

Cetaceans in the PBGB LOMA

Potentially Harmful Activity (X)			Potentially Harmful Stressor (X)		
Fishing	Bottom trawl	X	Marine pollution	Oil pollution	X
	Scallop dredges			Industrial effluent	
	Clam dredges			Fishplant effluent	
	Midwater trawl	X		Sewage	
	Gillnets (bottom)	X		Historic military waste	
	Gillnets (pelagic)	X		Long range transport of nutrients	
	Longline	X		Acid rain	
	Seine (pelagic)	X		Persistent Organic Pollutants	X
	Recreational cod fishery			Eutrophication	
	Crab pots	X		Ghost nets	X
	Lobster pots			Litter	X
	Whelk pots	X		Other contaminants (specify)	
	Other (specify)				
	Other harvest	Otter trapping			Climate Change
Seal hunt			Temperature change	X	
Seabird hunt			Sea-level rise		
Seaweed harvest			Ocean acidification	X	
Seabed alteration	Anchor drops/drags		Climate Change	Current shifts	X
	Ore spill			Increased storm events	
	Fish offal dumping			Increased UV light	
	Finfish aquaculture			Oxygen depletion	
	Dredge spoil dumping			Changes in freshwater runoff	
	Dredging			Other (specify)	
	Mining/Oil & gas drilling				
Coastal alteration	Freshwater diversion		Harmful species	Green crab	
	Subtidal construction			<i>Membranipora</i>	
	Intertidal/coastal construction			Golden Star Tunicate	
	Other (specify)			Violet Tunicate	
Disturbance	Vessel traffic	X	Harmful species	Vase Tunicate	
	Ship strikes	X		<i>Codium fragile</i>	
	Ecotourism	X		Clubbed Tunicate	
	Marine construction			<i>Didemnum</i>	
	Seismic surveys	X		Harmful Algal Blooms	X
	Navy sonar	X		Disease organisms (human waste)	
	Other (specify)			Disease organisms (aquaculture)	
		Other (specify)			
		Other			

Background Information

Five species of baleen whales occur in the Placentia Bay Grand Banks LOMA with regular frequency and are most commonly observed during summer months when prey species are most abundant. These include the humpback whale, blue whale, fin whale, sei whale and the minke whale (Templeman & Davis, 2006). Eight species of toothed whales are also observed regularly, with most occurring seasonally (mainly summer), but very little is known of their distribution and current population status (Templeman & Davis, 2006).

The role of cetaceans in the food web is complex as they range from top predators such as dolphins, to large baleen whale which are relatively low on the food chain despite their large size, and consume enormous quantities of krill, copepods, zooplankton, and small fish. Despite their relatively small numbers, they represent a significant biomass due to their large size, and contribute significantly to the energetics of the marine ecosystem.

Scoping

Bottom trawl:

While this is one of the most commonly used gear types on the Grand Banks, there is no evidence of significant whale entanglements in otter trawl gear in the Northwest Atlantic reports (Johnson et al., 2005; Ledwell & Huntington, 2007). **Screened out.**

Midwater trawl:

The main directed fishery using mid-water trawl within the LOMA target redfish. Fishing effort by Canadian vessels is concentrated in the Laurentian and Hermitage Channels with average annual landings of 770t from 2000-2003 (Fisheries and Oceans Canada, 2007). DFO Fisheries information from 1998 - 2007 show landings from midwater trawl totaled 14, 659 tonnes in the PBGB LOMA, but no landings have been reported in the LOMA since 2002. Russian vessels are also reported to use midwater trawl to some extent outside the 200 mile limit, but within the context of the LOMA as a whole, use of midwater trawl is minimal and is not considered to be a key threat. **Screened out**

Gillnet (groundfish):

Cetaceans are highly prone to entanglement in fishing gear, especially gillnets. Because of their low cost and widespread use, gillnets are responsible for a very high proportion of global cetacean bycatch. Read *et al* found that 84% of cetacean bycatch in US fisheries (1990-1999) occurred in gill nets (Read et al., 2003), and most experts seem to agree that gillnets are one of the most problematic gear types in relation to cetacean entanglement (Belden et al., 2006; Davoren et al., 2006; Johnson et al., 2005). Gillnets are used widely within the LOMA, inshore and offshore, focusing on areas of high productivity which are also areas where whales aggregate. **Screened in.**

Gillnets (pelagic):

Pelagic gillnets were traditionally used in inshore waters to target Atlantic salmon and other pelagics such as herring and mackerel, and were responsible for significant bycatch of seabirds and cetaceans. In 1992, a moratorium and voluntary license buyout program was introduced for Atlantic salmon in Newfoundland as a conservation measure, and use of

pelagic gillnets within the LOMA is greatly reduced. Herring is currently the dominant pelagic species landed, and accounts for less than 2% of the total landings in the LOMA, and purse seine and traps are responsible for the majority of the catch (Fisheries and Oceans Canada, 2008). As a result, pelagic gillnets are not considered a key activity within the LOMA. **Screened out**

Longline:

Landings by longline in the LOMA totalled just 2% from 1998 - 2007 (Fisheries and Oceans Canada, 2007). They are used to target cod, skate, white hake and halibut in the LOMA. Large pelagics are also targeted using longline along the edges of the Grand Bank. Although surface cuts from lines and hooks may be sustained by the whale during such encounters, serious injury is unlikely to be a significant stressor to all cetaceans in the LOMA. **Screened out.**

Seine (pelagic):

Groundfish landings by Scottish seine in the LOMA (Fisheries and Oceans Canada, 2007) are minimal, and restricted to a very small area. They are used to target cod and yellowtail flounder, both of which are primarily caught by otter trawl, with seine being a secondary gear. While this is a potential threat for entanglement with marine mammals, the activity occurs to a very small extent. **Screened out.**

Crab pots:

The Grand Banks: Atlas of Human Activities shows significant use of crab pots within the LOMA, particularly off the south coast, northeastern areas of the LOMA and areas of the shelf edge and slope (Fisheries and Oceans Canada, 2007). Crab pots may be set singly or in strings, and are attached by ropes to surface buoys. In Newfoundland waters, crab pots are generally linked together in a long chain by “groundlines” which float in the water column many meters off the bottom. Both ground lines and lines to surface buoys are responsible for frequent entanglement of large marine mammals such as humpback whales. Entanglement of whales in crab pot lines are rare but do occur, and may be significant given their low numbers. The use of lead (heavy) groundlines is a potential mitigation which can minimize entanglement in crab pots, but this mitigation is not widely adopted. **Screened in.**

Whelk pots:

Whelk pots can be set singly or in strings, and are attached by ropes to surface buoys. Both ground lines and lines to surface buoys are responsible for entanglement of large marine mammals and leatherback turtles. The whelk fishery within the LOMA is currently focused on St. Pierre Bank and average annual landings (1998-2007) amount to 571t or about 0.7% of the total landings for the LOMA (Fisheries and Oceans Canada, 2008). As a result, whelk pots are not considered a key activity or stressor within the LOMA. **Screened out.**

Vessel traffic:

Vessel traffic causes significant noise which affects the ability of cetaceans to feed and communicate. Vessel traffic also causes physical disturbance of cetaceans during feeding, resting or sleeping at or near the sea surface. Vessel traffic within the LOMA ranges from low to high, but overall has a moderate traffic density. Although noise from vessel traffic

may cause minor impacts to blue whales, it is not considered to be a key stressor. **Screened out.**

Ship strikes:

Historical records suggest that fatal ship strikes involving whales first began in the late 1800s when ships began to reach speeds of 13-15 knots, and increased over the last 50 years as the number and speed of ships increased. Laist et al. (2001) reports that most lethal or severe injuries are caused by ships 80 m or longer, traveling 14 knots or faster (Laist et al., 2001). A number of major shipping routes traverse the LOMA, and whales may be particularly vulnerable to ship strikes due to their large size. **Screened in.**

Seismic exploration:

Seismic exploration is known to cause significant harmful disturbance to cetaceans, and extensive seismic exploration is planned within the LOMA, particularly in the Northeast and Laurentian Channel areas. Mitigations are in place to help minimized the physical impacts of seismic activity, but the widespread disturbance to whale movement patterns and communication may be significant. **Screened in.**

Navy sonar:

Navy sonar has been known to cause disturbance to cetaceans, but this area is not a naval training area, largely because of the high frequency of fishing vessels. **Screened out.**

Oil pollution:

A number of major shipping routes traverse the LOMA, resulting in chronic oil release and the risk of large and small spills. Offshore oil exploration and production continue within the LOMA, with associated oil releases in produced water and accidental spills. Ports and urban runoff are sources of oil pollution in coastal waters, particularly Placentia Bay, Conception Bay and St. John's Harbour. Cetaceans are highly mobile and are able to avoid oil spills. However, at times, oil can foul the skin or be ingested through breathing or feeding at the site of a spill, or through ingestion of contaminated prey, causing soft tissue irritation and accumulation of toxins in the blubber. Whales are not particularly sensitive to oil pollution, and the risk of interaction between a whale and an oil spill within the LOMA is relatively low and so this is not considered a key stressor. **Screened out.**

Persistent organic pollutants (POPs):

Large baleen whales such as humpbacks, fin and blue whales, feed very low on the food chain, with krill and capelin being their preferred prey. As a result, they do not tend to accumulated POPS to a significant extent, but the smaller piscivorous whales such as belugas, pot heads, dolphin, porpoises and killer whales may be at greater risk. For example, high contaminant levels in beluga whales in the St. Lawrence Estuary (SLE) where a subject of significant concern in the 1980s, although recent data indicates an exponential decrease most POPS in SLE beluga blubber samples between 1987 and 2002 (Lebeuf et al., 2007).

Levels of POPs are generally reported to be low in Newfoundland and Labrador waters (Pierce et al., 1998), and since the CP is highly mobile, and a significant component of the

CP (baleen whale species) feed at a low trophic level, POPs are not considered to be a key stressor. **Screened out.**

Ghost nets:

Ghost nets are fishing gear that have been lost or discarded at sea. Since the 1960s, fishing nets have been constructed from highly durable plastic materials such as nylon which do not biodegrade. Unlike their natural predecessors, the new materials can last for years or decades in the marine environment, are largely impervious to biodegradation, and are resistant to chemicals and abrasion (National Academy of Sciences, 2008). Sun exposure can lead to photodegradation of some synthetic materials, but on the sea bottom, protected from UV radiation, there is no evidence that these nets weaken or degrade over time and as a result, lost gear can continue to fish for decades.

Gillnets, traps, trawls and line fisheries are considered the most harmful in relation to derelict fishing gear (National Academy of Sciences, 2008). Most ghost nets are anchored to the bottom, and incidents of entanglement of cetaceans within the LOMA are thought to be minimal. **Screened out.**

Litter:

Scientists have documented the consumption of plastic by 177 marine species, including 26 marine mammal species (The Marine Debris Team, 2005). Because cetaceans feed and rest on the sea surface where plastic debris tends to accumulate, they are prone to ingestion and entanglement resulting in morbidity and mortality. Marine debris accumulates at convergence zones, where prey is also naturally concentrated, and the magnitude of the threat that ingestion of marine debris poses may be grossly underestimated (James & Herman, 2001). Fishing boats and ships are a major source of litter. **Screened in.**

Temperature change:

Temperature change may have significant effects on distribution of key cetacean prey species such as capelin. A temperature change of less than 0.3°C is anticipated for this area over the next decade but is unlikely to cause significant loss of prey for highly mobile species such as cetaceans. **Screened out.**

Ocean acidification:

Ocean acidification affects the conductivity of seawater, which in turn affects the transmission of sound through water. As a result, ocean acidification intensifies the noise pollution in the ocean, reducing the ability of cetaceans to feed and communicate. Climate change models indicate that the Grand Banks are unlikely to be significantly impacted by ocean acidification over the next ten years, particularly in comparison to other areas of the Atlantic. **Screened out.**

Current shifts:

Climate change models project a slow down in the thermohaline circulation, the large-scale ocean circulation driven by fluxes of heat and salinity at the ocean surface. Cold water is more dense than warm water and so tends to sink, but saline water is more dense than freshwater and also tends to sink. The strength of this circulation depends on a subtle

balance between the rate of cooling and the input of less dense freshwater from melting ice sheets, precipitation and river runoff in sub-polar regions, and the rate of heating and evaporation in the tropics. Currently, thermal forcing dominates and circulation is driven by the sinking of cold water in polar regions, but without the temperature effects, circulation would reverse, with sinking in the tropics and rising in the sub-polar regions (Drijfhout, 2008). In the north Atlantic, the Gulf Stream is a warm, shallow (0-1500m), northeast flow, giving off heat and sinking as it moves north, returning as a deep (1500m-3,000m), cold, southwest flow. Global models generally show that Atlantic thermohaline circulation weakens by 15% to 50% with a doubling of atmospheric CO₂ (as predicted in moderate climate change scenarios by 2100), but the weakening will not occur in a simple linear manner. The actual amount of CO₂ is less important than the rate of increase – little happens at first as the circulation rapidly dilutes the freshwater, but there is a well defined threshold beyond which the thermohaline circulation cannot cope with additional freshwater and breaks down (Rahmstorf, 1997b). As a result, the thermohaline circulation can be subject to sudden transitions (linked to melting sub-polar ice sheets) which could lead to abrupt climate change, but this is not anticipated during the century (Drijfhout, 2008).

Current shifts may have significant effects on distribution of whale prey species. Even small fluctuations in ocean currents have led to the collapse of fish stocks and sea-bird populations in the past (Rahmstorf, 1997a). Changing ocean currents have also been linked to localized changes in temperature and salinity, and changes development and overturn of thermoclines, all of which may affect cetacean aggregation and feeding. Researchers in both Greenland and Antarctica have found the sinking of super-cooled water has weakened significantly, with Greenland now less than one quarter its former strength, and Antarctica one third of what it was a century ago (Gribbin, 2001; Leake, 2005), but significant changes are not expected in the near future. **Screened out.**

Harmful algal blooms (HABs):

The last 20 years have seen a drastic increase in harmful algal blooms worldwide, including Placentia Bay. Ballast water is considered a major vector of HABs, and climate change is expected to further promote the frequency of HAB, therefore high ship traffic, and Placentia Bay's southern location may increase its susceptibility to HABs. Harmful algal blooms of concern in the LOMA include toxic (PSP, ASP, DSP, Spirolides, Yessotoxin, Pectenotoxin). PSP (paralytic Shellfish poisoning) is among the most toxic HABs, with small quantities leading to rapid paralysis and death. HABs can accumulate in the foodchain leading to mortality of marine organisms at all trophic levels including zooplankton, fish, seabirds and marine mammals (Agriculture and Consumer Affairs, 2004) (Sindermann, 2003).

Species at the top of the foodchain such as piscivorous fish, sea birds and marine mammals are also vulnerable, as are baleen whales that consume large quantities of small pelagic fish and invertebrates. A recent discovery is that more than half of all marine mammal mortalities in US water are now attributed to marine biotoxins (UNESCO-IOC, 2009). Improved techniques and increased sampling of animal tissues may account for this apparent increase. **Screened in.**

Key Activities/Stressors:

- Gillnets (groundfish)
- Crab pots
- Ship strikes
- Seismic exploration
- Litter
- Harmful Algal Blooms

Reference List

1. Agriculture and Consumer Affairs (2004). Marine Biotoxins. *FAO Food and Nutrition Papers*.
2. Belden, D. L., Orphanides, C. D., Rossman, M. C., & Palka, D. L. (2006). *Estimates of Cetacean and Seal Bycatch in the 2004 Northeast Sink Gillnet and Mid-Atlantic Coastal Gillnet* (Rep. No. Reference Document 06-13). Northeast Fisheries Science Center, NOAA, U.S. Department of Commerce.
3. Davoren, G. K., Anderson, J. T., & Montevecchi, W. A. (2006). Shoal behaviour and maturity relations of spawning capelin (*Mallotus villosus*) off Newfoundland: demersal spawning and diel vertical movement patterns. *Can.J.Fish.Aquat.Sci.*, 63, 268-284.
4. Drijfhout, S. (2008). *Changes in the Atlantic Meridional Overturning Circulation* (Rep. No. 2005-2006 Biennial Reports). KNMI (Royal Netherlands Meteorological Institute).
5. Fisheries and Oceans Canada. (2007). The Grand Banks of Newfoundland: Atlas of Human Activities. The Grand Banks of Newfoundland: Atlas of Human Activities . Fisheries and Oceans Canada.
Ref Type: Map
6. Fisheries and Oceans Canada. (2008). 1998-2007 3LMNOP4R Effort and Catch. Policy and Economics Branch. [Newfoundland and Labrador Region Catch and Effort]. Fisheries and Oceans Canada.
Ref Type: Data File
7. Gribbin, J. (2001). Ocean Forces Threaten our climate. First Science [On-line]. Available: http://www.firstscience.com/home/articles/earth/ocean-forces-threaten-our-climate-page-3-1_125
8. James, M. C. & Herman, T. B. (2001). Feeding of *Dermochelys coriacea* on Medusae in the Northwest Atlantic. *Chelonian Conservation and Biology*, 4, 202-205.
9. Johnson, A., Salvador, G., Kenney, J., Robbins, J., Kraus, S., Landry, S. et al. (2005). Fishing Gear Involved in Entanglements of Right and Humpback Whales. *Marine Mammal Science*, 21, 635-645.
10. Laist, D. W., Knowton, A. R., Meade, J. G., Collet, A. S., & Podesta, M. (2001). Collisions Between Ships and Whales. *Marine Mammal Science*, 17, 35-75.
11. Leake, J. (2005). Britain faces big chill as ocean current slows. *The Sunday Times*.
12. Lebeuf, M., Noel, M., Trottier, S., & Measures, L. (2007). Temporal Trends (1987-2002) of persistent, bioaccumulative and toxic chemicals in beluga whale

- (Delphinapterus leucas) from the St. Lawrence estuary, *Canad. Sci. Total Environ.*, 383, 216-231.
13. Ledwell, W. & Huntington, J. (2007). *Whale and leatherback sea turtles incidental entrapment in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2006* A Report to the Department of Fisheries and Oceans, St. John's, Newfoundland and Labrador, Canada.
 14. National Academy of Sciences (2008). *Tackling Marine Debris in the 21st Century*.
 15. Pierce, R. C., Whittle, D. M., & Bramwell, J. B. ed. (1998). Chemical Contaminants in Canadian Aquatic Ecosystems. *Fisheries and Oceans Canada, Ottawa, ON*.
 16. Rahmstorf, S. (1997a). Risk of Sea-change in the Atlantic. *Nature*, 388, 825-826.
 17. Rahmstorf, S. (1997b). Risk of sea-change in the Atlantic. *Nature*, 388, 825-826.
 18. Read, A. J., Drinker, P., & Northridge, S. (2003). *By-catches of Marine Mammals in U.S. Fisheries and a First Attempt to Estimate the Magnitude of Global Marine Mammal By-catch* (Rep. No. Scientific Committee Document SC/55/BC). Cambridge, UK: International Whaling Commission.
 19. Sindermann, C. J. (2003). *Coastal Pollution*.
 20. Templeman, N. D. & Davis, M. B. (2006). *Placentia Bay-Grand Banks Ecosystem Overview and Assessment Report (DRAFT)* Newfoundland & Labrador: Fisheries and Oceans Canada.
 21. The Marine Debris Team, C. U. (2005). *The Marine Debris Research, Prevention and Reduction Act: A Policy Analysis*.
 22. UNESCO-IOC (2009). *Intergovernmental Panel on Harmful Algal Blooms, National Statement:USA* (Rep. No. Ninth Session).

Cetaceans in Placentia Bay Grand Banks LOMA

Gillnet (bottom)

Magnitude of Interaction

Areal extent:

- Whales have not been systematically surveyed around Newfoundland and distribution maps rely largely on opportunistic reporting. Fuller and Myers (2004) reported that marine mammal sightings are highest on the shallower waters of the banks, and rare past the edge of the continental shelf (Fuller, S. D. & Myers, R. A., 2004), but Templeman and Davis (2006) state that on the Grand Banks, whales have often been observed along the shelf break and in deep water basins (Templeman, N. D. & Davis, M. B., 2006).
- In general cetacean distributions in the LOMA often reflect areas of high productivity that support dense zooplankton patches and small fish schools (e.g., herring or capelin), and seems to correlate well with distribution of other species, such as seabirds.
- Important feeding areas for cetaceans have been identified within the PBGB LOMA (Templeman, N. D., 2007), with -Supplementary information provided by Lawson *et al.* as shown on Figure 1 below:

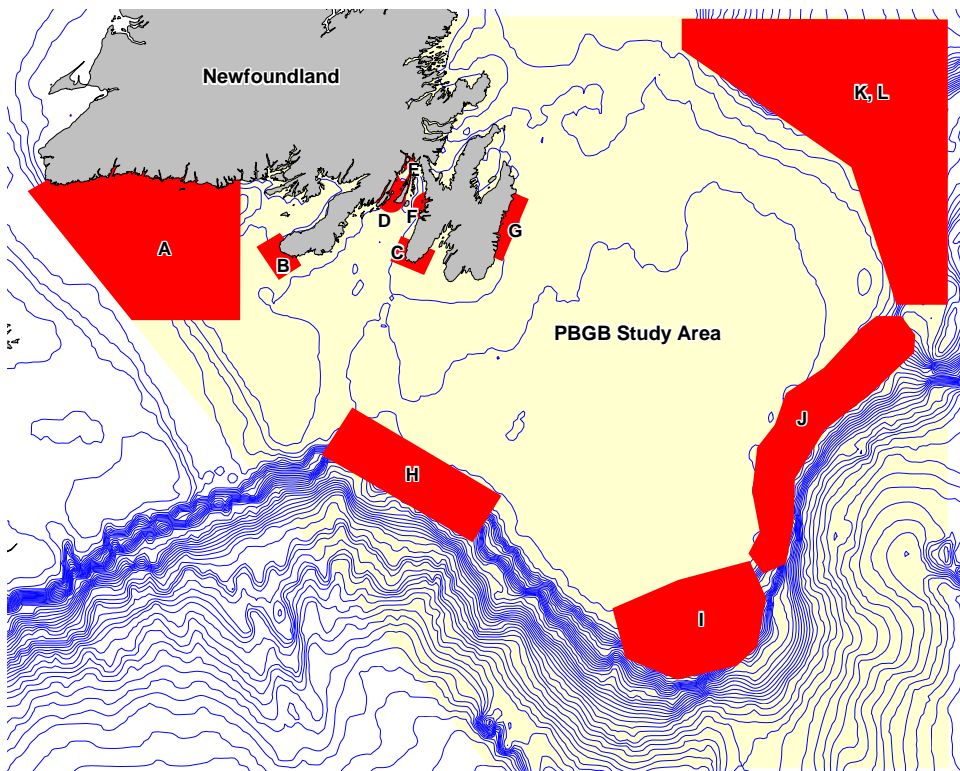


Figure. 1 Important Cetacean areas within the PBGA LOMA (Lawson, J., Sjare, B., & Stenson, G., 2007)

- The distribution of cetaceans on the Grand Banks was also discussed by Coughlan (Coughlan, G., 2002) (Figure 2) and Fuller and Meyers, 2004 (Fuller, S. D. & Myers, R. A., 2004) (Figure 3):

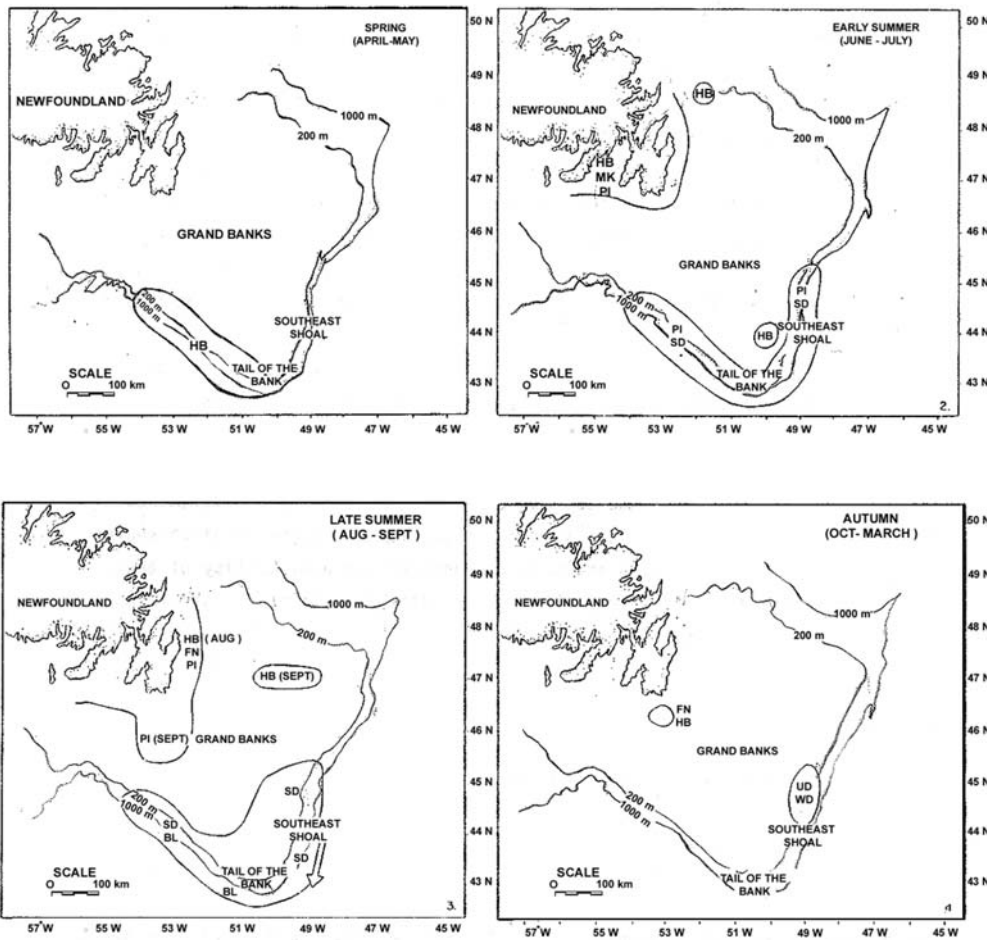


Figure. 2 Seasonal Distribution of Whales on the Grand Banks, 1980-81 (Coughlan, G., 2002). (BL–blue whale, FN–Fin, MK–minke, HB–humpback, PI–pilot SD–Saddleback dolphin, WD–whitebeaked dolphin, UD–unidentified).

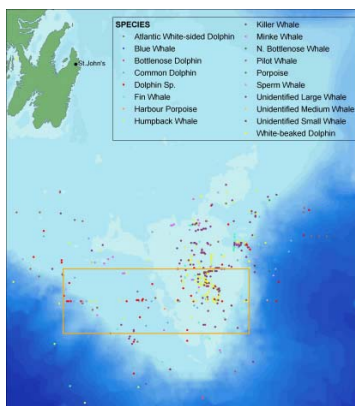


Figure. 3 Cetacean sightings collected opportunistically from research surveys and fisheries observer reports from 1979-1999 (Fuller, S. D. & Myers, R. A., 2004).

- This information indicates that cetaceans are broadly distributed throughout the LOMA, with greatest densities along the shelf break, and southern coastal areas.
- Geo-referenced demersal gillnet fishing locations are available for vessels over 35ft (Fig. 4 below) with major demersal gillnet fisheries in the LOMA targeting American plaice, Atlantic cod, grey sole, witch flounder, haddock, white hake, halibut, lumpfish, pollock, redfish Greenland halibut, skate, and winter flounder.

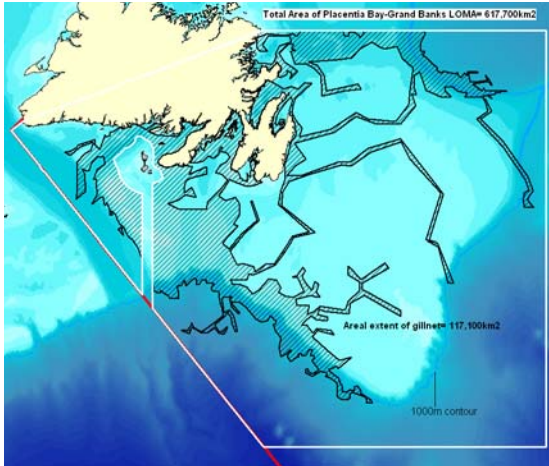


Figure. 4 Areal extent of gillnet fisheries (vessels > 35ft), Newfoundland Region fisheries, 1998-2007 (Fisheries and Oceans Canada, 2008). Areal extent of gillnet (108,000km²).

- This fishing activity occurs in over (117,100 km²/617,700 km²) 19.0% of the LOMA, most of it concentrating in southern coastal areas and the Southwest Shelf Edge and Slope.
- There is also a significant inshore gillnet fishery, largely targeting cod (3Ps), lumpfish and winter flounder.
- Based on this information we have estimated an area of overlap of 25%

Score 2.5

Contact:

- Quantitative Fishing Gear Scores (Fisheries and Oceans Canada, 2007a) for contact between bottom gillnets and cetaceans are low (occasionally 1-25%), yet Read *et al* found that 84% of cetaceans bycatch occurred in gill net fisheries (Read, A. J., Drinker, P., & Northridge, S., 2003).
- Since most experts seem to agree that gillnets are one of the most problematic gear types in relation to cetacean entanglement (Belden, D. L., Orphanides, C. D., Rossman, M. C., & Palka, D. L., 2006; Davoren, G. K., Anderson, J. T., & Montevecchi, W. A., 2006; Johnson, A. et al., 2005), we have selected a score at the low end of the medium range.

Score 4

Duration:

- Cetaceans are present in the LOMA throughout the year, although highest densities occur in summer (Coughlan, G., 2002) (Templeman, N. D., 2007).

- Bottom gillnet fishing is open within the LOMA for one or more fisheries all year round (100% of the time).

Score 10

Intensity:

- Global maps (Halpern, B. S. et al., 2008) for demersal non-destructive fisheries with high bycatch, which include gillnets, shows medium (light blue) to high (orange) intensity relative to global levels, for a score range of 20% to 80% (see Figure 5 below). This map can be used to provide guidance in scoring the intensity of a stressor in relation to maximum (100%) intensity in a global context, in accordance with the scale provided below. Halpern’s fishing maps are based on (1999-2003) data, and better represent NAFO fisheries, which are notoriously variable year to year, rather than Canadian fisheries, and are not as spatially precise on a local scale as long term local data is.

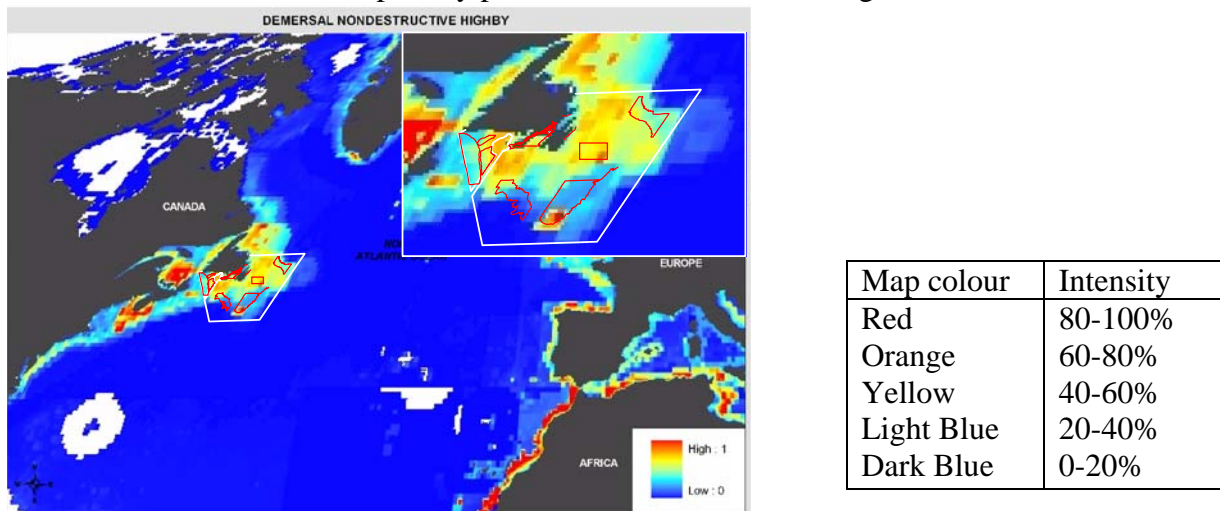


Figure 5. Global intensity of demersal non-destructive fisheries (adapted from (Halpern, B. S. et al., 2008)).

- Gillnet fisheries within the LOMA represented an average of 9% of the landings from 1998-2007, however in the Southwest Shelf Edge and Slope EBSA, gillnets accounted for 30% of landings from 1998 - 2007 (Fisheries and Oceans Canada, 2008).
- We have selected an intermediate score, suggested by Halpern’s map, of 50%.

Score 5

Magnitude of Interaction: $(2.5 \times 4 \times 10 \times 5) / 1000 = 0.5$

Sensitivity:

Sensitivity of the CP to acute impacts:

- Quantitative Fishing Gear Scores (Fisheries and Oceans Canada, 2007b) for *harm* resulting from an interaction between bottom gillnets and cetaceans are low (occasionally 1-25%), yet Read *et al* found that 84% of cetaceans bycatch in US fisheries (1990-1999) occurred in gill nets (Read, A. J., Drinker, P., & Northridge, S., 2003), and most experts seem

to agree that gillnets are one of the most problematic gear types in relation to cetacean entanglement (Belden, D. L., Orphanides, C. D., Rossman, M. C., & Palka, D. L., 2006; Davoren, G. K., Anderson, J. T., & Montevecchi, W. A., 2006; Johnson, A. et al., 2005). Global bycatch estimates of cetaceans in gillnet fisheries range from 218,513 to 466,392 annually between 1990 and 1994 (Read, A. J., Drinker, P., & Northridge, S., 2003).

- Off Newfoundland, humpback and minke whales are the two species most involved in entanglements: The Whale Research Group of Memorial University and the Whale Release and Strandings Program recorded entrapment of 770 humpback whales, 158 minke whales, and more than 180 other large whales in fishing gear in Newfoundland and Labrador from 1979 to 2006 (Ledwell, W. & Huntington, J., 2007).
- Prior to 1990 most reported entanglements of humpback and minke whales were in inshore cod traps and groundfish gillnets (Lien, J., 1994), but entanglement offshore gear such as cod gillnets and snow crab pots is becoming more common (Ledwell, W. & Huntington, J., 2007) as the offshore fishery began to dominant.
- Acute impacts due to entrapment may vary in severity from trivial to lethal depending on the species, and the extent of the entanglement. Mortality in Newfoundland humpbacks reported entrapped was 16% but 70% in minke whales (Lien, J., 1994).
- For large whales, it is apparent from the scarring data that, in many cases, entanglements are not fatal, since the animals are often powerful enough to carry large amounts of gear away with them.
- However, small whales, dolphins and porpoises often die because they aren't strong enough to break free and come to the surface to breathe.
- Although Quantitative Fishing Gear Score (Fisheries and Oceans Canada, 2007b) scores for *harm* are low, we have selected a score in the medium range since gillnets have been identified as one of the most problematic gear types in relation to cetacean entanglement (Belden, D. L., Orphanides, C. D., Rossman, M. C., & Palka, D. L., 2006; Davoren, G. K., Anderson, J. T., & Montevecchi, W. A., 2006; Johnson, A. et al., 2005; Read, A. J., Drinker, P., & Northridge, S., 2003).

Score 5

Sensitivity of the CP to chronic impacts:

- Cetaceans are long-lived and have low reproductive rates, making them particularly vulnerable to exploitation and other population stress. For example, the annual rate of population increase in sperm whales has been estimated to approximately 1 percent. Populations for some whale species have still not returned to historical levels since whaling from the 19th and early 20th century reduced populations to very low levels (Report to the Standing Committee on Small cetaceans, 2002).
- The blue whale is thought to live to 75 years, while the smaller minke whale lives to 30 and 40 years and does not mature until 6 to 8 years (Templeman, N. D. & Davis, M. B., 2006). Population trends in cetaceans are difficult to measure due to the imprecise nature of population estimates and limited availability of data.
- Chronic impacts of entanglement can range from minor rope scars, to debilitating injuries, or moderate to severe morbidity due to gear remaining attached or imbedded in the cetacean. In these cases, the ability of the whale to move and feed may be compromised by injuries, interference with vital body functions (rope/netting confining

- Whales towing gear for any length of time are unlikely to free themselves, and are more likely to become entangled again.
- Given the poor recovery rate for serious interactions, and low reproductive rates of cetaceans, we have selected a moderate score (5.5) for chronic sensitivity.
- Of the 13 species making up the CP, two are listed by COSEWIC as *endangered* (blue whale northern bottlenose whale) and two are listed as *special concern* (fin whale, and the harbour porpoise).
- Blue whales are listed as a depleted or rare species for the LOMA (Fisheries and Oceans Canada, 2007b) (**add 0.5**)

Score 6

Sensitivity of ecosystem to harmful impacts to the CP:

- The role of cetaceans in the food web is complex as they range from top predators such as the killer whale which consumes fish, squid as well as seals and other whales, to large baleen whale which are relatively low on the foodchain despite their large size, and consume enormous quantities of krill, copepods, zooplankton, and small fish.
- Despite their relatively small numbers, they represent a significant biomass due to their large size, and contribute significantly to the energetics of the marine ecosystem. Most species are highly mobile, and their large scale movements contribute to the transfer of energy and biomass from seasonally productive areas to distant marine systems.
- Dead whales also contribute significantly to the productivity of the marine ecosystem, with their large carcasses providing food for fish, sharks, birds and decomposers.
- Cetaceans, by virtue of their high visibility, and charismatic nature have long attracted human attention, and can be used as indicators of the health and stability of marine ecosystems.
- Cetaceans hold an important place in our history, culture and economy. Whale watching contributes significantly to ecotourism in the LOMA. The Witless Bay Seabird Sanctuary Ecological Reserve hosts as many as 10 to 15 tour boats per day during the peak of the season, and the industry is growing throughout coastal areas of the LOMA.
- Cetaceans represent a significant and important component of the LOMA, and the LOMA provides important feeding habitat for the CP, so we have selected a score in the medium range (5)
- Cetaceans are listed as Ecologically Significant Species (ESS) within the LOMA (Fisheries and Oceans Canada, 2007b) (**add 1 point**).

Score 6

Sensitivity: $(5 + 6 + 6)/3 = 5.7$

Risk of Harm: $0.5 \times 5.7 = 2.9$

Certainty Checklist

Answer yes or no to all of the following questions. Record the number of NO's to the 9 questions, and record certainty according to the scale provided below:

- 1 No's = High certainty
- 2- 3 No's = Medium certainty
- ≥ 4 No's = Low certainty

Y/N

- Y Is the score supported by a large body of information?
- N Is the score supported by general expert agreement?
- N Is the interaction well understood, without major information gaps/sources of error?
- Y Is the current level of understanding based on empirical data rather than models, anecdotal information or probable scenarios?
- Y Is the score supported by data which is specific to the region, (EBSA, LOMA, NW Atlantic)?
- Y Is the score supported by recent data or research (the last 10 years or less)?
- Y Is the score supported by long-term data sets (ten years or more) from multiple surveys (5 years or more)?
- Y Do you have a reasonable level of comfort in the scoring/conclusions?
- N Do you have a high level of confidence in the scoring/conclusions?

Score: Medium

For interactions with Low certainty, underline the main factor(s) contributing to the uncertainty

Lack of comprehensive data

Lack of expert agreement

Predictions based of future scenarios which are difficult to predict

Other (provide explanation)

Suggest possible research to address uncertainty:

Improved observer coverage of gillnet fisheries

Reference List

1. Belden, D. L., Orphanides, C. D., Rossman, M. C., & Palka, D. L. (2006). *Estimates of Cetacean and Seal Bycatch in the 2004 Northeast Sink Gillnet and Mid-Atlantic Coastal Gillnet* (Rep. No. Reference Document 06-13). Northeast Fisheries Science Center, NOAA, U.S. Department of Commerce.
2. Coughlan, G. (2002). *The Southeast Shoal Area of the Grand Banks of Newfoundland, Potential as a Marine Protected Area: A Biophysical and Socio-economic Area Examination*. Faculty of Environmental Design, University of Calgary.
3. Davoren, G. K., Anderson, J. T., & Montevecchi, W. A. (2006). Shoal behaviour and maturity relations of spawning capelin (*Mallotus villosus*) off Newfoundland: demersal spawning and diel vertical movement patterns. *Can.J.Fish.Aquat.Sci.*, 63, 268-284.
4. Fisheries and Oceans Canada (2007a). Draft proceedings of the Workshop on Qualitative Risk Assessment of Fishing Gears. In Government of Canada.
5. Fisheries and Oceans Canada (2007b). *Placentia Bay-Grand Banks Large Ocean Management Area Conservation Objectives* (Rep. No. 2007/042). Canadian Science Advisory Secretariat Science Advisory Report.
6. Fisheries and Oceans Canada. 1998-2007 3LMNOP4R Effort and Catch. Policy and Economics Branch. [Newfoundland and Labrador Region Catch and Effort]. 2008. Fisheries and Oceans Canada.
Ref Type: Data File
7. Fuller, S. D. & Myers, R. A. (2004). *The Southern Grand Bank: a marine protected area for the world* Halifax: World Wildlife Fund Canada.
8. Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C., Bruno, J. F., Casey, K. S., Ebert, C., Fox, H. E., Fujita, R., Heinemann, D., Lenihan, H. S., Madin, E. M. P., Perry, M. T., Selig, E. R., Spalding, M., Steneck, R., & Watson, R. (2008). A Global Map of Human Impact on Marine Ecosystems. *Science*, 319, 948-952.
9. Johnson, A., Salvador, G., Kenney, J., Robbins, J., Kraus, S., Landry, S., & Clapham, P. (2005). Fishing Gear Involved in Entanglements of Right and Humpback Whales. *Marine Mammal Science*, 21, 635-645.
10. Lawson, J., Sjare, B., & Stenson, G. Supplementary information on marine mammals. Templeman, N. D. Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas . Canadian Science Advisory Secretariat Research Document 052. 2007. Fisheries and Oceans Canada.

11. Ledwell, W. & Huntington, J. (2007). *Whale and leatherback sea turtles incidental entrapment in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2006* A Report to the Department of Fisheries and Oceans, St. John's, Newfoundland and Labrador, Canada.
12. Lien, J. (1994). *Entrapments of large cetaceans in passive inshore fishing gear in Newfoundland and Labrador (1979-1990)*. (Rep. No. Reports of the International Whaling Commission, Special Issue 15).
13. Read, A. J., Drinker, P., & Northridge, S. (2003). *By-catches of Marine Mammals in U.S. Fisheries and a First Attempt to Estimate the Magnitude of Global Marine Mammal By-catch* (Rep. No. Scientific Committee Document SC/55/BC). Cambridge, UK: International Whaling Commission.
14. Report to the Standing Committee on Small cetaceans (2002). International Whaling Commission. *Journal of Cetatean Research & Management (Supplement)*, 4, 338.
15. Templeman, N. D. (2007). *Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas* (Rep. No. 2007/052). Canadian Science Advisory Secretariat Research Document, Fisheries and Oceans Canada.
16. Templeman, N. D. & Davis, M. B. (2006). *Placentia Bay-Grand Banks Ecosystem Overview and Assessment Report (DRAFT)* Newfoundland & Labrador: Fisheries and Oceans Canada.

Cetaceans in Placentia Bay Grand Banks LOMA

Crab pots

Magnitude of Interaction

Areal extent:

- Whales have not been systematically surveyed around Newfoundland and distribution maps rely largely on opportunistic reporting. Fuller and Myers (2004) reported that marine mammal sightings are highest on the shallower waters of the banks, and rare past the edge of the continental shelf (Fuller, S. D. & Myers, R. A., 2004), but Templeman and Davis (2006) state that on the Grand Banks, whales have often been observed along the shelf break and in deep water basins (Templeman, N. D. & Davis, M. B., 2006).
- In general cetacean distributions in the LOMA often reflect areas of high productivity that support dense zooplankton patches and small fish schools (e.g., herring or capelin), and seems to correlate well with distribution of other species, such as seabirds.
- Important feeding areas for cetaceans have been identified within the PBGB LOMA (Templeman, N. D., 2007), with supplementary information provided by (Lawson, J., Sjare, B., & Stenson, G., 2007) as shown on Figure 1 below:

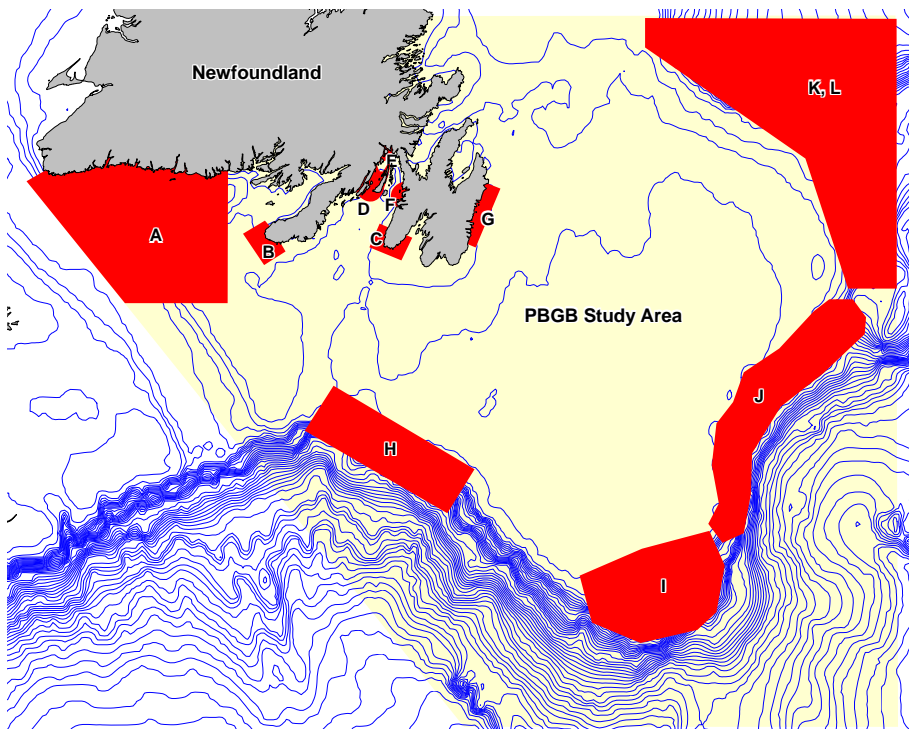


Figure 1. Important Cetacean areas within the PBGA LOMA (Lawson, J., Sjare, B., & Stenson, G., 2007)

- The distribution of cetaceans on the Grand Banks was also discussed by Coughlan (Coughlan, G., 2002) (Figure 2) and Fuller and Meyers, 2004 (Fuller, S. D. & Myers, R. A., 2004) (Figure 3):

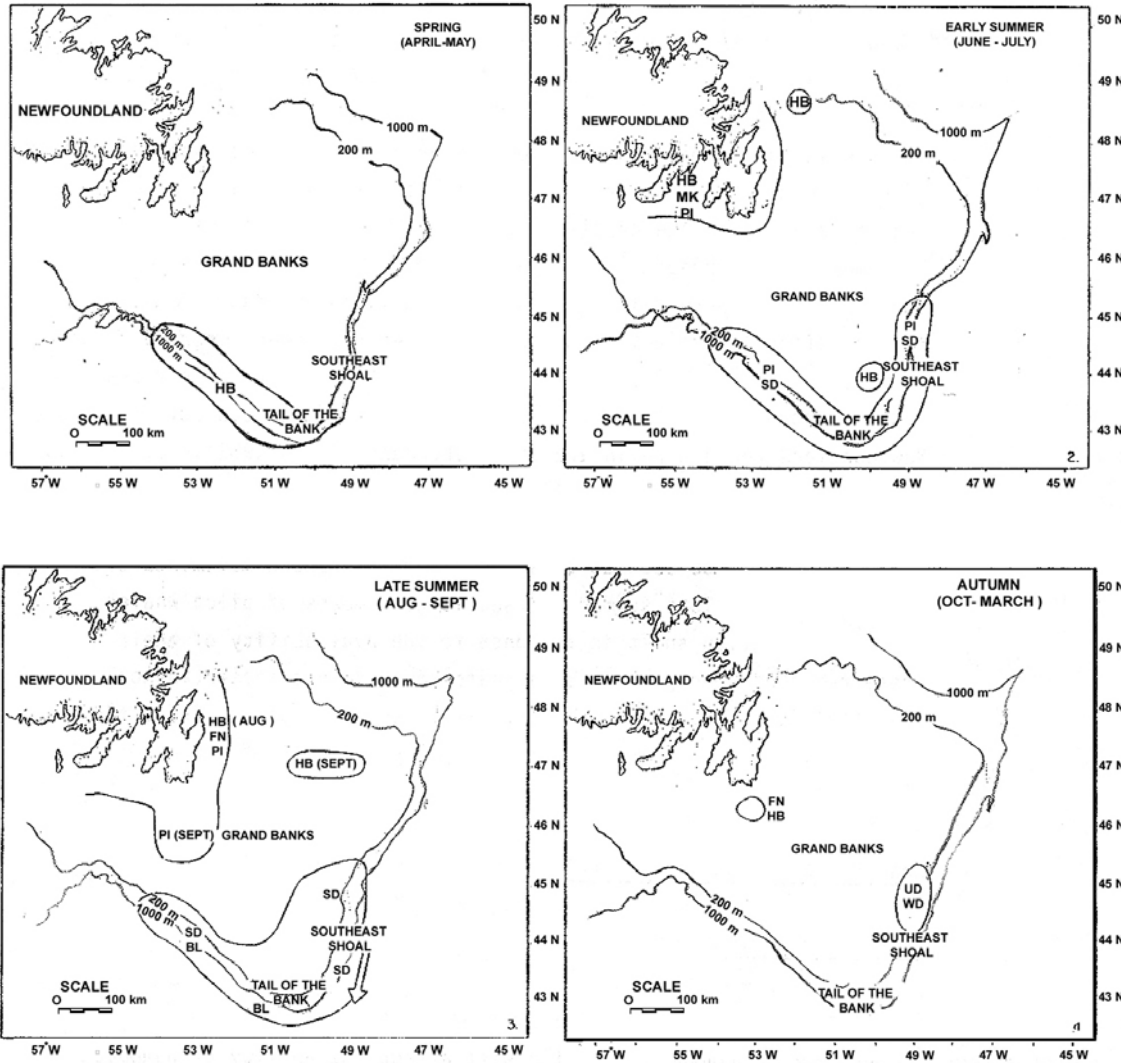


Figure 2. Seasonal Distribution of Whales on the Grand Banks, 1980-81 (Coughlan, G., 2002). (BL–blue whale, FN–Fin, MK–minke, HB–humpback, PI–pilot SD–Saddleback dolphin, WD–whitebeaked dolphin, UD–unidentified).

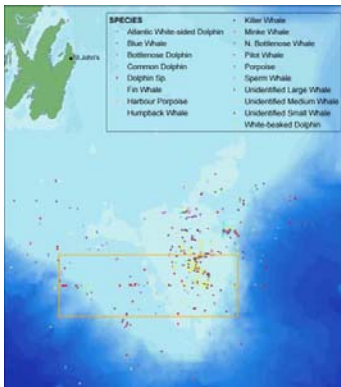


Figure 3. Cetacean sightings collected opportunistically from research surveys and fisheries observer reports from 1979-1999 (Fuller, S. D. & Myers, R. A., 2004).

- This information indicates that cetaceans are broadly distributed throughout the LOMA, with greatest densities along the shelf breaks, and southern coastal areas.
- Geo-referenced fishing locations for crab pots are available for vessels over 35ft are shown on Figure 4 below.

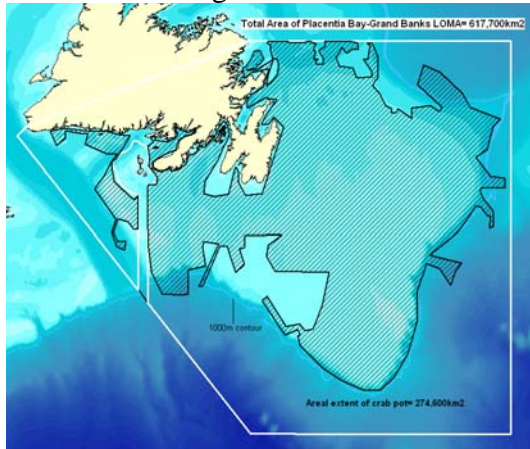


Figure 4. Areal extent of Snow Crab Pots (vessels > 35ft), Newfoundland Region fisheries, 1998-2007 (Fisheries and Oceans Canada, 2008). Areal extent (274,600km²)

- The snow crab fishery (vessels over 35ft) is conducted in an area (274,600 km²/ 617,700km²) encompassing 44.5% of the LOMA, including a significant portion of the southern LOMA.
- There is also a significant inshore crab fishery (vessels under 35'), accounting for a significant portion of the total landings for the LOMA from 1998-2007.
- Based on this information we have estimated an area of overlap of 70%.

Score 7

Contact:

- Quantitative Fishing Gear Scores (DFO 2007) for contact between snow crab pots and cetaceans are low (1-25% of the time), but province's Whale Release and Strandings Program reported significant entrapment of cetaceans in crab pots (Ledwell, W. & Huntington, J., 2007).
- Based on this information we have selected a score at the high end of the low range.

Score 3.5

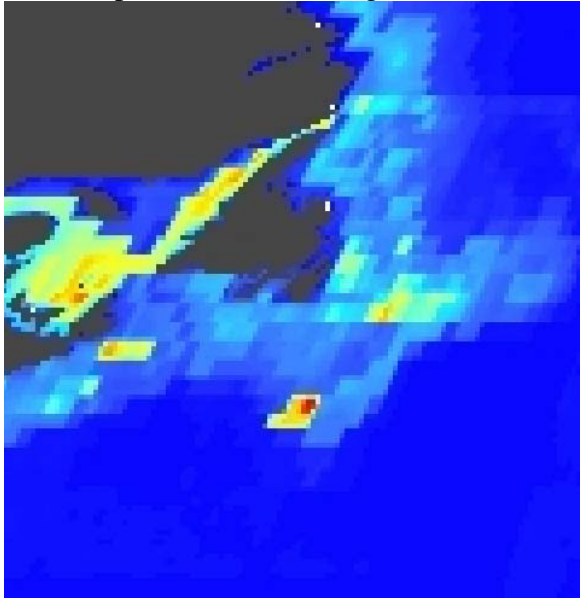
Duration:

- Cetaceans are present in the LOMA throughout the year, although highest densities occur in summer (Coughlan, G., 2002) (Templeman, N. D., 2007), April- Oct (~210 days)
- Snow crab fishing is open within different areas of the LOMA at slightly different times between April 10 to July 31 (Fisheries and Oceans Canada, 2008) or 63days/ 210 days. This amounts to 30% of the time occupied by the CP.

Score 3

Intensity:

- Halpern *et al.* (2008) have developed maps showing the global intensity of several anthropogenic stressors including a range of fisheries. These maps can be used to provide guidance in scoring the intensity of a stressor in relation to maximum (100%) intensity in a global context in accordance with the scale provided below.
- Halpern's map of demersal non-destructive fisheries with low bycatch, which include crab pots, is shown in Figure 5 below.



Map colour	Intensity
Red	80-100%
Orange	60-80%
Yellow	40-60%
Light Blue	20-40%
Dark Blue	0-20%

Figure 5. Global Intensity of demersal non-destructive fisheries with low bycatch, which include crab pots (adapted from (Halpern, B. S. et al., 2008).

- Figure 5 shows a highly variable intensity relative to global levels but is generally low for a score range of 20% to 40%.
- Since the snow crab fishery accounts for 36% of the landings in the LOMA, excluding vessels less than 35' we have selected a high score in this range.

Score 4

Magnitude of Interaction: $(7 \times 3.5 \times 3 \times 4) / 1000 = 0.3$

Sensitivity:

Sensitivity of the CP to acute impacts:

- Quantitative Fishing Gear Scores (Fisheries and Oceans Canada, 2007) for *harm* resulting from an interaction between crab pots and cetaceans are low (occasionally 1-25%), but the province's Whale Release and Strandings Program reported significant entrapment of cetaceans in crab pots (Ledwell, W. & Huntington, J., 2007).
- Prior to 1990 most reported entanglements of humpback and minke whales were in inshore cod traps and groundfish gillnets (Lien, J., 1994), but entanglement in gear such as snow crab pots has become more common (Ledwell, W. & Huntington, J., 2007) as the shellfish fisheries became more dominant.

- Acute impacts due to entrapment may vary in severity from trivial to lethal depending on the species, and the extent of the entanglement. Mortality in Newfoundland humpbacks reported entrapped was 16% but 70% in minke whales (Lien, J., 1994).
- For large whales, it is apparent from the scarring data that, in many cases, entanglements are not fatal, since the animals are often powerful enough to carry large amounts of gear away with them.
- In contrast, small whales, dolphins and porpoises often die because they aren't strong enough to break free and come to the surface to breathe.
- We have selected a score in the highest score in the low range since crab pots are recognized as a problematic gear types in relation to cetacean entanglement (Belden, D. L., Orphanides, C. D., Rossman, M. C., & Palka, D. L., 2006; Davoren, G. K., Anderson, J. T., & Montevecchi, W. A., 2006; Johnson, A. et al., 2005; Read, A. J., Drinker, P., & Northridge, S., 2003).

Score 3.5

Sensitivity of the CP to chronic impacts:

- Cetaceans are long-lived and have low reproductive rates, making them particularly vulnerable to exploitation and other population stress. For example, the annual rate of population increase in sperm whales has been estimated at approximately 1 percent. Populations for some whale species have still not returned to historical levels since whaling from the 19th and early 20th century reduced populations to very low levels (Report to the Standing Committee on Small cetaceans, 2002).
- The blue whale is thought to live 75 years, while the smaller minke whale, lives to 30 and 40 years and does not mature until 6 to 8 years (Templeman, N. D. & Davis, M. B., 2006). Population trends in cetaceans are difficult to measure due to the imprecise nature of population estimates and limited availability of data.
- Impacts of entanglement can range from minor rope scars, to debilitating injuries, or moderate to severe morbidity due to gear remaining attached or imbedded in the cetacean. In these cases, the ability of the whale to move and feed may be compromised by injuries, interference with vital body functions (rope/netting confining tail, fin or mouth movement) or by the weight of gear. In severe cases, death may occur months or even years later as a result of starvation or chronic infection (Report to the Standing Committee on Small cetaceans, 2002).
- Whales towing gear for any length of time are unlikely to free themselves, and are more likely to become entangled again.
- Given the poor recovery rate for serious interactions, and low reproductive rates of cetaceans, we have selected a moderate score (4) for chronic sensitivity.
- Of the 13 species making up the CP, two are listed by COSEWIC as *endangered* (blue whale, northern bottlenosed whale) and two are listed as *special concern* (fin whale, harbour porpoise). Blue whales are listed as a depleted or rare species for the LOMA (Fisheries and Oceans Canada, 2007) (**add 0.5**)

Score 4.5

Sensitivity of ecosystem to harmful impacts to the CP:

- The role of cetaceans in the food web is complex as they range from top predators such as the killer whale which consumes fish, squid as well as seals and other whales, to large baleen whales which are relatively low on the foodchain despite their large size, and consume enormous quantities of krill, copepods, zooplankton, and small fish.
- Despite their relatively small numbers, they represent a significant biomass due to their large size, and contribute significantly to the energetics of the marine ecosystem. Most species are highly mobile, and their large scale movements contribute to the transfer of energy and biomass from seasonally productive areas to distant marine systems.
- Dead whales also contribute significantly to the productivity of the marine ecosystem, with their large carcasses providing food for fish, sharks, birds and decomposers.
- Cetaceans, by virtue of their high visibility, and charismatic nature have long attracted human attention, and can be used as indicators of the health and stability of marine ecosystems.
- Cetaceans hold an important place in our history, culture and economy. Whale watching contributes significantly to ecotourism in the LOMA. The Witless Bay Seabird Sanctuary Ecological Reserve hosts as many as 10 to 15 tour boats per day during the peak of the season, and the industry is growing throughout coastal areas of the LOMA.
- Cetaceans represent a significant and important component of the LOMA, and the LOMA provides important feeding habitat for the CP, so we have selected a score in the medium range (5)
- Cetaceans are listed as Ecologically Significant Species (ESS) within the LOMA (Fisheries and Oceans Canada, 2007) **(add 1 point)**.

Score 6

Sensitivity: 3.5 +4.5 +6/3=4.7

Risk of Harm: 0.3x 4.7= 1.4

Certainty Checklist

Answer yes or no to all of the following questions. Record the number of NO's to the 9 questions, and record certainty according to the scale provided below:

- 1 No's = High certainty
- 2- 3 No's = Medium certainty
- ≥ 4 No's = Low certainty

Y/N

- N Is the score supported by a large body of information?
- N Is the score supported by general expert agreement?
- N Is the interaction well understood, without major information gaps/sources of error?
- Y Is the current level of understanding based on empirical data rather than models, anecdotal information or probable scenarios?
- Y Is the score supported by data which is specific to the region, (EBSA, LOMA, NW Atlantic)?
- Y Is the score supported by recent data or research (the last 10 years or less)?
- N Is the score supported by long-term data sets (ten years or more) from multiple surveys (5 years or more)?
- Y Do you have a reasonable level of comfort in the scoring/conclusions?
- N Do you have a high level of confidence in the scoring/conclusions?

Score: Low

For interactions with Low certainty, underline the main factor(s) contributing to the uncertainty

Lack of comprehensive data

Lack of expert agreement

Predictions based of future scenarios which are difficult to predict

Other (provide explanation)

Suggest possible research to address uncertainty:

Improved observer coverage

Reference List

1. Belden, D. L., Orphanides, C. D., Rossman, M. C., & Palka, D. L. (2006). *Estimates of Cetacean and Seal Bycatch in the 2004 Northeast Sink Gillnet and Mid-Atlantic Coastal Gillnet* (Rep. No. Reference Document 06-13). Northeast Fisheries Science Center, NOAA, U.S. Department of Commerce.
2. Coughlan, G. (2002). *The Southeast Shoal Area of the Grand Banks of Newfoundland, Potential as a Marine Protected Area: A Biophysical and Socio-economic Area Examination*. Faculty of Environmental Design, University of Calgary.
3. Davoren, G. K., Anderson, J. T., & Montevecchi, W. A. (2006). Shoal behaviour and maturity relations of spawning capelin (*Mallotus villosus*) off Newfoundland: demersal spawning and diel vertical movement patterns. *Can.J.Fish.Aquat.Sci.*, 63, 268-284.
4. Fisheries and Oceans Canada (2007). *Placentia Bay-Grand Banks Large Ocean Management Area Conservation Objectives* (Rep. No. 2007/042). Canadian Science Advisory Secretariat Science Advisory Report.
5. Fisheries and Oceans Canada. 1998-2007 3LMNOP4R Effort and Catch. Policy and Economics Branch. [Newfoundland and Labrador Region Catch and Effort]. 2008. Fisheries and Oceans Canada.
Ref Type: Data File
6. Fuller, S. D. & Myers, R. A. (2004). *The Southern Grand Bank: a marine protected area for the world* Halifax: World Wildlife Fund Canada.
7. Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C., Bruno, J. F., Casey, K. S., Ebert, C., Fox, H. E., Fujita, R., Heinemann, D., Lenihan, H. S., Madin, E. M. P., Perry, M. T., Selig, E. R., Spalding, M., Steneck, R., & Watson, R. (2008). A Global Map of Human Impact on Marine Ecosystems. *Science*, 319, 948-952.
8. Johnson, A., Salvador, G., Kenney, J., Robbins, J., Kraus, S., Landry, S., & Clapham, P. (2005). Fishing Gear Involved in Entanglements of Right and Humpback Whales. *Marine Mammal Science*, 21, 635-645.
9. Lawson, J., Sjare, B., & Stenson, G. Supplementary information on marine mammals. Templeman, N. D. Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas . Canadian Science Advisory Secretariat Research Document 052. 2007. Fisheries and Oceans Canada.
10. Ledwell, W. & Huntington, J. (2007). *Whale and leatherback sea turtles incidental entrapment in fishing gear in Newfoundland and Labrador and a*

summary of the Whale Release and Strandings Program during 2006 A
Report to the Department of Fisheries and Oceans, St. John's, Newfoundland
and Labrador, Canada.

11. Lien, J. (1994). *Entrapments of large cetaceans in passive inshore fishing gear in Newfoundland and Labrador (1979-1990)*. (Rep. No. Reports of the International Whaling Commission, Special Issue 15).
12. Read, A. J., Drinker, P., & Northridge, S. (2003). *By-catches of Marine Mammals in U.S. Fisheries and a First Attempt to Estimate the Magnitude of Global Marine Mammal By-catch* (Rep. No. Scientific Committee Document SC/55/BC). Cambridge, UK: International Whaling Commission.
13. Report to the Standing Committee on Small cetaceans (2002). International Whaling Commission. *Journal of Cetatean Research & Management (Supplement)*, 4, 338.
14. Templeman, N. D. (2007). *Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas* (Rep. No. 2007/052). Canadian Science Advisory Secretariat Research Document, Fisheries and Oceans Canada.
15. Templeman, N. D. & Davis, M. B. (2006). *Placentia Bay-Grand Banks Ecosystem Overview and Assessment Report (DRAFT)* Newfoundland & Labrador: Fisheries and Oceans Canada.

Cetaceans in Placentia Bay Grand Banks LOMA

Ship strikes

Magnitude of Interaction

Areal extent:

- Whales have not been systematically surveyed around Newfoundland and distribution maps rely largely on opportunistic reporting. Fuller and Myers (2004) reported that marine mammal sightings are highest on the shallower waters of the banks, and rare past the edge of the continental shelf (Fuller, S. D. & Myers, R. A., 2004), but Templeman and Davis (2006) state that on the Grand Banks, whales have often been observed along the shelf break and in deep water basins (Templeman, N. D. & Davis, M. B., 2006).
- In general, cetacean distributions in the LOMA often reflect areas of high productivity that support dense zooplankton patches and small fish schools (e.g., herring or capelin), and seems to correlate well with distribution of other species, such as seabirds.
- Important feeding areas for cetaceans have been identified within the PBGB LOMA (Templeman, N. D., 2007), and supplementary information provided by (Lawson, J., Sjare, B., & Stenson, G., 2007), Sjare, Stenson) as shown on Figure 1 below:

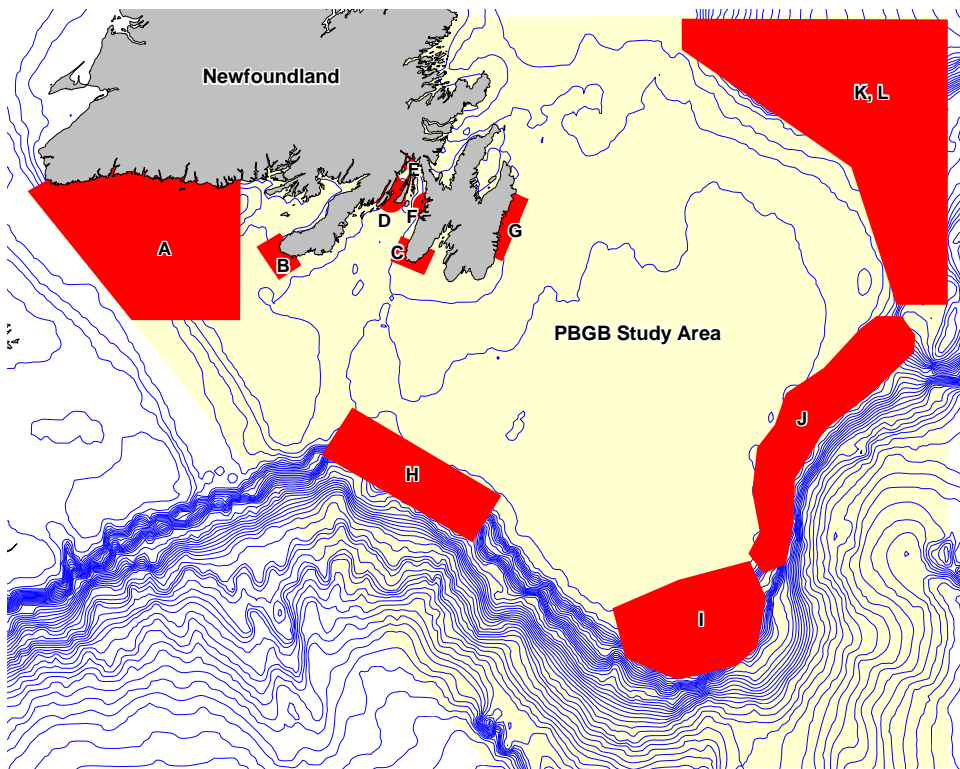


Figure 1. Important Cetacean areas within the PBGA LOMA (Lawson, J., Sjare, B., & Stenson, G., 2007).

- The distribution of cetaceans on the Grand Banks was also discussed by Coughlan (Coughlan, G., 2002) (Figure 2) and Fuller and Meyers, 2004 (Fuller, S. D. & Myers, R. A., 2004) (Figure 3):

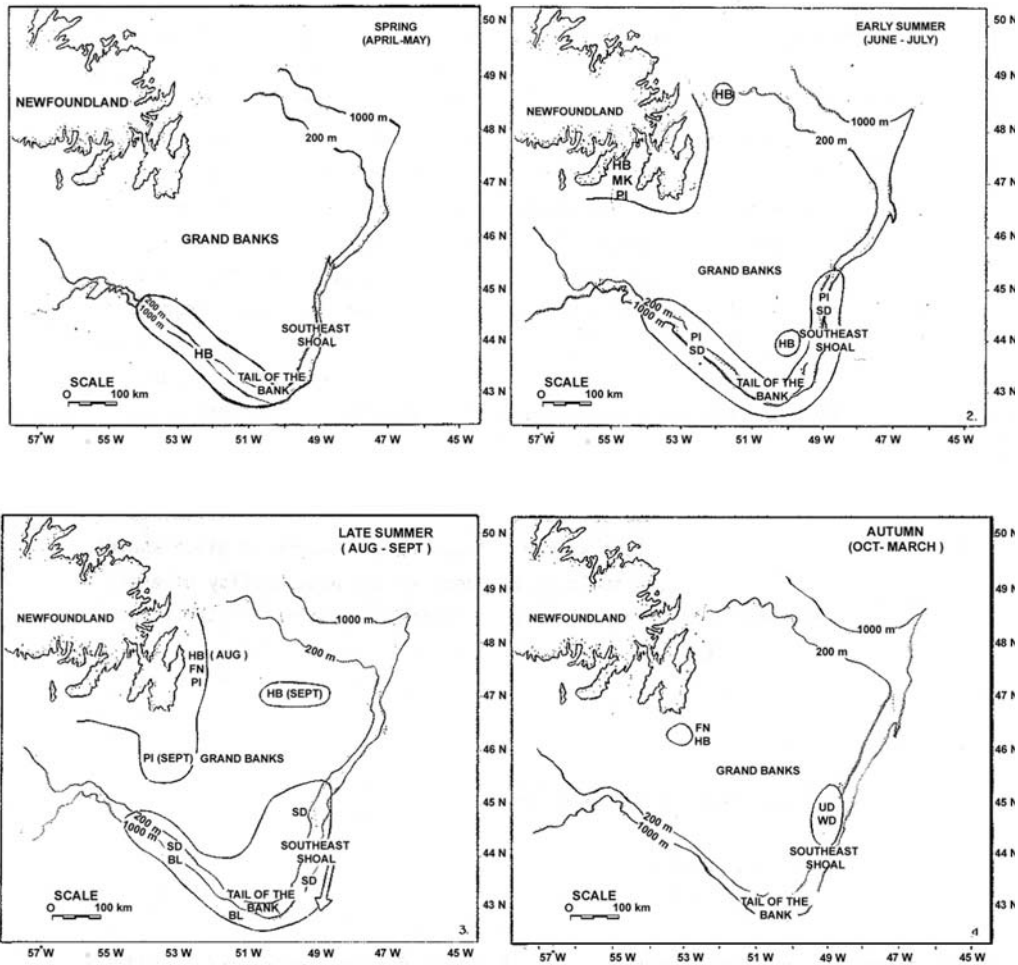


Figure 2. Seasonal Distribution of Whales on the Grand Banks, 1980-81 (Coughlan, G., 2002). (BL–blue whale, FN–Fin, MK–minke, HB–humpback, PI–pilot SD–Saddleback dolphin, WD–whitebeaked dolphin, UD–unidentified).

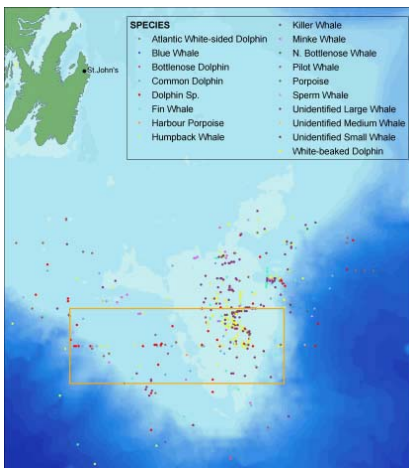


Figure 3. Cetacean sightings collected opportunistically from research surveys and fisheries observer reports from 1979-1999 (Fuller, S. D. & Myers, R. A., 2004).

- This information indicates that cetaceans are broadly distributed throughout the LOMA, with greatest densities along the shelf break, and southern coastal areas.
- The primary source of detailed local data on marine traffic for the LOMA is maintained by the Canadian Coast Guard (CCG), and is based on a mandatory reporting system for all commercial vessels over 500t (or carrying pollutants or dangerous cargo) transiting within Canada's 12 nautical mile territorial sea (Figure 4 below).

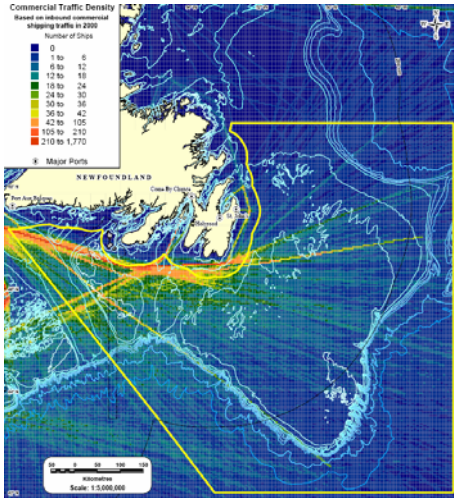


Figure 4. Commercial shipping, traffic density (from ECAREG data) (Fisheries and Oceans Canada, 2007b).

- The ECAREG system does not include information on vessels transiting through Canada's Exclusive Economic Zone (EEZ), and since significant foreign vessel traffic transits the outer edges of the LOMA en route between northern Europe and the US Eastern Seaboard (without entering territorial waters), we have also consulted the MARIN database (Pelot, R. & Wootton, D., 2004). This includes ECAREG data from 2001, but also includes merchant vessel movement data (2001) acquired from Lloyds of London, Marine Intelligence Unit, which records other ships transiting waters off the coast of Canada, primarily between the USA and Europe. Fishing data (1999) were drawn from each of the four Eastern Canada reporting regions: Laurentian, Gulf, Scotia-Fundy and Newfoundland. The individual GIS track files for each region and year were merged together into one layer where darker shades correspond to greater concentrations of vessel traffic.

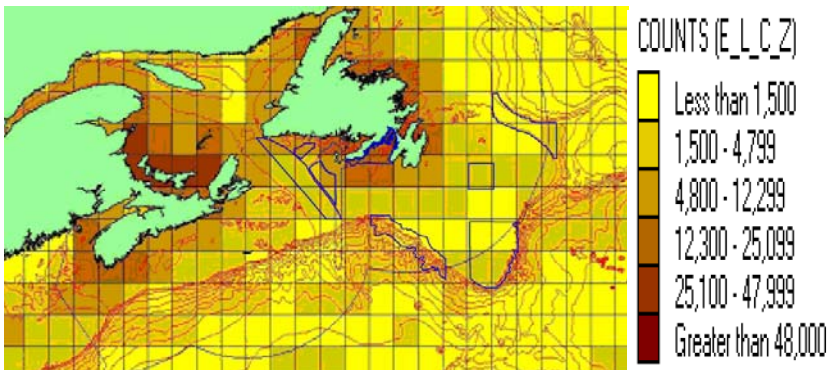


Figure 5. Annual vessel transits for all vessel types combined (merchant, fishing, cruise ships) (Pelot, R. & Wootton, D., 2004).

- Based on this information, the annual vessel traffic in the LOMA is considered to be moderate, with the highest vessel density in southern coastal areas, and lower densities along much of the shelf break. We have therefore selected a score in the moderate range.

Score 5

Contact

- Cetaceans surface to breathe, feed, and rest, and ship collisions with cetaceans are well documented (Elvina, S. S. & Taggart, C. T., 2008; Jensen, A. S. & Silber, G. K., 2004; Laist, D. W., Knowton, A. R., Meade, J. G., Collet, A. S., & Podesta, M., 2001; Vanderlaan, A. S., Taggart, C. T., Serdynska, A. R., Kenney, R. D., & Brown, M. W., 2008)
- While all sizes and types of vessels can collide with whales, most lethal or severe injuries are caused by vessels >80 m in length (Laist et al. 2001). Historical records suggest that fatal ship strikes involving marine mammals first began in the late 1800s when ships began to reach speeds of 13-15 knots, and increased over the last 50 years as the number and speed of ships increased (Laist, D. W., Knowton, A. R., Meade, J. G., Collet, A. S., & Podesta, M., 2001). The mean vessel speed which resulted in serious injury or mortality to the whale was 18.6 knots (Jensen, A. S. & Silber, G. K., 2004). Figure 6 below shows the frequency of whale collisions with various types of vessels.

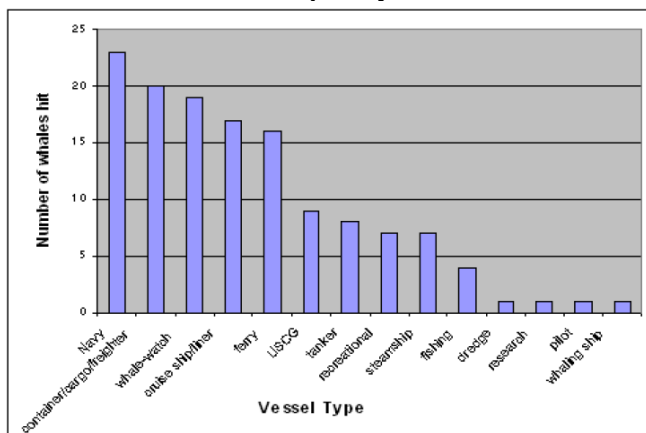


Figure 6. Types of vessels involved in collisions with large whales (where vessel type is reported) 1975 to 2002 (Jensen, A. S. & Silber, G. K., 2004).

- The high occurrence of Navy reports may reflect military and government reporting practice rather than an actual higher frequency of collisions relative to other ship types (Jensen, A. S. & Silber, G. K., 2004), and suggests that incidents may be significantly under-reported by commercial vessels.
- Based on this information, contact is considered to be high.

Score 8

Duration

- Cetaceans are present in the LOMA throughout the year, although highest densities occur in summer (Coughlan, G., 2002).

- Most vessel traffic is relatively consistent throughout the year, with the exception of fishing and passenger vessels which are greatly reduced in the winter (December to March) (Pelot, R. & Wootton, D., 2004).
- Since peak vessel traffic coincides with peak whale occurrence in the LOMA, duration is 100%

Score 10

Intensity:

- Various global maps of shipping density have been published, including the following map by Halpern *et al.* shown in Figure 7 below:

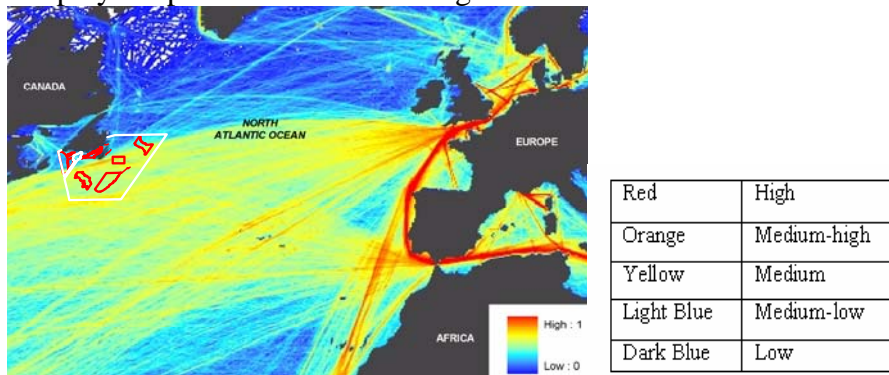


Figure 7. Commercial Shipping Activity in PBGB LOMA (Halpern, B. S. et al., 2008).

- Therefore commercial shipping within the LOMA can be considered moderate (40-60%) on a global scale, as the shipping density is predominantly yellow in colour.
- A moderate score is supported by data indicating that the highest incidents of vessel strikes to large whales in North American waters occurred in the US east coast, and was nearly 5 times higher than the frequency reported in Eastern Canada (Jensen, A. S. & Silber, G. K., 2004).

Score 5

Magnitude of Interaction: $(5 \times 8 \times 10 \times 5)/1000 = 2.0$

Sensitivity:

Sensitivity of the CP to acute impacts:

- Lethal and non-lethal ship collisions with cetaceans are well documented (Elvina, S. S. & Taggart, C. T., 2008; Jensen, A. S. & Silber, G. K., 2004; Laist, D. W., Knowton, A. R., Meade, J. G., Collet, A. S., & Podesta, M., 2001; Vanderlaan, A. S., Taggart, C. T., Serdyska, A. R., Kenney, R. D., & Brown, M. W., 2008).
- Ship strikes result in injuries to whales from propeller wounds characterized by external gashes or severed tails or flukes, and collisions with the hull resulting in blunt trauma injuries such as fractured skulls, jaws, and vertebrae, and massive bruises that sometimes lack external expression. The frequency of the two injury types varied among species, with blunt trauma resulting from the vast majority of the collisions with long, sleek rorquals such as the blue, fin and sei whales, and prop injuries more common in stockier

- It appears that large vessels traveling more than 14 knots (26 km/h), particularly high-speed container ships, present the greatest risk of ship strike mortality to cetaceans (Laist, D. W., Knowlton, A. R., Meade, J. G., Collet, A. S., & Podesta, M., 2001) as shown in Figure 8 below.

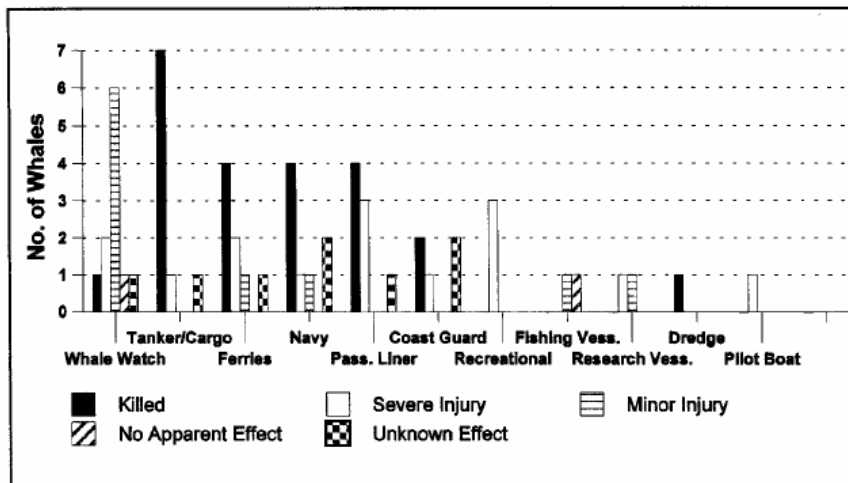


Figure 8. Number and fate of whales struck by different vessel types from collision accounts (Laist, D. W., Knowlton, A. R., Meade, J. G., Collet, A. S., & Podesta, M., 2001)

- Based on this information, acute sensitivity is considered to be moderate to high

Score 7.5

Sensitivity of the CP to chronic impacts:

- Cetaceans are long-lived and have low reproductive rates, making them particularly vulnerable to exploitation and other population stress. For example, the annual rate of population increase in sperm whales has been estimated to be approximately 1 percent. Populations for some whale species have still not returned to historical levels since whaling from the 19th and early 20th century reduced populations to very low levels (Fisheries and Oceans Canada, 2003) The blue whale is thought to live to 75 years, maturing at 5-15 years (Fisheries and Oceans Canada, 2006), while the smaller minke whale, lives to 30 and 40 years and does not mature until 6 to 8 years (Templeman, N. D. & Davis, M. B., 2006). Population trends in cetaceans are difficult to measure due to the imprecise nature of population estimates and limited availability of data.
- Although incidents of mortality of cetaceans from ship strikes within the LOMA is likely low, the death of even a few individuals could have a significant impact on the recovery of depleted species such as the blue whale, fin whale, humpback whale, northern bottlenose whale and the harbour porpoise, particularly in light of their low reproductive capacity, ship strike mortalities are a concern (Fisheries and Oceans Canada, 2003).

- Propeller injuries and non-lethal collisions with small or slow moving vessels appear to be more common for smaller whale species (Laist, D. W., Knowton, A. R., Meade, J. G., Collet, A. S., & Podesta, M., 2001), and are much less likely to be reported. Debilitating injuries which compromise the ability of the whale to move and feed or interfere with vital body functions may result in death from starvation or chronic infection months or even years later.
- Based on population level effects and incidents of non-lethal injuries, chronic sensitivity is considered to be moderate (5).
- Of the 13 species making up the CP, two are listed by COEWIC as *endangered* (blue whale, northern bottlenose whale) and two are listed as *special concern* (fin whale, and the harbour porpoise).
- Blue whales are listed as a depleted or rare species for the LOMA (Fisheries and Oceans Canada, 2007a) (**add 0.5**)

Score 5.5

Sensitivity of ecosystem to harmful impacts to the CP:

- The role of cetaceans in the food web is complex as they range from top predators such as the killer whale which consumes fish, squid as well as seals and other whales, to large baleen whale which are relatively low on the foodchain despite their large size, and consume enormous quantities of krill, copepods, zooplankton, and small fish.
- Despite their relatively small numbers, they represent a significant biomass due to their large size, and contribute significantly to the energetics of the marine ecosystem. Most species are highly mobile, and their large scale movements contribute to the transfer of energy and biomass from seasonally productive areas to distant marine systems.
- Dead whales also contribute significantly to the productivity of the marine ecosystem, with their large carcasses providing food for fish, sharks, birds and decomposers.
- Cetaceans, by virtue of their high visibility, and charismatic nature have long attracted human attention, and can be used as indicators of the health and stability of marine ecosystems.
- Cetaceans hold an important place in our history, culture and economy. Whale watching contributes significantly to ecotourism in the LOMA. The Witless Bay Seabird Sanctuary Ecological Reserve hosts as many as 10 to 15 tour boats per day during the peak of the season, and the industry is growing throughout coastal areas of the LOMA.
- Cetaceans represent a significant and important component of the LOMA, and the LOMA provides important feeding habitat for the CP, so we have selected a score in the medium range (5)
- Cetaceans are listed as Ecologically Significant Species (ESS) within the LOMA (Fisheries and Oceans Canada, 2007a) (**add 1 point**).

Score 6

Sensitivity: $(7.5+5.5+6) / 3 = 6.3$

Risk of Harm: $2 \times 6.3 = 12.6$

Certainty Checklist

Answer yes or no to all of the following questions. Record the number of NO's to the 9 questions, and record certainty according to the scale provided below:

- 1 No's = High certainty
- 2- 3 No's = Medium certainty
- ≥ 4 No's = Low certainty

Y/N

- Y Is the score supported by a large body of information?
- N Is the score supported by general expert agreement?
- N Is the interaction well understood, without major information gaps/sources of error?
- Y Is the current level of understanding based on empirical data rather than models, anecdotal information or probable scenarios?
- N Is the score supported by data which is specific to the region, (EBSA, LOMA, NW Atlantic)?
- Y Is the score supported by recent data or research (the last 10 years or less)?
- N Is the score supported by long-term data sets (ten years or more) from multiple surveys (5 years or more)?
- Y Do you have a reasonable level of comfort in the scoring/conclusions?
- N Do you have a high level of confidence in the scoring/conclusions?

Score: Low

For interactions with Low certainty, underline the main factor(s) contributing to the uncertainty

- Lack of comprehensive data
- Lack of expert agreement
- Predictions based of future scenarios which are difficult to predict
- Other (provide explanation)

Suggest possible research to address uncertainty:

Reference List

1. Coughlan, G. (2002). *The Southeast Shoal Area of the Grand Banks of Newfoundland, Potential as a Marine Protected Area: A Biophysical and Socio-economic Area Examination*. Faculty of Environmental Design, University of Calgary.
2. Elvina, S. S. & Taggart, C. T. (2008). Right whales and vessels in Canadian waters. *Marine Policy*, 32, 386.
3. Fisheries and Oceans Canada. *The Blue Whale a Fragile Giant*. 2003. Mont-Joli, Quebec.
4. Fisheries and Oceans Canada (2006). *Recovery Strategy for Blue, Fin, and Sei Whales (Balaenoptera musculus, B. physalus, and B. borealis) in Pacific Canadian Waters. Species at Risk Act Recovery Strategy Series*, 1-53.
5. Fisheries and Oceans Canada (2007a). *Placentia Bay-Grand Banks Large Ocean Management Area Conservation Objectives* (Rep. No. 2007/042). Canadian Science Advisory Secretariat Science Advisory Report.
6. Fisheries and Oceans Canada *The Grand Banks of Newfoundland: Atlas of Human Activities. The Grand Banks of Newfoundland: Atlas of Human Activities* (in press).
7. Fuller, S. D. & Myers, R. A. (2004). *The Southern Grand Bank: a marine protected area for the world* Halifax: World Wildlife Fund Canada.
8. Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C., Bruno, J. F., Casey, K. S., Ebert, C., Fox, H. E., Fujita, R., Heinemann, D., Lenihan, H. S., Madin, E. M. P., Perry, M. T., Selig, E. R., Spalding, M., Steneck, R., & Watson, R. (2008). A Global Map of Human Impact on Marine Ecosystems. *Science*, 319, 948-952.
9. Jensen, A. S. & Silber, G. K. (2004). *Large Whale Ship Strike Database* (Rep. No. NMFS-OPR-25). U.S. Department of Commerce.
10. Laist, D. W., Knowton, A. R., Meade, J. G., Collet, A. S., & Podesta, M. (2001). Collisions Between Ships and Whales. *Marine Mammal Science*, 17, 35-75.
11. Lawson, J., Sjare, B., & Stenson, G. Supplementary information on marine mammals. Templeman, N. D. *Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas*. Canadian Science Advisory Secretariat Research Document 052. 2007. Fisheries and Oceans Canada.

12. Pelot, R. & Wootton, D. (2004). *Maritime traffic distribution in Atlantic Canada to support an evaluation of a Sensitive Sea Area proposal* (Rep. No. 2004-05). Maritime Activity & Risk Investigation Network.
13. Templeman, N. D. (2007). *Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas* (Rep. No. 2007/052). Canadian Science Advisory Secretariat Research Document, Fisheries and Oceans Canada.
14. Templeman, N. D. & Davis, M. B. (2006). *Placentia Bay-Grand Banks Ecosystem Overview and Assessment Report (DRAFT)* Newfoundland & Labrador: Fisheries and Oceans Canada.
15. Vanderlaan, A. S., Taggart, C. T., Serdynska, A. R., Kenney, R. D., & Brown, M. W. (2008). Reducing the risk of lethal encounters: vessels and right whales in the Bay of Fundy and on the Scotian Shelf. *Endangered Species Research*, *4*, 283-287.

Cetaceans in Placentia Bay Grand Banks LOMA

Seismic surveys

Magnitude of Interaction

Areal extent:

- Whales have not been systematically surveyed around Newfoundland and distribution maps rely largely on opportunistic reporting. Fuller and Myers (2004) reported that marine mammal sightings are highest on the shallower waters of the banks, and rare past the edge of the continental shelf (Fuller, S. D. & Myers, R. A., 2004), but Templeman and Davis (2006) state that on the Grand Banks, whales have often been observed along the shelf break and in deep water basins (Templeman, N. D. & Davis, M. B., 2006).
- In general, cetacean distributions in the LOMA often reflect areas of high productivity that support dense zooplankton patches and small fish schools (e.g., herring or capelin), and seems to correlate well with distribution of other species, such as seabirds.
- Important feeding areas for cetaceans have been identified within the PBGB LOMA (Templeman, N. D., 2007), and supplementary information was provided by (Lawson, J., Sjare, B., & Stenson, G., 2007) as shown on Fig. 1 below:

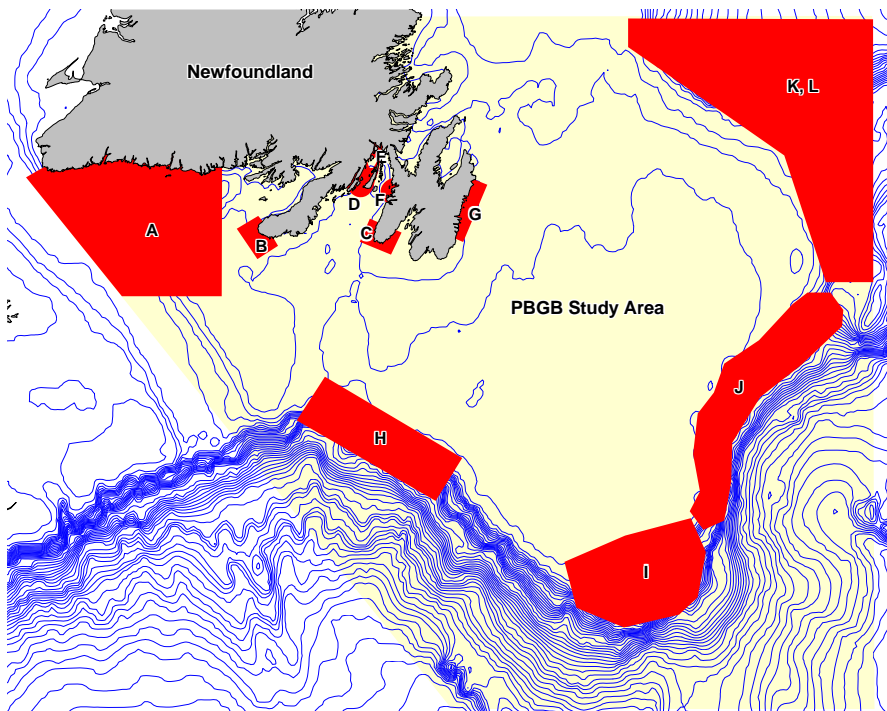


Figure 1. Important Cetacean areas within the PBGA LOMA (Templeman, N. D., 2007).

- The distribution of cetaceans on the Grand Banks was also discussed by Coughlan (Coughlan, G., 2002) (Figure 2) and Fuller and Meyers, 2004 (Fuller, S. D. & Myers, R. A., 2004) (Figure 3):

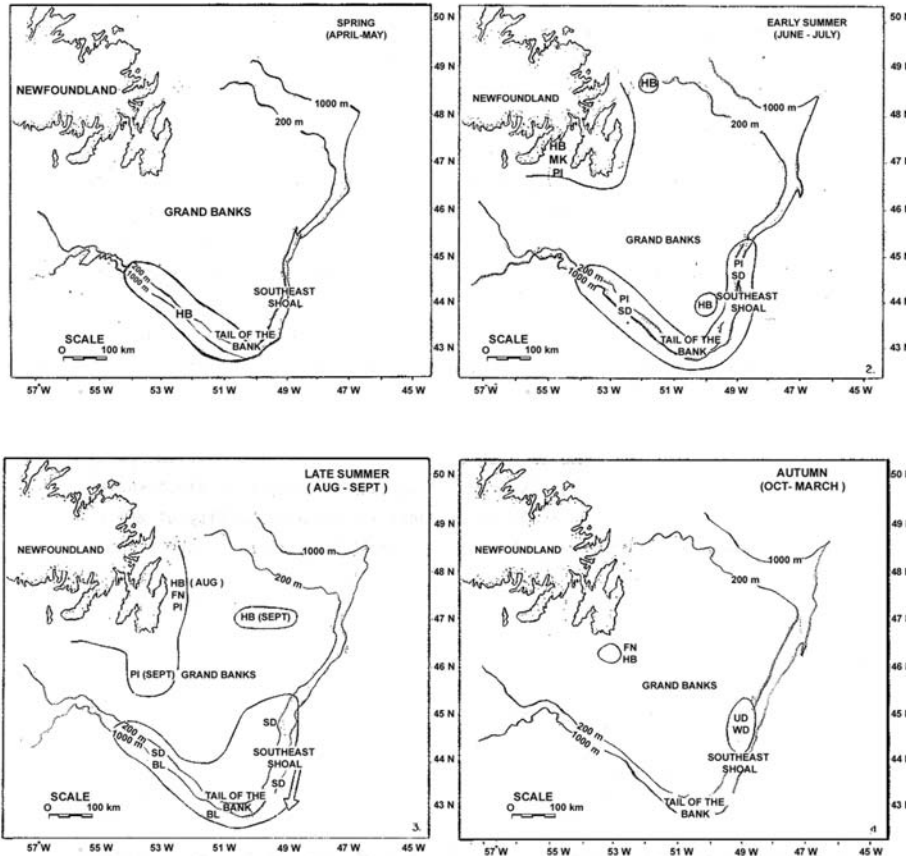


Figure 2. Seasonal Distribution of Whales on the Grand Banks, 1980-81 (Coughlan, G., 2002). (BL–blue whale, FN–Fin, MK–minke, HB–humpback, PI–pilot SD–Saddleback dolphin, WD–whitebeaked dolphin, UD–unidentified).

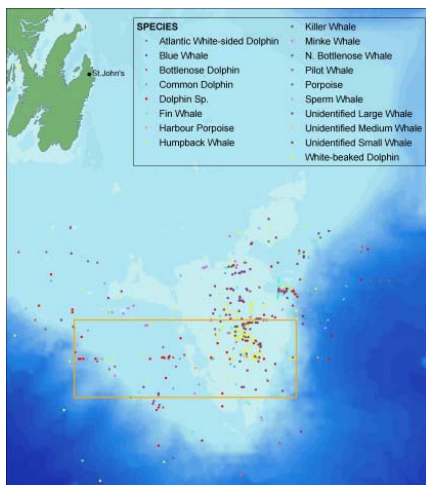


Figure 3. Cetacean sightings collected opportunistically from research surveys and fisheries observer reports from 1979-1999 (Fuller, S. D. & Myers, R. A., 2004).

- This information indicates that cetaceans are broadly distributed throughout the LOMA, with greatest densities along the shelf break, and southern coastal areas.

- Seismic surveys have been completed in many areas of the LOMA as shown on Figure 4 below.

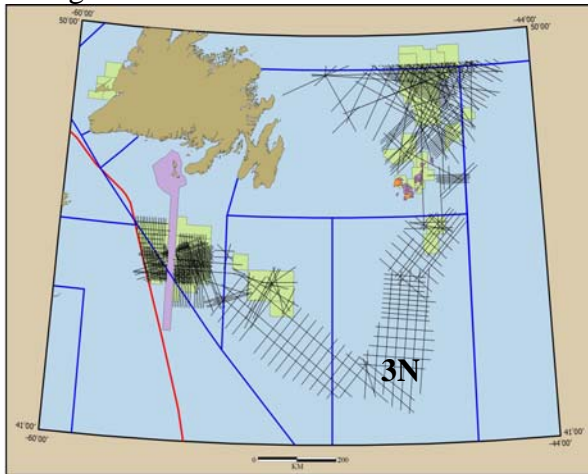


Figure 4. Spatial extent of seismic activity (2000- 2005) as well as the land holdings linked to the oil and gas sector on the Grand Banks study area (ORCA Inc., 2005).

- Seismic activity appears to be focused in offshore areas along the bank edge and slope and the South Whale Basin. Based on this information we have estimated the area of overlap of 50%.

Score 5

Contact:

- Cetaceans use sound for navigation, communication, mother/calf cohesion, group cohesion, individual recognition, and danger avoidance. Cetaceans have well developed auditory systems and can detect noise from long distances.
- Human-introduced noise has been documented to induce short-term behavioural reactions including cessation of feeding, socialising and vocalising, changes in diving behaviour as well as avoidance or attraction. In addition, noise has been documented as causing displacement of cetaceans from preferred habitats.

Score 8

Duration:

- Cetaceans are present in the LOMA throughout the year, although highest densities occur in summer (Coughlan, G., 2002).
- Seismic surveys occur annually within the LOMA as required, but are unlikely to continue for more than a portion of the year, or at a particular time of the year.
- Seismic surveys are considered chronic stressors, and since they are likely to occur annually within the LOMA over the next ten year period, we have selected a score in the moderate range.

Score: 5

Intensity:

- Halpern has mapped global intensity of oil rigs, and on a global scale, the LOMA could be considered moderate (Halpern, B. S. et al., 2008)

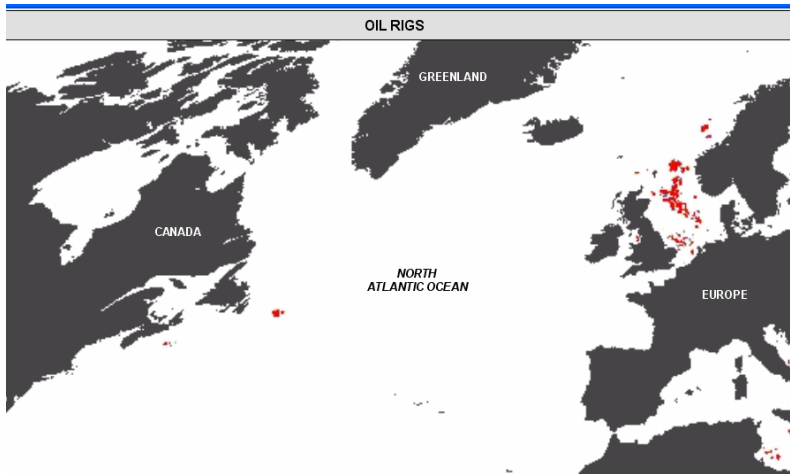


Figure 5. Global Intensity of Oil Rigs (adapted from (Halpern, B. S. et al., 2008).

- Since the offshore oil industry in the region is relatively new, seismic exploration within the LOMA increased markedly in 1990 and has generally shown a steady increase since that period. Expressed in km², there has been well over 1 million km² of seismic data acquired from the entire Newfoundland & Labrador offshore region (Department of Mines and Energy, 2000).
- Since seismic surveys are increasing within the LOMA, we have selected a score at the high end of the moderate range.

Score 7

Magnitude of Interaction: $(5 \times 8 \times 5 \times 7)/1000 = 1.4$

Sensitivity

Sensitivity of the CP to acute impacts:

- Cetaceans use sound for navigation, communication, mother/calf cohesion, group cohesion, individual recognition, and danger avoidance, and anthropogenic sound is a potential “stressor” for marine mammals. Not only can loud or persistent noise impact the auditory system of cetaceans, it may impact health by bringing about changes in immune function, as has been shown in other mammals. Human-introduced noise has been documented to induce short-term behavioural reactions including cessation of feeding, socialising and vocalising, changes in diving behaviour as well as avoidance or attraction. In addition, noise has been documented as causing displacement of cetaceans from preferred habitats.
- There is a long and widespread history of seismic surveys in the global marine environment with no documented marine mammal kills and only circumstantial evidence of marine mammal strandings associated with seismic surveys (Lawson, J. & McQuinn, I., 2004)

- A recent review of scientific information on impacts of seismic sound on a range of marine animals concluded that, “from available evidence, seismic sounds in the marine environment are neither completely without consequences nor are they certain to result in serious and irreversible harm to the environment.” (Fisheries and Ocean Canada, 2004).
- Potential acute effects range from induction of the bends, physical damage to body tissues including ears, temporary shift in hearing threshold, interference in ability to communicate or interpret other important sounds within the environment, interruption of key activities such as feeding, and displacement from area (The Whale and Dolphin Conservation Society, 2004)
- Acute sensitivity is generally considered to be in the low range.

Score 2

Sensitivity of the CP to chronic impacts:

- Cetaceans are long-lived and have low reproductive rates, making them particularly vulnerable to exploitation and other population stress. For example, the annual rate of population increase in sperm whales has been estimated to be approximately 1 percent. Populations for some whale species have still not returned to historical levels since whaling from the 19th and early 20th century reduced populations to very low levels (IWC, 2002). The blue whale is thought to live to 75 years, while the smaller minke whale, lives to 30 and 40 years and does not mature until 6 to 8 years (Templeman, N. D. & Davis, M. B., 2006). Population trends in cetaceans are difficult to measure due to the imprecise nature of population estimates and limited availability of data.
- Cetaceans have finely balanced energy budgets, and prolonged or repeated disturbance during peak feeding periods could lead to stress, loss of general or reproductive fitness, debilitation and ultimately mortality.
- Humpback whales subjected to explosions showed no obvious response, but local entanglement rates, and thus mortality, increased (The Whale and Dolphin Conservation Society, 2004).
- Potential chronic effects range from permanent shift in hearing threshold, decreased viability, increased vulnerability to disease, increased potential for impacts from negative cumulative effects (e.g. chemical pollution combined with noise-induced stress), sensitization to noise causing animals to remain close to damaging noise sources, reduced availability of prey, and increased vulnerability to predation or other hazards, such as collisions with fishing gear, strandings, etc. (The Whale and Dolphin Conservation Society, 2004)
- Given the low reproductive rates of cetaceans, and finely balanced energy budgets, we have selected a low to moderate score (4) for chronic sensitivity.
- Of the 13 species making up the CP, two are listed by COSEWIC as *endangered* (blue whale, northern bottlenose whale) and two are listed as *special concern* (fin whale and the harbour porpoise). Blue whales are listed as a depleted or rare species for the LOMA (Fisheries and Oceans Canada, 2007) **(add 0.5)**

Score 4.5

Sensitivity of ecosystem to harmful impacts to the CP:

- The role of cetaceans in the food web is complex as they range from top predators such as the killer whale which consumes fish, squid as well as seals and other whales, to large baleen whale which are relatively low on the foodchain despite their large size, and consume enormous quantities of krill, copepods, zooplankton, and small fish.
- Despite their relatively small numbers, they represent a significant biomass due to their large size, and contribute significantly to the energetics of the marine ecosystem. Most species are highly mobile, and their large scale movements contribute to the transfer of energy and biomass from seasonally productive areas to distant marine systems.
- Dead whales also contribute significantly to the productivity of the marine ecosystem, with their large carcasses providing food for fish, sharks, birds and decomposers.
- Cetaceans, by virtue of their high visibility, and charismatic nature have long attracted human attention, and can be used as indicators of the health and stability of marine ecosystems.
- Cetaceans hold an important place in our history, culture and economy. Whale watching contributes significantly to ecotourism in the LOMA. The Witless Bay Seabird Sanctuary Ecological Reserve hosts as many as 10 to 15 tour boats per day during the peak of the season, and the industry is growing throughout coastal areas of the LOMA.
- Cetaceans represent a significant and important component of the LOMA, and the LOMA provides important feeding habitat for the CP, so we have selected a score in the medium range (5)
- Cetaceans are listed as Ecologically Significant Species (ESS) within the LOMA (Fisheries and Oceans Canada, 2007) (**add 1 point**).

Score 6

Sensitivity: $2+4.5+6/3= 4.2$

Risk of Harm: $1.4 \times 4.2 = 5.9$

Certainty Checklist

Answer yes or no to all of the following questions. Record the number of NO's to the 9 questions, and record certainty according to the scale provided below:

- 1 No's = High certainty
- 2- 3 No's = Medium certainty
- ≥ 4 No's = Low certainty

Y/N

- Y Is the score supported by a large body of information?
- N Is the score supported by general expert agreement?
- N Is the interaction well understood, without major information gaps/sources of error?
- Y Is the current level of understanding based on empirical data rather than models, anecdotal information or probable scenarios?
- Y Is the score supported by data which is specific to the region, (EBSA, LOMA, NW Atlantic)?
- Y Is the score supported by recent data or research (the last 10 years or less)?
- N Is the score supported by long-term data sets (ten years or more) from multiple surveys (5 years or more)?
- Y Do you have a reasonable level of comfort in the scoring/conclusions?
- N Do you have a high level of confidence in the scoring/conclusions?

Score: Low

For interactions with Low certainty, underline the main factor(s) contributing to the uncertainty

Lack of comprehensive data

Lack of expert agreement

Predictions based of future scenarios which are difficult to predict

Other (provide explanation)

Suggest possible research to address uncertainty:

Reference List

1. Coughlan, G. (2002). *The Southeast Shoal Area of the Grand Banks of Newfoundland, Potential as a Marine Protected Area: A Biophysical and Socio-economic Area Examination*. Faculty of Environmental Design, University of Calgary.
2. Department of Mines and Energy (2000). Newfoundland and Labrador Oil and Gas Report. *Government of Newfoundland and Labrador*, <http://www.gov.nf.ca/mines%26en/energy/oil%26gasaug00>.
3. Fisheries and Ocean Canada (2004). *Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals*.
4. Fisheries and Oceans Canada (2007). *Placentia Bay-Grand Banks Large Ocean Management Area Conservation Objectives* (Rep. No. 2007/042). Canadian Science Advisory Secretariat Science Advisory Report.
5. Fuller, S. D. & Myers, R. A. (2004). *The Southern Grand Bank: a marine protected area for the world* Halifax: World Wildlife Fund Canada.
6. Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C., Bruno, J. F., Casey, K. S., Ebert, C., Fox, H. E., Fujita, R., Heinemann, D., Lenihan, H. S., Madin, E. M. P., Perry, M. T., Selig, E. R., Spalding, M., Steneck, R., & Watson, R. (2008). A Global Map of Human Impact on Marine Ecosystems. *Science*, 319, 948-952.
7. IWC (2002). *Report of the Standing Working Group on Environmental Concerns*.
8. Lawson, J. & McQuinn, I. (2004). *Review of the Potential Hydrophysical-related Issues in Canada, Risks to Marine Mammals, and Monitoring and Mitigation Strategies for Seismic Activities* (Rep. No. Research Document 2004/121). Canadian Science Advisory Secretariat, Fisheries and Oceans Canada.
9. Lawson, J., Sjare, B., & Stenson, G. Supplementary information on marine mammals. Templeman, N. D. Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas . Canadian Science Advisory Secretariat Research Document 052. 2007. Fisheries and Oceans Canada.
Ref Type: Generic
10. ORCA Inc. (2005). *Grand Banks Environmental Overview Report: Part D - Human Use* Prepared for: Dr. Robert S. Gregory, Environmental Sciences Division, Fisheries and Oceans Canada, St. John's, NL.

11. Templeman, N. D. (2007). *Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas* (Rep. No. 2007/052). Canadian Science Advisory Secretariat Research Document, Fisheries and Oceans Canada.
12. Templeman, N. D. & Davis, M. B. (2006). *Placentia Bay-Grand Banks Ecosystem Overview and Assessment Report (DRAFT)* Newfoundland & Labrador: Fisheries and Oceans Canada.
13. The Whale and Dolphin Conservation Society (2004). *Oceans of Noise*.

Cetaceans in Placentia Bay Grand Banks LOMA

Litter

Magnitude of Interaction

Areal extent:

- Whales have not been systematically surveyed around Newfoundland and distribution maps rely largely on opportunistic reporting. Fuller and Myers (2004) reported that marine mammal sightings are highest on the shallower waters of the banks, and rare past the edge of the continental shelf (Fuller, S. D. & Myers, R. A., 2004), but Templeman and Davis (2006) state that on the Grand Banks, whales have often been observed along the shelf break and in deep water basins (Templeman, N. D. & Davis, M. B., 2006).
- In general, cetacean distributions in the LOMA often reflect areas of high productivity that support dense zooplankton patches and small fish schools (e.g., herring or capelin), and seems to correlate well with distribution of other species, such as seabirds.
- Important feeding areas for cetaceans have been identified within the PBGB LOMA (Templeman, N. D., 2007), with supplementary information provided by Lawson *et al.* as shown on Figure 1 below:

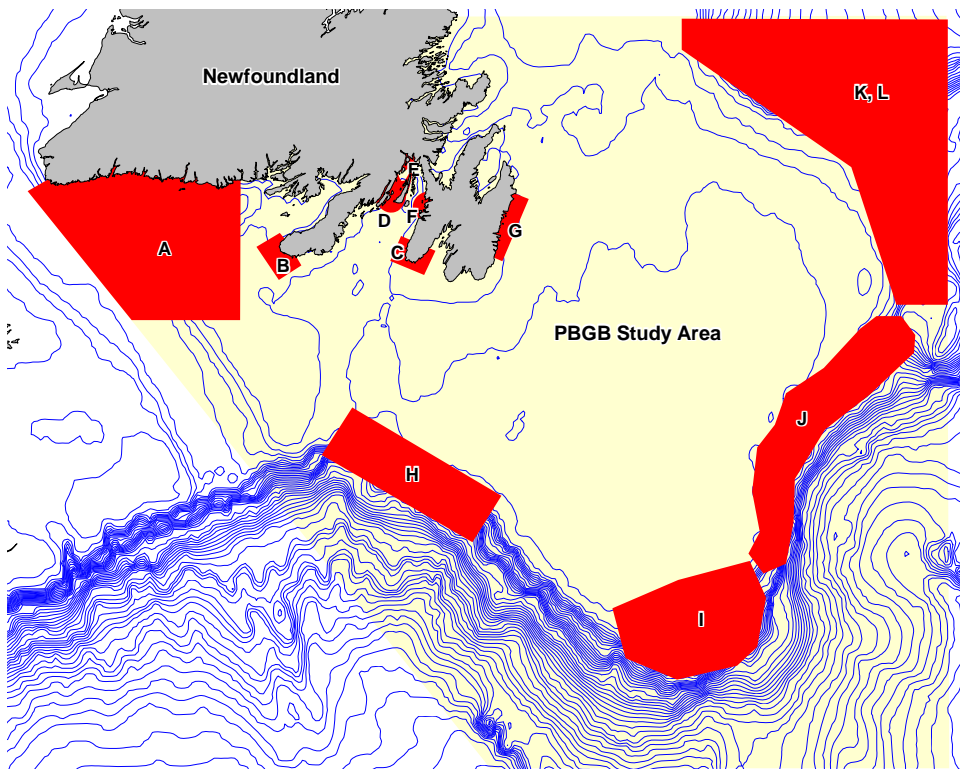


Figure 1. Important Cetacean areas within the PBGA LOMA (Lawson, J., Sjare, B., & Stenson, G., 2007)

- The distribution of cetaceans on the Grand Banks was also discussed by Coughlan (Coughlan, G., 2002) (Figure 2) and Fuller and Meyers, 2004 (Fuller, S. D. & Myers, R. A., 2004) (Figure 3):

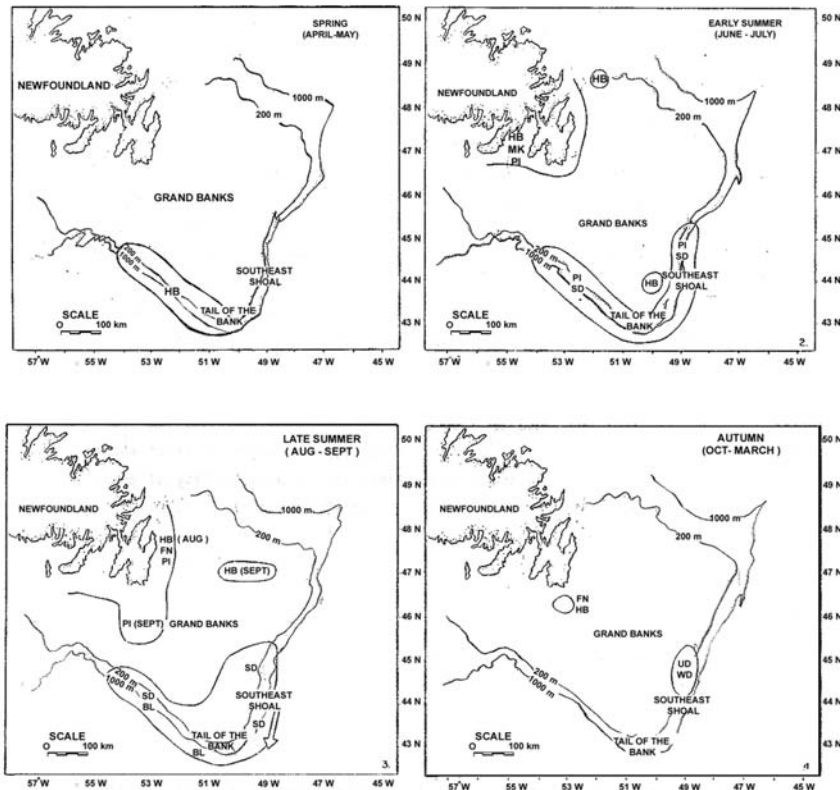


Figure 2. Seasonal Distribution of Whales on the Grand Banks, 1980-81 (Coughlan, G., 2002). (BL–blue whale, FN–Fin, MK–minke, HB–humpback, PI–pilot SD–Saddleback dolphin, WD–whitebeaked dolphin, UD–unidentified).

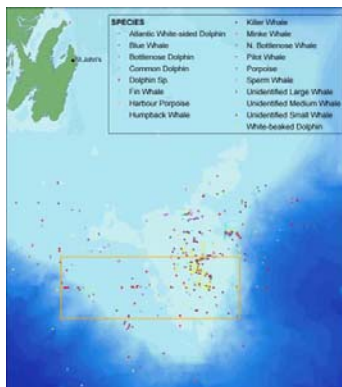


Figure 3. Cetacean sightings collected opportunistically from research surveys and fisheries observer reports from 1979-1999 (Fuller, S. D. & Myers, R. A., 2004).

- This information indicates that cetaceans are broadly distributed throughout the LOMA, with greatest densities along the shelf break, and southern coastal areas.
- It is estimated that 6.4 million tonnes of garbage go into the world's oceans every year (Keep Sweden Tidy Foundation, 2003). Plastic debris is of greatest concern due to its abundance, durability and buoyancy.

- There is no comprehensive data on marine litter available for the LOMA, although coastal surveys have identified significant accumulation of marine litter on coastal beaches in Placentia Bay, St. Mary's Bay and Conception Bay. In all areas, a high percentage of the debris was plastic. Domestic garbage was dominant in Conception Bay, while fishing-related debris dominated in Placentia Bay and St. Mary's Bay (Fisheries and Oceans Canada, 2005; Pink, D., 2004). Up to 80% of marine debris comes from the land, blowing and washing off beaches and carried to the sea by rivers, sewage systems, and storm drains. The remaining 20% is lost or discarded from boats and ships of all types and sizes (Federal-Provincial-Territorial Committee on NPA, 2000).
- Although little data is available on the concentration and distribution of marine litter in offshore areas of the LOMA, surface currents can carry significant quantities of floating litter, and floating debris is known to concentrate at convergence zones. Islands such as Sable Island accumulate significant quantities of plastic debris (Lucas, Z., 1992), and neuston net tows of surface waters of 'the Gully' and surrounding areas off Nova Scotia found plastics in 80% of tows. The density of large debris inside the mouth of the Gully averaged almost three times that seen outside this area. Items included plastic grocery bags, nylon rope, potato chip bags, ice cream container lids, styrofoam, textile fibres, fishing line and fragments of plastic. Average densities in the entire study area were greater than that reported by researchers in the North Sea, North Pacific and central Pacific, but less than the Mediterranean. (Dufault, S. & Whitehead, H., 1994).
- Major sources of marine litter include boat traffic (fishing and shipping) and ocean currents. Average annual marine traffic density in the LOMA are considered medium.
- Based on the pollution potential of the area (moderate to high) and existing data for the area, we have estimated the areal extent at the high end of the medium range.

Score 7

Contact:

- Marine debris accumulates at convergence zones, where prey is also concentrated.
- Floating plastic debris has a high degree of contact with cetaceans which spend much of their time on the sea surface, both feeding and resting. Baleen whales are relatively indiscriminate feeders and readily consume floating debris in feeding areas.

Score 9

Duration:

- Cetaceans are present in the LOMA throughout the year, but feeding aggregation occur from spring to fall (Templeman, N. D., 2007), April- Oct (~210 days)
- Litter is considered a chronic stressor which occurs every year, and so is given a score in the medium range. Since marine litter is persistent, consisting largely of plastic debris, and sources of litter (land-based activities, fishing boats, ships and winds/currents) are present throughout the year, we have selected a score at the top of the medium range.

Score 7

Intensity:

- Halpern *et al.* (2008) have developed maps showing the global intensity of several anthropogenic stressors including ocean pollution (see Fig. 4 below). This map can be used to provide guidance in scoring the intensity of a stressor in relation to maximum (100%) intensity in a global context, in accordance with the scale provided below.

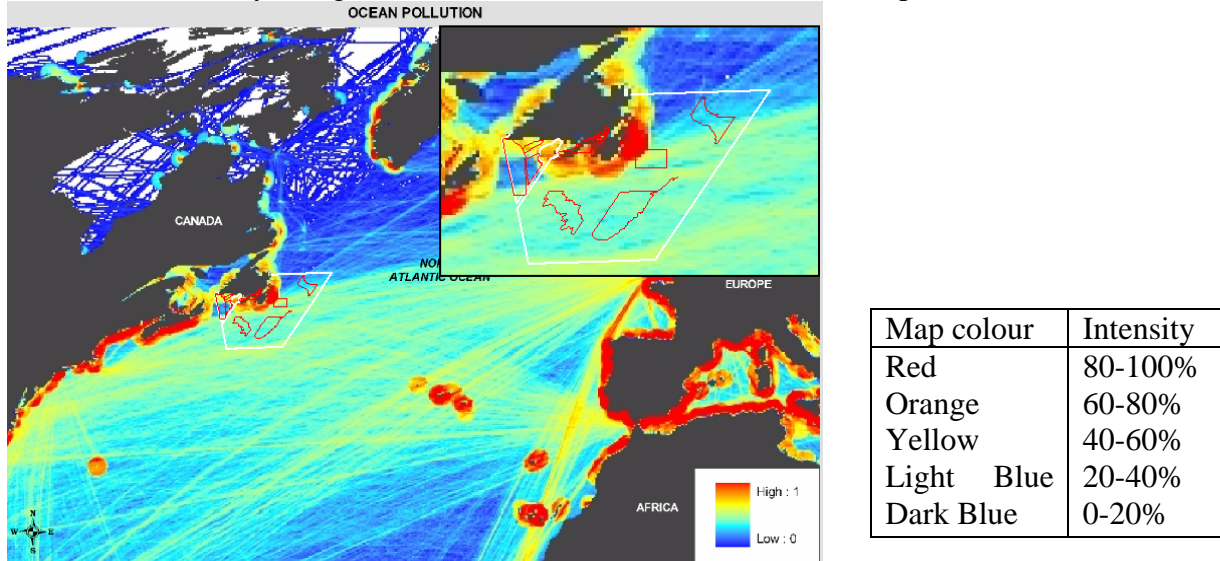


Figure 4. Global Intensity of Ocean Pollution (adapted from (Halpern, B. S. et al., 2008)

- Fig. 4 shows a range of intensities within the LOMA from high (red) intensity to low relative to global levels for a score range of 20% to 100%.
- We have selected an average score between 20% and 100% for a score of 60%.

Score 6

Magnitude of Interaction: $(7 \times 9 \times 7 \times 6)/1000 = 2.7$

Sensitivity:

Sensitivity of the CP to acute impacts:

- The magnitude of the threat that ingestion of marine debris poses may be grossly underestimated (James, M. C. & Herman, T. B., 2001)
- Acute impacts of ingestion of plastics, styrofoam and other waste can lead to both acute and chronic impacts. Acute impacts leading to mortality include blockage of the throat or digestive tract and physical injury from ingestion of hard objects (Derraik, J. G. B., 2002). For large species such as blue whales, chronic impacts are thought to be of greatest concern.

Score 2

Sensitivity of the CP to chronic impacts:

- Cetaceans are long-lived and have low reproductive rates, making them particularly vulnerable to exploitation and other population stress. For example, the annual rate of population increase in sperm whales has been estimated to be approximately 1 percent.

Populations for some whale species have still not returned to historical levels since whaling from the 19th and early 20th century reduced populations to very low levels (Fisheries and Oceans Canada, 2003) The blue whale is thought to live to 75 years, maturing at 5-15 years (Fisheries and Oceans Canada, 2006), while the smaller minke whale, lives to 30 and 40 years and does not mature until 6 to 8 years (Templeman, N. D. & Davis, M. B., 2006). Population trends in cetaceans are difficult to measure due to the imprecise nature of population estimates and limited availability of data.

- Plastic debris cannot be digested, and larger items often accumulate in the digestive tract, reducing appetite and feeding capacity (The Marine Debris Team, Columbia University, 2005). Ingested plastic can interfere with normal functioning of the digestive system, including severe ulceration leading to tissue necrosis resulting in malnutrition and death (Barreiros, J. & Barcelos, J., 2001; Simpson, M. R., Miri, C. M., & Busby, C., 2008).
- Moreover, the potential toxic effects of such ingestion, while poorly understood, may be significant (James, M. C. & Herman, T. B., 2001).
- Given their long lifespan, low reproductive rates, depleted status, and feeding strategies, even single encounters can negatively impact some species, and we have therefore selected a score in the moderate to high range (7)
- Of the 13 species making up the CP, one is listed by COSEWIC as *endangered* (blue whale) and four are listed as *special concern* (blue whale, fin whale, humpback whale, northern bottlenose whale and the harbour porpoise).
- Blue whales are listed as a depleted or rare species for the LOMA (Fisheries and Oceans Canada, 2007) (**add 0.5**)

Score 7.5

Sensitivity of ecosystem to harmful impacts to the CP:

- The role of cetaceans in the food web is complex as they range from top predators such as the killer whale which consumes fish, squid as well as seals and other whales, to large baleen whale which are relatively low on the foodchain despite their large size, and consume enormous quantities of krill, copepods, zooplankton, and small fish.
- Despite their relatively small numbers, they represent a significant biomass due to their large size, and contribute significantly to the energetics of the marine ecosystem. Most species are highly mobile, and their large scale movements contribute to the transfer of energy and biomass from seasonally productive areas to distant marine systems.
- Dead whales also contribute significantly to the productivity of the marine ecosystem, with their large carcasses providing food for fish, sharks, birds and decomposers.
- Cetaceans, by virtue of their high visibility, and charismatic nature have long attracted human attention, and can be used as indicators of the health and stability of marine ecosystems.
- Cetaceans hold an important place in our history, culture and economy. Whale watching contributes significantly to ecotourism in the LOMA. The Witless Bay Seabird Sanctuary Ecological Reserve hosts as many as 10 to 15 tour boats per day during the peak of the season, and the industry is growing throughout coastal areas of the LOMA.
- Cetaceans represent a significant and important component of the LOMA, and the LOMA provides important feeding habitat for the CP, so we have selected a score in the medium range (5)

- Cetaceans are listed as Ecologically Significant Species (ESS) within the LOMA (Fisheries and Oceans Canada, 2007) (**add 1 point**).

Score 6

Sensitivity: $2+7.5+6/3=5.2$

Risk of Harm: $2.6 \times 5.2=13.5$

Certainty Checklist

Answer yes or no to all of the following questions. Record the number of NO's to the 9 questions, and record certainty according to the scale provided below:

- 1 No's = High certainty
- 2- 3 No's = Medium certainty
- ≥ 4 No's = Low certainty

Y/N

- N Is the score supported by a large body of information?
- Y Is the score supported by general expert agreement?
- N Is the interaction well understood, without major information gaps/sources of error?
- Y Is the current level of understanding based on empirical data rather than models, anecdotal information or probable scenarios?
- N Is the score supported by data which is specific to the region, (EBSA, LOMA, NW Atlantic)?
- N Is the score supported by recent data or research (the last 10 years or less)?
- N Is the score supported by long-term data sets (ten years or more) from multiple surveys (5 years or more)?
- Y Do you have a reasonable level of comfort in the scoring/conclusions?
- N Do you have a high level of confidence in the scoring/conclusions?

Score: Low

For interactions with Low certainty, underline the main factor(s) contributing to the uncertainty

- Lack of comprehensive data
- Lack of expert agreement
- Predictions based of future scenarios which are difficult to predict
- Other (provide explanation)

Suggest possible research to address uncertainty:

Dedicated monitoring at convergence zones and other productive areas offshore

Reference List

1. Barreiros, J. & Barcelos, J. (2001). Plastic Ingestion by a Leatherback Turtle *Dermochelys coriacea* from the Azores (NE Atlantic). *Marine Pollution Bulletin*, 42, 1196-1197.
2. Coughlan, G. (2002). *The Southeast Shoal Area of the Grand Banks of Newfoundland, Potential as a Marine Protected Area: A Biophysical and Socio-economic Area Examination*. Faculty of Environmental Design, University of Calgary.
3. Derraik, J. G. B. (2002). The pollution of the Marine Environment by Plastic Debris: a review. *Marine Pollution Bulletin*, 44, 842-852.
4. Dufault, S. & Whitehead, H. (1994). Floating Marine Pollution in 'the Gully' on the continental slope, Nova Scotia, Canada. *Marine Pollution Bulletin*, 28, 489-493.
5. Federal-Provincial-Territorial Committee on NPA (2000). *Canada's National Programme of Action for the Protection of the Marine Environment from Land-Based Activities (NPA)*.
6. Fisheries and Oceans Canada. The Blue Whale a Fragile Giant. 2003. Mont-Joli, Quebec.
7. Fisheries and Oceans Canada. Marine Debris, Trashing our Oceans, Trashing our Future (poster). 2005. St. John's, NL.
8. Fisheries and Oceans Canada (2006). Recovery Strategy for Blue, Fin, and Sei Whales (*Balaenoptera musculus*, *B. physalus*, and *B. borealis*) in Pacific Canadian Waters. *Species at Risk Act Recovery Strategy Series*, 1-53.
9. Fisheries and Oceans Canada (2007). *Placentia Bay-Grand Banks Large Ocean Management Area Conservation Objectives* (Rep. No. 2007/042). Canadian Science Advisory Secretariat Science Advisory Report.
10. Fuller, S. D. & Myers, R. A. (2004). *The Southern Grand Bank: a marine protected area for the world* Halifax: World Wildlife Fund Canada.
11. Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C., Bruno, J. F., Casey, K. S., Ebert, C., Fox, H. E., Fujita, R., Heinemann, D., Lenihan, H. S., Madin, E. M. P., Perry, M. T., Selig, E. R., Spalding, M., Steneck, R., & Watson, R. (2008). A Global Map of Human Impact on Marine Ecosystems. *Science*, 319, 948-952.

12. James, M. C. & Herman, T. B. (2001). Feeding of *Dermochelys coriacea* on Medusae in the Northwest Atlantic. *Chelonian Conservation and Biology*, 4, 202-205.
13. Keep Sweden Tidy Foundation. Save the North Sea. 2003.
Ref Type: Audiovisual Material
14. Lawson, J., Sjare, B., & Stenson, G. Supplementary information on marine mammals. Templeman, N. D. Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas . Canadian Science Advisory Secretariat Research Document 052. 2007. Fisheries and Oceans Canada.
Ref Type: Generic
15. Lucas, Z. (1992). Monitoring Persistent Litter in the Marine Environment on Sable Island, Nova Scotia. *Marine Pollution Bulletin*, 24, 192-199.
16. Pink, D. (2004). *Analysis of Beach Litter Volumes, Sources, and Movements on Selected Coastlines of the Avalon Peninsula, Newfoundland and Labrador*. Masters of Environmental Science Department of Geography, Memorial University of Newfoundland.
17. Simpson, M. R., Miri, C. M., & Busby, C. (2008). *Assessment of Thorny Skate (Amblyraja radiata Donovan, 1808) in NAFO Divisions 3LNO and Subdivision 3Ps* (Rep. No. SCR Doc. 08/43, Serial No. N5545). Northwest Atlantic Fisheries Organization.
18. Templeman, N. D. (2007). *Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas* (Rep. No. 2007/052). Canadian Science Advisory Secretariat Research Document, Fisheries and Oceans Canada.
19. Templeman, N. D. & Davis, M. B. (2006). *Placentia Bay-Grand Banks Ecosystem Overview and Assessment Report (DRAFT)* Newfoundland & Labrador: Fisheries and Oceans Canada.
20. The Marine Debris Team, C. U. (2005). *The Marine Debris Research, Prevention and Reduction Act: A Policy Analysis*.

Cetaceans in Placentia Bay Grand Banks LOMA

Harmful Algal Blooms

Magnitude of Interaction

Areal extent:

- Whales have not been systematically surveyed around Newfoundland and distribution maps rely largely on opportunistic reporting. Fuller and Myers (2004) reported that marine mammal sightings are highest on the shallower waters of the banks, and rare past the edge of the continental shelf (Fuller, S. D. & Myers, R. A., 2004), but Templeman and Davis (2006) state that on the Grand Banks, whales have often been observed along the shelf break and in deep water basins (Templeman, N. D. & Davis, M. B., 2006).
- In general, cetacean distributions in the LOMA often reflect areas of high productivity that support dense zooplankton patches and small fish schools (e.g., herring or capelin), and seems to correlate well with distribution of other species, such as seabirds.
- Important feeding areas for cetaceans have been identified within the PBGB LOMA (Templeman, N. D., 2007) -Supplementary information provided by (Lawson, J., Sjare, B, & Stenson, G., 2007), as shown on Figure 1 below:

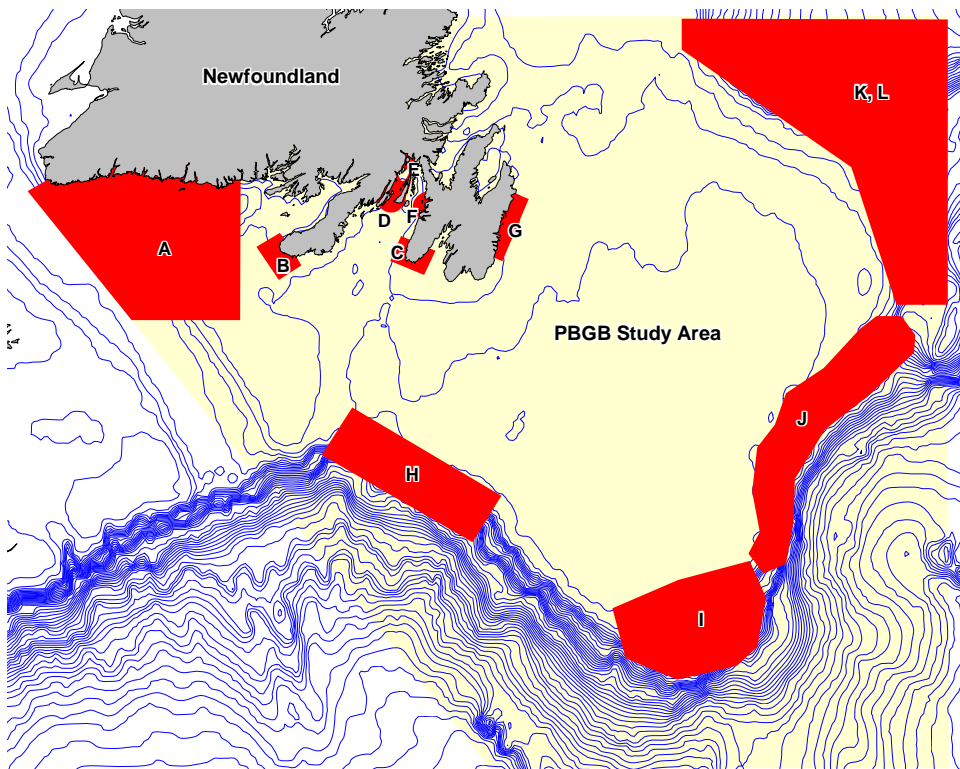


Figure 1. Important Cetacean areas within the PBGA LOMA (Lawson, J., Sjare, B, & Stenson, G., 2007)

- The distribution of cetaceans on the Grand Banks was also discussed by Coughlan (Coughlan, G., 2002) (Figure 2) and Fuller and Meyers, 2004 (Fuller, S. D. & Myers, R. A., 2004) (Figure 3):

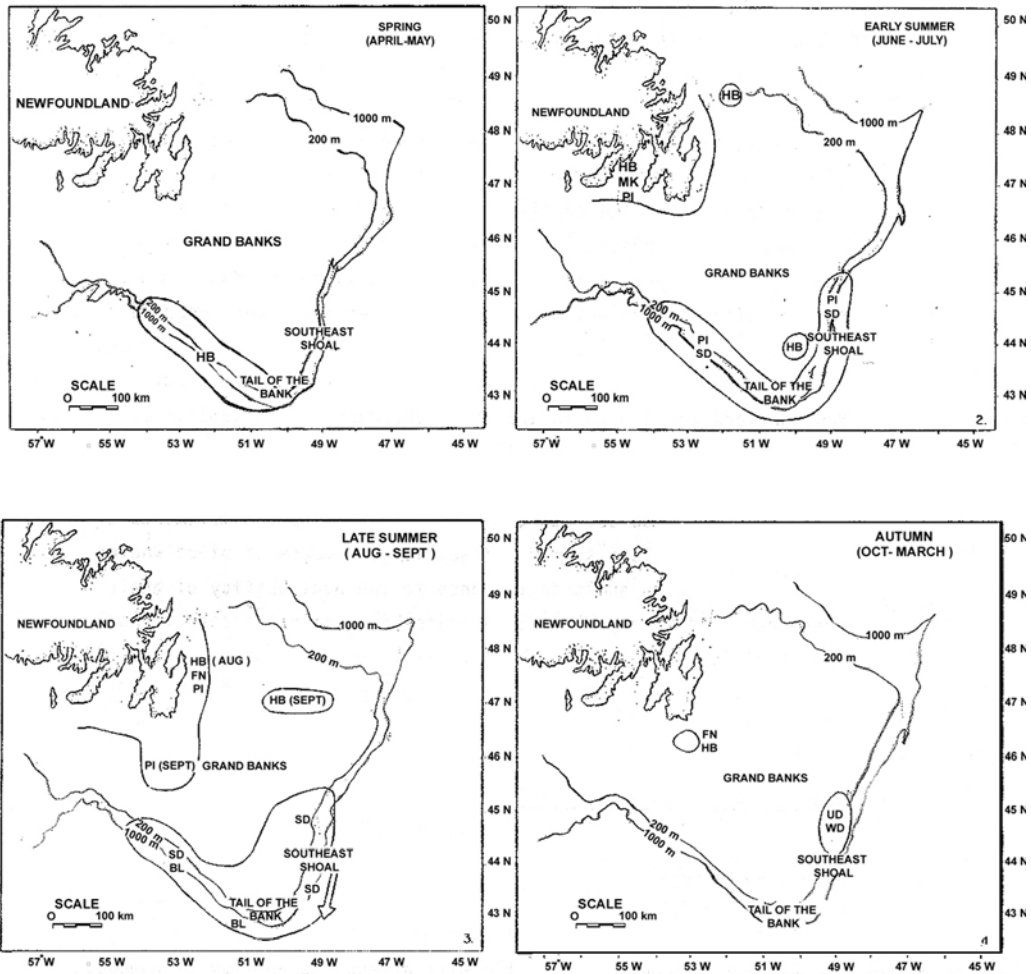


Figure 2. Seasonal Distribution of Whales on the Grand Banks, 1980-81 (Coughlan, G., 2002). (BL–blue whale, FN–Fin, MK–minke, HB–humpback, PI–pilot SD–Saddleback dolphin, WD–whitebeaked dolphin, UD–unidentified).

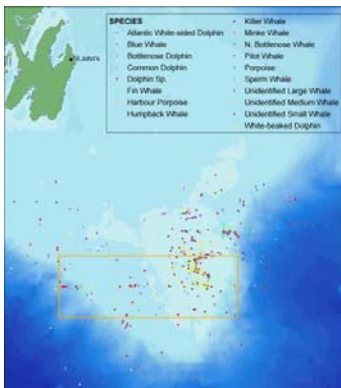


Figure 3. Cetacean sightings collected opportunistically from research surveys and fisheries observer reports from 1979-1999 (Fuller, S. D. & Myers, R. A., 2004).

- This information indicates that cetaceans are broadly distributed throughout the LOMA, with greatest densities along the shelf break, and southern coastal areas.
- The last 20 years have seen a drastic increase in harmful algal blooms worldwide, Fig. 4 below shows the incidents of harmful algal blooms in Atlantic Canada in 2007.
- There is little data on HABs available for the offshore areas of the LOMA since most monitoring is conducted inshore, largely in relation to shellfish harvest and human health, although HABs are known to be a problem offshore, and an outbreak of Domoic Acid was recently reported on the Flemish Cap in bivalves.

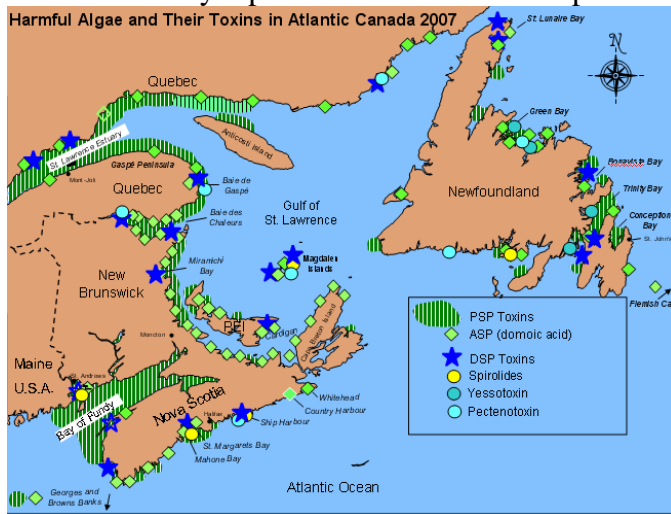


Figure 4. Risk Areas of Harmful Algal Bloom Events, Based on Historical Monitoring Records (modified from (Bates SS, Forbes JR, 2009).

- HABs are frequently associated with nutrient enrichment in inshore areas, but may also occur in productive offshore areas such as upwellings and shelf breaks.
- HABs are considered to be a chronic stressor, with a moderate risk of occurrence within the LOMA.

Score 5

Contact:

- Phytoplankton forms the basis of the marine foodchain, and algal blooms occur wherever adequate nutrients and sunlight (upper photic zone) are available. In the offshore, cetaceans feed in these productive zones, where prey is also naturally concentrated.
- Many harmful algal species are alien species, and ballast water exchange in the open ocean may contribute to the spread of HABs, and increased incidents world-wide (Carver, C. E. & Mallet A.L., 2002); (Humphrey, D. B., 2008).
- HABs occur in surface waters where baleen whales feed – these large whales are relatively indiscriminate feeders, consuming huge quantities of zooplankton, krill, copepods and small fish, readily ingesting harmful algal toxins directly or through their prey. Toothed whales are top predators, feeding on fish, squid and even seals and other whales, and can accumulate harmful algal toxins through the foodchain.
- It has recently been discovered that more than half of all marine mammal mortalities in US water can be attributed to marine biotoxins (UNESCO-IOC, 2009).

- Contact is considered high

Score 9

Duration:

- Cetaceans are present in the LOMA throughout the year, although highest densities occur in summer (Templeman, N. D., 2007).
- HABs are considered a chronic stressor which occurs every year, and are given a moderate score. Algal blooms are of short duration, and cysts of some species can remain dormant indefinitely in sediments, and resuspension of sediments (and cysts) into the photic zone is a significant concern, especially in coastal areas.
- Based on this information we have selected a moderate score in the medium range.

Score 5

Intensity:

- Incidents of harmful algal blooms are increasing world- wide, and incidents within the LOMA have increased correspondingly, although most data is associated with the inshore areas.

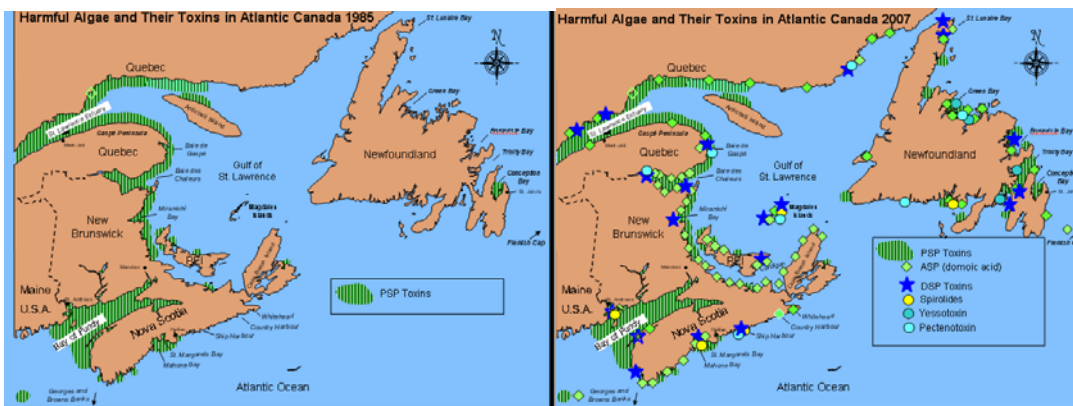


Figure 5. Increase in HABS in the Atlantic Canada from 1985 to 2007 (modified from (Bates SS, Forbes JR, 2009).

- Since intensity within the LOMA appears to be moderate relative to other areas in Atlantic Canada, we have selected a moderate score within the medium range

Score 5

Magnitude of Interaction: $(5 \times 9 \times 5 \times 5)/1000 = 1.1$

Sensitivity:

Sensitivity of the CP to acute impacts:

- Of the thousands of phytoplankton species, less than hundred or so are considered harmful. Those that produce toxins (poisons) or cause physical damage with sharp spines are members of groups called diatoms, dinoflagellates and raphidophytes. Harmful algal

- Severity of impacts vary considerably, depending on the HAB species.
- Incidents of mass mortality of whales (Agriculture and Consumer Affairs, 2004), have resulted from PSP poisoning over the last 20 years,
- Species at the top of the foodchain such as piscivorous fish, sea birds and marine mammals are also vulnerable, as are baleen whales that consume large quantities of small pelagic fish and invertebrates. A recent discovery is that more than half of all marine mammal mortalities in US water are now attributed to marine biotoxins (UNESCO-IOC, 2009). Improved techniques and increased sampling of animal tissues may account for this apparent increase.
- Based on this information we have selected a score in the high range.

Score 8

Sensitivity of the CP to chronic impacts:

- Cetaceans are long-lived and have low reproductive rates, making them particularly vulnerable to exploitation and other population stress. For example, the annual rate of population increase in sperm whales has been estimated at approximately 1 percent. Populations for some whale species have still not returned to historical levels since whaling from the 19th and early 20th century reduced populations to very low levels (Report to the Standing Committee on Small cetaceans, 2002). The blue whale is thought to live to 75 years, while the smaller minke whale, lives to 30 and 40 years and does not mature until 6 to 8 years (Templeman, N. D. & Davis, M. B., 2006). Population trends in cetaceans are difficult to measure due to the imprecise nature of population estimates and limited availability of data.
- Given their long lifespans and low reproductive rates, and relatively low numbers, cetaceans are particularly vulnerable to mass mortalities, and we have therefore selected a score in the moderate range (6)
- Of the 13 species making up the CP, one is listed by COSEWIC as *endangered* (blue whale) and four as *special concern* (fin whale, humpback whale, northern bottlenose whale and the harbour porpoise).
- Blue whales are listed as a depleted or rare species for the LOMA (Fisheries and Oceans Canada, 2007) (**add 0.5**).

Score 6.5

Sensitivity of ecosystem to harmful impacts to the CP:

- The role of cetaceans in the food web is complex as they range from top predators such as the killer whale which consumes fish, squid as well as seals and other whales, to large baleen whale which are relatively low on the foodchain despite their large size, and consume enormous quantities of krill, copepods, zooplankton, and small fish.

- Despite their relatively small numbers, they represent a significant biomass due to their large size, and contribute significantly to the energetics of the marine ecosystem. Most species are highly mobile, and their large scale movements contribute to the transfer of energy and biomass from seasonally productive areas to distant marine systems.
- Dead whales also contribute significantly to the productivity of the marine ecosystem, with their large carcasses providing food for fish, sharks, birds and decomposers.
- Cetaceans, by virtue of their high visibility, and charismatic nature have long attracted human attention, and can be used as indicators of the health and stability of marine ecosystems.
- Cetaceans hold an important place in our history, culture and economy. Whale watching contributes significantly to ecotourism in the LOMA. The Witless Bay Seabird Sanctuary Ecological Reserve hosts as many as 10 to 15 tour boats per day during the peak of the season, and the industry is growing throughout coastal areas of the LOMA.
- Cetaceans represent a significant and important component of the LOMA, and the LOMA provides important feeding habitat for the CP, so we have selected a score in the medium range (5)
- Cetaceans are listed as Ecologically Significant Species (ESS) within the LOMA (Fisheries and Oceans Canada, 2007) (**add 1 point**).

Score 6

Sensitivity: $(8 + 6.5 + 6)/3 = 6.8$

Risk of Harm: $1.1 \times 6.8 = 7.5$

Certainty Checklist

Answer yes or no to all of the following questions. Record the number of NO's to the 9 questions, and record certainty according to the scale provided below:

- 1 No's = High certainty
- 2- 3 No's = Medium certainty
- ≥ 4 No's = Low certainty

Y/N

- N Is the score supported by a large body of information?
- N Is the score supported by general expert agreement?
- N Is the interaction well understood, without major information gaps/sources of error?
- N Is the current level of understanding based on empirical data rather than models, anecdotal information or probable scenarios?
- N Is the score supported by data which is specific to the region, (EBSA, LOMA, NW Atlantic)?
- N Is the score supported by recent data or research (the last 10 years or less)?
- N Is the score supported by long-term data sets (ten years or more) from multiple surveys (5 years or more)?
- N Do you have a reasonable level of comfort in the scoring/conclusions?
- N Do you have a high level of confidence in the scoring/conclusions?

Score: Low

For interactions with Low certainty, underline the main factor(s) contributing to the uncertainty

- Lack of comprehensive data
- Lack of expert agreement
- Predictions based of future scenarios which are difficult to predict
- Other (provide explanation)

Suggest possible research to address uncertainty:

Information on high rate of marine mammal mortality associated with HABs is very recent, and further research is required.

Data on HABs in offshore areas is inadequate, and data on regional mortalities associated with HABs is unknown

Reference List

1. Agriculture and Consumer Affairs (2004). Marine Biotoxins. *FAO Food and Nutrition Papers*.
2. Bates SS, F. J. (2009). Phycotoxins and harmful marine algae of concern to Canada. (*manuscript in prep.*).
3. Carver, C. E. & Mallet A.L. (2002). *An assessment of the Risk of Ballast Water-mediated introduction of Non-indigenous Phytoplankton and Zooplankton into Atlantic Canadian Waters* (Rep. No. Prepared for Transport Canada, Marine Safety).
4. Coughlan, G. (2002). *The Southeast Shoal Area of the Grand Banks of Newfoundland, Potential as a Marine Protected Area: A Biophysical and Socio-economic Area Examination*. Faculty of Environmental Design, University of Calgary.
5. Fisheries and Oceans Canada (2007). *Placentia Bay-Grand Banks Large Ocean Management Area Conservation Objectives* (Rep. No. 2007/042). Canadian Science Advisory Secretariat Science Advisory Report.
6. Fuller, S. D. & Myers, R. A. (2004). *The Southern Grand Bank: a marine protected area for the world* Halifax: World Wildlife Fund Canada.
7. Humphrey, D. B. (2008). *Characterizing Ballast Water as a Vector for Nonindigenous Zooplankton Transport*. Master of Science The University of British Columbia.
8. Lawson, J., Sjare, B., & Stenson, G. Supplementary information on marine mammals. Templeman, N. D. Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas . Canadian Science Advisory Secretariat Research Document 052. 2007. Fisheries and Oceans Canada.
Ref Type: Generic
9. Report to the Standing Committee on Small cetaceans (2002). International Whaling Commission. *Journal of Cetatean Research & Management (Supplement)*, 4, 338.
10. Sindermann, C. J. (2003). *Coastal Pollution*.
11. Templeman, N. D. (2007). *Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas* (Rep. No. 2007/052). Canadian Science Advisory Secretariat Research Document, Fisheries and Oceans Canada.

12. Templeman, N. D. & Davis, M. B. (2006). *Placentia Bay-Grand Banks Ecosystem Overview and Assessment Report (DRAFT)* Newfoundland & Labrador: Fisheries and Oceans Canada.
13. UNESCO-IOC (2009). *Intergovernmental Panel on Harmful Algal Blooms, National Statement:USA* (Rep. No. Ninth Session).

Summary Table: Cetaceans in Placentia Bay Grand Banks LOMA

Key Activity/Stressor	a	c	d	i	MoI <i>(a x c x d x i)</i> 1000	as	cs	es	S <i>(as+cs+es)</i> 3	Risk of Harm	Certainty
Gillnets	2.5	4	10	5	0.5	5	6	6	5.7	2.9	Med
Crab Pots	7	3.5	3	4	0.3	3.5	4.5	6	4.7	1.4	Med
Ship Strikes	5	8	10	5	2.0	7.5	5.5	6	6.3	12.6	Low
Seismic surveys	5	8	5	7	1.4	2	4.5	6	4.2	5.9	Low
Litter	7	9	7	6	2.6	2	7.5	6	5.2	13.5	Low
HABs	5	9	5	5	1.1	8	6.5	6	6.8	7.5	Low
Cumulative CP Score										43.8	