



## **FIXED GEAR RECOMMENDATIONS FOR THE CUMBERLAND SOUND GREENLAND HALIBUT FISHERY**

### **Context**

In a letter dated March 14, 2008, the Nunavut Wildlife Management Board (NWMB) requested Fisheries and Oceans Canada (DFO) Science advice on ways Greenland halibut fishing could be conducted in Cumberland Sound such that conservation concerns with non-directed by-catch of marine mammals and Greenland sharks are minimized or alleviated. On March 31, 2008, Fisheries and Aquaculture Management (FAM) submitted a request to Science for advice to address this request.

Given the response was needed prior to the open-water fishing season (July 2008) and since the NWMB is the final advisory body for this request, DFO Central and Arctic Science determined that a Special Science Response Process would be used.

### **Background**

The Cumberland Sound Greenland halibut (turbot) fishery began in 1986 and has been traditionally exploited during the winter months using longline gear set on the bottom through holes cut in the ice. Fishing typically takes place along a deep trench (>500 m) that extends toward Imigen Island and Drum Islands (Fig. 1). In 2005, a new management zone was established in Cumberland Sound with a Total Allowable Catch (TAC) of 500 t separate from the Northwest Atlantic Fisheries Organization (NAFO) Division 0B TAC. Catches in the winter fishery peaked in 1992 at 430 t then declined to levels below 100 t through the late 1990s and peaked again at 245 t in 2003. However, in recent years catches have declined significantly with harvests of 9 t, 70 t and 3 t for 2005, 2006 and 2007 respectively. These periods of decline have been attributed to poor ice conditions and reduced fishing effort which are not necessarily mutually exclusive (DFO 2008). Recently there has been interest in fishing the quota remaining from the winter fishery in the open water season as well as exploring deeper areas (500 m to 1000 m) in the centre of Cumberland Sound, outside the winter fishing grounds (Fig. 1).

Three gear types are typically used to catch Greenland halibut during the open water period, bottom otter trawl, bottom set longline and bottom set gillnet. Bottom trawls and draggers are not permitted in Cumberland Sound (Northlands Consulting 1994) so bottom gillnets and bottom longlines are the two gears available to an open water fishery in Cumberland Sound and will be discussed below.

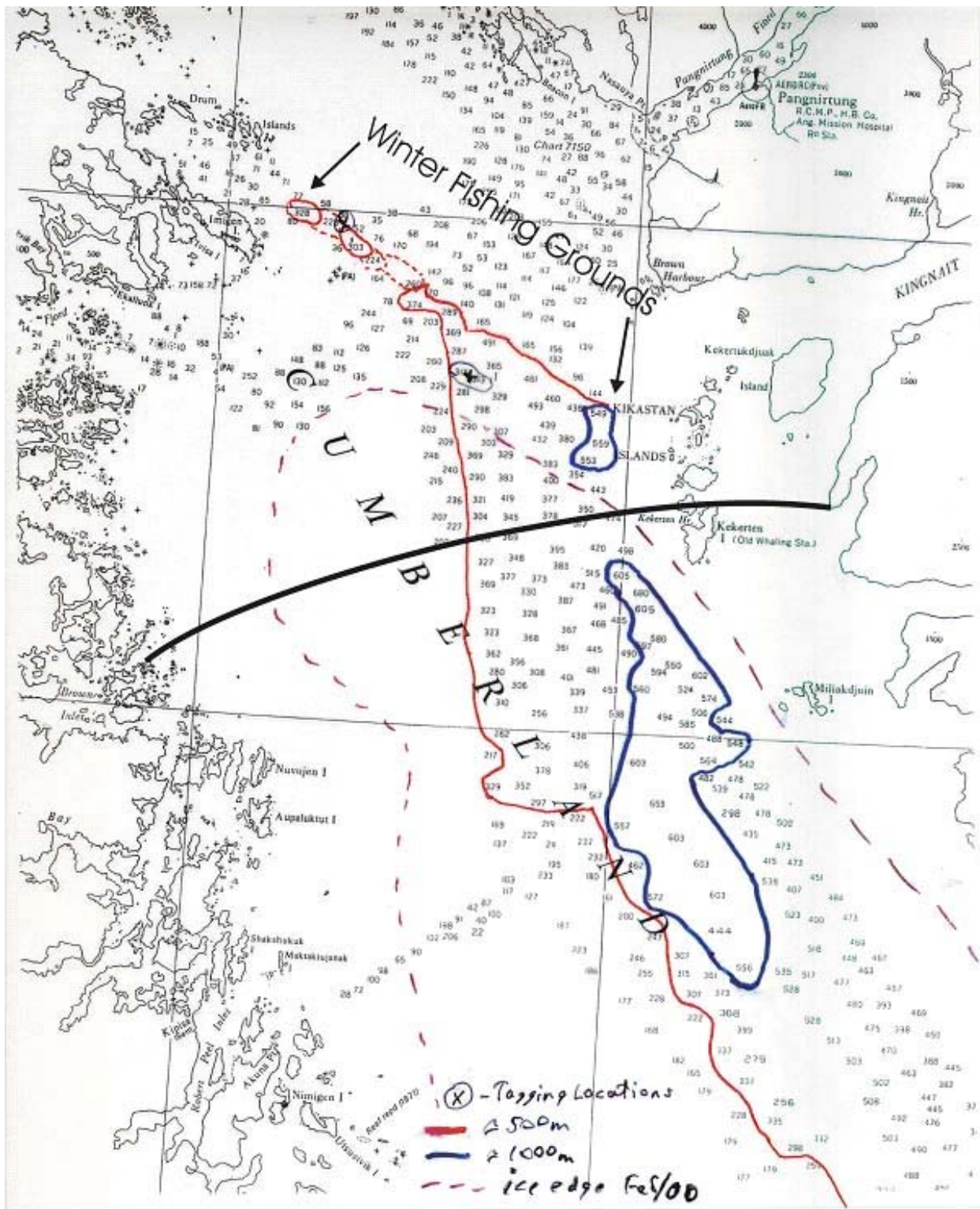


Figure 1. A portion of the Cumberland Sound bathymetric chart that includes the winter fishing grounds. The boundary for the Cumberland Sound Management Area is shown with a heavy black line running across the sound. A rough approximation of the 500 m and 1000 m depth contours are also shown. Locations where Greenland halibut were tagged during 1997 to 2000 are marked with an x.

Bottom gillnets and longlines are both used in the offshore Greenland halibut fishery in Davis Strait (NAFO Div. 0B) (Treble *et al.* 2007). Longline gear was used in the Baffin Bay (NAFO Div. 0A) fishery in 2002 and 2003 but they were replaced by gillnets in 2004 (Treble 2004 and Treble *et al.* 2007). Both gillnets and longlines are used in Greenland halibut fisheries in other jurisdictions, except for Alaska where longline is the only gear used in the Gulf of Alaska and Bering Sea fisheries (North Pacific Fishery Management Council 2008a, 2008b).

There are a number of issues particularly relevant to development of the Cumberland Sound summer fishery which will be discussed further below:

- 1) Gear Selectivity
- 2) Gear Loss
- 3) Gear Interaction with Other Species
- 4) COSEWIC and Canadian *Species at Risk Act*
- 5) Impacts of Fishing Methods

### Gear Selectivity

Biological samples taken from offshore catches in NAFO Divisions 2GH for 1992 and 1993 showed that females comprised 60%-98% of the catches by number, generally increasing with depth fished (Bowering and Brodie 1995). Nedre eas *et al.* (1996) compared gear selectivity in the Barents Sea Greenland halibut fishery using a 220 mm (8.5") and 180 mm (7") mesh gillnet, a bottom trawl with cod mesh 135 mm (5 1/4") and a long-line (hook size 12/0). They found that the size distribution of the longline catch (40-80 cm) was wider than that taken by gillnet (55-80 cm). In addition gillnets caught almost exclusively mature females (about 90%) while 14-30% of the longline catch and 30-40% of the trawl catch was immature fish. A gillnet-only fishery is not optimal given the high female to male ratio for this gear.

In a review of the Greenland halibut fisheries off Eastern Canada, Bowering and Brodie (1995) comment that by the late 1960s gillnets had replaced the traditional longline in the Newfoundland and Labrador inshore Greenland halibut fishery. Fishing effort increased dramatically and within only a few years most of the bays along the coast were fished out. By the late 1980s the fishermen had moved further offshore to deepwater areas along the shelf slope. In 2001, the use of gillnets was being discouraged in inshore areas of Newfoundland and Labrador (Andrew Duthie, DFO, pers. comm.).

### Gear Loss

When gillnets are lost there is a good chance they will continue to fish or "ghost fish" for months and sometimes years (Dayton *et al.* 1995, Cooper *et al.* 1988). Key causes of gear loss identified by a European study were listed in decreasing order of importance by Brown and Macfadyn (2007):

- conflict with other sectors, principally towed gear operators;
- working in deep water;
- working in poor weather conditions and/or on very hard ground;
- working very long fleets; and
- working more gear than can be hauled regularly.

Concern over ghost fishing in deepwater gillnet fisheries prompted the European Community to ban gillnetting in waters below 200 m beginning in February 2006 until long term management conditions could be developed (Brown and Macfadyen 2007)

Working in deepwater and in poor weather conditions are two key reasons gear is lost and both are relevant to the Cumberland Sound Greenland halibut fishery because Greenland halibut are most abundant in deep waters and the fishery is likely to be concentrated in depths at or below 500 m. Weather and ice conditions in the Arctic can be severe and unpredictable. Humborstad *et al.* (2003) documented large catches of Greenland halibut in ghost fishing gillnets off the coast of Norway in the Barents Sea. They concluded that gillnets lost in that area continue to fish for long periods of time.

Since the introduction of gillnets to the Div. 0A Greenland halibut fishery, nets have been inadvertently lost in each fishing year (Table 1). To date, a total of 684 nets have been lost which corresponds to a total length of approximately 68 km (each net is approximately 100 m). An additional 39 nets were lost in 2004 but were retrieved in 2005. Some of the gear loss in 2007 was attributed to sea ice and a sperm whale entanglement. These data come from reports provided by observers assigned to all vessels fishing in the Div. 0A Greenland halibut fishery.

The Div. 0B Greenland halibut fishery does not have the same level of observer coverage as Div. 0A but records available for 2007 indicated 231 nets were lost of which 50 had been retrieved.

*Table 1. Number of gillnets lost in Div. 0A Greenland halibut fishery since their introduction in 2004.*

Year	Number of Nets Lost
2004	174
2005	291
2006	135
2007	84

## Gear Interaction with Other Species

Deep sea gillnets pose a risk to marine mammals and this has been well documented in southern fisheries (Dayton *et al.* 1995; Laist *et al.* 1999 in Dayton *et al.* 2002). We could expect the same to be true for marine mammals that inhabit northern waters. There are two fishery observer reports of marine mammal entanglements in Baffin Bay (Div. 0A); a sperm whale was caught in Greenland halibut gillnets in 2007 and a narwhal was seen struggling at the surface, entangled in a line with a large float attached to it in 2004.

There are reports of bowhead whales entangled in harpoon lines and in fishing nets and lines (Philo *et al.* 1992; Angliss and Outlaw 2008). Inuit have reported bowheads swimming into nets set for belugas, narwhals and fish in Cumberland Sound and near Pangnirtung, resulting in destroyed nets and entanglement (NWMB 2000). Four bowheads have been reported caught in nets in Nunavut and West Greenland since 2003 (DFO, unpublished data).

Greenland shark are also abundant in Cumberland Sound and are vulnerable to being caught in gillnets set for Greenland halibut. Summer exploratory fisheries conducted in 1993 (near Qikiqtarjuaq) and 1994 (Davis Strait, Resolution Island and Cumberland Sound) tested several gear types, including gillnets (Hathaway 1993, Northlands Consulting 1994). In 1993, they reported catching three seals but could not identify which species they were. In both years, they reported significant bycatch of Greenland shark (52 sharks in 11 sets in 1993). The sharks tore the nets, raising concerns about the potential for losing gillnets in a commercial fishery.

Northlands Consulting (1994) recommended that gillnets not be used if a fishery for Greenland halibut was developed.

Longline gear will also catch non-targeted species, including Greenland shark. Greenland shark and Arctic skate are the main bycatch species during the winter longline fishery (DFO 2008). Over all years shark catch rates in the winter fishery have varied from 4/100 sets to 30/100 sets. In summer 2003, a fishery training course was conducted in Cumberland Sound. Over 10 sets, they caught 12 sharks, 113 skates and 198 turbot. Usually longline fish caught are still alive when they are brought onboard and it is possible that bycatch species caught using longline could survive capture if handled carefully and released.

Bottlenose whales are a concern for longline vessels operating in the offshore. These whales are not afraid of the vessels and will approach the lines as they are being hauled, feeding on Greenland halibut that are attached. However, bottlenose whales do not enter coastal areas along the Baffin coast so this would not be a concern for the Cumberland Sound fishery.

### COSEWIC and Canadian Species at Risk Act

Entanglement in fishing gear and “ghost nets” would potentially add an additional source of mortality to the following populations which have been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

- Narwhal are assessed as Special Concern (COSEWIC 2004a).
- Cumberland Sound Belugas are designated as Threatened and the High Arctic/Baffin Bay belugas are assessed as Special Concern (COSEWIC 2004b).
- Eastern Arctic bowhead whales are currently assessed as Threatened (COSEWIC 2005). The COSEWIC report stated that “The significance of mortality from entanglement is uncertain but it is not thought to be a major threat at present (Moshenko *et al.* 2003; Angliss and Outlaw 2008). The development of commercial fisheries in the Arctic presumably will increase the risks of entanglement.”

### Impacts of Fishing Methods

A review of mobile gear impacts was done in 2006 (DFO 2006) and DFO is currently considering draft policy concerned with managing the impacts of fishing on sensitive benthic areas as a result of this work. DFO has not yet reviewed the impacts of fixed gears but a study done for fisheries in the United States is available that ranks 10 gear types, including mobile and fixed gears. A group of fishers, managers and scientists participated in a study to assess ecological severity of the collateral impacts to habitat (physical and biological) and bycatch for 10 gear types (Chuenpagdee *et al.* 2003). They found that bottom trawl, bottom gillnet, dredge and midwater gillnet were rated as having a high impact and recommend very stringent fisheries management policies. Pots and traps, pelagic longline and bottom longline were of medium impact and they recommended moderately stringent policies. Midwater trawl, purse seines and hook and line methods were ranked as having a low impact and they suggest less stringent policies would be appropriate.

Specifically bottom gillnets had a medium impact on physical habitat and low impact on biological habitat, while bottom longline gear was rated as having a low impact overall for habitat (Morgan and Chuenpagdee 2003 in Chuenpagdee *et al.* 2003).

In terms of bycatch impacts bottom gillnets were rated high for marine mammals and finfish and medium for sharks and seabirds while bottom longlines were rated high for finfish, medium for sharks, low for seabirds and very low for marine mammals (Morgan and Chuenpagdee 2003 in Chuenpagdee *et al.* 2003)

The identification of sensitive benthic areas in the Arctic will be a challenge as there has been little research in this area. In the meantime it would prudent for new fisheries to employ gear(s) that would pose the lowest risk to benthic habitats as well as bycatch species.

## Fixed Gear Regulations in Greenland Halibut Fisheries

### DFO Central and Arctic Region NAFO SA0

The Greenland halibut management plan requires:

- 1) a minimum gillnet mesh size of 153 mm (6") be used in water depths less 730 m
- 2) a minimum gillnet mesh size of 190 mm (7.5") be used in depths greater than 730 m
- 3) a maximum number of 500 nets of 50 fathoms (300 feet or 91 m) each.
- 4) the minimum hook size for longlines is a #14 circle hook.

Additional measures implemented in 1998 but not mentioned in the plan (DFO 2005) concern the requirement to attach gillnet tags to all gillnets when fishing and to report any lost nets or tags. The need for increased observer coverage of the gillnet fleet was also identified.

### Newfoundland and Labrador Region (NAFO SA2&3)

Fishing with both gillnets and longlines is restricted to deeper depths (>293 m or >549 m, depending on the area) to avoid conflict with inshore crab fisheries. Authorized mesh size (6", 7.5") and number of nets (125, 200, 300, 400) varies with depth and fishing area. Gillnets must not exceed 91 m and require tags. Any lost nets must be reported (DFO Conservation Harvesting Plan 2008, unpublished report).

### Gulf of St. Lawrence (Quebec Region)

Gillnets of 50 fathoms (91.4 m) in length and a minimum mesh size of 152 mm (6") are authorized for use in the Gulf of St. Lawrence. A maximum of 90 nets are authorized for vessels fishing along the Lower North Shore. In other areas the maximum number of nets varies from 60 to 120 nets, depending on license conditions. All nets must be tagged prior to being put on the vessel for transport to the fishing grounds (DFO Conservation Harvesting Plan 2007, unpublished report)

Longlines are authorized only when the Atlantic halibut fishery is open. Circle hooks with a 12.6 mm opening are authorized. The maximum number of hooks varies and is set at either 4000 or 8000 depending on whether the fish harvester holds additional licenses for crab or lobster (DFO Conservation Harvesting Plan 2007, unpublished report).

Fishing generally occurs at depths of 200-300 m (D. Lemelin, pers. Comm.). The fishing season runs from April 1 to May 14 for the fleet under ITQ regime and from May 15 to October 31 for the competitive fleet. A portion of Div. 4R is closed from April 1 to June 23 and that portion of Div. 4T south of Cap Gaspé is closed all year in order to protect cod spawning areas and juvenile cod (DFO Conservation Harvesting Plan 2007, unpublished report).

### Greenland

The fishery in the Greenland fiords was traditionally a longline fishery. In the 1980s gillnets were introduced, by the late 1990s authorities introduced regulations limiting areas where gillnets could be used and in 2000 a total ban on gillnets was implemented. However, since 2004 authorities in Uummannaq and Upernavik municipalities have been allowed to set local fisheries regulations and gillnets with minimum mesh size of 110 mm (approx. 4.5") are now permitted in some areas (Lyberth and Boje 2006).

### Norway

The Greenland halibut fishery in Norway is restricted to longline and gillnet vessels that are less than 28 m (92 feet) in length. Trawl catches are limited to by-catch from other fisheries only. ([http://www.fisheries.no/marine\\_stocks/fish\\_stocks/Fish\\_halibut/north\\_east\\_arctic\\_halibut.htm](http://www.fisheries.no/marine_stocks/fish_stocks/Fish_halibut/north_east_arctic_halibut.htm)). The maximum soak time for gillnets set north of 62° N is 2 days and no fishing is permitted in this area between Sept. 1 and April 30. In the Storegga area the number of gillnets is restricted to 18 fleets of up to 25 nets (450 nets) and fishing is not allowed during Sept. 1 to April 30. Longline vessels that are larger than 21.35 m and that have auto longline systems are not allowed to fish within 4 nm of the coast. In certain areas these vessels are not allowed to fish within 10 nm of the coast between September 1 and December 31 and in one area the closed season extends from September 1 to April 30. ([http://www.fiskeridir.no/fiskeridir/english/regulations/080414\\_regulations\\_amending\\_the\\_regulations\\_relating\\_to\\_sea\\_water\\_fisheries](http://www.fiskeridir.no/fiskeridir/english/regulations/080414_regulations_amending_the_regulations_relating_to_sea_water_fisheries)).

### Alaska

In the Bering Sea and Gulf of Alaska gillnets are not permitted and the fishery is almost exclusively a longline fishery. Bottom trawls are allowed but halibut bycatch restrictions effectively prohibit the use of trawl gear to target Greenland halibut. There are several areas that have been fully closed to fishing or open only seasonally, depending on the gear type. (North Pacific Fishery Management Council 2008a and 2008b).

## Previous Recommendations Concerning Gillnet Regulations in the NAFO Subarea 0 Greenland Halibut Fishery

In February 1996, the Nunavut Wildlife Management Board (NWMB) passed Resolution #96-082 "that NWMB write to the Minister of DFO, suggesting the following nonquota limitations in the offshore areas of Area 0:

- 1) That the number of gillnets per vessel be limited;
- 2) That hanging twine in gillnets be biodegradable;
- 3) That use of longlines be encouraged, not prohibited.

Also moved, that the same restrictions be drafted for application within the marine waters of the NSA." (NWMB Minutes of Meeting No. 10).

Certain NWMB member's concerns over the use of gillnets in the Greenland halibut fishery were re-iterated during the May 1996 NWMB meeting and the minutes indicate that a letter was sent to the DFO Minister on March 11, 1996 making recommendations for the control of gillnetting.

The Parliamentary Standing Committee on Fisheries and Oceans made three recommendations in their report tabled on December 8, 1998 that came out of consultations held with residents of Iqaluit, Qikiqtarjuaq and Pangnirtung:

- 1) Recommendation # 4 called on DFO to encourage the use of gear types other than gillnets in the Davis Strait fishery, particularly the use of long lines.

- 2) Recommendation # 5 called on DFO to limit soak times in order to ensure a high product quality and to minimize waste.
- 3) Recommendation # 6 called on DFO to support further research to determine the extent of “ghost net” fishing and if warranted consider a ghost net retrieval program or consider requiring biodegradable net components.

In 2003, DFO Science recommended against the introduction of gillnets into the offshore Greenland halibut fishery in Division 0A citing conservation concerns (DFO, unpublished report). The risk of marine mammal entanglement and the risk of losing nets were considered to be greater in Div. 0A than in Div. 0B due to differences in marine mammal abundance, ice and weather conditions.

## **Analysis and Response**

### **Cumberland Sound Context**

The open water season is generally mid-July to mid-October for Cumberland Sound. The fishery would occur at depths below 500 m in the winter fishing grounds as well as the deeper central portion of Cumberland Sound (Fig. 1)

Ice and weather conditions for Cumberland Sound and inshore waters of Baffin Island can change quickly which could present a greater risk of losing gear compared to other more temperate areas. These adverse conditions could also reduce the chance of recovering nets that may become lost.

About 2000 belugas occupy Cumberland Sound year-round (P. Richard, DFO, unpublished data). Beluga whales gather at the flow edge in May and during June and July move through the sea ice within Cumberland Sound towards Clearwater Fiord (Kilabuk 1998). Beluga whales are mainly concentrated in Clearwater Fiord and the northwest end of Cumberland Sound during July and August. In late August and early September they begin to move back out to Cumberland Sound staying primarily along the west side of Cumberland Sound (Kilabuk 1998). Analysis of data from 12 beluga tagged in Clearwater Fiord during July and August in 1998 and 1999, 3 beluga tagged in 2006 and 2007 and an aerial survey conducted in 2005 show that Beluga whales are present in the inshore turbot management zone of Cumberland Sound during May to November (Fig. 2, Fig. 3 and Fig. 4). Dive data from tagged beluga also indicated that their habitat overlaps with Greenland halibut fishing depths. Most dives were in the 200-600m (110-328 fathoms) range with several dives down to depths > 900 m (492 fathoms).

Hundreds of narwhals winter in the pack ice of Cumberland Sound. A few remain in summer but most of them move north into Baffin Bay and into passages of the Arctic Archipelago (P. Richard, DFO, unpublished data). Narwhal are known to dive to deep depths (>800 m), likely foraging for food (Laidre and Heide-Jørgensen 2004 and Laidre 2003).



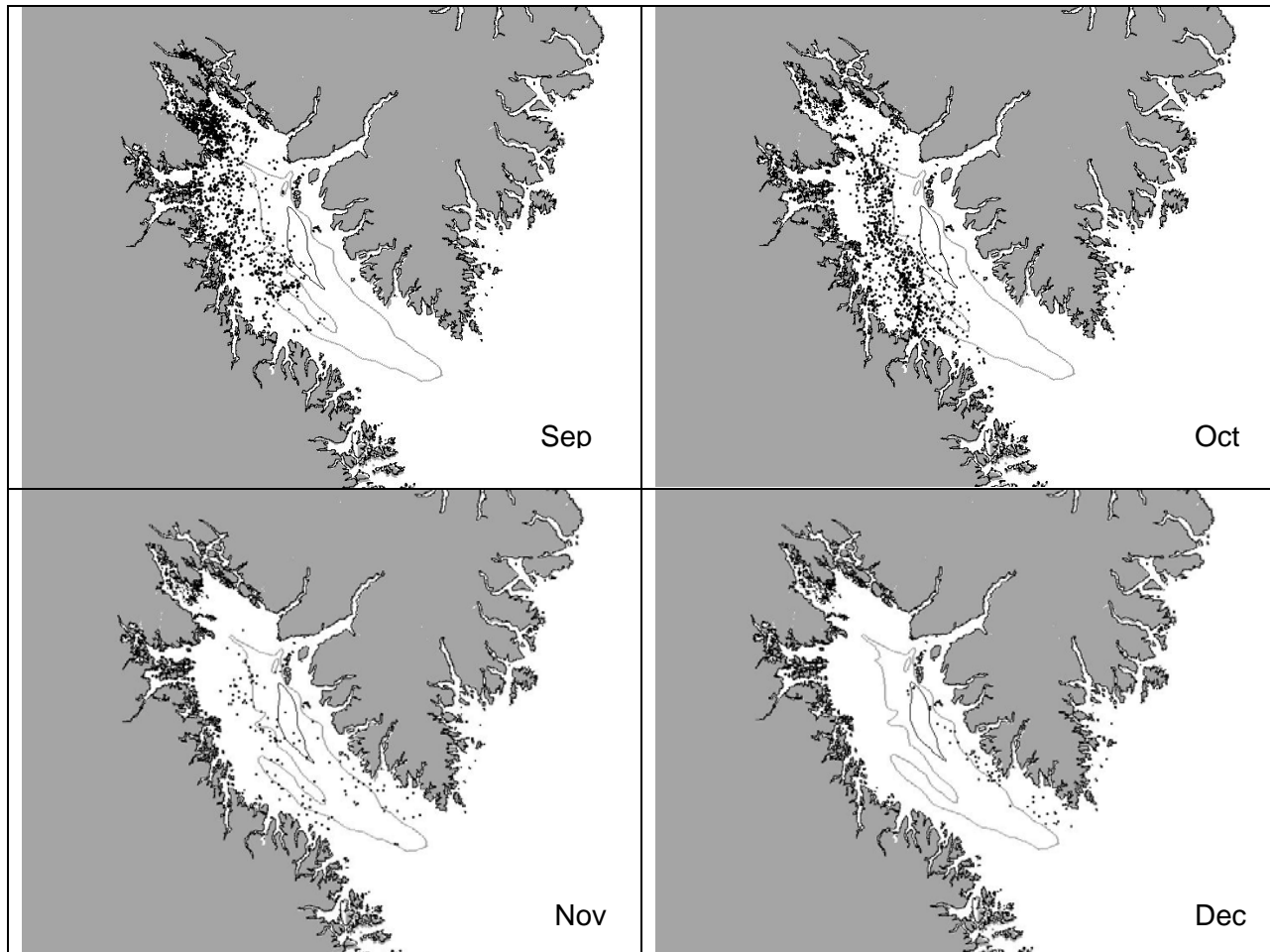


Figure 2: Monthly locations of 12 satellite-linked tagged belugas instrumented in 1998-99. The depth contour lines are 500 m (dotted line) and 1000 m (solid line).

Dozens of bowhead whales occupy Cumberland Sound year round. Local knowledge indicates that bowhead occur in Cumberland Sound in winter, are found near the flow edge in May and have also been observed throughout most of the summer period. Tagging data indicated that whales tagged in early July left Cumberland Sound by the end of July or mid- August. Bowhead whales have been recorded to dive to nearly 500 m (Laidre *et al.* 2007). There have been reports of bowhead whales entangled in gillnets in Greenland and Canadian waters.

Local knowledge also indicates that unknown numbers of walrus winter in Cumberland Sound (Pangnirtung HTA, pers. comm.).

Beluga, narwhal and bowhead whales, as well as seals (ringed, bearded, harp), walrus and Greenland shark would all be at risk of entanglement in gillnets set for Greenland halibut or nets that may become lost during Greenland halibut fishing. Longline gear poses a lower risk of entanglement for these species.

The high proportion of Greenland halibut females in a gillnet-only fishery is not optimal for the sustainability of the Cumberland Sound Greenland halibut stock. Longline gear selectivity results in a distribution of catch that includes both sexes and a broader size range.

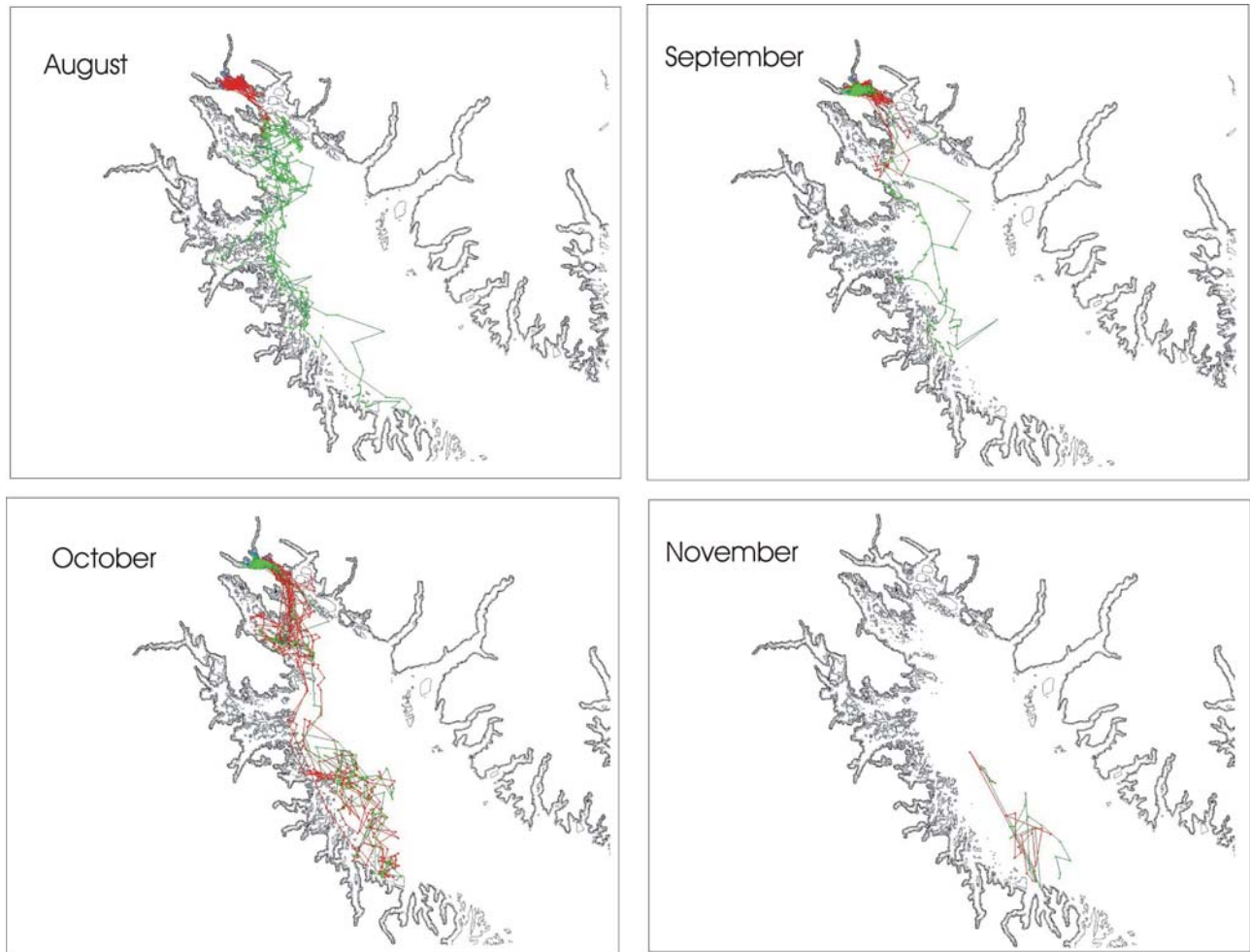


Figure 3. Track locations by month for 3 satellite-linked beluga whales instrumented in 2006-07.

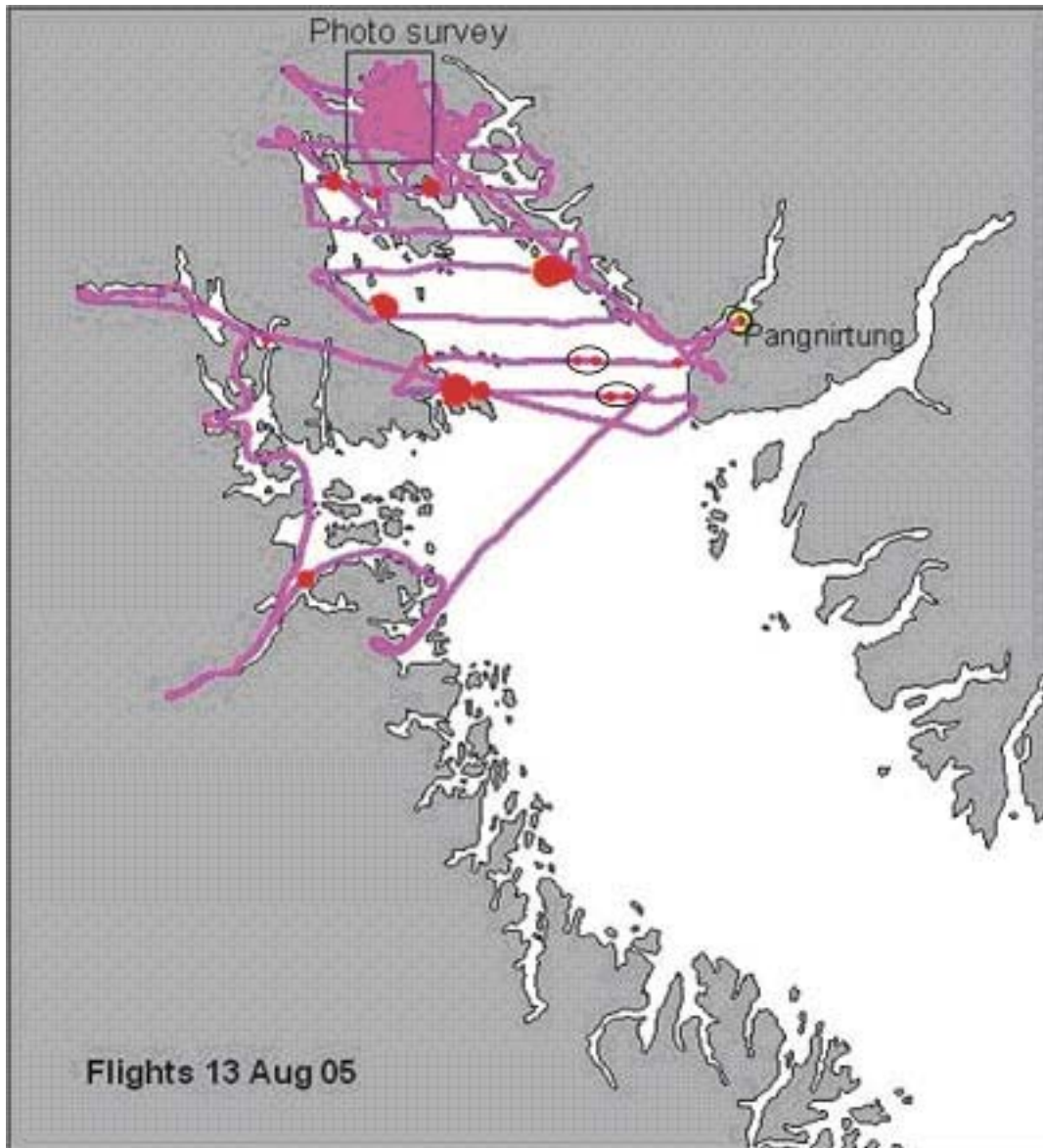


Figure 4. The track line for an aerial survey conducted Aug 13, 2005 in Cumberland Sound is shown. Beluga whale sightings are indicated by red circles (the larger the circle the greater the number of whales in the group). Most belugas were found in Clearwater Fiord (photo survey box) and in nearshore areas. There were several whales located near the Greenland halibut inshore fishing grounds (enclosed by black circles).

## Summary

DFO Science supports the NWMB's previous decision not to allow gillnets to be used in the Cumberland Sound fishery. Further, DFO Science notes that longline gear poses considerably fewer risks and should continue to be used in both winter and summer fisheries in Cumberland Sound.

There is significant risk to marine mammals, Greenland sharks and to inshore components of the Greenland halibut population if gillnets were permitted in Cumberland Sound.

- 1) The use of gillnets will increase the probability that non-target species, particularly marine mammals, will become caught or entangled. There are risks of entanglement of narwhal, bowhead and beluga whales as well as seals (ringed, bearded, harp) and walrus because of the overlap between their habitat and the inshore turbot fishing grounds.
- 2) The risk of losing nets, which could cause fish and marine mammal mortality during periods when the fishery is not operating, is high. Severe ice conditions can be encountered throughout the year, increasing the likelihood of losing gear that will continue to fish or present an underwater hazard, further impacting fish and marine mammals.
- 3) Gillnet caught fish are usually dead and damaged by the twine or by Greenland sharks that are caught along with them in the nets. Longline caught fish are usually still alive when they are brought onboard, resulting in a better quality product and there is a chance that bycatch could survive capture if handled carefully and released.
- 4) Gillnet catch is comprised primarily of large mature females and therefore has a greater potential to negatively impact the Greenland halibut population compared to longline gear which catches a broader size range and lower proportion of females. Monitoring programs might not detect an impact in time to reverse declines in abundance that could result from a gillnet-only fishery.
- 5) Gillnets have a greater risk of causing damage to sensitive benthic habitat than do longlines.

## **Conclusions**

NWMB has requested advice on a method by which a fishery in Cumberland Sound can be prosecuted in a sustainable manner during the summer open water season.

DFO Science advice supports the NWMB's previous decision not to allow gillnets to be used in the Cumberland Sound fishery. Further, DFO Science notes that longline gear poses considerably fewer risks and should continue to be used in both winter and summer fisheries in Cumberland Sound.

If NWMB chooses to authorize gillnets for inshore fisheries then we recommend they re-visit the recommendations they made in 1996, consider a mix of longline and gillnet gears and the relevance of regulations used in other jurisdictions (given above) for application to Cumberland Sound.

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