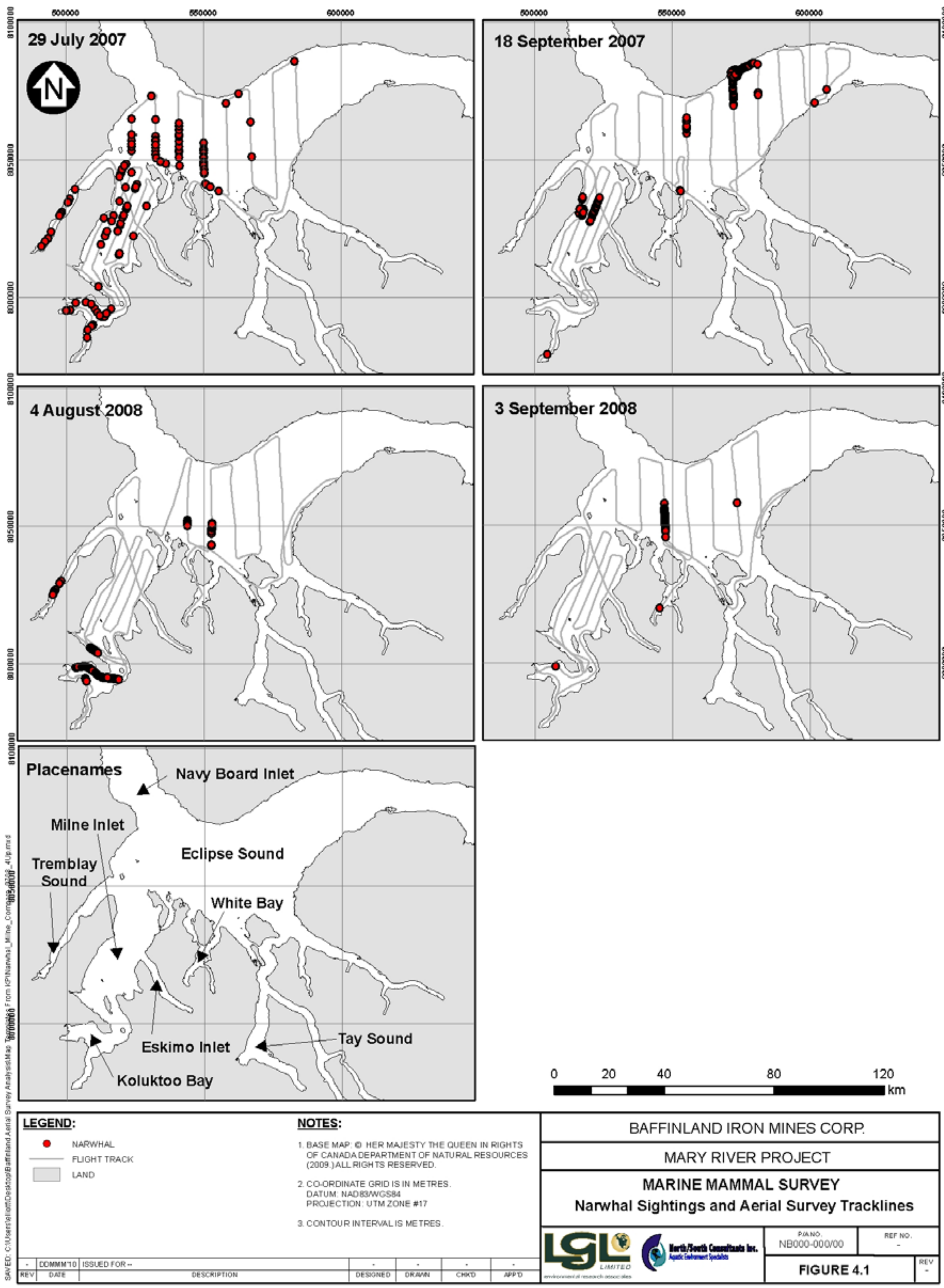

Figure 4.1 Narwhal Sightings and Aerial Survey Tracklines in Eclipse Sound, 2007 and 2008

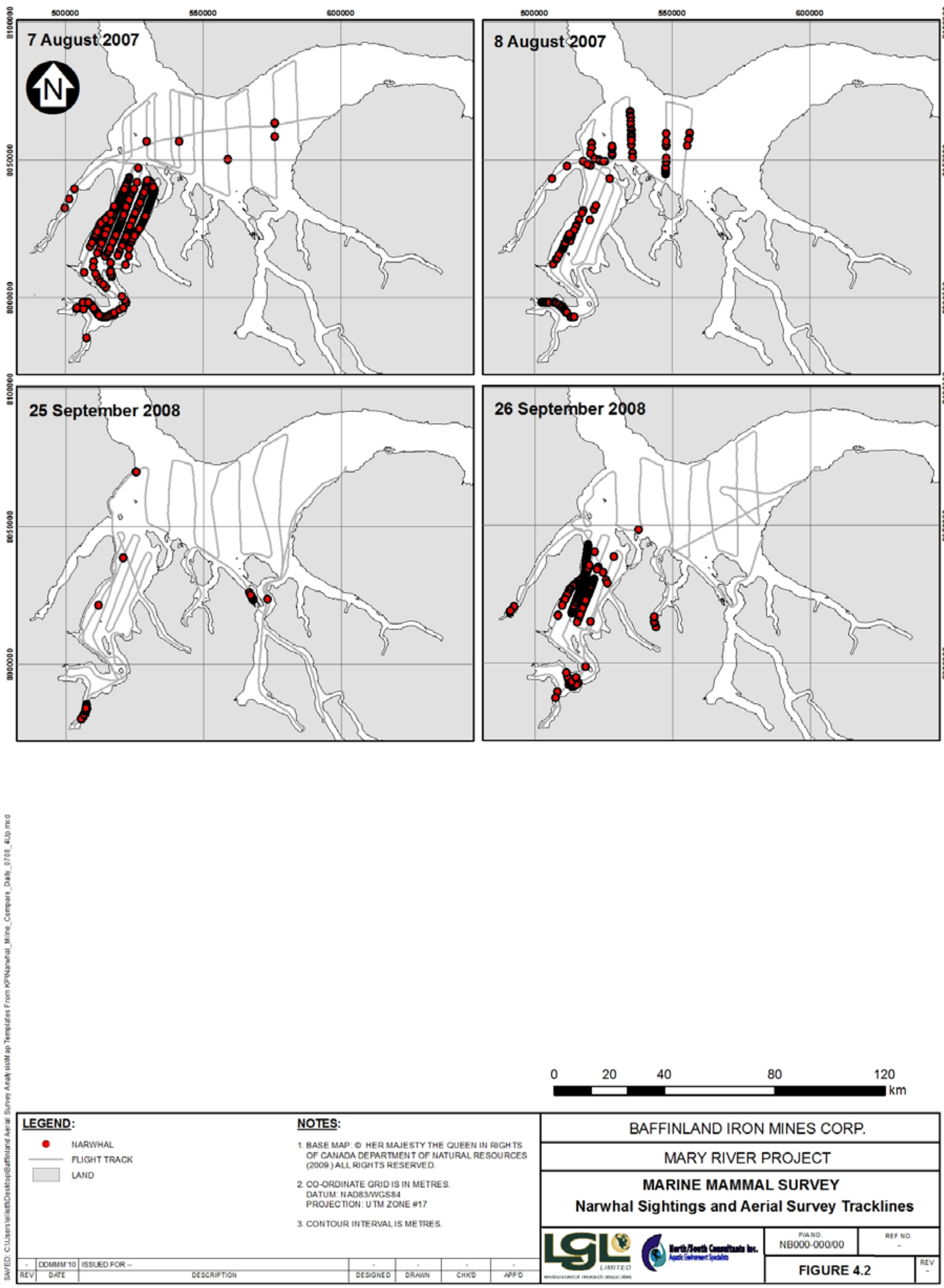

Figure 4.2 Examples of Day-To-Day Variation in Narwhal Distribution in Eclipse Sound and Milne Inlet

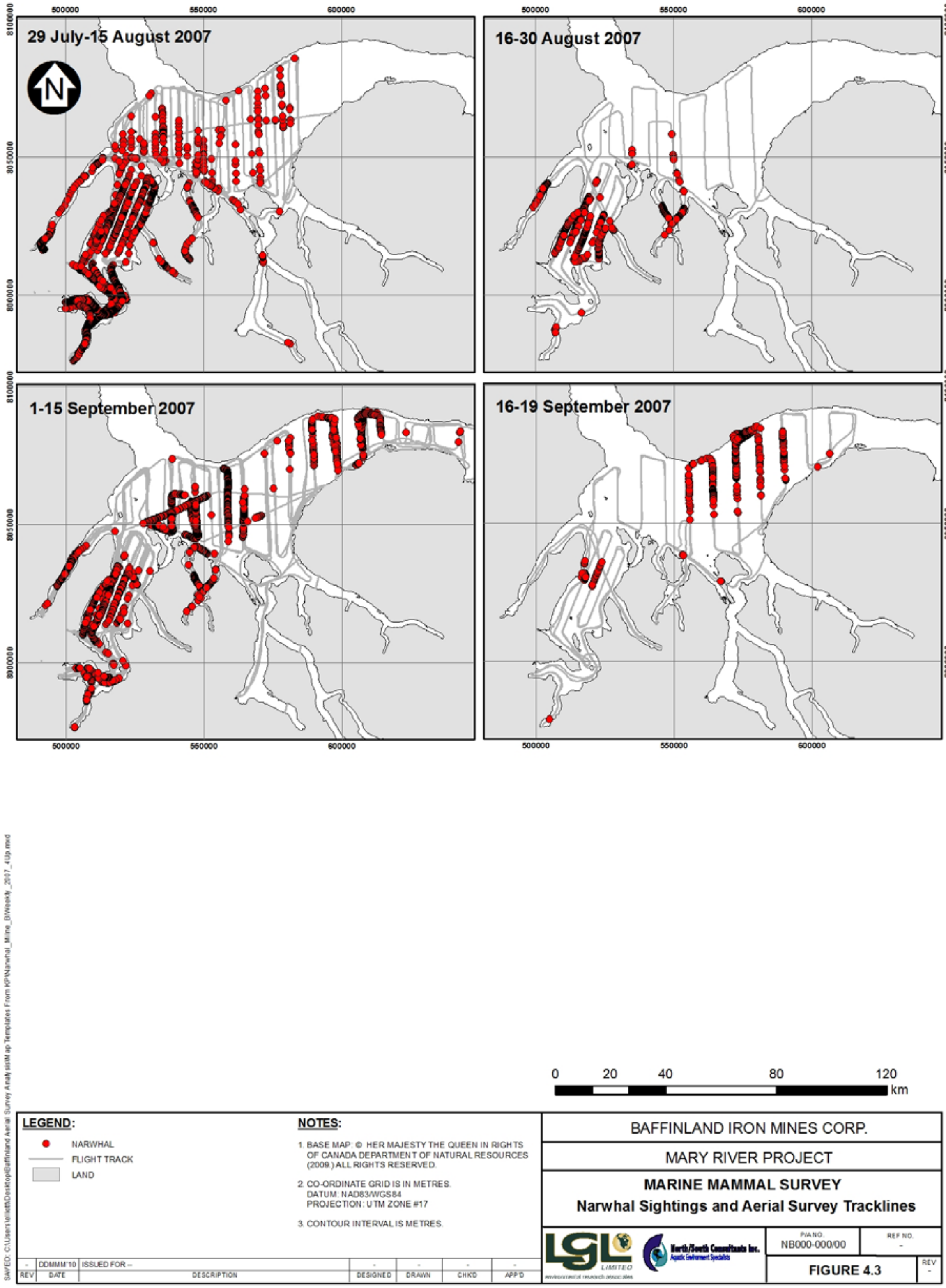

Figure 4.3 Bi-Weekly Distribution of Narwhal in Milne Inlet and Eclipse Sound, 2007

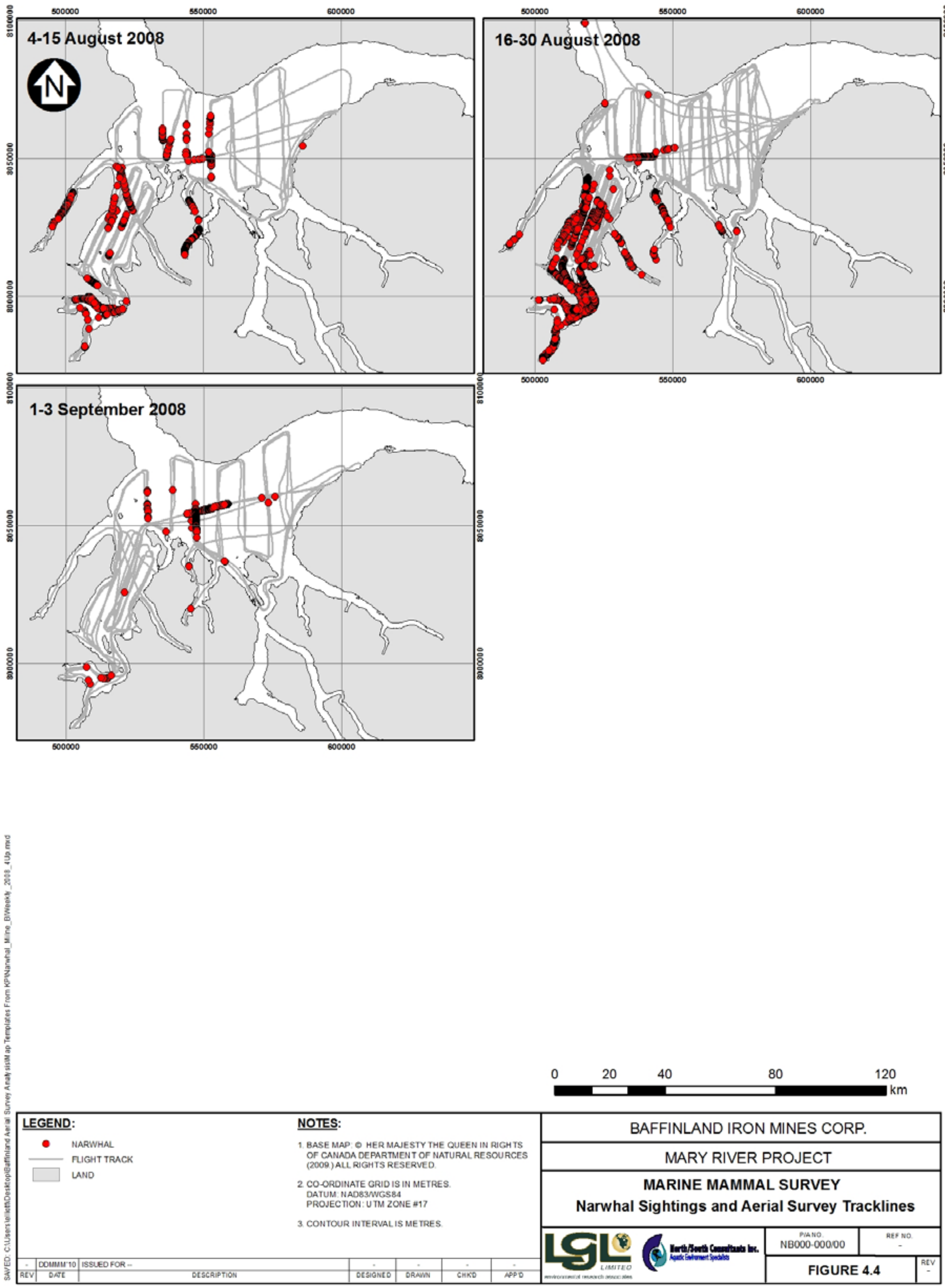

Figure 4.4 Bi-Weekly Distribution of Narwhal in Milne Inlet and Eclipse Sound, 2008

There were three killer whale sightings in Eclipse Sound on 17 September (see Figure 4.5 and Appendix 4, Figure A4.3), and narwhals might have moved back into Milne Inlet in response to predation by the killer whales.

For densities of narwhals by area and days surveyed in 2007, see Table 4.4 and for 2008, see Table 4.5. Densities varied considerably from day to day in all areas, e.g., 0 to 407/100 km^2 in Eclipse Sound, 0–328/100 km^2 in Milne Inlet, and 0–1,326/100 km^2 in 2007, with corresponding ranges of 0–138, 0–537, and 0–638/100 km^2 in 2008 (see Table 4.4 and Table 4.5). Densities also varied considerably from one two-week period to the next in all areas (see Table 4.2 and Table 4.3). As was evident in mapped distributions, the density trend in 2007 was an increase from August through September in Eclipse Sound and decreases in the other more sheltered bays and inlets and in overall density in the study area (see Table 4.2). The trends in 2008, when surveys extended only until 3 September, were not as evident (see Table 4.3).

During the survey period in 2007, two ships transited into and out of the port site at Milne Inlet, one to deliver construction materials and the other to deliver fuel to a fuel storage facility built after the materials were delivered. During the survey period in 2008, three ships transited into and out of the Milne Inlet port site, one to remove iron ore stockpiled over the previous winter, one to deliver construction materials, and one ship to deliver fuel to the storage facility. In Table 4.4 and Table 4.5, the transits through Eclipse Sound, Milne Inlet, and Koluktoo Bay are indicated as shaded rows among the narwhal density data. The shaded rows indicate the direction of the difference between densities observed before and after each ship transit through each area (drop, rise, or holding steady). There was no consistent difference in narwhal density before and after ship transits.

During the June 2006 aerial surveys of Eclipse Sound four narwhal were observed at the northern entrance to Navy Board Inlet (see Table 4.6 and Figure 4.6).

4.3.1.2 Bowhead Whale

Bowhead whales were observed in the Eclipse Sound study area in moderate numbers from 7 August to 17 September 2007 (51 sightings of 61 bowheads; Figure 4.5) and in low numbers from 4 to 26 August 2008 (12 sightings of 15 bowheads; Figure 4.7). In 2007 and 2008, most sightings were in Milne Inlet, Eclipse Sound, and to a lesser extent in Koluktoo Bay, and in 2007 there were also a few sightings in Tremblay Sound and Tay Sound (see Figure 4.5 and Figure 4.7). No bowhead whales were sighted during aerial surveys in June 2006 (see Figure 4.6). Densities of bowhead whales in all areas for two-week periods were <0.05 to 0.3/100 km^2 in 2007 and 0 to 0.2/ km^2 in August 2008 (see Table 4.2 and Table 4.3).

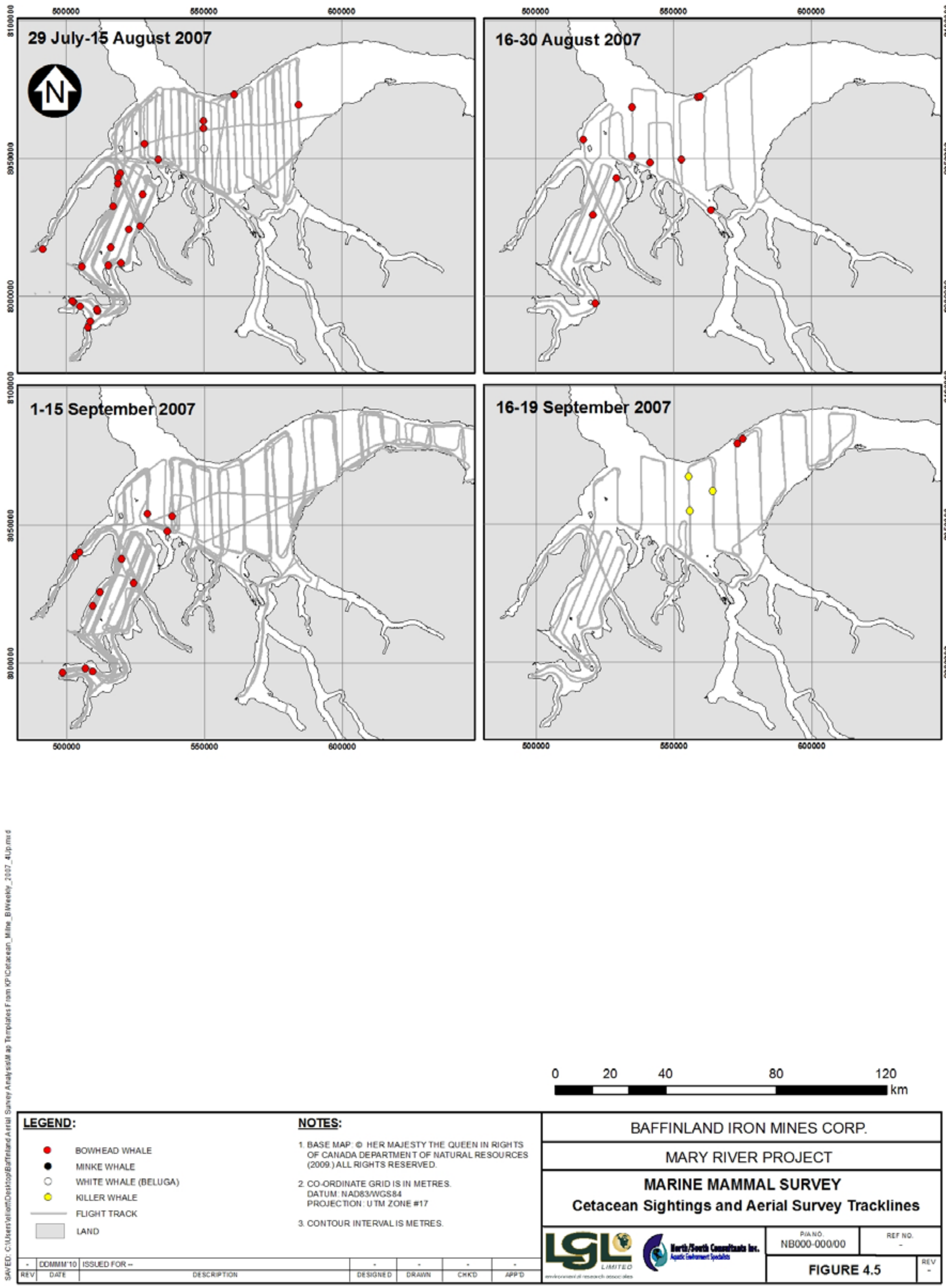

Figure 4.5 Bi-Weekly Distribution of Whales (Narwhal Excluded) in Milne Inlet and Eclipse Sound, 2007

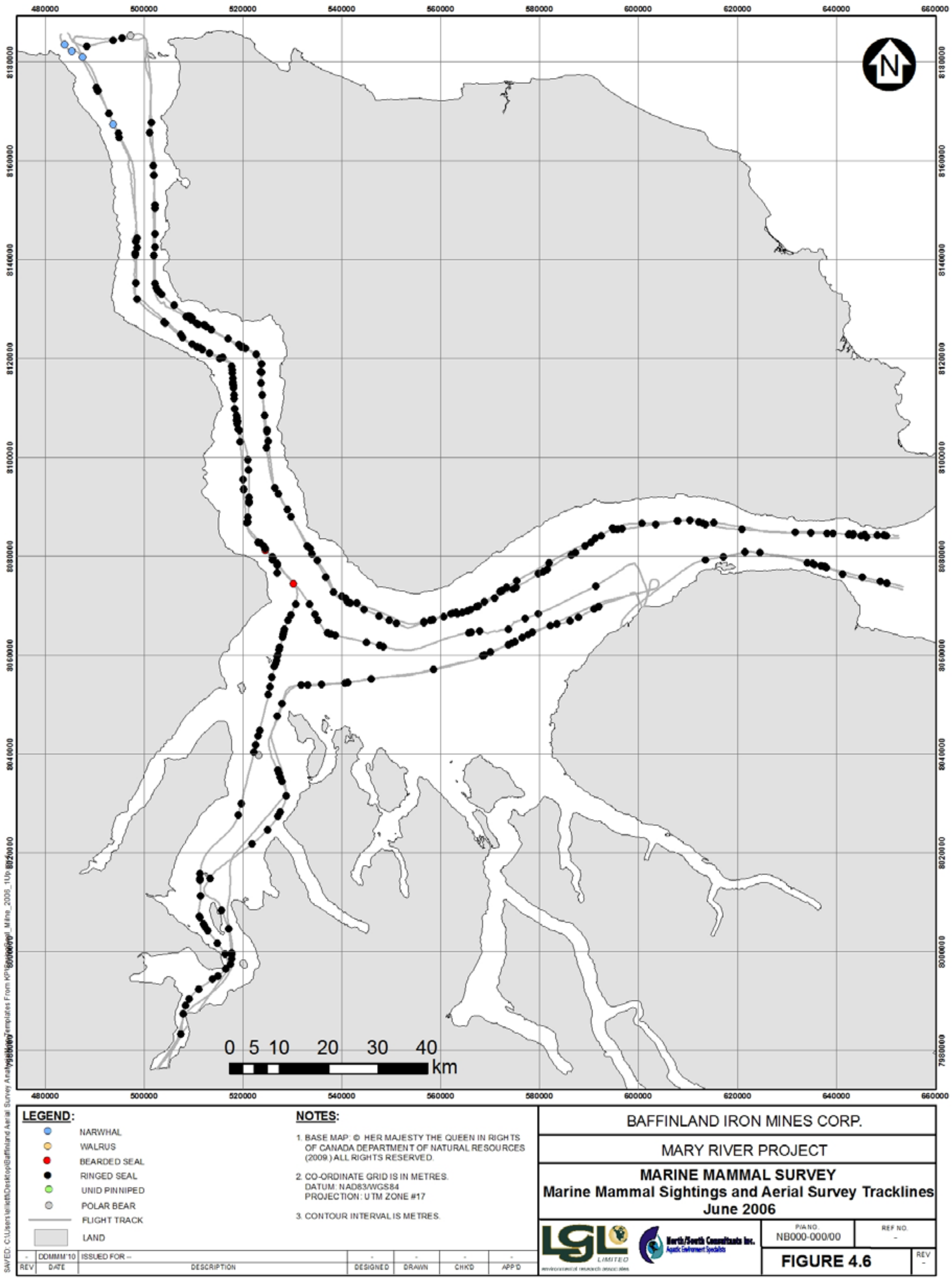

Figure 4.6 Marine Mammal Sightings and Aerial Survey Tracklines in Eclipse Sound, June 2006

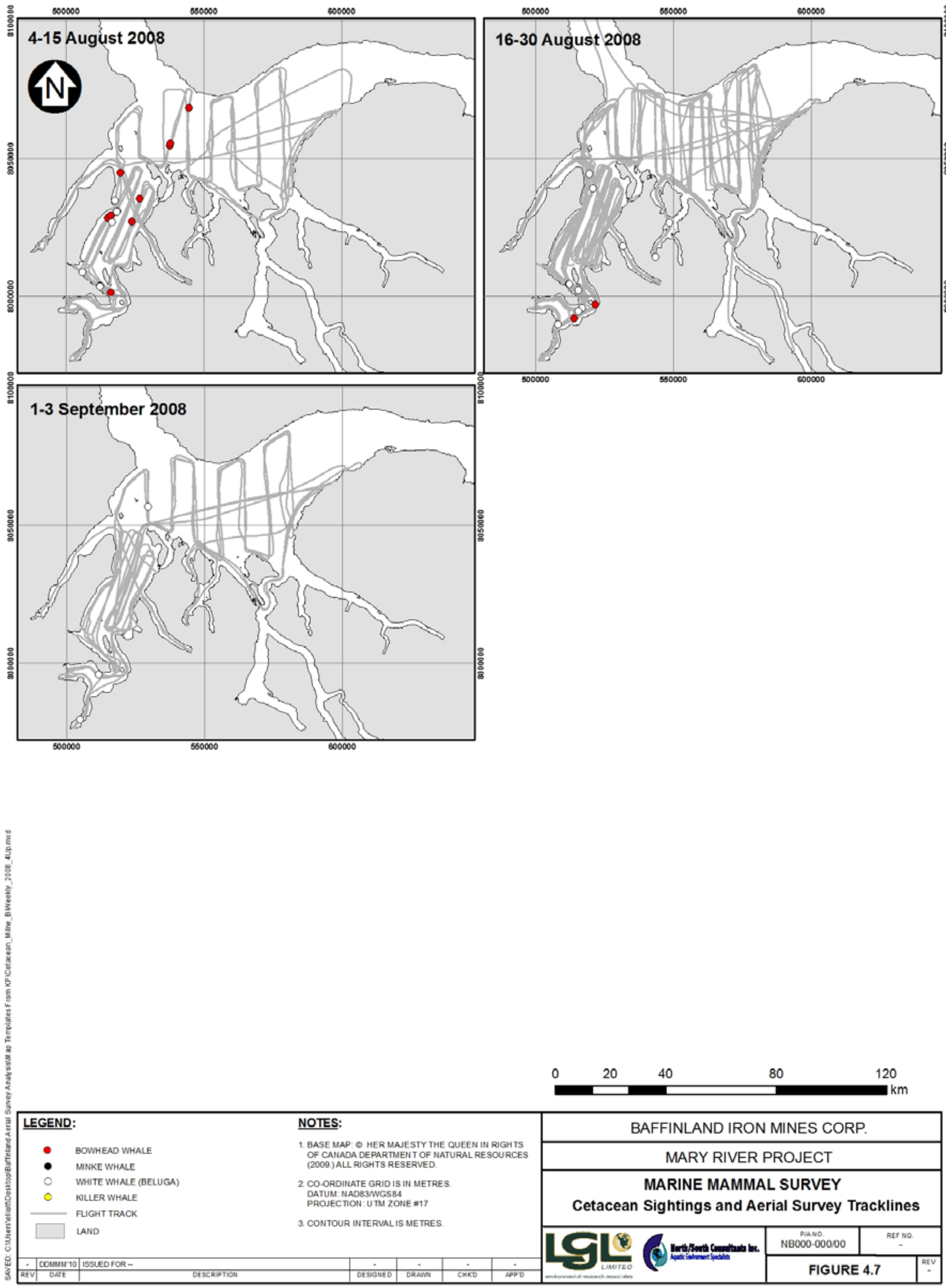

Figure 4.7 Bi-Weekly Distribution of Whales (Narwhal Excluded) in Milne Inlet and Eclipse Sound, 2008

Table 4.4 Density (#/100 km^2) of Narwhal by Date and Area in 2007

(Relative change in density after a ship transit is indicated by a highlighted line with the descriptor STEADY, RISE, or DROP).

Flight	Month	Day	Area							All Areas
			Eclipse Sound #/100 km^2	Eskimo Inlet #/100 km^2	Koluktoo Bay #/100 km^2	Milne Inlet #/100 km^2	Tay Sound #/100 km^2	Tremblay Sound #/100 km^2	White Bay #/100 km^2	#/100 km^2
1	July	29	20.1	0	48.4	17.6	0	418.7	0	32.4
	July	31	STEADY		RISE	DROP				
2	July	31	17.1	0	472.8	0	0	13.1	0	59.7
3	Aug	1	18.6	0	74.8	0.5	26.7	196.0	100.5	25.0
4	Aug	4	10.1	-	131.0	127.4	-	443.4	-	127.2
5	Aug	7	0	-	50.9	181.1	-	-	-	137.6
	Aug	7	STEADY		DROP	RISE				
5	Aug	7	0.7	-	22.5	327.5	-	2.3	-	98.1
7	Aug	8	41.0	-	57.7	38.6	-	4.3	0	38.3
8	Aug	10	0	269.1	247.8	5.1	0	177.4	288.5	36.1
9	Aug	12	0	0	1,325.8	179.6	20.4	592.9	523.5	239.9
10	Aug	30	3.1	0	26.3	208.5	0	90.9	246.3	90.3
11	Aug	31	10.7	60.3	5.5	136.7	-	116.8	293.5	96.8
12	Sep	1	406.8	0	155.9	75.9	-	164.7	353.4	171.5
13	Sep	3	274.7	0	15.1	40.3	-	80.8	70.4	114.9
14	Sep	8	12.3	0	0	94.9	0	191.3	40.3	34.5
15	Sep	9	5.0	-	0	19.5	-	-	-	9.9
	Sep	9	RISE			RISE				
15	Sep	9	131.6	0	0	51.7	0	8.4	0.9	48.9
17	Sep	10	3.8	0	0	0	0	166.7	11.0	11.4
19	Sep	13	79.2	0	16.4	0	0	51.9	4.3	50.5
20	Sep	14	48.2	-	29.5	10.4	-	-	0	42.9
	Sep	15	DROP		DROP	DROP				
22	Sep	15	2.1	-	0	0	0	0	-	1.2
23	Sep	17	71.3	0	0	0	0	0	0	35.7
24	Sep	18	49.8	0	0.9	21.0	0	0	0	33.8
All Flights			36.6	14.8	152.9	79.1	7.9	137.9	108.1	67.2

NOTES:

1. CELLS WITH - INDICATE NO SURVEY EFFORT.
2. DENSITY IS BASED ON SIGHTINGS THAT ARE ON-TRANSECT AND DURING ACCEPTABLE ENVIRONMENTAL CONDITIONS.

Table 4.5 Density (#/100 km^2) of Narwhal by Date and Area in 2008

(Relative change in density after a ship transit is indicated by a highlighted line with the descriptor STEADY, RISE, or DROP).

Flight	Month	Day	Area							All Areas #/100 km2
			Eclipse Sound #/100 km2	Eskimo Inlet #/100 km2	Koluktoo Bay #/100 km2	Milne Inlet #/100 km2	Tay Sound #/100 km2	Tremblay Sound #/100 km2	White Bay #/100 km2	
43	Aug	4	53.3	0	276.0	45.6	0	27.9	0	70.6
	Aug	5	DROP		DROP	DROP				
44	Aug	5	20.5	-	92.7	0	-	-	-	20.0
46	Aug	7	15.2	0	48.5	49.6	0	251.6	1,658.1	100.4
	Aug	9	STEADY		STEADY	DROP				
48	Aug	10	21.9	0	56.5	0.5	0	139.8	571.0	49.6
50	Aug	21	0	485.7	103.5	335.5	0	0	341.8	157.6
51	Aug	22	0	0	142.1	172.4	0	15.7	187.5	85.3
52	Aug	23	0	0	638.2	36.8	0	0	0	75.2
53	Aug	24	5.6	-	-	0	-	-	-	2.6
	Aug	25	STEADY		DROP	RISE				
54	Aug	25	3.1	0	181.9	2.8	13.2	-	0	20.4
	Aug	26	DROP		DROP	RISE				
55	Aug	26	0.4	0	33.0	537.3	0	16.5	69.9	177.9
56	Aug	29	0	0	11.4	36.9	0	0	20.5	14.5
57	Aug	31	137.7	-	67.9	12.6	-	-	-	44.0
	Aug	31	DROP		STEADY	DROP				
57	Aug	31	20.2	-	81.1	0	-	-	-	-
58	Sep	1	20.1	-	0	0	0	-	0	12.9
59	Sep	2	38.4	0	20.5	0.1	-	-	4.2	20.3
	Sep	2	STEADY		DROP	STEADY				
60	Sep	3	34.0	0	1.3	0	0	0	3.9	15.2
All Flights			18.1	48.1	116.8	86.4	4.6	48.2	264.2	60.7

NOTES:

1. CELLS WITH - INDICATE NO SURVEY EFFORT.
2. DENSITY IS BASED ON SIGHTINGS THAT ARE ON-TRANSECT AND DURING ACCEPTABLE ENVIRONMENTAL CONDITIONS.

Table 4.6 Density (#/100 km^2) of Marine Mammals in Eclipse Sound, Milne Inlet, and Navy Board Inlet in June 2006 During Ringed Seal Surveys

Species	Area								All Areas	
	Eclipse Sound		Koluktoo Bay		Milne Inlet		Navy Board Inlet			
	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.
Narwhal	0	0	0	0	0	0	0.9	4	0.4	4
Bearded Seal	0	0	0	0	0	0	0.7	3	0.3	3
Ringed Seal	41.4	212	25.6	15	37.6	51	39.2	170	39.3	448
Polar Bear	0	0	0	0	0.7	1	0.7	3	0.4	4

NOTES:

1. NO. INDICATE THE NUMBER OF SIGHTINGS THAT ARE ON-TRANSECT AND DURING ACCEPTABLE ENVIRONMENTAL CONDITIONS USED IN DENSITY CALCULATION
2. DENSITY SHOWN AS 0 IS EQUIVALENT TO A VALUE BETWEEN >0 AND <0.05.

4.3.1.3 Beluga Whale

Beluga were present in low numbers in Eclipse Sound and adjacent waterbodies. In 2007, one individual was sighted in Eclipse Sound on 29 July and two individuals were sighted in White Bay on 1 September (see Figure 4.5 and Appendix 4, Figure A4.3). In 2008, there were 23 sightings of a total of 70 beluga, from 4 August to 2 September, most in Milne Inlet, Koluktoo Bay, and White Bay (see Figure 4.7 and Appendix 4, Figure A4.4).

Beluga were often sighted with narwhals; most beluga sighted were single individuals, with the largest group sighted numbering 15. Beluga densities in all areas for two-week periods were <0.05/100 km^2 in 2007 and 0.1 to 0.5/100 km^2 in 2008 (see Table 4.2 and Table 4.3).

4.3.1.4 Killer Whale

Killer whales were sighted only on 17 September 2007, when there were three sightings in Eclipse Sound (see Figure 4.5 and Appendix 4, Figure A4.3). During the aerial survey, it appeared that a pod of narwhals were fleeing into shallow water and the surf zone along the south shore of Bylot Island during or after a killer whale attack. Shore-based whale researchers observed predatory behaviour of killer whales in Koluktoo Bay during 10 to 21 August 2008. A pod of killer whales was also observed and photographed in southern Eclipse Sound north of White Bay by a television film crew working in the area.

4.3.1.5 Ringed Seal

Ringed seals on landfast ice were surveyed in Milne Inlet and Koluktoo Bay during June 2006, 2007, and 2008. Ringed seals were distributed throughout the area surveyed (see Figure 4.6). Densities in Koluktoo Bay in 2006 were 26/100 km^2, in 2007 18/100 km^2, and in 2008 216/100 km^2. Densities in Milne Inlet in 2006 were 38/100 km^2, in 2007 30/100 km^2 and in 2008 130/100 km^2 (see Table 4.6, Table 4.7, and Table 4.8). The 2006 surveys also included a large portion of Eclipse Sound and Navy Board Inlet, respective densities of ringed seals in these areas were 41/100 km^2 and 39/100 km^2 (see Table 4.6).

Ringed seals were sighted in open water in moderate numbers in most areas throughout the survey period in 2007 (29 sightings of 32 seals; Figure 4.8) and from 4 August to 26 August 2008 (29 sightings of 35 seals; Figure 4.9). Densities where not calculated from aerial surveys at 305 m altitude because at that altitude it is only possible to detect ringed seals in the water under ideal conditions, which was rarely the case.

For ringed seal sightings and aerial survey tracklines in Milne Inlet in 2007, see Figure 4.10, and for seal, walrus, and polar bear sightings and aerial survey tracklines in Milne Inlet in 2008, see Figure 4.11.

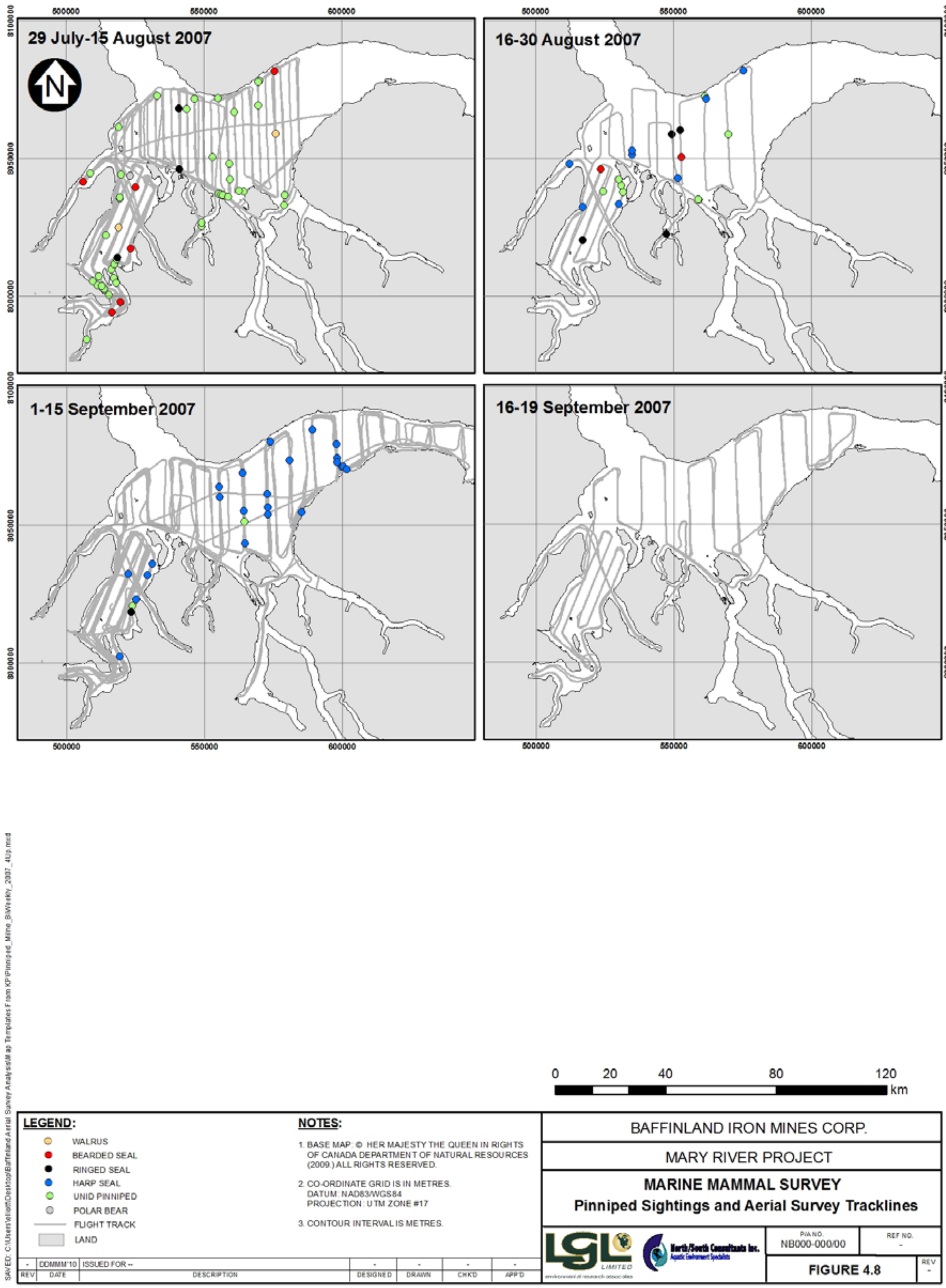

Figure 4.8 Bi-Weekly Distribution of Seal, Walrus, and Polar Bear in Milne Inlet and Eclipse Sound, 2007

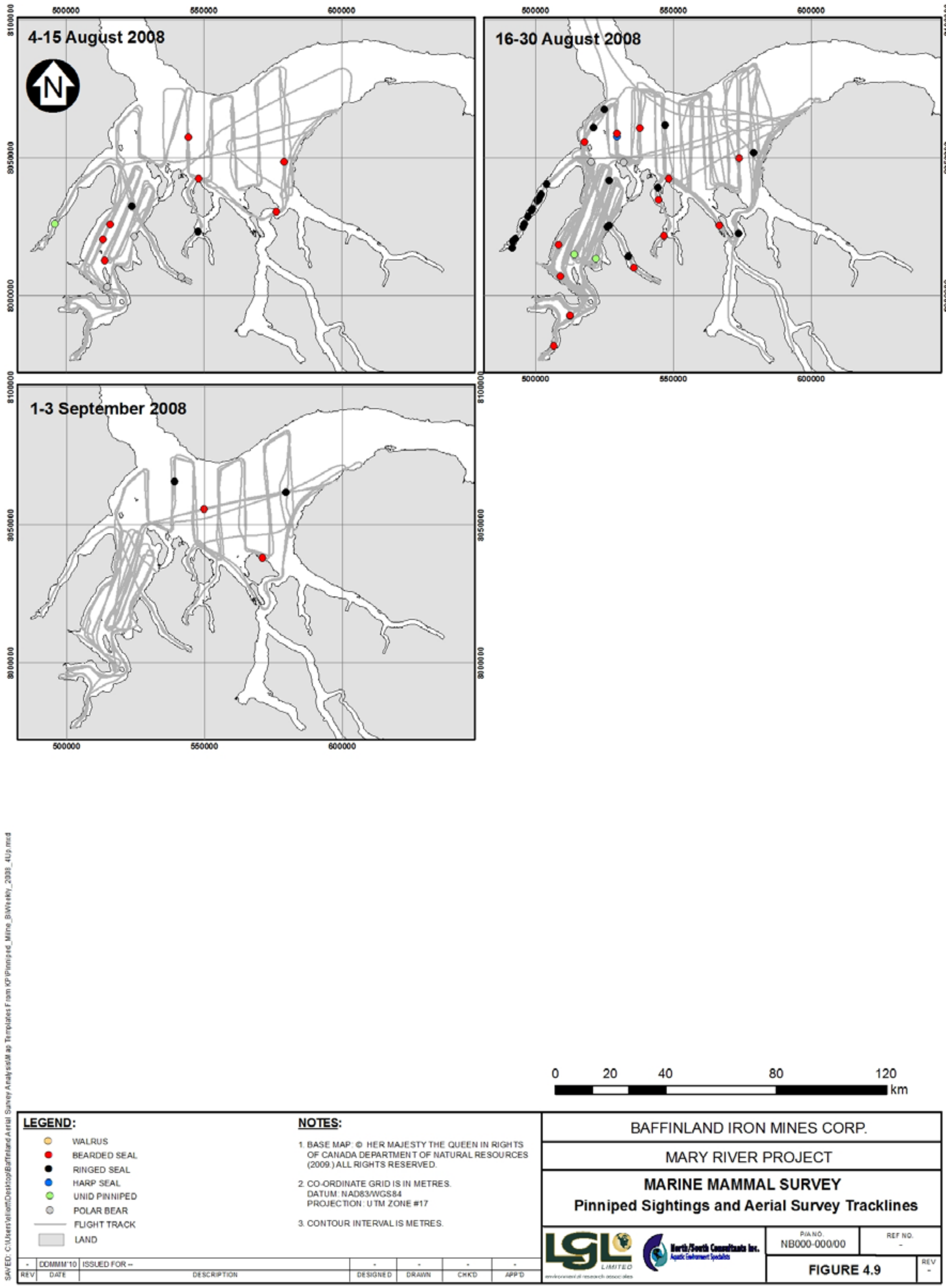

Figure 4.9 **Bi-Weekly Distribution of Seal, Walrus, and Polar Bear in Milne Inlet and Eclipse Sound, 2008**

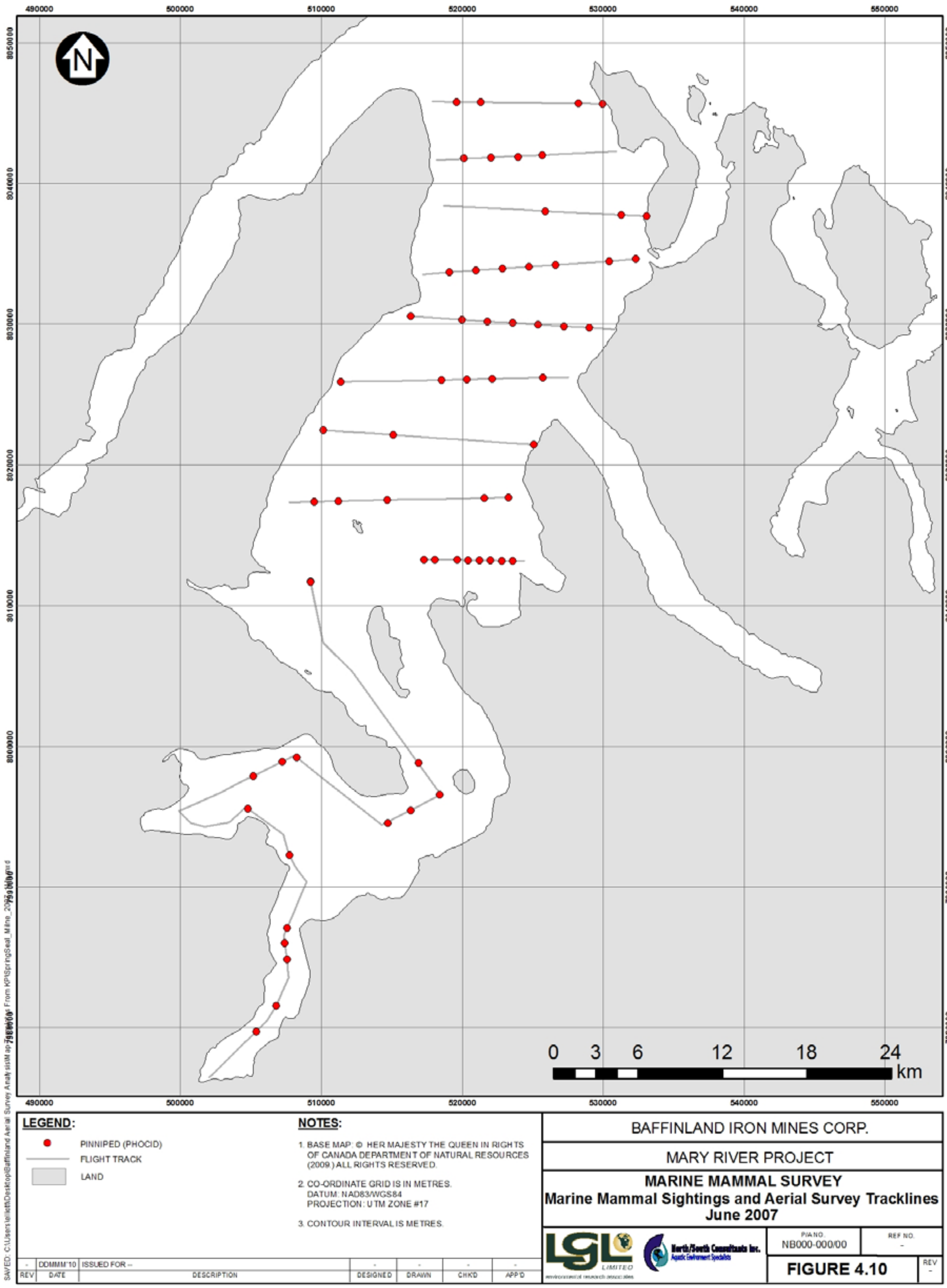

Figure 4.10 Ringed Seal Sightings and Aerial Survey Tracklines in Milne Inlet, 2007

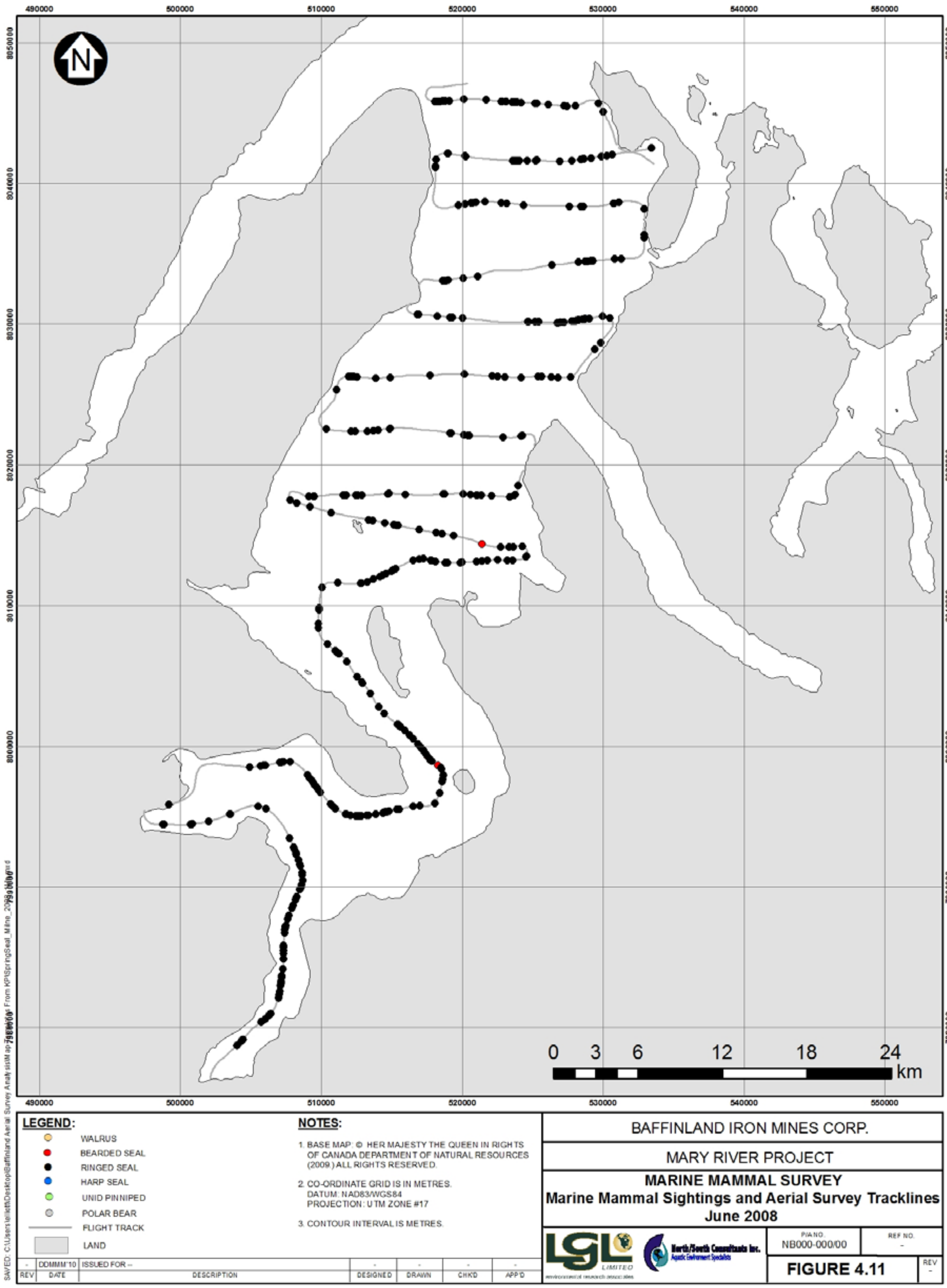

Figure 4.11 Seal, Walrus, and Polar Bear Sightings and Aerial Survey Tracklines in Milne Inlet, 2008

Table 4.7 Density (#/100 km²) of Ringed Seals in Milne Inlet and Steensby Inlet in June 2007

Species	Area						All Areas	
	Steensby Inlet		Milne Inlet		Koluktoo Bay			
	Density	No.	Density	No.	Density	No.	Density	No.
Ringed Seal	156.5	608	29.9	106	18.0	22	85.1	736

NOTES:

1. NO. INDICATE THE NUMBER OF SIGHTINGS THAT ARE ON-TRANSECT AND DURING ACCEPTABLE ENVIRONMENTAL CONDITIONS USED IN DENSITY CALCULATION

Table 4.8 Density (#/100 km2) of Marine Mammals in Koluktoo Bay, Milne Inlet, and Steensby Inlet in June 2008 During Ringed Seal Surveys

Species	Area					
	Steensby Inlet		Koluktoo Bay		Milne Inlet	
	Density	No.	Density	No.	Density	No.
Walrus	0.1	1	0	0	0	0
Bearded Seal	2.0	15	0	0	1.7	4
Ringed Seal	70.6	519	216.1	140	127.1	298
Harp Seal	0.3	2	0	0	1.3	3
Polar Bear	0.3	2	0	0	0	0

NOTES:

1. NO. INDICATE THE NUMBER OF SIGHTINGS THAT ARE ON-TRANSECT AND DURING ACCEPTABLE ENVIRONMENTAL CONDITIONS USED IN DENSITY CALCULATION

4.3.1.6 Bearded Seal

Bearded seals were sighted in low numbers in most areas from 29 July to 14 September in 2007 (12 sightings of 16 seals; Figure 4.8) and in moderate numbers from 4 August to 2 September 2008 (23 sightings of 25 seals; Figure 4.9). During aerial surveys at 305 m altitude, it is only possible to detect bearded seals in the water under ideal conditions. That was rarely the case, so densities were not calculated.

Three bearded seals were sighted in Navy Board Inlet during the June 2006 aerial surveys, this was equivalent to a density of 0.7/100 km² in Navy Board Inlet (see Table 4.6 and Figure 4.6).

During surveys of seals on landfast ice in Milne Inlet and Koluktoo Bay in June 2008, only four bearded seals were sighted, all in southeastern Milne Inlet (see Figure 4.11). The density was 1.7/100 km² (see Table 4.8).

4.3.1.7 Harp Seal

Harp seals were sighted in relatively high numbers in most areas near the end of the survey period in 2007, from 30 August to 18 September 2007 (133 sightings of 1,897 seals; Figure 4.8), but there was only 1 sighting of 15 seals in 2008, in Eclipse Sound on 26 August. Harp seals were seen frequently in large groups of 10 to 50, and in one case 400, and most sightings were in Eclipse Sound. During aerial surveys at 305 m altitude, it is only possible to detect harp seals in the water under ideal conditions except when they are in large groups. Conditions were rarely ideal, so densities were not calculated.

During surveys of seals on landfast ice in Milne Inlet and Koluktoo Bay in June 2008, only three harp seals were sighted, all in southeastern Milne Inlet (see Figure 4.11). The density was 1.7/100 km^2 (see Table 4.8).

4.3.1.8 Walrus

Walruses were sighted in very low numbers during open-water surveys; two were sighted in 2007, one on 29 July 2007 in Milne Inlet and one on 7 August in Eclipse Sound (see Figure 4.8), and none were sighted in 2008.

4.3.1.9 Polar Bear

Polar bears were sighted in very low numbers during open-water surveys; one polar bear was sighted on 29 July 2007 in Milne Inlet, and there were five sightings of six individuals between 5 August and 23 August 2008, in Eclipse Sound at the mouth of Milne Inlet, in Milne Inlet, and in Eskimo Inlet (see Figure 4.8 and Figure 4.9).

One polar bear was sighted during surveys of seals on landfast ice in Milne Inlet and Koluktoo Bay in June 2006 (see Figure 4.6). Three polar bears were sighted in Navy Board Inlet in June 2006 (see Figure 4.6).

4.3.2 Foxe Basin and Hudson Strait

Several marine mammal species, including the bowhead, beluga, narwhal, killer whale, walrus, bearded seal, ringed seal, harp seal, and polar bear were sighted during the 2006, 2007, and 2008 aerial surveys in Foxe Basin and Hudson Strait. The beluga was the most frequently sighted cetacean in the area and the walrus was the most frequently sighted pinniped. Ringed seals and bearded seals were readily sightable only when on landfast or pack ice. High-level aerial surveys can detect only a small fraction of pinnipeds in the water except for the largest species (e.g., walrus) and when large groups of harp seals are present.

4.3.2.1 Narwhal

Narwhal were present in Hudson Strait in moderate numbers but infrequently encountered in Foxe Basin during April–October 2008 (see Figure 4.12 to Figure 4.16). In 2006 no narwhals were sighted during surveys in August and September in northern Foxe Basin and Steensby Inlet and no narwhals were sighted during aerial survey in September 2007. In April 2008, there was one sighting of seven narwhals in northeast Foxe Basin (see Figure 4.12), possibly having overwintered there. In June, five narwhal were sighted in Foxe Basin (see Figure 4.13), and narwhal were absent from surveyed areas in Foxe Basin during August, September, and October. In Hudson Strait, the largest densities of narwhal were in April and June—0.6 and 0.8/100 km^2, respectively (see Table 4.9). Narwhal were absent from Hudson Strait in August (see Figure 4.14), were observed in moderate densities (0.6/100 km^2) there in September (see Table 4.9 and Figure 4.15), and were absent in October.

4.3.2.2 Bowhead Whale

Bowhead whales were encountered in Hudson Strait only in April and August (Figure 4.12 and Figure 4.14), and were present in low densities—0.12 and 0.06/100 km^2, respectively (see Table 4.9). They were present in northwest Foxe Basin in September 2008 and October 2008 (see Figure 4.15 and Figure 4.16) in moderate densities, 0.36 and 0.12/100 km^2, respectively (see Table 4.9), consistent with the known bowhead summering area in northwest Foxe Basin near Igloolik. Bowheads were not sighted in Steensby Inlet. During the limited aerial surveys in August and September 2006, bowhead whales were present in northwest Foxe Basin in a density of 0.5/100 km^2 and 0.4/100 km^2, respectively (see Table 4.10, Figure 4.17, and Figure 4.18). During limited survey in September 2007 bowhead whales were sighted in northeast and northwest Foxe Basin in densities of up to 2.3/100 km^2 and 1.9/100 km^2, respectively (see Table 4.11 and Figure 4.19).

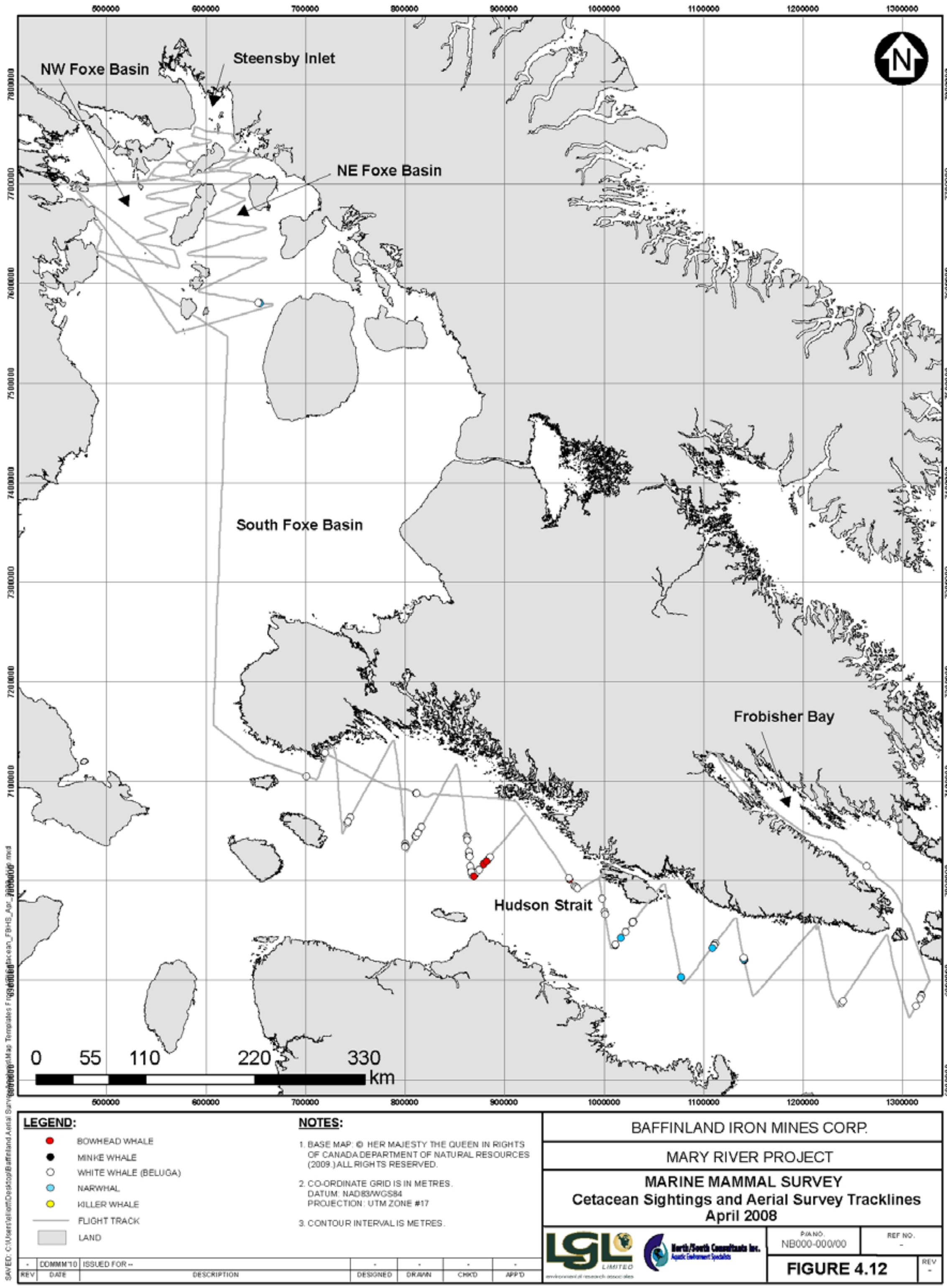

Figure 4.12 Whale Sightings and Aerial Survey Tracklines in Foxe Basin and Hudson Strait, April 2008

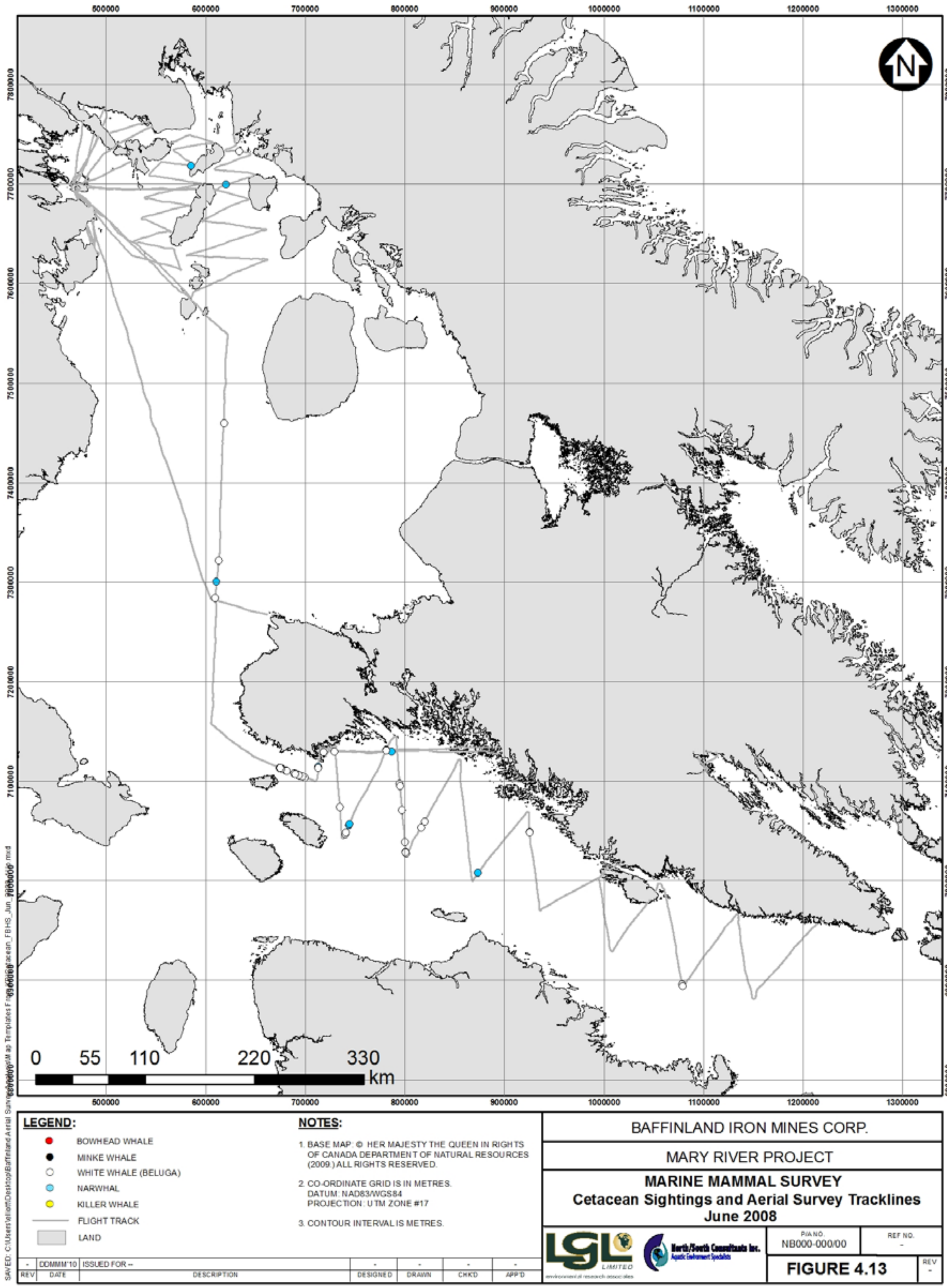

Figure 4.13 Whale Sightings and Aerial Survey Tracklines in Foxe Basin and Hudson Strait, June 2008

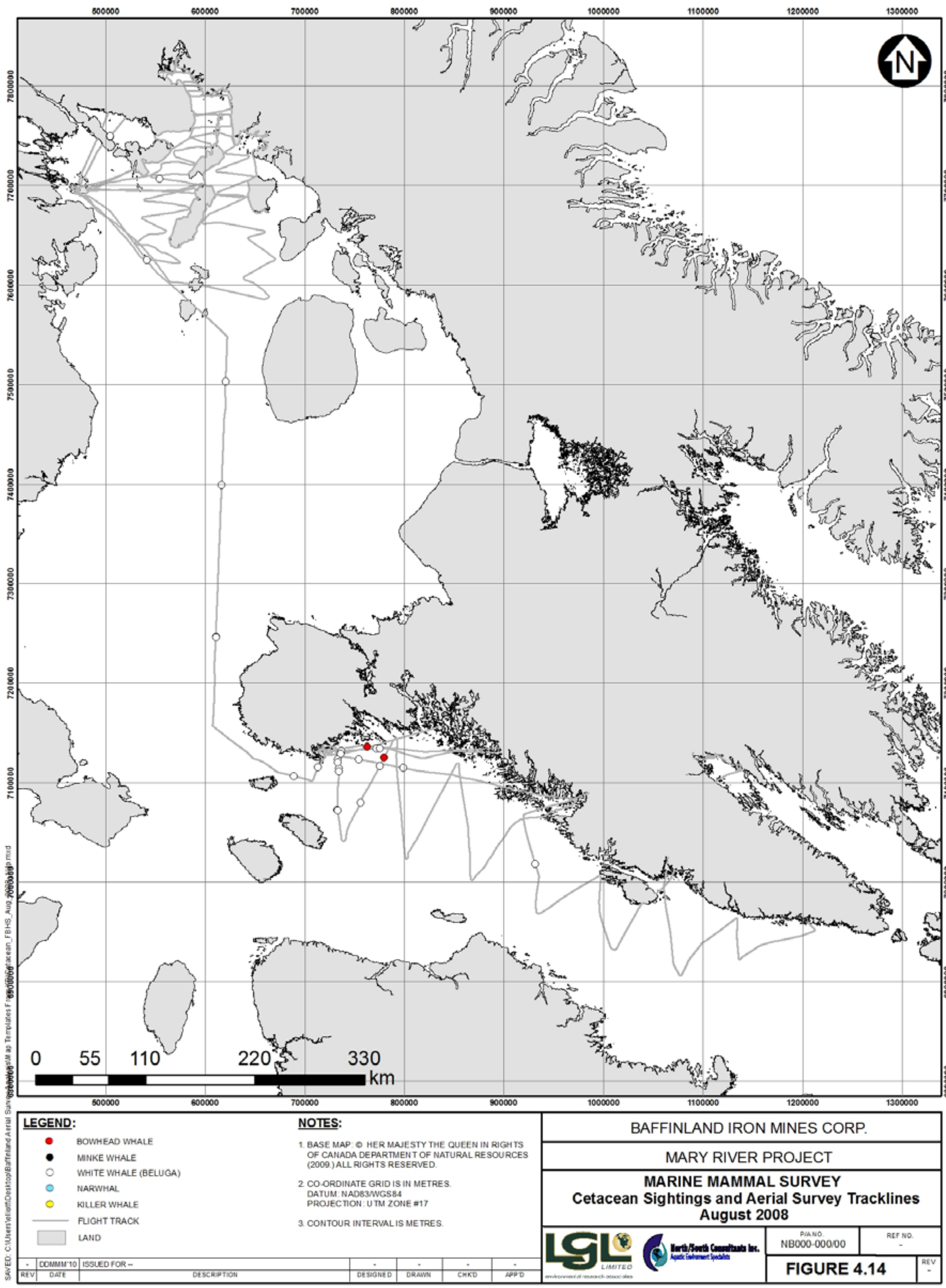

Figure 4.14 Whale Sightings and Aerial Survey Tracklines in Foxe Basin and Hudson Strait, August 2008

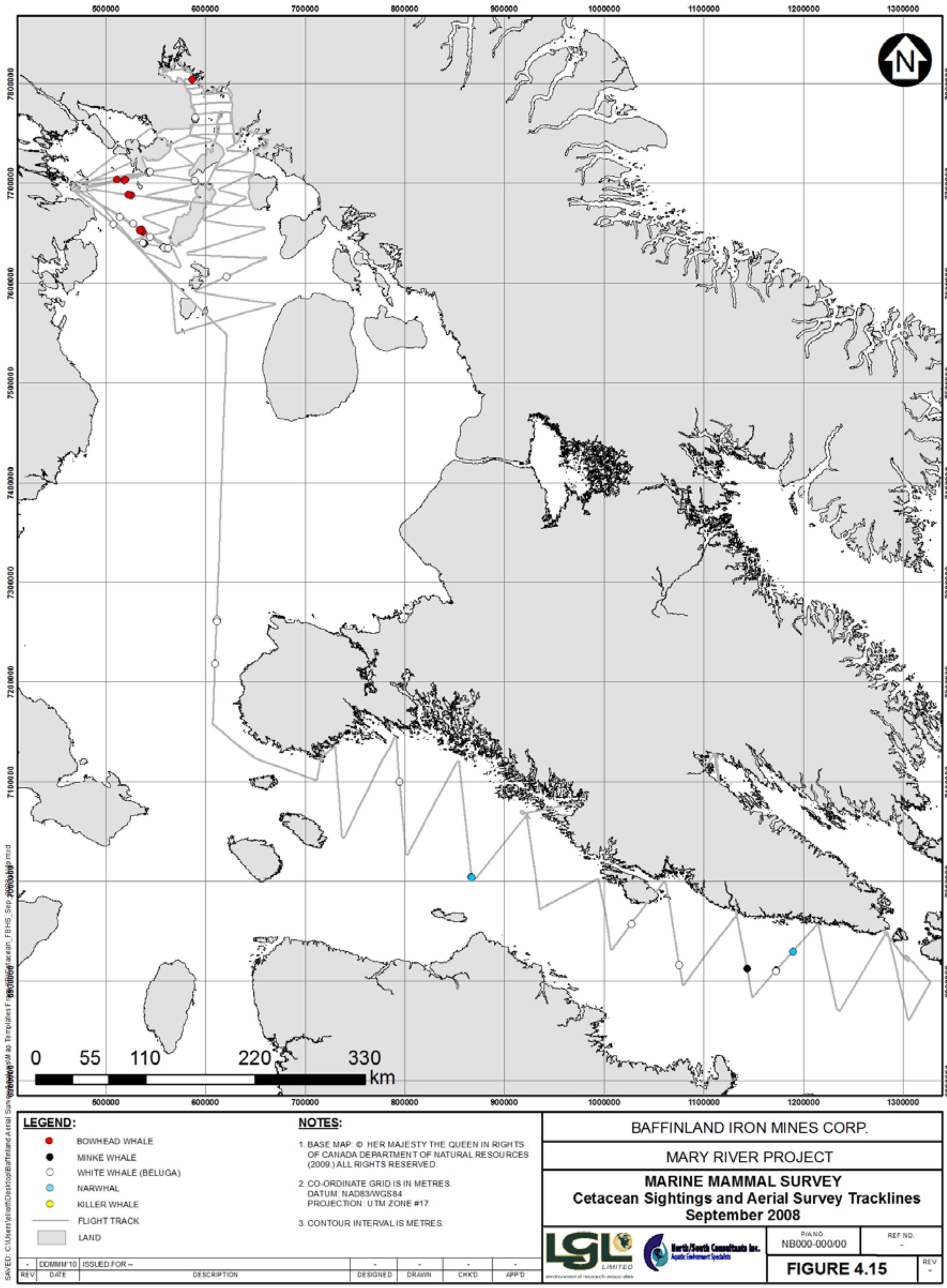

Figure 4.15 Whale Sightings and Aerial Survey Tracklines in Foxe Basin and Hudson Strait, September 2008

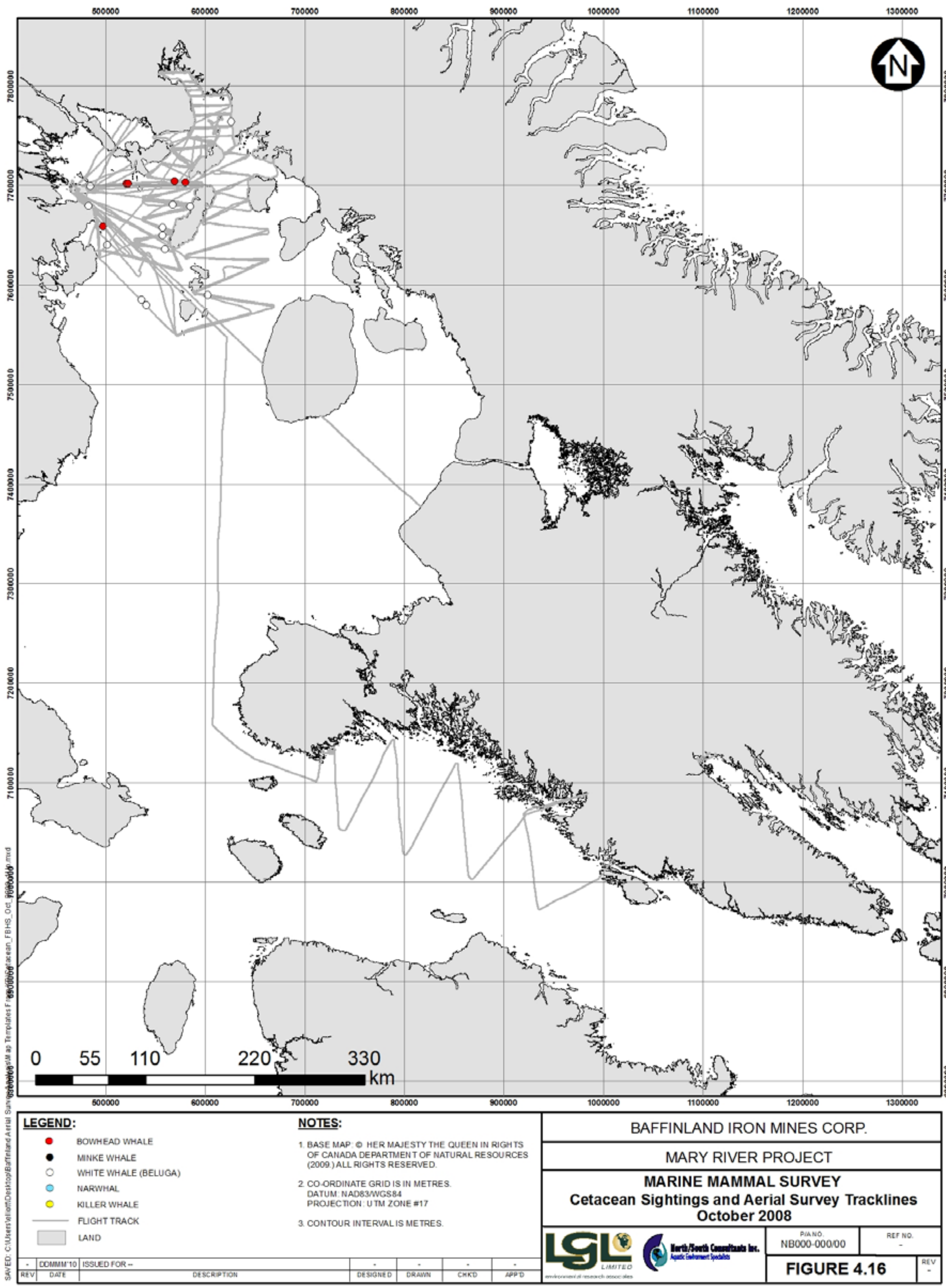

Figure 4.16 Whale Sightings and Aerial Survey Tracklines in Foxe Basin and Hudson Strait, October 2008

Table 4.9 Density (#/100 km^2) of Marine Mammals in Foxe Basin and Hudson Strait in April, June, Early August, Mid-September, and October 2008

Species	Period	Area												All Areas	
		NE Foxe Basin		Frobisher Bay		Hudson Strait		S Foxe Basin		Steensby Inlet		NW Foxe Basin			
		Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.
Bowhead Whale	April	0	0	0	0	0.1	4	0	0	0	0	0	0	0.0	4
	June	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	August	0	0	0	0	0.1	2	0	0	0	0	0	0	0.0	2
	September	0	0	0	0	0	0	0	0	0	0	0.4	11	0.1	11
	October	0	0	0	0	0	0	0	0	0	0	0.1	7	0.1	7
	All	0	0	0	0	0.0	6	0	0	0	0	0.1	18	0.0	24
Minke Whale	April	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	June	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	August	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	September	0	0	0	0	0.4	14	0	0	0	0	0	0	0.1	14
	October	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	All	0	0	0	0	0.1	14	0	0	0	0	0	0	0.0	14
Beluga	April	0.3	5	0	0	3.0	103	0	0	0	0	0.1	2	1.3	110
	June	0.2	2	0	0	2.0	70	0.3	4	0	0	0	0	0.8	76
	August	0	0	0	0	0.6	20	0.5	4	0	0	0.2	7	0.3	31
	September	0.1	2	0	0	0.3	9	0.2	1	1.0	8	1.0	30	0.5	50
	October	0.2	4	0	0	0	0	0	0	0.1	1	0.3	18	0.2	23
	All	0.2	13	0	0	1.3	202	0.2	9	0.3	9	0.3	57	0.6	290
Narwhal	April	0.4	7	0	0	0.6	22	0	0	0	0	0	0	0.3	29
	June	0.2	2	0	0	0.8	29	0.2	2	0	0	0.0	1	0.3	34
	August	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	September	0	0	0	0	0.6	19	0	0	0	0	0	0	0.2	19
	October	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	All	0.1	9	0	0	0.5	70	0.0	2	0	0	0.0	1	0.2	82

Table 4.9 Density (#/100 km^2) of Marine Mammals in Foxe Basin and Hudson Strait in April, June, Early August, Mid-September, and October 2008 (cont'd)

Species	Period	Area												All Areas	
		NE Foxe Basin		Frobisher Bay		Hudson Strait		S Foxe Basin		Steensby Inlet		NW Foxe Basin			
		Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.
Walrus	April	0.8	13	0	0	0.2	7	0.5	4	0	0	4.0	88	1.3	112
	June	0.6	7	0	0	0.1	3	1.2	16	0	0	3.2	115	1.5	141
	August	0.6	8	0	0	0.2	5	6.4	47	0.2	2	8.5	263	3.4	325
	September	6.8	126	0	0	0.0	1	0.3	2	0.7	6	15.3	467	6.1	602
	October	0.1	3	0	0	0	0	0.1	1	0.7	9	19.3	1,161	9.7	1,174
	All	1.8	157	0	0	0.1	16	1.6	70	0.6	17	11.7	2,094	4.7	2,354
Bearded Seal	April	0.3	4	0	0	0.7	25	0.1	1	0	0	1.8	39	0.8	69
	June	0.9	11	0	0	0.6	21	0.3	4	0	0	0.3	11	0.5	47
	August	-	2	-	0	-	39	-	7	-	1	-	20	-	69
	September	-	4	-	0	-	18	-	0	-	0	-	1	-	23
	October	-	1	-	0	-	0	-	0	-	2	-	3	-	6
	All	-	22	-	0	-	103	-	12	-	3	-	74	-	214
Ringed Seal	April	0.3	4	0.2	1	0.3	11	0	0	0	0	0.4	9	0.3	25
	June	6.0	74	0	0	0.2	7	0.2	2	0	0	26.0	932	10.4	1,015
	August	-	7	-	0	-	57	-	4	-	10	-	32	-	110
	September	-	3	-	0	-	72	-	0	-	1	-	9	-	85
	October	-	1	-	0	-	0	-	0	-	4	-	3	-	8
	All	-	89	-	1	-	147	-	6	-	15	-	985	-	1,243
Harp Seal	April	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	June	0	0	0	0	0.0	1	0	0	0	0	0	0	0.0	1
	August	-	0	-	0	-	11	-	0	-	0	-	11	-	22
	September	-	0	-	0	-	40	-	0	-	0	-	0	-	40
	October	-	0	-	0	-	0	-	0	-	0	-	0	-	0
	All	-	0	-	0	-	52	-	0	-	0	-	11	-	63

Table 4.9 Density (#/100 km^2) of Marine Mammals in Foxe Basin and Hudson Strait in April, June, Early August, Mid-September, and October 2008 (cont'd)

Species	Period	Area												All Areas	
		NE Foxe Basin		Frobisher Bay		Hudson Strait		S Foxe Basin		Steensby Inlet		NW Foxe Basin			
		Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.	Density	No.
Polar Bear	April	0.1	1	0.2	1	0.1	2	0	0	2.5*	1	0.4	9	0.2	14
	June	0	0	0	0	0.0	1	0	0	0	0	0.3	9	0.1	10
	August	0.1	1	0	0	0.0	1	0.5	4	0	0	0.0	1	0.1	7
	September	0.8	15	0	0	0	0	0	0	0	0	0.5	15	0.3	30
	October	1.0	24	0	0	0	0	0	0	0.1	1	0.3	19	0.4	44
	All	0.5	41	0.1	1	0.0	4	0.1	4	0.1	2	0.3	53	0.2	105

NOTES:

1. CELLS WITH - INDICATE SPECIES DENSITIES THAT CANNOT BE RELIABLY ESTIMATED BECAUSE OF SPECIES SIZE AND SURVEY CONDTIONS.
2. NO. INDICATE THE NUMBER OF SIGHTINGS THAT ARE ON-TRANSECT AND DURING ACCEPTABLE ENVIRONMENTAL CONDITIONS USED IN DENSITY CALCULATION
3. DENSITY SHOWN AS 0.0 IS EQUIVALENT TO A VALUE BETWEEN >0 AND <0.05.

* Inflated estimate, density based on a small coverage area of Steensby Inlet.

Table 4.10 Density (#/100 km²) of Marine Mammals in Foxe Basin in June, August, and September 2006 During Ringed Seal Surveys

Species	Period	Area						All Areas	
		NE Foxe Basin		Steensby Inlet		NW Foxe Basin			
		Density	No.	Density	No.	Density	No.	Density	No.
Bowhead Whale	June	0	0	0	0	0	0	0	0
	August	0	0	0	0	0.5	3	0.2	3
	September	0	0	0	0	0.4	3	0.1	3
	All	0	0	0	0	0.4	6	0.1	6
Beluga	June	0	0	0	0	0	0	0	0
	August	0	0	0	0	0	0	0	0
	September	0.3	2	0.5	7	3.6	25	1.2	34
	All	0.2	2	0.3	7	1.6	25	0.6	34
Walrus	June	1.6	3	0	0	15.1	44	4.4	47
	August	0	0	0	0	0.2	1	0.1	1
	September	0.1	1	4.3	66	0	0	2.3	67
	All	0.3	4	2.5	66	2.8	45	2.1	115
Bearded Seal	June	2.7	5	0.2	1	1.7	5	1.0	11
	August	-	0	-	0	-	0	-	0
	September	-	2	-	21	-	4	-	27
	All	-	7	-	22	-	9	-	38
Ringed Seal	June	0.5	1	20.1	117	0	0	11.2	118
	August	-	0	-	0	-	0	-	0
	September	-	0	-	0	-	0	-	0
	All	-	1	-	117	-	0	-	118
Polar Bear	June	0	0	0	0	0	0	0	0
	August	0	0	0	0	0	0	0	0
	September	0	0	0	0	0.3	2	0.1	2
	All	0	0	0	0	0.1	2	0.0	2

NOTES:

1. CELLS WITH - INDICATE SPECIES DENSITIES THAT CANNOT BE RELIABLY ESTIMATED BECAUSE OF SPECIES SIZE AND SURVEY CONDTIONS.
2. NO. INDICATE THE NUMBER OF SIGHTINGS THAT ARE ON-TRANSECT AND DURING ACCEPTABLE ENVIRONMENTAL CONDITIONS USED IN DENSITY CALCULATION
3. DENSITY SHOWN AS 0.0 IS EQUIVALENT TO A VALUE BETWEEN >0 AND <0.05.

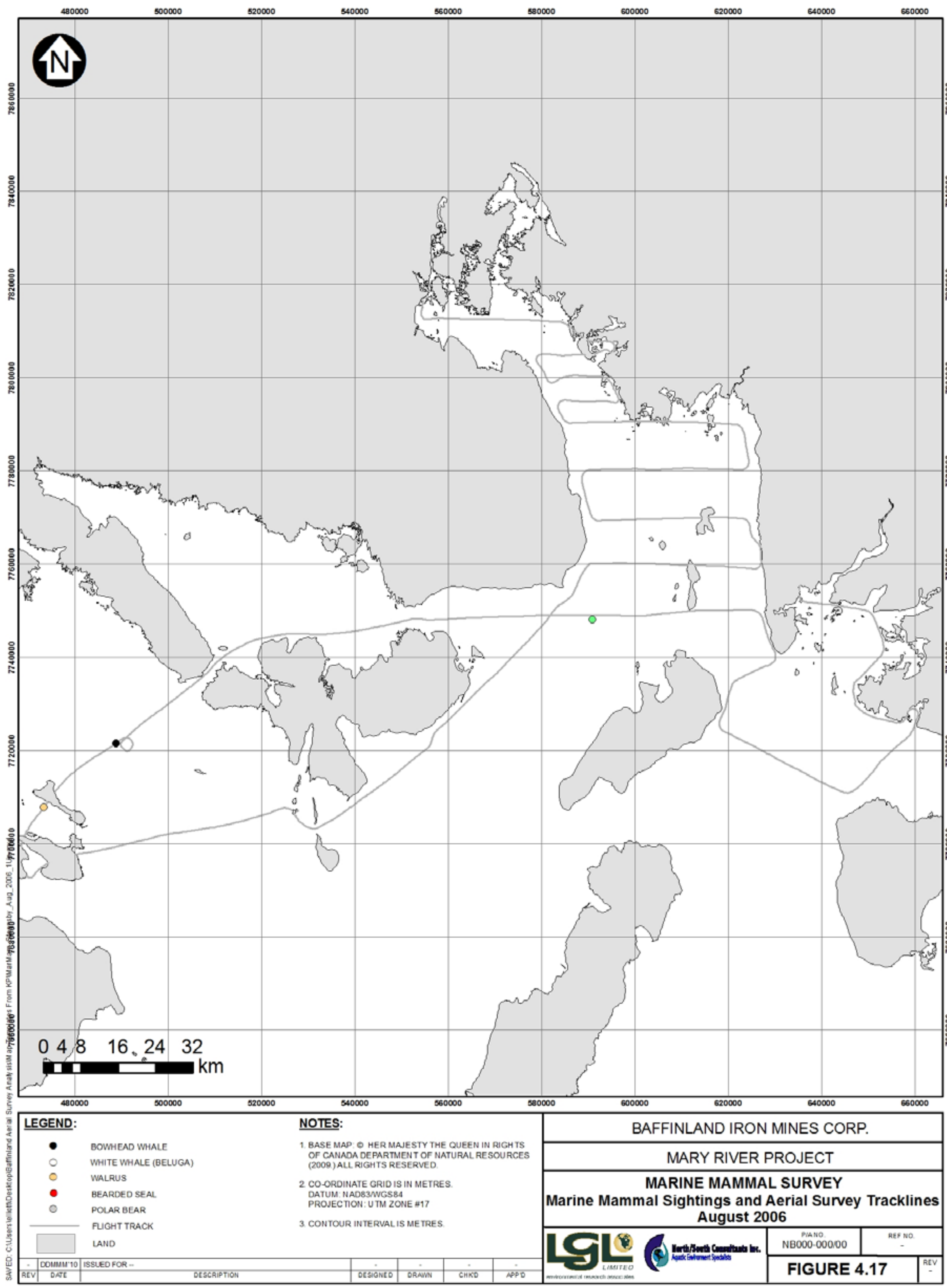

Figure 4.17 Marine Mammal Sightings and Aerial Survey Tracklines in Foxe Basin, August 2006

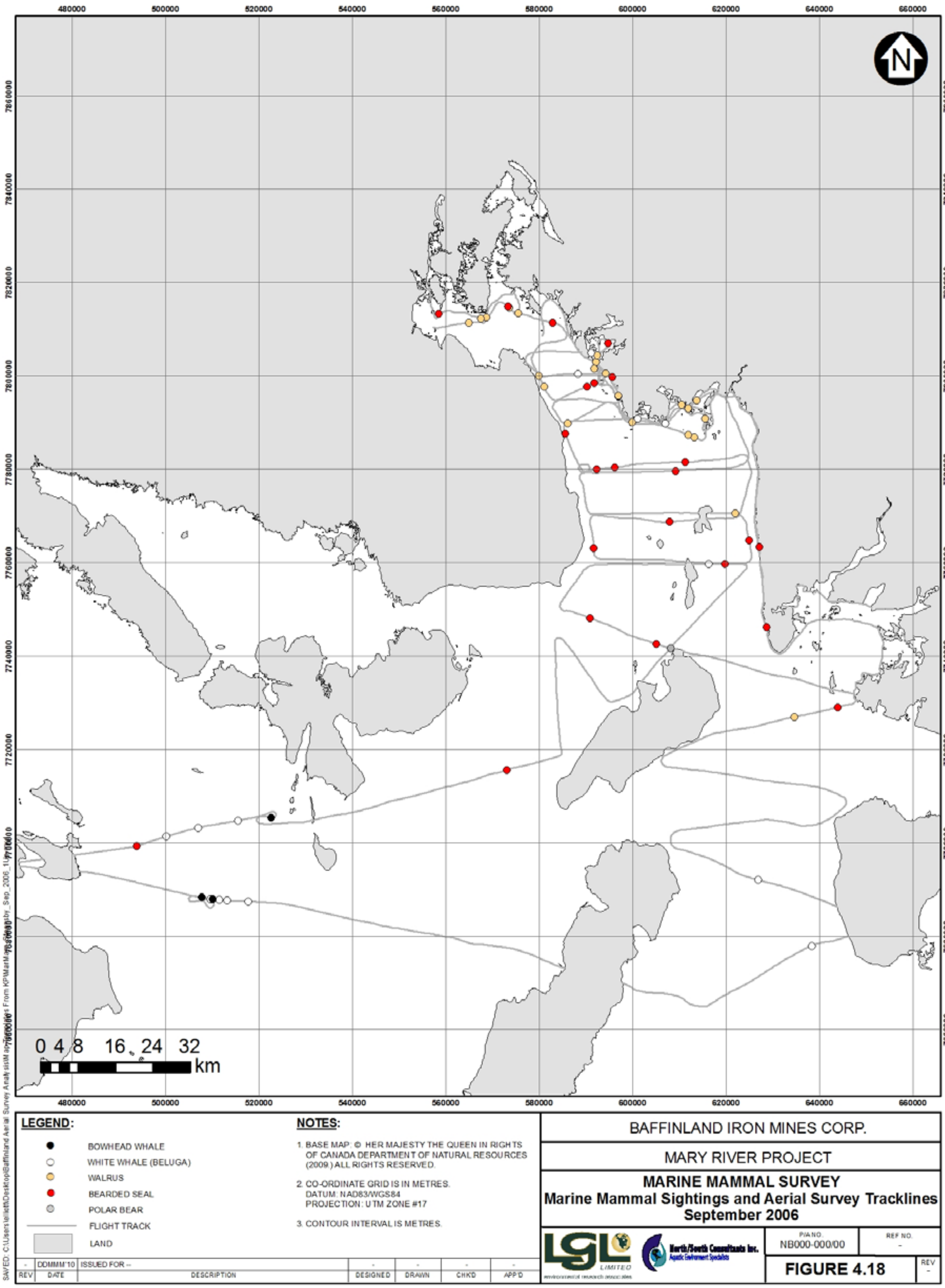

Figure 4.18 Marine Mammal Sightings and Aerial Survey Tracklines in Foxe Basin, September 2006

Table 4.11 Density (#/100 km^2) of Marine Mammals in Steensby Inlet and Northern Foxe Basin, September 2007

Species	Period	Area							
		NE Foxe Basin		Steensby Inlet		NW Foxe Basin		All Areas	
		Density	No.	Density	No.	Density	No.	Density	No.
Bowhead Whale	Se1	0.4	2	0	0	0	0	0.1	2
	Se2	0	0	0	0	0.8	5	0	0
	All	0.2	2	0	0	0.3	5	0.1	2
White Whale (Beluga)	Se1	0.6	3	0	0	0.1	1	0.2	4
	Se2	2.3	12	0	0	1.9	11	1.6	23
	All	1.4	15	0	0	0.8	12	0.9	27
Walrus	Se1	6.6	36	0.3	1	5.6	48	4.9	85
	Se2	0.8	4	0.6	2	2.7	16	1.5	22
	All	3.8	40	0.5	3	4.4	64	3.4	107
Bearded Seal	Se1	-	0	-	1	-	0	-	1
	Se2	-	3	-	8	-	0	-	11
	All	-	3	-	9	-	0	-	12
Ringed Seal	Se1	-	0	-	0	-	1	-	1
	Se2	-	2	-	1	-	0	-	3
	All	-	2	-	1	-	1	-	4
Harp Seal	Se1	-	10	-	0	-	20	-	30
	Se2	-	0	-	0	-	0	-	0
	All	-	10	-	0	-	20	-	30
Polar Bear	Se1	0	0	0	0	0	0	0	0
	Se2	0	0	0	0	0.3	2	0.1	2
	All	0	0	0	0	0.1	2	0.1	2

NOTES:

1. CELLS WITH - INDICATE SPECIES DENSITIES THAT CANNOT BE RELIABLY ESTIMATED BECAUSE OF SPECIES SIZE AND SURVEY CONDTIONS.
2. NO. INDICATE THE NUMBER OF SIGHTINGS THAT ARE ON-TRANSECT AND DURING ACCEPTABLE ENVIRONMENTAL CONDITIONS USED IN DENSITY CALCULATION
3. DENSITY OF 0.0 IS EQUIVALENT TO A VALUE BETWEEN >0 AND <0.05.

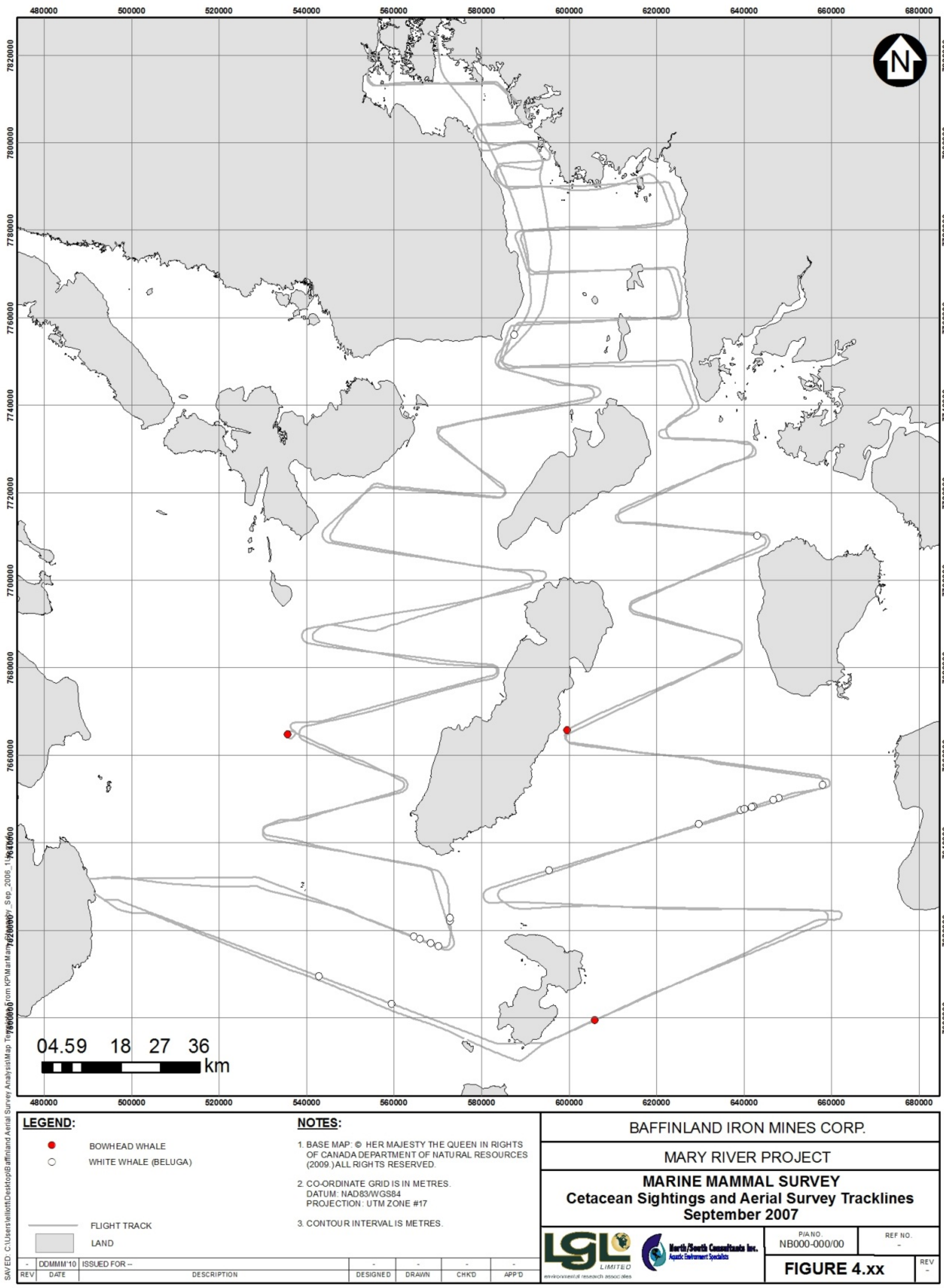

Figure 4.19 Marine Mammal Sightings and Aerial Survey Tracklines in Foxe Basin, September 2007

4.3.2.3 Minke Whale

Minke whales were only sighted once; one group of 14 was sighted in eastern Hudson Strait on 12 September 2008 (see Figure 4.15).

4.3.2.4 Beluga Whale

Beluga were widespread in most areas of Foxe Basin and Hudson Strait throughout the survey period (see Figure 4.12 to Figure 4.16), although densities varied by season and among the subareas. In April and June 2008, beluga were observed in low densities (0 to 0.3/100 km^2) in Foxe Basin (see Table 4.9). By August, densities of beluga increased in Foxe Basin (to 0.2 to 0.5/100 km^2), and in September, most of the beluga sighted were in northwest Foxe Basin and Steensby Inlet, with some sightings in other areas of Foxe Basin and Hudson Strait (see Figure 4.15). In October, they were only observed in northern Foxe Basin and Steensby Inlet (see Figure 4.16). In Hudson Strait, densities decreased gradually through the year, from 3/100 km^2 in April to none in October (see Table 4.9).

During the limited aerial surveys in September 2006, beluga were present in northwest Foxe Basin, northeast Foxe Basin and Steensby Inlet, respectively, in densities of 3.6/100 km^2, 0.3/100 km^2 and 0.5/100 km^2 (see Table 4.10 and Figure 4.18). During limited survey in September 2007 bowhead whales were sighted in eastern and western Foxe Basin in density of 0.4/100 km^2 and 0.8/100 km^2, respectively (see Table 4.11 and Figure 4.19).

It appears that small numbers of beluga might overwinter in the open-water areas in northern Foxe Basin. Hudson Strait is a focal point of winter (April) distribution, and as ice cover diminishes in June through August, beluga move westward and northward into Foxe Basin where they remain during the summer, returning to Hudson Strait in late fall.

4.3.2.5 Killer Whale

Killer whales were not sighted in Foxe Basin or Hudson Strait during the 2006, 2007, and 2008 aerial surveys.

4.3.2.6 Ringed Seal

Ringed seals are widespread throughout the study area (see Figure 4.20 to Figure 4.28). They are not easily observed from a survey altitude of 152 m or 305 m, particularly when environmental conditions are not optimal (clear water, no waves, and enough surface glare to indicate a surface disturbance from a seal). Ringed seals were present in all surveyed areas of Foxe Basin and Hudson Strait, and most sightings occurred during June and to a lesser extent August, when they were easily observed basking on pack ice; densities were calculated only for the April 2008 and June 2006 and 2008 surveys (see Table 4.9 and Table 4.10). The highest seal density (26/100 km^2) apparent in northwestern Foxe Basin in June 2008 (see Table 4.9 and Figure 4.24) is attributable to the presence of fast ice and heavy pack ice in that area.

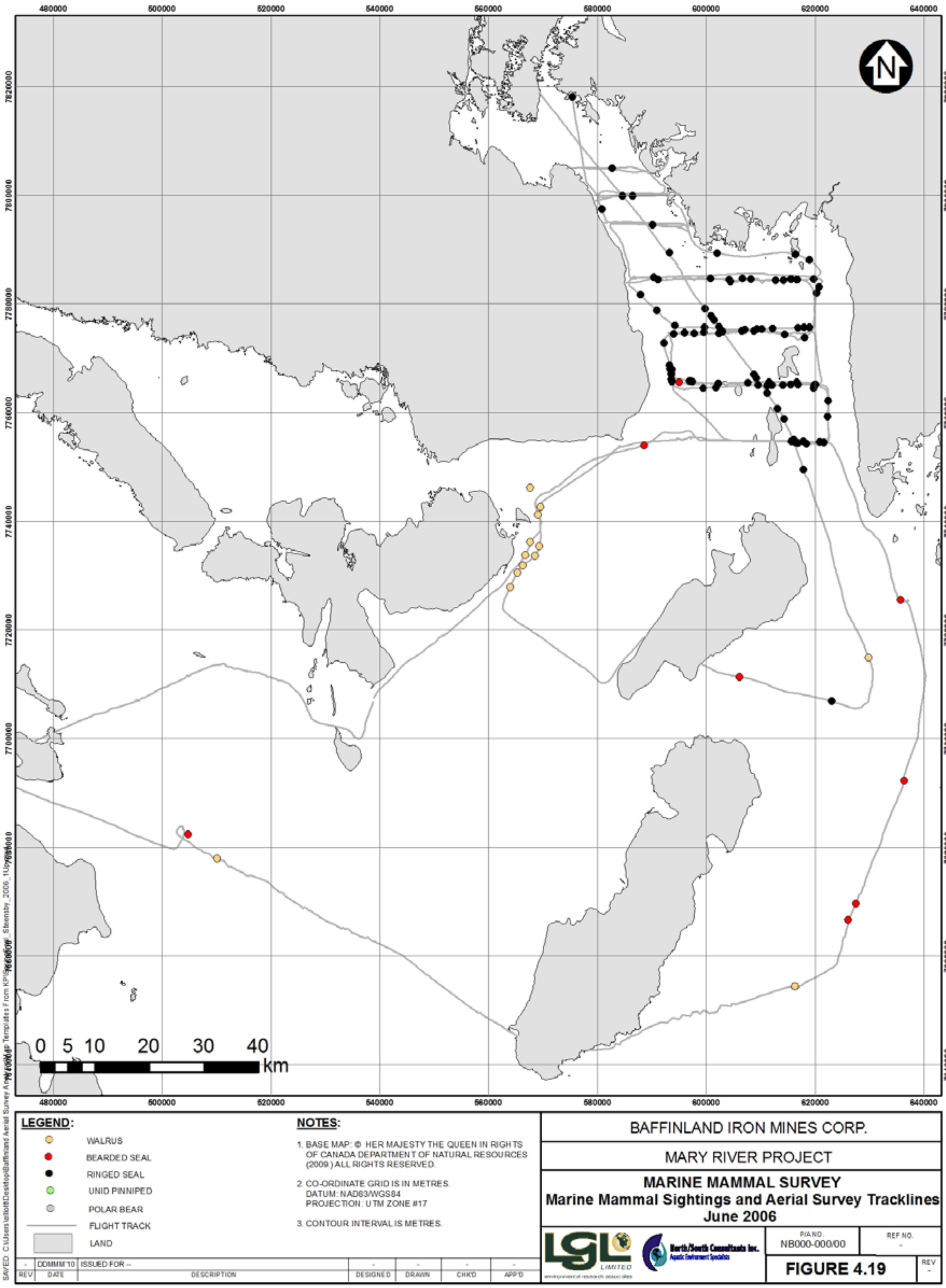

Figure 4.20 Seal, Walrus, and Polar Bear Sightings and Aerial Survey Tracklines in Foxe Basin, June 2006

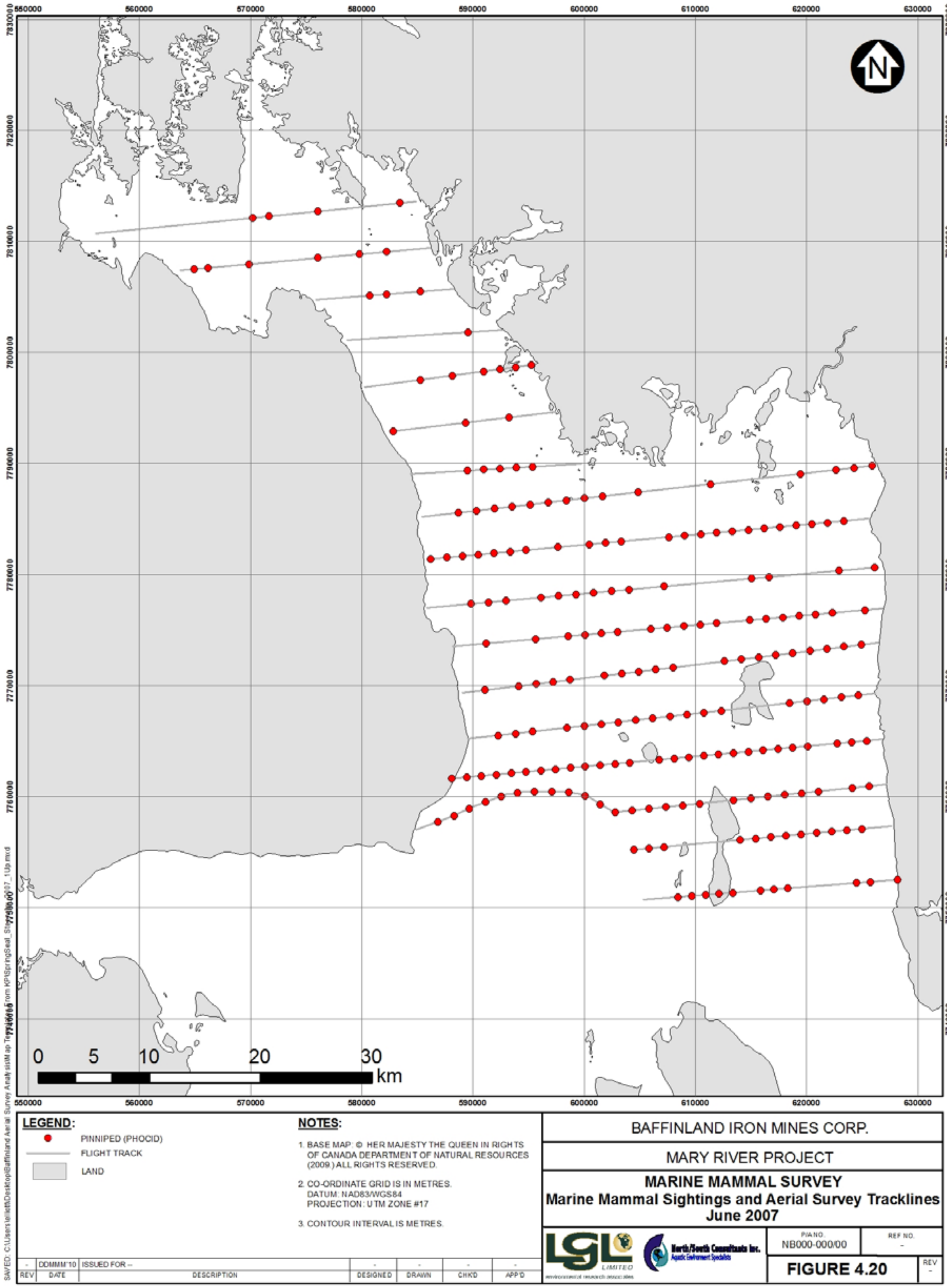

Figure 4.21 Ringed Seal Sightings and Aerial Survey Tracklines in Steensby Inlet, June 2007

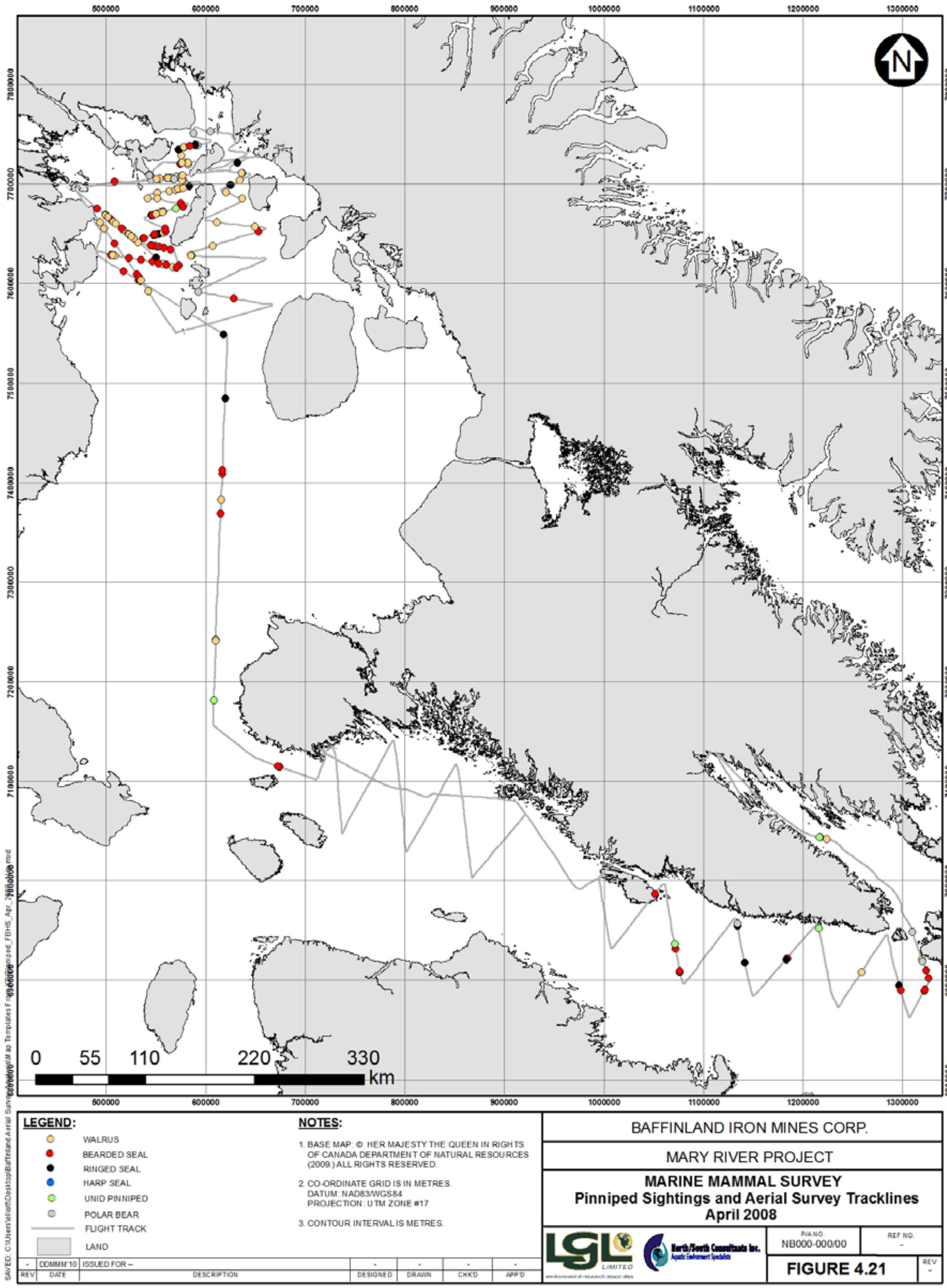

Figure 4.22 Seal, Walrus, and Polar Bear Sightings and Aerial Survey Tracklines in Foxe Basin and Hudson Strait, April 2008

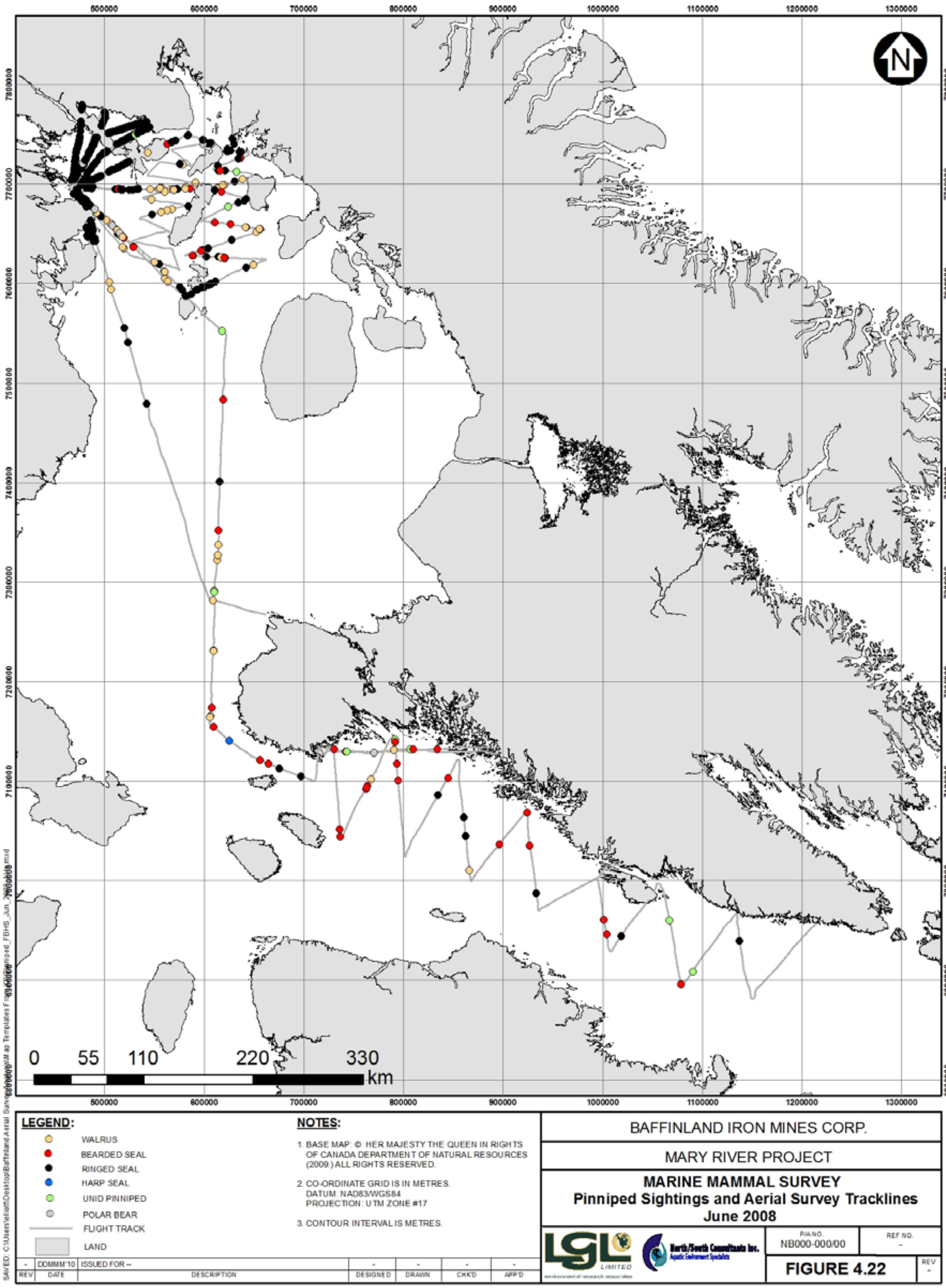

Figure 4.23 Seal, Walrus, and Polar Bear Sightings and Aerial Survey Tracklines in Foxe Basin and Hudson Strait, June 2008

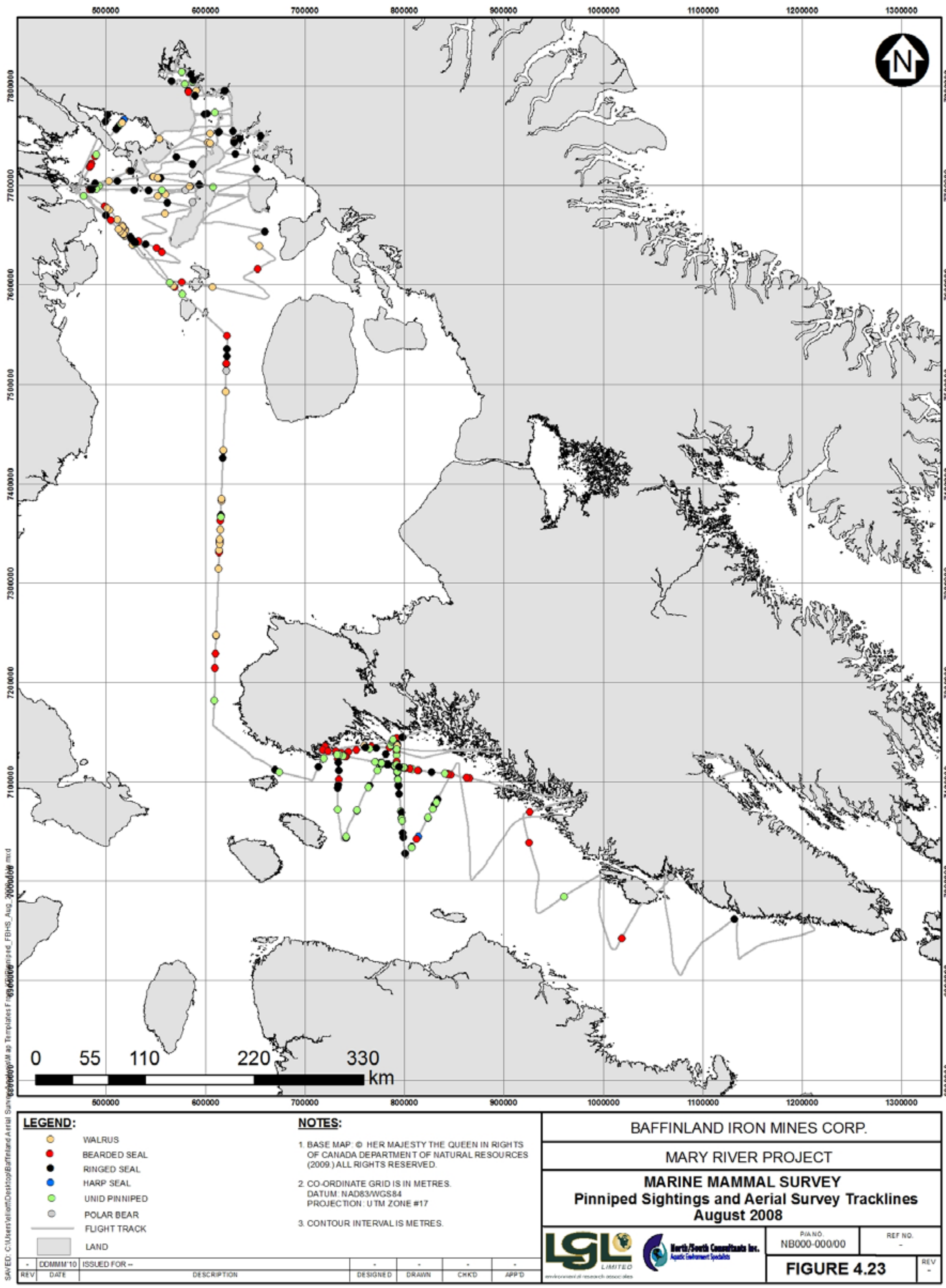

Figure 4.24 Seal, Walrus, and Polar Bear Sightings and Aerial Survey Tracklines in Foxe Basin and Hudson Strait, August 2008

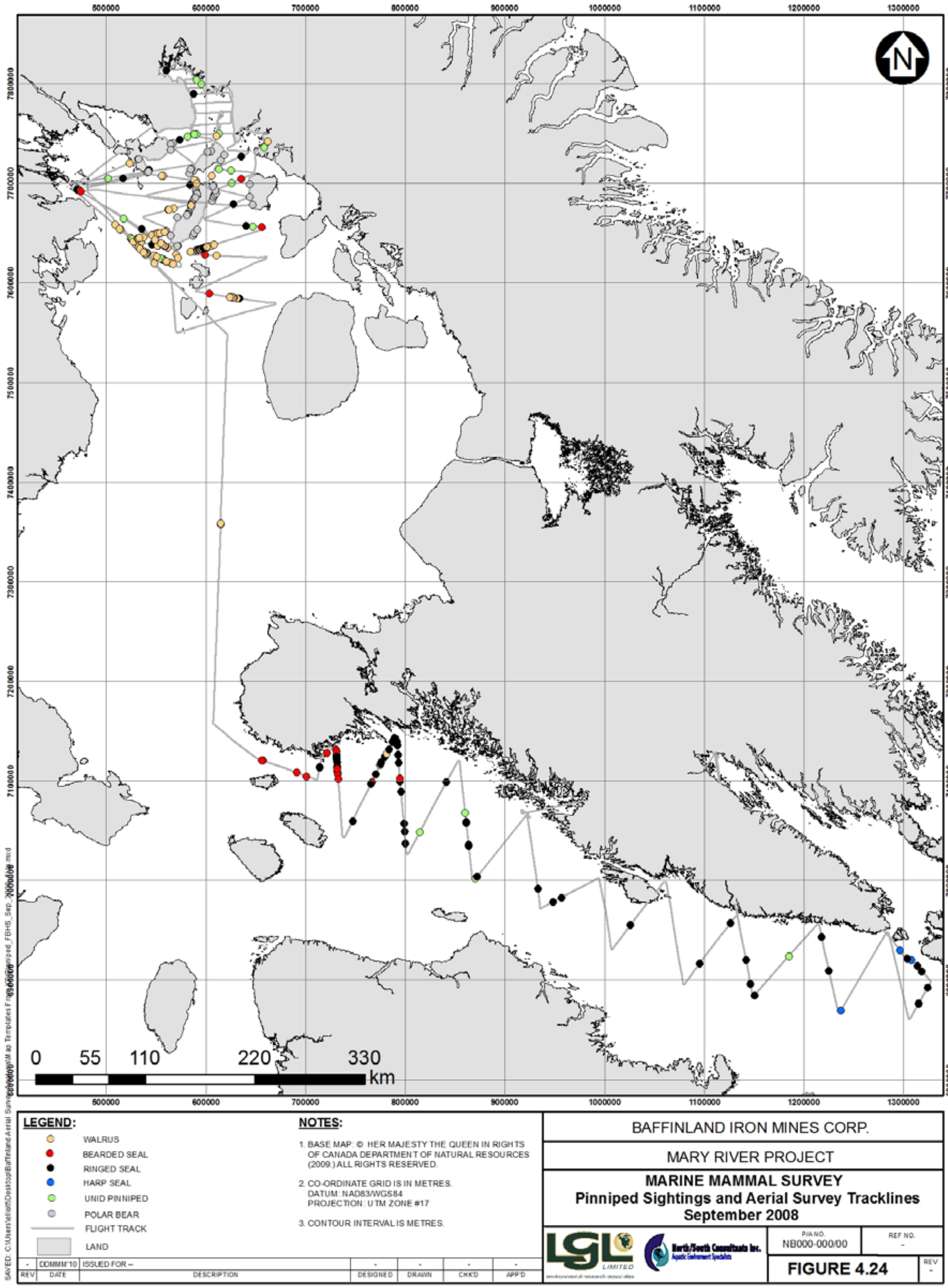

Figure 4.25 Seal, Walrus, and Polar Bear Sightings and Aerial Survey Tracklines in Foxe Basin and Hudson Strait, September 2008

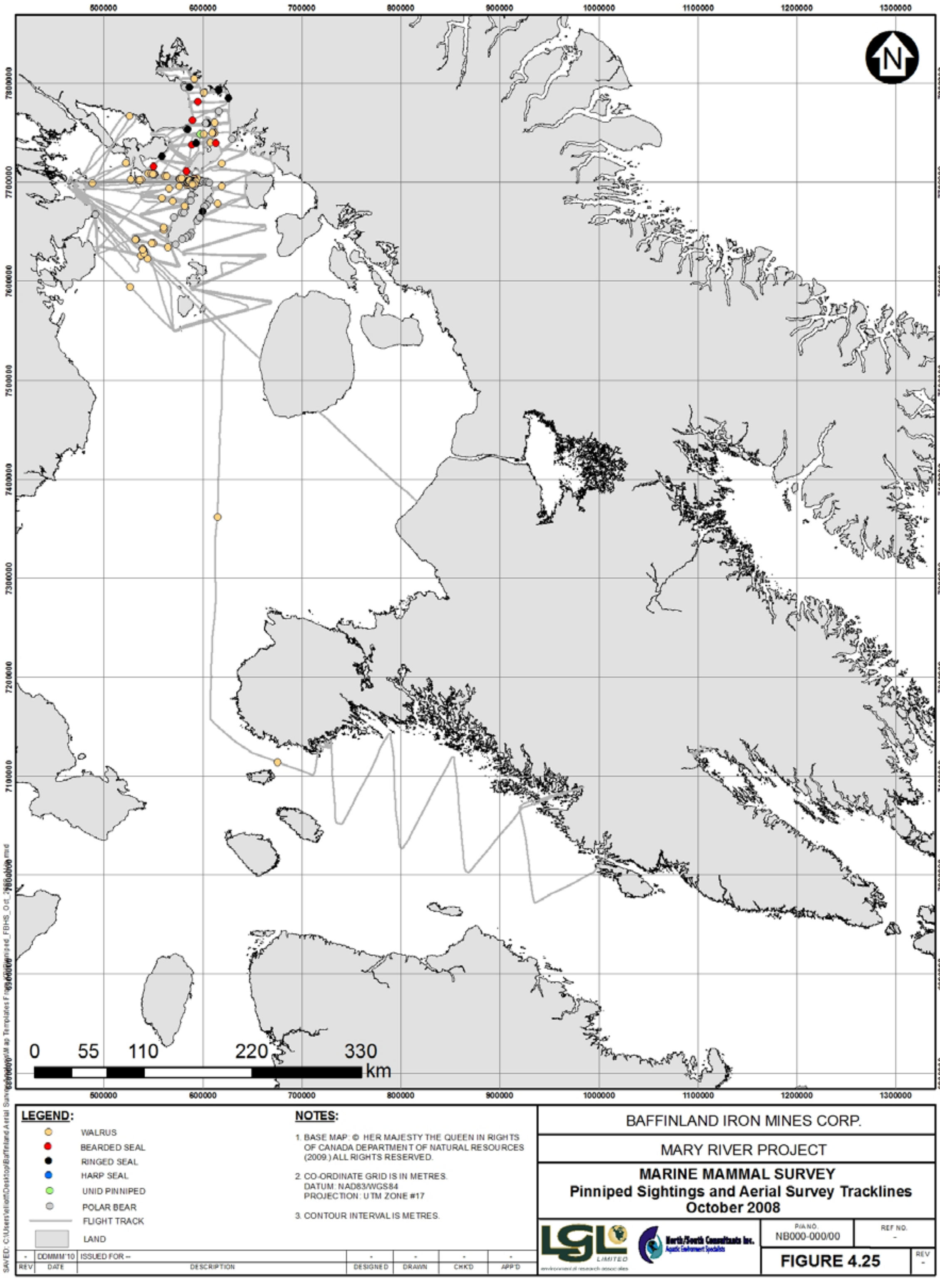

Figure 4.26 Seal, Walrus, and Polar Bear Sightings and Aerial Survey Tracklines in Foxe Basin and Hudson Strait, October 2008

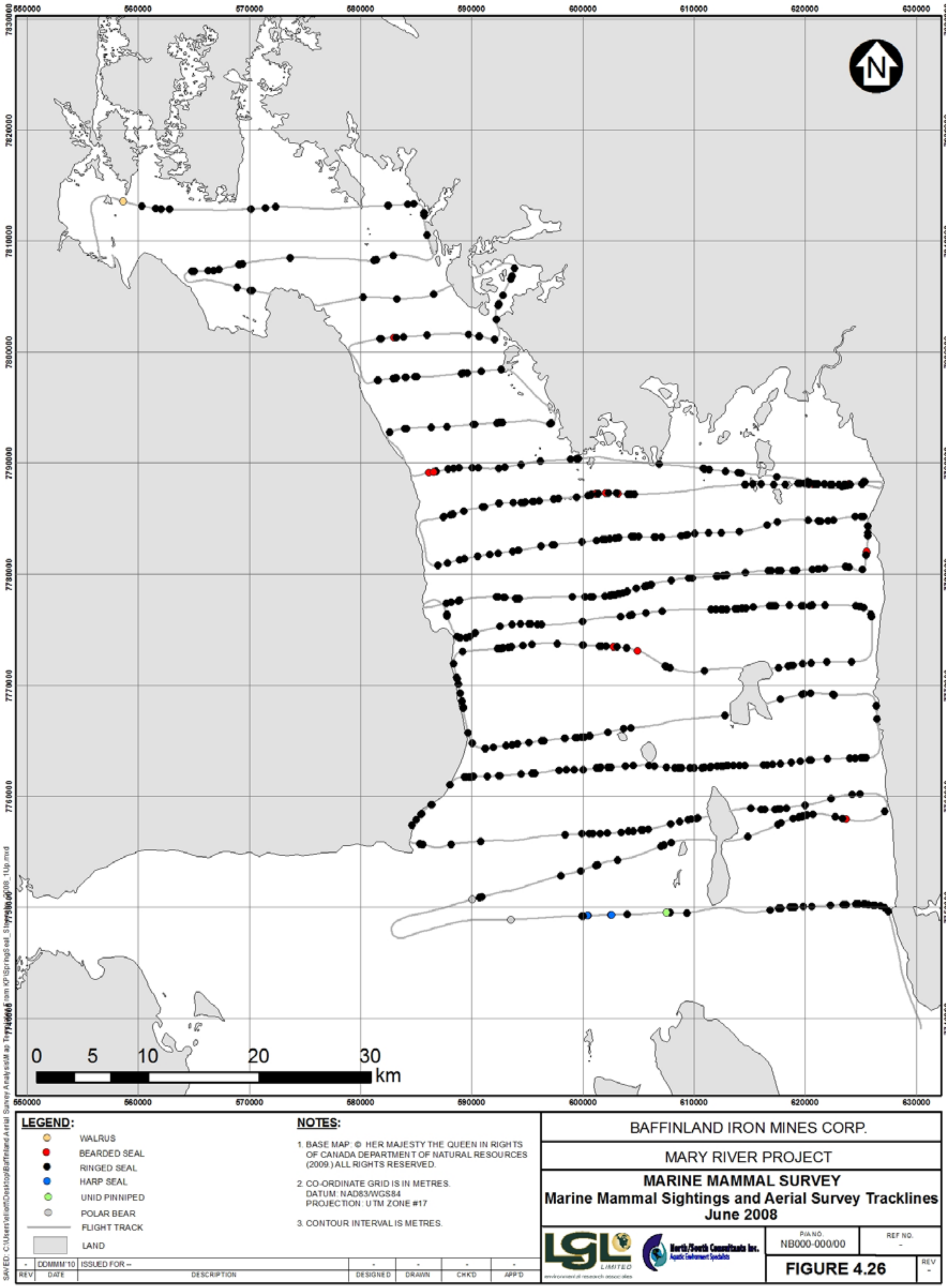

Figure 4.27 Seal, Walrus, and Polar Bear Sightings and Aerial Survey Tracklines in Steensby Inlet, June 2008

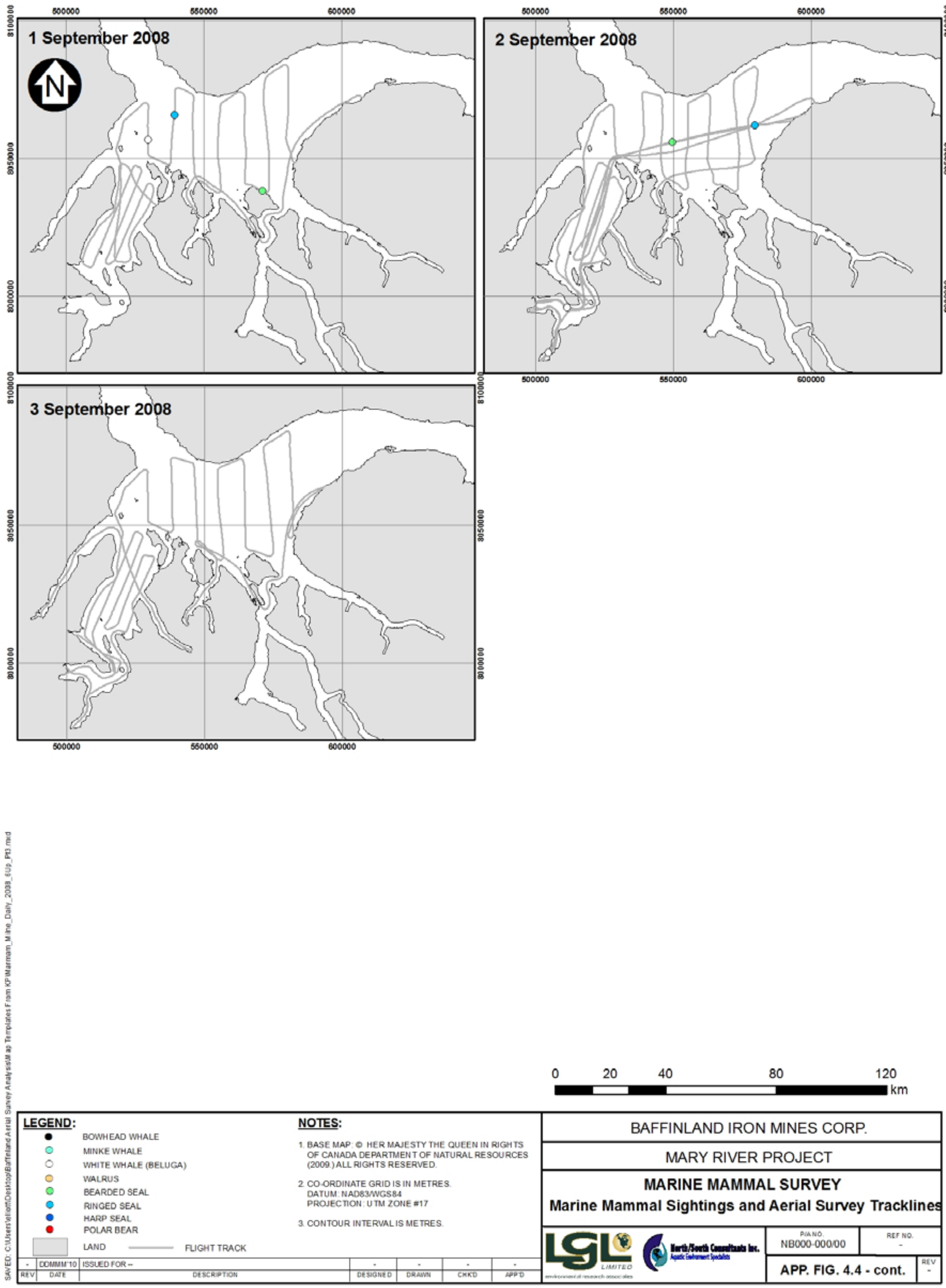

Figure 4.27 Seal, Walrus, and Polar Bear Sightings and Aerial Survey Tracklines in Steensby Inlet, June 2008 (cont'd)

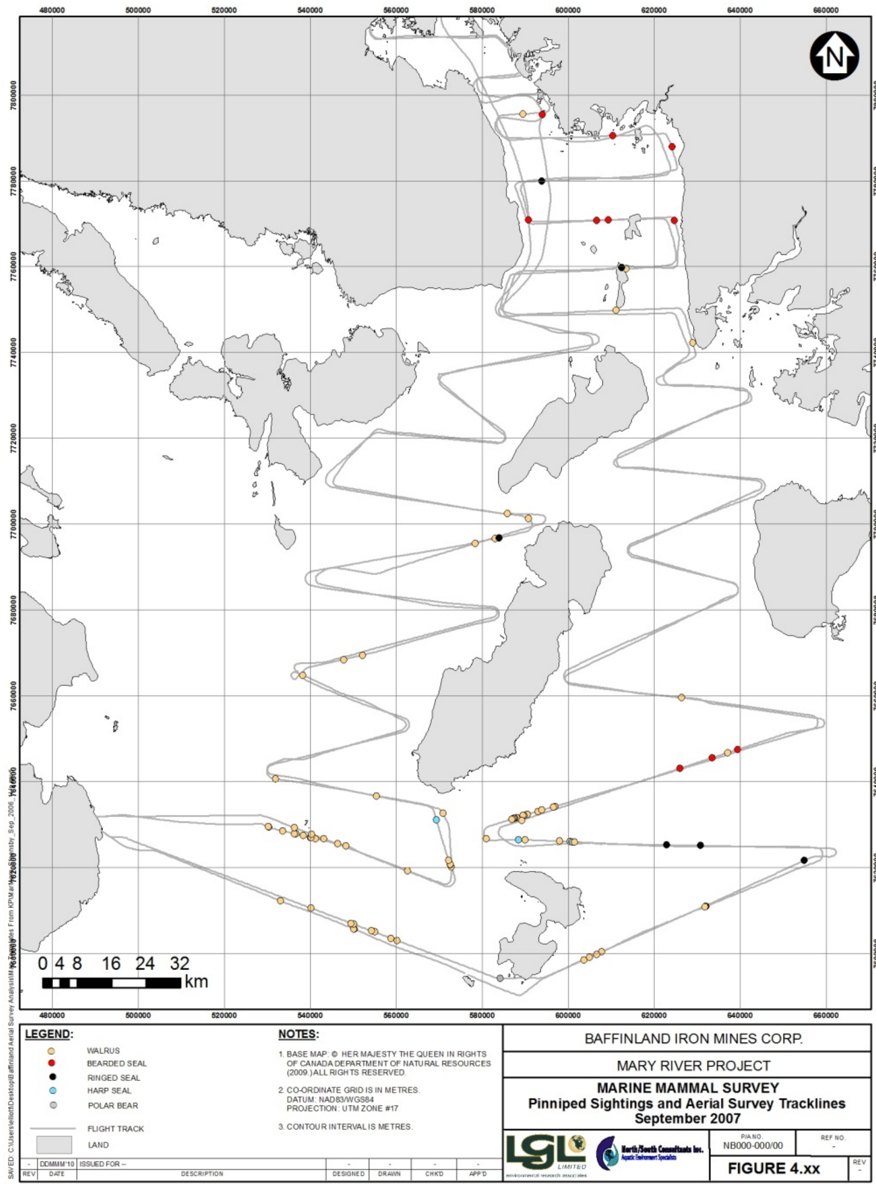

Figure 4.28 Seal, Walrus, and Polar Bear Sightings and Aerial Survey Tracklines in Foxe Basin, September 2008

Ringed seals were distributed throughout Steensby Inlet during directed ringed seal aerial surveys in 2006, 2007 and 2008. The density of seals basking on sea ice was 20/100 km^2 (see Table 4.10) in 2006, 157/100 km^2 in 2007 (see Table 4.7), and 71/100 km^2 in 2008 (see Table 4.8). Fewer ringed seals were sighted in June 2008 in areas of landfast and pack ice in northwest Foxe Basin (26/100 km^2; Table 4.9) or pack ice in northeast Foxe Basin, southern Foxe Basin, and Hudson Strait (6, 0.2, and 0.2/100 km^2, respectively; Table 4.9). These lower densities are likely underestimated given that surveys in June 2008 were conducted at higher altitude.

In 2008, surveys were extended to include Murray Maxwell Bay, and the fast ice between Igloolik and Hall Beach. The density of ringed seal in each area was 126/100 km^2 and 51.3/100 km^2, respectively (see Figure 4.29).

4.3.2.7 Bearded Seal

Bearded seals are abundant throughout the study area (see Figure 4.18, Figure 4.20, and Figure 4.22 to Figure 4.26) but are not easily observed from a survey altitude of 152 m or 305 m, especially if environmental conditions are not perfect (see above for ringed seals). They were present in all areas of Foxe Basin and Hudson Strait, and most sightings occurred from April to August when they are easily observed basking on sea ice.

Bearded seals were distributed throughout the survey area during aerial survey (152-m altitude) of northern Foxe Basin and Steensby Inlet in 2006. The densities observed in northwest Foxe Basin, northeast Foxe Basin and Steensby Inlet were respectively 1.7/100 km^2, 2.7/100 km^2 and 0.2/100 km^2 (see Figure 4.20 and Table 4.10) in 2006.

During the low-altitude surveys in June 2008, most bearded seals were sighted near the mouth of Steensby Inlet (see Figure 4.28). Density during this survey was 2/100 km^2 (see Table 4.8), similar to that on landfast ice in Milne Inlet. The density of bearded seals in June 2008 was lower in areas of landfast and pack ice in northwest Foxe Basin (0.3/100 km^2) or pack ice in northeast Foxe Basin, southern Foxe Basin, and Hudson Strait (0.9, 0.3, and 0.6/100 km^2, respectively; Table 4.9).

4.3.2.8 Harp Seal

Most harp seals were observed in the extreme eastern end of Hudson Strait during the September surveys (three sightings of 40, 40, and 85 seals on 12 September; Figure 4.25), usually in association with icebergs. There were also sightings in August, 2 of 11 seals in western Hudson Strait and 1 of 11 seals in Foxe Basin (see Figure 4.24).

4.3.2.9 Walrus

Walrus were abundant in the northern Foxe Basin portion of the study area in June 2006 (see Figure 4.17, Figure 4.18, and Figure 4.20). They were only observed in pack ice or open water. The highest densities of walrus were 15/100 km^2 in northwest Foxe Basin in June, and 4.3/100 km^2 in Steensby Inlet in September (see Table 4.10).

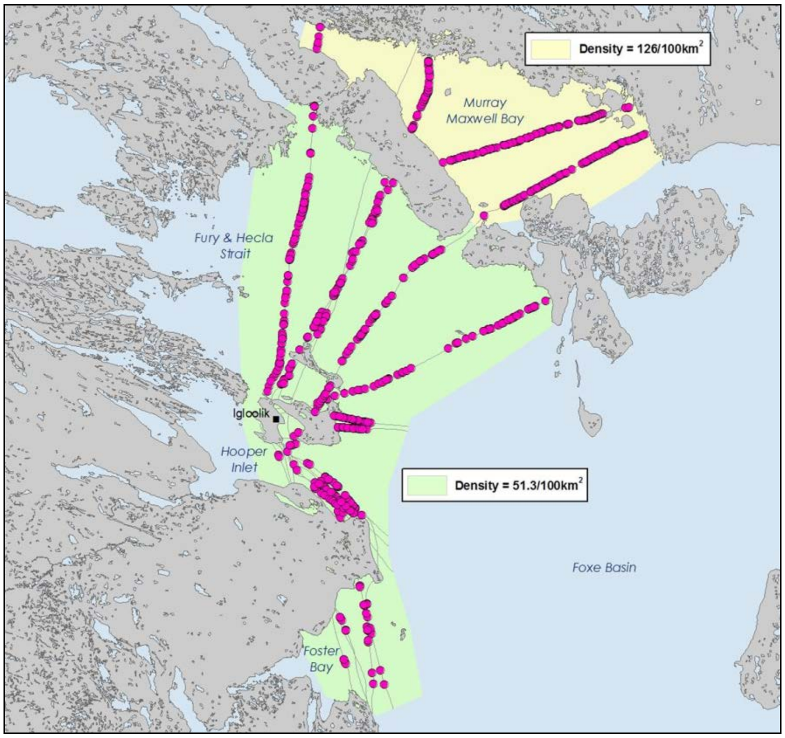

Figure 4.29 Aerial Survey Tracklines, Ringed Seal Sightings and Density in Murray Maxwell Bay and Between Igloolik and Hall Beach, June 2008

During limited surveys in September 2007, walrus were observed in Steensby Inlet and in northwest and northeast Foxe Basin (see Figure 4.19). The highest density of walrus was 6.6/100 km^2 in northwest Foxe Basin during September (see Table 4.11).

Walrus were abundant in the study area in 2008, especially in Foxe Basin where they were observed in each month surveyed (see Figure 4.22 to Figure 4.26). They were only observed in pack ice or open water. The highest density of walrus during each survey period was in northwest Foxe Basin, 3.2 to 19.3/100 km^2 (see Table 4.9). On average, walrus densities in northwest Foxe Basin were ~7 times higher than those observed in northeast Foxe Basin or southern Fox Basin. During the aerial surveys, two terrestrial walrus haul-out sites were observed, one at Manning Islands (mid-way between Hall Beach and Spicer Islands) and at Bushnan Rock (a small sandy islet west of the gap between Rowley and Koch Islands). Walrus densities in Hudson Strait (0.1/100 km^2) were lower than any observed in Foxe Basin. Overall (in all areas), walrus densities increased gradually from 1.3/100 km^2 in April to 9.7/100 km^2 in October (see Table 4.9).

4.3.2.10 Polar Bear

There were numerous sightings of polar bears in the study area in all months of 2008. Polar bears were observed on landfast ice, pack ice, swimming in open water, and in terrestrial areas in all areas of Foxe Basin and Hudson Strait, mostly in northern Foxe Basin. Highest densities were in September and October (see Table 4.9, Figure 4.25, and Figure 4.26), when they were very visible along shorelines of Steensby Inlet, Foxe Basin, and the islands in Foxe Basin (especially Koch, Rowley, and Bray Islands).

During months when ice cover predominated (April and June), the highest polar bear densities were seen in or near areas with the highest walrus densities, notably northwest Foxe Basin (see Table 4.9, Figure 4.22, and Figure 4.23). In 2006, only two polar bears were observed in northwest Foxe Basin with a density of 0.3/100 km^2 (see Table 4.10).

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APPENDIX 1

LITERATURE REVIEW OF CONTAMINANTS IN MARINE MAMMALS

CONTAMINANTS

HEAVY METALS

Heavy metals such as mercury, lead, selenium, and cadmium are highly migratory in water environments. They can enter the environment via mining activities and via landfill leachate.

Baleen Whales

Bowhead whales are long-lived, thus are susceptible to the accumulation of heavy metals over long periods. A recent investigation of heavy metals in the liver and kidneys of Alaskan bowhead whales found that heavy metal levels increased with age and that cadmium concentrations were strongly associated with degrees of lung and renal pathologies. However, aging in itself might be a causal factor in the process (Rosa et al. 2008).

Odontocetes

Mercury and other heavy metals have been reported to accumulate in tissues of beluga whales and narwhals in the Canadian Arctic (Wagemann et al. 1996; Lockart et al. 2005; Loseto et al. 2008). Levels of mercury and bioaccumulation increased with beluga length in the Beaufort Sea because large belugas tend to feed at higher trophic levels (Loseto et al. 2008). The concentration of total mercury in muktuk exceeds the Canadian Government Guideline for fish export and consumption (Wagemann and Kozlowska, 2005). Past studies have indicated that the level of mercury in the samples of beluga liver has increased compared with samples taken in the early 1980s, and that belugas in the western Canadian Arctic had higher levels of mercury than whales from the eastern Canadian Arctic (Wagemann et al. 1996). However, recent studies suggest that the regional difference might have diminished and that the difference is no longer statistically significant (Lockhart et al. 2005). Overall temporal trends of mercury levels over the past 20 to 30 years in the Canadian Arctic are inconsistent (Braune et al. 2005).

Mercury concentrations reported in flesh and liver samples of belugas in the western Arctic exceeded the Canadian consumption guidelines (Wagemann et al. 1996; Lockhart et al. 2005). Of liver, kidney, muscle, and muktuk samples analyzed by Lockhart et al. (2005), muktuk samples had the lowest mercury concentration levels. These levels, however, were above consumption guidelines in most cases (Lockhart et al. 2005). Although there are within-stock differences in mercury levels in belugas landed in locations in the eastern Canadian Arctic (Repulse Bay, Arviat, Coral Harbour, Sanikiluaq, Kangiqsujuaq, Kimmirut, Iqualuit, and Pangnirtung), overall mercury levels in the eastern Canadian Arctic are notably lower than in the western Canadian Arctic (Braune et al. 2005).

Hepatic mercury levels in Pond Inlet narwhals have also significantly increased for the period 1978–1979 to 1992–1994 (Wagemann et al. 1996). Cadmium concentrations seem to be significantly higher in narwhals than in other cetaceans. Narwhals in eastern Canada were reported to have the highest cadmium concentrations of narwhal populations; lead concentrations were highest in west Greenland animals (Born 1994 in Culik 2010).

Pinnipeds

Elevated concentrations of mercury, cadmium, selenium, and other heavy metals have been reported to accumulate in tissues of ringed and bearded seals (Wagemann et al. 1996, 2000; Sonne-Hansen et al. 2002; Riget et al. 2005). An early study of ringed and bearded seals sampled from seven locations across the Canadian Arctic reported high values of mercury in ringed seal liver tissues, but did not find any significant regional differences between locations (Smith and Armstrong 1978). Smith and Armstrong (1978) also noted a strong positive correlation between mercury and age, and between selenium and age. High mercury concentrations significantly exceeding Canadian consumption guidelines were recorded in ringed seal liver (Wagemann et al. 1996; Dietz et al. 2000a), although Wagemann et al. (2000) indicated that only half of the total mercury in the liver of ringed seals from the Canadian Arctic was potentially toxic mercury; they suggested that measuring all mercury species rather than just total mercury or methylmercury could represent a more accurate assessment of the actual health risk to animals and humans from the consumption of contaminated tissues.

More recent studies comparing the pattern of mercury and cadmium in ringed seal liver and kidneys found a significant difference among studied locations across the Arctic (Wagemann et al. 1996; Riget et al. 2005), and significantly higher concentrations in adult ringed seals than sub-adults (Riget et al. 2005). Concentrations of mercury were highest in the western Canadian Arctic and concentrations of cadmium were highest in the eastern Canadian Arctic and off West Greenland (Wagemann et al. 1996; Riget et al. 2005). Mercury concentrations showed an increasing trend from 1984 to 1998 off Northwest Greenland (Riget et al. 2004). Riget et al. (2005) suggested that these patterns are most likely related to the natural geological differences in minerals among regions. Despite elevated levels of cadmium in ringed seal kidneys sampled off northwest Greenland, none of the ringed seals showed any signs of cadmium-induced nephropathy or osteodystrophy (Sonne-Hansen et al. 2002). Sonne-Hansen et al. (2002) suggested that this could be explained through other components of the ringed seal diet that might counteract cadmium-induced damage.

A comparison of essential trace elements (iron, copper, zinc, and selenium) and non-essential elements (arsenic, cadmium, mercury, and lead) in the muscle, liver, and kidney of harp and hooded seals indicated that levels were lower in muscle tissue than in liver and kidney tissues (Julshamn and Grahl-Nielsen 2000). Levels of most elements were higher in the hooded seal than the harp seal, whereas the arsenic burden was higher in the harp seal (Julshamn and Grahl-Nielsen 2000).

Mercury levels in benthic feeding walrus are generally lower than levels in other marine mammals (Braune et al. 2005). However, because persistent organic pollutants are found in much higher concentrations in walrus that feed on ringed seals than on benthic invertebrates (see Section 2.3.16). Braune et al. (2002) suggested that marine-mammal feeding walrus might also have higher levels of mercury than walrus that feed at lower trophic levels. Outridge et al. (2002) found that mercury levels in the walrus teeth sampled at Igloolik in the 1980s and 1990s were similar to those of walrus teeth from pre-industrial times, indicating an absence of industrial mercury at this location.

Polar Bear

Heavy metal accumulation has been recorded in polar bears (Dietz et al. 2000b; Rush et al. 2008). However, samples taken from Lancaster Sound indicated that polar bears had a lower mean mercury concentration than ringed seals, their main prey (Atwell et al. 1998). It was suggested that this was the result of polar bears feeding preferentially on seal blubber, which has lower levels of mercury than other tissues (Atwell et al. 1998). There appears to be little change in the concentration of most elements over time in Canada, and concentrations of most elements in the polar bear did not exceed toxicity thresholds, although cadmium and mercury levels did exceed those that have been associated with the formation of hepatic lesions in laboratory animals (Rush et al. 2008).

SYNTHETIC ORGANIC CONTAMINANTS

Synthetic organic contaminants are a man-made group of chemicals that can include persistent organochlorine pesticides (DDT), PCBs, and dioxins. DDT contamination in the Arctic is the result of long-range atmospheric transport and accumulation of the chemicals in soil, water, and snow.

Baleen Whales

Chemical pollutants likely accumulate slowly in bowhead whales because of the low trophic level at which they feed (O'Hara et al. 1998). Limited information available suggests that contaminant exposure poses no present threat to bowhead populations or to people who eat them (Bratton et al. 1993 in COSEWIC 2009).

Toothed Whales

Persistent organic pollutants are known to accumulate in beluga whales and narwhals (Vorkamp et al. 2004a; Stern et al. 2005). Concentrations of organochlorines and PCBs from beluga whales sampled in the Canadian Arctic indicated that males had significantly higher concentrations than females (Stern et al. 2005). The concentration of many compounds was significantly higher for sites off south Baffin Island than sites sampled in the western Canadian Arctic (Stern et al. 2005). Total PCB levels in beluga whale blubber at Igloolik were similar to those at Naujaat, Pangnirtung, Kinngait, and Iqaluit (Braun et al. 2005). Accumulation of contaminants in beluga tissue has been widely studied in the St. Lawrence beluga population. Such contamination has been linked to reproductive impairment, repressed immune system, and the incidence of tumours (Becker 2000; Hickie et al. 2000). Recent studies report a significant decline in some organochlorines found in beluga blubber from Cumberland Sound. Toxaphene levels have also declined by 40% from 1996 to 2002 in the Cumberland Sound samples (Stern and Ikonomou 2003 in Braune et al. 2003). However, there has been a significant increase in new contaminants (PBDEs and PCDEs) in beluga blubber samples from southeast Baffin Bay over the period 1982 to 1997 (Stern and Ikonomou 2000 in Braune et al. 2005).

PCBs, chlorinated pesticides, and polybrominated diphenyl ethers (PBDEs) were found in relatively high concentrations in narwhal blubber from Svalbard, Norway. Compared with other marine mammals from the same area, contaminant levels are among the highest ever measured, indicating a low capacity for contaminant metabolism (Wolkers et a. 2006). PCB and DDT concentrations in West Greenland narwhals were half those found in East Greenland and Svalbard (Dietz et al. 2004).

In the eastern Canadian Arctic, levels of PCBs, DDTs, chlordanes, and toxaphene were higher in male Pond Inlet narwhals than those from Broughton Island or Grise Fiord (Braune et al. 2005). Levels of PCBs and DDTs from Pond Inlet were approximately half those measured in narwhals from Svalbard (Braune et al. 2005). There appears to be no decline in concentrations of PCBs, DDT, or toxaphene in narwhal samples from the Baffin Bay-Lancaster Sound region for the period 1992 to 1999 (Braune et al. 2005).

Organochlorine concentrations in reproductive female killer whales off British Columbia and Alaska were found to be lower than those of immature individuals or mature males in the population (Ylitalo et al. 2001). Concentrations also varied based on prey selection. Transient killer whales feed mainly on marine mammals, and sampled individuals had much higher concentrations of organochlorines than resident killer whales, which feed primarily on fish (Ylitalo et al. 2001). There is no published information on contaminant levels in Canadian arctic killer whales (Higdon et al. 2007).

Pinnipeds

Persistent organochlorine contamination has been reported in ringed seals and Pacific walrus (Cleemann et al. 2000; Seagars and Garlich-Miller 2001; Fisk et al. 2002; Vorkamp et al. 2004a,b; Addison et al. 2005; Hickie et al. 2005; Kucklick et al. 2006). Based on ringed seal samples taken from Holman, NWT, PCB concentrations, had not significantly changed between 1981 and 2000, and changes in the distribution of PCB congeners during this period were considered to be consistent with atmospheric transport processes (Addison et al. 2005). Persistent organic pollutant concentrations in ringed seals appear to be lower (or similar) in the western Arctic compared to the eastern Canadian Arctic (Kucklick et al. 2006). Regionally, organochlorine concentrations did not vary between ringed seals from the east and west side of the Northwater Polynya in the Canadian Arctic (Fisk et al. 2002). Diet does not appear to be an important factor affecting the concentration of organochlorine in ringed seals (Fisk et al. 2002). Modelled simulations indicated that nursing ringed seal mothers could transfer 5% to 40% of their persistent organic pollutant burden to their milk during a 40-day lactation period (Hickie et al. 2005). Hickie et al. (2005) argued that the combination of this capacity to eliminate many persistent organic pollutants with the rapid growth of juveniles and the fast rate of population turnover results in fairly rapid responses to changes in contaminant loading, thus making the ringed seal an effective tool to monitor spatial and temporal trends of persistent organic pollutants in the arctic marine ecosystem. One of the most toxic congeners (variants) of toxaphene (a banned insecticide) was found in significant concentration in ringed seal blubber from Arviat (Loewen et al. 1998; Braune et al. 2005). A new chemical compound, the synthetic polycyclic musk HHCB (an artificial fragrance used in household products) has recently been reported in blubber from Labrador ringed seals. The source of the contaminant is unknown (Bidleman et al. 2001 in Braune et al. 2005).

Hobbs et al. (2002) noted a number of differences in PCB and organochlorinated pesticide concentrations among harp, hooded, grey, and harbour seals. These among-species differences may be explained by differences in migratory patterns, habitat use (including proximity to sources of industrial and agricultural pollutants), diet, and species-specific ability to eliminate the compounds (Hobbs et al. 2002).

Immune function decreased relative to increased levels of PCBs in free-ranging harbour seals in British Columbia and Washington State (Mos et al. 2006). In a study of captive harbour seals, those fed herring contaminated with PCBs were found to have impaired immune responses to viruses, which might be a contributing factor to the mass mortalities observed from morbilliviruses (Ross et al. 1996).

Information on levels of persistent organic pollutants in the walrus is limited. Pollutants are found in much higher concentrations in male walruses that feed on ringed seals than those that feed on benthic invertebrates (de March et al. 1998 in Braune et al. 2005). Organochlorine concentrations in Foxe Basin walruses were similar to those in eastern Hudson Bay walruses (excluding those that eat seals) and Pacific walruses (Braune et al. 2005).

Polar Bears

High levels of many contaminants have recently been recorded in polar bear tissues (Kucklick et al. 2002; Oskam et al. 2004; Smithwick et al. 2005; Muir et al. 2006). Polar bears generally have the highest concentrations of organochlorines reported of any arctic animal (Braune et al. 2005). The actual impact of this contamination on polar bear individuals and populations or their prey remains unclear, but studies have linked contaminant levels with possible impaired endocrine function (Skaare et al. 2001; Oskam et al. 2004), impaired immune function (Bernhoft et al. 2000; Skaare et al. 2002; Lie et al. 2005), and disruption of bone mineral composition (Sonne et al. 2004).

Overall levels for several (but not all) organochlorines have declined in female polar bear fat from 1968 to the 1990s (Braune et al. 2005). No temporal change in concentration levels was found in male polar bears from northern Baffin Bay between 1984 and 1990 (Braune et al. 2005). A significant and consistent decline in DDT concentrations has been reported in polar bears in the eastern Canadian Arctic for the period 1968 to 1984 (Braune et al. 2005). A study of perfluoroalkyl contaminants (PFC) of East Greenland however, indicated an increase in concentrations from 1984 to 2006 (Dietz et al. 2008). Dietz et al. (2008) warned that if the PFC concentrations continue to increase according to the steepest observed trends, the lowest no-adverse-effect level and lowest adverse-effect level, as detected in laboratory animals, would be exceeded in 2014 to 2024 (2035 to 2067 if using the most conservative trend). Most recently a new organohalogen, perfluorooctane sulphonate or PFOS (used in fabric protectors and anti-reflective coating) has been reported in polar bear livers from Hudson Bay (Martin et al. 2004; Braune et al. 2005).

APPENDIX 2

DATE, LOCATION, AND NUMBER OF KILOMETRES SURVEYED DURING AERIAL SURVEY FLIGHTS IN 2006, 2007, AND 2008

Table A2.1 Summary of Aerial Survey Flights in June, August, and September 2006

Month	Day	Survey	Km	Flights
June	21	Milne Inlet and Eclipse Sound	712	1
June	22	Foxe Basin	452	1
June	26	Foxe Basin	871	1
June	27	Milne Inlet and Eclipse Sound	713	1
Aug	22	Foxe Basin	733	1
Sep	23	Foxe Basin	322	1
Sep	24	Foxe Basin	1,141	1
Total			4,944	7

Table A2.2 Summary of Aerial Survey Flights in August and September 2007

Month	Day	Survey	Km	Flights
June	14	Milne Inlet	198	1
June	20	Milne Inlet	198	1
June	22	Milne Inlet	198	1
June		Steensby Inlet	486	1
Aug	29	Milne Inlet and Eclipse Sound	850	1
Aug	31	Milne Inlet and Eclipse Sound	769	1
Aug	1	Milne Inlet and Eclipse Sound	898	1
Aug	4	Milne Inlet and Eclipse Sound	520	1
Aug	7	Milne Inlet and Eclipse Sound	1,246	2
Aug	8	Milne Inlet and Eclipse Sound	554	1
Aug	10	Milne Inlet and Eclipse Sound	811	1
Aug	12	Milne Inlet and Eclipse Sound	801	1
Aug	30	Milne Inlet and Eclipse Sound	785	1
Aug	31	Milne Inlet and Eclipse Sound	686	1
Sep	1	Milne Inlet and Eclipse Sound	548	1
Sep	3	Milne Inlet and Eclipse Sound	467	1
Sep	8	Milne Inlet and Eclipse Sound	891	1
Sep	9	Milne Inlet and Eclipse Sound	1,276	2
Sep	10	Milne Inlet and Eclipse Sound	875	1
Sep	12	Foxe Basin and Hudson Strait	1,934	2
Sep	13	Milne Inlet and Eclipse Sound	893	1
Sep	14	Milne Inlet and Eclipse Sound	607	1
Sep	15	Milne Inlet and Eclipse Sound	835	1
Sep	17	Milne Inlet and Eclipse Sound	905	1
Sep	18	Milne Inlet and Eclipse Sound	917	1
Sep	20	Foxe Basin and Hudson Strait	1,572	2
Total			19,641	26

APPENDIX 4

MARINE MAMMAL SIGHTINGS AND AERIAL SURVEY TRACKLINES FROM INDIVIDUAL SURVEYS IN MILNE INLET, 2007 AND 2008

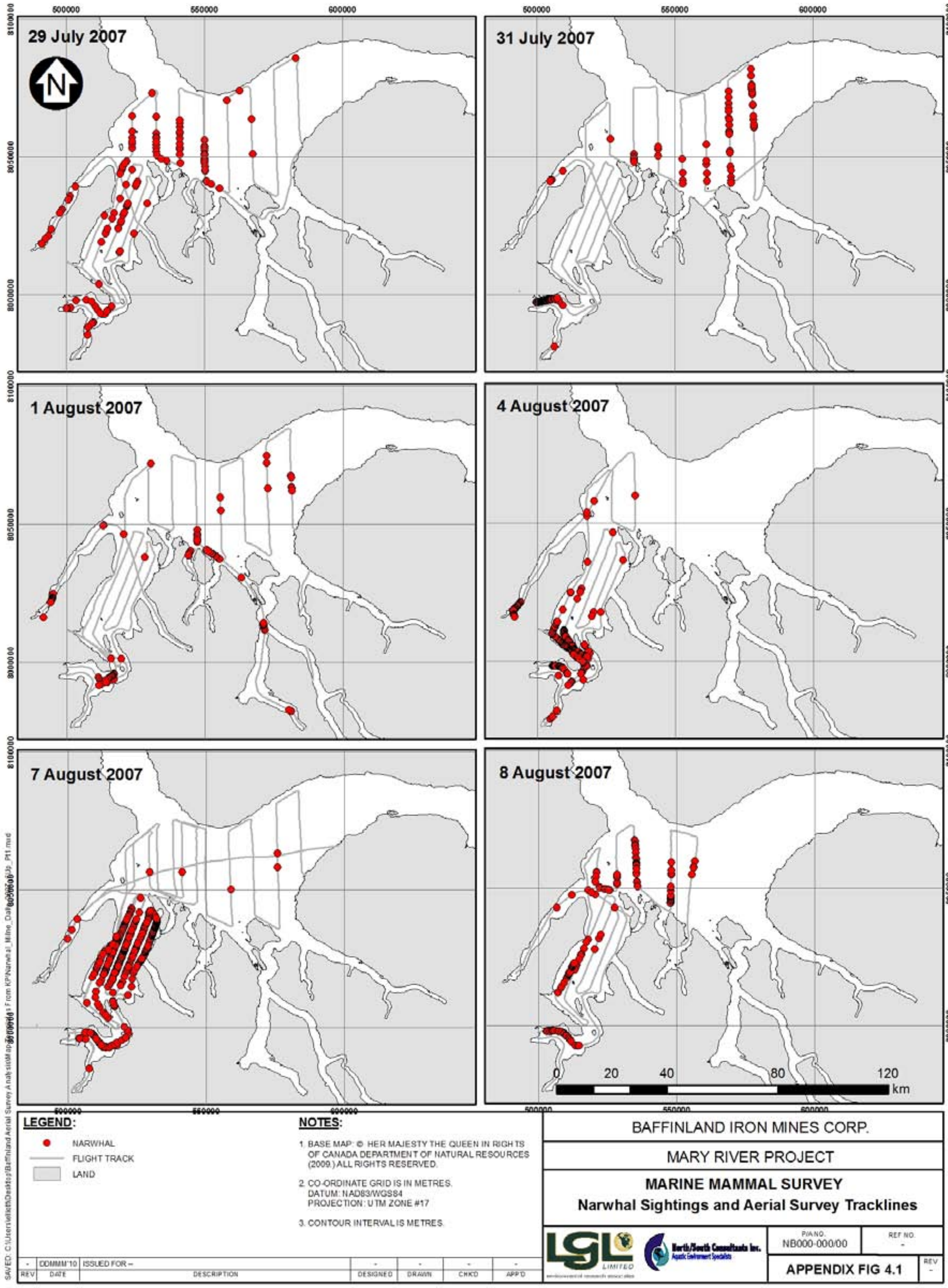

Figure A4.1 Narwhal Sightings and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2007

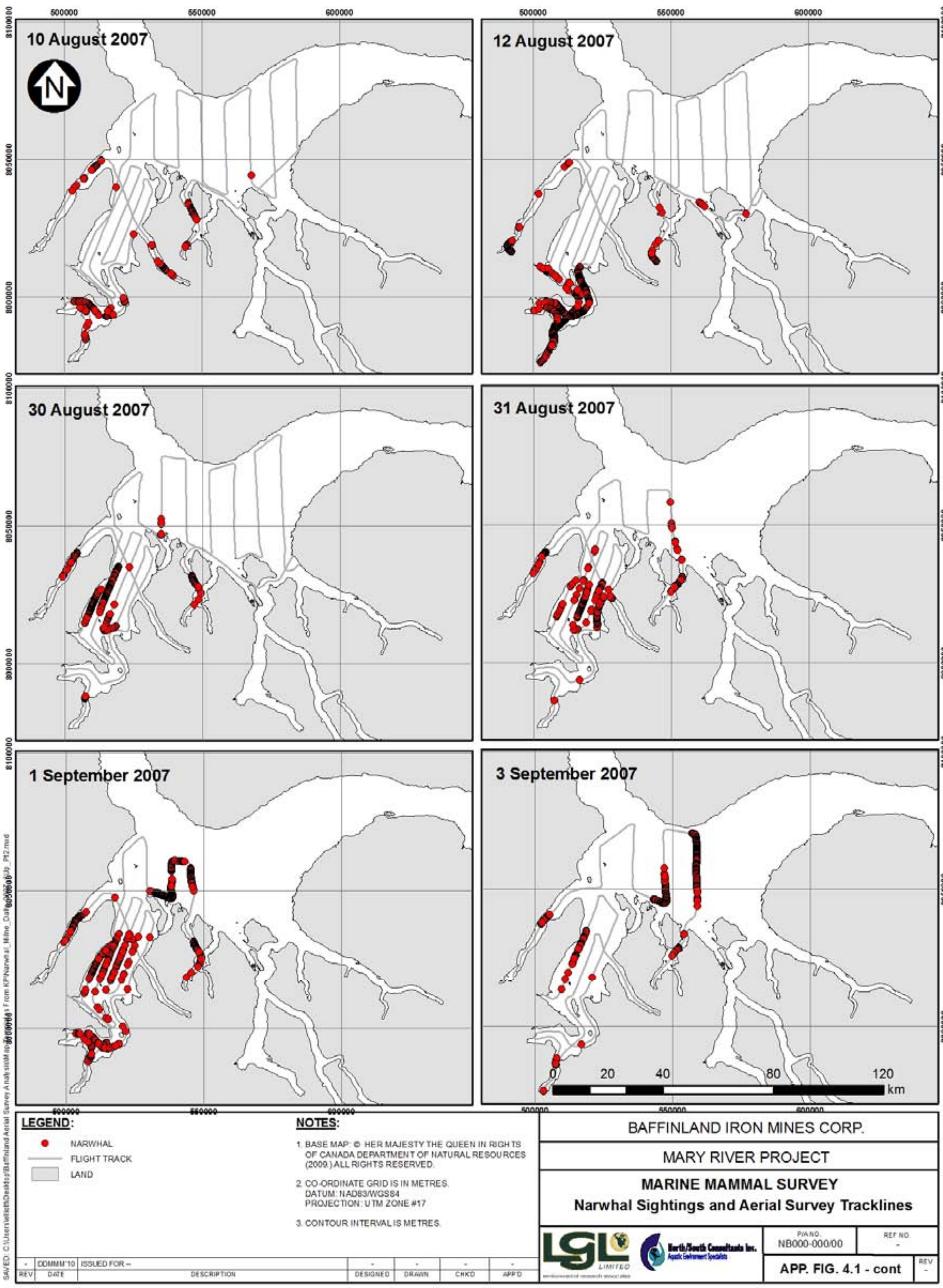

Figure A4.1 Narwhal Sightings and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2007 (cont'd)

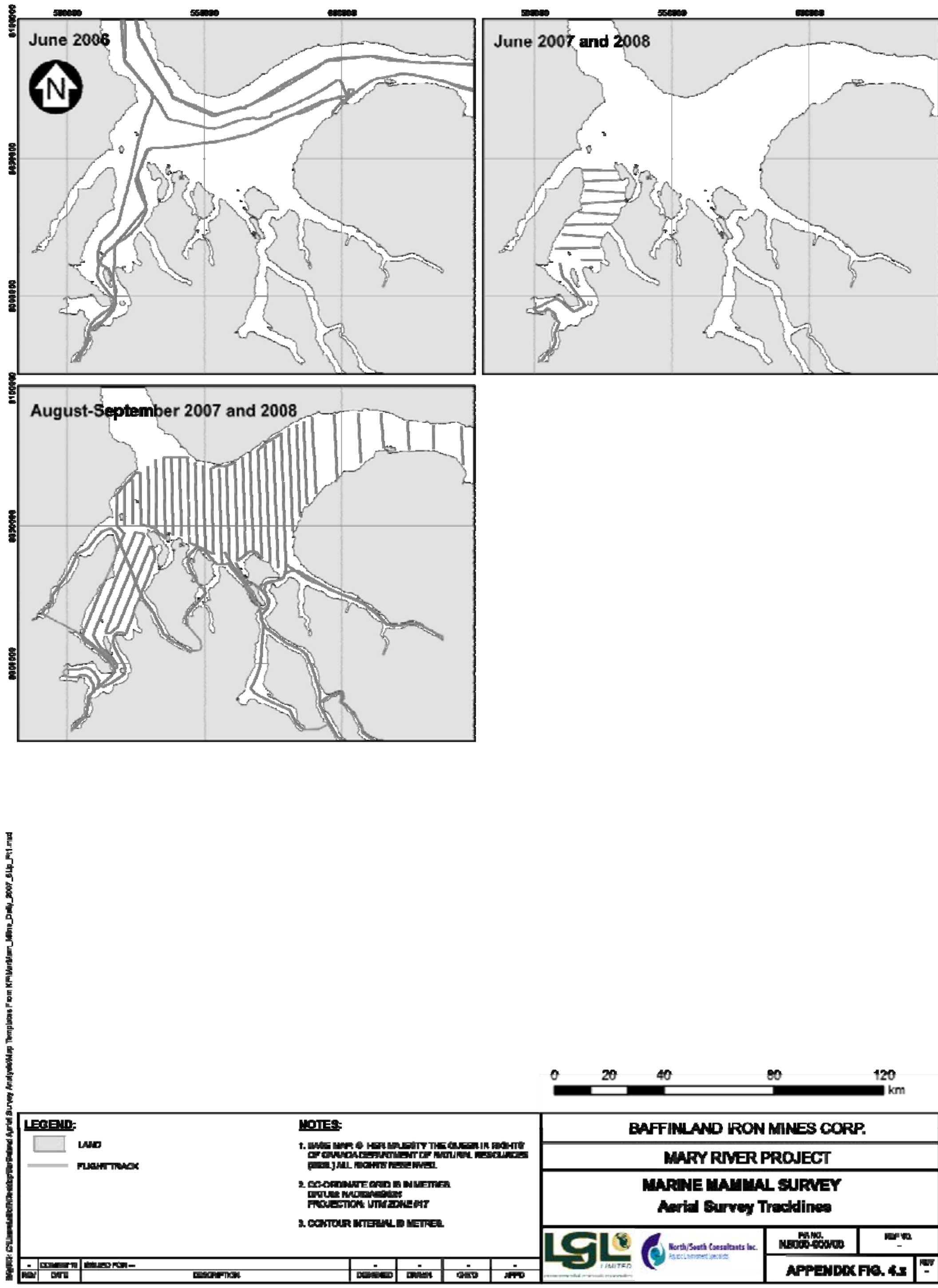

Figure A3.1 Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2006, 2007 and 2008

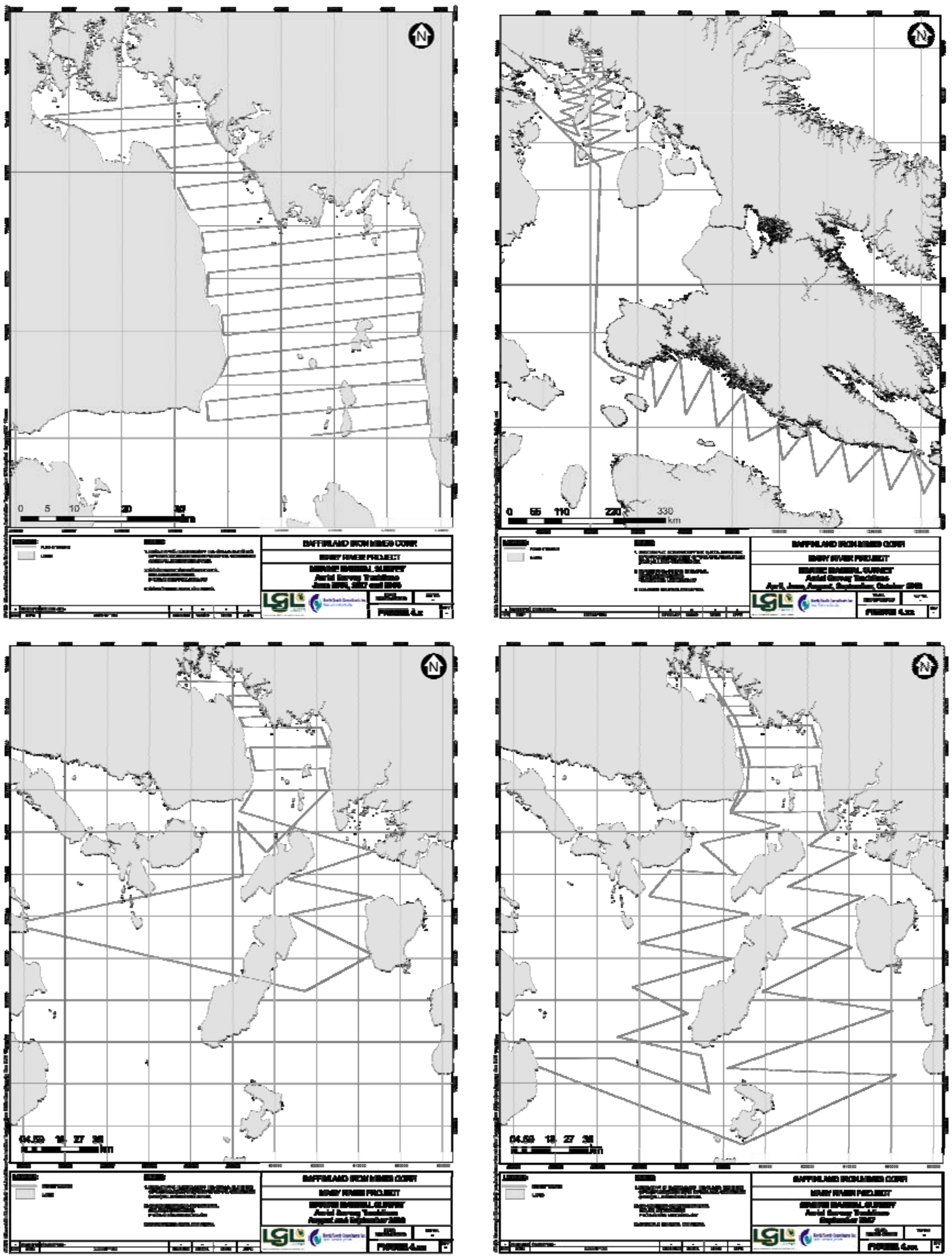

Figure A3.2 Aerial Survey Tracklines in Steensby Inlet, Foxe Basin and Hudson Strait, 2006, 2007 and 2008.

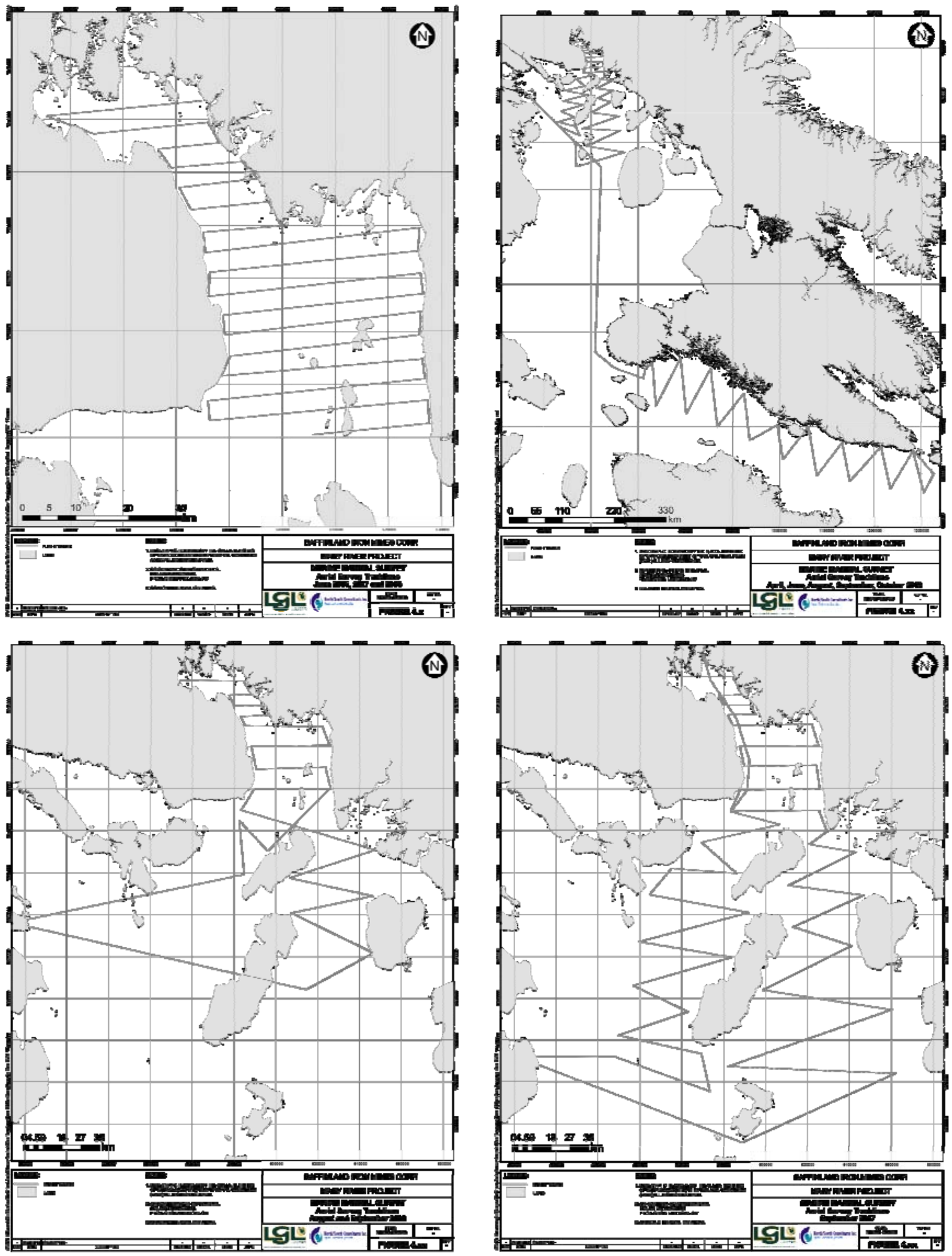

Figure A3.2 Aerial Survey Tracklines in Steensby Inlet, Foxe Basin and Hudson Strait, 2006, 2007 and 2008.

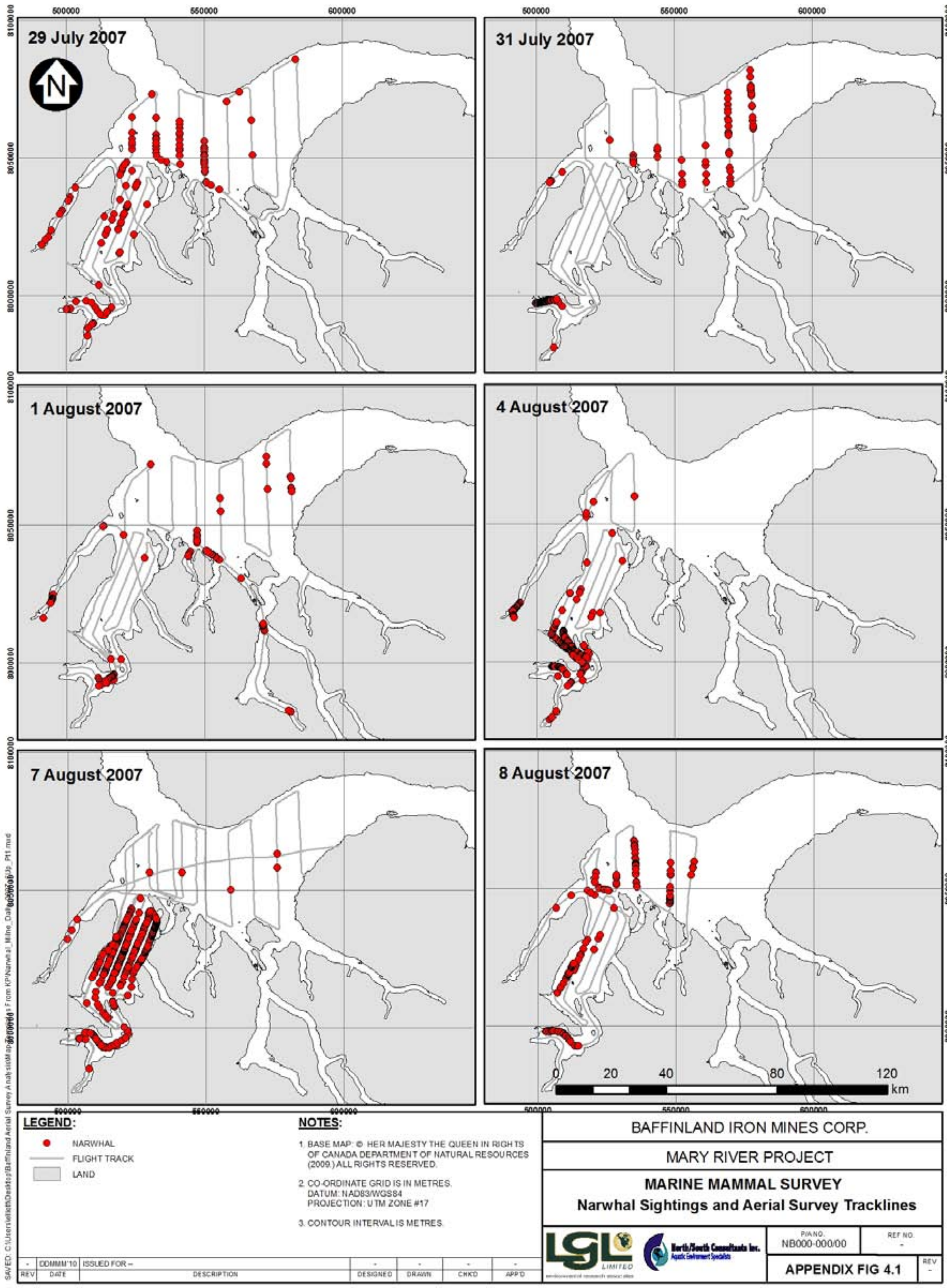

Figure A4.1 Narwhal Sightings and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2007

APPENDIX 3

RINGED SEAL AND MARINE MAMMAL AERIAL SURVEY TRACKLINES 2006, 2007, AND 2008

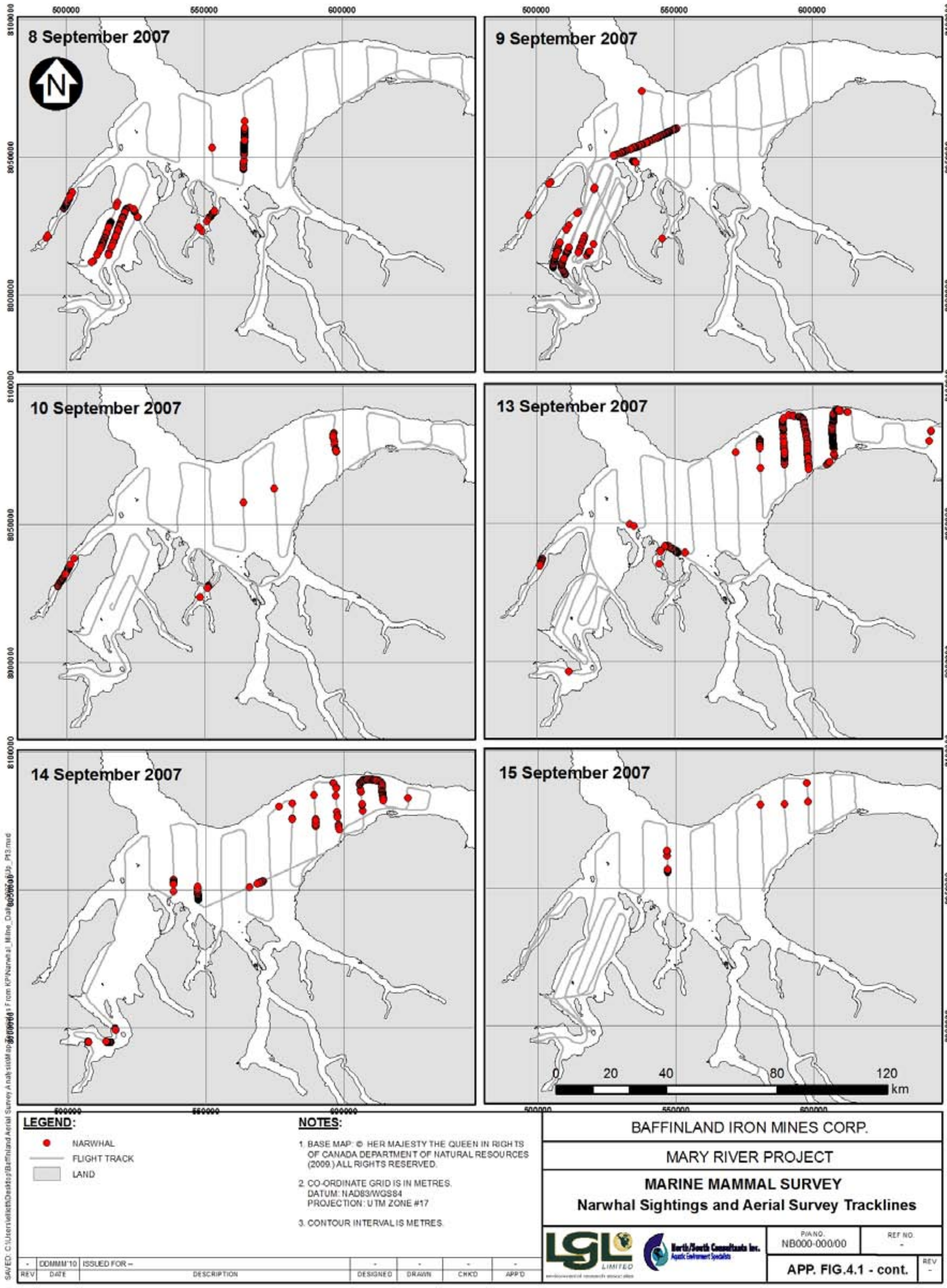

Figure A4.1 Narwhal Sightings and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2007 (cont'd)

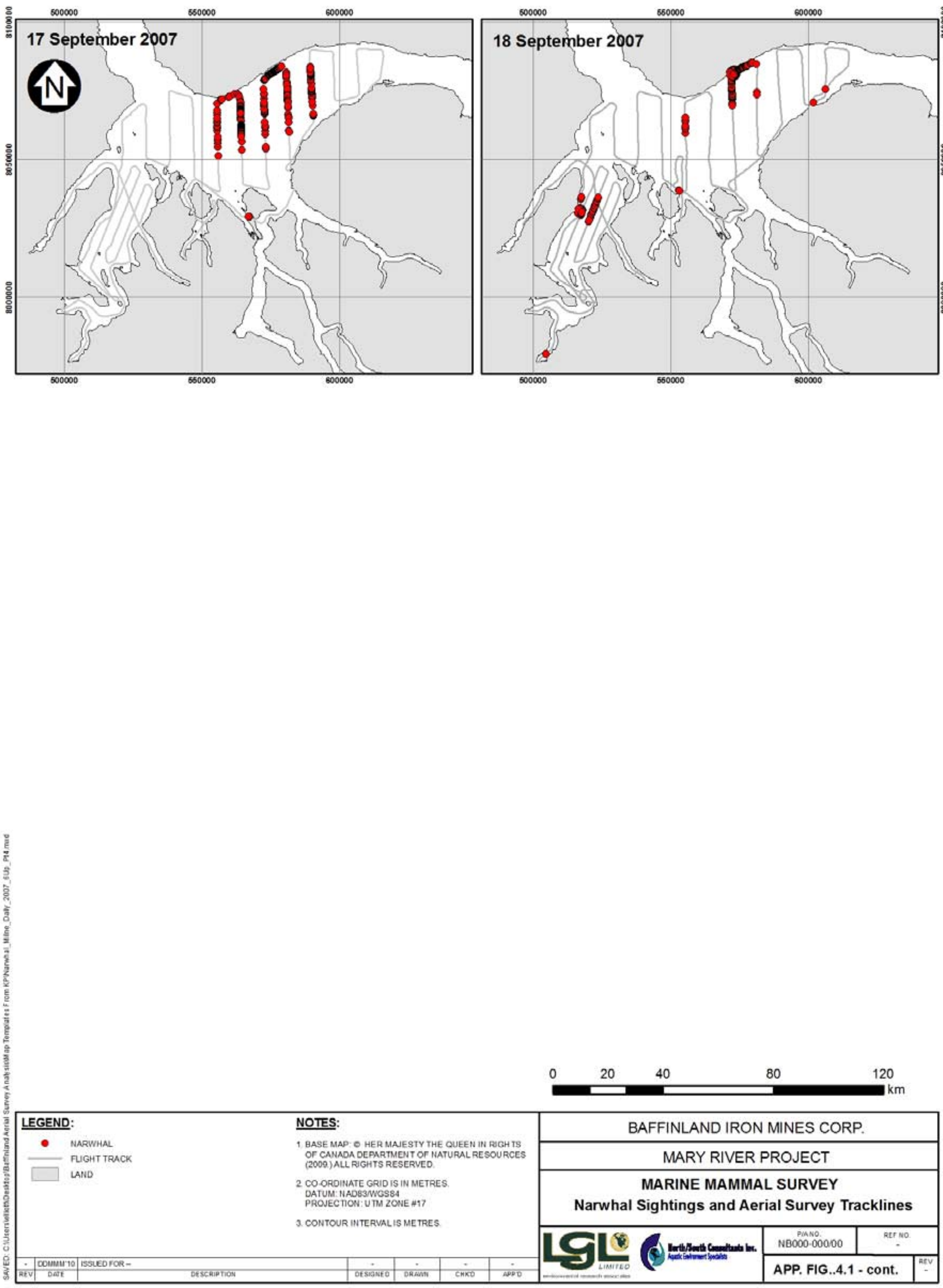

Figure A4.1 Narwhal Sightings and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2007 (cont'd)

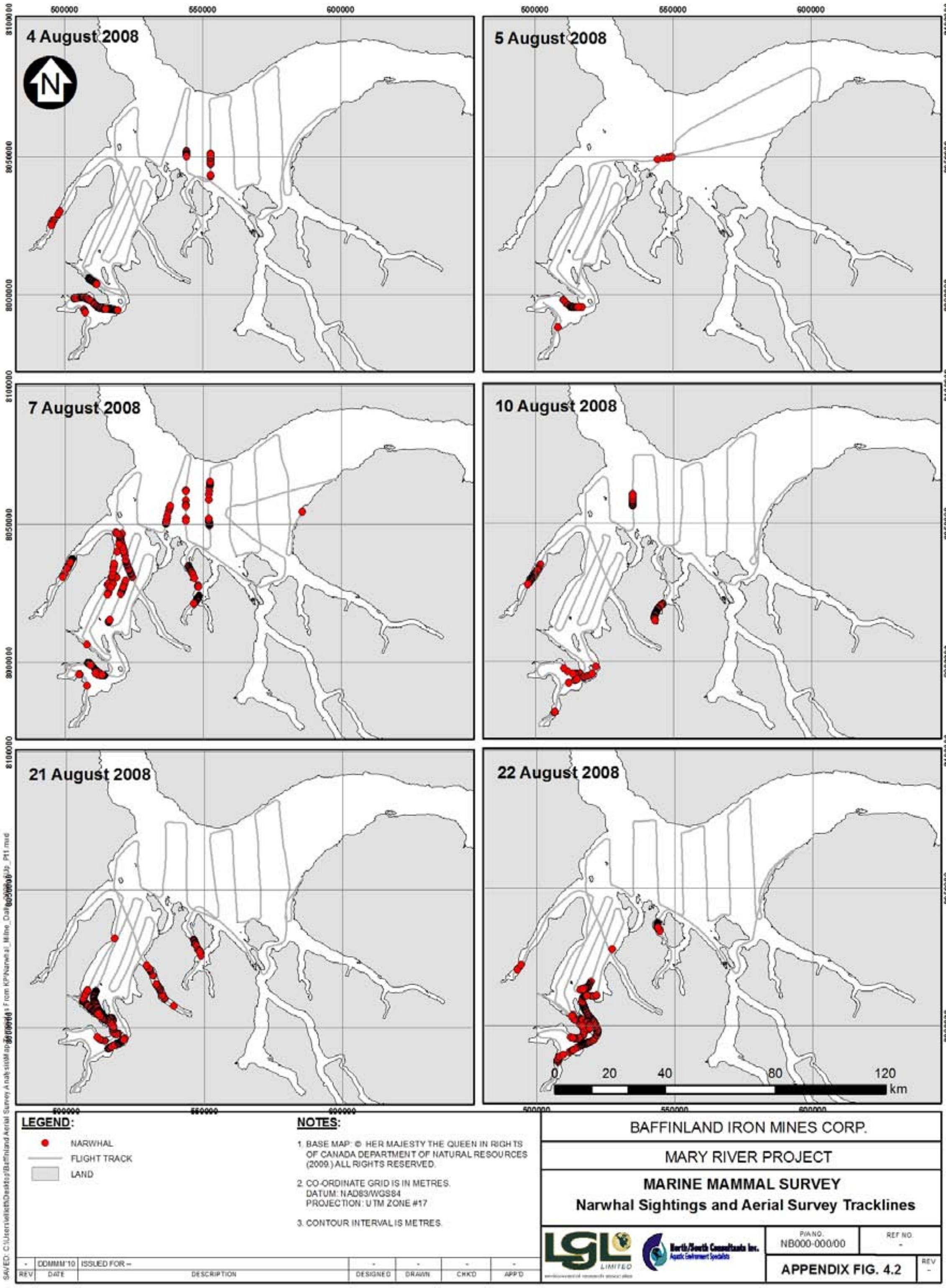

Figure A4.2 Narwhal Sightings and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2008

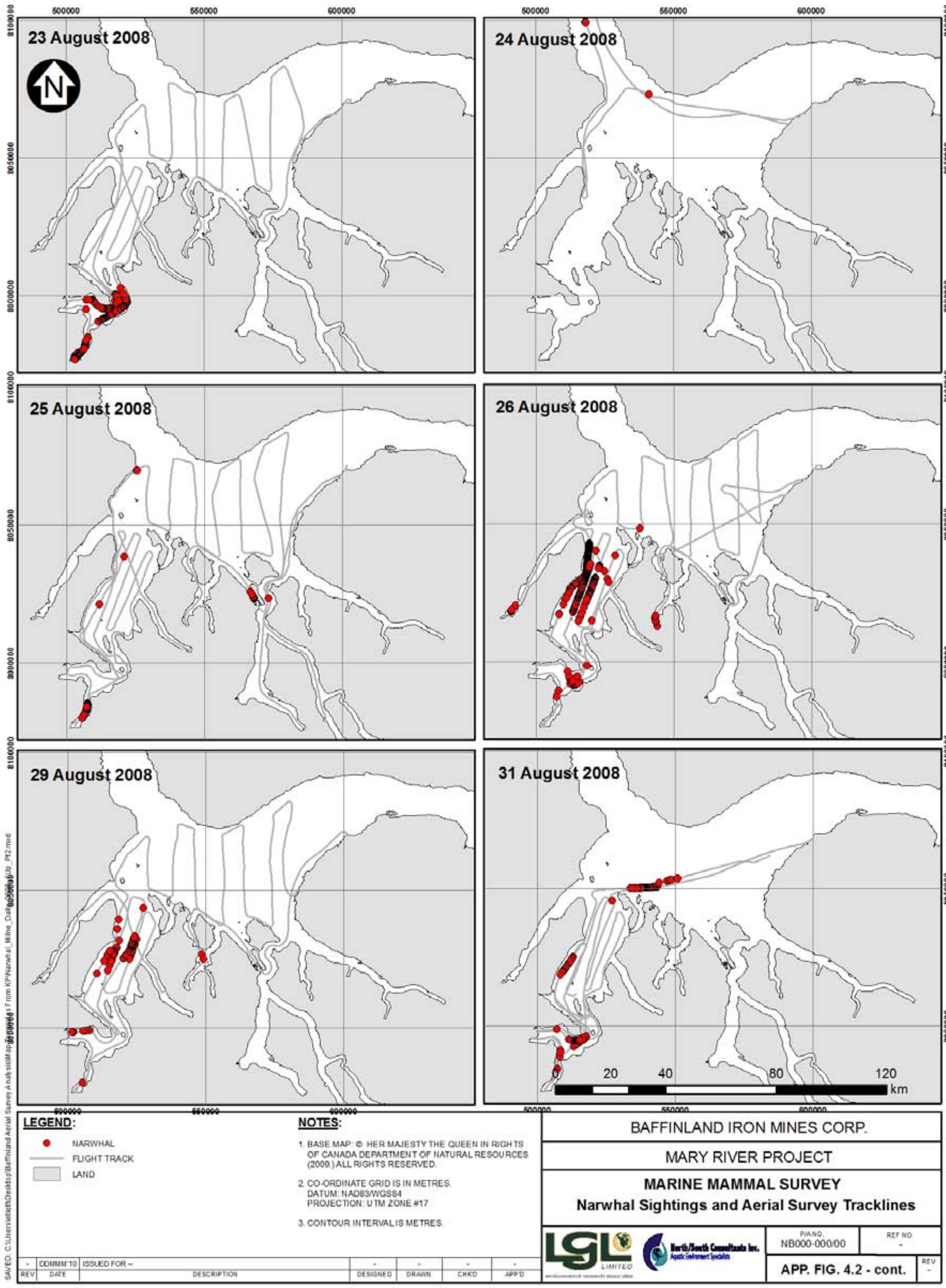

Figure A4.2 Narwhal Sightings and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2008 (cont'd)

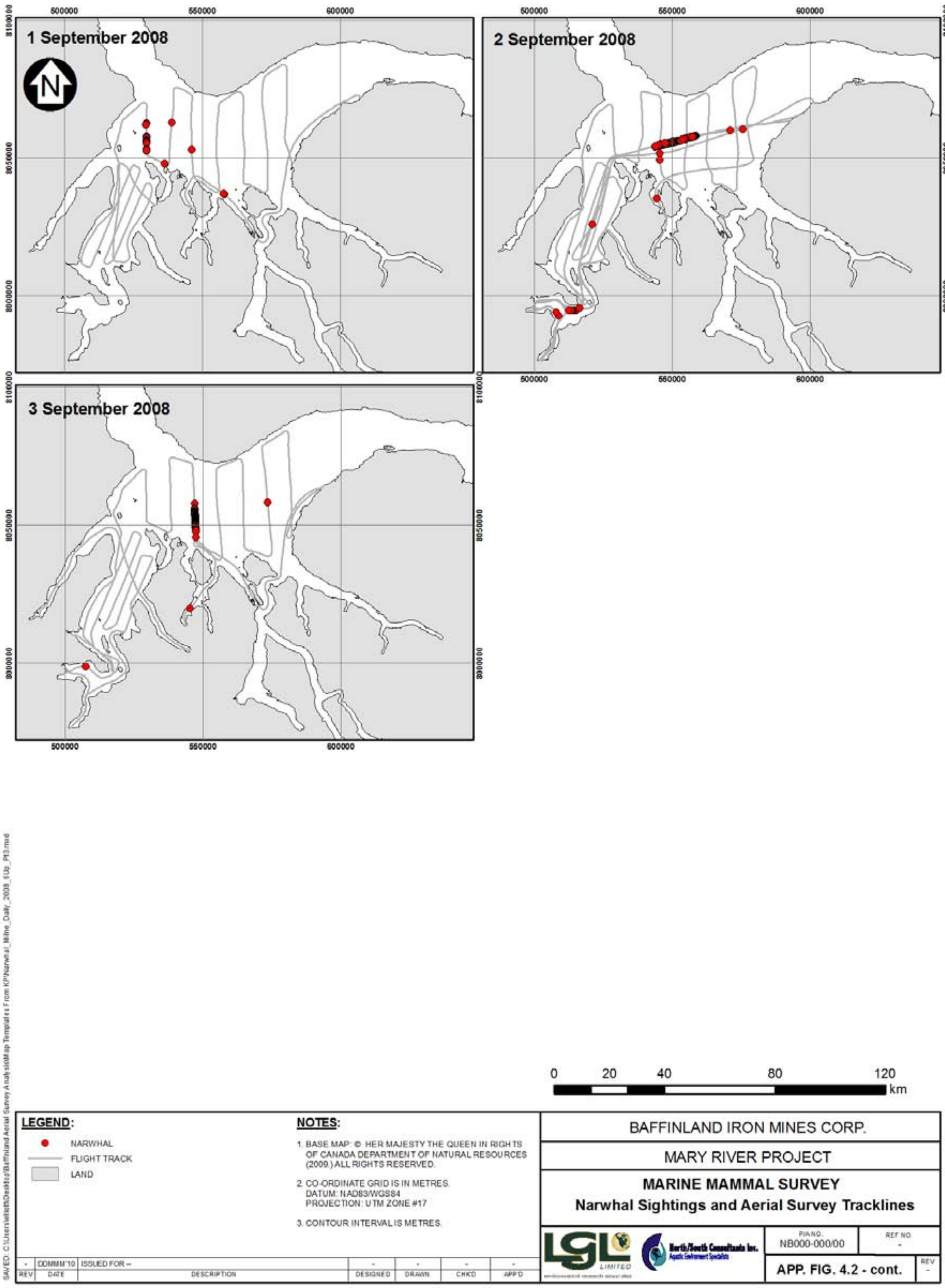

Figure A4.2 Narwhal Sightings and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2008 (cont'd)

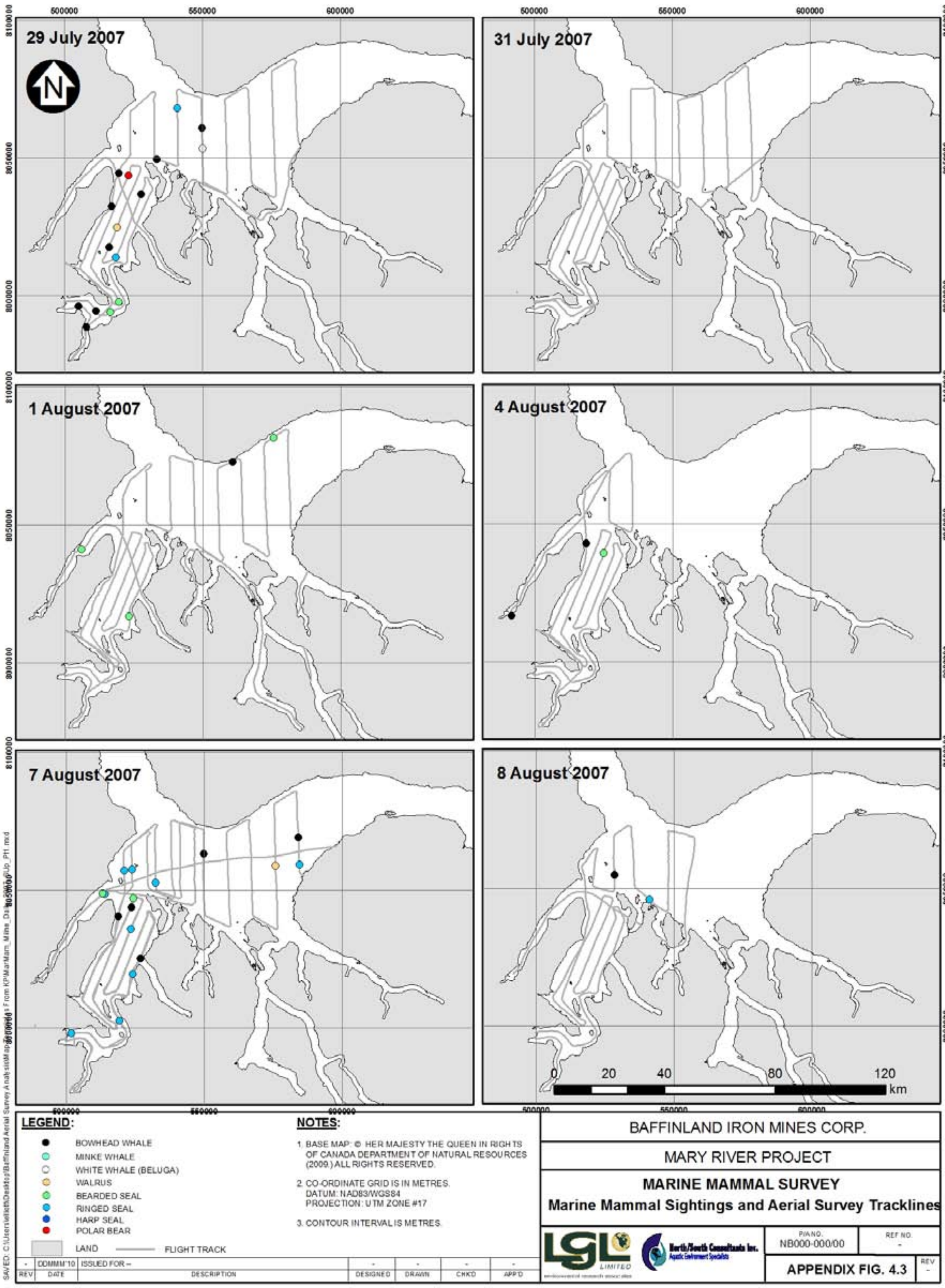

Figure A4.3 Marine Mammal Sightings (Narwhal Excluded) and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2007

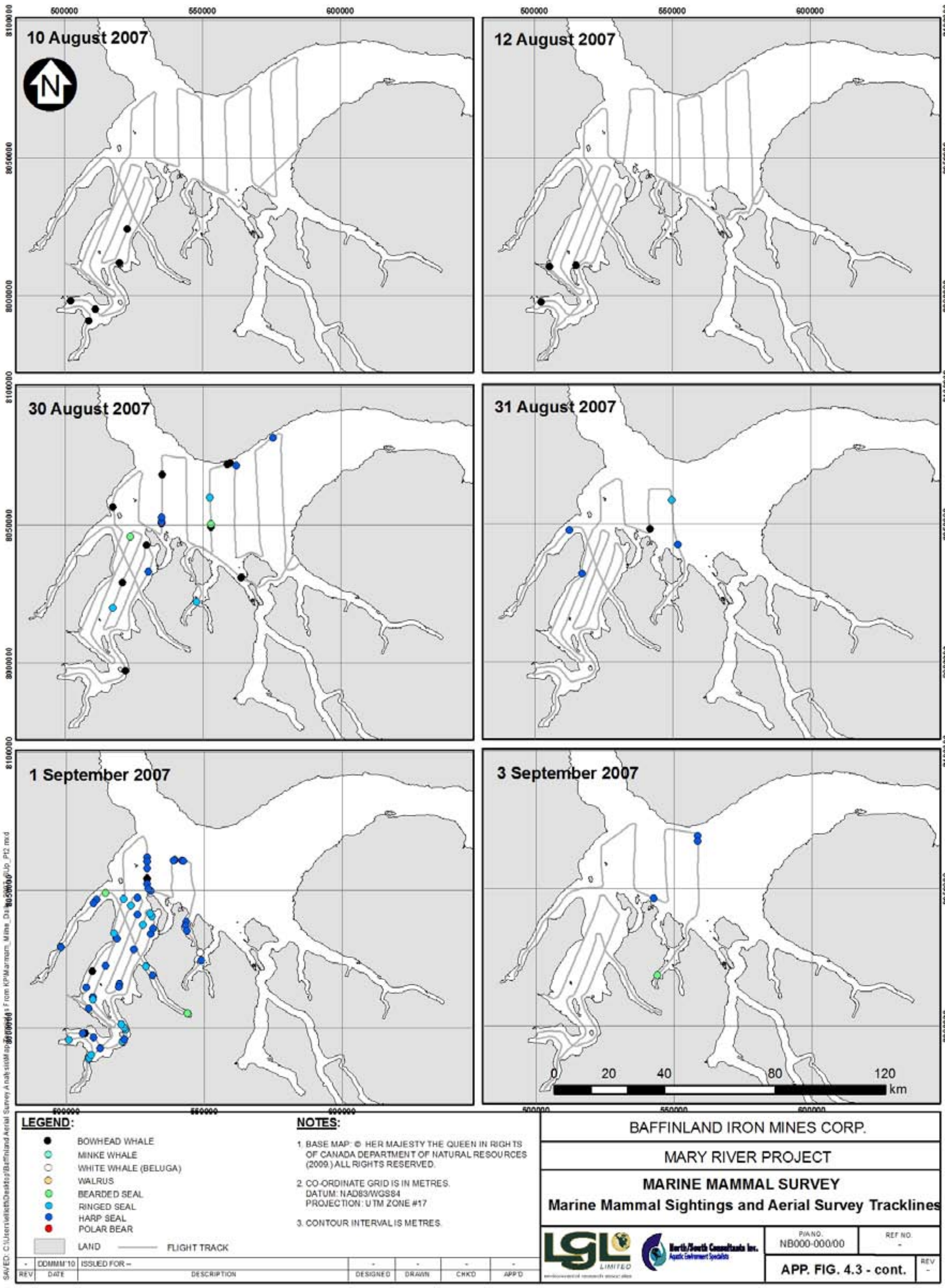

Figure A4.3. Marine Mammal Sightings (Narwhal Excluded) and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2007 (cont'd)

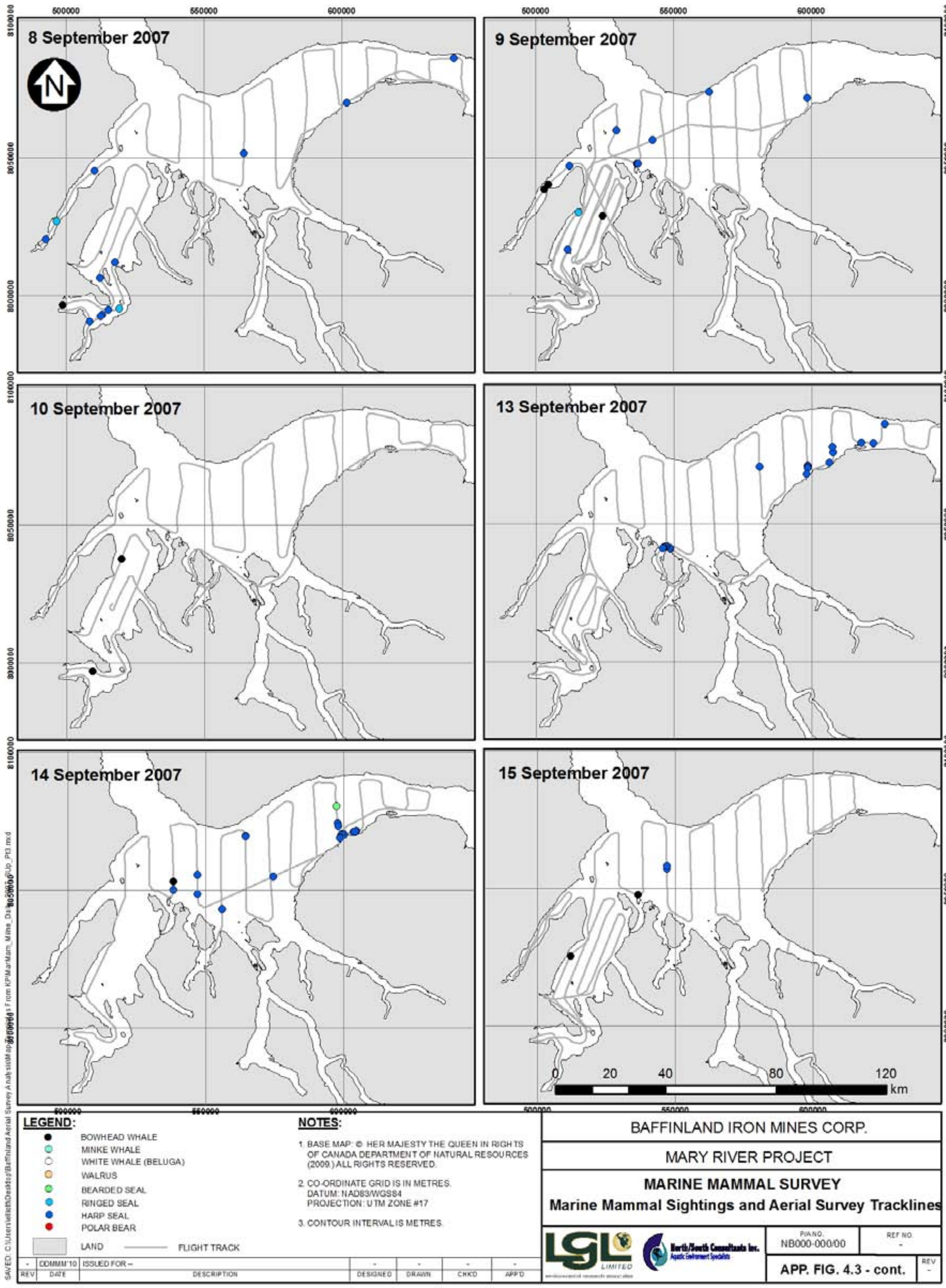

Figure A4.3. Marine Mammal Sightings (Narwhal Excluded) and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2007 (cont'd)

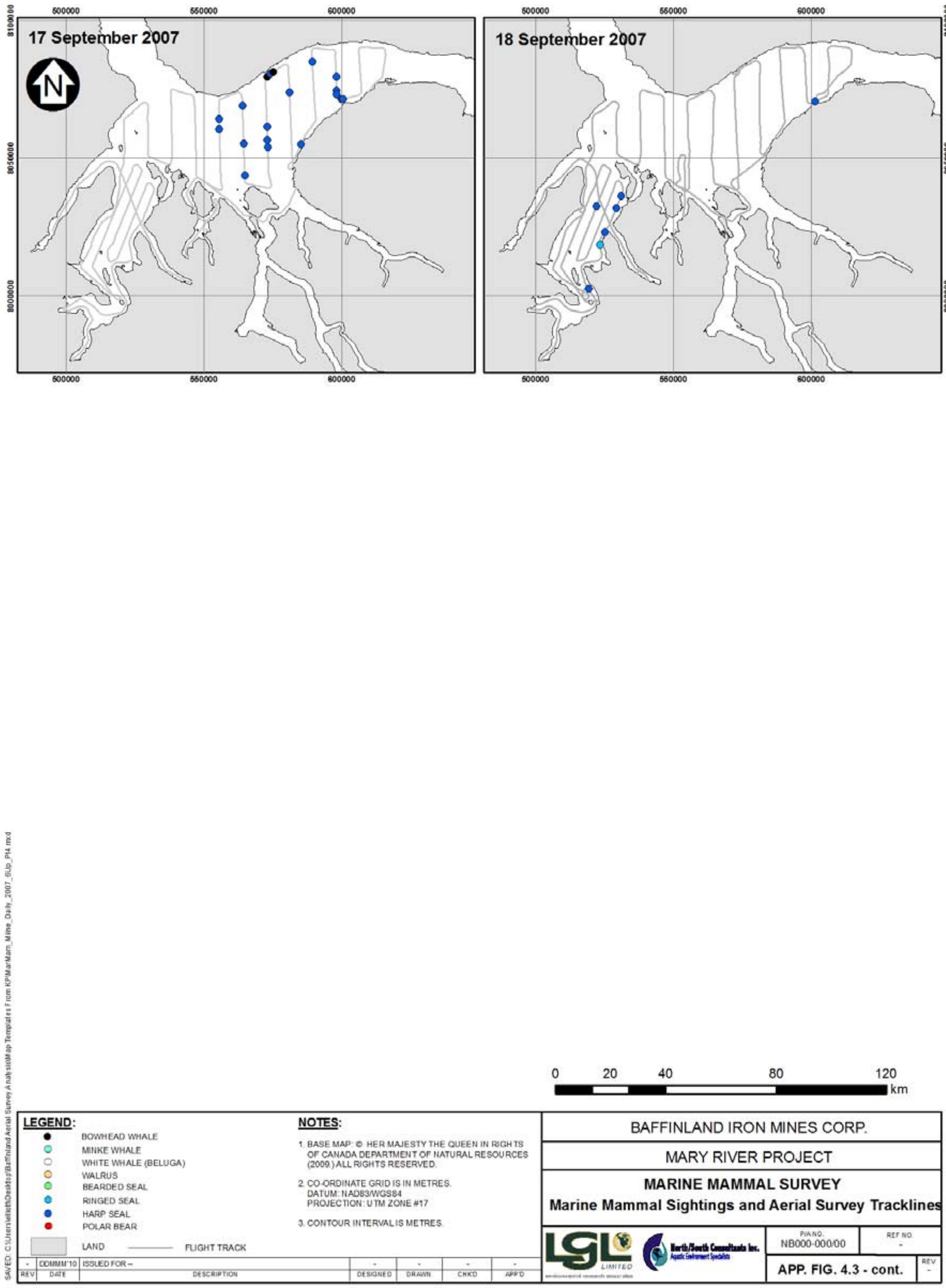

Figure A4.3. Marine Mammal Sightings (Narwhal Excluded) and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2007 (cont'd)

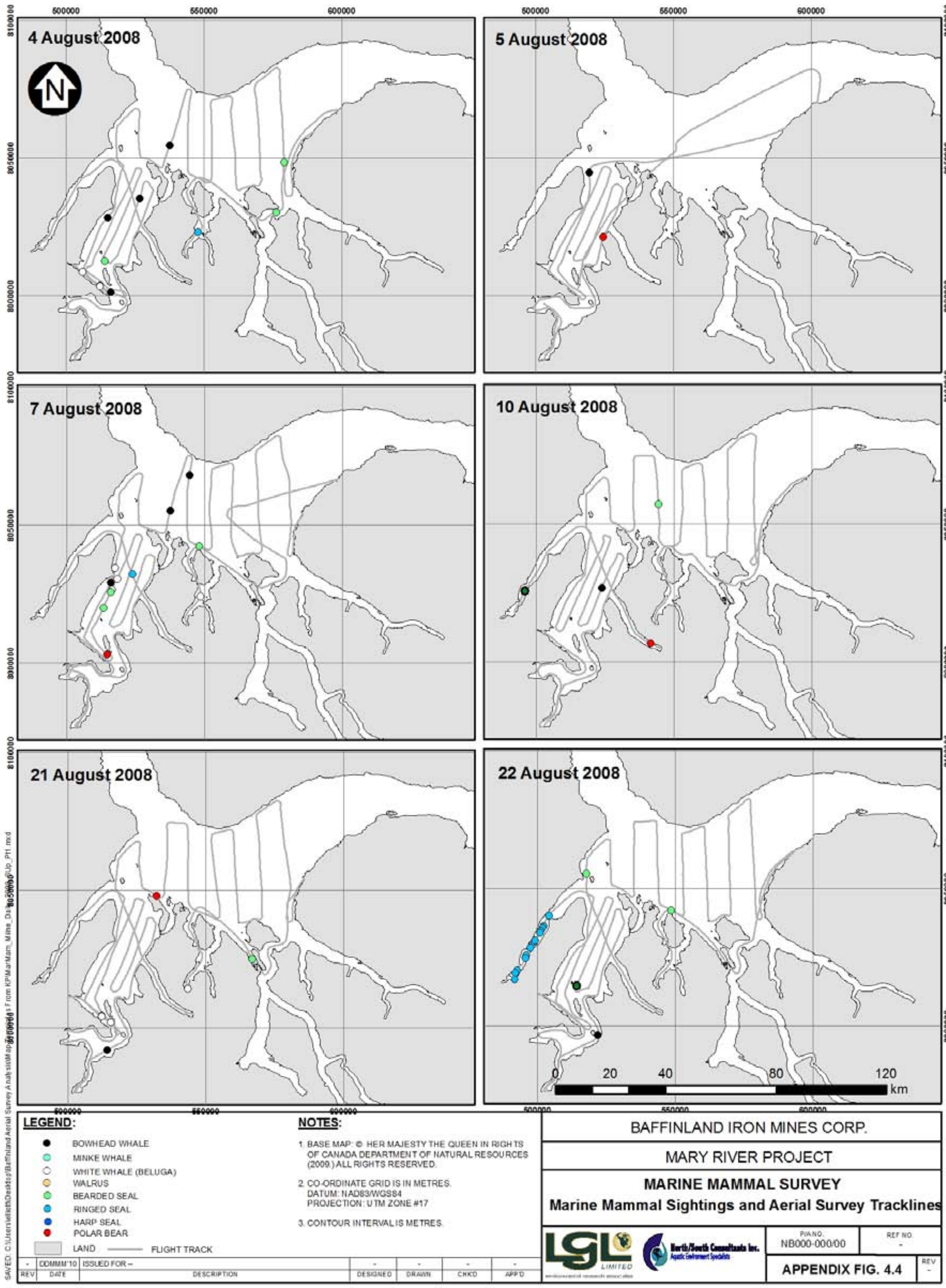

Figure A4.4. Marine Mammal Sightings (Narwhal Excluded) and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2008

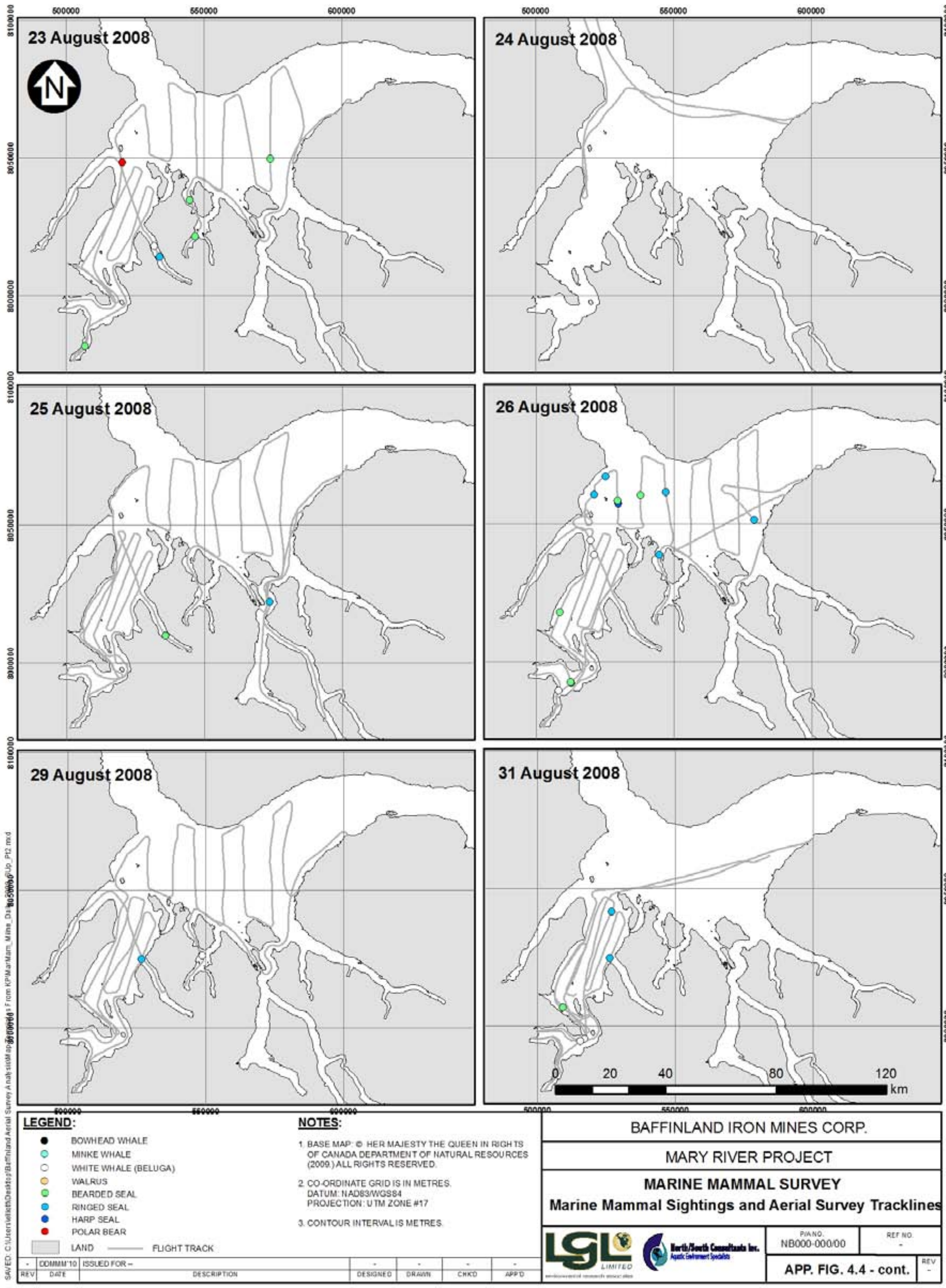

Figure A4.4. Marine Mammal Sightings (Narwhal Excluded) and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2008 (cont'd)

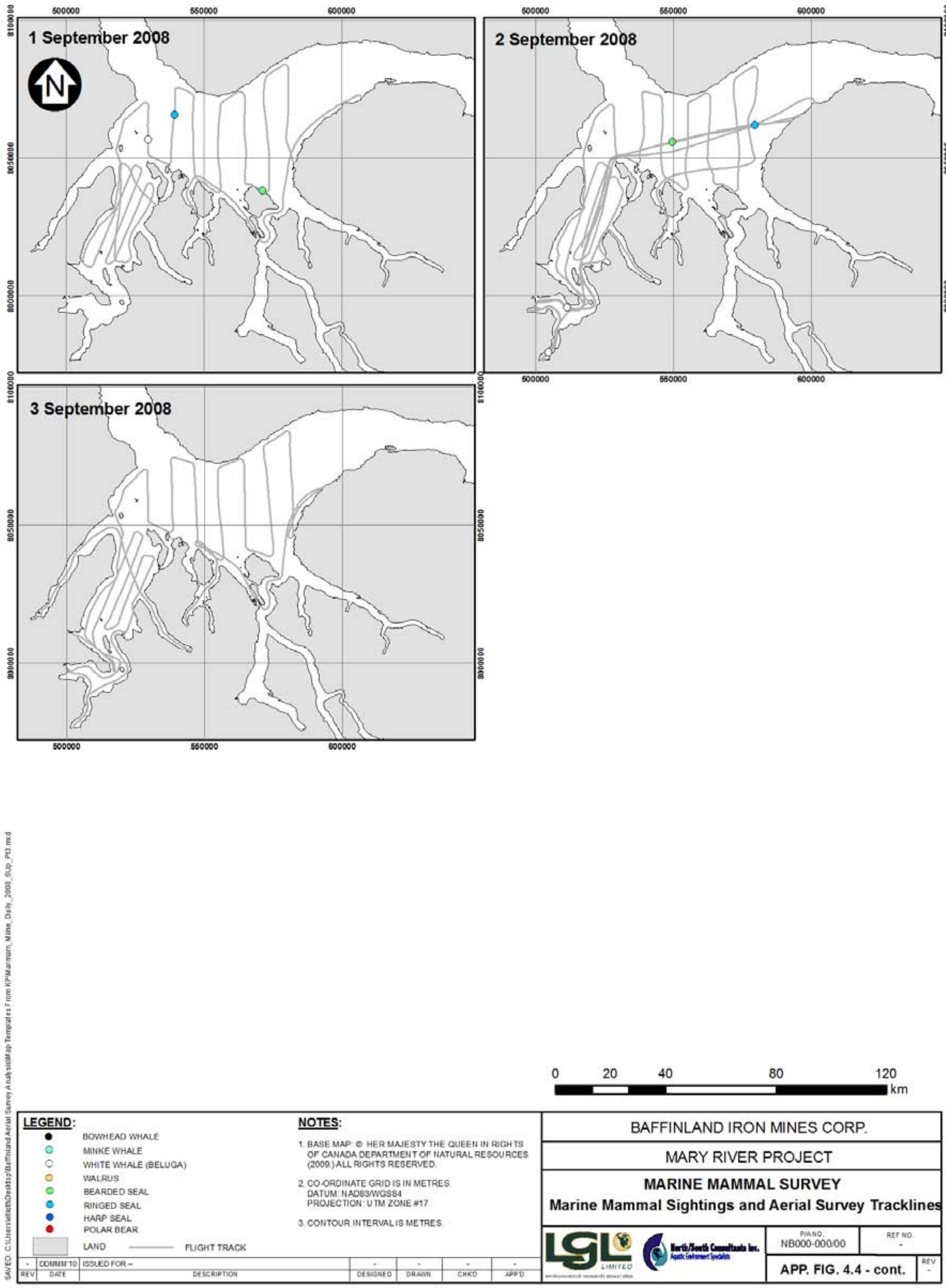

Figure A4.4. Marine Mammal Sightings (Narwhal Excluded) and Aerial Survey Tracklines in Eclipse Sound and Milne Inlet, 2008 (cont'd)