Bathurst Inlet Port and Road Project

Baseline Marine Mammal Studies, June–July 2007

prepared by

William E. Cross and Ted Elliott

LGL Limited, environmental research associates
22 Fisher St., POB 280
King City, ON L7B 1A6

for

Bathurst Inlet Port and Road Joint Venture
340 Park Place, 666 Burrard Street
Vancouver, BC V6C 2X8

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1. Introduction

1.1 Background

The proposed Bathurst Inlet Port and Road (BIPR) Project consists of a port on Bathurst Inlet connected to mines and mineral deposits in Nunavut and Northwest Territories by a new, 211-km, all-weather road to Contwoyto Lake, and the existing “Tibbitt to Contwoyto” winter road. The port site will include a wharf to serve large ice-class vessels delivering fuel and bulk cargo to the port; a dock to handle barges serving the Kitikmeot communities of Kugluktuk, Bathurst Inlet, Cambridge Bay, Umingmaktok, Gjoa Haven, and Taloyoak; a 150-person camp and services; a 180 million-L diesel fuel tank farm; a truck and trailer maintenance shop; and a 1200-m airstrip. Noise, other disturbance, habitat alteration, and various types of discharges from project activities at the port and elsewhere along the shipping route during the construction and operations phases may disturb marine mammals. In winter and spring, ringed seals and probably some bearded seals are expected to occur in Bathurst Inlet near the proposed port. In summer, belugas and some pinnipeds may occur near the port.

1.2 Objectives

This baseline report presents and reviews background information on abundance, distribution, movement patterns, and natural history of marine mammals occurring in Bathurst Inlet during spring. The report also includes the results of original field surveys conducted for this project during June–July 2007.

2. Methods

The spring seal surveys were conducted from a fixed wing aircraft during 27 June–1 July 2007. Strip transect methodology was used, generally following the methods of Frost and Lowry (1988) and Moulton et al. (2002a). That methodology has been standard for previous aerial surveys of ringed seals in Alaska.

2.1 Survey Design

The baseline surveys of the seal population that may be affected by the BIPR Project were designed to:

- coincide with the peak period of seal haul-out during the spring,
- cover not only the immediate area of the proposed dock location but also an area beyond, where seals may be influenced by noise and other disturbance effects, and
- sample the seal population quantitatively in a manner that would be repeatable.

Surveys covered an area that extended from the extreme south of Bathurst Inlet north to a line from the southwest tip of the Kent Peninsula to Cape Barrow, at ~68.1°N (Fig. 1). Coverage of the southern portion of Bathurst Inlet, from the extreme south, ~25 km south of the proposed dock site, to ~67.4°N, ~100 km north of the proposed dock site, was repeated on the first and last days. Transects generally were oriented north-south but also east-west in some channels between the islands in Bathurst
Figure 1. Bathurst Inlet, showing locations named in text and transect lines flown during 27 June–1 July 2007.
Inlet. The total length of all transects was 3585 km, and the total area surveyed was ~2823 km². Adjacent lines were ~2.8 km apart.

### 2.2 Survey Procedures

The surveys were flown in a single-engine, high-wing aircraft (DeHavilland Beaver) at an altitude of 91 m (300 ft) above sea level and at a ground speed of 130–157 km/h (70–85 knots). The survey aircraft and two pilots were provided by Bakers Narrows Air Service of Flin Flon, Manitoba. There were bubble windows on the passenger doors of the aircraft.

Three observers were on the aircraft—two LGL biologists and an Inuit observer who was trained by the LGL biologists. The two LGL biologists (primary observers) sat on opposite sides of the aircraft, two seats behind the pilot (left side) and co-pilot (right side), respectively. The Inuit observer sat on the right side of the aircraft, one seat behind the LGL observer on that side.

We surveyed transect strips ~410 m wide on each side of the aircraft. These strips extended ~135 m–545 m from the centerline. Strip boundaries were marked on the aircraft’s windows with tape at the appropriate inclinometer angles, which were 9.5º and 34º below the horizontal for surveys at 91-m altitude. Sightings of seals inside 135 m or beyond 545 m were recorded as off-transect sightings. For consistency with previous ringed seal surveys, we have not attempted to adjust the strip boundaries or calculated densities to take account of the “earth curvature” corrections described by Lerczak and Hobbs (1998). The transect width used in the BIPR surveys likely is underestimated, but the error associated with inclinometer angles >5º is negligible.

The surveys were usually flown during mid-day, when numbers of seals hauled out on the ice were expected to be highest.

### 2.3 Data Recording Procedures

Data on wildlife sightings and environmental variables were recorded by each observer. The position of the aircraft was recorded by a data-logging system.

For each seal sighting, the observer dictated onto audio tape the time of the sighting to the nearest second, and the species, number of individuals, habitat (hole or crack), and behaviour (look, move, dive, or none) of the seal(s), and noted whether the sighting was on or off transect. Similar data were recorded for other wildlife sightings. Beginning on 28 June, unoccupied seal holes were recorded also. The specific times of sightings were used to extract their locations subsequently from the GPS data log files (see below).

The two primary observers also recorded the visibility (nautical miles), ice cover (%), ice deformation (%), melt water (%), sun glare (none, moderate, or severe), and overall sightability conditions (ranging from “excellent” to “impossible”, and incorporating glare, fog, and precipitation). Those observations, along with the time, were recorded onto audio tape at the end of each 1-min (2.1–2.6-km) time period, and were the estimated average values of each variable during the preceding 1-min interval. An electronic timer signaled the observers at 1-min intervals. Estimated percentage values were categorized by intervals of 10%. Ice cover, ice deformation, and melt water variables applied to the conditions on transect only. Ice deformation was the estimated percent of the on-transect ice surface surveyed during the preceding minute that was deformed rather than smooth ice. Cracks and leads in the
ice were also noted by the observers at the specific times when seen, allowing their locations to be extracted subsequently from the data log files. Cloud cover (in tenths), wind speed (knots), wind direction (°T), and air temperature (°C) were recorded (with the assistance of the pilots) at least once during each survey flight. Wind data were acquired from the aircraft’s GPS, and air temperature from a thermometer mounted externally on the aircraft.

The data logging system consisted of two GPS units (Garmin Model eTrex Vista and Garmin GPSMap CS). The GPS receivers were positioned on the dashboard of the aircraft. Both GPS receivers were set to log aircraft position every 5 seconds, storing it in the unit's onboard memory. The pilots did not have a GPS moving map display, so they were given maps and longitude coordinates for the north-south transect lines and they followed those as best they could while maintaining the target survey speed and altitude.

2.4 Data Analysis Procedures

The location of each seal (and other wildlife) sighting was determined by matching the time of the sighting with the position recorded for that time in the GPS logs. Time periods with severely impaired sightability conditions were excluded from all analyses. Each sighting was also linked to the environmental variables recorded for the corresponding 1-min (2.1–2.6-km) time period.

2.5 Survey Effort

A summary of survey effort is presented in Table 1. Surveys were flown on each of the five days between 27 June and 1 July. Total survey effort comprised 25.1 hours and 3585 km.

<table>
<thead>
<tr>
<th>Date</th>
<th>Survey Period</th>
<th>Survey Effort</th>
<th>Average Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Date</td>
<td>Start Finish</td>
<td>Time (h)</td>
</tr>
<tr>
<td>27 June</td>
<td>11:25 – 15:43</td>
<td>4.3</td>
<td>676.3</td>
</tr>
<tr>
<td>28 June</td>
<td>10:31 – 15:22</td>
<td>4.8</td>
<td>678.5</td>
</tr>
<tr>
<td>29 June</td>
<td>10:26 – 16:00</td>
<td>5.6</td>
<td>797.0</td>
</tr>
<tr>
<td>30 June</td>
<td>10:07 – 16:16</td>
<td>5.8</td>
<td>752.7</td>
</tr>
<tr>
<td>1 July</td>
<td>10:23 – 14:59</td>
<td>4.6</td>
<td>680.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3585.0</td>
</tr>
</tbody>
</table>

3. Results and Discussion

3.1 Bathymetry and Ice Cover

At the mouth of Bathurst Inlet, water depth is up to 200 m, with a few small basins >250 m deep. Depths are <20 m throughout the southern half of the inlet (south of the Barry Islands), among the Barry Islands, and generally within ~1 km of the shoreline in the northern half. The entire survey area was covered by landfast ice, and there was no pack ice offshore. There were varying degrees of ice deformation (rough vs. smooth) and amounts of melt water on top of the ice surface. Several small cracks in the ice were interspersed throughout the survey area.
Ice break up was not far advanced even at the end of the survey (1 July 2007). Rivers were completely ice free, open water was present around the mouths of the larger rivers and in several narrow channels between islands, and turbid river floodwater had covered large areas of near-shore ice near the mouths of the rivers.

The results of the review of the literature and the June–July 2007 surveys are presented below for the two species that were encountered.

3.2 Ringed Seal (Pusa hispida)

3.2.1 Range and Population Status

Ringed seals have a continuous northern circumpolar distribution. In Canada, their distribution is centred in the Arctic Archipelago, but they range from Newfoundland to the Beaufort Sea. Canadian populations are considered “Not at Risk” by COSEWIC (2006).

Ringed seals are the most abundant marine mammal in the Canadian Arctic, but accurate population estimates are difficult to obtain. Canadian researchers have estimated the numbers of visible seals hauled out on the ice in spring; but those estimates may substantially underestimate the actual size of the populations. Some of the estimates are: (1) at least 40,000 ringed seals in the Canadian Beaufort Sea (Stirling et al. 1981); (2) 50,000 in northern Amundsen Gulf (Kingsley 1990); (3) 49,000 in Prince Albert Sound (Kingsley 1990); and (4) 90,000 in the Canadian High Arctic (Kingsley 1985, 1990). No population estimates are available for Coronation Gulf or Bathurst Inlet.

There can be large natural variations in the numbers of ringed seals in an area over a period of a very few years (Stirling et al. 1977). In 1974–1975, there was a marked decrease in the abundance and productivity of seals in the Canadian Beaufort Sea and Amundsen Gulf (Stirling et al. 1977; Smith and Stirling 1978). There was another such decrease between 1982 and 1985 (Harwood and Stirling 1992).

Ringed seal harvests were reported for all four communities on Coronation Gulf (Kugluktuk, Cambridge Bay, Bathurst Inlet, and Umingmaktok) from 1996 to 2001 (Priest and Usher 2004). The numbers of seals harvested were small in the small communities of Bathurst Inlet and Umingmaktok. Kugluktuk recorded the highest harvest, an average of ~280 seals per year for the five years. Most (76%) were harvested in August and September, but smaller numbers were harvested in every other month. The harvest in Cambridge Bay increased from 38 in 1996/1997 to 277 in 2000/2001, with a five-year average of ~96 seals per year. Most were harvested in July to September (68%) and May and June (26%) with small numbers taken in November, December, March, and April. (The numbers above include some unidentified seals, most of which are thought to be ringed seals.)

3.2.2 Natural History

Ringed seals are year-round residents in the Arctic and are highly adapted for living in arctic conditions. Ice conditions influence ringed seal distribution and abundance (Smith and Stirling 1975, 1978; Moulton et al. 2002a), and densities have been shown to vary with ecological circumstances such as biological productivity (Kingsley et al. 1985; Stirling and Øritsland 1995).
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 lairs. As the ice forms in autumn, ringed seals open and then maintain breathing holes in the sea ice throughout the ice-covered period using the claws of their front flippers (Vibe 1950). Each seal maintains numerous breathing holes because it must breathe every 15 min. or so (Riedman 1990:105). As snow drifts over their breathing holes, seals excavate lairs in the drifts. There are two types of lairs; the haul-out lair and the breeding lair. Haul-out lairs are made as early as January, and ringed seals frequently begin to haul out in the open air on top of the ice to undergo moult from mid-May through early June. Breeding lairs are constructed in mid-March at the earliest (Smith et al. 1991). Ringed seals prefer to breed on landfast ice in all areas within the study area (McLaren 1958; Kelly 1988). However, ringed seals may also breed in the pack ice (Finley et al. 1983; Kelly 1988).

Ringed seal pups are born in the birth lairs in April. They nurse for 38–44 d (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 may be as high as 40% (Smith 1976).

During summer, ringed seals are dispersed throughout open-water areas. Some disperse to offshore areas after the landfast ice breaks up in summer (Heide-Jørgensen et al. 1992); in some regions, they move into coastal waters. Seasonal concentrations related to food sources are known in offshore waters of the Canadian Beaufort Sea off the Tuktoyaktuk Peninsula and off CapeDalhousie (McLaren and Davis 1985; Harwood and Stirling 1992). Ringed seals encountered in the Alaskan Beaufort Sea during open-water seismic exploration were broadly dispersed as individuals or small groups (Harris et al. 1997, 1998; Lawson and Moulton 1999, 2001; Moulton and Lawson 2000, 2001; Moulton et al. 2002b).

Ringed seals are capable of moving distances of 1000 km or more during the summer (Heide-Jørgensen et al. 1992; Kapel et al. 1998; Teilmann et al. 1999), although they tend to show site fidelity (Teilmann et al. 1999). Ringed seals feed primarily on fish (especially arctic cod) and large crustacean zooplankters such as amphipods, euphausiids, epibenthic mysids, and decapods (Bradstreet et al. 1986; Smith 1987).

### 3.2.3 Results of June–July 2007 Surveys

Ringed seals were widely distributed throughout Bathurst Inlet during the study period (Figs. 2 to 6). A total of 841 ringed seals were seen on transect. Some seals undoubtedly were the same individuals seen on other days, particularly in the bottom of the inlet, which was surveyed twice. The surveys covered a total of 2823 km² of fast ice habitat. The observed overall uncorrected density of seals was 0.3/km² (Table 2). Uncorrected density means that no adjustments were made for the estimated proportions of seals not hauled out (availability bias) or on the ice but missed (detection bias). This density is well within the normal range of densities for ringed seals seen on landfast ice during studies in other areas in the Canadian and U.S. Arctic (Table 3). Ringed seals were observed in most parts of the inlet, but density was considerably lower in the southern part of the inlet (Table 2), especially near the proposed dock site. Only one seal was seen south of the proposed dock site (~15 km south; Fig. 6), and the closest seal was ~7.5 km north of the proposed dock site (Fig. 2). A few unoccupied seal holes were seen within 5 km of the proposed dock site (Fig. 7).
Figure 2. Ringed seal distribution during an aerial survey in Bathurst Inlet, Coronation Gulf, on 27 June 2001.
Figure 3. Ringed seal distribution during an aerial survey in Bathurst Inlet, Coronation Gulf, on 28 June 2001.
Figure 4. Ringed seal distribution during an aerial survey in Bathurst Inlet, Coronation Gulf, on 29 June 2001.
Figure 5. Ringed seal distribution during an aerial survey in Bathurst Inlet, Coronation Gulf, on 30 June 2001.
Figure 6. Ringed seal distribution during an aerial survey in Bathurst Inlet, Coronation Gulf, on 1 July 2001.
Table 2. Survey date (= area) vs. observed and expected numbers of ringed seal sightings on landfast ice in Bathurst Inlet during 27 June–1 July 2007. See Figures 2-6 for survey locations within the inlet.

<table>
<thead>
<tr>
<th>Survey date</th>
<th>Area surveyed (km²)</th>
<th>Proportion of total area surveyed</th>
<th>Observed # seal sightings</th>
<th>Expected # seal sightings¹</th>
<th>Proportion of total observed in each interval</th>
<th>95% Bonferroni Confidence Limits on proportion of occurrence</th>
<th>Observed proportion relative to CI</th>
<th>Observed density (#/km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>27-Jun</td>
<td>526.36</td>
<td>0.19</td>
<td>68</td>
<td>157</td>
<td>0.08</td>
<td>0.06, 0.11</td>
<td>&lt;Expected</td>
<td>0.13</td>
</tr>
<tr>
<td>28-Jun</td>
<td>541.17</td>
<td>0.19</td>
<td>219</td>
<td>161</td>
<td>0.26</td>
<td>0.22, 0.30</td>
<td>&gt;Expected</td>
<td>0.40</td>
</tr>
<tr>
<td>29-Jun</td>
<td>630.11</td>
<td>0.22</td>
<td>215</td>
<td>188</td>
<td>0.26</td>
<td>0.21, 0.30</td>
<td>Within</td>
<td>0.34</td>
</tr>
<tr>
<td>30-Jun</td>
<td>596.3</td>
<td>0.21</td>
<td>266</td>
<td>178</td>
<td>0.32</td>
<td>0.27, 0.36</td>
<td>&gt;Expected</td>
<td>0.45</td>
</tr>
<tr>
<td>01-Jul</td>
<td>529.45</td>
<td>0.19</td>
<td>73</td>
<td>158</td>
<td>0.09</td>
<td>0.06, 0.11</td>
<td>&lt;Expected</td>
<td>0.14</td>
</tr>
<tr>
<td>Total</td>
<td>2823.39</td>
<td>1.00</td>
<td>841</td>
<td>841</td>
<td>1</td>
<td>1</td>
<td>0.30</td>
<td></td>
</tr>
</tbody>
</table>

¹Expected numbers are proportional to area surveyed, assuming the same number of sightings/km² in each stratum. Observed vs. expected number of seal sightings per date bin for all strata: χ² = 164.45, df = 4, P < 0.001.

Table 3. Observed ringed seal densities (#/km²) on landfast ice from other studies in the Alaskan and Canadian Arctic.

<table>
<thead>
<tr>
<th>Year, Location</th>
<th>Country</th>
<th>Citation</th>
<th>#/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975 Canada, Central Arctic (early June)</td>
<td>1.32</td>
<td>Finley 1976</td>
<td></td>
</tr>
<tr>
<td>1975 Canada, Central Arctic (late June)</td>
<td>0.67</td>
<td>Finley 1976</td>
<td></td>
</tr>
<tr>
<td>1978 Canada, Baffin Island Fiords</td>
<td>1.72</td>
<td>Finley et al. 1983</td>
<td></td>
</tr>
<tr>
<td>1979 Canada, Northwest Baffin Island</td>
<td>1.31</td>
<td>Finley et al. 1983</td>
<td></td>
</tr>
<tr>
<td>1980, 1981 Canada, Central Arctic</td>
<td>0.27, 0.41</td>
<td>Kingsley et al. 1985</td>
<td></td>
</tr>
<tr>
<td>1981 to 1984 Canada, Beaufort, Amundsen, Prince Albert Sound</td>
<td>0.06-0.41</td>
<td>Kingsley 1986</td>
<td></td>
</tr>
<tr>
<td>1985 to 1999 US, North Slope, Alaska</td>
<td>0.58-1.67</td>
<td>Frost et al. 2002</td>
<td></td>
</tr>
<tr>
<td>1997 Canada, Barrow Strait Fiords</td>
<td>8.70</td>
<td>Finley 1979</td>
<td></td>
</tr>
<tr>
<td>1997 to 2002 US, Prudhoe Bay Area</td>
<td>0.39-0.83</td>
<td>Moulton et al. 2005</td>
<td></td>
</tr>
<tr>
<td>2004 Canada, Coronation Gulf</td>
<td>0.69</td>
<td>LGL Ltd., unpubl. data</td>
<td></td>
</tr>
</tbody>
</table>

Most ringed seals did not exhibit any obvious “negative” response to the aircraft as it flew overhead. Almost half (43.8%) showed no obvious response, 37.2% looked up at the aircraft, 9.5% moved on the ice, and 8.7% dove into their holes or cracks in apparent response to the aircraft. Five seals were in their holes, and two were swimming in the water.

Figure 7 shows all seal holes sighted during the surveys¹, including unoccupied holes and holes occupied by ringed seals, most of which were basking on the snow beside a hole. All ringed seal sightings are shown in Figure 8. A comparison of the two figures shows that there are many more holes than seals. The overall density of seal holes was ~1.1/km² (Table 4), ~3.5 x the density of seals. Although some seals likely were underwater during the surveys, the difference is mostly because each seal maintains numerous breathing holes.

¹ Unoccupied seal holes were not counted on 27 June.
Figure 7. Distribution of all unoccupied seal holes during aerial surveys in Bathurst Inlet, Coronation Gulf, on each day during 28 June–1 July 2001, and all occupied holes during 27 June–1 July 2001.
Figure 8. Distribution of ringed seals during aerial surveys in Bathurst Inlet, Coronation Gulf, on each day during 27 June–1 July 2001.
Table 4. Survey date (= area) vs. observed and expected numbers of ringed seal holes on landfast ice in Bathurst Inlet during 28 June–1 July 2007\(^1\). See Figures 3-6 for survey locations within the inlet.

<table>
<thead>
<tr>
<th>Survey date</th>
<th>Area surveyed (km(^2))</th>
<th>Proportion of total area surveyed</th>
<th>Observed # seal holes</th>
<th>Expected # seal holes(^2)</th>
<th>Proportion of total observed in each interval</th>
<th>Proportion of total occurrence Bonferroni CI</th>
<th>Observed proportion relative to CI</th>
<th>Observed density (#/km(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-Jun</td>
<td>541.17</td>
<td>0.24</td>
<td>560</td>
<td>573</td>
<td>0.23</td>
<td>0.21–0.25</td>
<td>Within</td>
<td>1.03</td>
</tr>
<tr>
<td>29-Jun</td>
<td>630.11</td>
<td>0.27</td>
<td>667</td>
<td>667</td>
<td>0.27</td>
<td>0.25–0.30</td>
<td>Within</td>
<td>1.06</td>
</tr>
<tr>
<td>30-Jun</td>
<td>596.3</td>
<td>0.26</td>
<td>739</td>
<td>631</td>
<td>0.30</td>
<td>0.28–0.33</td>
<td>&gt;Expected</td>
<td>1.24</td>
</tr>
<tr>
<td>01-Jul</td>
<td>529.45</td>
<td>0.23</td>
<td>466</td>
<td>561</td>
<td>0.19</td>
<td>0.17–0.21</td>
<td>&lt;Expected</td>
<td>0.88</td>
</tr>
<tr>
<td>Total</td>
<td>2297.03</td>
<td>1.00</td>
<td>2432</td>
<td>2432</td>
<td>1</td>
<td></td>
<td></td>
<td>1.06</td>
</tr>
</tbody>
</table>

\(^1\) Unoccupied seal holes were not counted on 27 June, so all data from that date are excluded from the analysis.

\(^2\) Expected numbers are proportional to area surveyed, assuming the same number of sightings/km\(^2\) in each stratum. Observed vs. expected number of holes sighted per date bin for all strata: \(\chi^2 = 164.45, df = 4, P <0.001\).

The observed number of seal holes was lower than expected in the southernmost part of the inlet (surveyed on 1 July; Table 4), as was the case with the numbers of seals (Table 2). The observed numbers of seals and seal holes were higher than expected in the area surveyed on 30 June (Fig. 5), most of which was the farthest north of any of the areas surveyed. Differences could be attributable to water depth or availability of prey. It is also possible that the seals had moved out of the far south of the inlet because of freshwater input with the spring melt; the ratio of seal holes to seals was high there (6.8) when compared with ratios on days when the northern part of the inlet was surveyed (2.59–3.11).

### 3.2 Bearded Seal (Erignathus barbatus)

#### 3.2.1 Range and Population Status

Bearded seals have a northern circumpolar distribution. They are distributed throughout the Canadian Arctic in relatively low densities. Canadian populations are designated “Not at Risk” (COSEWIC 2006).

The most recent estimates for the size of the eastern Beaufort Sea population of the bearded seal range from 1200 to 3100 animals (Stirling et al. 1977, 1981, 1982). The Bering/Chukchi population, some of which summer in the Beaufort Sea, is estimated at 300,000–450,000 (Burns 1981).

Uncorrected estimates of the number of bearded seals in eastern Lancaster Sound and western Baffin Bay ranged from 7400 to 9500 animals (Koski and Davis 1980). Maximum densities of bearded seals in that region ranged from 0.05 to 0.24 seals/km\(^2\) (Finley 1976; Koski and Davis 1979; Koski 1980a,b; Koski and Davis 1980; Kingsley et al. 1985).

Bearded seal harvests were reported for all communities on Coronation Gulf except Cambridge Bay during 1996–2001 (Priest and Usher 2004). The numbers of seals harvested were small in all communities. Kugluktuk recorded the highest harvest, an average of two bearded seals per year for the five years. Bearded seals were taken from May to September, with the majority (50%) harvested in July.
3.2.2 Natural History

During winter, bearded seals are primarily restricted to areas of moving, broken pack ice. Because they have only a limited capability to maintain breathing holes in ice, most bearded seals are excluded from areas of fast ice during winter (e.g., many of the channels in the Arctic Archipelago), although some use ice holes made by ringed seals. Most bearded seals undertake seasonal migrations in response to the advance and retreat of fast ice (Martell et al. 1984). Limited numbers of bearded seals overwinter in polynyas (Cleator et al. 1989).

The bearded seal is a benthic feeder that is most abundant in areas where it can reach the bottom to feed, usually in waters <200 m deep (Burns and Frost 1983; Finley and Evans 1983). In the Canadian Beaufort Sea, the bearded seal is most abundant over depths of 25–50 m (Stirling et al. 1981). Thus, bearded seals prefer shallow-water areas with some amount of pack ice cover on which to haul out. The bearded seal’s preferred habitat is areas with thin, broken or rotten ice, or the floe edge (Kingsley 1985). This species also prefers less stable ice during break-up, and tends to avoid areas heavily used by walruses (Cleator and Stirling 1990).

In the Beaufort Sea and other parts of Alaska, this species feeds mainly on shrimp, crabs, clams (mainly the cockle, *Serripes*), octopus, gammarid amphipods, isopods, and fish (Burns and Frost 1983). During the summer open-water period, much of the Canadian Beaufort is unsuitable for feeding because the pack-ice habitat preferred by bearded seals typically retreats north to waters deeper than those preferred by bearded seals. During marine mammal monitoring during seismic exploration off the Mackenzie Delta and Tuktoyaktuk Peninsula in late July–early October 2001 and July–August 2002, low numbers of bearded seals were observed (Moulton et al. 2002b; Miller and Moulton 2003). However, bearded seals are relatively common in certain nearshore areas along southern Banks Island, Cape Parry, and Herschel Island during summer.

In the eastern Arctic Islands, fish, especially arctic cod, comprise much of the diet (Finley and Evans 1983). There, bearded seals are most abundant where water depths are <100 m (Kingsley 1985). Throughout the year, bearded seals typically occur alone or in small groups.

3.2.3 Results of June–July 2007 Surveys

There were 40 sightings and a total of 42 bearded seals recorded during all surveys (Fig. 8). Two sightings included two individuals, and the remainder were singletons. Sightings were dispersed within the inlet except in the south (only one bearded seal was seen south of Kanuyak Island) and in the deeper areas of the northern part of the inlet. Bearded seals tended to be close to shore (Fig. 8); 26 of the 42 seals (62%) were in water depths <20 m, and only 3 (7%) were in water >100 m deep.

Of the 25 bearded seals whose behaviour was recorded, most (72%) showed little or no apparent reaction to the aircraft (12 showed no response, 6 looked up, 1 was swimming). Four dove and two moved. Density calculations and further analyses were not conducted because of the small number of bearded seals seen.
Figure 8. Bearded seal distribution recorded during aerial surveys in Bathurst Inlet, Coronation Gulf, on each day during 27 June–1 July 2001.
4. Literature Cited


WesternGeco, LLC, Anchorage, AK, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD.


