Unique Spawning area for Northern Atlantic cod in Smith Sound

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

We have interpreted this CP to include the physical environment, with stressors limited to changes in the physical, chemical or biological environment of Smith Sound or activities which cause disturbance (or mortality) to the cod in Smith Sound during the spawning period (April-July).

Gillnets (bottom):
Fishing mortality is considered the greatest threat to Smith Sound cod, and there is a risk that fishing inshore may impede recovery of the entire stock (Fisheries and Oceans Canada, 2008). Following the discovery of dense aggregations of cod in Smith Sound in 1995, a small (Wiese & Ryan, 2003) fishery directed at these inshore populations was introduced in 1998. Catch rates declined and the fishery was closed in 2003. Catches during 2004-2005 were limited mainly to bycatch (>600t) in the winter flounder fishery (Fisheries and Oceans Canada, 2008) and sentinel fisheries. Sentinel catch rates near Trinity Bay (southern 3K and northern 3L) have generally increased since 2002 and are currently above average for the time series. A directed stewardship fishery was reopened in the inshore in 2006 to replace the index fishery. Reported landings from the 2007 stewardship fishery were 2,364t. In addition, 182t were landed in the sentinel fishery. These fisheries largely utilize gillnets. Bycatch in other directed fisheries, including winter flounder and lumpfish, which utilize gillnets, are also significant.

Total fishing mortality is estimated at 20% of the biomass (Corey Morris, Biologist, Fisheries and Oceans Canada, PO Box 5667, St. John's, NL, A1C 5X1, "pers. comm."). Stewardship fishery catch rates in 2006-07 were slightly higher than in earlier fisheries between 1998 and 2002. A pre-recruit index suggests that the strength of the 2003-2006 year-classes will be much lower than those that have supported recent fisheries (Fisheries and Oceans Canada, 2008). Gillnet fishing is clearly a major source of mortality and has been screened in for further analysis.

The main directed fisheries for cod using bottom gillnet occur in the late summer or fall (September-October), including the stewardship and sentinel fisheries. Bycatch of cod may occur in other gillnet fisheries including the winter flounder fishery (August), and the turbot and lumpfish fisheries which typically take place in June-July. The turbot fishery does not take place within the bay. Only the lumpfish fishery overlaps with the cod spawning period, and mesh size of lumpfish gillnets is large (265mm) compared to nets used to target cod (140-165mm) so that bycatch is limited to very large cod. Since Smith Sound is known for large cod, and large cod contribute disproportionately to spawning productivity due to their high fecundity, impacts may be significant. **Screened in.**

Recreational cod fishery:
Historically, cod has been an important part of the diet in Newfoundland, and access to a winter supply of fish is considered a traditional right which residents took for granted until the implementation of the groundfish moratorium. As a result, there was intense pressure to open a food/recreational fishery when dense aggregations of fish were detected in Smith Sound and adjacent coastal areas in 1995. In response to public pressure, a food fishery was opened for a number of years, but was closed again in 2003 in response to declining inshore stocks. The fishery was reopened in 2006.

Only handline and angling gear is permitted. Handlines include baited hooks, feathered hooks and artificial lures. A maximum of three (3) hooks per line may be used. The season dates are set each year, typically 3-4 weeks in late July/early August, and an additional 1-2 weeks in late September-early October, for a total of five weeks. Recreational fishers are limited to five (5) groundfish per day (including cod), and 15 per boat trip.

Estimates of landings from the recreational fishery are variable. The 2007 DFO Survey (BriLev Consulting Inc., 2008) estimated that anglers caught 1,128,635 fish in the 2007 recreational fishery, with 308,160 in Trinity Bay alone. This suggests that the recreational catch was equivalent to that of the stewardship fishery (Fisheries and Oceans Canada, 2008), and may be a significant stressor to Smith Sound cod. However, the recreational fishery does not occur in Smith Sound during the period (April-July) when cod spawning occurs. **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, polypropylene and polyethylene, which do not biodegrade. Unlike their natural predecessors, the new materials can last for years or decades in the marine environment. They are largely impervious to biodegradation; they are resistant to chemicals and abrasion (National Academy of Sciences, 2008). Gillnets, traps, trawls and line fisheries are considered the most harmful in relation to derelict fishing gear (National Academy of Sciences, 2008). Major factors which contribute to increased loss of gear include deep water, poor weather conditions, high fishing intensity and large volumes of gear per harvester. For example, research has shown a clear connection between water depth and loss rates in the Norwegian gillnet fishery, with an estimated loss of 15 nets per day in the Greenland halibut fishery at depths of 550 to 700m (Hareide et al., 2005).

Gillnets are considered the most problematic gear in relation to fish mortality, and are the most common gear used in Smith Sound. Smith Sound is a small, narrow, relatively sheltered area where significant gear loss is unlikely to occur, but any lost gear is likely to end up in one of the two deep trenches where dense aggregations of cod overwinter, and significant mortalities could result. Since cod are widely distributed throughout the Sound, often high in the water column during the spawning period, ghost nets are not considered a key stressor to spawning cod. **Screened out.**

Temperature change:
Drinkwater (UNEP & UNFCCC, 2002) predicts a temperature increase of 2-4^{o}C in Southern Newfoundland waters by 2100 based on IPCC 2001 models. Temperature rise will likely not be linear, but is expected to accelerate over time. Even given the worst case scenario, an increase in 0.4^{o}C is likely the most we can expect over the next ten years. Many believe that temperature shifts were at least partially responsible for the poor recovery of over-fished cod stocks in the 1990s (Rose, 2007). Drinkwater (2005) states that the range of cod may extend northward with increasing temperature, and it is likely that spring migrations will occur earlier, and fall returns will be later (Drinkwater, 2005). These responses of cod to future climate changes are highly uncertain, however, as they will also depend on the changes to climate and oceanographic variables besides temperature, such as stratification, plankton

production, the prey and predator dynamics and industrial fishing. Temperature changes are not likely to be significant over the next 10 years, and a small increase of 0.4^{o}C or less would likely be beneficial to cod in Smith Sound. **Screened out.**

Increased storm events:
Recent scientific evidence suggests a link between the destructive power, or intensity, of hurricanes and higher ocean temperatures, driven in large part by global warming. Two factors that contribute to more intense tropical cyclones, ocean heat content and atmospheric water vapour, have both increased over the past several decades. As warm, moist air rises, it lowers air pressure at sea level and draws the surrounding air inward and upward in a rotating pattern, powering the storm. As the moist air spirals in and rises to higher altitudes, it cools and releases heat as it condenses to rain (Union of Concerned Scientists, 2006).

Atlantic tropical cyclones are getting stronger on average, with a 30-year trend that has been related to an increase in ocean temperatures, and are predicted to impact the NW Atlantic at a high level of intensity relative to other areas of the globe (Elsner et al., 2008). The years 1995-2000 experienced the highest level of North Atlantic hurricane activity in the reliable record (Goldenberg et al., 2001). The largest increase in hurricanes reaching categories 4 and 5 occurred in the Pacific and Indian Oceans, but the highest increase in the number of cyclones and cyclone days occurred in the North Atlantic (Webster et al., 2005). The relationships between a warming environment and increasing storm events is complex, and research results and predictions are variable, and more research is clearly required (Emanuel, 2005; Emanuel, 2000; Goldenberg et al., 2001; Webster et al., 2005).

Increased storm surges can potentially contribute to super-cooling events during severe winter storms where the motion keeps seawater in a liquid state at temperatures well below -2^{o}C and can lead to mass mortalities. A super-cooling event in Smith Sound several winters ago resulted in mass mortality (~500,000 fish) of overwintering cod. **Screened in.**

Key Activities/Stressors:

- Gillnets (bottom)
- Increased storm events

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2. Drinkwater, K. F. (2005). The response of Atlantic cod (*Gadus morhua*) to future climate change. *ICES Journal of Marine Science, 62,* 1327-1337.

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Unique spawning area for northern Atlantic cod in Smith Sound

Gillnets (bottom)

<u>Magnitude of Interaction</u>

Areal extent:

- Smith Sound is a small area which supports a very dense aggregation of spawning cod. A deep (200m) trench provides over-wintering habitat for pre-spawning fish, and as deep waters cool in the spring, warming surface layers provide above zero waters if deep water should fall below optimal temperatures for spawning and survival of cod. Thus, during the spawning season, cod may be seen throughout Smith Sound.

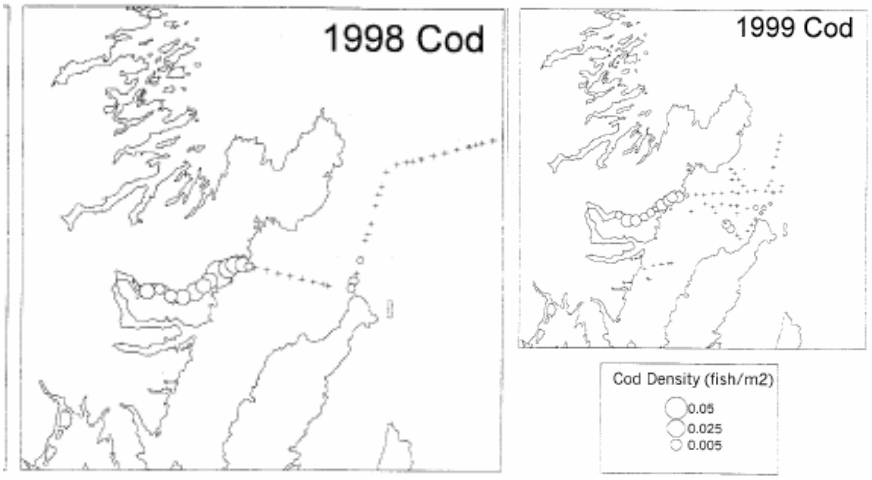


Figure 1. Cod distributions in Trinity Bay from acoustic surveys (O'Driscoll et al., 2000).

- Gillnet fishing within Smith Sound may include directed sentinel and stewardship fisheries, and winter flounder and lumpfish fisheries. There are no restrictions on the locations of these fisheries within the Sound, therefore, we have assumed that the entire EBSA is subject to gillnet fishing.

Score 10

Contact:

- In relation to bottom gillnet, Quantitative Fishing Gear Scores (Fisheries and Oceans Canada, 2007) for "contact" are high (75-100%) for bony fish species.
- Since there is a directed fishery for cod in Trinity Bay, we have given a score of 100%.

Score 10

Duration:

- Cod spawning in Smith Sound is variable, but generally occurs between April and July (4 months).
- The main directed fisheries for cod using bottom gillnet occur in the late summer or fall (September- October), including the stewardship and sentinel fisheries. Bycatch of cod

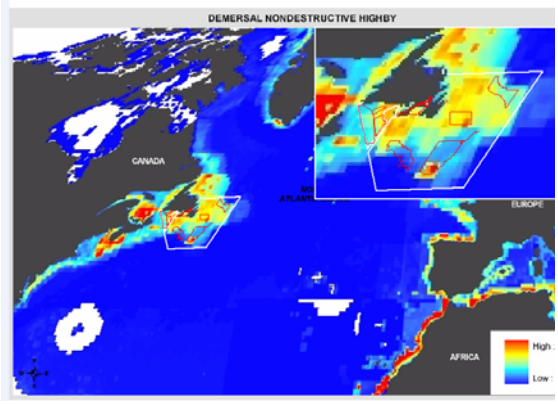
may occur in other gillnet fisheries including the winter flounder fishery (August), and the turbot and lumpfish fisheries which typically takes place in June-July. The turbot fishery does not take place within the bay. Gillnet fishing (lumpfish only) therefore occurs from June to October (2 month overlap).

- 2/4 = 50%

Score 5

Intensity:

- Halpern *et al.* (2008) have developed maps showing the global intensity of several anthropogenic stressors including 'demersal non-destructive fishing with high bycatch', which includes bottom gillnet fisheries (see Figure below). This map can be used to provide guidance in scoring the intensity of a stressor in relation to maximum intensity in a global context, in accordance with the scale provided below
- This map shows a medium (yellow) intensity relative to global levels for a score range of 40% to 60% for the LOMA**.**



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

Figure 2. Global intensity of bottom gillnets (adapted from (Halpern et al., 2008).

- Gillnets are the dominant gear impacting cod within the inshore, with landings of cod (including bycatch) estimated at 2500t in 2007. Although landings are greatly reduced compared to historical levels, landings are significant in relation to the estimated biomass of inshore stocks (10%). Fishing intensity is minimal during the spawning period (April-July). We have therefore selected the lowest score within the suggested range.

Score 4

<u>Magnitude of Interaction</u>: (10 x 10 x 5 x 4)/1000 = 2

<u>Sensitivity</u>

Sensitivity of the CP to acute impacts:

- Fishing mortality within the Sound and throughout inshore areas of NAFO area 2J3KL is considered the greatest threat to the unique spawning aggregations in Smith Sound.
- Although there are significant directed gillnet fisheries for cod in coastal areas of 2J3KL, including Smith Sound, these fisheries occur in the fall of the year (usually September-

October) when Smith Sound cod are widely distributed in adjacent coastal and offshore waters, and therefore will not affect the "unique spawning area" within Smith Sound. Gillnet fisheries for winter flounder generally occur in late summer, and are subject to closure if bycatch limits for cod are exceeded. Spring gillnet fisheries for lumpfish may occur within Smith Sound and adjacent areas where Smith Sound cod migrate to spawn, although bycatch of cod is reported to be low in this fishery. Due to the large mesh size used in this fishery, any cod captured would be very large fish.

- Although the "unique spawning area" in Smith Sound may be subject to minor alteration as a result of gillnet fishing for lumpfish and potentially winter flounder if spawning extends into July, the acute sensitivity of the area and its unique spawning aggregations is likely low in relation to gillnet fishing.

Score 2

Sensitivity of the CP to chronic impacts:

- Smith Sound cod belong to the Newfoundland and Labrador population of Atlantic cod which was assessed by COSEWIC in 2003 and designated **'**endangered'**.** The Status Report lists fishing (including legal, illegal and unreported catches) and fishing-induced changes to the ecosystem as key threats to cod recovery.
- Inshore components of the stock appear more productive than offshore components. Stewardship fishery catch rates in 2006-07 were slightly higher than in earlier fisheries between 1998 and 2002, and sentinel fisheries catch rates near Trinity Bay (southern 3K and northern 3L) have generally increased since 2002 and are currently above average for the time series.
- A pre-recruit index suggests that the strength of the 2003-2006 year-classes will be much lower than those that have supported recent fisheries (Fisheries and Oceans Canada, 2008).
- Clearly, significant fishing mortality can affect the long-term stability of the stock, but the spawning aggregation within the Sound does not appear to sustain significant chronic impacts as a result of gillnet fishing.
- Chronic sensitivity is therefore considered to be low (2).
- Atlantic cod are listed in the CP document as a 'depleted and rare species', and will therefore rank higher on this scale than other CPs because they are already in need of recovery (**add one point**).

Score 3

Sensitivity of ecosystem to harmful impacts to the CP:

- Smith Sound cod belong to the Newfoundland and Labrador population of Atlantic cod, one of two major cod stocks within the LOMA.
- Cod have historically had a huge influence on the ecosystem of the LOMA, mainly because of their large biomass and broad distribution compared to other species, and their significant role as both predator and prey at all trophic levels as they grow and move from one trophic level to another. Even though they are currently at less than one percent of their former biomass, they still represent a significant component of the total groundfish population.

- Since the sharp decline in cod biomass in the 1990s, stocks of invertebrates such as shrimp and crab have expanded to record highs in what has been termed a trophic cascade. These changes have been blamed on over-fishing resulting in perturbations to the predator-prey systems, and although environmental change may have had a contribution, it is clear that the role of Atlantic cod in the ecosystem is highly significant to its structure and function.
- Smith Sound is an important overwintering area for the severely depleted population of Northern cod. The very dense aggregation of fish in the relatively small geographical area of Smith Sound during the winter not only represents the largest group in terms of numbers of fish, but the fish are also very large in size and hence fecundity, and can potentially contribute significant numbers of eggs to Smith Sound and adjacent areas. Smith Sound is considered the largest remaining spawning area for Northern Cod. Extensive eelgrass beds at the head of the Sound provide high quality nursery habitat. Much of the currently known spawning that occurs along the northeast coast appears to originate from migrating subgroups of cod which overwintered in Smith Sound (Templeman, N. D., 2007). Smith Sound cod aggregations may be critical to the recovery of the population (Templeman, N. D., 2007), although the potential role of bay stocks such as those in Smith Sound in rebuilding the offshore stocks is unknown (Rose, G. A., 2007).
- Given the importance of this population to one of the two major stocks within the LOMA, we have selected a score of 6.
- Atlantic cod are listed in the CP document as an 'ecologically significant species (**add one point**).

Score 7

<u>Sensitivity:</u> (2 + 3 + 7)/3 = 4

<u>Risk of Harm:</u> MoI x S = 2 x 4 = 8

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?
Y Is the score supported by general expert agreement?
Y 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?

Certainty Score: Medium

Reference List

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Unique spawning area for northern Atlantic cod in Smith Sound

Increased storm events

<u>Magnitude of Interaction</u>

Areal extent:

- Smith Sound is a small area which supports a very dense aggregation of spawning cod. A deep (200m) trench provides over-wintering habitat for pre-spawning fish, and as deep waters cool in the spring, warming surface layers provide above zero waters if deep water should fall below optimal temperatures for spawning and survival of cod. Thus, during the spawning season, cod may be seen throughout Smith Sound.

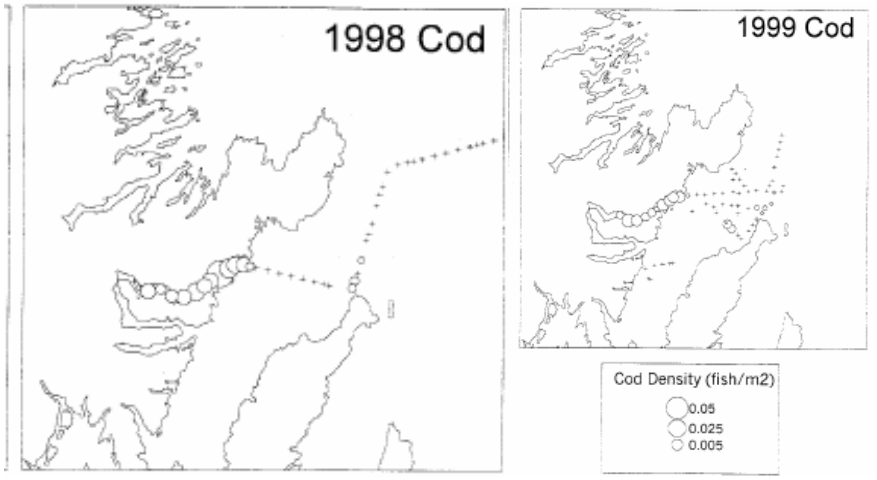

Figure 1. Cod distributions in Trinity Bay from acoustic surveys (O'Driscoll et al., 2000).

- Increased storm events are an escalating stressor related to climate change which is predicted to impact the entire LOMA.

Score 10

Contact:

- Increased storm events will impact the entire water column in shallow coastal waters, therefore contact with the CP associated with coastal waters are scored as 100%.

Score 10

Duration:

- Cod spawning in Smith Sound is variable, but generally occurs between April and July (4 months).
- Super-cooling events resulting from storm mixing are most likely in the spring of the year when ice cover (which prevents wind related mixing) is gone, but surface waters are below 0^{o}C (March-April)- but these events are not expected to occur annually.

- Chronic stressors which are unlikely to occur annually are scored in the **low** range. We have selected a score at the low end of the range to reflect the anticipated low frequency and duration of the stressor.

Score 1

Intensity:

- Atlantic tropical cyclones are getting stronger on average, with a 30-year trend that has been related to an increase in ocean temperatures, and are predicted to impact the NW Atlantic at a high level of intensity relative to other areas of the globe (Elsner et al., 2008).
- The years 1995-2000 experienced the highest level of North Atlantic hurricane activity in the reliable record (Goldenberg et al., 2001).
- The largest increase in hurricanes reaching categories 4 and 5 occurred in the Pacific and Indian Oceans, but the highest increase in the number of cyclones and cyclone days occurred in the North Atlantic (Webster et al., 2005). The relationships between a warming environment and increasing storm events is complex, and research results and predictions are variable, and more research is clearly required (Emanuel, 2005; Emanuel, 2000; Goldenberg et al., 2001; Webster et al., 2005).
- Based on the available information we have selected a score at the low end of the high range.

Score 7.5

<u>Magnitude of Interaction</u>: (10 x 10 x 1 x 7.5)/1000 = 0.75

<u>Sensitivity</u>

Sensitivity of the CP to acute impacts:

- It is not clear exactly what factors contribute to making Smith Sound a unique spawning area for northern Atlantic cod, but the abundance of prey, particularly capelin, refuge from the intense fishing effort that led to the decline of offshore stocks, as well as the deep (200m) trench within a sheltered sound which offers over-wintering habitat for pre-spawning aggregations, are likely important factors.
- Spawning in Smith Sound begins in early April and continues into the summer, with spawning observed as late as July in some years (Rose, 2007). Some fish appear to remain in Smith Sound all year, but the majority migrate seasonally in and out of the bay. In a normal year, migrating cod return to Smith Sound in late fall or early winter when deep waters in the trench are warm (3-5^{o}C). As spring approaches, deep waters cool, but temperatures are still above 0^{o}C when cod begin to spawn in early April. By late May, temperatures in deep waters may dip below 0^{o}C and the fish either move up into the warming surface waters or out into adjacent areas (Rose, 2007).
- Increased storm surges can potentially lead to super-cooling events during severe winter storms where the motion keeps seawater in a liquid state at temperatures well below -2^{o}C and can lead to mass mortalities of fish.
- In the spring of 2003, the normal cooling of the deep waters accelerated quickly in early April, trapping the cod in sub-zero waters deep in the Sound, and about 5% (500,000

fish) froze to death in the super-cooled water (Rose, 2007). This type of event is rare, occurring when specific environmental conditions coincide, and may never occur again, but increased storm events may increase the risk of reoccurrence, although the additional risk is considered low (3).

Score 3

Sensitivity of the CP to chronic impacts:

- Smith Sound cod belong to the Newfoundland and Labrador population of Atlantic cod which was assessed by COSEWIC in 2003 and designated endangered. The Status Report lists fishing (including legal, illegal, and unreported catches) and fishing-induced changes to the ecosystem as key threats to cod recovery.
- Inshore components of the stock appear more productive than offshore components. Stewardship fishery catch rates in 2006-07 were slightly higher than in earlier fisheries between 1998 and 2002, and sentinel fisheries catch rates near Trinity Bay (southern 3K and northern 3L) have generally increased since 2002 and are currently above average for the time series.
- A pre-recruit index suggests that the strength of the 2003-2006 year-classes will be much lower than those that have supported recent fisheries (Fisheries and Oceans Canada, 2008).
- Generation time is reportedly 11 years for Atlantic cod (Lough, 2004). Sexual maturity is reached in females around 5-8 years, with males being slightly younger (Lear, 1993). Cod are very prolific, particularly large cod. Female cod about 80 cm long produce about two million eggs, while a cod of about 130 cm produces over 11 million eggs. Cod are batch spawners, releasing eggs in batches over a period of weeks or months depending on their size.
- Atlantic cod populations are currently at a very low level compared to historical levels, and although TAC are correspondingly low, catch rates are significant given the low level of the stock. Gillnets are responsible for 50% of landings by weight in this EBSA over the period 1998-2007. In the last five years (2003-2007), landings from gillnet averaged 479t.
- Mortality from the 2003 super-cooling event were significant (500,000 fish), but are sustainable (5% of biomass) provided other mortality sources are adjusted in consideration of the loss for the year in which the event occurs. This type of event is rare, occurring when specific environmental conditions coincide, and may never occur again, but increased storm events may increase the risk of reoccurrence, although the additional risk to the long term survival of cod spawning in Smith Sound is considered to be low (score 2).
- Atlantic cod are listed in the CP document as a ‘depleted and rare species’, and will therefore rank higher on this scale than other CPs because they are already in need of recovery (**add one point**).

Score 3

Sensitivity of ecosystem to harmful impacts to the CP:

- Smith Sound cod belong to the Newfoundland and Labrador population of Atlantic cod, one of two major cod stocks within the LOMA.
- Cod have historically had a huge influence on the ecosystem of the LOMA, largely because of their large biomass and broad distribution compared to other species, and their significant role as both predator and prey at all trophic levels as they grow and move from one trophic level to another. Even though they are currently at less then one percent of their former biomass, they still represent a significant component of the total groundfish population.
- Since the sharp decline in cod biomass in the 1990s, stocks of invertebrates such as shrimp and crab have expanded to record highs in what has been termed a trophic cascade. These changes have been blamed on over-fishing resulting in perturbations to the predator-prey systems, and although environmental change may have had a contribution, it is clear that the role of Atlantic cod in the ecosystem is highly significant to its structure and function.
- Smith Sound is an important overwintering area for the severely depleted population of Northern cod. The very dense aggregation of fish in the relatively small geographical area of Smith Sound during the winter not only represents the largest group in terms of numbers of fish, but the fish are also very large in size and hence fecundity, and can potentially contribute significant numbers of eggs to Smith Sound and adjacent areas. Smith Sound is considered the largest remaining spawning area for Northern Cod. Extensive eelgrass beds at the head of the Sound provide high quality nursery habitat. Much of the currently known spawning that occurs along the northeast coast appears to originate from migrating subgroups of cod which overwintered in Smith Sound (Templeman, 2007). Smith Sound cod aggregations may be critical to the recovery of the population (Templeman, 2007), although the potential role of bay stocks such as those in Smith Sound in rebuilding the offshore stocks is unknown (Rose, 2007).
- Given the importance of this population to one of the two major stocks within the LOMA, we have selected a score of 6.
- Atlantic cod are listed in the CP document as an 'ecologically significant species' (**add one point**).

Score 7

<u>Sensitivity:</u> (3 + 3 + 7)/3 = 4.3

<u>Risk of Harm:</u> MoI x S = 0.75 x 4.3 = 3.2

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)?
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?

Certainty 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:

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Summary Table: Unique spawning area for northern Atlantic cod in Smith Sound

Key Activity/Stressor	a	c	d	i	**MoI** (a x c x d x i) / 1000	as	cs	es	**S** (as+cs+es) / 3	**Risk of Harm**	Certainty
Gillnets (groundfish)	10	10	5	4	**2**	2	3	7	**4**	**8**	**Med**
Increased storm events	10	10	1	7.5	**.75**	3	3	7	**4.3**	**3.2**	**Low**
Cumulative CP Score										**11.2**	