Environmental Impact Assessment for Hazards Surveys: Cree, West Sable, North Eagle and Chebucto Sites

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EXECUTIVE SUMMARY

ExxonMobil Canada, as operator, proposes to conduct four hazards surveys south of Sable Island between mid-August and mid-September, 2001. Surveys at each site consist of high resolution seismic and a combination of sub-bottom profiling, side scan sonar, magnetometer and bathymetric mapping. A multibeam bathymetric survey will also be performed along all survey lines.

In this document, potential interactions between the proposed surveys and valued ecosystem components are reviewed, and the potential for cumulative impacts examined. The timing of the proposed survey falls between April and October and is not located within 10 km of any whale sanctuary, meeting the key requirements for consideration (timing and location) under the generic seismic assessment (Davis et al., 1998).

Hazards surveys have negligible impacts on the marine environment, because pressure waves from the equipment cause minimal injury to eggs and larvae and reach ambient levels at much shorter distances than those used in a large-scale seismic survey. Four 40 in^3 airguns will be used as the sound source for the high resolution seismic. These guns produce the largest pressure waves of any of the equipment used in the hazards surveys, but they are still about six times less powerful than those used in a large-scale seismic survey.

Based on survey data collected from 1978 to 1982, the highest number of fish larvae, primarily silver hake, are found near the Cree site in August. Shock waves produced by air guns can injure or kill eggs and larvae of invertebrates and fish. However, the low source outputs of these devices will kill a very small proportion (<0.02%) of the eggs and larvae in and around the survey sites.

Silver hake are known to spawn on western Sable Island Bank in late summer and the presence of large numbers of larvae near the Cree site suggested that silver hake might spawn nearby. Noise from the discharging airguns can affect fish behaviour and thus proximity to concentrations of silver hake were examined using the last 30 years of annual research survey data obtained from DFO. The closest large aggregation of silver hake to the west of Cree was 15 km distant, sufficiently far that noise from the airguns would drop below levels considered to result in behaviour change to fish (Davis et al., 1998).

Relatively little fishing activity occurs in and around the proposed hazards survey sites when surveys are scheduled. Fishing for large pelagics generally occurs in deeper waters along the Shelf Edge. Dragging for scallop, which occurs in and around the Chebucto site, is the only major commercial fishery within any of the hazards survey areas. The small area and short duration of the hazards surveys should not result in loss of fishing time or catch.

Cree is the closest of the four proposed survey sites to the 4W Haddock Spawning Closure at 55 km. North Eagle is the closest of the sites to the Gully Whale Sanctuary at 30 km. The West Sable site is 1.1 km from Sable Island.

Survey work will be carried out near Sable Island, however, no personnel will be required to land on the Island. Juvenile fish of many species, and seals, are found in the shallow waters around Sable Island, frequently in large numbers. Noise from hazard surveys carried out on the West Sable site will reach the Island, but at levels that should not elicit specific behavioural responses (Davis, et al., 1998). The short duration of the surveys near Sable Island should ensure that any effects on the biological resources of the Island are negligible. Timing of work at the West Sable site can be scheduled to avoid any conflict with a three-week DFO seal research study on Sable Island.

All effects of the proposed hazards surveys on marine biological resources are expected to be negligible. No loss of fishing time or catch is expected, but minor local impacts may occur of very short duration. Fishing interests will be notified about survey activities in advance.

The hazards surveys will be carried out in compliance with the operating conditions specified by CNSOPB. The operator has already sent information to relevant parties concerning interactions between the operator and the fishers.

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1. INTRODUCTION

This environmental assessment describes the potential impacts of four proposed hazards surveys in reference to the **Environmental Assessment of Seismic Exploration on the Scotian Shelf** (Davis et al., 1998). This report reviews the major features of the environment relevant to potential impacts of these hazards surveys and identifies any areas of concern where the findings of the class assessment would not be relevant.

This assessment has been prepared for submission to the Canada-Nova Scotia Offshore Petroleum Board (CNSOPB). Established in 1990, the CNSOPB is an independent joint agency of the governments of Canada and Nova Scotia.

2. PROJECT DESCRIPTION

ExxonMobil Canada, as operator, proposes to conduct four hazards surveys south of Sable Island between mid-August and mid-September, 2001. The survey areas are illustrated in Figure 1.

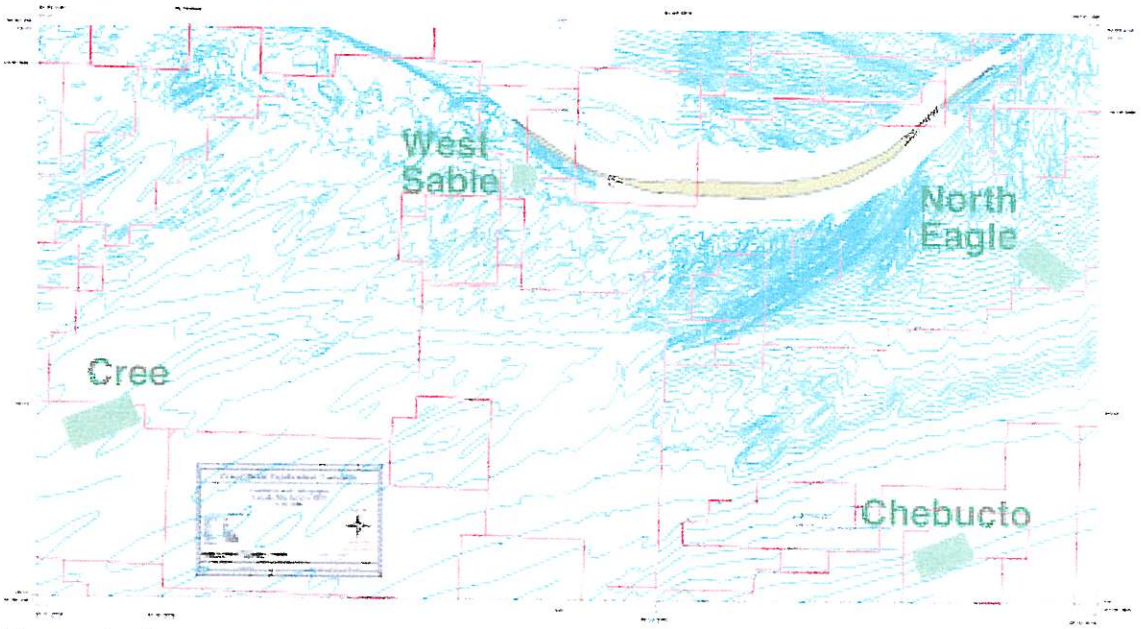

Figure 1: Location of Hazards Survey Sites in Relation to Sensitive Features

Surveys at each site consist of high resolution seismic (referred to as digital data collection) and a combination of sub-bottom profiling, side scan sonar, magnetometer and bathymetric mapping (grouped as analog data collection). A multibeam bathymetric survey will also be performed along all survey lines.

The size of the survey areas, number of lines and line spacing are summarized in Table 1. As noted, line spacing will be closer over the shallow water west Sable site.

Table 1 – Hazards Survey Areas and Line Layout

	Survey Areas			
	West Sable	Chebucto	Cree	North Eagle
Approximate Water Depth	15 meters	110 meters	60 meters	40 meters
Survey Area Dimensions	2km x 2km	4.7km x 2.5km	6km x 2.7km	4.5km x 2.3km
Distance From Sable Island	1.1 km	30 km	40 km	12 km
Center Coordinates WGS84 (Latitude/Longitude)	43.93312°N 60.15091°W	43.66627°N 59.70915°W	43.73673°N 60.56914°W	43.88342°N 59.61529°W
Center Coordinates UTM 21N (Easting/Northing)	247020mE 4869050mN	281509mE 4838153mN	212507mE 4848605mN	289839mE 4862028mN
Primary Line Orientation	007°/187°	070°/250°	069°/249°	128°/308°
Primary Line Spacing (analogue)	75 meters	100 meters	100 meters	100 meters
No. of Primary Lines (analogue)	18	16	17	19
Primary Line Spacing (simultaneous digital and analogue)	225 meters	300 meters	300 meters	300 meters
No. of Primary Lines (simultaneous digital and analogue)	9	8	9	10
Secondary Line Orientation	097°/277°	160°/340°	159°/339°	038°/218°
Secondary Line Spacing (simultaneous digital and analogue)	500 meters	500 meters	500 meters	500 meters
No. of Secondary Lines (simultaneous digital and analogue)	5	10	10	13
Total Line km (analogue only) (Simultaneous digital and analogue)	36 km 28 km	72 km 59 km	80 km 68 km	114 km 96 km
Total Number of Lines	32	34	36	42

A typical layout of a survey block, showing primary and secondary line areas, is illustrated in Figure 2. Lines nearest the well site are considered primary lines. Secondary lines are near the outside of the survey area.

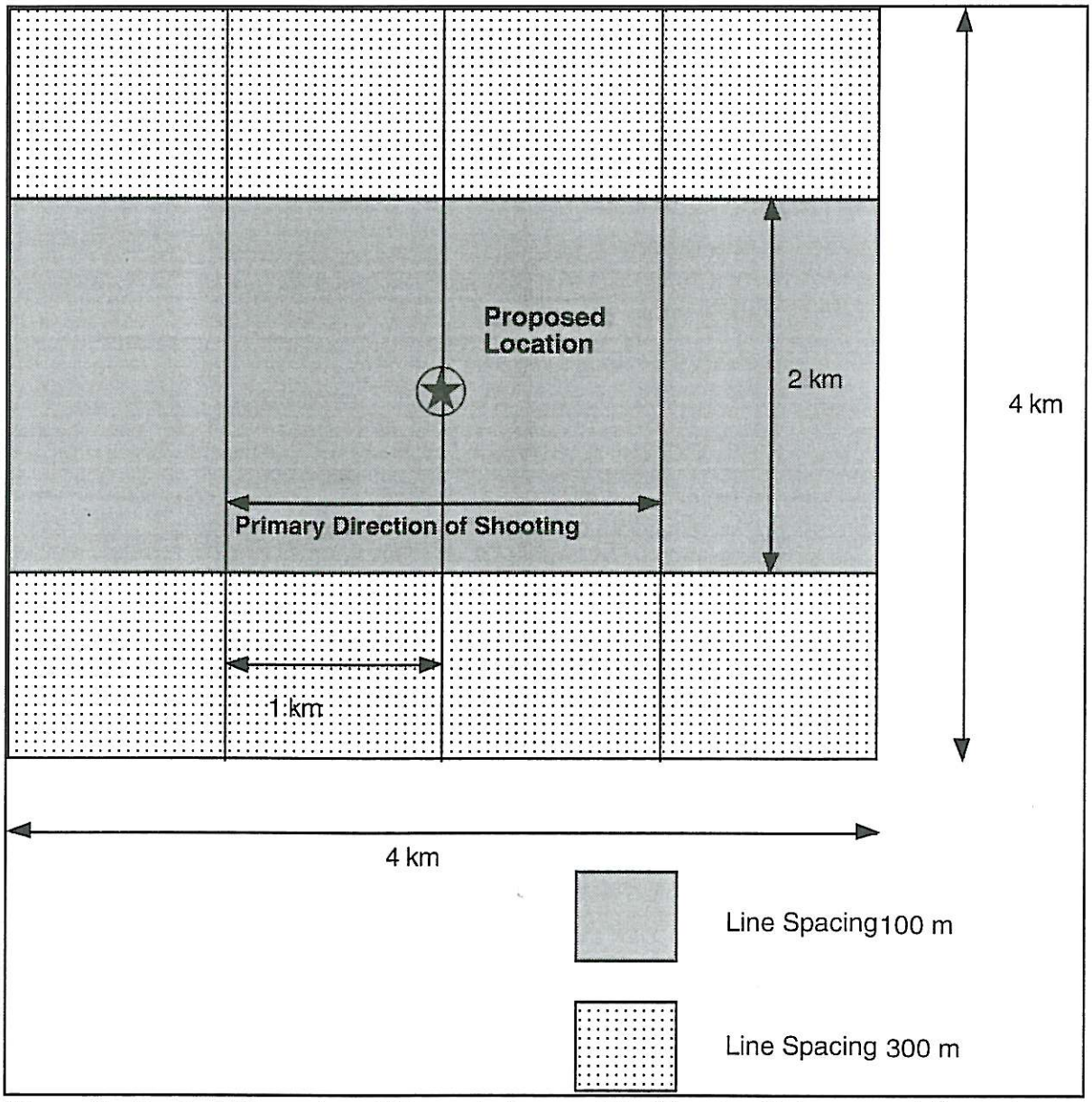

Figure 2: Typical Geometry of Hazards Survey Site Showing Primary and Secondary Line Areas

The actual geometry of the surveys may be adjusted during acquisition to account for water depth, sea state and local conditions. The choice of sub-bottom profiler (shallow or deep tow) depends on water depth. In addition to acoustic data collection, grab samples and bottom camera photographs will be taken where appropriate.

The sound source for the high resolution seismic will be a 4 x 40 cubic inch sleeve gun array mounted on a one metre square frame. The system is designed for evaluation of gas hazards to depths of 1 km below the seafloor. Large airgun arrays used in full-scale seismic surveys typically produce sound pressure levels of 262 dB re 1µPa at 1 m (Davis et al., 1998). The four gun array

used in hazards surveys is about one-sixth as powerful, producing sound pressure levels of about 2 – 3 bar metres, or between 220 and 230 dB re 1μPa at 1 m.

Sub-bottom profiling will use a shallow tow system for sites in shallow water, but the option will be retained to use a deep tow system if required. The primary use of the profiler is to evaluate the first 10 m of sediment for support of structures. The sub-bottom profiler will emit a sound pressure level of about 0.2 bar metres, between 170 and 200 dB re 1μPa at 1 m.

Work is planned to commence August 15, 2001 and continue to the middle of September 2001.

One or two additional smaller guns of 10 or 20 cubic inches could be added without significantly changing peak pressure levels used to assess impacts. Two 150 cubic inch GI guns might also be used in deep water areas instead of the 4 x 40 cubic inch guns. Although the larger guns will produce more energy at a lower frequency than the smaller gun array, output will be in the upper range estimated and substantially less than a full exploration seismic system. The larger guns would not be used over the shallow water West Sable site close to Sable Island.

One or two regional tie lines may also be run between potential drill sites.

Operations can continue in weather up to about Sea State 4 or wave heights of about 2 m.

3. APPLICATION TO THE GENERIC ASSESSMENT

A generic assessment of the environmental impacts of seismic surveys on the Scotian Shelf was completed in 1998 (Davis et al., 1998). This document provides a summary of the impacts of seismic surveys and makes mention of hazards surveys, but does not provide a detailed assessment of their potential effects. In general, however, hazards surveys use less intrusive equipment to collect information within a much smaller area than typical seismic surveys. Thus, environmental effects are much less, and usually considered negligible on all valued ecosystem components (Davis et al., 1998).

The proposed survey is scheduled for August and is not located within 10 km of any whale santuary, meeting the requirements for consideration under the generic assessment. Nonetheless, potential interactions between the proposed surveys and valued ecosystem components are reviewed, and the potential for cumulative impacts examined.

4. SURVEY AREA DESCRIPTION

4.1 Physical Conditions

The meteorology station on Sable Island provides observations for over 100 years. Between June and July monthly average temperatures range from 11° to 15.5° C and monthly average wind speed are between 18 and 20 km/h. Weather during the proposed survey period is generally good with infrequent storms, but fog can persist for a number of days hampering visibility. The mean number of days with fog in a month range from 20 in June to 22 in July.

Water depths in the survey areas range from 15 m to 110 m. West Sable and Cree sites fall within the coverage of Chart CHS 4099. Chebucto and North Eagle are covered by CHS Chart 4098.

Sable Island

The seabed near Sable Island slopes moderately away from shore to 10 m depth, at a typical rate of 10 to 17 metres per kilometres. Sand bars to the East and West bars are essentially flat. The slope typically is more gradual between 10 and 20 metres depth, but is particularly steep on the northern and northeastern sides of the island. Depths of 25 to 30 metres but up to 40 m are found at six kilometres from the island, except in the northeast part of the Sable Island and East Bar, where a steep slope leads to depths of approximately 55 metres within 6 km of shore.

The seabed near the island is predominantly medium sand (0.25-0.5 mm particle diameter) with occasional shell debris and coarse sand. An inshore zone of high energy sandy environments has bedded sands, wave-formed ripples and sand bars parallel to shore at depths shallower than 20 metres. A deeper water zone further from shore contains sand ridges connected to the shore and extends seaward. The sand is constantly redistributed in response to wave and current activity (Amos and Nadeau, 1988).

Noise

The generic assessment provides a comparison of ambient and seismic noise levels. The assessment modeled sound propagation over Sable Island Bank in four directions from Sable Island. The modeling showed that noise from typical airgun arrays would diminish to values of 150 to 160 dB within 4.5 to 14.5 km, depending on bottom type, water depth and sea state.

Ambient open ocean noise at Sea State 4 ranges from 75 to 90 dB between 100 and 1000 Hz. In contrast, information available on underwater noise within the surf zone predicts noise levels would be between 110 – 120 dB in the 100-1000 Hz band at a distance of 200 m from the surf under winds of 25-35 knots (Wilson et al., 1985).

Existing Cables and Pipelines

Representatives of the Canadian Hydrographic Services (CHS) and the Department of National Defence were contacted to provide information on submersed cables and explosive sites in the hazard sites.

A previously abandoned cable, Cantat 2, was reactivated within the last year, and currently runs through the southwest corner of the Cree Site (Figure 3). No other cables, abandoned or active, have been recorded by the CHS in the vicinity of the hazard survey sites (Palmer, R., CHS, pers. comm.). DND verified that it has no record of cables or explosive sites in any of the hazard sites (Cptn. A. Raiche-Marsden, DND).

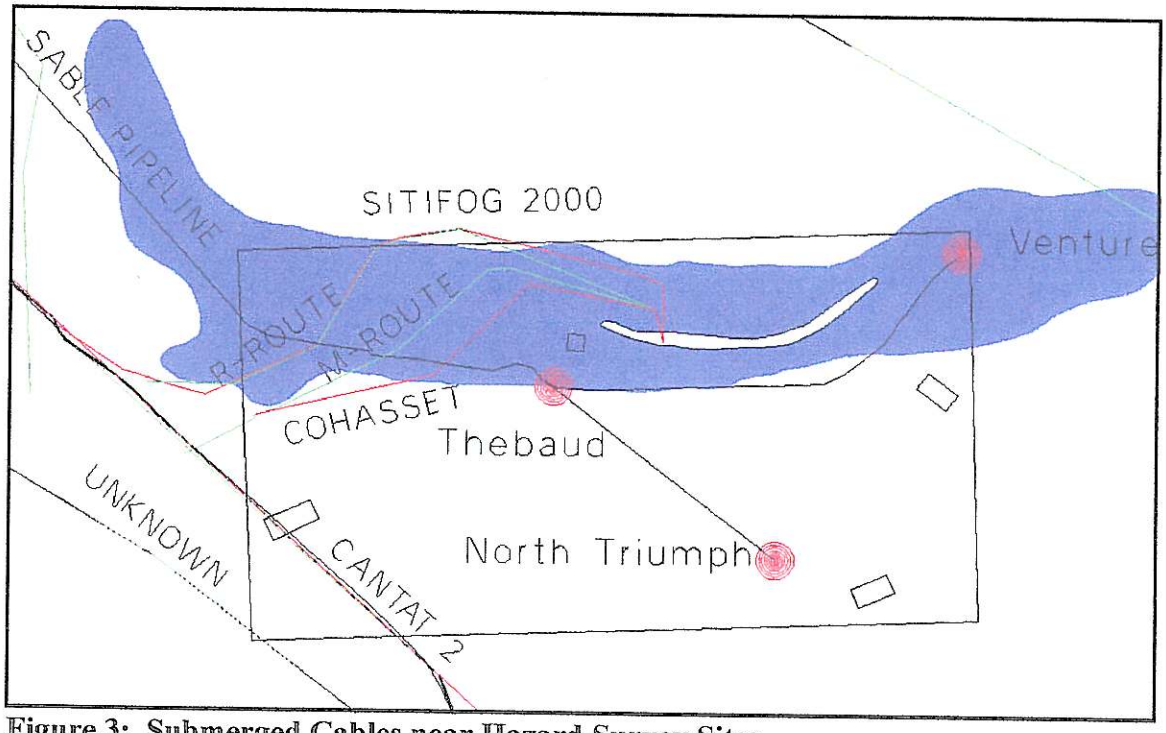

Figure 3: Submerged Cables near Hazard Survey Sites

4.2 Biological Environment

Marine Invertebrates

Animals present on Sable Island Bank include sponges and sea cucumbers, sand dollars and, in some areas, commercial quantities of sea scallops. Biomass and animal numbers are expected to be low and diversity moderate in most areas. Shallow water wave and surf zones are suitable for species of bivalves which can tolerate disturbance by waves and currents, as well as other organisms, such as polychaetes, amphipods, nematodes. Shallow water environments on the bank typically have reduced diversity and biomass of organisms, and communities are dominated by few species. The proposed survey areas are located in deeper water zones where diversity is higher and commercial quantities of sea scallops are known to occur.

Surveys for ocean quahaug (*Arctica islandica*) and Stimpson's Surf Clam *(Mactromeris polynyma*) have shown these species to be present in non-commercial quantities on Sable Island Bank. The northern propeller clam (*Cyrtodaria siliqua*) also occurs, but is not currently harvested (Roddick and Lemon, 1992). One non-commercial invertebrate species (sand shrimp, *Crangon septemspinosa*) is known to occur in grey seal diets on Sable Island (W.D. Bowen, DFO, pers. comm.).

Marine Fish

During the winter months most groundfish species are found in deeper warmer waters along bank edges and adjoining basins. These include cod, haddock, silver hake, American plaice and wolffish. Some flounder and most skate remain on the banks throughout the winter. Migratory species such as tuna and swordfish are absent in winter.

As surface waters warm in the spring, groundfish move into shallower water on the banks. In June large pelagics, such as swordfish and tuna, move into the area between the Gulf Stream and the Shelf Edge.

In summer, most groundfish species disperse over the tops of the banks. These include Atlantic cod, haddock, silver hake, American plaice, wolffish and halibut. Porbeagle and dogfish sharks are found along the Shelf. Squid are widely distributed, with some concentrations along the Shelf Edge. Swordfish and tuna are found along the Shelf Edge and Slope, before moving southward in September.

In early autumn, migratory summer residents move offshore and south. Atlantic mackerel move through the area to wintering grounds along the Shelf beginning in October. Tuna and swordfish are gone from the Shelf by November. Squid move offshore toward the Gulf Stream in October and November. In late autumn, most groundfish species move into deeper waters along the bank edges and the basins. Spiny dogfish migrate out of the area in November and December.

Ichthyoplankton

Table 2 provides the abundance of eggs from the Scotian Shelf Ichthyplankton Program (SSIP) stations adjacent to the proposed survey sites. This provides an indication of when fish are spawning in the local area. It is impossible to differentiate some species at early stages of development, and thus some species like cod appear a number of times in the table. The largest number of eggs were found in April, which also corresponds to the highest abundance of cod and haddock eggs. No cod or haddock eggs were found in June.

Table 2: Abundance of Eggs from SSIP Stations adjacent to the Hazards Survey Sites

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cod	0.019	0.003	0.000	0.054	0.014	0.000	0.000	0.000	0.000	0.027	0.133	0.204
Haddock	0.000	0.000	0.000	0.003	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002
Plaice	0.000	0.001	0.014	0.485	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hake et al.	0.003	0.000	0.000	0.000	0.002	0.008	0.168	0.009	0.007	0.003	0.001	0.000
Cod/Had	0.000	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.036	0.000
Silver Hake	0.000	0.000	0.000	0.000	0.001	0.000	0.211	0.307	0.076	0.053	0.000	0.000
Cod/Had /Wch	0.188	0.052	0.050	0.543	0.037	0.013	0.030	0.004	0.001	0.015	0.023	0.366
Cunytail	0.000	0.000	0.000	0.103	0.060	0.529	0.034	0.000	0.000	0.000	0.000	0.000
Pollock	0.008	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.002	0.122	0.070
Total	0.217	0.130	0.065	1.188	0.119	0.550	0.444	0.320	0.085	0.101	0.315	0.641

Notes: Hake et al. includes red and white hake and four bearded rocking; Cod/Had includes cod and haddock; Cod/Had/Wch includes cod, haddock and witch flounder; Cuntail includes Cunner and Yellowtail.

Atlantic cod (*Gadus morhua*) is a particularly important commercial species, which currently remains in historically low numbers on the Scotian Shelf. Research conducted primarily by the Dalhousie University OPEN project on Western Bank found that spring spawning on cod had largely disappeared in that area. Other DFO research, however, shows that the Sable Island/Western Bank stock of cod remains a bimodal population and thus spring spawning probably continues to occur in other areas, possibly including within the proposed survey sites (Miller et al., 1995).

The SSIP also provides abundance of larvae of potentially important species. Figure 4 illustrates the monthly abundance of larvae for each proposed survey block. By far the highest abundance of larvae were found near the Cree site in August. Larval abundance in June and July is low.

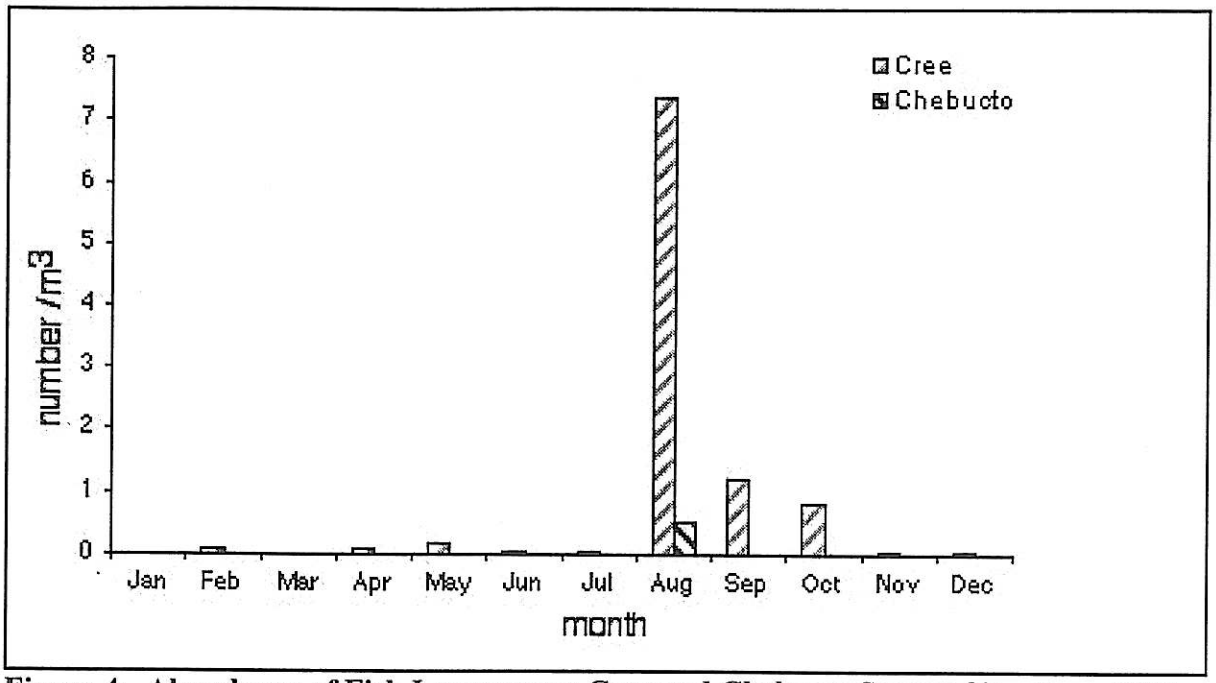

Figure 4: Abundance of Fish Larvae near Cree and Chebucto Survey Sites from SSIP Data

Juvenile Fish

The only major survey of juvenile fish in the nearshore waters of Sable Island was conducted by Scott (1988). The surveys were based on a half-hour tow at a set grid of 57 stations and employed a Western IIA or Concord otter trawl fitted with a 1/2-inch mesh codend liner. All tows were conducted during daylight to a minimum depth of 16 m. The survey was carried out once a year in August between 1981 and 1985. Thirty-six species (including squid) were caught (Table 3). Haddock, silver hake, cod and yellowtail flounder were consistently the most abundant with the exception of high catches of dollarfish and longhorn sculpin in one year for each species. Review of the length/frequency distributions indicated that the abundance of haddock, and to a lesser degree, cod, was related to the strength of particular year classes.

Table 3: Mean Catch of Fish per Tow Near Sable Island, 1981 - 1985.

Species	1981	1982	1983	1984	1985
Haddock	1321.8	264.9	411.0	5.4	13.3
Silver hake	103.1	109.4	78.2	14.8	59.4
Atlantic cod	60.9	56.6	26.6	6.5	25.1
Yellowtail flounder	12.2	28.4	11.0	16.5	22.3
Herring	11.2	0.9	7.7	-	-
Dollarfish	3.9	0.5	22.7	0.1	0.1
Mackerel	2.8	2.9	6.9	0.7	3.1
Winter skate	1.1	2.1	0.4	0.5	2.0
Sand lance	0.9	3.3	6.5	0.5	0.2
Brill	0.8	1.4	0.2	0.4	2.2
Longhorn sculpin	0.5	2.5	0.7	11.7	2.1
Squid	0.5	5.2	0.8	0.3	0.1
Winter flounder	0.4	2.0	4.6	2.0	10.7
Pollock	0.3	-	0.3	1.6	-
Plaice	0.2	1.6	0.8	0.4	-
Sea raven	0.2	0.2	0.2	0.4	0.6
Witch flounder	-	-	0.1	0.1	-
Thorny skate	-	-	0.3	-	-
Little skate	-	0.7	0.2	1.9	9.8
Red hake		0.1	-	0.8	0.4
White hake		-	1.7	0.8	-
Angler		0.2	0.4	0.2	0.2
Atlantic halibut		0.1	0.2	-	0.1
Spiny dogfish		-	0.2	-	
Argentine			1.9	-	
Round scad			0.4	-	
Gaspereau			0.2		
Cunner				0.1	1.2

Source: Scott (1988) Note: the table does not include species for which fewer than 5 fish were caught.

Spawning Aggregations

Silver Hake are known to spawn on Sable Island bank, predominately in August or September (Scott and Scott, 1988). Silver hake has at times been thought to represent a particularly important component in the ecology of the Scotian Shelf, both being both major predator and prey at different parts of its life cycle. Spawning of silver hake is the only major biological activity occurring during the proposed survey time, and possible near the Cree site.

The relative location of spawning aggregations and the proposed survey sites were examined by plotting catch of silver hake from the last 30 years of DFO research vessels surveys in the area. The tows were completed between July 5 and August 5. These data, illustrated in Figure 5, provide the best estimation of where spawning aggregations occur in the area.

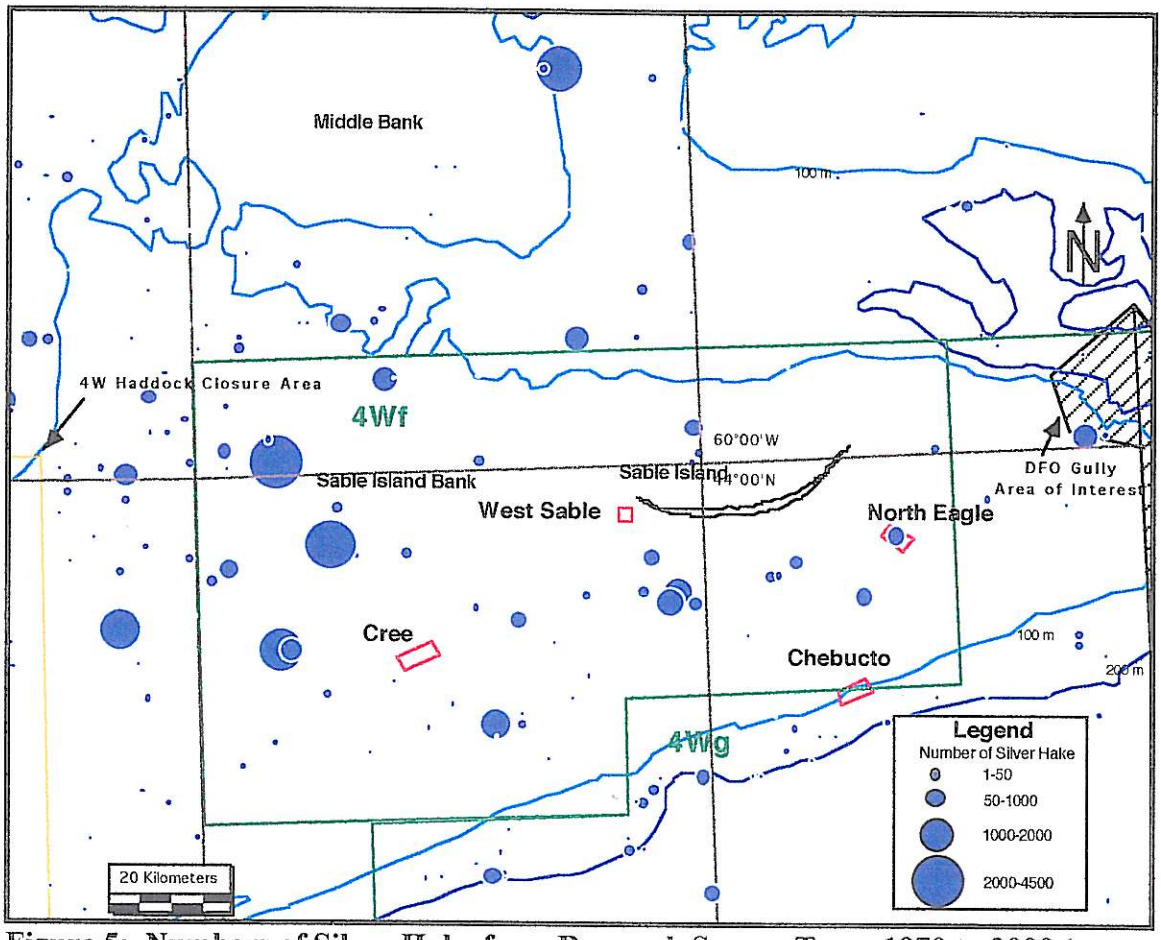

Figure 5: Numbers of Silver Hake from Research Survey Tows, 1970 to 2000 (source: DFO)

In the area where silver hake spawning is thought to primarily occur, major aggregations are at least 15 km to the west of the Cree survey site. The single moderate-sized catch at the North Eagle site is not considered indicative of a spawning aggregation.

Marine Mammals

Whales and seals are found throughout the study area, with particular concentrations around Sable Island and The Gully. The Gully, in particular, is an area of high biological productivity and diversity, and houses a number of marine mammal concentrations, including a breeding population of Northern Bottlenose.

The most recent data on broad abundance and distribution of marine mammals of the Shelf and Slope is provided by the Northeast Fisheries Science Center's (NEFSC) 1995 and 1998 summer

line-transect abundance surveys (Bundy, A. and Palka, D., pers. comm.). In 1995, 54 groups of cetaceans were found in the Eastern Scotian stratum. This included two groups of bottlenose dolphin, one common dolphin, 22 white-sided dolphin, six pilot whale, four minke whale, nine fin whale, nine humpback whale, and one sperm whale group. The average group size ranged from one to 40 animals per group.

Whale distributions in the study area change with the seasons. Most northern hemisphere baleen whales tend to feed in higher latitudes in summer, and move south for the winter; mating and calving usually take place on the winter grounds. Nonetheless, representatives of all species can be found in the study area throughout the year, albeit in lower numbers in winter than in summer. Indications are that migration into the study area begins as early as March, and that initially whales move along the Shelf Edge, with later entry onto the Shelf and into The Gully. It appears that blue whales are the earliest migrants, entering the study area along the Shelf Edge in March.

In summer, humpback, sei, fins, pilots and blues are more common on the Shelf itself than are sperms and northern bottlenose. The latter tend to be sighted along the Shelf edge and the Slope, in waters over 180 m; the bottlenose regularly dives to over 1,000m. In The Gully area, a resident, non-migratory, breeding population of Northern Bottlenose exists, which has been studied for a number of years by Dalhousie University researchers under the direction of Dr. Hal Whitehead.

Migrations out of the study area to the south begin in October and November, with most migrants out of the area by January.

Small toothed whales, dolphins and porpoise could be in the study area year round. However, in general, most species frequent the Shelf and Shelf Edge during summer and early fall, moving to the southwest as winter approaches (Kenney, 1994). This probably coincides with seasonal distributions of favoured prey.

Grey and harbour seals are the dominant pinniped species in the area; they can be found anywhere on the Shelf when not at their primary breeding location on Sable Island, or at a few smaller coastal rookeries. Both spend much time offshore with some seasonal variation; little is known about their lives at sea. Some harp and hood seals have begun to frequent the Sable Island area in recent years, and appear to be more common in winter.

Birds and Forage Species

The seabird fauna of the Scotian Shelf is characterized by numbers of pelagic species widely distributed offshore throughout the year, and by concentrations of seabirds nesting at coastal colonies from late spring through summer. The offshore seabird community is composed primarily of shearwaters and storm-petrels during the summer months, and by alcids and fulmars during the winter. At all times of the year, the highest concentrations of pelagic species occur near the edge of the continental shelf and on the shallow fishing banks (Thomson et al., 2000).

Sand lance, a fish species that inhabits the seabed part of the time, is the principal food item of Grey Seal in the area (Harrison and Bowen 1994). Sand lance, juvenile hake and other small fish also provide food for seabirds, including breeding colonies on Sable Island.

Numerous marine birds forage in the waters of Sable Island Bank, but little potential exists for interactions with seismic surveys (Davis et al., 1998). Nonetheless, marine birds could be affected indirectly if their food source was reduced.

Species at Risk

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assigns national status to species at risk in Canada. Table 4 summarizes those marine species which may occur in the study area and which have COSEWIC designations in categories other than Not At Risk.

Table 4: Species with COSEWIC Designations in the Study Area

Common name	Latin name	Taxonomic group	Range	Risk category	Year of designation
Leatherback Turtle	*Dermochelys coriacea*	Reptiles	Atlantic and Pacific Oceans	Endangered	1981
Right Whale	*Eubalaena glacialis*	Mammals (marine)	Atlantic and Pacific Oceans	Endangered	1990
Roseate Tern	*Sterna dougallis*	Bird (marine)	Atlantic, Indian and Pacific Oceans	Endangered	1999
Harbour Porpoise	*Phocoena phocoena*	Mammals (marine)	Atlantic Ocean	Threatened	1991
Blue Whale	*Balaenoptera musculus*	Mammals (marine)	worldwide	Special Concern	1983
Humpback Whale	*Megaptera novaeangliae*	Mammals (marine)	worldwide	Special Concern	1985
Fin Whale	*Balaenoptera physalus*	Mammals (marine)	worldwide	Special Concern	1987
Northern Bottlenose Whale (Gully population)	*Hyperoodon ampullatus*	Mammals (marine)	Northern Atlantic	Special Concern	1996
Atlantic Cod	*Gadus morhua*	Fish	Atlantic Ocean	Special Concern	1998

table data from COSEWIC, 2000.

4.3 Special Areas

Fisheries Closures

There are eight areas with some type of fisheries restriction on the Scotian Shelf (Davis et al., 1998). Those relevant to this assessment are described in more detail; distances are the shortest possible between outside boundaries.

The 4W Haddock Spawning Closure is the largest of all commercial fishery closures on the Scotian Shelf. The closure applies to all fishing activity directed at groundfish. Covering all of

Emerald and Western Banks and extending west to halfway between LaHave and Emerald banks, the closure lies approximately 55 km from the closest survey site, Cree.

Whale Conservation Zones

Two whale conservation zones have been identified on the Scotian Shelf through the Canadian Coast Guard Notices to Mariners. Only DFO's Gully Whale Sanctuary Area of Interest is close to the proposed survey sites. The closest survey sites are North Eagle and Chebucto, at 30 and 44 km, respectively.

Sable Island

The western bar of Sable Island is just over one kilometer from the West Sable survey site. The general environment of the island is comprehensively described in the generic assessment. The island is 41 km long island, composed of sand, has a diverse flora and fauna. The shape of the island changes slowly as a result of erosion and deposition, but vegetative cover and general current patterns maintain its crescent shape.

Major biological features of the island include feral horses, birds and seals. The horses were introduced to the island sometime shortly after 1738 and now range in number between 150 and 400.

Migrant and breeding bird species are common on and around Sable Island. Sable is the only breeding ground of the rare Ipswich Sparrow, and is also home from mid-May to mid-July to small breeding numbers of the threatened Roseate Tern, as well as Arctic Terns, gulls, sandpipers, plovers, black ducks and mergansers.

Grey seals pup from late December to early February on Sable, with births peaking in early January. Adults swim in the surrounding waters and may feed as well if prey is available. A small breeding population of Harbour seals still exists on Sable, hauling out on the Island throughout the year and pupping in late May to early June.

A research study on seals, led by Dr. Don Bowen of the Bedford Institute of Oceanography (DFO), is being conducted on Sable Island beginning in early September and lasting three weeks. Dr. Bowen has expressed concern that their research might be made more difficult if seals leave the area because of noise produced by survey operations, specifically discharge of airguns. The research methodology involves finding previously branded seals, the probability of which is expected to lessen with the total number of seals present (Bowen, Don, DFO, pers. comm.). The study is not intended to directly examine seal behaviour.

4.4 Fishing Activity

Fisheries in the area primarily target groundfish, crab, scallop, and large pelagics. This section describes the timing and location of the major fisheries in and around the proposed survey sites.

Catch and effort data are coded into management areas, referred to as Unit Areas. The Cree, West Sable andNorth Eagle sites are contained within Unit Areas 4Wf, and the Chebucto site straddles 4Wf and 4Wg. The average catch by month and major species or species group for 1996 to 2000 is provided in Table 5 for 4Wf and Table 6 for 4Wg. Catches in the tables are listed under the directed species but represent total catch for all species for each vessel report. They include only landings within the Scotia Fundy region, with preliminary numbers for 2000.

Table 5: Average Catch (metric tonnes) for Species or Species Group for Unit Areas 4Wf, 1996 - 2000

Species or Species Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Groundfish	0.0	0.0	0.1	0.0	20.3	26.3	20.8	32.8	48.4	18.1	0.6	4.3
Crab	0.0	0.0	0.0	0.0	0.0	22.2	37.0	52.9	30.8	17.0	2.9	2.4
Scallops	0.0	6.1	0.7	1.6	18.4	80.3	105.8	126.4	136.5	61.7	14.4	9.9
Shrimp	0.0	0.0	0.0	0.0	9.9	2.6	4.5	1.6	0.0	0.0	0.0	0.0
Shark	0.2	0.2	0.0	0.0	0.8	1.8	0.0	0.0	0.0	0.0	0.0	0.0
Swordfish	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.7	0.1	0.0	0.0
Tuna	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Pelagics	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0

Source: DFO Scotia/Fundy Catch and Effort Database

Table 6: Average Catch (metric tonnes) for Species or Species Group for Unit Areas 4Wg, 1996 - 2000

Species or Species Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Groundfish	8.9	35.3	6.9	10.4	26.3	19.2	33.7	8.4	2.0	16.3	4.2	0.5
Crab	0.0	0.0	0.0	0.0	0.0	4.5	22.6	21.4	20.0	4.9	1.6	0.0
Scallops	2.7	18.5	4.5	0.0	11.8	34.8	20.3	3.2	15.0	35.8	4.6	0.8
Mahi Mahi	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.5	0.1	0.0	0.0	0.0
Shark	0.2	0.6	30.3	16.5	34.0	8.8	5.8	7.2	2.3	0.0	0.0	0.0
Swordfish	0.0	0.0	0.0	0.0	0.0	0.0	37.8	31.5	16.0	1.5	0.0	0.0
Tuna	0.0	0.0	0.0	0.0	0.0	0.0	0.7	3.3	0.9	0.2	0.0	0.0
Otter Pelagics	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.3	0.0	0.0	0.0

Source: DFO Scotia/Fundy Catch and Effort Database

Unit area 4Wf primarily covers Sable Island Bank around Sable Island. Unit area 4Wg is to the south and generally covers the Shelf Edge and deeper waters. Thus, the catch and effort statistics for 4Wf are mostly indicative of fisheries on the top of the banks, such as scallop and groundfish. The catch and effort for 4Wg mostly represents the Slope fisheries, such as crab, shark and large pelagics.

Groundfish

Fishing for groundfish occurs throughout the year. From May to September the fishery is primarily on Sable Island Bank. From October to May, when the surface waters of the banks are coldest, fishing is generally concentrated along the edges of the banks. Longlining is the predominant gear, but bottom trawling also occurs. Monkfish, pollock and cusk were the primary directed species in 2000.

A relatively small proportion of the groundfish catch between 1996 and 2000 occurred within any of the survey sites. Where it occurs in shallower water (<100 m), groundfish are fished between May and September. More fishing for groundfish occurs in deeper water areas, at depths down to 200 m, and it may occur at any time of year.

Large Pelagics

The fishery for large pelagics, tuna and swordfish, begins in July and occurs almost exclusively in waters deeper than 100 m. The location of these fisheries in 1996 to 2000 are shown in Figure 6. Swordfish and tuna are fished by drift longlines, which can be several kilometers in length.

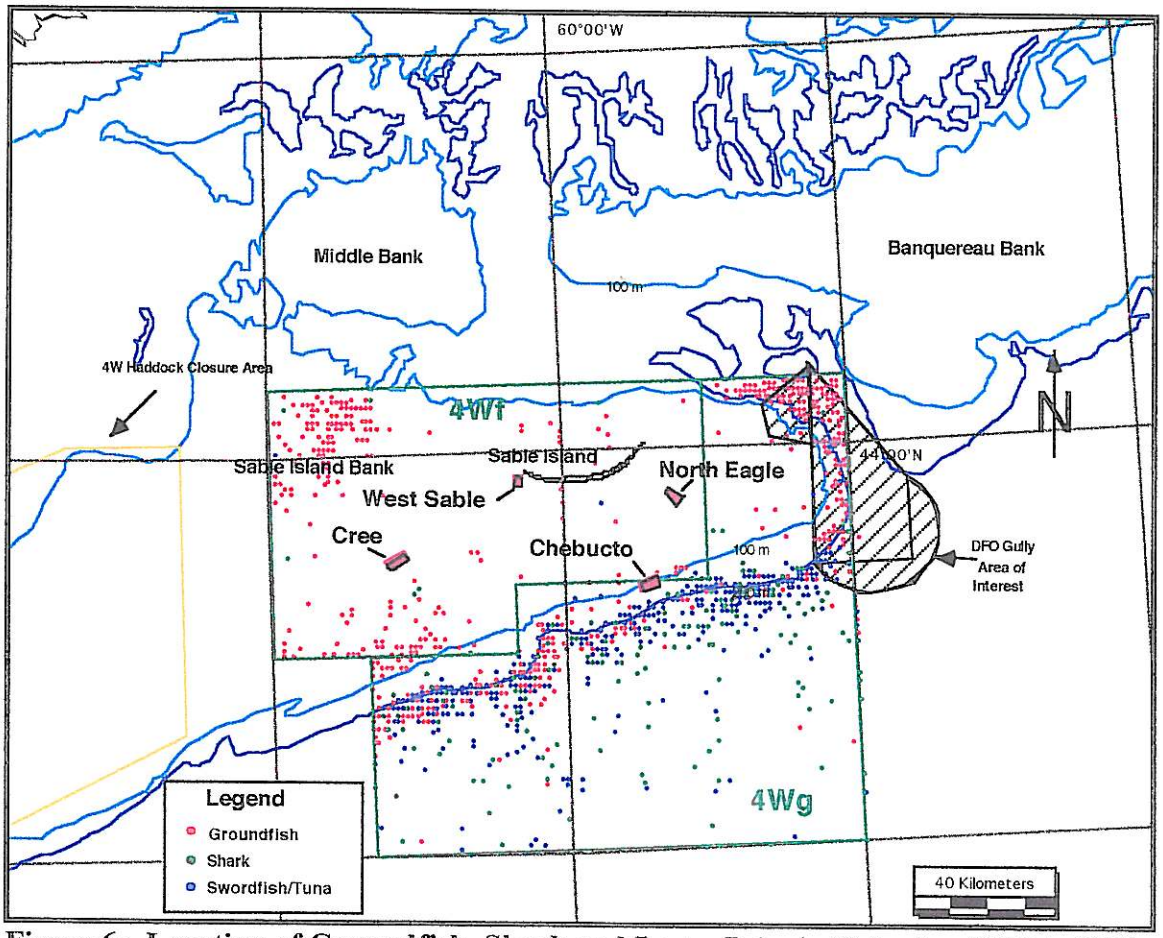

Figure 6: Location of Groundfish, Shark and Large Pelagic Fisheries, 1996 to 2000

A fishery for shark also occurs in deep waters off the Shelf Edge, but this fishery occurs throughout the year.

There was proportionately little fishing for swordfish, tuna or shark between 1996 and 2000 within the sites proposed for survey, but conditions are highly variable from year to year.

Invertebrates

Invertebrate fisheries include crab, scallop, and shrimp. Scallop are, by far, the major invertebrate fishery on Sable Island Bank. The location of the fishery remains relatively constant from year to year, as illustrated in Figure 7. Scallop are fished by moderately large draggers, generally between June and October, but fishing may occur at any time of year.

Snow or queen crab are caught in deeper water primarily along the northern edge of Sable Island Bank. Other crab, including Jonah crab, are also fishing along the Slope Edge to the south. The major location of crab catches in 2000 are shown in Figure 7.

Shrimp are occasionally fished in deeper water to the north of Sable Island Bank, but no shrimp catch has been reported in 1999 or 2000 from 4Wf or 4Wg.

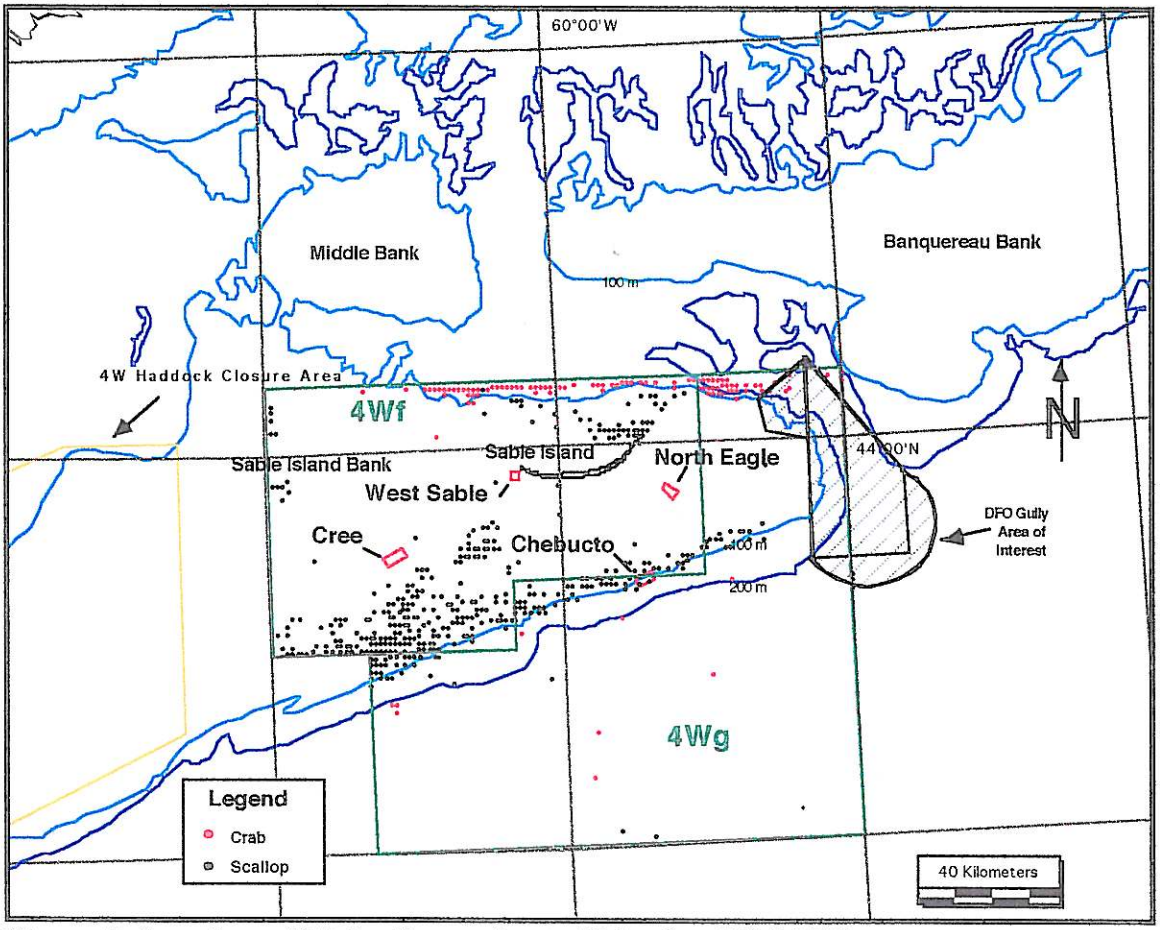

Figure 7: Location of Major Invertebrate Fisheries, 1996-2000

5. POTENTIAL ISSUES AND CONCERNS

Pathways for environmental effects related to hazards surveys, particularly the discharge of airguns, on the Scotian Shelf include:

- injury from pressure waves;
- disturbance by noise leading to behavioural change; and
- interference with marine vessel traffic, particularly fishing vessels and gear.

5.1 Effects on Sable Island

The proposed work will take place near the Island, but will not require any personnel to land on the Island. Sable Island does, however, provide facilities in case of an emergency.

Noise from the airgun discharges will reach the nearshore environment of Sable Island from the surveys done at the West Sable site, which is only 1.1 km from the Western Bar. Studies in Alaska found that measured received levels from large seismic arrays reached 160 dB re µ1 Pa rms at distances of 2 to 6 km from the source when shooting in depths of 4 to 20 m (Burgess et al. in LGL, 1999)[1]. Since the source pressure levels used in the hazards surveys are 30 to 40 dB less than those used in full-scale seismic surveys, sound levels near Sable Island would be expected to be comparably lower. At one kilometre, noise levels would be close to ambient levels experienced in the surf zone, but would still be detectable to organisms such as seals or fish when surf was low. Noise levels, however, should be lower than those cited by Davis et al. (1998) as necessary to elicit specific behavioural responses.

At times, the nearest surveys will be detectable to organisms near the shores of Sable Island, but significant behaviour changes are not anticipated. The short duration of the surveys near Sable Island should ensure that any effects on the biological resources of the Island are negligible. Still, the proposed DFO seal research work is anticipated to last only three, and it should be feasible to avoid carrying out hazards survey work at the West Sable site concurrently.

5.2 Effects on Fish and Invertebrates

Injury from Pressure Waves

Shock waves from air guns can injure or kill invertebrates and fish. The short rise time of the overpressure caused by high explosives is what kills fish and other organisms. Pressure pulses from airguns have slower rise times and cause relatively little injury to fish (Davis et al., 1998). Output of the most powerful acoustic device, the 4 by 4, 40 in^3 airgun array, is between 220 and 230 dB re 1µPa at 1 m. A lethal range of 2 metres for eggs and larvae for this size of array would

[1] The presence of permafrost may enhance received levels at distance by up to 20 dB. Thus, the Alaskan data are considered to be conservative relative to the Sable Bank (LGL, 1999).

conform with the information provided in the generic assessment on Page 93, as well as Turnpenny and Nedwell (1994). An overall volume of 4 m^3 has been assumed as the lethal volume given that most of the energy is directed downward, with little upward or to the sides.

The total lethal volume is calculated using the total length of seismic survey (digital) lines from Table 1. An estimate of the total water volume containing eggs and larvae is required to calculate the relative impact of this total lethal volume. For this calculation, a conservative estimate that eggs and larvae are distributed within the upper 20 m of the water column is used. Since West Sable is shallower than 20 m, a depth of 15 m was assumed for this site. It is also assumed that the survey vessel travels at 10 km/hr, with the airgun firing every 5 seconds. Results of the calculations are provided in Table 7.

Table 7: Lethal Volumes for Hazards Survey Sites

Description	Survey Areas			
	West Sable	Chebucto	Cree	North Eagle
Area Dimensions	2 x 2 km	4.7 x 2.5 km	6 x 2.7 km	4.5 x 2.3 km
Area Volume (km^3)	0.06	0.235	0.324	0.207
Total Lines (km) (digital)	28	59	68	96
Lethal Volume (km^3)	0.000008	0.00002	0.00002	0.00003
Percent lethal/total volume	0.013	0.0085	0.0062	0.014

The potential loss of eggs and larvae from the relatively low power seismic array is very small and would have a negligible impact on marine populations of the area.

The bottom profiler is of substantially less output than the seismic array. No injury of eggs, larvae or fish are expected with this device, or the other lower output devices used in the hazards survey, such as the multibeam and side scan sonars.

Sand lance are likely to be the most common fish in the shallow waters near Sable Island. They can remain buried in sand above the low tide mark, between high and low tides, occasionally thrusting their heads out of the sand (Scott and Scott, 1988). In addition to sand lance, a large number of juvenile fish frequent the waters near Sable Island and no doubt provide additional forage for seabirds and marine mammals. The importance of this area to the local haddock stock is discussed in detail in Appendix 3 of the Seismic Class Assessment (Davis et al., 1998). It reports that large numbers of juvenile haddock would be expected in the waters around Sable Island if a particular year-class were unusually abundant. The low source outputs of these devices used in these hazards surveys will not result in any significant impact on these valued resources.

Disruption of Spawning Behaviour

The spawning aggregations for silver hake are at least 15 km from the Cree survey site, the site considered closest to potential spawning aggregations. The low amplitude of the sound source and the distance will ensure spawning behaviour is not disturbed even if it occurs during work at Cree.

5.3 Effects on Marine Mammals

Seals are thought to be relatively tolerant of seismic activity and have been observed near operating airguns (Davis et al., 1998). Operations are far enough from the DFO Area of Interest around the Gully to reduce sounds levels to near ambient. No significant effects are expected on marine mammals.

5.4 Effects on Fishing Activity

Seismic streams are typically several kilometres in length. In the hazards surveys that are the subject of this report, the sleeve guns will be towed within a fixed frame, approximately 10 to 20 metres off the stern of the vessel, and at a depth of three to four metres. The sub-bottom profiler will trail up to 150 metres behind the vessel, but will typically be much closer to the vessel in shallow water. The relatively small amount of gear will allow the survey vessel substantial maneuverability and should not interfere with fishing operations.

Some surveys occur in areas of potential interest to scallop draggers, but the hazards surveys occupy relatively small amounts of space for short periods of time. Any restriction in access, particularly for the scallop fleet, should not result in any loss in catch or fishing time, because advance notice will be provided. Still, minor and local impacts might occur for a very brief period of time (a few days).

Fisheries associations will be notified about the upcoming hazards surveys even though no interactions are anticipated.

6. CUMULATIVE EFFECTS

The Cumulative Effects Assessment Practitioners Guide (Hegmann et al. 1999) defines cumulative effects as:

> *"changes to the environment that are caused by an action in combination with other past, present and future human actions."*

A Cumulative Effects Assessment (CEA) is intended to assess the potential effects of a project in relation to other past, ongoing and reasonably-foreseeable human activities and developments. The assessment typically enlarges the scale of an environmental impact assessment to a regional

level, and considers a longer time interval than the assessment of project effects (Hegmann et al., 1999).

6.1 CEA Approach and Methodology

As discussed by Hegmann *et al.* (1999), a project-specific CEA should demonstrate the following:

- determine if the project will have an effect on the important resource in question
- if such an effect can be demonstrated, determine if the incremental effect acts cumulatively with the effects of other actions, either past, existing or future
- determine if the effect of the project, in combination with other effects, may cause a significant change, now or in the future, in the characteristics of the important resource after the application of mitigation for that project.

Under the *Canadian Environmental Assessment Act* (*CEA Act*), only those effects resulting from the project that have the potential to interact with similar effects from other projects need to be considered. However, they need not be significant to warrant their inclusion in the CEA.

For CEA, scoping of the assessment includes:

- the identification of regionally important resources of concern from a cumulative effects perspective[2];
- the selection of the study area boundaries for the assessment;
- the selection of the time period for the assessment; and
- the identification of other unrelated land use activities influencing the same regionally important resources.

In relation to the hazards surveys, the key project-specific effects that may interact with similar effects from other human activities and development in the region include:

- injury from pressure waves;
- disturbance by noise; and
- interference with marine vessel traffic, particularly fishing vessels and gear.

The small-scale and short time period of the hazards surveys limited potential project effects to the local area, probably within 10 km. Table 8 identified the other oil and gas projects closest to the proposed hazards surveys. Large-seismic programs are not currently planned within 25 km of any of the hazards surveys (Theriault, Eric, CNSOPB, pers. comm.).

[2] These are often referred to as Valued Ecosystem Components (VECs) which are defined as species, populations or resources which if affected would be of concern to the public, scientists or resource managers.

Table 8: Other Oil and Gas Projects Close to the Proposed Hazards Surveys

Site	Closest Porject	Distance (km)
West Sable	Thebaud	6
Cree	Cohasset	11
Chebucto	North Triumph	9
North Eagle	Venture	15

6.2 Scoping of Potential CEA Issues

Two valued ecosystem components (or important resource groups) were identified for consideration in the CEA: marine mammals (particularly seals on Sable Island) and commercially-important species of fish and invertebrates.

The review of impacts has not identified any potentially significant impacts. In the case of potential interference with the seal research project, any interaction can be avoided easily by timing. The other oil and gas project close to the hazards survey sites are all production facilities, with no potential for cumulative impacts. Large-scale seismic surveys are not planned within 25 km of any of the proposed hazard survey sites during the proposed work period. Thus, the potential for cumulative impacts is considered negligible in relation to the three pathways examined.

7. MITIGATING MEASURES

7.1 Operating Conditions

A number of operating conditions are specified by the CNSOPB:

- the survey crew will not discharge any litter overboard, in particular, plastics or paper;
- air guns will only be activated below the surface of the water;
- an approved 'ramp-up' procedure will be followed when airgun operations begin;
- operations will not take place within the DFO Area of Interest defined for the Gully or Roseway Basin;
- the fishing industry will be consulted with the assistance of the CNSOPB Fisheries and Environment Advisory Committee; and
- appropriate Notices to Mariners will be issued and a damage claim process will be put in place.

These conditions will all be met by the proponent, including pre-consultations held with the fishing industry. The results of consultations are described next, followed by a discussion of mitigating measures.

7.2 Consultations

The highest potential for interactions is with the drift longline fishery for swordfish and tuna. The operator, Exxon/Mobil Canada has sent information on the hazards surveys to relevant fisheries organizations. In addition, information on relevant physical features, such as existing cables, and other oil and gas activities, were obtained from the appropriate government agencies. These consultations are summarized in Table 9.

Table 9: Contacts Made with Government and the Fishing Industry

Organization	Issue	Contact Person	Location	Activity
CNSOPB	other oil and gas projects in proximity	Eric Theriault	Halifax, NS	brief phone consultation with Norval Collins
DFO	seal research program on Sable Island	Dr. Don Bowen	Dartmouth, NS	brief phone consultation with Norval Collins
CHS	cables	Richard Palmer	Dartmouth, NS	obtained specific reference figure at BIO
International Telecom	cables	Ross W. Lee	Bridgewater, NS	brief phone consultation with Shawn Martin
Navigable Waters Protection Act Office	navigable waters	Stan Meyers	Dartmouth, NS	brief phone consultation with Shawn Martin
DND	cables and explosives	Captain A. Raiche-Marsden	Halifax, NS	brief phone consultation with Shawn Martin
Nova Scotia Swordfishermen's Association	longlining for swordfish and small tuna other than bluefin	John Angel and Troy Atkinson	Head of St. Margaret's Bay, Halifax	Exxon/Mobil sent information by email
Eastern Shore Fishman's Protection Association	groundfishing	Neillie Baker	Eastern Passage	Exxon/Mobil sent information by email
Sambro Fisheries Ltd.	longlining, trawling, crab pots	Donnie Hart	Sambro	Exxon/Mobil sent information by email
National Sea Products	trawling	Russell Mossman	Lunenburg	Exxon/Mobil sent information by email
CNSOPB Fisheries and Environmental Advisory Committee	overview	committee representatives	Halifax	presentation to committee on July 11

7.3 Additional Operating Measures

All potential impact for impact on the Sable Island seal research project can be avoided by completing the West Sable site first, as long as the start date remains close to August 15, 2001. Alternatively, if the start of the hazards survey work is delayed until close to September 1, the West Sable site should be completed last, after the research work has been completed. The first two weeks of the research work are considered the most crucial (Bowen, Don, DFO, pers. comm.).

The contracted vessel carrying out the hazards survey work will be required to have an HSE plan, which includes an oil spill contingency plan, in place to ensure that responses to accidental

releases of hydrocarbons are prompt and appropriate. These plans will be aligned with SOEI's Emergency Response Plan, Document 14-E-04-001-C2.

Potential interactions between the survey vessel and fishing vessels will be minimized by clearly communicating plans through the onboard observer. In the event that gear is damaged, a compensation program is in place to replace the gear.

The proponent will make sure all interested parties in the fisheries have advance notice of the planned operations.

8. CONCLUSION

Following application of mitigating measures, residual impacts on the biological environment are expected to be negligible. Any impact on the fishing industry is expected to be minor, local and of very short duration. The proposed program fits the requirements of the Generic Assessment for Seismic Exploration of the Scotian Shelf (Davis, et al., 1998).

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