Unique black dogfish (*Centroscyllium fabricii*) pupping and aggregation in the Laurentian Channel and Slope

Potentially Harmful Activity (X)			Potentially Harmful Stressor (X)		
Fishing	Bottom trawl	**X**	Marine pollution	Oil pollution	**X**
	Scallop dredges	**X**		Industrial effluent	
	Clam dredges			Fishplant effluent	
	Midwater trawl	**X**		Sewage	
	Gillnets (bottom)	**X**		Historic military waste	**X**
	Gillnets (pelagic)			Long range transport of nutrients	
	Long line	**X**		Acid rain	
	Scottish seining	**X**		Persistent Organic Pollutants	
	Purse seining			Eutrophication	
	Recreational cod			Ghost nets	**X**
	Crab pots	**X**		Litter	
	Lobster pots			Other contaminants (specify)	
	Whelk pots		Climate Change	Ice distribution	
Other harvest	Otter trapping			Temperature change	**X**
	Seal hunt			Sea-level rise	
	Seabird hunt			Ocean acidification	
	Seaweed harvest			Current shifts	**X**
Seabed alteration	Anchor drops/drags			Increased storm events	
	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	
	Oil & gas drilling/Mining	**X**		*Membranipora*	
	Cables			Golden Star Tunicate	
Coastal alteration	Freshwater			Violet Tunicate	
	Subtidal construction			Vase Tunicate	
	Intertidal/coastal construction			*Codium fragile*	
				Clubbed Tunicate	
	Other (specify)			*Didemnum*	
Disturbance	Vessel traffic	**X**		Toxic Algal Blooms	
	Ship strikes			Disease organisms (human waste)	
	Ecotourism			Disease organisms (aquaculture)	
	Marine construction			Other (all species included)	**X**
	Seismic surveys	**X**	Other		
	Navy sonar	**X**			
	Other (specify)				

Background Information

- The Laurentian Channel is an alternative ballast water exchange zone, and therefore susceptible to Aquatic Invasive Species (AIS) (Simard & Hardy, 2004).
- A research priority listed on the National Plan of Action for Sharks is "Assessment of a potential pupping ground for black dogfish in the Laurentian Channel" (Government of Canada, 2007).
- Parks Canada's National Marine Conservation Areas System Plan has listed the Laurentian Channel as a marine region of interest. This region is not yet represented in the national marine conservation areas system. Five preliminary representative marine areas have been identified: Anticosti Island/Gaspé Peninsula, Cow Head/Bay of Islands, Strait of Belle Isle, Cabot Strait and South Coast Fjords. Studies to confirm the representative marine areas, followed by selection of the preferred site for consideration as a possible national marine conservation area, are the next steps.

Distribution

Six species of small sharks have been recorded in Canadian waters, but only two are abundant: spiny dogfish and black dogfish (Kulka, 2006). Black dogfish are concentrated in the Laurentian Channel, into Hermitage Channel and near the St. Pierre Bank. Virtually all large catches in the NL surveys (defined as >15 individuals per tow) were located in the Laurentian Channel. There, black dogfish were about 10 times more densely concentrated than in the Grand Banks and Labrador Shelf slope waters (Kulka, 2006).

Black dogfish, are a deep-water species distributed in the Northwest Atlantic: South Baffin Island and Greenland to Virginia, USA and possibly the Gulf of Mexico; and in the eastern Atlantic: Iceland along Atlantic slope to Senegal; Guinea to Sierra Leone; Namibia to Quoin Point, South Africa (González et al., 2007).

Black dogfish are a bathy-demersal species resident in waters as shallow as 300 m but generally found in water deeper than 500 m. They can occupy a wide range of depths: 98% from 400 to 1 400 m, highest concentrations in 350-500 m (Simard & Hardy, 2004). Black dogfish were associated primarily with temperatures > 3.8°C. Large (pregnant) females migrate to the shallow (<400 m) portion of the Laurentian Channel where pupping occurs. The young then move into deeper waters of the channel. As they mature they move out of the channel and onto the slope waters. As they grow they move into deeper waters of the slope (Kulka, 2006).

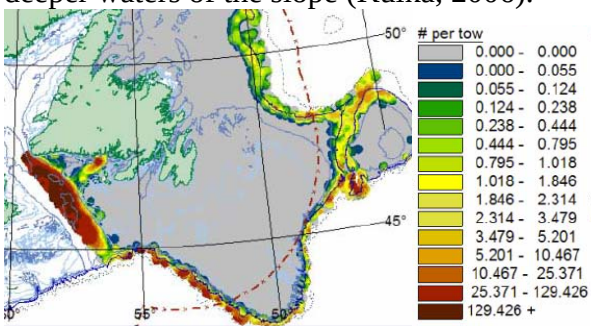

Figure 1. Distribution of black dogfish from the Grand Banks to Davis Strait based on NL trawl survey data from 1971-2005 (Kulka, 2006)

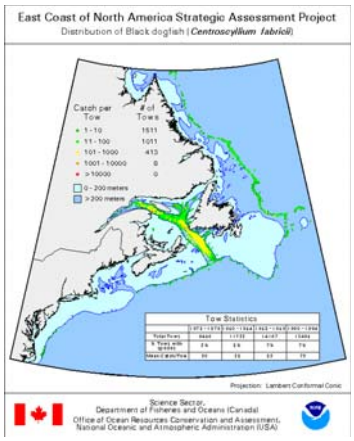

Figure 2. Distribution of black dogfish (Brown et al., 2005)

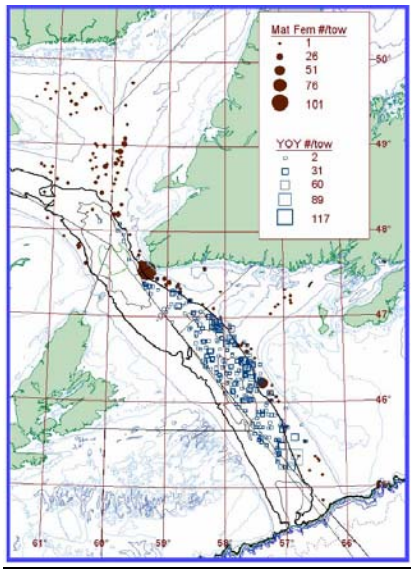

Figure 3. Distribution of large mature females (filled circles) and young of the year (open squares) black dogfish in Canadian waters (Kulka, 2006).

Age Structured Distribution

Black dogfish have a highly structured distribution with separation of life stages by area and depth. Large mature (presumably pregnant) females are concentrated along the periphery (<400 m) of the Laurentian Channel. Newly born (17-30 cm) young concentrate in the deeper mid-channel and older juveniles are found within the deepest part of the channel at 500-600 m. Young of the year are largely absent from areas outside the Channel, except off Greenland. Some older juveniles but primarily adults (>60 cm) occupy the slope waters off Canada at depths >800 m, including within the NRA and around the Flemish Cap. Most fish in the Div. 3NO Spanish survey were between 40 and 75 cm. This spatially different size structure indicates that black dogfish reproduction (pupping) occurs only in the Laurentian Channel while presumably larger juveniles and non-reproductive adults occupy slope waters (NAFO, 2006).

The smallest mode of (15-30 cm) fish in Grand Banks occurred almost exclusively in the Laurentian Channel. This young of the year mode was observed primarily at depths <600 m in the Laurentian Channel. A small number of these <30 cm fish were also observed on the slope in 401-600 m but in close proximity to the outer extent of the Laurentian Channel. As well, there are a substantial proportion of mature females in the shallowest portion of the Laurentian Channel. Thus it appears that the Laurentian Channel is a pupping ground for this species in the northwest Atlantic (Kulka, 2006).

Pupping

Black dogfish are ovoviviparous, bearing live young (Jacques Whitford, 2003) with embryos reliant on the yolk sac during development. Litter size was 4 to 40 and the smallest size observed was 16.5 cm (Kulka, 2006).

The Laurentian Channel appears to be a pupping ground for this species. Large pregnant females migrate to shallow waters in the Laurentian Channel where pupping occurs. The young migrate in to deeper waters of the channel where as they mature, they migrate out of the Laurentian Channel in to the slope waters. They may migrate significant distances to the Labrador shelf. As they continue to grow, they continue to move into deeper waters (Kulka, 2006).

Biology

It is presumed that the black dogfish, as is true of all sharks in the Squalidae family, grows slowly, reaches sexual maturity at a late age and has low fertility. They reach lengths of over 100 cm (Fisheries and Ocean Canada, 1996).

Black dogfish preyed mostly on pelagic and benthopelagic prey (crustaceans, scyphozoans and fish) (González et al., 2007) and redfish. They also feed on crustaceans, cephalopods, jellyfish and small fishes. There are no known predators (Jacques Whitford, 2003).

Temperature Range

In terms of bottom temperature, black dogfish were associated primarily with the warmest available bottom temperature: 92% of all individuals captured in the trawl survey were taken where temperatures >3.8^{o}C. With few exceptions, the largest catches (defined as >15 individuals per tow) came from the warmest available locations where bottom temperature was between 5 and 6.5^{o}C, primarily in the Laurentian Channel (Kulka, 2006).

Kulka (2006) refers to one study in Canadian waters which found that juveniles were located in both the coldest and warmest temperatures while adults were largely constrained to locations where temperatures were mid-range, 2.1-3.7°C (Kulka, 2006).

Population Trend

In the Laurentian Channel, the spring index fluctuated at a relatively low level during the 1970s and early 1980s then increased rapidly. The index leveled off and stabilized until the mid-1990s. Since that time, it has declined, perhaps reaching stability in recent years.

It appears that the adult (spawning stock) segment of the population was stable after 1995 while juveniles in the Laurentian Channel declined (Kulka, 2006).

The species is thought to be highly gregarious, and it is not unusual to see very large catches in some places and very small or no catches in others. This wide spatial variability makes population estimates very uncertain (Fisheries and Ocean Canada, 1996).

Bycatch

Black dogfish are not reported in the NAFO statistics. However, an average of 423 tons of "dogfish (ns)" was reported annually between 2000 and 2005. This unspecified dogfish category may comprise up to 5 species but black dogfish is the most common shark in the NAFO Regulatory Area and are most abundant along the slope at the depths that Greenland halibut are fished. Thus, "dogfish (ns)" likely comprise mainly black dogfish (NAFO, 2006).

Bycatch in Canadian waters (based on fishery observer bycatch records) averaged 68 tons annually between 1996 and 2005 and was observed in a wide range of fisheries, primarily: with Greenland halibut (Div. 2G to 3O- gillnet, longline, trawl), crab pots (Div. 2J to 3Ps), shrimp, monkfish/white hake mixed fishery (gillnet, longline), redfish (trawl) and witch flounder (Div. 3NOP- trawl). Bycatch in the NRA was primarily associated with the Greenland halibut and redfish trawl fisheries (Kulka, 2006).

	Observed Catch (t)		Total Estimated Catch (t)	
Year	Black Dogfish	Spiny Dogfish	Black Dogfish	Spiny Dogfish
1996				
1997				
1998	8.822	1.178	52.939	9.453
1999	8.868	0.084	115.130	1.313
2000	42.166	3.733	74.258	24.710
2001	18.853	0.995	75.760	6.429
2002	21.933	0.461	50.000	10.000
2003	15.168	0.823	44.417	7.752
2004	42.816	4.281	86.930	42.521
2005	17.131	1.382	40.822	7.383
2006				
2007				
Average	21.970	1.617	67.532	13.695

Table 1: Commercial bycatch of spiny and black dogfish in Canadian fisheries on the Grand Banks, 1996 to 2005 (Kulka, 2006).

Year	Fishery (Directed Species, Gear, Vessel Class, Area)	Estimated Black dogfish Bycatch (t)	% Annual Total
1998	Greenland_Halibut Gillnet 4-7 north	16.8	32%
	Crab Pot 1-3 2J3K	12.0	23%
	Greenland_Halibut Gillnet 1-3 2J3K	5.5	10%
	Crab Pot 1-3 3LNOPs	3.8	7%
	Shrimp Shrimp Trawl 1-3 2J3K	3.4	6%
	All Others	11.4	22%
	All 1998	52.9	100%
1999	White_Hake Longline 1-3 3LNOPs	37.8	33%
	Crab Pot 1-3 2J3K	36.4	32%
	Crab Pot 1-3 3LNOPs	20.4	18%
	All Others	20.5	18%
	All 1999	115.1	100%
2000	Greenland_Halibut Gillnet 4-7 3LNOPs	19.9	27%
	Crab Pot 1-3 2J3K	17.9	24%
	Redfish_Seb.Sp. Otter Trawl 4-7 3LNOPs	12.8	17%
	Crab Pot 1-3 3LNOPs	7.5	10%
	All Others	16.1	22%
	All 2000	74.1	100%
2001	Greenland_Halibut Gillnet 1-3 3LNOPs	15.6	22%
	Greenland_Halibut Gillnet 4-7 3LNOPs	11.7	16%
	Greenland_Halibut Gillnet 1-3 2J3K	11.3	16%
	Crab Pot 1-3 3LNOPs	10.6	15%
	Greenland_Halibut Gillnet 1-3 north	7.5	10%
	All Others	15.0	21%
	All 2001	71.7	100%
2002	Greenland_Halibut Gillnet 1-3 2J3K	19.5	28%
	Crab Pot 1-3 3LNOPs	12.7	18%
	Shrimp Shrimp Trawl 4-7 3M	7.8	11%
	Crab Pot 4-7 3LNOPs	6.3	9%
	Redfish_Seb.Sp. Otter Trawl 4-7 3LNOPs	4.7	7%
	Greenland_Halibut Otter Trawl 4-7 2J3K	3.0	4%
	Greenland_Halibut Gillnet 4-7 north	2.5	4%
	All Others	12.9	19%
	All 2002	69.5	100%
2003	Greenland_Halibut Longline 1-3 3LNOPs	9.0	20%
	Greenland_Halibut Gillnet 1-3 2J3K	8.7	20%
	Greenland_Halibut Longline 4-7 3LNOPs	7.6	17%
	Monkfish Gillnet 1-3 3LNOPs	4.2	10%
	Redfish_Seb.Sp. Otter Trawl 4-7 3LNOPs	4.2	10%
	Crab Pot 1-3 3LNOPs	2.1	5%
	All Others	8.6	19%
	All 2003	44.4	100%
2004	Shrimp Shrimp Trawl 4-7 3M	21.9	25%
	Atlantic_Halibut Longline 4-7 3LNOPs	13.9	16%
	Shrimp Shrimp Trawl 1-3 2J3K	8.4	10%
	Witch_Flounder Otter Trawl 4-7 3LNOPs	8.4	10%
	Redfish_Seb.Sp. Otter Trawl 4-7 3LNOPs	7.4	8%
	Greenland_Halibut Gillnet 1-3 3LNOPs	6.6	8%
	All Others	20.3	23%
	All 2004	86.9	100%
2005	Greenland_Halibut Longline 4-7 3LNOPs	21.8	53%
	Greenland_Halibut Otter Trawl 4-7 north	4.0	10%
	Redfish_Seb.Sp. Otter Trawl 4-7 3LNOPs	2.6	6%
	Greenland_Halibut Gillnet 4-7 2J3K	2.5	6%
	Greenland_Halibut Gillnet 4-7 north	2.4	6%
	All Others	7.6	19%
	All 2005	40.8	100%

Table 2: Commercial bycatch of black dogfish in Canadian fisheries on the Grand Banks, 1996 to 2005 (Kulka, 2006).

Scoping

Bottom trawl:
Trawls are long, wedge-shaped nets of synthetic webbing that narrow into a funnel-shaped bag. The bottom trawl is dragged along the seafloor and kept open during a tow with large, oval, metal plates (doors). Footropes are often rigged with heavy steel rollers or chains to keep the net on the seafloor. Multi-year studies of the impacts of groundfish trawling carried out in the Atlantic by DFO show short-term disruption of benthic communities, including reductions in the biomass and diversity of benthic organisms. Some previously fished seafloor habitats showed recovery within one to three years but frequently trawled habitats remain in an altered state (Fisheries and Oceans Canada, 2006).

This EBSA includes portions of Subdivisons 3Pn, 3Psd, and 3Psg, and fisheries within each of these varies, but over the period 1998-2007, bottom trawl accounted for the most landings by weight, of any gear type (55%). Fisheries using bottom trawl in the Laurentian Channel EBSA include cod, skate, and redfish (Appendix A, Table 7). There is no directed fishery for black dogfish, but they are taken as bycatch in trawl fisheries. Bycatch in Canadian waters (based on fishery observer bycatch records) averaged 68 tonnes annually between 1996 and 2005. Vessels registered in Newfoundland accounted for 67.4% of the total landings, and vessels registered in Scotia-Fundy region accounted for the remainder, as of 2003 (Jacques Whitford, 2003).

Black dogfish are a deepwater species, and are most abundant along the slope at the depths that redfish are harvested. Ninety-seven percent of landings in this EBSA from 1998-2007 were redfish (Appendix A, Table 26). Bottom trawl is the most commonly utilized gear type for redfish, although midwater trawl was also utilized from 1998-2002 (Appendix A, Table 18). Bycatch of black dogfish was primarily associated with the Greenland halibut and redfish trawl fisheries (Kulka, 2006). Canadian fisheries do not target Greenland halibut with bottom trawl gear in the Laurentian Channel EBSA, but it is targeted with longline and gillnet (Appendix A, Table 7). Table 2 above shows commercial bycatch of black dogfish in Canadian fisheries on the Grand Banks from 1996 – 2005. Over this period, there was intermittent bycatch of black dogfish from redfish 3LNOPs bottom trawl, totalling 40.1 tonnes (Kulka, 2006).

Black dogfish are concentrated in this EBSA; reproduce there; are thought to be highly gregarious; are slow-growing; reach sexual maturity at a late age and have low fertility (Kulka, 2006). They are caught as bycatch in Canadian and foreign trawl fisheries. **Screened in.**

Scallop dredges:
While the scallop harvest in 3Ps accounts for a significant portion of annual landings, the actual locations of scallop harvesting occur mainly within the St. Pierre Bank, and in the northern portion of 3Psd- both of which are outside the EBSA boundary. Only 1% of the landings in this EBSA are resultant from scallops (Fisheries and Oceans Canada, 2008). In addition, these fisheries occur usually <200m depth, whereas black dogfish are most

common at depths >500m, and they have free-swimming pups (no eggs deposited on seafloor, therefore not susceptible to seafloor damage). **Screened out.**

Mid-water trawl:
Mid-water trawls resemble otter trawls in that they are cone-shaped and constructed of webbing, except it is designed to fish at varying depths in the water column, and the nets are much bigger. They also have fewer weights, and thus can be adjusted for towing at various depths. This adjustment is made by increasing the vessel's speed or by increasing or decreasing the length of the cable or "warp" between the vessel and the net. Mid-water trawls can be used to catch many species of fish, most commonly herring, mackerel, redfish, pollock, capelin and shrimp. They are mainly used to capture pelagic species, but may also catch groundfish that rise off the bottom (Fisheries and Oceans Canada, 1989).

Mid-water trawl was responsible for 43% of landings (8,642 tonnes) over the years 1998-2007 in this EBSA, but all the landings were taken during 1998-2002. Redfish is the main species targeted with this gear type. Black dogfish occupy a wide range of depths- 98% of specimens recorded in the NL survey came from sets in the 400 to 1400 m range. Highest concentrations were observed at 300-500 m, nearly all within the Laurentian Channel. There are a substantial proportion of mature females in the shallowest portion of the Laurentian Channel, where pupping takes place, therefore this gear type may be a key stressor to the CP (Kulka, 2006). **Screened in.**

Gillnets:
Gillnets are fixed gear, and consist of vertical walls of mesh, with mesh openings sized such that target species in the desired size range are caught as they attempt to swim through the webbing, entangling their gills. Bottom gillnets are secured in direct contact with the seafloor by weights and have a high incidence of bycatch. Within the LOMA, offshore license holders are limited to 40-500 nets that are 91m in length and are usually joined together (Appendix A, Table 5). This amounts to a maximum of 45.5 km of net per license holder.

Fisheries data from 1998-2007 show that gillnets were responsible for only 1% of landings by weight in this EBSA (Appendix A, Table 18). The main fisheries executed in the EBSA using gillnet are Atlantic cod, Greenland halibut, monkfish/skate, and white hake. The cod fishery was closed in 3Pn in 2003. The cod fishery in 3Ps is divided among gear types, with gillnetting accounting for 45% of the quota. Because black dogfish are resident in waters as shallow as 300 m but generally found in water deeper than 500 m, and highly congregated, this gear could catch black dogfish as bycatch, especially since there are a substantial proportion of mature females in the shallowest portion of the Laurentian Channel (important for pupping). However, total landings with this gear type in the EBSA are minimal (high of 39 t in 2003 to a low of 1 tonne in 2004) (Appendix A, Table 18). Table 2 above shows that a total of 58 tonnes of black dogfish bycatch was taken by gillnet from 1998-2005 in the 3LNOPs area. **Screened out.**

Longline:
Bottom longlines are fixed gear, and consist of a single mainline to which shorter lines, armed with baited hooks, are attached (maximum of 6,000). Anchors attached to the longline secure the gear to the ocean floor. The directed fisheries using longlines in the EBSA target Atlantic cod, Atlantic halibut, Greenland halibut, and white hake. Longlines are often deployed deeper than trawls (>500m). Based on observer data for the Newfoundland region, average depths fished with longline in the offshore are 867m for Atlantic halibut and 1,070m for Greenland halibut (Wareham & Edinger, 2007), although annual Conservation Harvest Pans may include specific depth provisions for a given fishery or area. Longlines are not commonly used in this EBSA, and is responsible for just 27 tonnes (0%) of total landings by weight over the period 1998-2007 (Fisheries and Oceans Canada, 2007; Fisheries and Oceans Canada, 2008). **Screened out.**

Danish/Scottish Seine:
Witch flounder is the only species targeted using Danish seine in 3Ps. The average annual catch during 1996-2004 was approximately 470 tonnes (Jacques Whitford, 2007). In this EBSA, all landings from 1998-2007 were taken in 3Pn, and Danish seine was responsible for less than 1% of landings in the last 10 years. **Screened out.**

Crab pots:
Although crab is a very important fishery in 3Ps, most of the important harvesting areas are to the east of the EBSA in sub-Divisions 3Psf and 3Psh. Table 2 above lists crab pots in 3LNOPs as a source of black dogfish bycatch- totalling 57.1 tonnes from 1998-2005. Crab made up less than 1% of landings from 1998-2007 in the Laurentian Channel EBSA (Appendix A, Table 26). Harvesting locations are shown in the Grand Banks Atlas of Human Activities covering the years 2000 - 2003 (Fisheries and Oceans Canada, 2007) and the Sydney Basin SEA covering 2003 – 2005 (Jacques Whitford, 2007)- both of which show that crab is taken from the area east of the Canada-France boundary. In addition, almost all of the landings are taken in the limited period of May – July. **Screened out.**

Oil and gas drilling:
The EBSA encompasses two oil and gas 'offshore areas'- Sydney Basin and the Laurentian Sub-basin. The Sydney Basin offshore area encompasses the upper half of the Laurentian Channel and Slope EBSA, and one exploration licence has been approved for this area to date. The Laurentian Sub-basin offshore area covers the lower half of the EBSA, and two exploration licenses have been approved as of 2009, and a 'call for bids' has gone out on another parcel, just below the two existing ones.

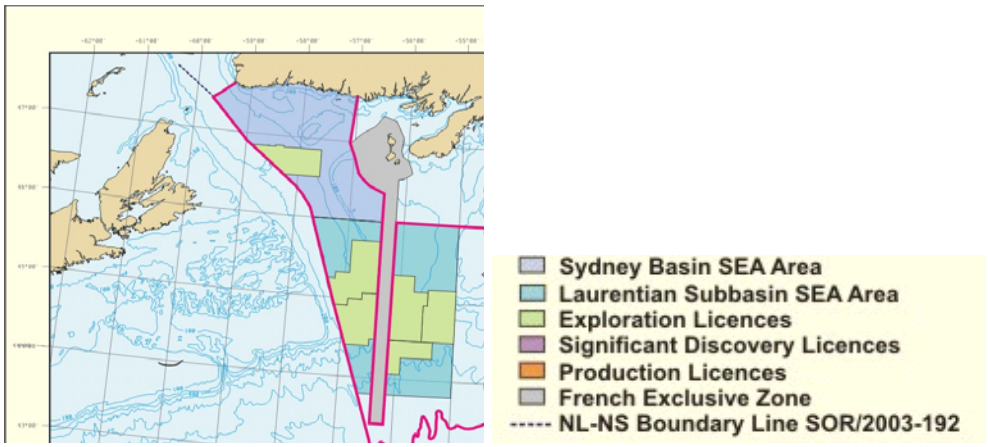

Figure 4. Petroleum offshore areas and exploration licences (CNLOPB, 2009)

In the Laurentian Sub-basin area, the proposed drilling area is located near the mouth of the Laurentian Channel at the offshore entrance to the Gulf of St. Lawrence.
The first well is tentatively planned for the November of 2009 on EL1087. A second well may be drilled on EL 1081. Depending on results and seismic data interpretation, additional exploration and appraisal wells may be drilled in ELs 1082, 1085 and 1086. Drilling may occur year round up to the period of expiration for these licences. It is anticipated that from one to four wells per year could be drilled. Each well will take from 50 to 100 days to complete. Drilling will be conducted by a drill rig (jack-up, anchored or dynamically-positioned drill ship or semi-submersible), depending on water depth. Activities will be supported by supply vessels and offshore helicopters. Vertical seismic profiling (VSP) and well site shallow geohazard survey activities may also be conducted in conjunction with the drilling (Jacques Whitford, 2003).

The exploration drilling activities will be carried out in water depths ranging from 200 m to 3,000 m along the Laurentian Slope, and will include the Laurentian shelf, slope and abyssal plain. The drill rig will be the only surface structure. A safety exclusion zone would extend approximately 500 m from a drill rig with an exclusion zone of 0.8 km^2 in total area. The presence of the structure and a 0.8 km^2 temporary fishery exclusion zone may alter the local abundance and distribution of fish in the area; however, it will be for a short duration (generally 80-100 days). The temporary alteration of habitat would have an overall short term duration (1 – 12 months), low magnitude and small (<1 -10 $km)^3$ geographic extent effect on fish populations. Therefore, the overall effect on fish and fish habitat is considered to be 'not significant' in the Strategic Environmental Assessment (Jacques Whitford, 2003).

The Sydney Basin is a much newer project, and received one exploration licence in 2009. No drilling has occurred to date, but will occur in the near future when drill rigs become available (Baird, 2009). The current exploration licence and remaining 2 parcels range in water depth from 200 to 400 m and are within the 200-mile limit (Jacques Whitford, 2007).

Potential interactions between offshore drilling activities and fish and fish habitat relate primarily to:

- attraction to subsurface structures and lights
- avoidance due to noise or other disturbances
- potential contamination due to wastewater discharges (e.g. deck drainage)
- potential smothering, contamination and habitat alteration due to the discharge and deposition of drill muds and cuttings
- well abandonment
- contamination in the event of a spill or blowout (Jacques Whitford, 2003). **Screened in.**

Vessel traffic:
There are a substantial proportion of mature females in the shallowest portion of the Laurentian Channel. Thus it appears that the Laurentian Channel is a pupping ground for this species in the northwest Atlantic (Kulka, 2006). The boundary of the EBSA encompasses an area bordering the 200m bathymetry contour, and therefore even the 'shallow' waters of the EBSA are deeper than 200m. The Laurentian Channel and Slope EBSA have between 4800-12,299 total vessel transits in an average year (Pelot & Wootton, 2004). This is considered 'medium-low' within the LOMA. Although vessel traffic is of a medium-low concentration in this area, it is not expected to cause disturbance to black dogfish pupping. **Screened out.**

Seismic surveys:
The most accurate and widely used means of finding good drilling locations is the seismic survey. Seismic surveying involves sending sound waves down into the ground and recording the echoes that bounce back off the various sedimentary layers. The shock waves are generated by a high pressure air gun towed near the back of the ship.

The EBSA will undergo seismic exploration during the next 10 years, as it lies almost completely within two CNLOPB 'offshore areas': the Sydney Basin Offshore Area and the Laurentian Channel Offshore Area (see Fig. 4 above). Three exploration licences are located within the EBSA. Activities that may be associated with exploration licences include seismic and other geophysical surveys. Vertical seismic profiling (VSP) and well site shallow geohazard survey activities may also be conducted in conjunction with the drilling. These activities will occur at water depths ranging from 200m to 400m (Jacques Whitford, 2007).

Potential interactions between offshore seismic surveys and drilling activities and fish and fish habitat relate primarily to:
- behavioural effects, injury or mortality due to seismic signals
- attraction to subsurface structures and lights
- avoidance due to noise or other disturbances (Jacques Whitford, 2003)

There are no records of mass fish kills associated with the operation of airgun arrays. Rise times are too slow and peak pressures too low to cause serious injury, except perhaps to fish that were within a few meters of the airgun at the time of release. Prior to coming close to an airgun, it is likely that most fish would be driven away by the approaching noise source. At slightly longer ranges, non-lethal injuries may occur, such

as hearing loss, hemorrhaging of the eyes, swim bladder rupture, or stunning. Depending on the size of the airgun array and the position of the fish relative to the vessel, injuries to eyes and internal organs would occur only within a few tens of meters of the seismic vessel, with lesser symptoms such as hearing damage, possibly out to a few kilometers (Jacques Whitford, 2003).

The physical effects on fish are only expected to occur if fish are very close (<10 m) to a sound source. Thus, physical effects from the project are not likely. The more probable effect on fish is likely to be behavioural effects associated with the avoidance of sound. Due to the temporary nature of the Project, effects of noise will be low magnitude, not extensive geographically, and short to medium duration. This results in a negligible to minor, not significant adverse effect on fish and fish habitat (Jacques Whitford, 2003). **Screened out.**

Navy sonar:
Within Canada's 200 nautical mile limit, exercise areas can be found in Nova Scotia, Newfoundland and the Gulf of St. Lawrence. Before any exercises are conducted in these areas, Maritime Command Atlantic of the National Defence coordinates the publication of a notice to mariners for the specified area. The area of southern Newfoundland, except within French territorial waters, are susceptible to holding sub surface exercises but the National Defence indicates that these zones have not been used in the past five years and there is no intention of using them in the next five years(Maritime Innovation, 2005). **Screened out.**

Oil pollution:
Sources of oil pollution in the Laurentian Channel may come from ship traffic and oil exploration activity. This EBSA has a high density of vessel traffic due to ships moving from Newfoundland to Nova Scotia and the US eastern seaboard, as well as international traffic to and from the St. Lawrence seaway and the Gulf region.

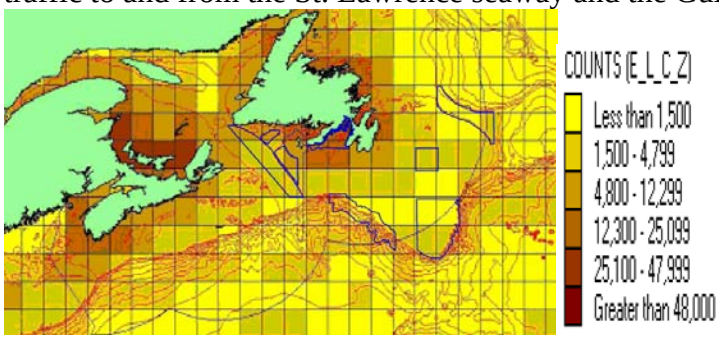

Figure 5**.** Annual vessel transits for all vessel types combined (merchant, fishing, cruise ships) (Pelot & Wootton, 2004).

The Laurentian Channel is the main route for ships entering and leaving the Gulf of St. Lawrence and the St. Lawrence seaway. The Cabot Strait for example, sees approximately 6,400 commercial vessel transits annually (Jacques Whitford, 2003). The Laurentian Channel and Slope EBSA have between 4800-12,299 total vessel transits in an average year. This is considered 'medium-low' within the LOMA (Pelot & Wootton, 2004).

Oil pollution is also a stressor posed by petroleum-related activities occurring in the two 'Offshore Areas' (detailed information provided above under 'Oil and Gas Drilling') which includes exploring, drilling and testing for petroleum. These activities include:

- potential contamination due to operational discharges and wastewater discharges (e.g. deck drainage)
- potential smothering, contamination and habitat alteration due to the discharge and deposition of drill muds and cuttings
- well abandonment
- contamination in the event of a spill or blowout (Jacques Whitford, 2007).

While vessel traffic is very common in this EBSA, and some oil exploration is expected to occur in the future, oil pollution is not known to be a threat to black dogfish aggregation and pupping, as it is a deepwater species. **Screened out.**

Historic military waste:
The dumping of munitions at sea was an accepted method of disposal from WWI until the 1970s. There is a single known munitions dumpsite (approximately 10 nautical miles by ten nautical miles in area) located on the southeastern edge of the Laurentian Basin study area (44o40'N, 55o00'W) (Jacques Whitford, 2003). Information regarding the type or munitions present or its present day condition cannot be provided. The Department of National Defence will be investigating a number of munitions dumpsites including the one located in the Project Area. The intent of the investigations is to determine what is present at these sites, their conditions, and if further action (remediation) is warranted. It may also be worthy to note that the Laurentian Channel is noted as the most seismically active portion of the Newfoundland Continental Shelf, with a number of earthquakes recorded in this area (Jacques Whitford, 2003). Once drilling locations are identified, ConocoPhillips will consult with the Department of National Defence to determine if they may be present. If the well site is considered to be in a risk area for munitions, a screening survey will be conducted using sonar methodology and possibly a magnetometer (Jacques Whitford, 2007). **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, 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). Bottom trawl is responsible for 55% of the landings in the EBSA, midwater trawl for 43% and gillnet for just 1% over the period 1998-2007 (Appendix A, Table 18). Lost gillnets are thought to be the

most problematic as ghost nets because they can re-suspend in the water column and cause habitat damage. Black dogfish are a common bycatch in Greenland halibut fisheries (gillnet and longline gear) because they are found at similar depths and slope locations. Gillnets were more commonly used in the past, and likely some ghost nets continue to capture this species, but unlikely to cause serious harm due to their low use rates. **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. This rise will likely not be linear, but is expected to accelerate over time, and even given the worst case scenario an increase in 0.4^{o}C is all we can expect over the next ten years. This predicted rise in temperature may be balanced by a potential drop in temperature resulting from a reduced flow of the warm Gulf Stream Current and increased flow from the Labrador Currents as a result of increased ice melt.

One of the strongest characteristic of this area is that the surface temperature presents a large seasonal change (approximately 12°C magnitude) between summer and winter. In contrast, the bottom temperature remains quite constant, representing the on-shelf water penetration associated with the Scotian shelf slope-derived lower layer (Jacques Whitford, 2007). During the winter (January to March), cool (approximately 0°C to 1°C) and more salty (32.5 psu) surface water cover the entire area, contrasting with coolest subzero water flowing out of the east Cabot Strait. During the summer (July to August), the area shows a strong stratification of the water column; warm and relatively fresh water spreading over the two precedent winter waters. Finally, the change in salinity between winter and summer (drop of approximately 1 psu) clearly shows the influence of annual cycle of rivers discharge (Jacques Whitford, 2007).

In terms of bottom temperature, black dogfish were associated primarily with the warmest available bottom temperature: 92% of all individuals captured in trawl survey were taken where temperatures >3.8^{o}C. With few exceptions, the largest catches (defined as >15 individuals per tow) came from the warmest available locations where bottom temperature was between 5 and 6.5^{o}C, primarily in the Laurentian Channel (Kulka, 2006). A temperature change could affect this population which is at the northern extent of their range, form aggregations, and seeks out a specific temperature zone.

Temperature changes are not likely to be significant over the next 10 years unless annual fluctuations in temperature are much greater than the average predicted change, but for the CP any changes are likely to be positive. **Screened out.**

Current shifts:
The flow of major ocean currents is driven by the sinking of super-cooled (heavy) water in specific areas of the ocean - as cold water sinks, warm water flows in to replace it, driving the large scale circulation of the ocean. Global warming is weakening this process. This weakening could cause changes in the currents over the next few years or decades. The exact effect and timing of such changes is hard to predict because currents and weather systems take years to respond and because there are other (unstudied) areas

around the north Atlantic where water sinks, helping to maintain circulation. A decline in sub-polar circulation in the North Atlantic has been detected in recent years (Hakkinen & Rhines, 2004), potentially indicating a weakening of the Labrador Current. At the same time, rising temperatures leading to increased polar ice melt may at least temporarily increase the volume and decrease the salinity of the Labrador Current. The progress and consequences of these changes are difficult to forecast and research and monitoring are required to produce more informed predictions.

Aggregations and pupping of black dogfish could potentially be affected by this stressor. Current shifts are unlikely to reach a level where the CP is seriously harmed within the next ten years, but has the potential to permanently impact black dogfish in the future. **Screened out.**

Harmful species (all potential species included):
Currently, all ships entering Canadian waters are expected to exchange ballast water outside the EEZ in locations where water depths are not less than 2000m. If ballast water exchanges in the Atlantic Ocean are not feasible due to safety concerns (such as weather conditions) ships arriving from outside the EEZ are allowed to conduct their exchange in an alternative ballast water exchange zone (ABWEZ) located within the Laurentian Channel. The rationale for mid-ocean exchange is underpinned by two assumptions: 1) coastal species contained in ballast water will be replaced by oceanic species which are unlikely to survive when discharged into a coastal environment and 2) oceanic communities is less diverse and abundant than coastal communities (Simard & Hardy, 2004). Ballast water age and tank volume affect the density of zooplankton found in individual ships (Humphrey, 2008).

The International shipping activities navigating through the Laurentian Channel is quite intense and a high proportion of vessels arrive ‘in ballast’. Although the shipping industry does not appear to use the Laurentian Channel extensively as an ABWEZ, analyzed data indicated that a high number of vessels (1948), transporting 12.2Mt of ballast waters, could have transited in this area in 2000 and potentially use it to perform ballast water exchanges. Data collected in 1997 show that 56 ships used the Laurentian Channel for ballast adjustment or discharge. This number was 43 ships in 2000. The quantities of ballast water exchanged in the Laurentian Channel were reported for only 12 of the last 49 vessels and averaged 2444 tonnes of ballast water per vessel (ranging from 238 to 9594 tonnes). However, since there is currently no ballast water regulation and control, this number may be underestimated. The vessels which declared to have used the Laurentian Channel for this purpose originated principally from FAO Region A (Northwest Atlantic), but the majority of all ballast waters originate in FAO Region B. Simulations of the discharge of organisms in the Laurentian Channel showed that inoculated plankton is retained within the Gulf and transported towards coastal areas.

One concern about ballast water exchanged in the Laurentian Channel is that some vessels may not completely exchange ballast water in this area due to time constraints. A full ballast water exchange my take up 18 hours to 36 hours. At a typical speed of 13 knots, a ship covers about 400 km during this operation. Since the ABWEZ is about

400km long, some vessels may not have sufficient time to complete their exchange and may discharge unexchanged ballast water in arrival ports or outside of the prescribed zone. The relative risk to the Laurentian Channel was estimated as 0.5% of the quantity of alien species introduced in the Gulf and Estuary as a whole. Ballast exchange in this zone is only recommended if the ship is transiting the Laurentian Channel between December 1 and May 1, or if the ship is carrying freshwater ballast (Simard & Hardy, 2004). Due to the low rate of use of this area as an exchange zone the risk of introduced species is low. **Screened out.**

Key Stressors/Activities

- Bottom trawl
- Midwater trawl
- Oil and gas drilling

Reference List

1. Baird, M. (2009). ConocoPhillips leases offshore rig- Oil and gas company expects to drill a well off south coast later this year or early next. The Telegram [On-line]. Available: http://www.thetelegram.com/index.cfm?sid=267038&sc=82

2. Brown, S. K. R., Zwanenburg, K., & Branton, R. (2005). *East Coast of North America Strategic Assessment Project, Groundfish Atlas* Bedford Institute of Oceanography, Dartmouth, Nova Scotia: OBIS Canada.

3. CNLOPB (2009). Canada-Newfoundland and Labrador Offshore Petroleum Board. Internet [On-line]. Available: http://www.cnlopb.nl.ca/

4. Fisheries and Ocean Canada (1996). *The black dogfish in the Gulf of St. Lawrence* (Rep. No. Stock Status Report 96/61).

5. Fisheries and Oceans Canada (1989). *Underwater World: Atlantic Fishing Methods* Ottawa, Canada: Communications Directorate, DFO.

6. Fisheries and Oceans Canada (2006). *Impacts of trawl gears and scallop dredges on benthic habitats, populations and communities* (Rep. No. Science Advisory Report 2006/025). Canadian Science Advisory Secretariat, National Capital Region.

7. Fisheries and Oceans Canada The Grand Banks of Newfoundland: Atlas of Human Activities. *The Grand Banks of Newfoundland: Atlas of Human Activities,* (in press).

8. 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

9. González, C., Teruel, J., López, E., & Paz, X. (2007). *Feeding Habits and Biological Features of Deep-Sea Species of the Northwest Atlantic: Large-eyed Rabbitfish (Hydrolagus mirabilis), Narrownose Chimaera (Harriotta raleighana) and Black Dogfish (Centroscyllium fabricii)* (Rep. No. 07/63).

10. Government of Canada (2007). *National Plan of Action for the Conservation and Management of Sharks* Fisheries and Oceans Canada, Communications Branch.

11. Hakkinen, S. & Rhines, P. (2004). Decline of Subpolar North Atlantic Circulation During the 1990s. *Science, 304,* 555-559.

12. Humphrey, D. B. (2008). *Characterizing Ballast Water as a Vector for Nonindigenous Zooplankton Transport.* Master of Science The University of British Columbia.

13. Jacques Whitford (2003). *Strategic Environmental Assessment Laurentian Subbasin*.

14. Jacques Whitford (2007). *Strategic Environmental Assessment Sydney Basin Offshore Area*.

15. Kulka, D. W. (2006). *Abundance and Distribution of Demersal Sharks on the Grand Banks with Particular Reference to the NAFO Regulatory Area* (Rep. No. 06/20).

16. Maritime Innovation (2005). *Marine Traffic Surveys* (Rep. No. Gros Cacouna LNG Terminal).

17. NAFO (2006). *Report of Scientific Council Meeting*.

18. National Academy of Sciences (2008). *Tackling Marine Debris in the 21st Century*.

19. 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.

20. Simard, N. & Hardy, M. (2004). The Laurentian Channel as an Alternate Ballast Water Exchange Zone: Risks, Analysis and Recommendations. CSAS 120[1], 72. Ref Type: Journal (Full)

21. UNEP & UNFCCC (2002). *Climate Change Information Kit* UNEP and UNFCCC.

22. Wareham, V. E. & Edinger, E. N. (2007). Distribution of deep-sea corals in the Newfoundland and Labrador region, Northwest Atlantic Ocean. *Bulletin of Marine Science, 81*, 289-313.

Unique black dogfish pupping and aggregation in the Laurentian Channel and Slope

Bottom trawl

Magnitude of Interaction

Areal extent:

- Black dogfish are concentrated in the Laurentian Channel, into Hermitage Channel and near the St. Pierre Bank. Virtually all large catches in the NL surveys by Kulka (defined as >15 individuals per tow) were located in the Laurentian Channel. Black dogfish were about 10 times more densely concentrated there than in the Grand Banks and Labrador Shelf slope waters (Kulka, 2006).
- Black dogfish are a bathy-demersal species resident in waters as shallow as 300 m but generally found in water deeper than 500 m. They can occupy a wide range of depths: 98% from 400 to 1 400 m, but highest concentrations are found in 350-500 m in the Laurentian Channel (Kulka, 2006).
- Large (pregnant) females migrate to the shallow (<400 m) portion of the Laurentian Channel where pupping occurs. The young then move into deeper waters of the channel. As they grow they move into deeper waters of the slope (Kulka, 2006).

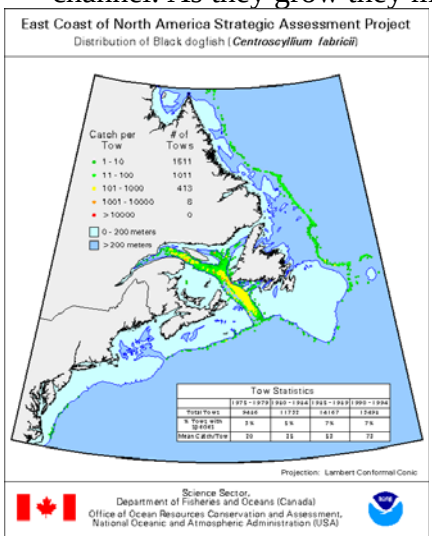

Figure 1. Distribution of black dogfish (Brown et al., 2005).

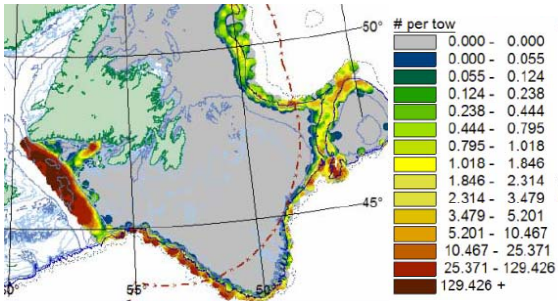

Figure 2. Distribution of black dogfish from the Grand Banks to Davis Strait based on NL trawl survey data from 1971-2005 (Kulka, 2006).

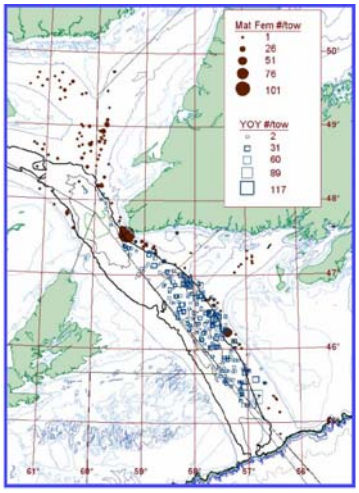

Figure 3. Distribution of large mature females (filled circles) and young of the year (open squares) black dogfish in Canadian waters (Kulka, 2006).

- Black dogfish are a deepwater species, and are most abundant along the slope at the depths that redfish are harvested. Ninety-seven percent of landings (19,445 tonnes) in this EBSA during 1998-2007 were redfish (Appendix A, Table 26). Bottom trawl is the most commonly utilized gear type for redfish. Bycatch in the northwest Atlantic was primarily associated with the Greenland halibut and redfish trawl fisheries (Kulka, 2006).
- Bottom trawl has been utilized heavily in some parts of this EBSA over the period 1980-2000 (Kulka & Pitcher, 2001).

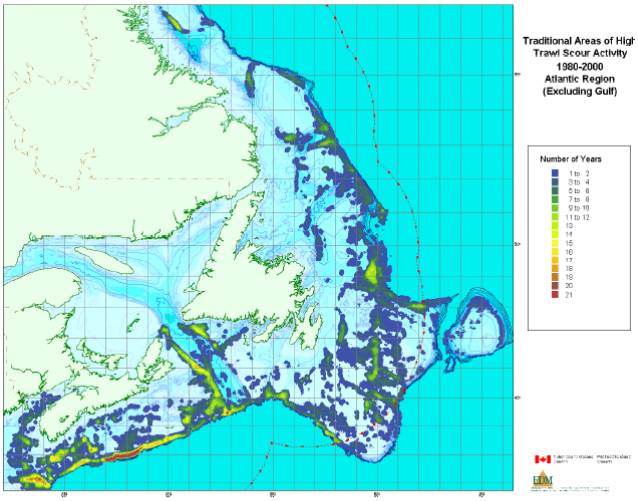

Figure 4. Maps depicting persistent areas of high intensity trawling in the Atlantic over the period 1980-2000 (Kulka & Pitcher, 2001).

- Table 2 (in Scoping document) shows commercial bycatch of black dogfish in Canadian fisheries on the Grand Banks from 1996 - 2005. Over this period, there was intermittent bycatch of black dogfish from redfish 3LNOPs bottom trawl (Kulka, 2006).

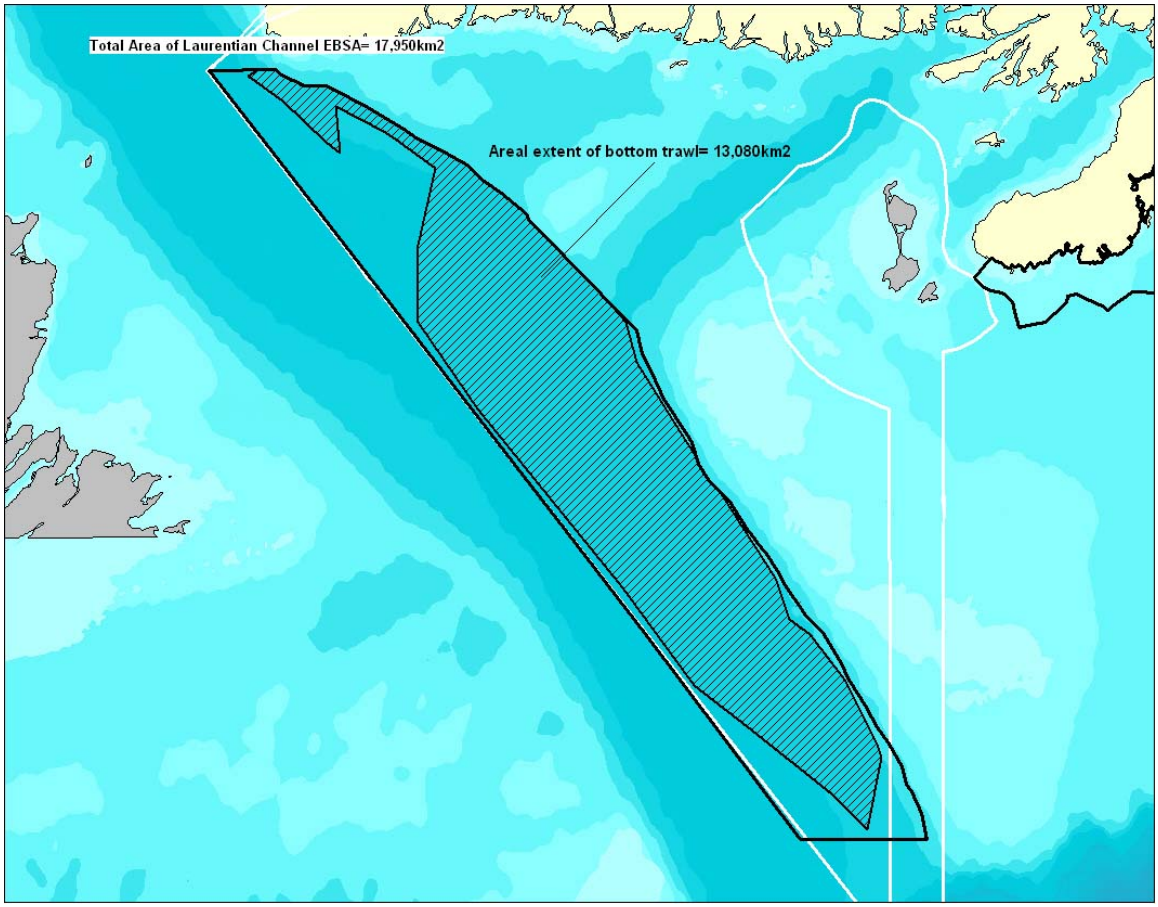

Figure 5. Areal extent of bottom trawl use 1998-2007, Newfoundland Region fisheries (Fisheries and Oceans Canada, 2008).

- The Laurentian Channel and Slope EBSA encompass an area from the slopes of the banks (approximately 300m deep) to the western LOMA boundary in the middle of the Channel (500m deep).
- Trawling activity within the EBSA from 1998-2007 covered approximately 13,080km^2 (see Fig. 5 above).
- Kulka (2006) shows black dogfish is distributed throughout the entire EBSA, with some separation between adults and juveniles (Kulka, 2006).
- Based on the distribution maps of black dogfish above, and the areal extent of bottom trawl, the overlap estimated to be 13,080 / 17,950 = 73%

Score 7.3

Contact:

- In relation to bottom trawl, Quantitative Fishing Gear Scores (Fisheries and Oceans Canada, 2007) for "contact" are high (75-100%) for elasmobranchs (sharks).
- Black dogfish is a bathydemersal species taken occasionally at depths as shallow as 300 m but generally deeper than 500 m. The mean length of fish increases with depth. Black dogfish occupy a wide range of depths: 98% of specimens recorded in the Newfoundland Region survey came from sets in the 400 to 1400 m range. Highest

- Observations that have been made since 1990 show that, in the Gulf, the black dogfish is limited to the deep water (more than 275 m) of the Laurentian Channel (Fisheries and Oceans, 1996).
- Black dogfish have a highly structured distribution with separation of life stages by area and depth. Large mature (presumably pregnant) females are concentrated along the periphery (<400 m) of the Laurentian Channel. Newly born (17-30 cm) young concentrate in the deeper mid-channel and older juveniles are found within the deepest part of the channel at 500-600 m (NAFO, 2006).

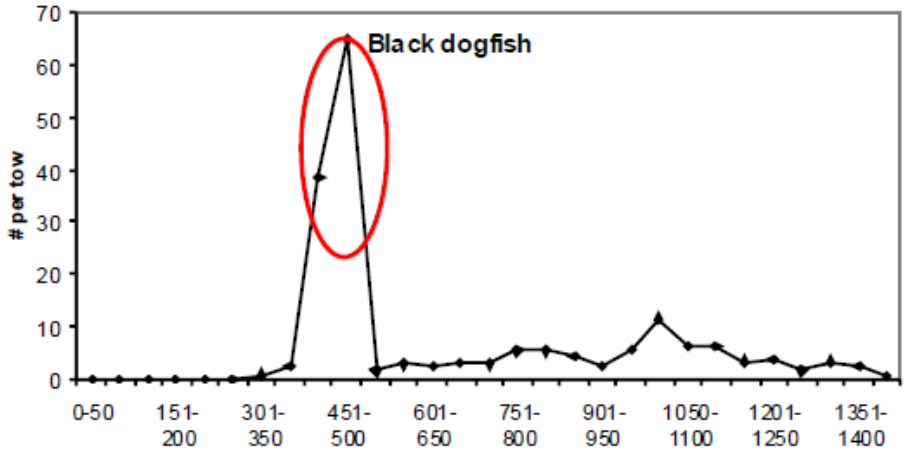

Figure 6. Distribution of black dogfish by depth, NL trawl surveys 1971 – 2005. The large values within the red circle occur in the Laurentian Channel (Kulka, 2006)

- Trawling activity in this EBSA targets redfish almost exclusively, which is also a deepwater species (redfish comprised 97% of landings from 1998-2007) (Fisheries and Oceans Canada, 2008). Areal extent of trawling includes depths from 300m to 500m (see Fig. 5 above).
- Although there is no directed fishery for black dogfish, they are captured in trawls in the Laurentian Channel and Slope, but observed landings totaled only 40.1 tonnes over the period 1996-2005 from redfish fisheries in this area (Kulka, 2006)
- Therefore we have selected a score at the low end of the 75-100% range.

Score 7.5

Duration:

- Little is known about the biology of black dogfish. We have little specific information regarding when black dogfish are present in the EBSA, and when pupping occurs.
- Summer surveys in the Gulf region resulted in catches of black dogfish in the Laurentian Channel (Fisheries and Ocean Canada, 1996).
- The annual autumn trawl survey does not cover NAFO Subdiv. 3Ps where the most dense concentrations of black dogfish occur. Therefore, the spring survey data were used to estimate trends in abundance in the Laurentian Channel. Using this spring 3Ps

- All evidence indicates that black dogfish in Canadian waters have a highly structured distribution with some separation by stage. Large (pregnant) females migrate to the shallow (<400 m) portion of the Laurentian Channel where pupping occurs. The young then move into deeper waters of the channel. As they mature they move out of the channel and onto the slope waters. As they grow they move into deeper waters of the slope (Kulka, 2006). From Kulka (2006) it would seem that black dogfish remain in the Laurentian Channel area throughout their life.
- Fisheries and Oceans 'Conservation harvesting plans' outline the timeframe for specific fisheries in NAFO Division areas and are presented in Appendix A, Table 7. This EBSA is comprised of four different Sub-Divisons: 3Pn, 3Psd, 3Pse, and 3Psg. The duration of trawling varies between areas. Based on current conservation harvesting plans which are reviewed annually, bottom trawl is permitted within the EBSA:
  - 3Pn: July 1- Feb 28 (8 months)
  - 3Psd: July 1 – Nov 15 (4.5 months)
  - 3Pse: April 1- March 31 (12 months)
  - 3Psg: April 1 – March 31 (12 months)
- Since bottom trawling occurs throughout the year, in at least some portions of the EBSA, and black dogfish are present throughout the year (based on best available information), overlap in duration is 100%

Score 10

Intensity:

- Halpern *et al.* (2008) have developed maps showing the global intensity of several anthropogenic stressors including demersal destructive fishing, which includes bottom trawl 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.
- (Halpern et al., 2008) show a low to medium range (dark blue (0-20%) to light blue (20-40%)) for the Laurentian Channel and Slope EBSA. Halpern's maps are based on 1999-2003 data.

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

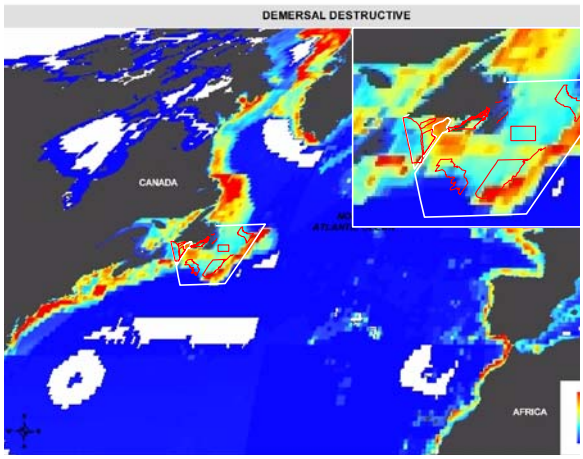

Figure 7. Global intensity of bottom trawl use, adapted from (Halpern et al., 2008).

- Kulka and Pitcher (2001) studied the spatial extent of highly trawled areas in the Grand Banks (below). Some locations within the EBSA are shown as being persistent areas of high intensity trawling. These are also the more shallow slope areas where pregnant females are known to aggregate (Kulka, 2006).

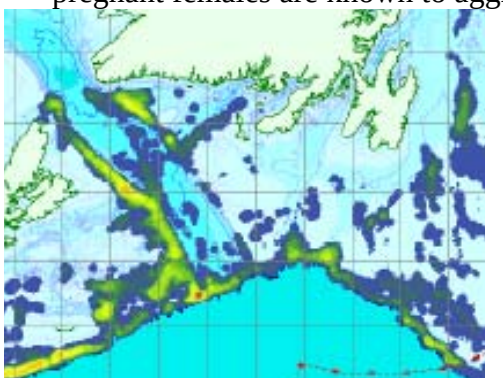
Figure 8. Maps depicting persistent areas of high intensity trawling in the Atlantic over the period 1980-2000 (Kulka & Pitcher, 2001).

- There is no directed fishery for black dogfish, but they are taken as bycatch in trawl fisheries. Bycatch in Canadian waters (based on fishery observer bycatch records) averaged 68 tonnes annually between 1996 and 2005 (Kulka, 2006). Over the period 1995-2006, there was intermittent bycatch of black dogfish from redfish 3LNOPs bottom trawl, totaling 40.1 tonnes.
- Over the period 1998-2007, bottom trawl accounted for the most landings by weight, of any gear type (55%) in this EBSA (Fisheries and Oceans Canada, 2008). Fisheries using bottom trawl in the Laurentian Channel EBSA include cod, skate, and redfish (Appendix A, Table 7), but redfish made up 97% of landings from 1998 – 2007. There is no directed fishery for black dogfish, but they are taken as bycatch in trawl fisheries, as redfish occur within a similar depth range.
- Therefore, we will score the intensity at the high end of the range suggested by the global map from Halpern (2008), at 40%.

Score 4

Magnitude of Interaction: **(7.3 x 7.5 x 10 x 4)/ 1000= 2.2**

Sensitivity

Sensitivity of the CP to acute impacts:

- In relation to bottom trawl, Quantitative Fishing Gear Scores (Fisheries and Oceans Canada, 2007) for "harm" are variable (0-75%) for elasmobranchs (sharks), and without greater detail on the rationale behind the scores, they do not provide particularly useful guidance.
- Bottom trawl was assigned an ecological rating of "high impact" (the highest of 5 categories) in relation to groundfish (Fuller et al., 2008).
- The species is thought to be highly gregarious, and it is not unusual to see very large catches in some places and very small or no catches in others. This wide spatial variability makes population estimates very uncertain (Fisheries and Oceans, 1996).
- The highest concentrations of black dogfish in the entire Newfoundland Region were observed at 350-500 m, nearly all within the Laurentian Channel (Kulka, 2006).
- Black dogfish have a highly structured distribution with separation of life stages by area and depth. Large (pregnant) females migrate to the shallow (<400 m) portion of the Laurentian Channel where pupping occurs. The young then move into deeper waters of the channel. As they mature they move out of the channel and onto the slope waters (Kulka, 2006). This spatially different size structure indicates that black dogfish reproduction (pupping) occurs only in the Laurentian Channel while presumably larger juveniles and non-reproductive adults occupy slope waters (NAFO, 2006).
- The total estimated black dogfish bycatch for Canadian fisheries on the Grand Banks is 540 tonnes, from 1995 to 2006 (see Scoping doc.). Bycatch in the NAFO Regulatory Area (NRA) was primarily associated with the Greenland halibut and redfish trawl fisheries (Kulka, 2006).
- As per the Conservation Harvesting Plan, Groundfish, Mobile gear, Vessels <65ft, 3Ps: An incidental catch of Shark is permitted that does not exceed 10% of the total weight of the authorized Groundfish onboard your vessel, to a maximum of 500 kilograms (1100 pounds). At the time of landing and weighing of the Shark, all or a portion of the tailfin must be attached to the carcass. In addition, the pelvic fin (the paired fins adjacent to the cloaca or "vent") must be left intact and attached to the carcass (Fisheries and Ocean Canada, 2008).
- A research priority listed on the National Plan of Action for Sharks is an "assessment of a potential pupping ground for black dogfish in the Laurentian Channel" (Government of Canada, 2007).
- Black dogfish are concentrated in the Laurentian Channel within the PBGB LOMA; have a highly structured distribution with separation by age and depth; they are a demersal species found feeding on or just off the seafloor; pregnant females (ovoviparous species, therefore eggs develop inside and are born almost fully formed) and juveniles are found at various depths in the EBSA where trawling occurs; pupping has only been reported in the Laurentian Channel; bycatch is reported in trawl fisheries, but is not extremely high.
- For these reasons, acute sensitivity is in the low end of the high range.

Score 8

Sensitivity of the CP to chronic impacts:

- Like many elasmobranch species, the black dogfish grows slowly, reaches sexual maturity at a late age and has low fertility (Fisheries and Oceans, 1996).
- Litter size is typically around 4 to 40 live young (Kulka, 2006).
- Life history of this deep-water species has proven they are vulnerable, and potential risk increased due to the fishing effects, which have been extending towards deeper water in the last years (González et al., 2007).
- In the Laurentian Channel, the spring index fluctuated at a relatively low level during the 1970s and early 1980s then increased rapidly. The index leveled off and stabilized until the mid-1990s. Since that time, it has declined, perhaps reaching stability in recent years. It appears that the adult (spawning stock) segment of the population was stable after 1995 while juveniles in the Laurentian Channel declined (Kulka, 2006).

	Observed Catch (t)		Total Estimated Catch (t)	
Year	Black Dogfish	Spiny Dogfish	Black Dogfish	Spiny Dogfish
1996				
1997				
1998	8.822	1.178	52.939	9.453
1999	8.868	0.084	115.130	1.313
2000	42.166	3.733	74.258	24.710
2001	18.853	0.995	75.760	6.429
2002	21.933	0.461	50.000	10.000
2003	15.168	0.823	44.417	7.752
2004	42.816	4.281	86.930	42.521
2005	17.131	1.382	40.822	7.383
2006				
2007				
Average	21.970	1.617	67.532	13.695

Table 1: Commercial bycatch of spiny and black dogfish in Canadian fisheries on the Grand Banks, 1996 to 2005 (Kulka, 2006).

- Table 1 shows that commercial bycatch of black dogfish varies from year to year, but the estimated catch is much larger than the observed catch (Kulka, 2006).
- The Laurentian Channel is the only known area of aggregation, and the only known pupping site within the northwest Atlantic (Kulka, 2006), and fisheries in this area predominantly use bottom trawl. Therefore the score will be assigned in the high range.

Score 8

Sensitivity of ecosystem to harmful impacts to the CP:

- Black dogfish preyed mostly on pelagic and benthopelagic prey (crustaceans, scyphozoans and fish) and redfish. The also feed on cephalopods, jellyfish and small fishes (González et al., 2007; Jacques Whitford, 2003).
- This species has no known predators (Jacques Whitford, 2003).
- There is a lack of information in published documents regarding the trophic role of black dogfish or their association with other organisms.

Score 2

Sensitivity: (8 + 8 + 2)/3 = 6

Risk of Harm: MoI x S= 2.2 x 6 = 13.2

Certainty Checklist

Answer yes or no to all of the following questions. Record the number of NOs 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?
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 year period or more)?
Y Do you have a reasonable level of comfort in the scoring/conclusions?
Y Do you have a high level of confidence in the scoring/conclusions?

Certainty 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.

- **Autumn surveys do not cover the Laurentian Channel therefore information is based on spring survey results**
- **No information on length of gestation, or actual pupping locations**

Reference List

1. Brown, S. K. R., Zwanenburg, K., & Branton, R. (2005). *East Coast of North America Strategic Assessment Project, Groundfish Atlas* Bedford Institute of Oceanography, Dartmouth, Nova Scotia: OBIS Canada.

2. Fisheries and Ocean Canada (1996). *The black dogfish in the Gulf of St. Lawrence* (Rep. No. Stock Status Report 96/61).

3. Fisheries and Ocean Canada (2008). *Conservation Harvesting Plan, Groundfish, Vessels less than 65 feet, Mobile Gear, Division 3Ps* Fisheries and Oceans Canada, Newfoundland Region, FAM.

4. Fisheries and Oceans (1996). *The Black Dogfish in the Gulf of St. Lawrence* (Rep. No. Stock Status Report 96/61).

5. Fisheries and Oceans Canada (2007). Draft proceedings of the Workshop on Qualitative Risk Assessment of Fishing Gears. In Government of Canada.

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.

7. Fuller, S. D., Picco, C., Ford, J., Tsao, C.-F., Morgan, L. E., Hangaard, D. et al. (2008). *How we fish matters: Addressing the Ecological Impacts of Canadian Fishing Gear* Ecology Action Centre, Living Oceans Society, and Marine Conservation Biology Institute.

8. González, C., Teruel, J., López, E., & Paz, X. (2007). *Feeding Habits and Biological Features of Deep-Sea Species of the Northwest Atlantic: Large-eyed*

Rabbitfish (Hydrolagus mirabilis), Narrownose Chimaera (Harriotta raleighana) and Black Dogfish (Centroscyllium fabricii) (Rep. No. 07/63).

9. Government of Canada (2007). *National Plan of Action for the Conservation and Management of Sharks* Fisheries and Oceans Canada, Communications Branch.

10. Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C. et al. (2008). A Global Map of Human Impact on Marine Ecosystems. *Science, 319*, 948-952.

11. Jacques Whitford (2003). *Strategic Environmental Assessment Laurentian Subbasin*.

12. Kamenos, N. A., Moore, P. G., & Hall-Spencer, J. M. (2004). Small-scale distribution of juvenile gadoids in shallow inshore waters; what role does maerl play? *ICES Journal of Marine Science, 61*, 422-429.

13. Kulka, D. W. (2006). *Abundance and Distribution of Demersal Sharks on the Grand Banks with Particular Reference to the NAFO Regulatory Area* (Rep. No. 06/20).

14. Kulka, D. W. & Pitcher, D. A. (2001). *Spatial and Temporal Patterns in Trawling Activity in the Canadian Atlantic and Pacific* (Rep. No. ICES CM 2001/R:02).

15. NAFO (2006). *Report of Scientific Council Meeting*.

Unique black dogfish pupping and aggregation in the Laurentian Channel and Slope

Midwater trawl

Magnitude of Interaction

Areal extent:

- Black dogfish are concentrated in the Laurentian Channel, into Hermitage Channel and near the St. Pierre Bank. Virtually all large catches in the NL surveys by Kulka (defined as >15 individuals per tow) were located in the Laurentian Channel. Black dogfish were about 10 times more densely concentrated there than in the Grand Banks and Labrador Shelf slope waters (Kulka, 2006).
- Black dogfish are a bathy-demersal species resident in waters as shallow as 300 m but generally found in water deeper than 500 m. They can occupy a wide range of depths: 98% from 400 to 1 400 m, but highest concentrations are found in 350-500 m in the Laurentian Channel (Kulka, 2006).
- Large (pregnant) females migrate to the shallow (<400 m) portion of the Laurentian Channel where pupping occurs. The young then move into deeper waters of the channel. As they grow they move into deeper waters of the slope (Kulka, 2006).

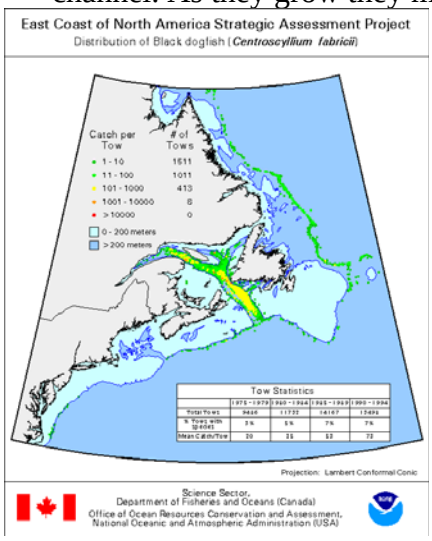

Figure 1. Distribution of black dogfish (Brown et al., 2005)

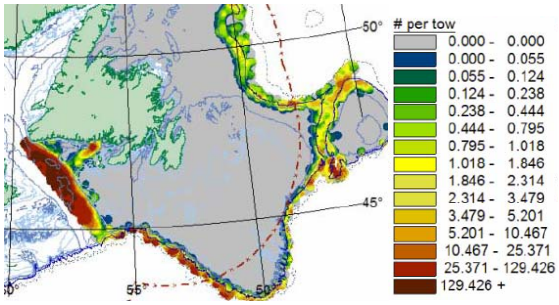

Figure 2. Distribution of black dogfish from the Grand Banks to Davis Strait based on NL trawl survey data from 1971-2005 (Kulka, 2006)

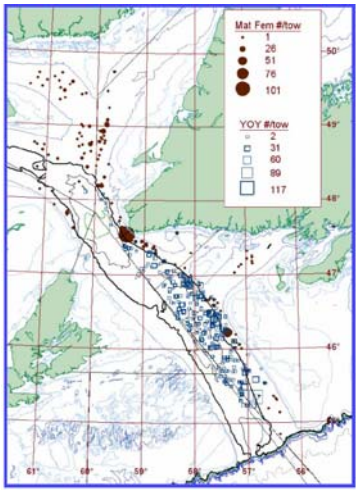

Figure 3. Distribution of large mature females (filled circles) and young of the year (open squares) black dogfish in Canadian waters (Kulka, 2006).

- Black dogfish are a deepwater species, and are most abundant along the slope at the depths that redfish are harvested. Ninety-seven percent of landings (19,445 tonnes) in this EBSA during 1998-2007 were redfish (Appendix A, Table 26). Bottom trawl is the most commonly utilized gear type for redfish. Bycatch in the northwest Atlantic was primarily associated with the Greenland halibut and redfish trawl fisheries (Kulka, 2006).
- Over the period 1998-2007, midwater trawl accounted for the second highest landings by weight, of all gear types (43%) in this EBSA for Newfoundland Region fisheries, however, all landings were taken before 2002 (Fisheries and Oceans Canada, 2008). Redfish is the only species in the PBGB LOMA that is targeted with midwater trawl (Templeman & Davis, 2006).
- Table 2 (in Scoping document) shows commercial bycatch of black dogfish in Canadian fisheries on the Grand Banks from 1996 - 2005. Over this period, there was no reported bycatch in midwater trawl. Removals of black dogfish in all fisheries, in the NAFO area averaged 68 tonnes annually between 1996 and 2005 (Kulka, 2006).
- From 200 – 2003, midwater trawl was used exclusively in the Laurentian Channel areas, but landings ranged from 0 to 160 metric tonnes (see Fig. 4 below).
- Fisheries information from the Newfoundland Region for the period 1998 – 2007 show that midwater trawl was used, but landings with this gear have not been reported since 2002 (Fisheries and Oceans Canada, 2008).

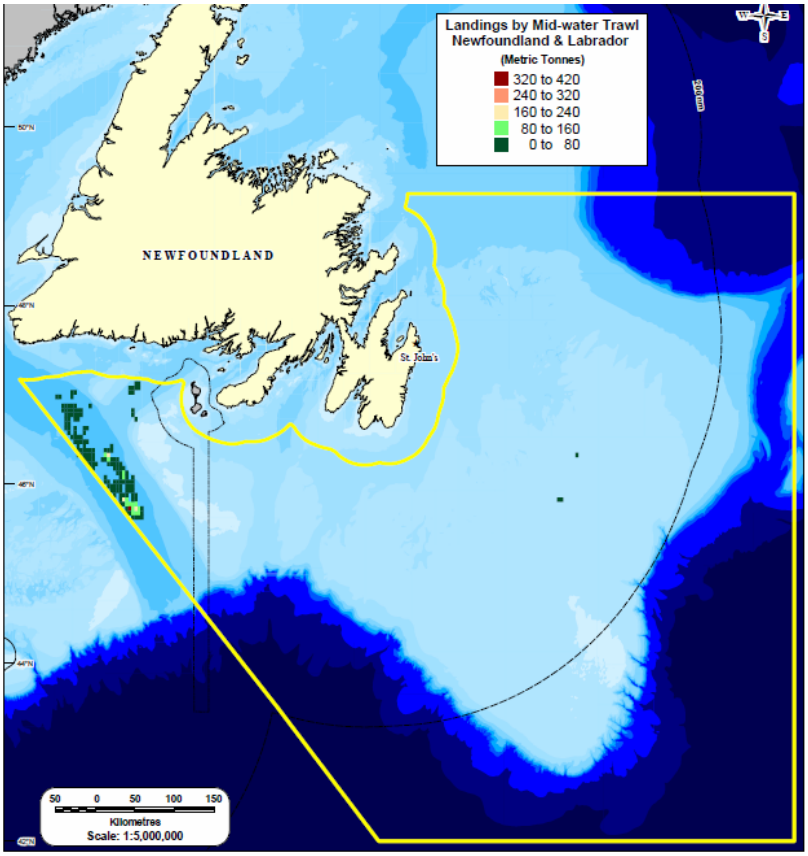

Figure 4. Groundfish landings by midwater trawl, 2000 – 2003 (Fisheries and Oceans Canada, 2007b)

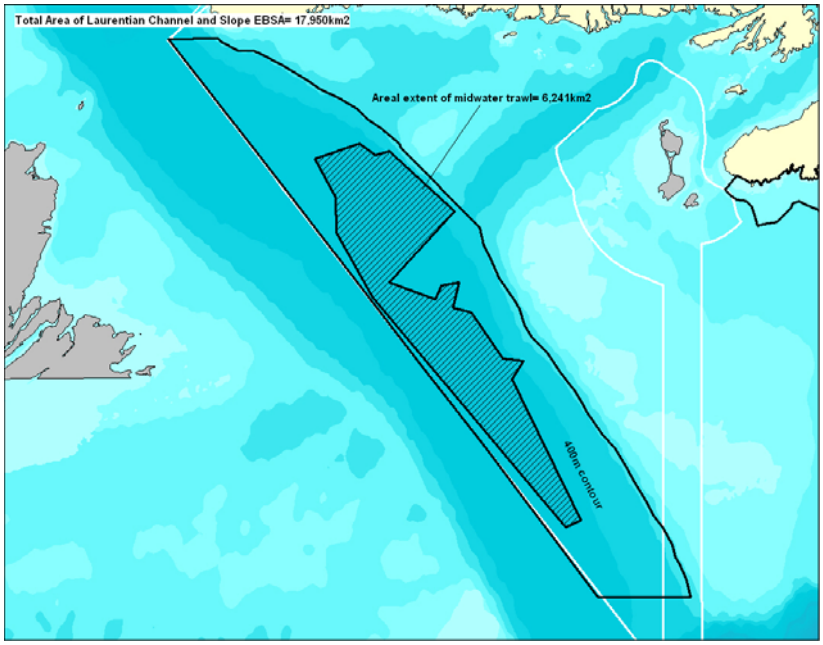

Figure 5. Areal extent of midwater trawl 1998-2007, Newfoundland Region fisheries (6,241km^2) (Fisheries and Oceans Canada, 2008)

- Assuming black dogfish are distributed throughout the EBSA, areal extent overlap with midwater trawl is 6,241km^2 / 17,950km^2 = 35%

Score 3.5

Contact:

- Midwater trawl is not included in the Quantitative Fishing Gear Scores (Fisheries and Oceans Canada, 2007a)
- Black dogfish is a bathydemersal species taken occasionally at depths as shallow as 300 m but generally deeper than 500 m. The mean length of fish increases with depth. Black dogfish occupy a wide range of depths: 98% of specimens recorded in the Newfoundland Region survey came from sets in the 400 to 1400 m range. Highest concentrations were observed at 350-500 m, nearly all within the Laurentian Channel. The Laurentian Channel appears to be unusual in terms of depth of capture of black dogfish (Kulka, 2006).
- Observations that have been made since 1990 show that, in the Gulf, the black dogfish is limited to the deep water (more than 275 m) of the Laurentian Channel (Fisheries and Oceans, 1996).
- Black dogfish have a highly structured distribution with separation of life stages by area and depth. Large mature (presumably pregnant) females are concentrated along the periphery (<400 m) of the Laurentian Channel. Newly born (17-30 cm) young concentrate in the deeper mid-channel and older juveniles are found within the deepest part of the channel at 500-600 m (NAFO, 2006).
- Midwater trawl is designed to fish at varying depths in the water column. They are mainly used to capture pelagic species, but may also catch groundfish that rise off the bottom(Fisheries and Oceans Canada, 1989). Figure 4 and 5 above show that midwater trawl in this EBSA is used in 400-500m depth.
- Without Quantitative Fishing Gear Scores to guide this factor, the score is based on the depth black dogfish occur, and the general depth of midwater trawl use.

Score 5

Duration:

- Little is known about the biology of black dogfish. We have very little specific information regarding when black dogfish are present in the EBSA, and when pupping occurs.
- Summer surveys in the Gulf region resulted in catches of black dogfish in the Laurentian Channel (Fisheries and Oceans, 1996).
- The autumn trawl survey does not cover NAFO Subdiv. 3Ps where the densest concentrations of black dogfish occur. Therefore, the spring survey data were used to estimate trends in abundance in the Laurentian Channel. Using this spring 3Ps series as an index of abundance assumes that densities observed in NAFO Subdiv. 3Ps are representative of the entire Laurentian Channel and that there is no significant movement into and out of adjacent areas (Kulka, 2006). Pregnant females and juveniles were reported, therefore must be present during spring survey period.

- All evidence indicates that black dogfish in Canadian waters have a highly structured distribution with some separation by stage. Large (pregnant) females migrate to the shallow (<400 m) portion of the Laurentian Channel where pupping occurs. The young then move into deeper waters of the channel. As they mature they move out of the channel and onto the slope waters. As they grow they move into deeper waters of the slope (Kulka, 2006). From Kulka (2006) it would seem that black dogfish remain in the Laurentian Channel area throughout their life.
- Fisheries and Oceans 'Conservation harvesting plans' outline the timeframe for specific fisheries in NAFO Division areas and details are presented in Appendix A, Table 7 (Fisheries and Ocean Canada, 2008). Midwater trawl is a mobile gear, and therefore the same rules are applied as with bottom trawl.
- Since bottom trawling occurs throughout the year, in at least some portions of the EBSA, and black dogfish are present throughout the year (based on best available information), overlaps in duration is 100%. However, landings with midwater trawl have not been reported since 2002, which is half of the period 1998-2007. Therefore we will take the duration score from bottom trawl, and divide by half. 10/2=5.

Score 5

Intensity:

- The global map (Halpern et al., 2008) for pelagic, high bycatch fisheries (which includes midwater trawling) does not contain data for the northwest Atlantic Ocean, therefore we have no global map to gauge this factor. Presumably, this indicates that these types of fisheries are not common in the Northwest Atlantic.
- Midwater trawl took substantial landings within the EBSA by Newfoundland Region fisheries from 1998-2000, averaging 2,766 tonnes per year (Fisheries and Oceans Canada, 2008). No landings were reported since 2002.
- We have no specific bycatch information for black dogfish in midwater trawls, but since the trawls were targeting redfish which inhabit similar depths, and also rise off the bottom to feed, it is quite likely that black dogfish were taken occasionally. Intensity of bottom trawl was scored at 4, so midwater trawl will be scored as 2, since landings have not been reported since 2002.

Score 2

<u>Magnitude of Interaction:</u> (3.5 x 5 x 5 x 2)/ 1000= 0.175 = 0.2

<u>Sensitivity</u>

Sensitivity of the CP to acute impacts:

- Quantitative Fishing Gear Scores (Fisheries and Oceans Canada, 2007a) do not include midwater trawl.
- Midwater trawl was assigned an ecological rating of "medium impact" (3rd of 5 categories) in relation to sharks and large pelagics (Fuller et al., 2008).
- The species is thought to be highly gregarious, and it is not unusual to see very large catches in some places and very small or no catches in others. This wide spatial variability makes population estimates very uncertain (Fisheries and Oceans, 1996).

- The highest concentrations of black dogfish in the entire Newfoundland Region were observed at 350-500 m, nearly all within the Laurentian Channel (Kulka, 2006).
- Black dogfish have a highly structured distribution with separation of life stages by area and depth. Large (pregnant) females migrate to the shallow (<400 m) portion of the Laurentian Channel where pupping occurs. The young then move into deeper waters of the channel. As they mature they move out of the channel and onto the slope waters (Kulka, 2006). This spatially different size structure indicates that black dogfish reproduction (pupping) occurs only in the Laurentian Channel while presumably larger juveniles and non-reproductive adults occupy slope waters (NAFO, 2006).
- The total estimated black dogfish bycatch for Canadian fisheries on the Grand Banks is 540 tonnes, from 1995 to 2006 (Table 2, see Scoping doc) (Kulka, 2006).
- A research priority listed on the National Plan of Action for Sharks is an "assessment of a potential pupping ground for black dogfish in the Laurentian Channel" (Government of Canada, 2007).
- As per the Conservation Harvesting Plan, Groundfish, Mobile gear, Vessels <65ft, 3Ps: An incidental catch of Shark is permitted that does not exceed 10% of the total weight of the authorized Groundfish onboard your vessel, to a maximum of 500 kilograms (1100 pounds). At the time of landing and weighing of the Shark, all or a portion of the tailfin must be attached to the carcass. In addition, the pelvic fin (the paired fins adjacent to the cloaca or "vent") must be left intact and attached to the carcass (Fisheries and Ocean Canada, 2008).
- Black dogfish are concentrated in the Laurentian Channel within the PBGB LOMA; have a highly structured distribution with separation by age and depth; they are a demersal species found feeding on or just off the seafloor; pregnant females (ovoviparous species, therefore eggs develop inside and are born almost fully formed) and juveniles are found at various depths in the EBSA where midwater trawling occurred; pupping has only been reported in the Laurentian Channel; bycatch is reported in trawl fisheries, but is not extremely high.
- While black dogfish may be vulnerable to midwater trawls, this gear type is only used in one fishery, and has not been utilized in the last 6 years- therefore it will be scored in the low range.

Score 3

Sensitivity of the CP to chronic impacts:

- Like many elasmobranch species, the black dogfish grows slowly, reaches sexual maturity at a late age and has low fertility (Fisheries and Oceans, 1996).
- Litter size is typically around 4 to 40 live young (Kulka, 2006).
- Life history of this deep-water species has proven they are vulnerable, and potential risk increased due to the fishing effects, which have been extending towards deeper water in the last years (González et al., 2007)
- In the Laurentian Channel, the spring index fluctuated at a relatively low level during the 1970s and early 1980s then increased rapidly. The index leveled off and stabilized until the mid-1990s. Since that time, it has declined, perhaps reaching stability in recent years. It appears that the adult (spawning stock) segment of the

- The Laurentian Channel is the only known area of aggregation, and the only known pupping site within the northwest Atlantic (Kulka, 2006).
- Due to the fact that midwater trawls are not currently being used, this score is lower than that of bottom trawl, but still remains 'high' because the Laurentian Channel is the only area of concentration for this species, and the only area where pupping is known to occur. Midwater trawl may be utilized again in the near future.

Score 8

Sensitivity of ecosystem to harmful impacts to the CP:

- Black dogfish preyed mostly on pelagic and benthopelagic prey (crustaceans, scyphozoans and fish) and redfish. The also feed on cephalopods, jellyfish and small fishes (González et al., 2007; Jacques Whitford, 2003).
- This species has no known predators (Jacques Whitford, 2003).
- There is a lack of information in published documents regarding the trophic role of black dogfish or their association with other organisms.

Score 2

<u>Sensitivity:</u> (3 + 8 + 2)/3 = 4.3

<u>Risk of Harm:</u> MoI x S= 0.2 x 4.3 = 0.9

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

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?
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 year period 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?

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:

- There is no information available on the bycatch of black dogfish in midwater trawls in this region.
- It would be useful to understand why midwater trawls are no longer utilized in this EBSA, so that we could anticipate whether they will be used in the future.

Reference List

1. Brown, S. K. R., Zwanenburg, K., & Branton, R. (2005). *East Coast of North America Strategic Assessment Project, Groundfish Atlas* Bedford Institute of Oceanography, Dartmouth, Nova Scotia: OBIS Canada.

2. Fisheries and Ocean Canada (2008). *Conservation Harvesting Plan, Groundfish, Vessels less than 65 feet, Mobile Gear, Division 3Ps* Fisheries and Oceans Canada, Newfoundland Region, FAM.

3. Fisheries and Oceans (1996). *The Black Dogfish in the Gulf of St. Lawrence* (Rep. No. Stock Status Report 96/61).

4. Fisheries and Oceans Canada (1989). *Underwater World: Atlantic Fishing Methods* Ottawa, Canada: Communications Directorate, DFO.

5. Fisheries and Oceans Canada (2007a). Draft proceedings of the Workshop on Qualitative Risk Assessment of Fishing Gears. In Government of Canada.

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. 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.

8. Fuller, S. D., Picco, C., Ford, J., Tsao, C.-F., Morgan, L. E., Hangaard, D. et al. (2008). *How we fish matters: Addressing the Ecological Impacts of Canadian Fishing Gear* Ecology Action Centre, Living Oceans Society, and Marine Conservation Biology Institute.

9. González, C., Teruel, J., López, E., & Paz, X. (2007). *Feeding Habits and Biological Features of Deep-Sea Species of the Northwest Atlantic: Large-eyed Rabbitfish (Hydrolagus mirabilis), Narrownose Chimaera (Harriotta raleighana) and Black Dogfish (Centroscyllium fabricii)* (Rep. No. 07/63).

10. Government of Canada (2007). *National Plan of Action for the Conservation and Management of Sharks* Fisheries and Oceans Canada, Communications Branch.

11. Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C. et al. (2008). A Global Map of Human Impact on Marine Ecosystems. *Science, 319,* 948-952.

12. Jacques Whitford (2003). *Strategic Environmental Assessment Laurentian Subbasin*.

13. Kulka, D. W. (2006). *Abundance and Distribution of Demersal Sharks on the Grand Banks with Particular Reference to the NAFO Regulatory Area* (Rep. No. 06/20).

14. NAFO (2006). *Report of Scientific Council Meeting*.

15. Templeman, N. D. & Davis, M. B. (2006). *Placentia Bay-Grand Banks Ecosystem Overview and Assessment Report (DRAFT)* Newfoundland & Labrador: Fisheries and Oceans Canada.

Unique black dogfish pupping and aggregation in the Laurentian Channel and Slope

Oil and gas drilling

Magnitude of Interaction

Areal extent:

- Black dogfish are concentrated in the Laurentian Channel, into Hermitage Channel and near the St. Pierre Bank. Virtually all large catches in the NL surveys by Kulka (defined as >15 individuals per tow) were located in the Laurentian Channel. Black dogfish were about 10 times more densely concentrated there than in the Grand Banks and Labrador Shelf slope waters (Kulka, 2006).
- Black dogfish are a bathy-demersal species resident in waters as shallow as 300 m but generally found in water deeper than 500 m. They can occupy a wide range of depths: 98% from 400 to 1 400 m, but highest concentrations are found in 350-500 m in the Laurentian Channel (Kulka, 2006).
- Large (pregnant) females migrate to the shallow (<400 m) portion of the Laurentian Channel where pupping occurs. The young then move into deeper waters of the channel. As they grow they move into deeper waters of the slope (Kulka, 2006).

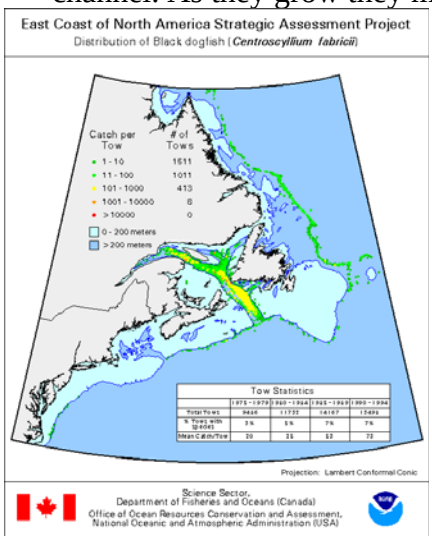

Figure 1. Distribution of black dogfish (Brown et al., 2005).

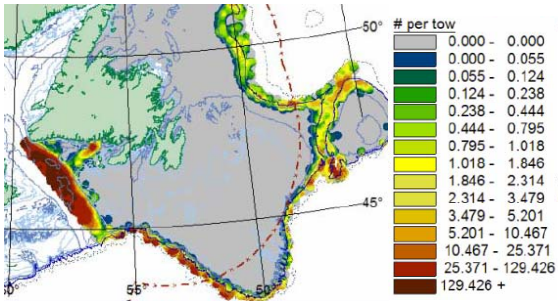

Figure 2. Distribution of black dogfish from the Grand Banks to Davis Strait based on NL trawl survey data from 1971-2005 (Kulka, 2006).

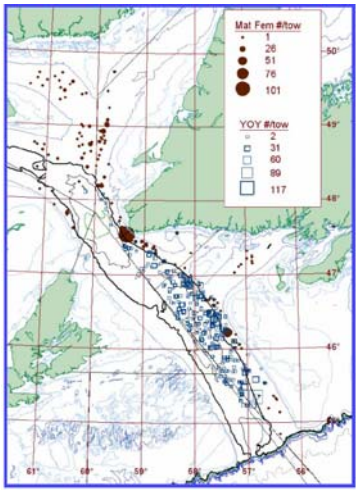

Figure 3. Distribution of large mature females (filled circles) and young of the year (open squares) black dogfish in Canadian waters (Kulka, 2006).

- The EBSA boundary overlaps with two oil and gas 'offshore areas'- Sydney Basin and the Laurentian Sub-basin (see Fig. 4 below). To date, no drilling has occurred in the Sydney Basin offshore area, but is expected in the near future, and drilling is scheduled to begin in the Laurentian Sub-basin in November 2009 (Baird, 2009). The Sydney Basin offshore area encompasses the upper half of the Laurentian Channel and Slope EBSA, and one exploration licence has been approved for this area to date. The Laurentian Sub-basin offshore area covers the lower half of the EBSA, and two exploration licenses have been approved as of 2009.
- For the Laurentian Sub-basin area, the proposed drilling area is located near the mouth of the Laurentian Channel at the offshore entrance to the Gulf of St. Lawrence (see Fig. 5). The proposed program is within exploration licences (ELs) 1081, 1082, 1085, 1086, and 1087 held by ConocoPhillips (Jacques Whitford, 2003). For the Sydney Basin, the proposed drilling area is located in 3Psd (see Fig. 5).
- Assuming black dogfish are present throughout the EBSA, the areal extent is calculated for the 'parcels' that have been delineated to date- 3 in the Sydney Basin area (see Fig. 4 below), and the 3 parcels shown in the Laurentian Sub-basin (see Fig. 5 below). The overlap is estimated at 50%.

Score 5

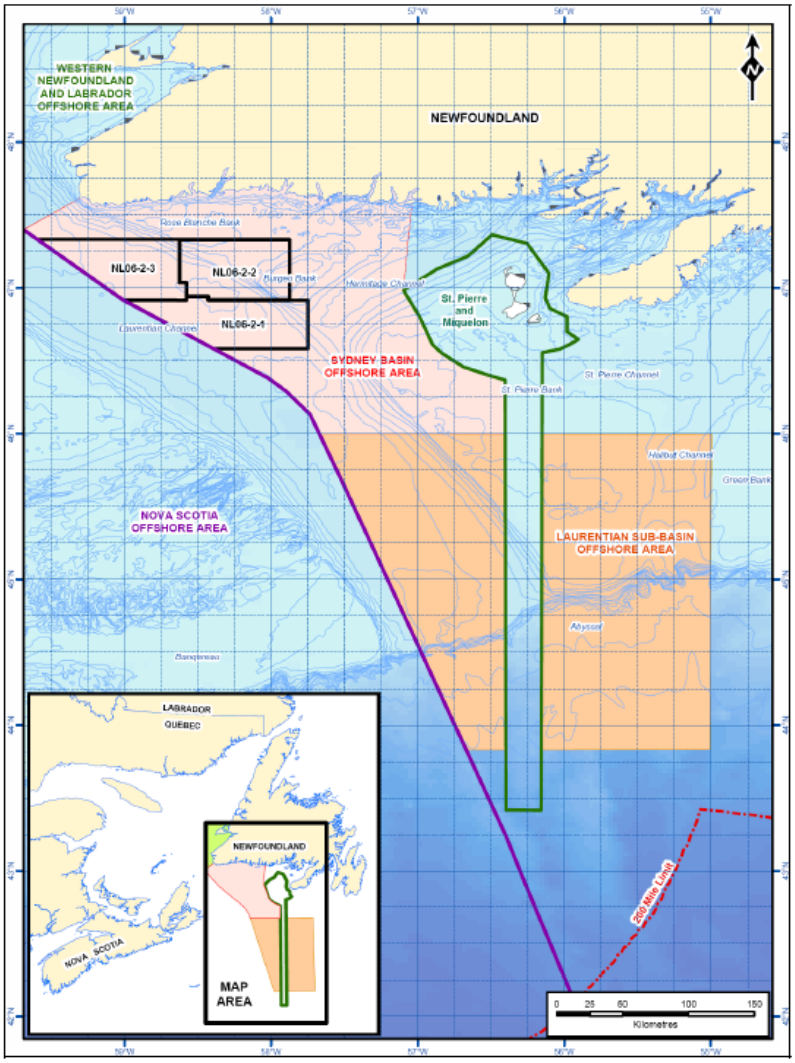

Figure 4. Sydney Basin Offshore Area and the Laurentian Sub-basin Offshore Area (Jacques Whitford, 2007).

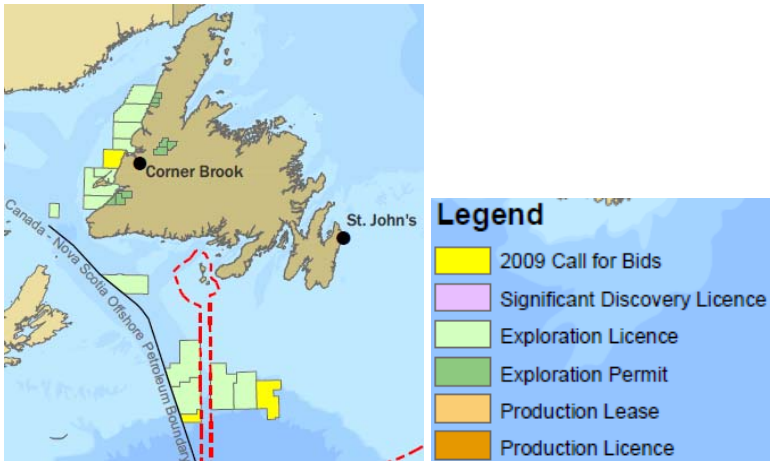

Figure 5. Laurentian Sub-basin Offshore Area exploration licences (green) and areas delineated as call for bids (yellow) (CNLOPB, 2009)

Contact:

- Black dogfish is a bathydemersal species taken occasionally at depths as shallow as 300 m but generally deeper than 500 m. The mean length of fish increases with depth. Black dogfish occupy a wide range of depths: 98% of specimens recorded in the Newfoundland Region survey came from sets in the 400 to 1400 m range. Highest concentrations were observed at 350-500 m, nearly all within the Laurentian Channel. The Laurentian Channel appears to be unusual in terms of depth of capture of black dogfish (Kulka, 2006).
- Observations that have been made since 1990 show that, in the Gulf, the black dogfish is limited to the deep water (more than 275 m) of the Laurentian Channel (Fisheries and Oceans, 1996).
- Black dogfish have a highly structured distribution with separation of life stages by area and depth. Large mature (presumably pregnant) females are concentrated along the periphery (<400 m) of the Laurentian Channel. Newly born (17-30 cm) young concentrate in the deeper mid-channel and older juveniles are found within the deepest part of the channel at 500-600 m (NAFO, 2006).
- *For the Laurentian Channel Sub-basin*: the exploration drilling activities will be carried out in water depths ranging from 200 m to 3,000 m along the Laurentian Slope, and will include the Laurentian shelf, slope and abyssal plain (Canada-Newfoundland and Labrador Offshore Petroleum Board, 2007).
- *For the Sydney Basin*: the current exploration licence and remaining 2 parcels range in water depth from 200 to 400 m and are within the 200-mile limit (Jacques Whitford, 2007).
- Drilling will be conducted by a drill rig (jack-up, anchored or dynamically-positioned drill ship or semi-submersible), depending on water depth. Activities will be supported by supply vessels and offshore helicopters. Vertical seismic profiling (VSP) and well site shallow geohazard survey activities may also be conducted in conjunction with the drilling (Canada-Newfoundland and Labrador Offshore Petroleum Board, 2007).
- Black dogfish are most commonly found between 300-500m in this area. The exploration licences currently approved are also within that depth range.
- Black dogfish are bathydemersal, and oil drilling occurs on the seafloor, with parts of the rig leading right to the surface. Therefore contact is considered high.

Score 8

Duration:

- Little is known about the biology of black dogfish. We have little specific information regarding when black dogfish are present in the EBSA, and when pupping occurs.
- Summer surveys in the Gulf region resulted in catches of black dogfish in the Laurentian Channel (Fisheries and Ocean Canada, 1996).
- The annual autumn trawl survey does not cover NAFO Subdiv. 3Ps where the most dense concentrations of black dogfish occur. Therefore, the spring survey data were used to estimate trends in abundance in the Laurentian Channel. Using this spring 3Ps

- All evidence indicates that black dogfish in Canadian waters have a highly structured distribution with some separation by stage (Kulka, 2006). From Kulka (2006) it would seem that black dogfish remain in the Laurentian Channel area throughout their life.
- *For the Laurentian Sub-basin*: the first well is tentatively planned for the second quarter of 2009 on EL1087. A second well may be drilled on EL 1081. Depending on results and seismic data interpretation, additional exploration and appraisal wells may be drilled in ELs 1082, 1085 and 1086. Drilling may occur year round up to the period of expiration for these licences (9 years). It is anticipated that from one to four wells per year could be drilled. Each well will take from 50 to 100 days to complete (Canada-Newfoundland and Labrador Offshore Petroleum Board, 2007).
- *For the Sydney Basin*: the exploration activities considered within the scope of the SEA include exploratory and delineation drilling, seismic surveys including two-dimensional (2-D), three-dimensional (3-D), vertical seismic profiling (VSP) and geohazards surveys and well-site abandonment. The temporal boundary is the oil and gas activities as described that may occur in the SEA Area within the next 10 years (Jacques Whitford, 2007).
- If 1 to 4 wells could be drilled per year, and there are two oil exploration areas, then that means potentially 2 to 8 wells per year could be drilled in the EBSA. We will score the 8 possible wells (because it is almost certain that more parcels will be explored within 10 years from now). Each well may take from 50 to 100 days to complete, and again, we take greater of estimates (100 days). Therefore, there could potentially be 800 days of drilling (cumulative within both areas) in these two Offshore Areas. Since black dogfish are found throughout the year, duration is scored at a maximum of 100%.

Score 10

Intensity:

- Halpern *et al.* (2008) have developed maps showing the global intensity of several anthropogenic stressors including oil pollution (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.
- The global map below (Halpern et al., 2008) for oil pollution (which includes oil production, vessel and land pollution) show a medium to high range (yellow: 60-80%) for the Laurentian Channel and Slope EBSA. Halpern's maps are based on 1999-2003 data.

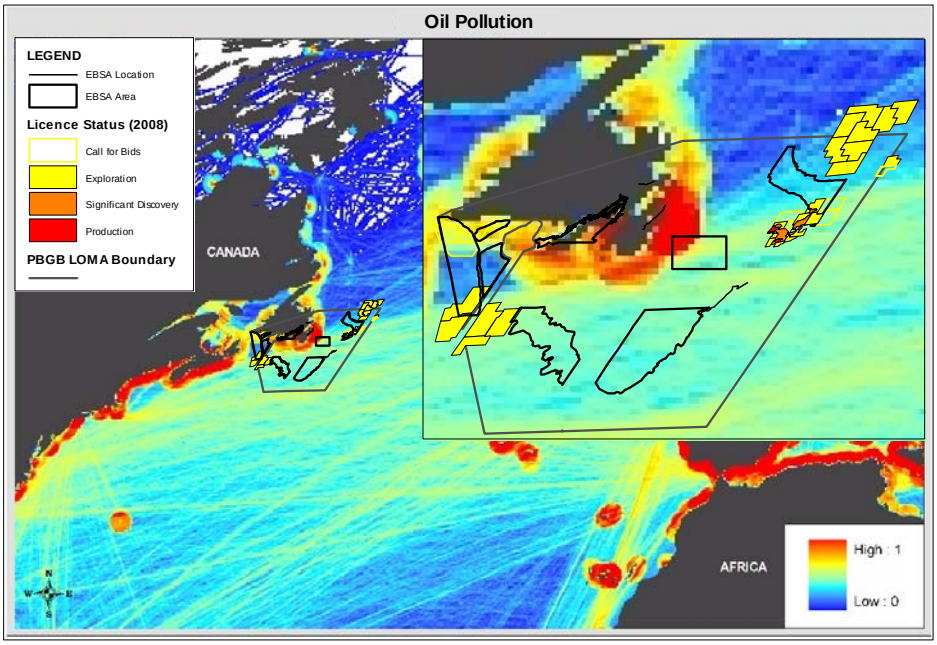

Figure 6. Global intensity of oil pollution, showing oil exploration licences and production facilities, adapted from (Halpern et al., 2008)

- An Exploration Licence confers the right to explore for, and the exclusive right to drill and test for, petroleum; the exclusive right to develop those portions of the Newfoundland and Labrador offshore area in order to produce petroleum; and the exclusive right, subject to compliance with the other provisions of the Accords Acts, to obtain a production licence (Jacques Whitford, 2007).
- Drilling is scheduled to occur in 3 different exploration license areas within the EBSA, with additional drilling likely to occur in the areas that have been delineated for 'calls for bids'. The C-NLOPB issues an official call for nominations annually, in the fall (Jacques Whitford, 2003; Jacques Whitford, 2007).
- Because there are three different areas ready to undergo exploration drilling within the EBSA, this factor will be scored in the high end of the range suggested by Halpern.

Score 8

<u>Magnitude of Interaction:</u> (5 x 8 x 10 x 8)/ 1000= 3.2

<u>Sensitivity</u>

Sensitivity of the CP to acute impacts:

- Potential interactions between offshore drilling activities and fish and fish habitat relate primarily to:
  - attraction to subsurface structures and lights
  - avoidance due to noise or other disturbances
  - potential contamination due to wastewater discharges (e.g. deck drainage)

- potential smothering, contamination and habitat alteration due to the discharge and deposition of drill muds and cuttings
- well abandonment
- contamination in the event of a spill or blowout (Jacques Whitford, 2003).

- A safety exclusion zone would extend approximately 500 m from a drill rig with an exclusion zone of 0.8 km^2 in total area. The presence of the structure and a 0.8 km^2 temporary fishery exclusion zone may alter the local abundance and distribution of fish in the area; however, it will be for a short duration (generally 80-100 days). The temporary alteration of habitat would have an overall short term duration (1 – 12 months), low magnitude and small (<1 -10 $km)^3$ geographic extent effect on fish populations. Therefore, the overall effect on fish and fish habitat is considered to be 'not significant' in the Strategic Environmental Assessment (Jacques Whitford, 2003).
- Drilling Muds: ConocoPhillips is proposing to use Water Based Mud (WBM) with a Synthetic Based Mud (SBM) necessary for a portion of its drilling program. WBM have very small amounts of toxic components. These include biocides, corrosion inhibitors, and surfactants, which may account for only a small fraction of the total WBM composition but which contribute a significant fraction of total WBM toxicity. WBM will be directly discharged to the seafloor when drilling the initial sections of the hole, after that cuttings will be discharged from the rig at surface. The fate of cuttings and muds are estimated from a discharge point at the center of the drill location. WBM cuttings (1-mm layer) will be deposited over an area <0.002 km^2 for the deep water well location and <0.1 km^2 for the "shallow" location (Canada-Newfoundland and Labrador Offshore Petroleum Board, 2007).
- Operational Discharge: Wastes and discharges from the rig include deck drainage, cooling water (semi-submersible only), sanitary and domestic waste (approximately 50 and 25 m^3/day of grey and black water, respectively), garbage and other solid waste, ballast water, bilge water, and produced fluids. All discharges will comply with the Offshore Waste Treatment Guidelines (OWTG) (Canada-Newfoundland and Labrador Offshore Petroleum Board, 2007).
- In exploration drilling programs, produced water would only be discharged once the well is tested for production. However, if any produced water is encountered during the well test, it is likely that it will be atomized and flared during testing (Canada-Newfoundland and Labrador Offshore Petroleum Board, 2007).
- Accidental Spills: During exploration drilling programs, the possible accidental events, which may impact the environment, include blowouts and batch spills. For the proposed drilling program, the probability of a blowout during the drilling of an exploration well is estimated to be 1 in 19,500 for spills greater than 150,000 bbl, 1 in 6,500 for spills greater than 10,000 bbl, and 1 in 4,875 for spills greater than 1,000 bbl (Canada-Newfoundland and Labrador Offshore Petroleum Board, 2007).
- We are not aware of any specific habitat requirements for black dogfish aggregation and pupping. There is no information provided regarding drilling activities impacts on black dogfish specifically, but the effects on fish listed above would be similar. Some of these affects are potential stressors which may or may not occur (ie. well blowout), and the overall impact will be a function of how many drilling operations are ongoing at one time.

- Presence of drilling activity will result in a safety exclusion zone which will extend approximately 500 m from a drill rig with an exclusion zone of 0.8 km^2 in total area. This zone will exclude fishing activity and possibly limit the bycatch of black dogfish in those areas, if they were not already avoiding the drilling rig.
- Considering the range of activities and discharges from oil exploration drilling, black dogfish are likely to be impacted by disturbance and avoidance of the area, but probably not resulting in death in most cases. However, because this is an area known for pupping, pregnant females and juveniles may be more susceptible to contaminants and disturbance. Therefore, sensitivity is scored in the medium-high range.

Score 7

Sensitivity of the CP to chronic impacts:

- Like many elasmobranch species, the black dogfish grows slowly, reaches sexual maturity at a late age and has low fertility (Fisheries and Oceans, 1996).
- Litter size is typically around 4 to 40 live young (Kulka, 2006).
- In the Laurentian Channel, the spring index fluctuated at a relatively low level during the 1970s and early 1980s then increased rapidly. The index leveled off and stabilized until the mid-1990s. Since that time, it has declined, perhaps reaching stability in recent years. It appears that the adult (spawning stock) segment of the population was stable after 1995 while juveniles in the Laurentian Channel declined (Kulka, 2006).
- Currently, there are only exploration licences in the EBSA, not production licences. In the offshore area, exploration licences have the maximum nine-year term typically consisting of two consecutive periods of five years and four years. The interest owner is required to drill or spud and diligently pursue one exploratory well on or before the expiry date of Period I as a condition precedent to obtaining tenure to period II. Failure to drill or spud a well will result in reversion to Crown reserve of the licence. A drilling program that has resulted in a significant discovery entitles the interest owner to a Significant Discovery Licence, which is of no definite length (Jacques Whitford, 2003). Therefore, within the next 10 years there is a probability of many more drilling exercises within both the Laurentian Channel Sub-basin and the Sydney Basin. Long term exposure to drilling activity, discharges and possible blowouts could negatively impact the black dogfish population.
- The Laurentian Channel is the only known area of aggregation, and the only known pupping site within the northwest Atlantic (Kulka, 2006), therefore the score will be assigned in the high range.

Score 8

Sensitivity of ecosystem to harmful impacts to the CP:

- Black dogfish preyed mostly on pelagic and benthopelagic prey (crustaceans, scyphozoans and fish) and redfish. The also feed on cephalopods, jellyfish and small fishes (González et al., 2007; Jacques Whitford, 2003).
- This species has no known predators (Jacques Whitford, 2003).

- There is a lack of information in published documents regarding the trophic role of black dogfish or their association with other organisms.

Score 2

<u>Sensitivity:</u> (7 + 8 + 2)/3 = 5.7

<u>Risk of Harm:</u> MoI x S= 3.2 x 5.7 = 18.2

Certainty Checklist

Answer yes or no to all of the following questions. Record the number of NOs 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?
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 year period 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.

- **Autumn surveys do not cover the Laurentian Channel therefore information is based on spring survey results**
- **No information on length of gestation, or actual pupping locations**
- **We do not have specific information regarding the impacts of oil drilling and associated discharges on black dogfish. We have assumed that impacts to fish would be similar to those on elasmobranchs.**

Reference List

1. Baird, M. (2009). ConocoPhillips leases offshore rig- Oil and gas company expects to drill a well off south coast later this year or early next. The Telegram [On-line]. Available: http://www.thetelegram.com/index.cfm?sid=267038&sc=82

2. Brown, S. K. R., Zwanenburg, K., & Branton, R. (2005). *East Coast of North America Strategic Assessment Project, Groundfish Atlas* Bedford Institute of Oceanography, Dartmouth, Nova Scotia: OBIS Canada.

3. Canada-Newfoundland and Labrador Offshore Petroleum Board (2007). *ConocoPhillips Laurentian Subbasin Exploration Drilling Program Screening Report* CNLOPB.

4. CNLOPB (2009). Canada-Newfoundland and Labrador Offshore Petroleum Board. Internet [On-line]. Available: http://www.cnlopb.nl.ca/

5. Fisheries and Ocean Canada (1996). *The black dogfish in the Gulf of St. Lawrence* (Rep. No. Stock Status Report 96/61).

6. Fisheries and Oceans (1996). *The Black Dogfish in the Gulf of St. Lawrence* (Rep. No. Stock Status Report 96/61).

7. González, C., Teruel, J., López, E., & Paz, X. (2007). *Feeding Habits and Biological Features of Deep-Sea Species of the Northwest Atlantic: Large-eyed Rabbitfish (Hydrolagus mirabilis), Narrownose Chimaera (Harriotta raleighana) and Black Dogfish (Centroscyllium fabricii)* (Rep. No. 07/63).

8. Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C. et al. (2008). A Global Map of Human Impact on Marine Ecosystems. *Science, 319,* 948-952.

9. Jacques Whitford (2003). *Strategic Environmental Assessment Laurentian Subbasin*.

10. Jacques Whitford (2007). *Strategic Environmental Assessment Sydney Basin Offshore Area*.

11. Kulka, D. W. (2006). *Abundance and Distribution of Demersal Sharks on the Grand Banks with Particular Reference to the NAFO Regulatory Area* (Rep. No. 06/20).

12. NAFO (2006). *Report of Scientific Council Meeting*.

Summary Table: Unique black dogfish pupping and aggregation in the Laurentian Channel and Slope

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
Bottom trawl	7.3	7.5	10	4	**2.2**	8	8	2	**6**	**13.2**	**Med**
Midwater trawl	3.5	5	5	2	**0.2**	3	8	2	**4.3**	**0.9**	**Low**
Oil & gas drilling	5	8	10	8	**3.2**	7	8	2	**5.7**	**18.2**	**Low**
Cumulative CP Score										**32.3**	