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Review of Fishing Equipment - Strait of Belle Isle LC-EN-019

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REVIEW AND ASSESSMENT OF FISHING GEAR AND EQUIPMENT - STRAIT OF BELLE ISLE

Introduction

This report has been prepared for the Engineering Deliverables Team of the Labrador-Island Transmission Link (the Project).

Nalcor Energy is proposing to develop a High Voltage Direct Current (HVdc) transmission system extending from Central Labrador to the Island of Newfoundland's Avalon Peninsula. The Project will include submarine cable crossings of the Strait of Belle Isle.

Project planning and design are currently at a stage of having identified a 2 km wide corridor for the on-land portions of the proposed transmission line, and 500 m wide corridors for the proposed Strait of Belle Isle cable crossings, as well as various alternative corridor segments in particular areas (Figure 1). Project planning is in progress, and it is anticipated that the Project description will continue to evolve as engineering and design work continue. Nalcor is currently preparing an Environmental Impact Statement (EIS) for the Project. In preparation for and in support of the Project's EIS, a Marine Fisheries Component Study was prepared on behalf of Nalcor Energy by Canning & Pitt Associates Inc. in 2009 to provide baseline marine fisheries information for eventual use in the EIS. This present report draws on information presented in the Fisheries Component Study (i.e., baseline analysis).[1]

The proposed Strait of Belle Isle cable crossings will extend under and across the Strait and make landfall on the northwestern side of the Island of Newfoundland's Northern Peninsula. Two potential submarine cable corridors across the Strait have been identified.

A number of methods will likely be used to protect the cables across the Strait of Belle Isle. Primarily, the currently identified corridors make use of natural seabed features to shelter the cables in valleys and trenches to minimize the possibility of iceberg contact or interaction with fishing activity. In order to access these natural deep valleys and ocean bed contours and to provide further required protection, various cable protection techniques are under consideration.

[1] That baseline report - Marine Fisheries in the Strait of Belle Isle Component Study (March 2010) - describes fisheries activities in the area proposed for the submarine cable crossings of the Strait of Belle Isle. The report describes relevant fisheries activities, 1989-2008, for the wider Strait of Belle Isle area (NAFO Unit Area 4Ra) and then focuses on more recent local fisheries near the potential submarine cable corridors that fall within the Study Area for the present report. In addition to fisheries statistical data, the baseline report also drew on consultations with representatives of fishers from ports on both sides of the Strait.

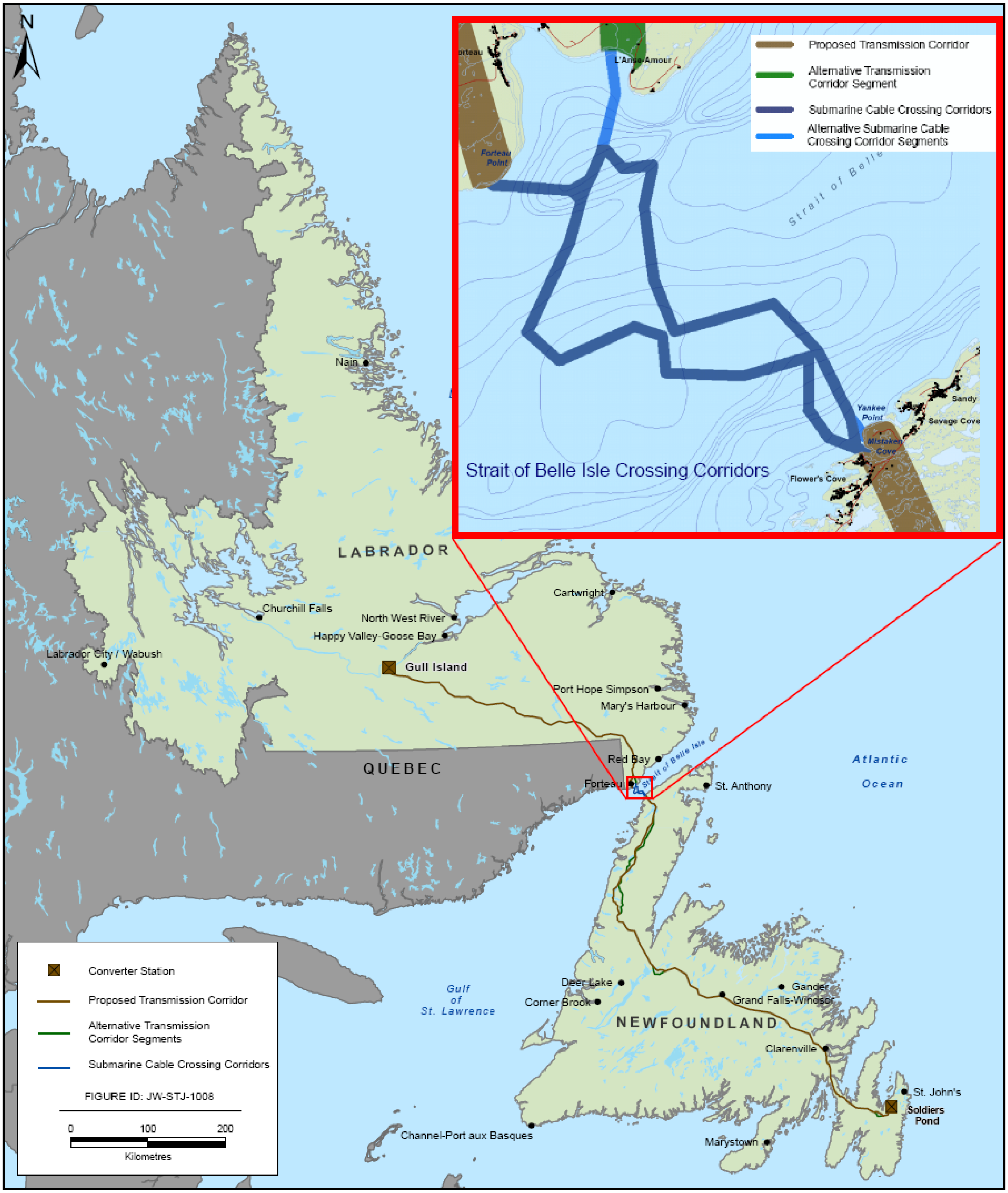

Figure 1. The Labrador-Island Transmission Link.

Engineering analyses are ongoing to assess potential approaches and techniques for protection of the sub-sea cables. The selection of particular approaches and methods for cable protection along the route and specific portions of it is the subject of on-going analysis, and will be based on water depths, terrain and seabed geology, substrate characteristics, risk exposure, and overall technical and economic viability.

Study Objective

The scope of this study is to identify the specific types of fishing gear and related equipment used in the Strait of Belle Isle in the area of the identified cable corridor(s), with a particular focus on those that would come in contact with the seabed, and which may therefore interact with the cables once installed. In addition to identifying and describing relevant fishing gear, the study terms of reference also asked the consultants "to indicate the nominal amount of fishing activities based on gear type summarizing the duration or season of use and the expected number of passes over the study area per season. The intent of this portion is to obtain an order of magnitude value of existing and potential fishing operations and gear utilization in the seabed area where the proposed power cables would be located."

Study Area

The Study Area for the baseline report focused on a relatively large geographic area within the Strait of Belle Isle that encompassed most of the established fishing grounds used by fishers based in relevant communities (i.e., homeports) on both sides of the Strait.[2] However, for various reasons, that analysis did not consider it necessary to identify any specific study area boundaries.

The boundaries of the study area for the present report are shown in Figure 2. This represents just a part of the fishing grounds used by fishers from the same homeports examined in the baseline study. However, given the specific objectives of this study, the analysis is primarily focused on the seabed zone through which the proposed power cable corridors will pass. The consultants have used the term "Gear Assessment Zone" to describe this study area.

The boundaries of this assessment area are approximately 5 km from any point along either one of the corridors. This 5 km "buffer" was selected based on a preliminary review of the geo-referenced catch data which indicated that most of the harvesting activities in the vicinity of both corridors are for scallop.

This species is typically fished by towing the gear along the seabed for a distance of about one nautical mile (Nm). As such, the "buffer" on each side of the corridors captures all of the catch locations which might possibly involve a scallop gear tow over the seabed area on which one of

[2] The homeports considered in the Fisheries Component Study are shown in Figure 3-1 in Appendix 3.

the cables might be located. Catch locations more than 5 km from any point along the corridors would not, in all likelihood, result in a scallop vessel tow across one of the proposed cables.

In this report the term "Gear Assessment Zone" and Study Area are used interchangeably. Gear Assessment Zone appears in the legends on each of the maps, and this term is also be used in the report text where appropriate.

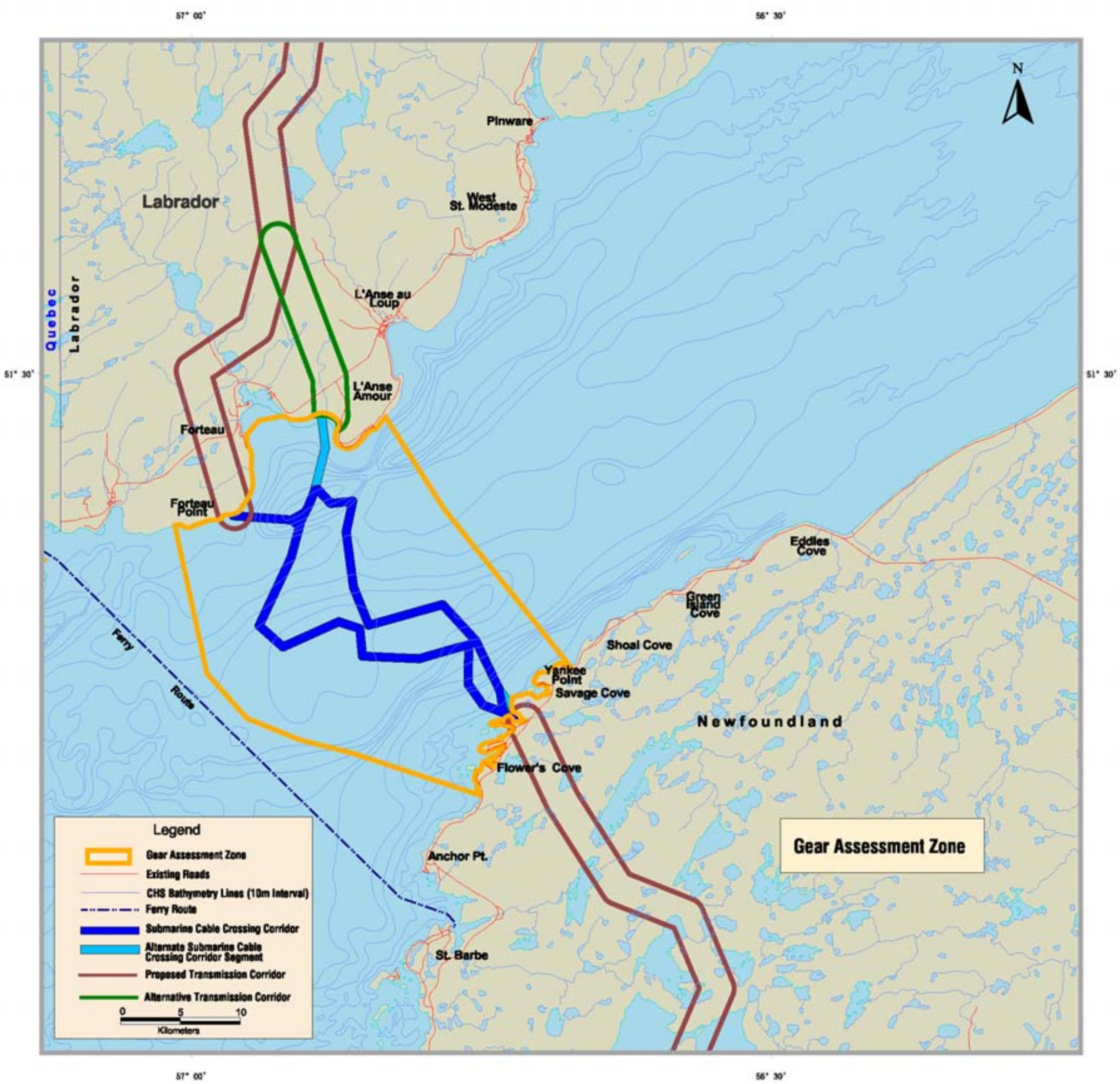

Figure 2. **Study Area (Gear Assessment Zone) Location Map.**

Statistical Data Sources

The statistical information and analysis used in this study are based on time-series data from Fisheries and Oceans Canada (DFO) Newfoundland and Labrador Region - Statistics Division, Policy and Economics Branch, which describe the quantity, month and location by fisheries management Unit Area (UA) of fish harvesting. The datasets also include information on fishing gear, vessels, and other aspects of the fisheries. They were acquired from DFO in digital form, for the period 1999 to 2009, inclusive. The resulting dataset contains 11 years of data which indicate year, month, species, vessel class, gear type, UA of harvest, quantity of harvest, and value[3] of harvest. A portion of this dataset also indicates the specific location of the catch in degrees and minutes of latitude and longitude, where available.

For the homeport analysis presented in the Fisheries Component Study, a special dataset was prepared and provided by DFO Newfoundland and Labrador Region containing harvesting data by fishing enterprises registered in homeports within the general corridor area. Fishers from these ports typically conduct at least part of their harvest within or immediately adjacent to the proposed submarine transmission corridors. Some of these homeport data are used in this report to describe harvesting activities, catch levels and licences associated with study area fishing enterprises. However most of analysis is based on the geo-referenced data from the larger 1999-2009 times-series dataset from DFO.[4]

Consultations with area fisheries in late 2009 also confirmed that fishing activity in this area of the Strait of Belle Isle is undertaken almost exclusively by fishers based in Newfoundland and Labrador, and that most of these catches are made by fishers based in the homeports located on both sides of the Strait adjacent to the transmission corridors.

Consultations

Baseline Report Consultations

In October 2009, Nalcor Energy's fisheries consultants organized meetings with representatives of the fishing industry from both sides of the Strait of Belle Isle. The main purpose of those meetings was to gather additional baseline information on fisheries resources and established fish harvesting activities in the vicinity of the proposed transmission corridors. The meetings also offered an opportunity to provide fishers with more information about the Project, and for fishers to ask questions about or comment on the proposed cable corridors and their potential effects for consideration in the EA. Some of the information obtained from fishers attending the October 2009 meetings is included in this report.

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[3] It should be noted that the value data reflect several other factors than simple resource availability or fishing effort since value differences from year to year may be the result of price changes and external market factors which are affected by international exchange rates. Prices may even vary within the fishing season. Consequently, much of the historical analysis provided in this report involves quantity of harvests (tonnes of fish landed), which is more directly comparable from year to year.

[4] All of the catch data used in the present study (as well as in the baseline analysis) represent fish landings in the Newfoundland and Labrador Region only. An analysis of the Quebec Region and Gulf Region DFO data for recent years (e.g. 2003 and 2004) indicated that less than 10 tonnes (<0.1%) on average of the fish harvested from UA 4Ra is landed in those two regions combined.

2010 Interviews with Fishers and Agency Managers

Consultations for the present study were undertaken with vessel operators involved in scallop and other fishing activities. Some of these fishers attended the meetings in 2009. Other fisheries participants were identified with the assistance of Darrell O'Brien, Fisheries Development Officer, Newfoundland and Labrador Department of Fisheries and Aquaculture (DFA) and Roland Hedderson, Staff Representative for the Fish, Food and Allied Workers (FFAW). Mr. O'Brien also provided current data on scallop and other fisheries in the Study Area. The study team also consulted with Mr. Don Ball, DFO's Area Chief of Resource Management based in Corner Brook. Mr. Ball has an extensive knowledge of scallop resources, species licensing and harvesting activities in the Strait of Belle Isle area.

The operators of eight separate scallop vessels were interviewed via telephone. Each interview took approximately 45 minutes to complete and covered a variety of topics related to their scallop and other fisheries and more detailed questions about the size, capacity and operating parameters of their fishing gear. The Questionnaire used for these interviews with enterprise operators is included as Appendix 2.

Assessment Methodology

The DFO time-series data were queried to identify the total number of geo-referenced catch records (or "hits") falling within the Study Area over the period 1999 to 2009. These data were then examined in more detail to determine the key species harvested and the catch distribution by vessel size, amongst other parameters. The catch data were then plotted to show their locations within the Study Area. Areas of concentrated harvesting activity were identified using a "cell analysis". This Study Area was divided into a series of grids, or "cells", and the number of catch records falling within each grid was calculated. Cells with the highest number of "hits" (i.e., catch records) were considered to be fishing "hot spots". These data were then combined with other information obtained through study research and fisher consultations to determine an order of magnitude value of existing and potential fishing operations and gear utilization in the seabed area where the proposed power cables would be located.

In the discussion and analysis, which follows, the geo-referenced DFO catch records are used as the primary measure of harvesting activity levels.[5] If a particular area contains a relatively large number of catch records, it is assumed that it is a more important, or more frequented, fishing ground compared to another area with fewer records. An individual fisher, or any number of

[5] All fishers operating vessels larger than 34 feet are required to record the geographic coordinates (i.e., the longitude and latitude) of their species catch. They enter this information in their vessel logbooks each day, along with other information about the catch, such as the species caught, vessel size, the gear used, date and weight, among other parameters. This logbook data is then entered into the DFO catch and effort data base and made available to researchers and consultants, et al. These data can then be plotted on maps using GIS technology and presented in various graphic formats, such as the species maps presented in this report.

fishing enterprises, may return to the same area many times during the fishing season and/or from one year to the next. As such, the number of catch records for a particular geographic area will begin to "stack up" over time so that the geo-referenced database will display multiple "hits" (i.e., catch records), many of them having the exact same longitude/latitude coordinates.

As discussed in the section dealing with statistical sources, the DFO catch data also include the weight of the species harvested, and in some cases it might be important to calculate the weight of the product attached to a particular catch record. However, in this assessment, knowing the weight of the raw material, e.g., scallops, harvested at a specific location is of secondary importance. A more important consideration is the fact that a catch record indicates the presence of a fishing gear that poses a significant risk to valuable/sensitive seabed equipment. In the case of the scallop fisheries, especially considering the number of tows a scallop vessel makes each fishing day, the existence of multiple (i.e., stacked) "hits" at a particular location is a very good indicator of harvesting intensity and of the potential risk to which Nalcor's sub-sea equipment might be exposed to in future.

Findings

Study Area Harvesting Locations

Figure 3 shows the harvesting locations of all species within the study area for the period 1999 to 2009, and Figure 4 shows the geo-referenced catch locations for species other than scallop. The data records shown in Figure 4 (a total of 65 "hits", as indicated in Table 1) represent small catches of cod, other groundfish, herring and capelin harvested some time during the past 11 years. These catches were taken using fishing gears such as handlines, longlines, purse seines and gillnets. With the possible exception of purse seines, none of these fixed fishing gears pose a threat to Nalcor Energy's proposed seabed facilities. The DFO data have no records of catches by other potentially problematic gears such as otter/shrimp trawls.

Principal Species Fishery in the Gear Assessment Zone (GAZ)

Analysis of the DFO catch data clearly demonstrate that scallop has been the dominant fishery in the GAZ for the past 11 years, as shown in Table 1. On average, this species represents almost 84% of the geo-referenced catch records in the study period. In some years, this species has accounted for all the catch records.[6]

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[6] Other species, e.g., cod, halibut and capelin are harvested in the Study Area, and are recorded in DFO's catch and effort database as a geo-referenced data record. However some species, e.g., lumpfish, herring, harvested in the area are not part of the geo-referenced dataset because they are caught by fishers using vessels < 34 feet who are not required to record longitude/latitude coordinates of those catches.

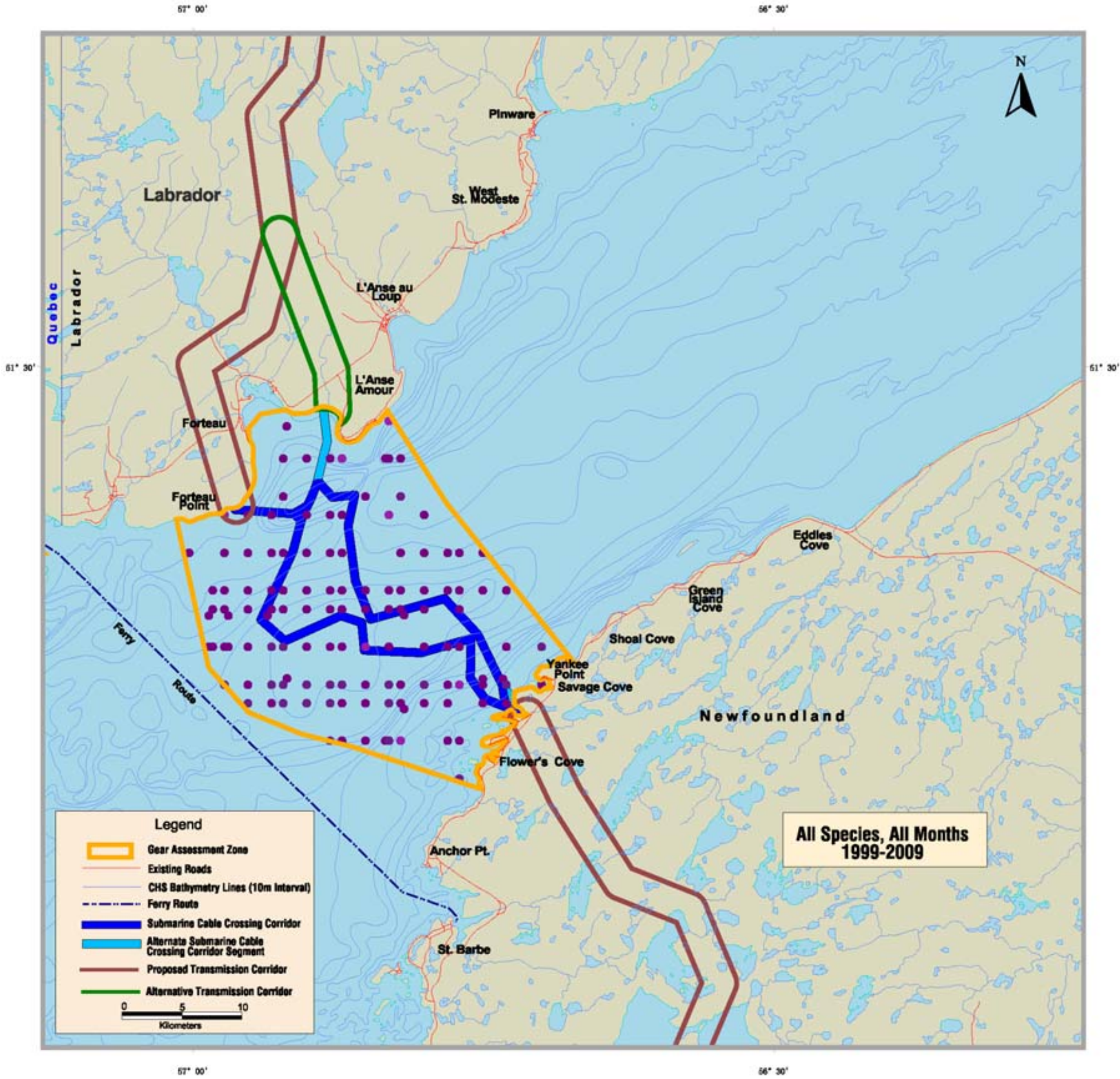

Figure 3. Study Area Catch Locations 1999-2009, All Species.

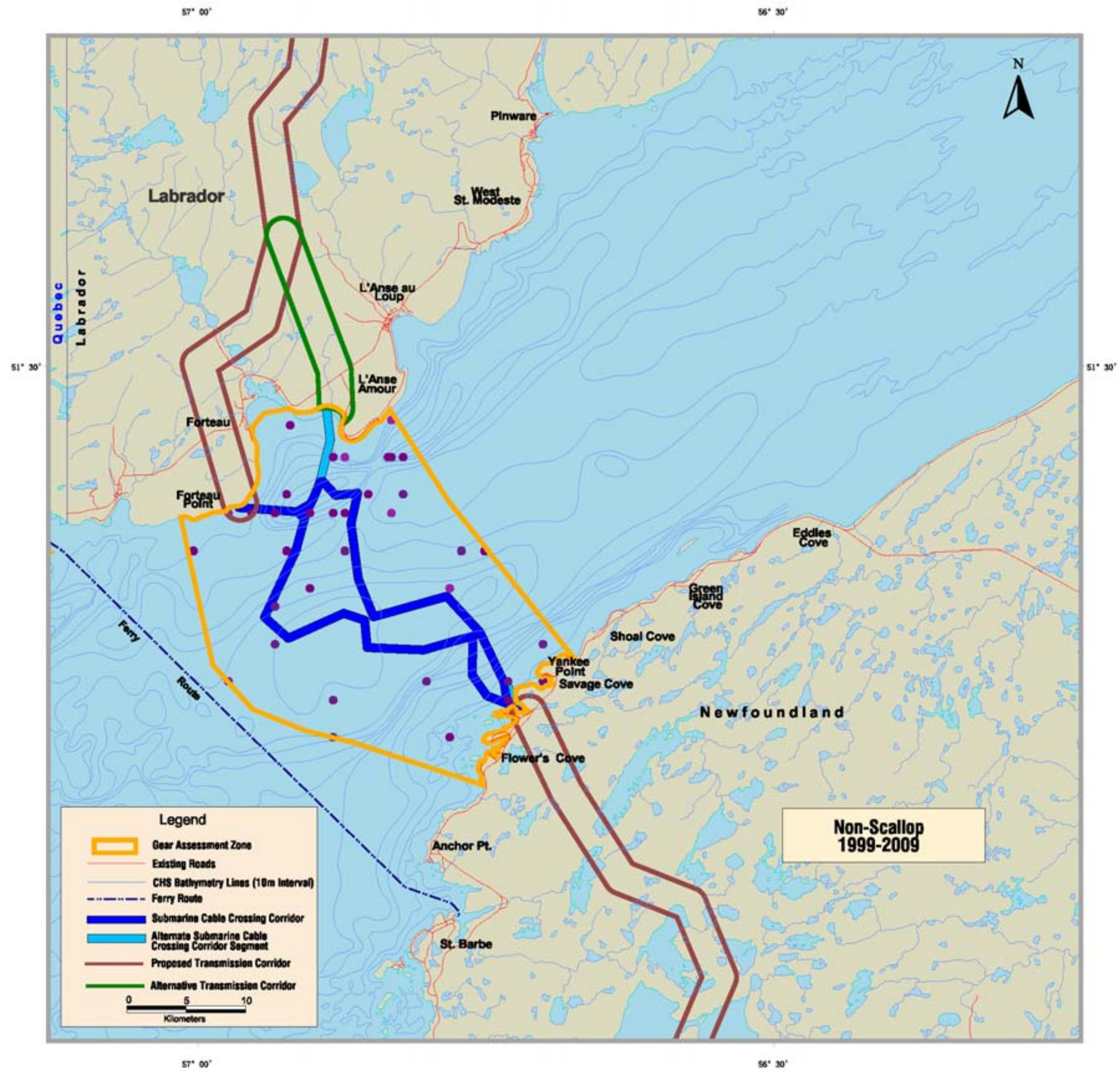

Figure 4. Study Area Catch Locations 1999-2009, All Species Except Scallop.

Table 1. Distribution of Species Catch Records in the Gear Assessment Zone (GAZ) and Unit Area 4Ra by Year, 1999 to 2009.

Year	Scallop Records	All-Species Records	% Scallop Records in GAZ	Scallop Records in UA 4Ra	% 4Ra Scallop Records in GAZ
2009	135	135	100	182	74
2008	13	18	72	39	33
2007	9	25	36	77	12
2006	33	46	72	174	19
2005	8	11	73	45	18
2004	0	2	0	0	0
2003	7	7	100	75	9
2002	4	6	67	129	3
2001	6	7	85	196	3
2000	86	105	82	1284	7
1999	28	32	88	495	6
Total	329	394	84	2696	17

Concentration and Distribution of Scallop Harvesting Locations in the GAZ

Figure 5 shows the distribution of the scallop catch records within the Study Area. For this analysis, the GAZ was divided into 133 cells. The number appearing in each cell of Figure 5 represents the frequency of scallop records within that cell.

Each cell is 1.4 km by 2.3 km and thus represents a surface (or seabed) area of about 3.2 square kilometres.[7] For the purpose of discussion, each cell has been assigned a reference number from 1 to 133 as shown in Figure A3.2, Appendix 3.

If the frequency of catch records in each cell is used to measure fishing intensity, then Figure 5 indicates the location of several scallop fishing "hotspots" within the GAZ. These are as follows:

1. Cells # 67, 83 and 99 have 16, 17 and 15 "hits" respectively. Of these cells, the western corridor passes through Cell # 67 with 16 catch records.
2. The western corridor towards the Newfoundland side is another intensely fished scallop area, falling within Cells # 104 and 105, each of which has 11 catch records.
3. In the middle of the Strait, the eastern corridor passes through another fishing "hotspot" encompassed by Cells # 69, 70 and 71, with cell frequencies of 13, 13 and 10, respectively.

Further examination of the catch frequency data in Figure 5 shows that many of the GAZ cells have no catch records. This is particularly the case for the cells located north of a line drawn east-west across the Strait from a point just below Green Island Cove. This portion of the Study Area has very low, or zero, catch record frequencies because it was a designated scallop

[7] Some of these cells extend beyond the Study Area because they contain one or more catch records that fall within this zone, either very close to, or on top of, one of the GAZ boundary lines (shown in yellow).

“Refugium” for about eight years starting in 2001.[8] DFO closed the area to scallop fishing as a conservation measure; it was re-opened to scallop fishers just before the start of the 2009 fishing season (Appendix 3, Figure A3.3).

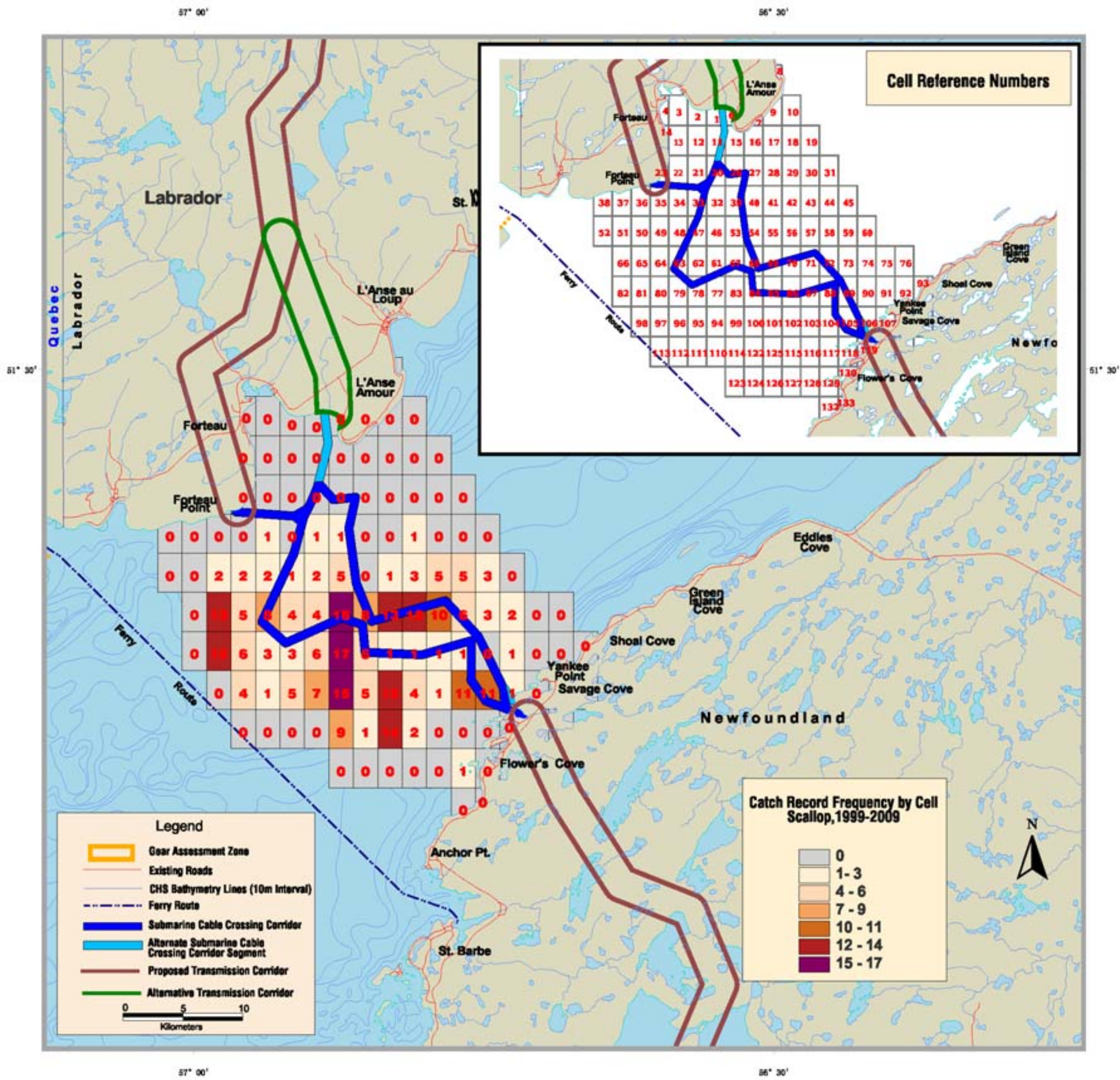

Figure 5. **Scallop Catch Record Frequency by Cell, 1999-2009.**

Scallop Catches by Vessel Size

Table 2 shows the distribution of scallop catch records by vessel size class. Vessels less than 44 feet in length have generated most (82%) of the harvesting activities (Table 2). In recent years, 2007 to 2009, vessels in the 35 to 44 foot class have dominated this fishery accounting for about 64% of the catch records.

[8] The location of the Scallop Refugium in relation to the Study Area and the cell frequency grid is shown in Appendix 3 as Figure A3.3.

Table 2. Distribution of 1999-2009 Scallop Catch Records in GAZ by Vessel Class.

Year	Class 1-34ft	Class 35-44ft	Class 45-54ft	Class 55-64ft
2009	30	84	13	8
2008	2	11	0	0
2007	3	5	1	0
2006	3	13	17	0
2005	8	0	0	0
2004	0	0	0	0
2003	1	6	0	0
2002	4	0	0	0
2001	6	0	0	0
2000	60	14	12	0
1999	12	7	9	0
Total	129	140	52	8
% of Total	39%	43%	16%	2%

Number of Scallop Enterprises and Active Licences

Fishers based in Study Area homeports hold a total of 56 scallop licences. Twelve licenced scallop enterprises are based on the Labrador side, and there are 44 licence holders on the Newfoundland side. The scallop fleet includes 35 vessels > 40 feet and 21 vessels < 40 feet. For a variety of reasons (primarily market related) only a small number of licence holders have been involved in this fishery during the past several years. Fisher representatives report that, currently (August 2010) only 12 vessels are actively fishing this species; 10 on the Newfoundland side and two on the Labrador side. DFO managers confirmed this information noting that only 12 scallop licence holders participated in the 2009 fishery.

Data on Scallop Gear Utilization and Harvesting Operations

This section presents the information obtained via the telephone interviews with each fishing enterprise, and supplemented with additional related information and observations from agency and industry managers (DFO, DFA and FFAW). Table 3 provides a summary of relevant key operating parameters and factors, and the following section – Other Comments – summarizes more general comments and qualitative information from fishers and agency managers in response to topics addressed in the Questionnaire.

Table 3. Description of Scallop Enterprise Fishing Gear and Operating Parameters.

Operating Parameter	Ent # 1	Ent # 2	Ent #3	Ent #4	Ent # 5	Ent # 6	Ent # 7 and # 8*
Vessel Length (ft)	42	63	45	45	38	34' 11"	58 and 45
Engine Size and Type	335 hp GM	500 hp Cummings CT1150	400 hp Cat.	365 hp Volvo	300 hp Cummings	300 hp Cummings	58-ft vessel: 400 hp Cummings; 45-ft vessel: 230 hp GM
Rake Length Overall (ft)	10	12	11	10	9	9	10
Estimated Rake Weight Empty (lbs)	2,200-2,500	3,000-3,500	800-1,000	1,500-2,000	2,000	2,000	1,500-1,800
Estimated Rake Weight Loaded (lbs)	3,400-3,700	5,000 + (if rocks are incl.)	1,100-1,300 (scallop only, no rocks)	approx. 2,200 (more if rocks are also raked up)	4,000 (incl. rocks and scallops)	3,000-4,000	2,500-2800
Cable size (in.)	1/2 or 9/16	9/16	5/8	1/2 or 9/16	1/2	1/2	9/16
Warp to depth ratio (or usual cable length)	3:1	3:1	uses about 120 fath. of cable	uses about 175 fath. of cable	3:1	usually has 100-125 fath. of cable out	3:1 (usually 150 fath. of cable deployed)
Winch type/model	"Howbolt"	"Howbolt"	not available	"PL 5" (5,000lb cap.)	"Howbolt" 1426"	"PullMaster PL4"	"Howbolt"
Shackles/Swivel Size (in.)	1	5/8 – 3/4 for shackle at the end of the cable	5/8 for chain shackle and 1 for shackle at cable end	1/2 and 5/8	5/8 for chains and 1.25 on ring attch. to cable	Uses two ¾" shackles at end of cable; and swivel is attch. to tow bar with two 1" shackles	1 - 1.25 in. shackle attached to swivel, and four 5/8" shackles attach. to the tow bar ring
Tow speed (knots)	3.5-3.7	2.5-3.0	3.5-3.8	3.8-4.0	4.2	4.0	58-ft vessel: 4.7-4.8 45-ft vessel: 4.1-4.2
Tow length (Nm)	1	0.6	1	1	1.1 – 1.4	1.3-1.5	1-1.5
Tow duration (min.)	15	10-12	12-15	12-15	15-20	20	15-20
Usual Tow Direction	E to W and NE to SW	al directions	E to W and NE to SW	usually E-W	all directions	all directions but usually E-W	all directions
Average No. Tows/day	30	35-50	at least 20-25	25	25-30	25-30	30-35
Water Depths (fath.)	20-60	35-45	30-50	35	28 - 60	30-40	35-45
No. Fishing days / week	6	6	6	6	3-5	4-5	4-5
Operating Season	May-Oct.	May-Sept.	May-Oct.	May-Sept.	Late June to mid-Oct.	May-end of Sept.	May-Oct.

Note: * Enterprise # 7 and Enterprise # 8 are separate scallop dragging operations, but both of these licenced vessels are owned by the same person. The data in this column apply to both vessels except where noted.

Other Comments

Other comments and qualitative information obtained from fishers during the course of the interviews are discussed below under various headings:

Scallop gear. All of the fishers interviewed used the same basic gear - generally referred to as the "Labrador (scallop) Rake" - and they reported that this was the standard gear used throughout the Strait. This equipment is made/assembled locally using a variety of readily available materials, such as chains, shackles, flat steel bar, rubber matting and heavy netting. (Three views of a typical Labrador Scallop Rake are presented in Appendix 4.)

This gear - described in more detail in the next section - consists of two, and sometimes three, buckets linked together and affixed to a heavy "tow bar" via a number of chains and shackles. The buckets are attached to the tow bar with heavy chains linked together at a heavy shackle (e.g., 1 inch), or ring. This ring is then attached to the vessel via another shackle which has been spliced onto the end of the cable. Most fishers also use a heavy-duty swivel attached to the tow bar which helps keep the gear aligned with the warp as it is towed across the seabed.[9]

As noted, most fishers prefer to use a number of buckets - either two or three - attached in tandem, versus one long bucket; this makes it easier to unload the gear when it is hauled on board. Thus, if a fisher is using a 10 foot rake, it would consist of two five-foot buckets; if it is a 9 foot rake, he would use two 4.5 foot buckets, and so on. The overall length of a scallop rake is limited to a maximum of 13 feet by DFO.

The weight of an individual Labrador Scallop Rake will vary depending on the number and size of buckets being used and the thickness of the tow bar and the shackles. Fishers noted that the tow bar alone comprises a significant portion of the overall weight of the gear; one fisher noted his tow bar weighed about 1,000 lbs. Based on the interview data, when empty, scallop gear currently used in the Study Area will range in weight from 800-1,000 lbs to 3,000-3,500 lbs.

Loaded/towing weight. Most fishers report that considerable quantities of rock, gravel, bottom debris, etc., accumulate in the net end of the gear as it is being dragged along the seabed. This material accounts for most of the extra weight of the gear when it is hauled at the end of each tow. One fisher noted his rake weighs about 2,000 lbs when empty but often 4,000 lbs when hauled, with the catch often comprising as little as 150 lbs of the "fully-loaded" gear weight.

Cable breakage, snagging and lost gear. Fishers report very few cases where their warp snapped when the gear got snagged on the bottom, even in cases where a ½ inch cable was being used. In cases where a cable did break, it was primarily because it was old and/or worn out. There were

[9] These swivels are readily available from most local fishing gear supply outlets, e.g., IMP Group Ltd., Mercer's Marine Equipment Ltd.

other cases where gear was lost because the shackles attached to the end of the cable broke; the fisher in question resolved this problem by using stronger (i.e., heavier) shackles. Another case was mentioned in which the gear could not be hauled because the winch broke under the strain.

In all cases where fishers reported snagging their gear, there were no reports of the cable snapping as the operator attempted to disentangle the gear by continuing to steam ahead, usually at a higher throttle level. They noted that what usually happens when the gear becomes snagged is that the vessel will start to slow down and shortly come to a halt as any slack in the warp is taken up. The skipper will then take the vessel out of gear, or put it in reverse, and proceed to pull up the cable using his winch. As the cable is shortened - thereby decreasing the warp to depth ratio, the gear usually comes free from the bottom. There were reports of gear being lost and not recovered, but in all cases this was due to a failure of the shackle spliced into the end of the cable and attached to the ring joining the chains going back to the tow bar.

Recording of scallop catch locations. As discussed above (see Footnote 5, Assessment Methodology), all fishers operating larger (> 34 feet) are required to record the longitude/latitude coordinates of their catches in their logbooks. In the case of fixed gear, e.g. a string of crab pots, the operator will identify and record the longitude/latitude position of the catch when the gear is hauled onto the vessel. At the same time, he will usually record the quantity of the catch harvested at that same location. As such, subsequent users of the DFO geo-referenced catch data will be able to look at an individual catch record and conclude that a certain weight of a species catch was harvested from a seabed area located at a specific set of coordinates.

Using GIS technology, researchers can then plot geo-referenced data points on maps and proceed to make some observations about the location, timing, and intensity of fish harvesting activities within a particular marine area, for example the GAZ considered in this report.

Scallop fishers use a variety of procedures to record their catch locations, as discussed with vessel operators during the interviews. The procedure differs from the one described above used by other (e.g., fixed-gear) fishers, and this fact is of some relevance to the assessment of potential impacts on the proposed power cables across the Strait, as briefly explained below.

As Table 3 suggests scallop vessels usually aim to complete an average of 25 to 35 tows per day in order to obtain their desired daily catch levels. The general practice is for the vessel to deploy its gear as soon as it has reached a known/potential scallop ground. If the ground yields a good catch from the first tow, the vessel will deploy the gear and tow it back over the exact same route. The operator may make 10 to12 similar tows, or more, as long as the yield from each haul is adequate. Or, he may shift his tow line 20 to 30 m to the side of the first set of tow lines and then proceed to tow over that ground for the rest of the day. Or, after completing 10 tows along a line, he may decide to move to another fishing area a kilometre or two away.

Regardless of how many tows he may complete in any one day, or the distance between one set of tows completed in the morning and another later in the afternoon on a different ground, the standard logbook entry practice of all Study Area fishers is to record ***only two*** sets of coordinates for the entire day's fishing. In other words, a fisher's logbook will show only two geo-referenced data records, despite the fact that his scallop catches were actually harvested (i.e., hauled out of the water) at the end points of as many as 30 to 50 tow lines.

As such, when one plots these geo-referenced logbook catch data, it appears that the vessel harvested scallops at just two points on the ocean during the course of a single day. In actual fact, this vessel could well have been operating in and around a very much larger marine area, perhaps covering an area of 7-8 square Nm.

Another potential "data distortion" related to these catch location recording procedures could arise if the DFO data contain a number of catch records "stacked" on top of one another, i.e. catch records with the exact same geo-referenced data point. But, in this case, we would get the inverse of the above-noted discrepancy. For example, if there were ten catch records stacked up at a location with the same longitude/latitude coordinates, one might reasonably conclude that there were only ten hauls of raw material made at that location. In actual fact, each of those data points could represent the activities of ten different operators, each of whom ended 20 (or even 30) of their tows at the same geographic end point. In other words, those ten scallop catch records could conceivably represent harvesting activities associated with 200 to 300 scallop tows; i.e., 10 different fishers each of whom ended 20 of their tows at that particular point but were only required to enter one catch record and associated longitude/latitude coordinates in their logbook for those 20 tows.

In actual practice, as fishers reported in the interviews, most operators will attempt to fish the entire day on the same tow line. In other words, they will only move to another location if the catches on that line start to drop off. Many fishers noted that they quite often strike a good scallop ground and stay in that same location the entire day. In such cases, the two logbook entries - one in the morning and one at the end of the day – are an accurate record of the fishing ground utilized that particular day.

Direction of tows. Though some fishers report towing their gear in all directions, most of the tows are made from NE to SW or E to W, and vice versa. Fishers report that the tow direction is heavily influenced by the tides and wind conditions found in the Strait.

Number of fishing days per week. The number of days fished per week ranges from three to six days; on average, about 5.2 days a week for the eight scallop enterprises consulted for this report. Fishers noted that, in reality, the number of days they are able to fish is very dependent on the weather. DFO has also imposed a weekly catch limit, or quota, which in some cases may restrict the number of operating days per week for a scallop vessel. If a vessel catches more than 18,872 lbs of shell-on scallops (equal to about 2,700 lbs of meat) in any one week, it must cease fishing for that week. The fisher cannot resume harvesting until the start of the next quota week. Fishers report that, given resource conditions in the SOBI, it would be rare for any vessel to reach its weekly catch limit.

Current and potential/future activity levels. At present, only 12 of the 56 licence holders are actively involved in the Study Area scallop fishery. This low level of participation is due primarily to low product prices and unfavourable market conditions in the past several years. However fishers also note that scallop dragging is very difficult work and is also hard on the vessel and the equipment. Nevertheless, fishers report that they will continue to maintain their scallop licences because this species is something of a “safety net”, i.e., an alternative they can pursue if they need to “top up” their annual income if required. As such, the number of enterprises involved in future years could increase significantly if product markets and prices improved, or if there is a turndown in other species fisheries.

DESCRIPTION AND ANALYSIS OF POTENTIAL PHYSICAL IMPACTS OF SCALLOP GEAR

Scallop Dredge/Rake Harvesting Operations

Icelandic scallops are harvested in the Strait of Belle Isle between Southern Labrador and the Northern Peninsula. Because they are bottom dwellers, they are harvested by dragging the gear - dredges, or rakes - over the seabed. The gear type and method have remained relatively unchanged for many years. The most commonly used gear is the modified Labrador rake (see Figure 6). It has a heavy, rectangular steel mouth and weighs about three tonnes when full. The front section is fitted with a diving plate on top and a cutter bar along the bottom, and consists of netting, rings, and rubber circles that make up the collector bag. A cutting bar is located at the front of the rake, and the mouth may be fitted with rock chains/bars to keep large rocks from entering the rake and netting. Behind this opening are steel links that attach to the collector bag. The bag is then connected to a sweep chain on the bottom terminating in a dump bar.

Modified Labrador rakes are usually towed at speeds of between 2.0 - 4.0 knots with most scallop tows (or sets) lasting approximately 15 to 20 minutes. The rakes are fished in water depths between 120 and 360 ft and use a 3 to 1 warp to depth ratio (e.g. 30 feet of warp to every 10 feet of water depth). Scallop fishers usually complete approximately 30 to 50 tows per day and each tow covers 0.5 to 1.5 nautical miles (speed dependent).



Figure 6. Typical Modified Labrador Scallop Rake used in the Strait of Belle Isle.

A large modified Labrador rake does not normally exceed 12 feet in width; this is the largest possible size that can be used safely onboard a smaller vessel. Most rakes range between 4 – 10 feet in width. Inshore scallop fisheries such as Bay, Calico and Icelandic scallops can be caught with smaller versions of the Labrador rake. This means that, in many areas, the width of the gear will vary. Depending on their vessel characteristics, harvesters will fish one or two rakes in a line attached to a tow bar. The Labrador rake and Digby bucket can be attached to a bar in succession to make up a large dredge (see Figure 7). This type of rigging is used in the Eastern Canadian and U.S fisheries. The size of rake used depends on vessel size, type of bottom and species harvested.

Labrador rakes used in the Strait of Belle Isle weigh approximately between 800 and 3,000 lbs depending on vessel size and on the number of rakes fished in tandem. The gear is attached to the vessel by a warp and attached to a winch with a 3,000 – 8,000 lb capacity range. The winch lowers and raises the dredge before and after fishing.

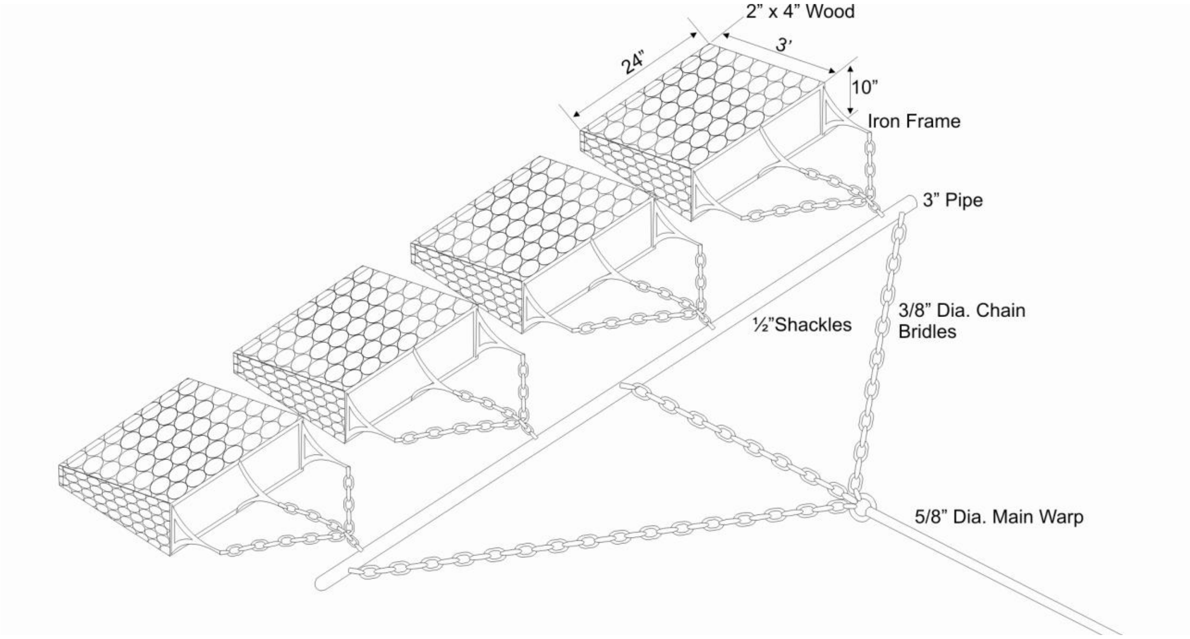

Figure 7. Typical Scallop Dredge (with four rakes attached in tandem).

The warp has a fibre core insert and typically consists of 6 strands with 19 wires in each strand (see Figure 8). Warp diameters range from ½ inch to $^{9}/_{16}$ inch. The warps are attached to the rakes using chain, a swivel and ½ to ¾ inch hammerlocks. Table 4 shows the recommended loads and minimum breaking strengths of warps typically utilized in the scallop fisheries.

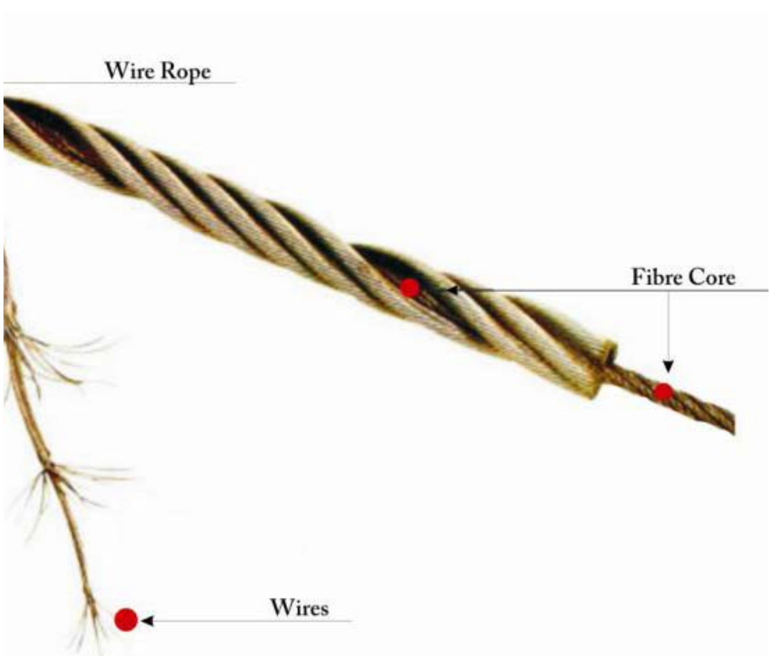

Figure 8. Components of the Wire Rope used in Labrador Scallop Rake Towing Warps.

Table 4. Minimum Breaking Strength of Wire Rope Diameters used in the SOBI Scallop Fisheries.

Warp Diameter		Minimum Breaking Strength		Weight	
(in)	*(mm)*	*(lb)*	*(kg)*	*(lb/ft)*	*(kg/m)*
1/4	6.4	5480	2440	0.11	0.16
5/16	8	8520	3790	0.16	0.24
3/8	9.5	12200	5430	0.24	0.36
7/16	11.5	16540	7360	0.32	0.48
1/2	13	21400	9520	0.42	0.63
9/16	14.5	27000	12000	0.53	0.79
5/8	16	33400	14900	0.66	0.98
3/4	19	47600	21200	0.95	1.41
7/8	22	64400	28600	1.29	1.92
1	26	83600	37200	1.68	2.50

Forces Generated by Labrador Rake Scallop Gear

Forces generated by dredges/rakes can potentially cause damage to sub-sea cables. These forces are different than drag forces produced during harvesting operations and are usually a result of the fishing gear coming in contact with, or snagging, obstacles on the seafloor during dragging operations.

Horizontal Impact: This is the initial impact loading when a part of the fishing gear (i.e. the rake) makes contact with some part of a sub-sea structure/installation. This force is instantaneous - lasting less than a second - and usually causes damage at the point of impact. The loads are a transfer of energy from the fishing gear component to the sub-sea structure and are calculated as follows:

$$E = \frac{1}{2} m_t V^2$$

Where: E = Impact energy (kilojoules kJ)
m_t = steel mass of dredge/rake (kilograms kg)
V = effective impact velocity (metres per second m/s)

The following Table 5 shows the approximate impact forces generated by the towing of various size study area scallop rakes at typical vessel speeds.

Table 5. Impact Energy Generated by Towing Different Size Scallop Gear at Typical Speeds.

Size of Rake	Approximate Gear Weight (kg)	Typical Speeds Knots / m/s		Impact energy KJ
8 feet	700	3.7	1.90	1.27
9 feet	905	4.2	2.16	2.11
10 feet	1045	3.5	1.8	1.69
12 feet	1500	2.8	1.44	1.55

Horizontal Snag: This occurs when part or all of the fishing gear becomes caught or tangled in the sub-sea structures. If this situation occurs, a large force equal to the breaking strength of the fishing component snagged or the sub-sea structure will be experienced. If the gear becomes fastened to a sub-sea structure, the loads/forces will depend on the breaking strength of the component snagged (i.e. trawl warp) and the bollard pull of the vessel (Table 6).

Table 6. Typical Snag Loads that could be Generated Based on Size of Study Area Scallop Vessels.

Vessel Type	Warp Diameter Mm/inches		Warp Max Breaking Load tonnes
45 ft Scallop dragger	13	½	9.45
65 ft Scallop dragger	14.5	$^{9}/_{16}$	12.2

Summary Assessment

Scallop dredges/rakes present a potential and significant threat to proposed study area power corridor installations. Dredges can dig 1 to 10 inches into the seabed depending on bottom types and thus have the potential to get snagged in equipment lying on the seafloor.

As such, in order to protect the equipment and to prevent/minimize any snagging of fishing gear, forces exerted by dredges should be considered in the design of cables and in the application of associated protection philosophies and methodologies.

CONCLUSIONS

1. ***Risk from scallop fishing gear***. Scallop gear poses the primary, and most significant, potential threat to the proposed power cable installations. This fishery utilizes a very heavy mobile gear which is dragged/towed along the seabed. Contacts between scallop rakes (even the smaller, lighter ones) and a sub-sea power cable have the potential to damage this equipment.

2. ***Potential impacts from other species harvesting operations.*** Although scallop harvesting operations have dominated Study Area fishing activities during the past decade or so, other species have been caught, and other potentially problematic gears have been utilized, in this zone. However, based on data analysis and consultations with industry participants and agency managers, future fishing activities associated with these species and gear types are not expected to present a significant problem for the cable crossing installations. In the past, otter trawls have harvested cod and other groundfish in the Study Area. However, there has not been a directed otter trawl cod fishery since a moratorium on the harvesting of this species was imposed almost two decades ago. Fishers and agency managers agree that such a fishery is very unlikely to resume in the future. Purse seines have some potential to become entangled with seabed equipment such as cables. However, within the Study Area, this gear has only been utilized on an occasional basis during the past 11 years; the DFO data show just 9 catch records (herring and capelin) since 1999, and none at all since 2006.

3. ***Potential interactions with other fisheries-related activities***. Both the FFAW and DFO conduct regular annual research surveys in the Strait of Belle Isle region. These are stratified random sample surveys that take place in designated research stations, some of which are probably located in the Study Area. The FFAW mobile gear sentinel survey takes place over a two-day period each July and the DFO Research Vessel survey occurs in August. These surveys are conducted with mobile fishing gears (essentially modified otter trawls) and, as such, might present a problem if they were to come in contact with a sea-bed power cable. The mobile sentinel research data, and a map showing the research stations from the 2009 survey, are displayed at the following DFO web-site: http://ogsl.ca/en/sentinel/data/mobile.html. A scan of the site data indicates that only one of the annual stratified random research stations from the 2009 survey fell within the study area. See Appendix 3, Figure A3.5.

4. ***Future importance of the Study Area as a scallop fishing zone in the SOBI region.*** Based on recent catch trends and industry consultations, the Study Area will continue to be an important scallop fishing zone within the larger region (see Figure A3.4). As Table 1 indicates, the GAZ has become an increasingly more important component of the overall 4Ra scallop fishery in the last few years; since 2006, the GAZ has accounted for 40% of the total number of catch records in UA 4Ra, and in 2009 catches in the Study Area accounted for almost 75% of the overall total in 4Ra as a whole. This situation is likely to prevail over the next several years.

5. ***Changes expected in the future distribution of scallop catch locations within the Study Area.*** The distribution pattern of catch locations within the Study Area as depicted in Figure 3 and Figure 5 will gradually change over the next few years as fishers continue to re-occupy and re-use former scallop grounds that were closed via the Refugium during the eight year period 2001-2008. In other words, the distribution of scallop catches illustrated in Figure 5 is somewhat skewed, because fishers were excluded from the Refugium and thus

concentrated more of their harvesting effort on grounds to the south of the Refugium. As conditions gradually return to "normal", one may expect to see a more "evenly" spread pattern of harvesting effort over more of the cells shown in Figure 5.

6. ***Possible closure of the entire Study Area to scallop harvesting.*** Fishers and FFAW representatives stated that they would rather not see the entire Study Area being closed to scallop fishing operations in the future as the only way to avoid potential negative interactions between scallop rakes and power cables on the sea bed. Scallop fishers noted that they could likely manage to "work around" and could easily avoid any power cables if these seabed installations were clearly marked on the relevant marine chart. Their preference, however, would be to have this equipment buried or covered.

7. ***Current (2009) levels of gear utilization***. One of the study objectives was to quantify existing and future/potential levels of gear utilization, or fishing intensity levels, in order to consider what the impacts of harvesting operations on sea-bed equipment might be. Nalcor Energy asked the consultants to estimate "order of magnitude values of gear usage" within the Study Area. Given the information and analysis presented above, the number of scallop towing operations per year is considered to be an appropriate measure of fishing intensity levels.

   As such, the current (2009) level of fishing intensity in the Study Area may be calculated using the following operational parameters and assumptions, based on information obtained during consultations:

   <u>Operational Parameters (based on data from eight enterprises)</u>

   1. Number of scallop enterprises actively fishing: 12
   2. Number of scallop licence holders: 56
   3. Number of scallop catch records in the GAZ: 135
   4. Number of scallop catch logbook entries per day: 2
   5. Average number of scallop harvesting tows per day: 30
   6. Average length of one tow: 1.1 Nm

   <u>Assumptions</u>

   1. Number of tows associated with each catch record logbook entry: 15

   <u>Calculation of 2009 "Fishing Intensity"</u>

   Each of the 135 catch records represents 15 tows of a scallop rake. As such, the total number of scallop tows in the GAZ in 2009 was 135 x 15 = 2,025. Since each tow is, on average, 1.1 Nm long, these scallop harvesting operations generated about 2,228 Nm of towing activity.

(As discussed earlier, the distribution of these towing activities within the Study Area over the past 11 years is shown in Figure 5.)

The concentration of fishing intensity at any particular portion of the GAZ, and/or along a specific portion of the proposed cable crossing corridors, can be roughly estimated by looking at the number of catch records in each of the cells shown in Figure 5, as long as one remembers that these data are for an 11-year period. Cell # 67 (see Figure A3.2), for example, shows 16 catch records for the 11 years, or about 1.5 records per year. As such, the average annual level of fishing intensity within Cell # 67 is calculated at about 23 tows (1.5 catch records times 15 tows per record. Based on our assumptions, it is reasonable to conclude that a scallop vessel would be towing a scallop rake back and forth over this part of the cable corridor about 23 times a year.

8. Future levels of gear utilization

Future/anticipated levels of fishing intensity may be calculated using the same operational parameters described above and several alternate assumptions scenarios about future scallop harvesting activities in the area. A variety of "fishing intensity" scenarios can be articulated depending on what assumptions are used.

Scenario Assumptions

1. The GAZ will continue to be an important scallop fishing area.
2. Harvesting activities in the GAZ will continue to increase as scallop fishers continue to seek out and exploit re-opened grounds in the Refugium portion of the Study Area. As such, annual harvesting levels will be more similar to those that occurred in the non-Refugium years (1999, 2000 and 2009) than to those that occurred during the period 2001 to 2008.
3. Any significant improvement in market conditions or product prices would encourage more licence holders to resume their scallop fisheries.
4. There will not be any significant changes in scallop fishing practices or in the type and size of mobile scallop gear currently in use.
5. Resource/stock conditions and DFO management policy will remain unchanged.

"Fishing Intensity" 2015 (Sample Scenario)

Scallop markets increase and product prices improve significantly. As a result, the number of licence holders actively involved in harvesting scallop resources is double the current (2009) level. The total number of scallop tows in the GAZ increases to an annual level of about 4,050 scallop towing operations.

APPENDIX 1. PERSONS CONSULTED

The following persons were consulted during the study research process.

Fishers - Labrador Side

Marcel O'Brien, L'Anse au Loup
Kevin Normore, L'Anse au Loup
Garry Saulter, Forteau
George Saulter, Forteau
Dorman Fowler, L'Anse au Loup
Hollis Fowler, Capstan Island

Fishers - Newfoundland Side

Jarvis Walsh, Flower's Cove
Edmund Moores, Flower's Cove
Seaward Dredge, Black Duck Cove

Other Agencies and Organizations

Darrell O'Brien, Fisheries Development Officer, Department of Fisheries and Aquaculture, L'Anse au Loup
Roland Hedderson, FFAW Staff Representative (Union agent for the SOBI area prior to 2010), Clarenville
Jason Spingle, current FFAW Staff Representative for the SOBI area, Corner Brook
Don Ball, Area Chief of Resource Management, DFO Corner Brook

APPENDIX 2. SOBI FISHING GEAR ASSESSMENT QUESTIONNAIRE

Name of Fisher and homeport:

Gear Used – Scallop Drag/Rake:

1. Vessel
- Type/size vessel used:
- Vessel weight (tonnes):
- Engine type, size/capacity (hp)
- What is the typical size vessel involved in the area's scallop fishery?
- Do you expect to see any change over time in the size of vessels being used?

2. Scallop gear description
- Type/name, model number/supplier name (if known)
- Dimensions
- General description of the gear;
- Weight (kgs) when empty;
- Weight (kgs) when full;

3. Towing equipment
- cable size, type (e.g. 5/8" steel);
- no. of cables used;
- cable length (from boat to gear) i.e., the "warp to depth ratio"
- winch used – capacity, type and model number;

4. Equipment (winch/cable) breaking strength
- what is the usual practice regarding hauling the gear? Is it hauled when you think it is fully loaded, i.e., when a specific tug/load weight is felt? Or is the gear hauled after one tow is completed? Or is the tow based on a certain time that the rake has been on the bottom, i.e. fishing?
- what is the cable breaking load? (Have you ever had a cable snap? If so, what weight was on the cable?
- What is the breaking point (i.e., the "maximum load limiter setting") of the winch?
- What size (dimension) shackles do you use to attach the wire (cable) to the rake?

5. Operational parameters
- normal water depths in scallop fishing areas
- what bottom type is fished
- operating speed (usual towing speed)
- typical length of each tow (or do they vary depending on bottom, resource conditions?)

- what is the usual direction of your scallop tows (e.g., NE to SW, or E to W, depends on other factors, i.e., the direction of the tides)?
- how long does one tow usually last, or take to complete?
- Average number of tows per trip/day, or per fully loaded vessel. i.e., do you fish until you have enough raw material on board, or when a certain number of tows are completed?
- How many days per week, month or season do you usually operate?
- How long does the scallop season generally last?

6. Recording the position of the catch

- How or when do you record the location (long/lat) of your catch when you haul the rake on board? Do you record the location at the start of the tow, or at the end of the tow?
- Do you sometimes tow one way and then -- maybe because there is not enough scallop to haul the rake on board -- turn the boat around and tow back over the same ground and – only then, at the end of the 2^{nd} tow - record your catch location?

7. Other parameters or data

- Of the total number (SOBI Area = # licences) of scallop licences held by fishers, how many are presently active (or have been active in the past several years)?
- Where do you usually fish your scallop (long/lats, distance from shore, etc.) Do you usually fish in the same general area each year, and during the season
- Did you once fish in the closed area or in the seabed area where the proposed cable crossing is planned? If not, will you be fishing more in the Refugium area now that it is re-opened?
- Do you expect to see any change over time in the number of fishers/vessels involved in this fishery?

APPENDIX 3. SUPPORTING/ADDITIONAL INFORMATION

Figure A3.1 shows the homeports considered in the Fisheries Component Study.

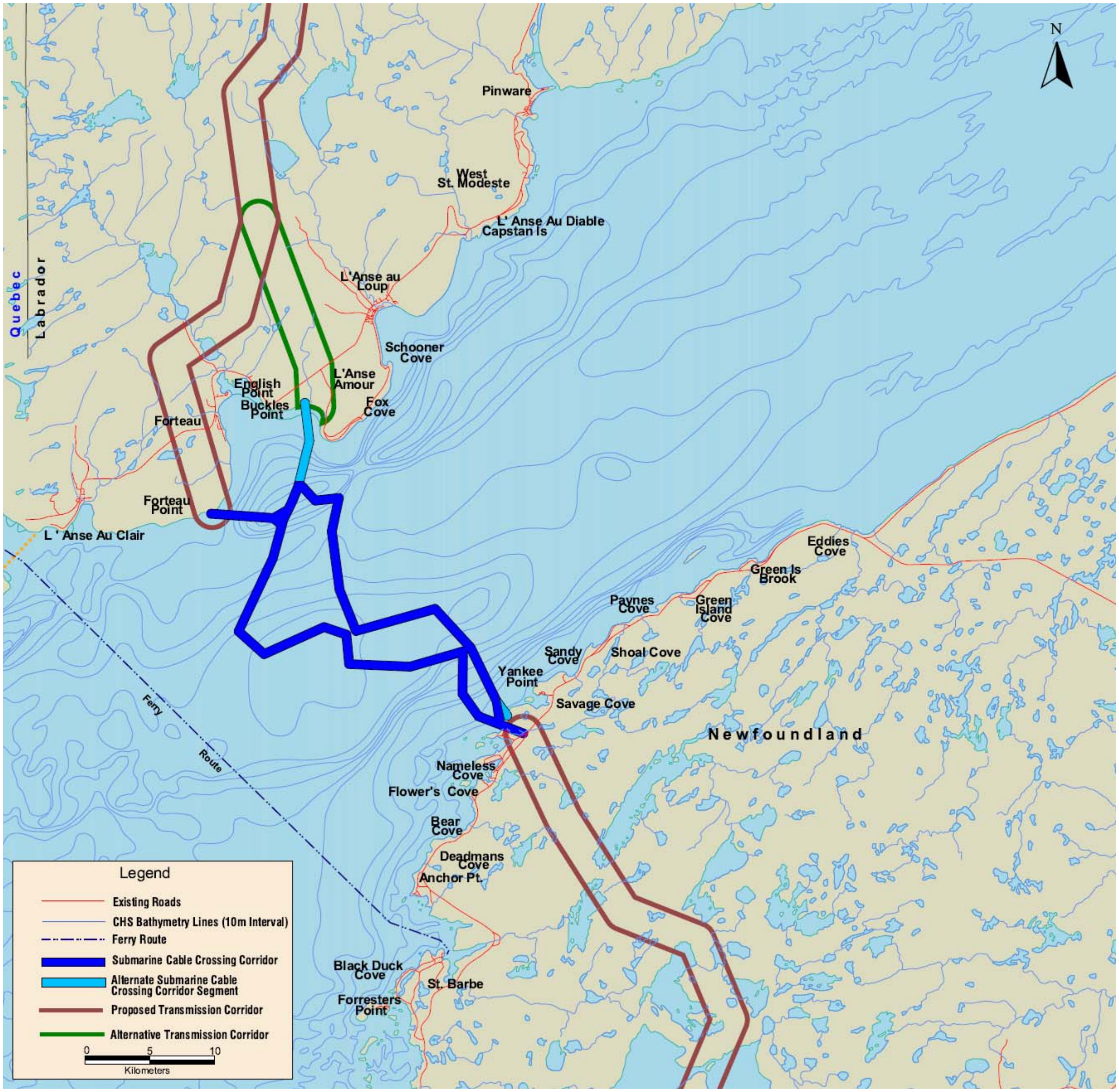

Figure A3.1 Fisheries Component Study Area Homeports

Figure A3.2 shows the division of the GAZ into a grid pattern and the Cell Reference Numbers (1-133).

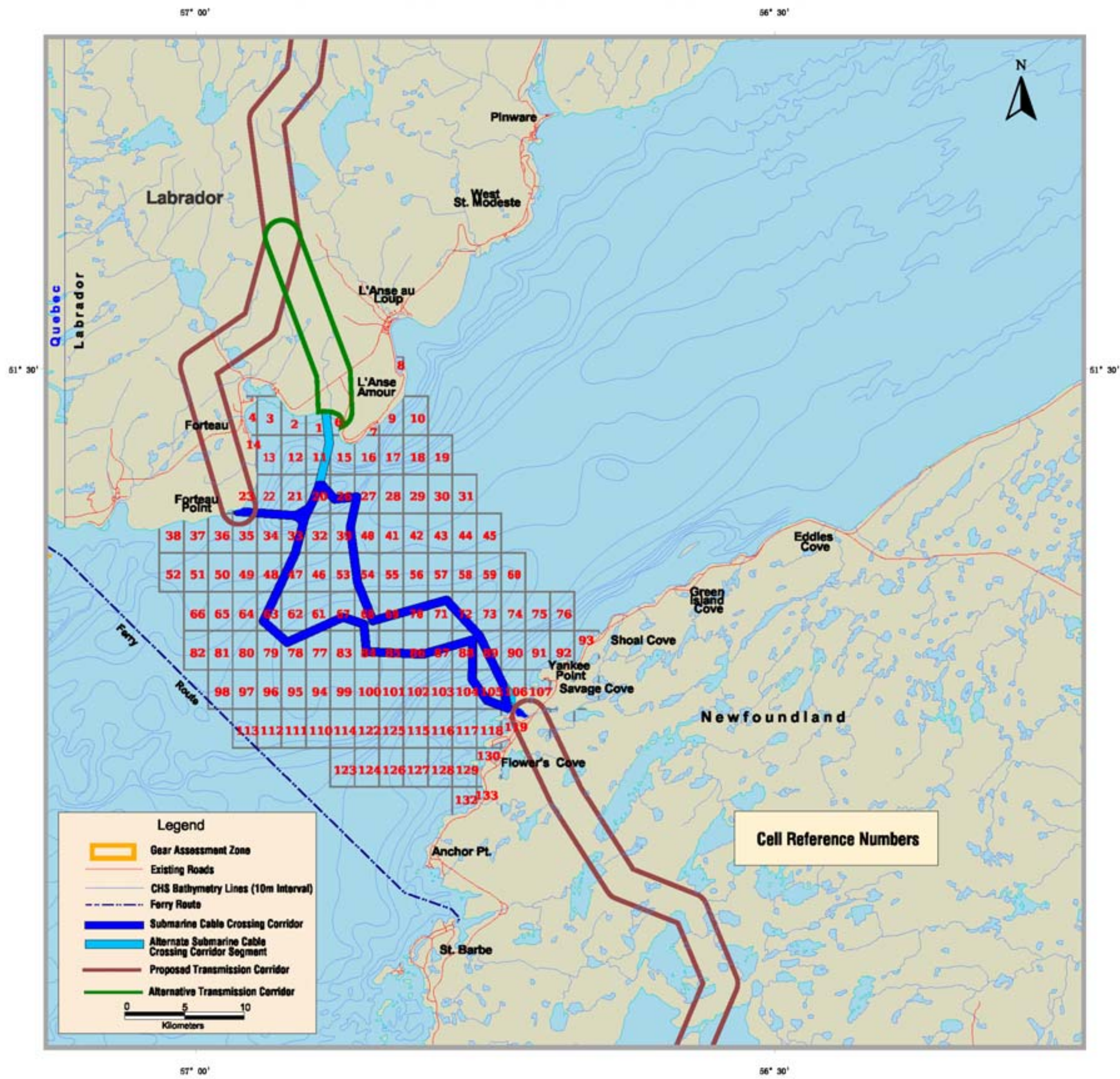

Figure A3.2 GAZ Grid Pattern and the Cell Reference Numbers

Figure A3.3 shows the location of the Scallop Refugium (shown in pale green) in relation to the GAZ.

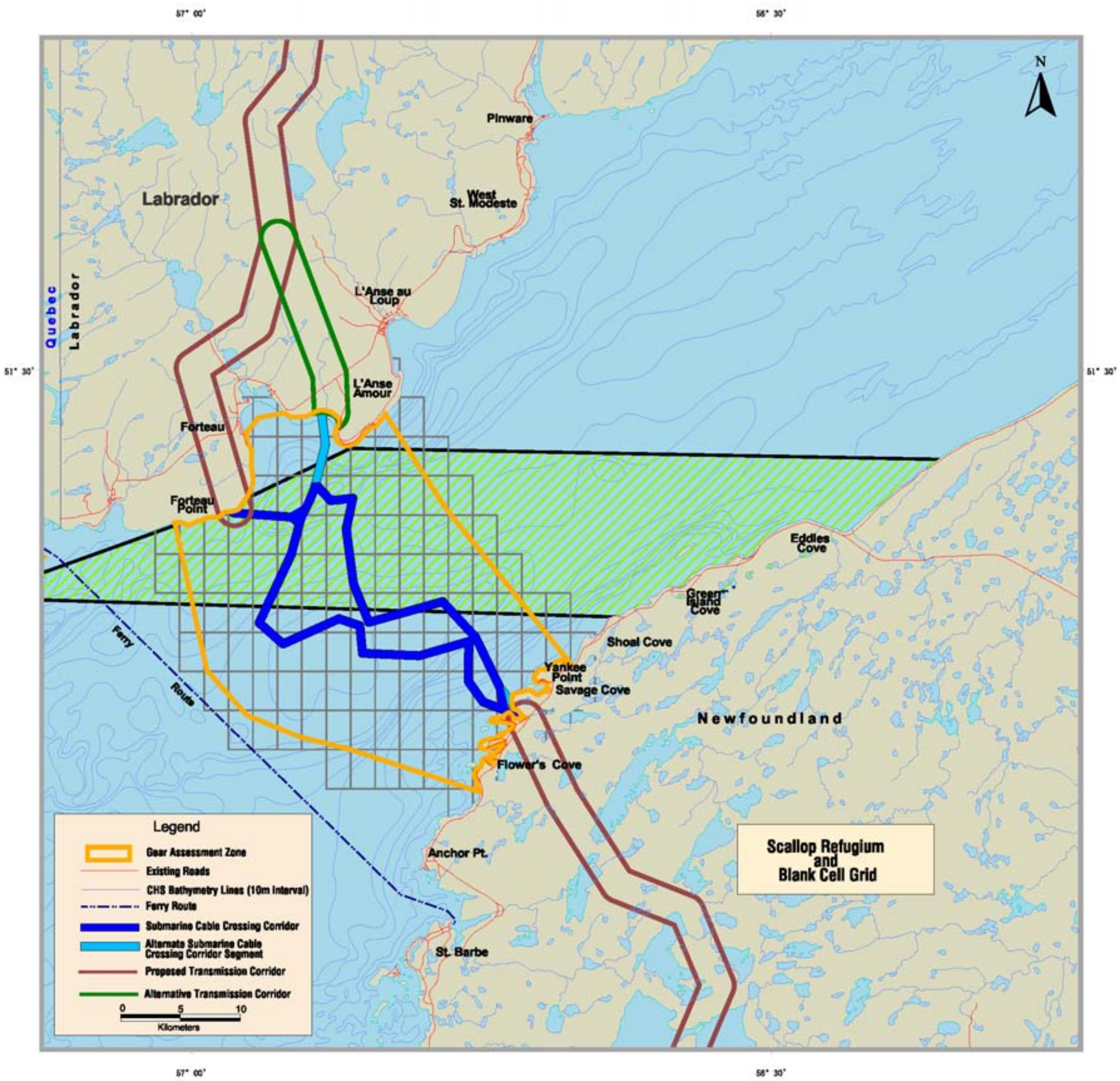

Figure A3.3 Study Area, Scallop Refugium and Blank Cell Grid

Figure A3.4 shows the regional context of the Study Area scallop fisheries vis a vis species harvesting locations within Unit Area 4Ra.

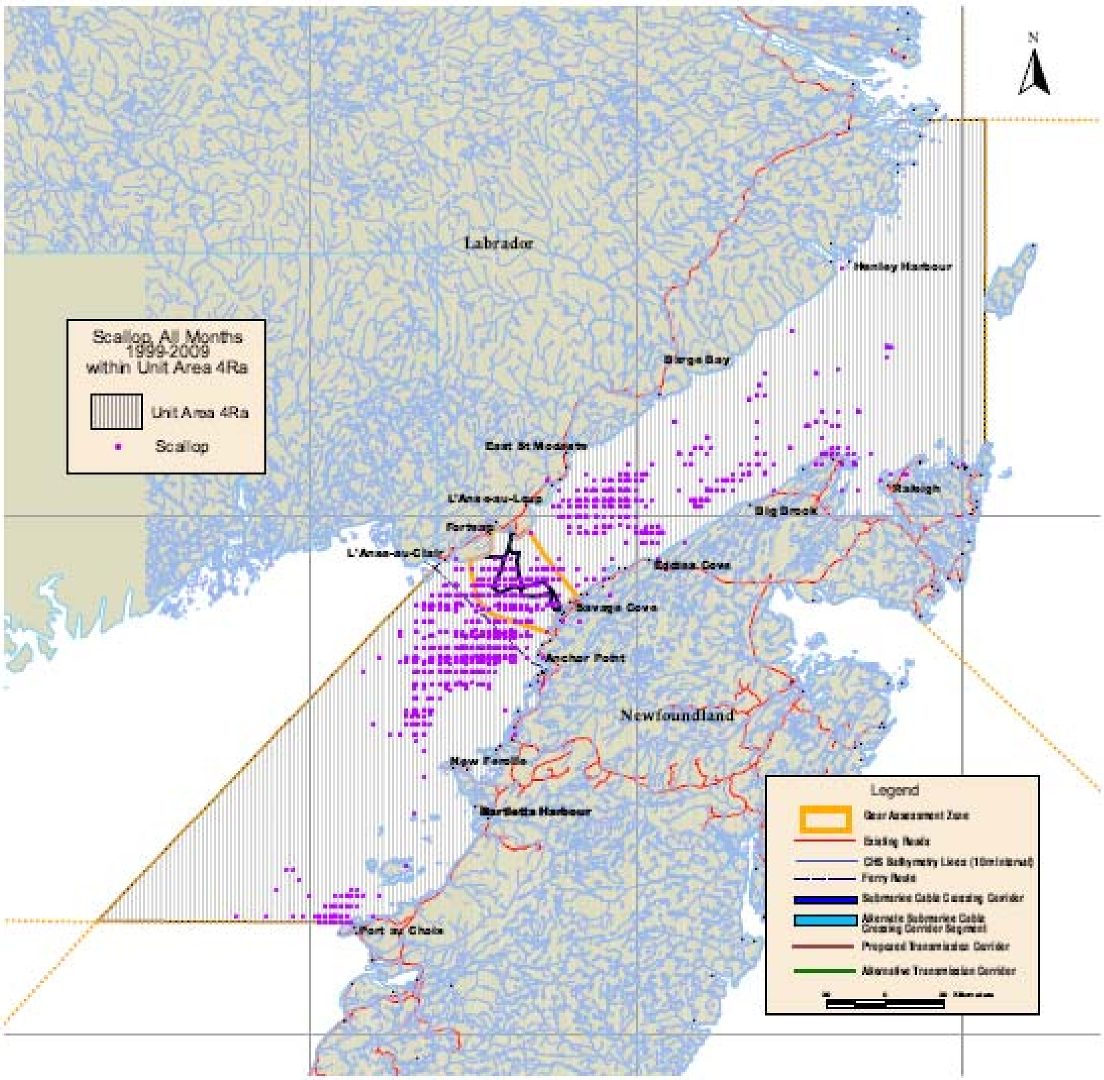

Figure A3.4 Distribution of Scallop Harvesting Locations within NAFO Unit Area 4Ra and the Nalcor Gear Assessment Study Area

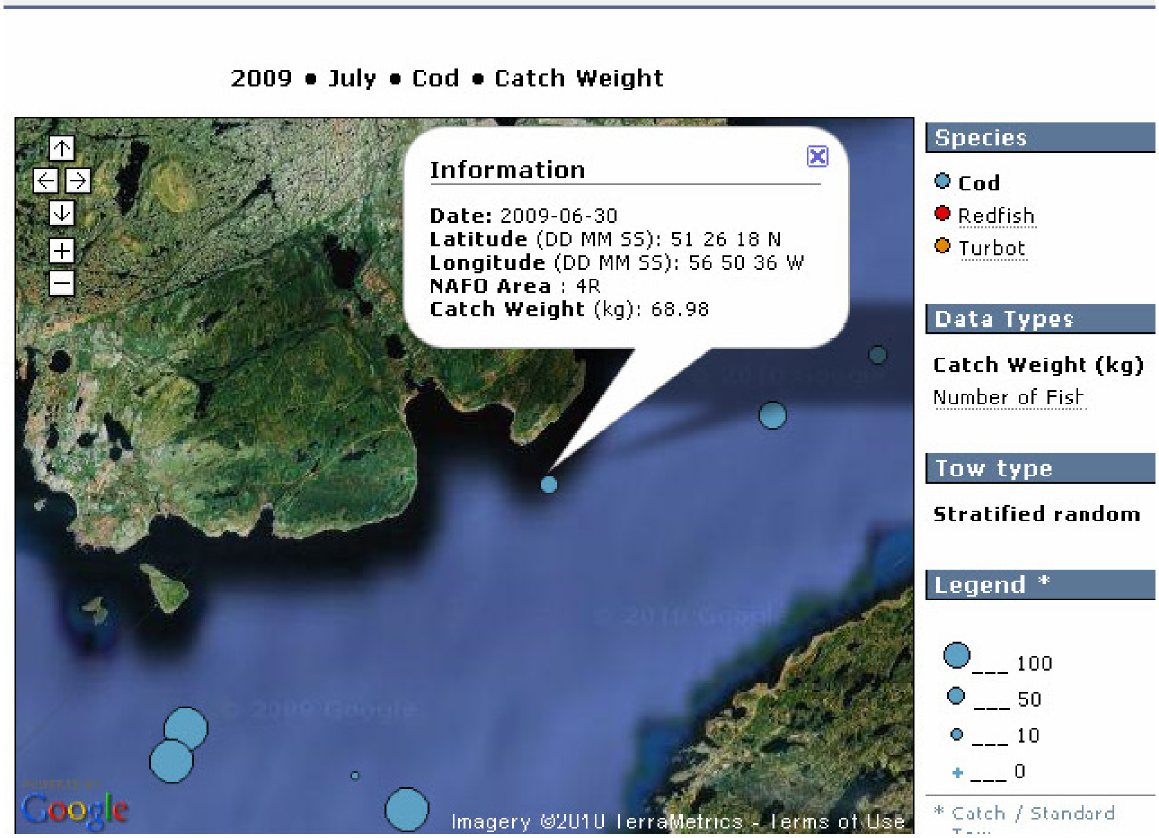

Figure A3.5 Mobile sentinel research stations in the vicinity of the Study Area, 2009 DFO RV Survey

APPENDIX 4. PHOTOS OF A TYPICAL LABRADOR SCALLOP RAKE

The following digital images of a scallop rake currently being used in the Study Area were provided to the consultant by Mr. Darrell O'Brien, Fisheries Development Officer, Department of Fisheries and Aquaculture.

Image 1 – Side View

Image 2 – Front View

Image 3 – Rear view