
Labrador – Island Transmission Link

Marine Flora, Fauna, and Habitat Survey - Strait of Belle Isle Submarine Cable Crossing Corridors 2008 and 2009 *Final Report*

Prepared for:

Nalcor Energy
Hydro Place
500 Columbus Drive
PO Box 12800, St. John's, Newfoundland and Labrador
A1B 0C9

WTO# TBR0071, WO# 672951

Prepared by:

AMEC Earth and Environmental
A Division of AMEC Americas Limited
133 Crosbie Road
PO Box 13216, St. John's, Newfoundland and Labrador
A1B 4A5

AMEC# TF8110460

February 2010

EXECUTIVE SUMMARY

Background

Nalcor Energy is proposing to develop the Labrador – Island Transmission Link, a High Voltage Direct Current (HVdc) transmission system extending from the Gull Island in Central Labrador to Soldiers Pond on the Island of Newfoundland's Avalon Peninsula.

The Project will include the installation and operation of submarine power cables across the Strait of Belle Isle (Strait) between Labrador and the Island of Newfoundland. A number of approaches and techniques are under consideration as a means of crossing the Strait of Belle Isle, including the potential to install the cables within two identified submarine cable corridors. Using this approach, various cable protection techniques are under consideration, including tunnelling and rock trenching, as well as possible rock placement and the laying of concrete mattresses over the cables in specific areas.

As part of the environmental assessment (EA) for the Project, Nalcor Energy carried out a marine survey of the two identified submarine cable corridors in the Strait of Belle Isle in 2008 and 2009. This information, along with previous geophysical (sonar) surveys undertaken by the proponent in the Strait in 2007, provides useful and detailed environmental information on marine habitats (substrate and depth characteristics) and the presence, abundance and distribution of marine flora and fauna within the two subsea cable crossing corridors.

Characterization of the marine and shoreline environments in the area which may interact with the Project is useful and required for several purposes including the Project EA and applicable regulatory/permitting requirements. The survey data may also assist in final engineering design.

Study Design and Methods

The marine survey field program was designed to gather environmental baseline information on marine fauna, flora, and associated depth and substrate distributions along the two proposed submarine cable corridors (a total distance of approximately 55 km) and four potential shoreline cable landing points.

The strategy of the 2008 field program included drop video marine survey transects of representative areas selected based on depth and substrate identified from the 2007 geophysical (sonar) survey. The substrate categories utilized to classify marine substrates included bedrock, coarse-large (>130 mm), coarse-small (gravel and cobble 20 mm – 130 mm), fine (detritus/clay/silt/sand >0.06 mm – 2 mm), and shell (calcareous remains of shellfish or other invertebrates containing shells). For the video analysis, the broad substrate categories were further broken down into detailed substrate categories listed in Table i. The depth categories included <30 m, 30-60 m, 60-90 m, and 90-130 m.

Table i. Broad and Detailed Substrate Categories

Broad Substrate Categories	Detailed Substrate Categories	Definition
Bedrock	Bedrock	Continuous solid bedrock
Coarse-large	Small and Large Boulder	Rocks greater than 250 mm
	Rubble	Rocks ranging from 130 mm – 250 mm
Coarse-small	Cobble	Rocks ranging from 30 mm – 130 mm
	Gravel	Granule size or coarser, 2 mm - 30 mm
Fine	Sand	Fine deposits ranging from 0.06 mm -2 mm
	Mud	Material encompassing both silt and clay < 0.06 mm
	Organic/Detritus	A soft material, 85% or more organic materials
Shell	Shell	Calcareous remains of shellfish or other invertebrates containing shells

The 2008 marine survey (between October 2 to 12, 2008, inclusive) was carried out using a drop-video camera mounted in a steel frame and deployed off the stern of a boat. Video was obtained along a total of 53 georeferenced transects of the seafloor within the two identified cable corridors with a linear distance of approximately 52 km. Due to the shallow depths of the nearshore area on the Newfoundland side, the drop video system was not able to be used in this area. For this shallow (< 30 m) nearshore area, a 2009 survey was performed with a smaller vessel and a team of surface-supply divers covering an additional 2.8 km. Divers utilized a more mobile video system.

For both marine surveys, the video was viewed and analysed for data relating to substrate, macrofloral, and macrofaunal distributions, similar to standard DFO (Fisheries and Oceans Canada) characterization. The data was then compiled into a GIS database and interpreted for trends. For the 2008 survey, each video transect was further broken down into reaches based on the substrate composition. Due to changes in methodology for the 2009 survey, each dive transect was broken down into five metre reaches. For both surveys, macrofaunal and macrofloral distributions were identified to the lowest possible taxonomic level and analysed for both percent occurrence (presence/absence) and abundance. Percent occurrence is defined as the percent total length of all the reaches where the taxon was present. This strictly indicates whether a species was present or absent within a specific reach and does not account for abundance or density. The other distribution metric is abundance. The ranking of each taxon within each reach with an abundance score provided an indication of how frequently the species occurred within each reach, although unquantifiable in many instances. The four abundance categories utilized are outlined below:

- **Abundant (A)** -Numerous (not quantifiable) observations made throughout the entire reach.
- **Common (C)** - Numerous (not quantifiable) observations made intermittently along the reach.
- **Occasional (O)** - Quantifiable observations made intermittently along the reach.
- **Uncommon (U)** - Quantifiable observations made infrequently along the reach.

A marine shoreline and intertidal survey was also conducted on the four potential landing sites (Forteau Point, L'Anse Amour, Mistaken Cove, and Yankee Point) in 2008. Sites were subdivided into transects based upon changes in habitat, and photos were taken. Substrate characteristics, flora and fauna and field habitat descriptions were recorded. The field information together with aerial photos and marine charts were used to describe the ecosystem type, oceanographic environment, coastal type, shore unit classification, and zone characteristics.

2008 Marine Survey Results

Substrate Distribution

Substrate distributions within the proposed submarine corridors in the 2008 survey predominantly fell within the broad substrate categories of coarse-small and coarse-large which respectively constituted 53% and 31% (84% total) of the marine survey area (Table ii). Shell was the dominant substrate category in 10% of the marine survey area, and these areas were primarily restricted to within two geographical areas (a small zone in the center of the Strait of Belle Isle and a larger zone in the western portion of the Strait) with depths in excess of 60 m. Bedrock was rarely encountered and was the dominant substrate in only 4% of the marine survey area. Its distribution was neither depth nor geographically restricted. Bedrock was usually encountered (though not exclusively so) in relation to the edge zone of a trench. Fine substrates were dominant in only 2% of the marine survey area and were restricted to depths of less than 50 m.

Table ii: Dominant Substrate Summary by Transect Subsection in 2008 Marine Survey

Broad Substrate Category	Detailed Substrate Categories	Number of Reaches with Substrate Dominant	Total Distance with Substrate Present (m)	Coverage (%)
Coarse-small	Gravel and cobble	123	27,648.2	53.1
Coarse-large	Rubble, small boulder, and large boulder	101	15,926.9	30.6
Shell	Calcareous remains	34	5,390.2	10.4
Bedrock	Continuous rock	16	2,066.0	4.0
Fine	Detritus, clay, silt, and sand	3	1,006.0	1.9
Total	-	277	52,037.4	100.0

Macrofauna Species Distributions

A total of 35 macrofaunal taxa were identified within the submarine corridors during the 2008 marine survey. Taxa are listed below in order of their percent occurrence (Table iii). Percent occurrence is defined as the total length of all the reaches (an area with the same substrate composition) where the taxon was present.

The most widely distributed macrofauna taxa with distributions of 75 to 100% of the reaches surveyed included starfish (*Asterias sp.*), starfish (*Crossaster sp.*), pale urchin (*Strongylocentrotus pallidus*), and hydroids (numerous species present). Macrofauna taxa with distributions ranging from 50 to 75% included sea anemone (non *Metridium* species), toad crab (*Hyas sp.*), stalked sea squirt (*Boltenia sp.*), bryozoan (various species), barnacle (*Balanus sp.*), deep sea scallop (*Placopecten magellanicus*), soft coral (*Gersemia sp.*), Icelandic scallop (*Chlamys islandica*), and sponge (Porifera). Macrofauna taxa with distributions ranging from 25 to 50% included brittle star (Ophiuroidea), starfish (*Solaster sp.*), sea squirt (Ascidiacea), basket star (*Gorgonocephalus sp.*), and snow crab (*Chionoecetes opilio*). Macrofauna species with distributions ranging from 5 to 25% included sea cucumber (*Cucumaria frondosa*), sculpin (*Myoxocephalus sp.*), sand dollar (*Echinarachnius parma*), Atlantic cod (*Gadus morhua*), and alligatorfish (*Aspidophoroides monoptyerygius*). Macrofauna taxa that were rarely encountered with distributions <5% within the marine survey area included blue mussel (*Mytilus edulis*), rock crab (*Cancer sp.*), cushion star (*Asterina sp.*), fan worm (Polychaeta), green urchin (*Strongylocentrotus droebachiensis*), unidentified fish, whelk (*Buccinum sp.*), stalked jellyfish (Stauromedusae), sea anemone (*Metridium sp.*), hermit crab (*Pagurus sp.*), gastropod, and pycnogonid (Pycnogonida). Most of these taxa with distributions <5% occurred in only one or two reaches in the uncommon abundance category and were not considered in the depth and substrate analysis below.

All taxa analyzed had their highest percent occurrence on coarse-small substrates. Taxa that had some of their highest abundances on coarse-small substrates included hydroids, sea anemone, toad crab, deep sea scallop, soft coral, Icelandic scallop, brittle star, starfish (*Solaster sp.* and *Crossaster sp.*), and snow crab.

Taxa that had some of their highest abundances on coarse-large substrate included starfish (*Asterias sp.* and *Crossaster sp.*), pale urchin, hydroids, toad crab, stalked sea squirt, bryozoans, deep sea scallop, soft coral, sponge, brittle star, basket star, snow crab, sea cucumber, and sand dollar.

No taxon analyzed had their highest percent occurrence on shell substrate but toad crab, sea squirt, and deep sea scallop had some of their highest abundances on shell substrate. No taxon analyzed had their highest percent occurrence on bedrock but barnacle and soft coral did have some of their highest abundances on bedrock substrate. No taxon analyzed had their highest percent occurrence on fine substrate; however, starfish (*Solaster sp.*) had some of their highest abundances on fine substrate.

All macrofaunal species observed during the 2008 survey were cross-checked with the species at risk public registry for special conservation status (SARA 2009) and the provincial registry of endangered species (NL Endangered Species Act). The Atlantic cod population as a whole is listed under Schedule 3 of SARA as a species of Special Concern. The area of the 2008 marine survey is adjacent to both the Newfoundland and Labrador population and the Laurentian north population of Atlantic cod. The Newfoundland and Labrador population has a COSEWIC (Committee on the Status of Endangered Wildlife in Canada) designation of endangered whereas the Laurentian north population is designated as threatened by COSEWIC.

Table iii. Macrofaunal Taxa Observed in 2008 Marine Survey

Rank*	Percent Occurrence	Common Name	Taxon	Category
1	90.0	Starfish	<i>Asterias sp.</i>	Echinoderm
2	83.7	Starfish	<i>Crossaster sp.</i>	Echinoderm
3	80.8	Pale urchin	<i>Strongylocentrotus pallidus</i>	Echinoderm
4	77.4	Hydroids	-	Cnidarian
5	73.1	Sea anemone	-	Cnidarian
6	69.6	Toad crab	<i>Hyas sp.</i>	Crab
7	62.6	Stalked sea squirt	<i>Boltenia sp.</i>	Tunicate
8	62.3	Bryozoans	-	Colonial
9	60.1	Barnacle	<i>Balanus sp.</i>	Mollusc
10	57.2	Deep sea scallop	<i>Placopecten magellanicus</i>	Shellfish
11	55.7	Soft coral	<i>Gersemia sp.</i>	Colonial
12	55.2	Icelandic scallop	<i>Chlamys islandica</i>	Shellfish
13	52.8	Sponge	Porifera	Colonial
14	39.7	Brittle star	Ophiuroidea	Echinoderm
15	29.0	Starfish	<i>Solaster sp.</i>	Echinoderm
16	27.3	Sea squirt	Ascidiacea	Tunicate
17	25.0	Basket star	<i>Gorgonocephalus sp.</i>	Echinoderm
18	24.9	Snow crab	<i>Chionoecetes opilio</i>	Crab
19	16.4	Sea cucumber	<i>Cucumaria frondosa</i>	Echinoderm
20	8.2	Sculpin	<i>Myoxocephalus sp.</i>	Fish
21	7.3	Sand dollar	<i>Echinarachnius parma</i>	Echinoderm
22	6.6	Atlantic cod	<i>Gadus morhua</i>	Fish
23	6.1	Alligatorfish	<i>Aspidophoroides monopterygius</i>	Fish
24	4.6	Blue mussel	<i>Mytilus edulis</i>	Shellfish
25	4.3	Rock crab	<i>Cancer sp.</i>	Crab
26	3.4	Cushion Star	<i>Asterina sp.</i>	Echinoderm
27	2.3	Fan worm	Polychaeta	Other
28	1.6	Green urchin	<i>Strongylocentrotus droebachiensis</i>	Echinoderm
29	1.3	Unidentified Fish	-	Fish
30	1.3	Whelk	<i>Buccinum</i>	Mollusc
31	1.2	Stalked jellyfish	Stauromedusae	Cnidarian
32	1.1	Sea anemone	<i>Metridium sp.</i>	Cnidarian
33	0.2	Hermit crab	<i>Pagurus sp.</i>	Crab
34	0.1	Gastropod	-	Mollusc
35	0.1	Pycnogonid	Pycnogonida	Other

*Rank is based on percent occurrence, the percentage of the total transect length of all the reaches where the taxon was present

Macroflora Species Distributions

Nine macrofloral taxa were identified within the marine survey area, and are listed below in order of their percent occurrence (Table iv).

Macroflora species which were found within 20 to 30% of reaches surveyed included coralline algae (various species) and crustose algae (*Lithothamnium sp.*). Macroflora species with distributions ranging from 5 to 20% included sea colander (*Agarum cribrosum*), red fern (*Ptilota sp.*), and sour weed (*Desmarestia sp.*). Macroflora species with distributions ranging from 1 to 5% included kelp (*Laminaria sp.*), knotted wrack (*Ascophyllum nodosum*), edible kelp (*Alaria sp.*), and rockweed (*Fucus sp.*). Knotted wrack, edible kelp, and rockweed were not analysed further as they had low abundances and observed in only one to three reaches.

Storm toss taxa (individuals of macroflora taxa which have become unattached from or do not attach to a substrate and are carried throughout the water column by wave/current action) included kelp (*Laminaria sp.*), red fern (*Ptilota sp.*), rockweed (*Fucus sp.*), sea colander (*Agarum cribrosum*), and sour weed (*Desmarestia sp.*). Storm toss was found across all depth and substrate categories. The most common storm toss species was sea colander (*Agarum cribrosum*), which was encountered along 25.8% of the area surveyed.

Taxa analysed that had their highest percent occurrence in coarse-small substrates included coralline algae, crustose algae, sea colander, red fern, sour weed, and kelp. Taxa that had their highest abundances on coarse-small substrates included crustose algae, red fern, and sour weed.

Taxa that had their highest abundances on coarse-large substrate included coralline algae, red fern, and sour weed.

Crustose algae, sea colander, red fern, and kelp (*Laminaria spp.*) all had their highest abundances on bedrock substrate.

No macrofloral taxon had their highest percent occurrence or highest abundances on fine or shell substrates.

All macrofloral species observed during the 2008 survey were cross-checked with the species at risk public registry for special conservation status (SARA 2009) and the provincial registry of endangered species (NL Endangered Species Act). No macrofloral species of special conservation status were encountered during the 2008 survey.

Table iv. Macrofloral Taxa Observed in 2008 Marine Survey

Rank*	Percent Occurrence	Common Name	Taxon	Macrofloral Type
1	28.9	Coralline algae	Various species	Red algae
2	25.0	Crustose algae	<i>Lithothamnium sp.</i>	Red algae
3	8.3	Sea colander	<i>Agarum cribrosum</i>	Brown algae
4	7.5	Red fern	<i>Ptilota sp.</i>	Red algae
5	6.7	Sour weed	<i>Desmarestia sp.</i>	Brown algae
6	3.1	Kelp	<i>Laminaria sp.</i>	Brown algae
7	1.2	Knotted wrack	<i>Ascophyllum nodosum</i>	Brown algae
8	0.4	Edible kelp	<i>Alaria sp.</i>	Brown algae

Rank*	Percent Occurrence	Common Name	Taxon	Macrofloral Type
9	0.4	Rockweed	<i>Fucus sp.</i>	Brown algae

*Rank is based on percent occurrence, the percentage of the total transect length of all the reaches where the taxon was present

2009 Marine Survey Results

Substrate Distribution

Substrate distributions within the proposed submarine corridors in the 2009 survey predominantly fell within the broad substrate categories of bedrock and coarse-small which respectively constituted 51% and 31% (82% total) of the marine survey area (Table v). Coarse-large was the dominant substrate category in 18% of the marine survey area. Fine substrate was rarely encountered and was the dominant substrate in only 0.2% of the marine survey area whereas shell substrate was not encountered during the 2009 marine survey.

Table v: Dominant Substrate Summary by Transect Subsection for 2009 Marine Survey

Broad Substrate Category	Detailed Substrate Categories	Number of Reaches with Substrate Dominant	Total Distance with Substrate Dominant (m)	Coverage (%)
Bedrock	Continuous rock	286	1430	51.1
Coarse-small	Cobble and gravel	173	865	30.9
Coarse-large	Rubble, small boulder, and large boulder	100	500	17.9
Fine	Detritus, clay, silt, and sand	1	5	0.2
Shell	Calcareous remains	0	0	0
Total	-	560	2,800	100

Macrofauna Species Distributions

A total of 20 macrofaunal taxa were identified within the submarine corridors in the 2009 marine survey (September 4-6, 2009, inclusive) and are listed below in order of their percent occurrence (Table vi). The most widely distributed macrofauna species observed, which occurred within >50% of all reaches surveyed, included a single taxon, periwinkles (*Littorina sp.*). Macrofauna species with distributions ranging from 25 to 50% included a single taxon, starfish (*Asterias sp.*). Macrofauna species with distributions ranging from 5 to 25% included blue mussel (*Mytilus edulis*), green urchin (*Strongylocentrotus dreobachiensis*) and rock crab (*Cancer sp.*). Macrofauna species with distributions ranging from 1 to 5% included hermit crab (*Paragus sp.*), whelk (Gastropod), barnacle (*Balanus sp.*), limpet (Patellogastropoda), and sponge (Porifera). Macrofauna species with distributions with < 1% to 0.4% occurrence included sculpin (*Myoxocephalus sp.*), sea cucumber (*Cucumaria frondosa*), isopod (Isopoda), and grass shrimp (*Palaemonetes sp.*). Single occurrences were also observed of brittle star (Ophiuroidea), cunner (*Tautogolabrus adspersus*), ribbon whelk (Gastropoda), sea anemone

(*Metridium sp.*), winter flounder (*Pseudopleuronectes americanus*), and ocean pout (*Zoarces americanus*). Species with percent occurrences < 1% were observed too infrequently to analyse for trends in substrate composition.

Taxa analysed that had their highest percent occurrence on bedrock substrates included periwinkle, starfish (*Asterias sp.*), blue mussel, green urchin, whelk, barnacle, limpet, and sponge. Taxa analysed that had their highest abundances on bedrock substrates included periwinkle, starfish, blue mussel, green urchin, hermit crab, whelk, barnacle, and limpet.

The only taxon analysed which had their highest percent occurrence on coarse-small substrates was hermit crab. Taxa that had their highest abundances on coarse-small substrate included starfish (*Asteria sp.*) and periwinkle.

The only taxon analysed which had their highest percent occurrence on coarse-large substrates was rock crab. Taxa that had their highest abundances on coarse-large substrate included periwinkle, starfish, blue mussel, green urchin, and rock crab.

No taxon had their highest occurrences or abundances on fine substrate.

All macrofaunal species observed during the 2009 survey were cross-checked with the species at risk public registry for special conservation status (SARA 2009) and the provincial registry of endangered species (NL Endangered Species Act). No macrofaunal species of special conservation status were encountered during the 2009 survey.

Table vi: Macrofaunal Taxa Observed in 2009 Marine Survey

Rank*	Percent Occurrence	Common Name	Taxon	Category
1	52.5	Periwinkle	<i>Littorina sp.</i>	Mollusc
2	44.1	Starfish	<i>Asterias sp.</i>	Echinoderm
3	11.3	Blue mussel	<i>Mytilus edulis</i>	Mollusc
4	10.2	Green urchin	<i>Strongylocentrotus droebachiensis</i>	Echinoderm
5	5.7	Rock crab	<i>Cancer sp.</i>	Crustacean
6	4.1	Hermit crab	<i>Paragus sp.</i>	Mollusc
7	3.9	Whelk	Gastropod	Mollusc
8	2.1	Barnacle	<i>Balanus sp.</i>	Mollusc
9	1.4	Limpet	Patellogastropoda	Mollusc
10	1.1	Sponge	Porifera	Other (Porifera)
11	0.9	Sculpin	<i>Myoxocephalus sp.</i>	Fish
12	0.7	Sea cucumber	<i>Cucumaria frondosa</i>	Echinoderm
13	0.5	Isopod	Isopoda	Crustacean
14	0.4	Grass shrimp	<i>Palaemonetes sp.</i>	Crustacean
**15	0.2	Brittle Star	<i>Ophiuroidea</i>	Echinoderm
**15	0.2	Cunner	<i>Tautoglabrus adspersus</i>	Fish
**15	0.2	Ribbon whelk	Gastropoda	Mollusc

Rank*	Percent Occurrence	Common Name	Taxon	Category
**15	0.2	Sea anemone	<i>Metridium sp.</i>	Other (Cnidarian)
**15	0.2	Winter flounder	<i>Pseudopleuronectes americanus</i>	Fish
**15	0.2	Ocean pout	<i>Zoarces americanus</i>	Fish

*Rank is based on percent occurrence, the percentage of the total transect length of all the reaches where the taxon was present

** All taxa ranked as 15 occurred within 0.2 % of the reaches (single reach)

Macroflora Species Distributions

Seventeen macrofloral taxa were identified within the 2009 marine survey area. The macrofloral taxa encountered in the marine survey are listed below in order of their percent occurrence (Table vii).

Macroflora taxa with distributions ranging from 50 to 100% included crustose algae (*Lithothamnium sp.*), kelp (*Laminaria longicuris*), and coralline algae (*Corallina officinalis*). Macroflora taxa with distributions ranging from 25 to 50% included crustose algae (other than *Lithothamnium sp.*), sea colander (*Agarum cribrosum*), and sour weed (*Desmarestia sp.*). Macroflora taxa with distributions ranging from 10 to 24% included red fern (*Ptilota sp.*), rockweed (*Fucus sp.*), and edible kelp (*Alaria sp.*). Macroflora taxa with distributions ranging from 1 to 10% included brown filamentous algae, green filamentous algae, and dulse (*Palmaria palmata*). Kelp (*Laminaria digitata*), unidentified brown algae, knotted wrack (*Ascophyllum nodosum*), sea lettuce (*Ulva sp.*), and cord weed (*Chorda sp.*) had a percent occurrence < 1% and were observed too infrequently to analyse for trends in substrate composition.

Taxa analysed that had their highest percent occurrence on bedrock substrates included coralline algae (*C. officinalis*), kelp (*Laminaria longicuris*), crustose algae (*Lithothamnium sp.*), crustose algae (other than *Lithothamnium sp.*), rockweed, edible kelp, and dulse. Taxa analysed that had their highest abundances on bedrock substrates included crustose algae (*Lithothamnium sp.*), kelp (*Laminaria longicuris*), coralline algae (*Corallina officinalis*), crustose algae (other than *Lithothamnium sp.*), sour weed, edible kelp, brown filamentous algae, and dulse.

Taxa analysed that had their highest percent occurrence on coarse-small substrates included sea colander, sour weed, and red fern. Taxa that had their highest abundances on coarse-small substrate included kelp (*Laminaria longicuris*), sea colander, red fern, rockweed, and brown filamentous algae.

Taxa analysed that had their highest percent occurrence on coarse-large substrates included brown filamentous algae and green filamentous algae. Taxa analysed that had their highest abundances on coarse-large substrate included kelp (*Laminaria longicuris*), red fern, brown filamentous algae, and green filamentous algae.

No taxon had their highest occurrences or abundances on fine substrate.

All macroflora species observed during the 2009 survey were cross-checked with the species at risk public registry for special conservation status (SARA 2009) and the provincial registry of endangered species (NL

Endangered Species Act). No macroflora species of special conservation status were encountered during the 2009 survey.

Table vii: Macrofloral Taxa Observed in 2009 Marine Survey

Rank*	Percent Occurrence	Common Name	Taxon
1	83.8	Crustose Algae	<i>Lithothamnium sp.</i>
2	68.0	Kelp	<i>Laminaria longicuris</i>
3	53.8	Coralline Algae	<i>Corallina officinalis</i>
4	45.7	Crustose Algae	other than <i>Lithothamnium sp.</i>
5	35.0	Sea Colander	<i>Agarum cribosum</i>
6	34.5	Sour weed	<i>Desmarestia sp.</i>
7	23.0	Red Fern	<i>Ptilota sp.</i>
8	14.8	Rockweed	<i>Fucus sp.</i>
9	13.9	Edible Kelp	<i>Alaria sp.</i>
10	3.8	Brown Filamentous Algae	Phaeophyceae
11	3.6	Green Filamentous Algae	Arachaeplastida
12	1.4	Dulse	<i>Palmaria palmata</i>
13	0.9	Kelp	<i>Laminaria digitata</i>
14	0.9	Unidentified Brown Algae	---
15	0.4	Knotted Wrack	<i>Ascophyllum nodosum</i>
16	0.2	Sea Lettuce	<i>Ulva sp.</i>
17	0.2	Cord Weed	<i>Chorda sp.</i>

*Rank is based on percent occurrence, the percentage of the total length of all the reaches where the taxon was present

2008 Shoreline Survey Results

All four potential landing sites (Forteau Point, L'Anse Amour, Mistaken Cove, and Yankee Point) were categorized as a mixture shoreline type, as outlined in Lee and Teasdale (2008) produced by the Department of Fisheries and Oceans Marine Environment and Habitat Management Division. This shoreline type is identified as containing some exposed bedrock but with other substrates present. The Forteau Point shore unit (Labrador) was categorized as a sand beach on a narrow rock platform. The L'Anse Amour (Labrador) shore unit was categorized as a gravel beach on a wide rock platform. The Yankee Point (Newfoundland) shore unit was categorized as a gravel beach on a wide rock platform. Mistaken Cove (Newfoundland) shore unit was categorized as a sand gravel beach on a wide rock platform.

Table of Contents

1.0	INTRODUCTION	1
1.1	Project Overview.....	1
1.2	Study Purpose and Objectives	4
1.3	Study Planning and Design.....	4
1.4	Revisions and Adaptations of the 2008 Study Design	9
2.0	APPROACH AND METHODS	11
2.1	Study Team	11
2.2	2008 Marine Survey	11
2.2.1	Drop Video Deployment.....	11
2.2.2	Video Collected	12
2.3	2009 Marine Survey.....	15
2.3.1	Dive Deployment.....	15
2.3.2	Video Collected	16
2.4	Video Analysis (2008 and 2009).....	19
2.4.1	Substrate Distribution	19
2.4.2	Macrofloral and Macrofaunal Metrics.....	19
2.5	2008 Shoreline Survey	20
3.0	RESULTS	22
3.1	2008 Marine Survey.....	22
3.1.1	Substrate	22
3.1.2	Macrofauna	26
3.1.3	Macroflora.....	39
3.2	2009 Marine Survey.....	43
3.2.1	Substrate	43
3.2.2	Macrofauna	45
3.2.3	Macroflora.....	52
3.3	2008 Shoreline Surveys.....	57
3.3.1	Forteau Point (Labrador)	57
3.3.2	L’Anse Amour (Labrador).....	58
3.3.3	Mistaken Cove (Newfoundland).....	58
3.3.4	Yankee Point (Newfoundland).....	59

4.0 DISCUSSION AND SUMMARY 60

4.1 2008 Marine Survey 60

 4.1.1 Substrate 60

 4.1.2 Macrofauna 61

 4.1.3 Macroflora 63

4.2 2009 Marine Survey 65

 4.2.1 Substrate 65

 4.2.2 Macrofauna 65

 4.2.3 Macroflora 66

4.3 2008 Shoreline Survey 67

 4.3.1 Forteau Point (Labrador) 67

 4.3.2 L’Anse Amour (Labrador) 67

 4.3.3 Mistaken Cove (Newfoundland) 67

 4.3.4 Yankee Point (Newfoundland) 67

5.0 REFERENCES 68

List of Figures

Figure 1.1: Strait of Belle Isle Cable Crossings: Potential Landing Sites and Corridors3
 Figure 1.2: Proposed 500 m Wide Submarine Corridor and 200 m Wide Survey Areas for the Initial Geological Analysis - 20075
 Figure 2.1: Marine Survey for the Strait of Belle Isle Subsea Corridors - 200814
 Figure 2.2: Marine Survey Strait of Belle Isle Subsea Corridors - 200918
 Figure 2.3: Shoreline Survey Areas for the Proposed Submarine Corridors - 200821

List of Tables

Table 1.1: 2007 Geophysical Data Collection in the Strait of Belle Isle6
 Table 1.2: Substrate Categories from IMHIR*7
 Table 1.3: Broad Substrate Categories for Marine Survey, Strait of Belle Isle, 2008.....7
 Table 1.4: Depth Categories from IMHIR*8
 Table 1.5: Depth Categories for Marine Surveys, Strait of Belle Isle8
 Table 1.6: Initial Strategy for Video Coverage, Combined Depth-Substrate Category, Areas (planned) and Percentages of Total 200-m Corridor Sorted by Surficial Area (m²), Strait of Belle Isle, 2008...9
 Table 2.1: Video and Track File Summary for 2008 Marine Survey12
 Table 2.2: Video and Track File Summary for 2009 Marine Survey16
 Table 3.1: Dominant Substrate Summary by Reach for the 2008 Marine Survey24
 Table 3.2: Depth/Substrate Category Summary for the 2008 Marine Survey24
 Table 3.3: Broad and Detailed Substrate Summary for the 2008 Marine Survey25
 Table 3.4: Macrofaunal Taxa Observed in 2008 Marine Survey26
 Table 3.5: Macrofaunal Distributions by Percentage Occurrence Categories for the 2008 Marine Survey29
 Table 3.6: Macrofaunal Species Distribution Summary with Relative Abundances for the 2008 Marine Survey30
 Table 3.7: Macrofloral Taxa for the 2008 Marine Survey39
 Table 3.8: Macrofloral Distributions by Percentage Occurrence Categories for the 2008 Marine Survey40
 Table 3.9: Macrofloral Species Distribution Summary for the 2008 Marine Survey40
 Table 3.10: Dominant Substrate Summary by Reach for the 2009 Marine Survey44
 Table 3.11: Broad and Detailed Substrate Summary for the 2009 Marine Survey45
 Table 3.12: Macrofaunal Taxa Observed in 2009 Marine Survey46
 Table 3.13: Macrofaunal Distributions by Percentage Occurrence Categories for 2009 Marine Survey47
 Table 3.14: Macrofaunal Distribution Summary with Relative Abundances for the 2009 Marine Survey48
 Table 3.15: Macrofloral Taxa for the 2009 Marine Survey52
 Table 3.16: Macrofloral Distributions by Percentage Occurrence Categories for the 2009 Marine Survey53
 Table 3.17: Macrofloral Species Distribution Summary for the 2009 Marine Survey54

List of Appendices

Appendix A	Study Team Member Profiles
Appendix B	Vessel, Video System, and Diver Photographs
Appendix C	Transect Summary Tables
Appendix D	Substrate Distributions
Appendix E	Macrofauna, Substrate, and Macroflora Photographs
Appendix F	Macrofaunal Distributions
Appendix G	Depth/Substrate Charts and Tables for Macrofauna and Macroflora
Appendix H	Macrofloral Distributions
Appendix I	Shoreline Tables and Figures

1.0 INTRODUCTION

Nalcor Energy is proposing to develop the Labrador – Island Transmission Link (the Project), a transmission line approximately 1,100 km long and associated infrastructure extending from Gull Island in Central Labrador to Soldiers Pond on the Island of Newfoundland's Avalon Peninsula. The Project will include the installation and operation of submarine power cables across the Strait of Belle Isle between Labrador and the Island of Newfoundland.

In 2008 and 2009, Nalcor Energy contracted AMEC Earth and Environmental to conduct a marine survey in the Strait of Belle Isle, in order to obtain information on marine habitats (substrate and depth characteristics) and the presence, abundance and distribution of marine flora and fauna within two identified subsea cable crossing corridors across the Strait of Belle Isle, for use in the Project's environmental assessment (EA) and in subsequent Project design and permitting processes.

1.1 Project Overview

The Project involves the construction and operation of transmission infrastructure within and between Labrador and the Island of Newfoundland. Nalcor Energy is proposing to establish a High Voltage Direct Current (HVdc) transmission system extending from Gull Island in central Labrador to Soldiers Pond on the Island's Avalon Peninsula. The Project will include the installation and operation of submarine power cables across the Strait of Belle Isle between Labrador and the Island of Newfoundland.

The proposed 450 kV transmission system, as currently planned, will include the following key components:

- an alternating current-direct current (ac-dc) converter station at Gull Island in central Labrador, on the north side of the Churchill River adjacent to the switchyard for the Lower Churchill Hydroelectric Generation Project;
- an HVdc transmission line extending from Gull Island across southeastern Labrador to the Strait of Belle Isle. This overhead transmission line will be approximately 407 km in length with a cleared right-of-way averaging 60 m wide, and consisting of single galvanized steel lattice towers;
- subsea cable crossings of the Strait of Belle Isle with associated infrastructure, which may involve placing three to five cables within two separate corridors across the Strait and under the seafloor through various means to provide the required cable protection;
- an HVdc transmission line (similar to that described above) extending from the Strait of Belle Isle across the Island of Newfoundland to the Avalon Peninsula, for a distance of approximately 688 km;
- a direct current-alternating current (dc-ac) converter station at Soldiers Pond on the Island of Newfoundland's Avalon Peninsula; and

- electrodes at each end of the HVdc transmission line in Labrador and Newfoundland with overhead wood pole lines connecting them to their respective converter stations.

Project planning and design work to date have 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. It is these proposed transmission corridors and components that were the subject of Nalcor Energy's 2008 and 2009 environmental baseline study program. Project planning is in progress, and it is anticipated that the Project description will continue to evolve as engineering and design work continue.

In terms of the proposed Strait of Belle Isle cable crossings, the HVdc transmission line will extend from Central Labrador to a crossing point on the Labrador side of the Strait of Belle Isle. From there, cables will extend under and across the Strait and make landfall on the northwestern side of the Island of Newfoundland's Northern Peninsula. Two alternative cable landing sites have been identified and are being considered on the Labrador side - Forteau Point and L'Anse Amour. On the Newfoundland side, two options are also being considered - Mistaken Cove and nearby Yankee Point (Figure 1.1).

Two proposed submarine cable corridors have also been identified for these cable crossings, which extend from these potential landing sites and across the Strait (Figure 1.1). These 500 m wide cable corridors are approximately 27 – 36 km in length, depending upon the specific landing sites selected (Figure 1.1).

Construction of the submarine crossings would include the placement of three to five cables within two separate corridors across the Strait (two to four cables to carry the power and one to be used as a spare). Both cable crossing corridors would be utilized along with the inshore segments selected on either end of the subsea cable (Figure 1.1). The eventual selection of specific cable locations within the two 500 m wide corridors is subject to ongoing engineering analysis. While the cables themselves will, as indicated above, be installed in relatively narrow locations, considerable flexibility in the specific location of the cable routes within the 500 m corridors will be required up to and during the cable installation process, in order to select and utilize an optimal path for the cable to ensure adequate protection and reliability.

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 sea-bed 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, including tunneling and rock trenching. In addition, rock placement and the laying of concrete mattresses over the cables are also being evaluated for specific areas.

Ongoing engineering analyses will continue to evaluate the potential approaches and techniques for protection of the subsea cables. The final selection of particular approaches and methods for cable protection along the location 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.



FIGURE 1.1

Stait of Belle Isle Cable Crossings: Potential Landing Sites and Corridors

1.2 Study Purpose and Objectives

The purpose of this study was to conduct a marine survey in the Strait of Belle Isle, in order to obtain information on marine habitats (substrate and depth characteristics) and the presence, abundance, and distribution of marine flora and fauna within the two identified cable crossing corridors across the Strait. This was undertaken in accordance with the Department of Fisheries and Oceans (2008) *Interim Marine Habitat Information Requirements* (IMHIR) as provided by Fisheries and Oceans Canada's Marine Environment and Habitat Management Division (MEHM).

The objective was to collect and present relevant and useful information on the existing marine environment which could potentially interact with the Project's works and activities, for use in the Project's environmental assessment (EA) and in subsequent Project design and permitting processes.

1.3 Study Planning and Design

The following sections provide an overview of the design process for the 2008 and 2009 marine survey in the Strait of Belle Isle. The study was designed with consideration of existing and available information related to the marine environment in the Strait, and in accordance with the Department of Fisheries and Oceans Canada's (DFO) IMHIR, to provide detailed and useful information on the existing marine environment in the area.

2007 Geophysical Survey Program

Nalcor Energy's previous engineering and environmental survey work in the Strait of Belle Isle has involved detailed subsea surveys of the general crossing area and identified cable corridors, including desktop analysis and mapping, side-scan sonar, multi-beam sonar, and sub-bottom profile surveys. In 2007, the proponent contracted Fugro Jacques Geosurveys Incorporated to conduct a detailed bathymetric survey of the Strait of Belle Isle. The purpose of this work was to further investigate and verify the seabed conditions of the Strait and aid in the eventual planning and design of the submarine cable corridors.

Prior to survey operations, information on the natural and human environments in and around the Strait of Belle Isle was identified and compiled. The objective was to bring together all known existing information concerning the geology, bathymetry, oceanography, ecology, fisheries, archaeology and other aspects of the Strait. This study also involved mapping these and other environmental phenomena and constraints.

Following completion of the desktop analyses, detailed subsea geophysical (sonar) surveys of the general crossing area and identified corridors were planned and undertaken in the fall of 2007, including side-scan sonar, multi-beam sonar, and sub-bottom profile surveys. The 2007 sonar surveys provided detailed bathymetric information on the two proposed subsea HVdc cable corridors (Figure 1.2).

The surveys were carried out by an offshore vessel traveling over a pre-selected survey grid with appropriate line spacing. A total of 840 km of geophysical survey lines were surveyed. The equipment and methods used to collect geophysical information throughout the 2007 survey is outlined in Table 1.1.

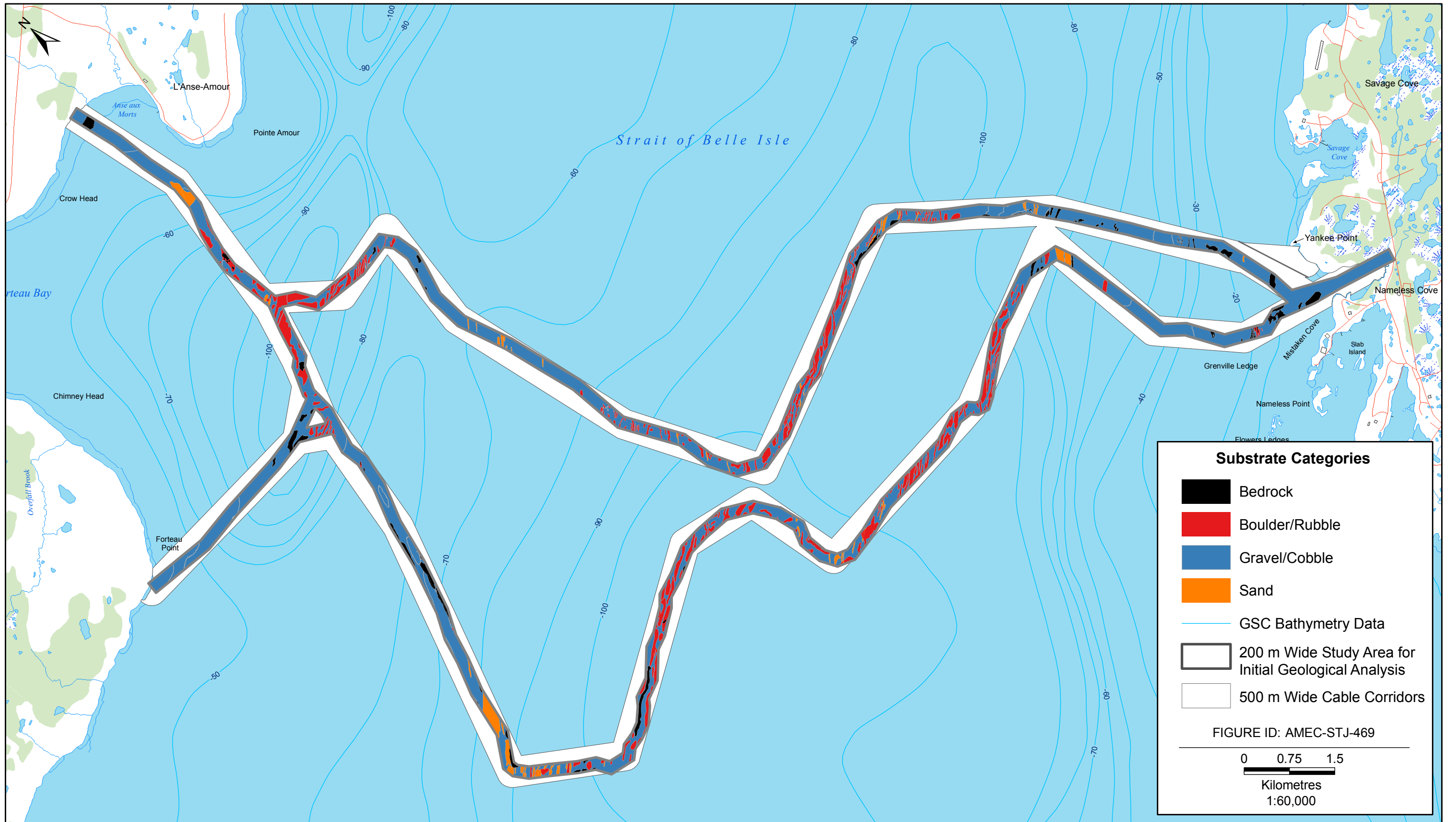


Figure 1.2

Proposed 500 m Wide Submarine Cable Corridors
and 200 m Wide Study Area for the Initial Geological Analysis - 2007 Survey



Table 1.1: 2007 Geophysical Data Collection in the Strait of Belle Isle

Data	Deep Water	Nearshore
Sub-bottom data	Acquired by a Hunter Boomer Deep Tow System (DTS) operating at 240/135 Joules with a frequency range between 0.5-6kHz (center frequency 2.5 kHz) and 0.5 second firing rate	Acquired by a surface-towed IKB Seistec system operating at 200 Joules with a frequency range between 0.5-6kHz and 0.5 second firing rate
Multibeam bathymetry	Acquired by a Reson SeaBat 8111 system operating at a frequency of 240 kHz	Acquired by a Rason SeaBat 8108 system operating at a frequency of 455kHz
Side scan data	Acquired by an Edgetech DF-1000 digital side scan sonar operating at both 100kHz and 380kHz at 150m slant range on both channels	Acquired by a Klein 3000 digital side scan sonar operating at both 100kHz and 500kHz at 150m slant range on both channels

Side-scan mosaics were generated at 1 m (nearshore) and 2 m (offshore) spatial resolutions for interpretation and analysis. Interpretations were validated against original side scan data at full resolution using Caris Sonar Image Processing System software. All survey results were analyzed and processed.

Geologists used this information to formulate a description of the subsea corridor conditions by interpreting the findings of all three survey results. In 2007, that initial analysis focused on a 200-m wide core study area (totaling approximately 12,326,425 m² in area) within the two larger 500-m wide submarine cable crossing corridors (Figure 1.2). This represented approximately 41.1% of the total area of the two 500-m wide corridors (29,987,606 m²).

This initial analysis of the 2007 geophysical survey data resulted in the production of surficial geology maps for these areas within the subsea cable corridors which illustrated the area’s general water depth and substrate characteristics. These substrate categories included bedrock, boulder/rubble, gravel/cobble, and sand (Figure 1.2). Each substrate category was mapped within the corridor as geo-referenced polygons.

To obtain an appropriate and representative sample of the marine flora, fauna, and habitat types found within the two proposed cable corridors, the 2007 geophysical survey data was used to design the initial sampling strategy for the 2008 marine survey. This is discussed in the following sections as well as the eventual evaluation of the study design and approach.

2008 Study Design (Initial)

Fisheries and Oceans Canada, Marine Environment and Habitat Management (DFO, MEHM) have developed an interim guide for Marine Habitat Information Requirements (IMHIR, DFO, MEHM, 2008). The substrate categories recommended by DFO, MEHM are provided in Table 1.2. As previously discussed, the 2007 geophysical analysis (upon which the 2008 marine survey was designed) included the substrate categories of bedrock, boulder/rubble, gravel/cobble, and sand. In consultation with DFO, MEHM, an amalgamation of the substrate categories from the 2007 geophysical analysis and the DFO, MEHM requirements was developed (Table 1.3). The substrate categories for the 2008 marine survey included bedrock, coarse-large, coarse-small, fine, and shell.

Table 1.2: Substrate Categories from IMHIR*

Broad Categories	Detailed Categories	Definition
Bedrock	Bedrock	Continuous solid bedrock
Coarse	Boulder	Rocks greater than 250 mm
	Rubble	Rocks ranging from 130 mm – 250 mm
Medium	Cobble	Rocks ranging from 30 mm – 130 mm
	Gravel	Granule size or coarser, 2 mm – 30 mm
Fine	Sand	Fine deposits ranging from 0.06 mm -2 mm
	Mud	Material encompassing both silt and clay < 0.06 mm
Organic	Organic/Detritus	A soft material, 85% or more organic materials
Shell	Shells	Calcareous remains of shellfish or other invertebrates containing shells.

*DFO (2008)

Table 1.3: Broad Substrate Categories for Marine Survey, Strait of Belle Isle, 2008

Broad Substrate Categories	Definition
Bedrock	Continuous rock
Coarse-large	Rubble and boulder (>130 mm)
Coarse-small	Gravel and cobble (2 mm – 130 mm)
Fine	Detritus/clay/silt/sand (> 0.06 mm – 2 mm)
Shell	Calcareous remains of shellfish or invertebrates containing shells.

For the purposes of establishing a practical and statistically representative habitat quantification approach, a number of depth categories were also developed for the 2008 marine survey field program design. These categories were based as much as possible upon the categories provided in the IMHIR (DFO 2008), (Table 1.4). Depth categories utilized during the 2008 survey were < 30 m, 30-60 m, 60-90 m, and 90-130 m respectively (Table 1.5).

Table 1.4: Depth Categories from IMHIR*

Depth Category	Description
Intertidal zone	Between high and low tide
Shallow subtidal	Mean low tide - 30 m
Deep subtidal	> 30 m

*DFO (2008)

Table 1.5: Depth Categories for Marine Surveys, Strait of Belle Isle, 2008

Depth Category	Description
Intertidal zone	Between high and low tide
Shallow subtidal	Mean low tide - 30 m
30-60 Deep subtidal	30-60 m
60-90 Deep subtidal	60-90 m
90-120 Deep subtidal	90-120 m

Depth and substrate divisions were grouped into 16 representative combined depth-substrate categories (Table 1.6). Within each depth-substrate category, the number of representative individual areas (polygons) and their associated surficial areas (m²) were calculated within a GIS framework (Table 1.6).

To assist in determining an appropriate sampling effort the representative depth-substrate categories were sorted based upon their area (m²) of the total 200 m wide corridor area using the 2007 geophysical (sonar) data. Substrate distributions were subdivided by depth categories of <30 m, 30-60 m, 60-90 m, and 90-130 m (Table 1.6).

Based upon the 2007 geological (sonar) data (Figure 1.2), the predominant habitat category within the proposed subsea corridor was composed of coarse-small substrates (gravel and cobble) within the depth distributions of 90-130 m (37.1%) and 60-90 m (21.4%), (Table 1.6). Coarse-large (rubble and boulder) substrates within the depth distribution of 90-130 m represented 15.7% of available habitat (Table 1.6). Coarse-small substrates (gravel and cobble) within the depth distribution of < 30m represented 11.2% of available habitat (Table 1.6). All other depth-substrate categories combined accounted for less than 15% of the overall surficial area of the 200 m wide area (Table 1.6).

The initial study design was based upon a 14-day field program with an estimated sampling efficiency of five sites per day for a total of 70 potential sampling locations.

To obtain representative data with respect to the distribution of the available habitat types within the 200 m wide corridor the following strategy was employed:

- Two sampling locations were sampled for all depth-substrate categories representing less than 1% of the total surficial area of the corridors, accounting for 8 of the 70 survey sites. Note that the categories of 30-60 m bedrock and 30-60 m coarse-large were excluded as the surficial areas identified were too small for investigation.

- Four sampling locations were visually groundtruthed for all depth-substrate categories that accounted for 1 to 10% of the total surficial area (m²) of the corridors. This accounted for a total of 24 sites out of 70 (Table 1.6).
- The remaining 38 (out of 70) potential visual marine survey stations were distributed among the largest substrate/depth categories based upon the percentage that each category represents with respect to the corridor surficial area (m²), (Table 1.6).

Table 1.6: Initial Strategy for Video Coverage, Combined Depth-Substrate Category, Areas (planned) and Percentages of Total 200 m Corridor Sorted by Surficial Area (m²), Strait of Belle Isle, 2008

Depth/Substrate Category	Number of Polygons Containing Substrate Category	Area (m ²)	Total Area of 200 m Wide Corridors (%)	Number of Video Stations
90 - 130 m Coarse-small	7	4,574,429	37.1	16
60 - 90 m Coarse-small	11	2,636,313	21.4	10
90 - 130 m Coarse-large	298	1,929,534	15.7	7
< 30 m Coarse-small	3	1,382,776	11.2	5
30 - 60 m Coarse-small	4	582,387	4.7	4
90 - 130 m Fine	69	303,258	2.5	4
90 - 130 m Bedrock	41	255,304	2.1	4
< 30 m Bedrock	31	183,201	1.5	4
60 - 90 m Bedrock	37	182,697	1.5	4
60 - 90 m Coarse-large	36	141,185	1.1	4
60 - 90 m Fine	14	111,439	0.9	2
30 - 60 m Fine	1	31,470	0.3	2
< 30 m Coarse-large	14	10,243	0.1	2
< 30 m Fine	1	2,155	0.02	2
30 - 60 m Bedrock	1	32	0.0003	0
30 - 60 m Coarse-large	0	0	0.0	0
Totals	568	12,326,425	100	70

1.4 Revisions and Adaptations of the 2008 Study Design

The initial approach to collecting the field data in accordance with the above involved the deployment of a Remote Operated Vehicle (ROV) within the Strait of Belle Isle in mid September 2008. A number of stations were attempted from September 11 to 18, 2008, however current strengths encountered (in excess of 7 knots or 13 km/hr) exceeded the capabilities of the ROV unit. The initial field program was therefore aborted and alternative methodologies were investigated.

After internal discussion and consultation with Nalcor Energy and DFO, MEHM, a drop-video system was selected as the methodology that would be most suitable for the environmental conditions encountered. The

general sampling strategy outlined in Table 1.6 was not altered and the second field effort was based upon sampling the same 70 previously identified stations.

Fieldwork for the second sampling effort commenced October 2, 2008. The drop video system performed far beyond expectations and permitted significant additional coverage of the proposed submarine cable corridors. Once the initial 70 pre-selected stations (approximately 11% of the two corridors) were completed the field program was expanded to the extent that marine survey video footage was obtained for approximately 84% (52km) of the two proposed corridors.

Due to the shallowness of the near shore area on the Newfoundland side, the drop video system was not able to be used there. For this area, a 2009 survey was performed with a smaller vessel and a team of surface-supply divers.

The methodology of both marine surveys is described in the following chapter.

2.0 APPROACH AND METHODS

The following section outlines the methods used in the marine field program conducted in October 2008 and September 2009 in the Strait of Belle Isle.

For the 2008 survey, “station” refers to one of the 70 pre-selected sampling areas corresponding to the depth/substrate combinations identified in Table 1.6. A station is a single point based upon individual GPS coordinates. Drop video transects were structured such that individual “station” points were encountered along video transect lines of varying length ranging from relatively short transects (from 200-300 m) incorporating one station, to long transects (up to 3600 m) incorporating a number of individual stations. For the 2009 survey, stations were 100 m apart and signify the start and the end of each transect.

2.1 Study Team

For the 2008 marine survey, the field crew included three AMEC personnel, three vessel crew, and one drop video operator from Fugro Jacques Geosurveys Incorporated. The AMEC personnel included Eugene Lee, Overall Project Supervisor and Senior Marine Biologist, Derm Kenny, Field Technician, and Michael Teasdale, Marine Biologist. The vessel crew included Dennis Burden, vessel captain, and two crew members. Curtis Strickland from Fugro Jacques Geosurveys Incorporated was the drop video operator. Only the AMEC personnel were involved in the shoreline surveys. Short biographies of the study team can be found in Appendix A.

For the 2009 marine survey, the field crew included two AMEC personnel, two vessel crew, and four divers from Central Diving Limited. The AMEC personnel included Michael Teasdale, Overall Project Supervisor and Marine Biologist, and Derm Kenny, Field Technician. The vessel crew included Lewis Hughes, vessel captain, and Marvin Hughes, crew. The dive crew included Everett Brinson, dive supervisor, and three other divers. Short biographies of the study team can be found in Appendix A.

2.2 2008 Marine Survey

2.2.1 Drop Video Deployment

Video transect surveys took place on October 2 to 12 (inclusive), 2008 (Table 2.1). The vessel used to conduct the study was the *MV Labrador Venture*, a 55' longliner vessel owned and operated by a local fisherperson based in L'Anse au Loup, Labrador (Photo B-1, Appendix B). The drop video system was supplied and operated by Fugro Jacques Geosurveys Incorporated. The drop video system was comprised of a stainless steel frame that contained the video camera, two lights, and one 24-volt marine battery (Photo B-2, Appendix B). The drop video system was deployed using a stern-mounted A-frame and an electromechanical winch powered by a generator (Photos B-3 and B-4, Appendix B). The video feed traveled through a single-armoured steel cable, through a slip-ring on the winch to a monitor and DVD burner located in the ship's galley where the video was viewed in real-time.

To deploy the drop video, the vessel approached the survey station, the engine was shifted to neutral, and the drop video frame was lowered into the water column to a depth of approximately 1.5 m from the seafloor. The track file and DVD began recording as the boat was put back in gear. The boat traveled along the transect length at the slowest speed possible to maintain direction and forward momentum (approximately 0.4-1.5 knots or 0.8-2.8 km/hr). The winch was lowered and raised to keep a clear visual of the seafloor on the video and required continual adjustment for water depth and sea state. A scale bar with 10 cm increments was located on the video frame to provide a size reference.

The video footage was synchronized to the boat’s logged global positioning system (GPS) coordinates by recording the video date, chapter, and time, GPS position from a hand-held GPS, water depth, cable warp, and distance from/to the next waypoint (station). Comparing the cable warp with the water depth provided an indication of the position of the drop video with respect to the vessel. For example, if the drop video cable warp reading was 55 m and the depth was 50 m then the position of the drop video camera was within at least 5 m of the stern of the vessel. Due to the position of the vessel’s GPS receiver (6 m from the stern of the boat) and the large amount of cable released, the position of the camera was considered approximate but well within the study corridor.

2.2.2 Video Collected

The video file summary and areas covered are presented in Table 2.1 and Figure 2.1. Table 2.1 catalogues the video footage and the corresponding georeferenced boat track. Transects were named in accordance with the station(s) that were surveyed in each transect.

After transects for the original pre-selected 70 stations were completed, additional footage collected between stations were referred to as “track gaps” (TG). For example, TG137-138 is a video survey of the remaining area between Stations 137 and 138.

In total, 53 transects with 28.5 hours of video were recorded in 2008 covering a distance of 52 km. Although the original goal of the field program was to cover approximately 7 km of the proposed submarine corridors (11%), video footage of 52 km (84%) of the 62 km long submarine corridors was obtained.

Table 2.1: Video and Track File Summary for 2008 Marine Survey

DVD (#)	Date	Transect Name	Direction	Distance (m)	Average Speed (km/hr)
SOBI 1	October 2	Station 124-127	East	2,008.2	2.1
SOBI 2	October 2	Station 127-133	East	2,292.1	2.1
SOBI 3	October 5	Station 141-140	West	22.6	1.3
	October 5	Station 173	West	449.6	1.9
	October 5	Station 172	West	649.6	2.8
SOBI 4	October 5	Station 171-170	West	1,071.9	1.5
	October 5	Station 174	West	425.9	2.6
SOBI 5	October 5	Station 142	East	208.2	0.8
	October 5	Station 143	East	242.8	1.0
	October 5	Station 144-145	East	455.3	1.4
SOBI 6	October 5	Station 175-177	East	1,839.2	2.0

DVD (#)	Date	Transect Name	Direction	Distance (m)	Average Speed (km/hr)
	October 5	Station 178	East	358.8	1.8
SOBI 7	October 5	Station 179-180	East	633.3	2.1
	October 7	Station 169	East	441.2	1.2
	October 7	Station 168	West	585.5	1.6
SOBI 8	October 7	Station 167	West	515.0	1.5
	October 7	Station 166	East	539.9	1.8
	October 7	Station 165-164	West	865.4	1.6
SOBI 9	October 7	Station 163	West	467.2	1.8
	October 7	Station 162	West	397.4	1.7
	October 7	Station 139	West	424.6	1.4
	October 7	Station 138	West	438.8	1.5
SOBI 10	October 7	Station 137	West	461.7	1.2
	October 7	Station 136	East	435.5	1.3
	October 7	Station 146	West	414.7	1.6
SOBI 11	October 7	Station 186	West	657.9	1.4
	October 7	Station 184-181	West	1,263.4	2.0
SOBI 12	October 7	Station 147	East	555.9	1.9
	October 7	Station 148	East	330.3	2.0
	October 7	Station 149	East	416.3	1.8
	October 7	Station 150	East	695.4	1.5
SOBI 13	October 7	Station 188	West	916.6	1.7
SOBI 14	October 9	Station 160-161	East	1,499.6	2.0
SOBI 15	October 9	Station 135-133	West	1,649.9	2.2
SOBI 16	October 9	TG 137-136	West	1,343.0	2.0
SOBI 17	October 9	TG 140-139	West	1,691.4	1.8
SOBI 18	October 10	TG 142-143	East	1,543.3	1.3
SOBI 19	October 10	TG 143-144	East	945.6	1.5
SOBI 20	October 10	TG 146-145	West	1,681.7	2.2
	October 10	TG 178-179	East	343.3	1.7
SOBI 21	October 10	TG 138-137	West	1,201.9	1.7
SOBI 22	October 10	TG 139-138	West	763.9	1.0
SOBI 23	October 11	Station 152-149	West	1,895.8	2.3
SOBI 24	October 11	Station 191-188	West	923.2	2.4
	October 11	TG 147-146	West	1,353.2	2.0
SOBI 25	October 11	TG 171-172	East	1,531.3	1.6
SOBI 26	October 11	TG 135-136	East	378.2	1.3
	October 11	TG 135-134	West	547.9	2.3
	October 11	TG 162-161	West	726.3	2.1
	October 12	TG 166-165	West	624.6	1.9
SOBI 27	October 12	TG 136-135	West	1,728.9	2.0
SOBI 28	October 12	Station 155-159	East	3,594.5	1.8
SOBI 29	October 12	TG 180-181	East	2,086.6	1.7
TOTALS	-	53	-	52,037.4	1.9

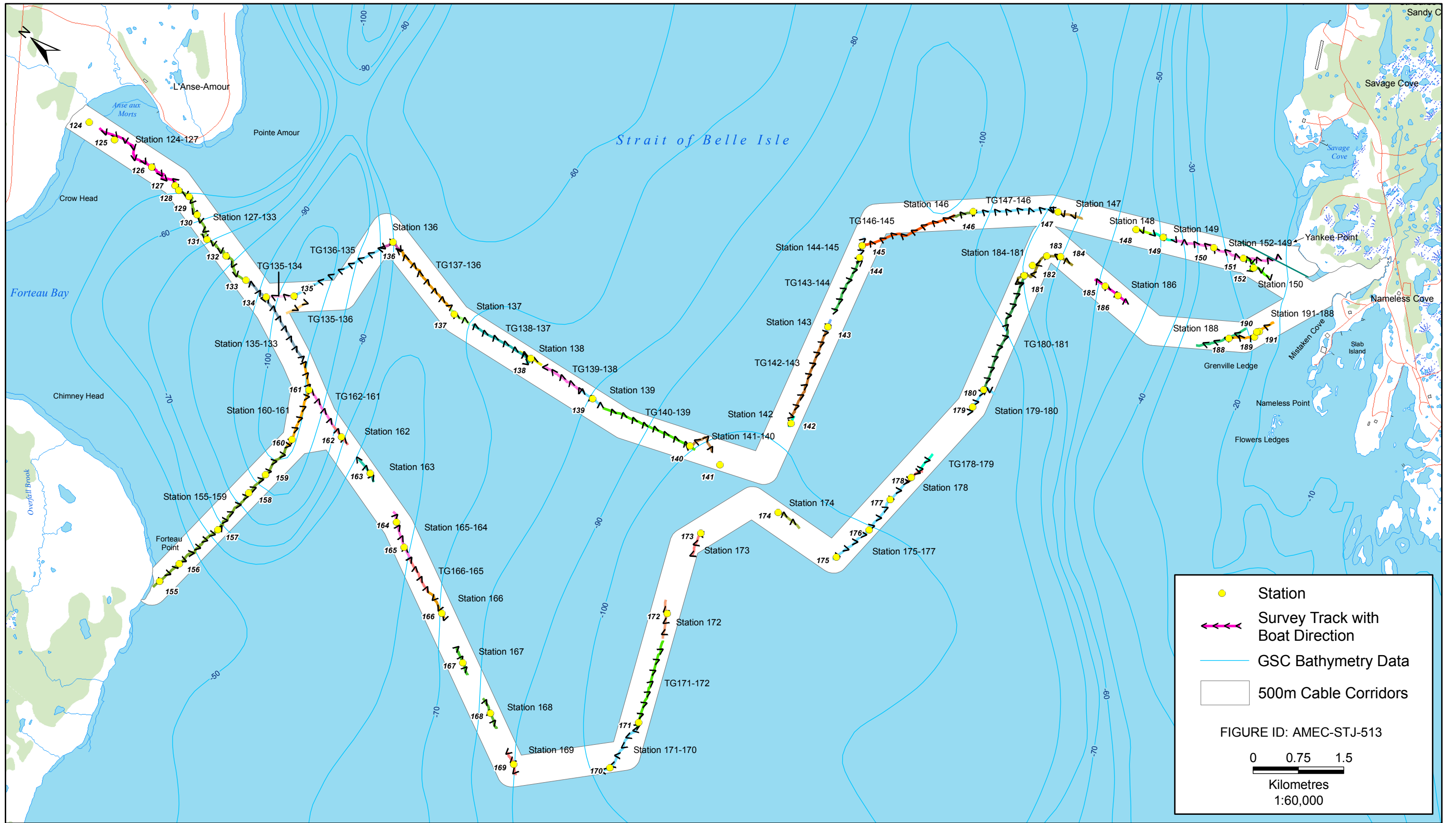


Figure 2.1



Marine Survey for the Proposed Submarine Corridors - 2008 Survey

Sediment Sampling

Sediment samples were attempted using a stainless steel, van Veen and a Shipek sediment grab, at stations known to have fine and coarse-small substrates. The van Veen grab is typically used for deep sea sampling and can be used in rough seas without premature firing (USEPA 2001). As it is designed for deep-sea work, it is typically used on soft non-compacted sediments and larger substrates such as gravel can cause an incomplete seal and the sample can be lost (USEPA 2001). The Shipek grab is also designed for the near offshore and it typically used on finer substrates (compacted silts, soft ooze) but can be used on substrates up to 5 cm (Envco 2009). By using these samplers in combination, substrates ranging from compacted silts to 5 cm can be collected.

At each sampling station the grab was lowered through the water column into the substrate at a uniform and quick rate of descent. Once the grab was on the bottom a position and depth for each station was recorded via the onboard GPS unit. Upon retrieval, each grab was placed into a tub to evaluate whether the grab was complete (i.e., that the grab captured the surface material and is full to each edge) and to evaluate sampler fullness. If the grab was incomplete, it was discarded. If the grab was complete, the grab was rinsed to ensure the complete removal of all material.

Sampling was attempted 3-4 times at each site, and if no sediment sample was retrieved, another site was chosen. If the sediment sampling was successful, one sediment sample was removed and placed into a 500 ml glass jar for particle size analysis, and the remaining sediment sample was used for sediment analysis. A plastic spoon was used to obtain three 250 ml benthic invertebrate samples which were immediately placed into three laboratory supplied sterilized glass jars and preserved with the addition of 80% ethyl alcohol. Sediment sampling was attempted at 25 stations in the 2008 survey in areas thought to be dominated by fine and coarse-small substrates based on the distributions in Figure 1.2.

2.3 2009 Marine Survey

Several areas within the corridor on the Newfoundland side were too shallow and hazardous to be covered by the drop video system. These areas were surveyed in 2009 (Figure 2.2) using surface-supplied divers with a video camera and a smaller vessel.

2.3.1 Dive Deployment

Video transect surveys took place from September 4 to 6 (inclusive), 2009 (Table 2.2). The vessel used to conduct the study was the M.V. *Shannon Trevor*, a 35' longliner vessel owned and operated by Lewis and Marvin Hughes, local fisherpersons based in Green Island Brook, NL (Photo B-5, Appendix B). Diving was performed by Central Diving Limited and used a surface-supplied air and communication system operated from the deck of the vessel (Photo B-6 through B-8, Appendix B).

Transects were run along a lead line marked in five-meter increments. The locations of transects were determined based upon a site drawing and coordinates provided by Nalcor Energy. Transect start and end positions were determined in the field via GPS. Transects were surveyed utilizing an underwater video camera operated by a Canadian Standards Association-approved diver with surface supplied air. The video feed traveled

through the umbilical cord to a monitor and DVD burner located in the ship’s wheelhouse where the video was viewed in real-time.

The underwater video surveillance generally encompassed a span of approximately one meter to either side of the transect line. Seabed characterization consisted of field observations provided by the dive crew and an office review of the video footage. Observations of substrate, flora, fauna, and depth distributions along the video transect were made for each five meter reach as outlined in Section 2.4 of this report.

2.3.2 Video Collected

The video file summary and areas surveyed are presented in Table 2.2 and Figure 2.2. Table 2.2 catalogues the video footage. In total, 28 transects with 10 hours of video were recorded in 2009 covering a distance of 2.8 km. Note that the transects that surveyed Mistaken Cove were terminated at the shoreline at a depth of less than 1 m in an area that was intertidal (SC14→SC15).

Table 2.2: Video and Track File Summary for 2009 Marine Survey

Corridor	Transect Name	Distance (m)	Date	Dive (#)
Northern Corridor	NC1→NC2	100	September 5	6
	NC2→NC3	100	September 5	6
	NC3→NC4	100	September 5	7
	NC4→NC5	100	September 5	7
	NC5→NC6	100	September 5	8
	NC6→NC7	100	September 5	8
Middle Corridor	MC1→MC2	100	September 6	11
	MC2→MC3	100	September 6	11
	MC3→MC4	100	September 6	12
	MC4→MC5	100	September 6	12
	MC5→MC6	100	September 6	13
	MC6→MC7	100	September 6	13
	MC7→MC8	100	September 6	14
	MC8→MC9	100	September 6	14
Southern Corridor	SC1→SC2	100	September 4	1
	SC2→SC3	100	September 4	1
	SC3→SC4	100	September 4	2
	SC4→SC5	100	September 4	2
	SC5→SC6	100	September 4	3
	SC6→SC7	100	September 4	3
	SC7→SC8	100	September 4	4
	SC8→SC9	100	September 4	4
	SC9→SC10	100	September 4	5
	SC10→SC11	100	September 4	5
	SC11→SC12	100	September 5	9
	SC12→SC13	100	September 5	9
SC13→SC14	100	September 5	10	

Corridor	Transect Name	Distance (m)	Date	Dive (#)
	SC14→SC15	100	September 5	10
TOTALS	28	2.8 km	3 days	14

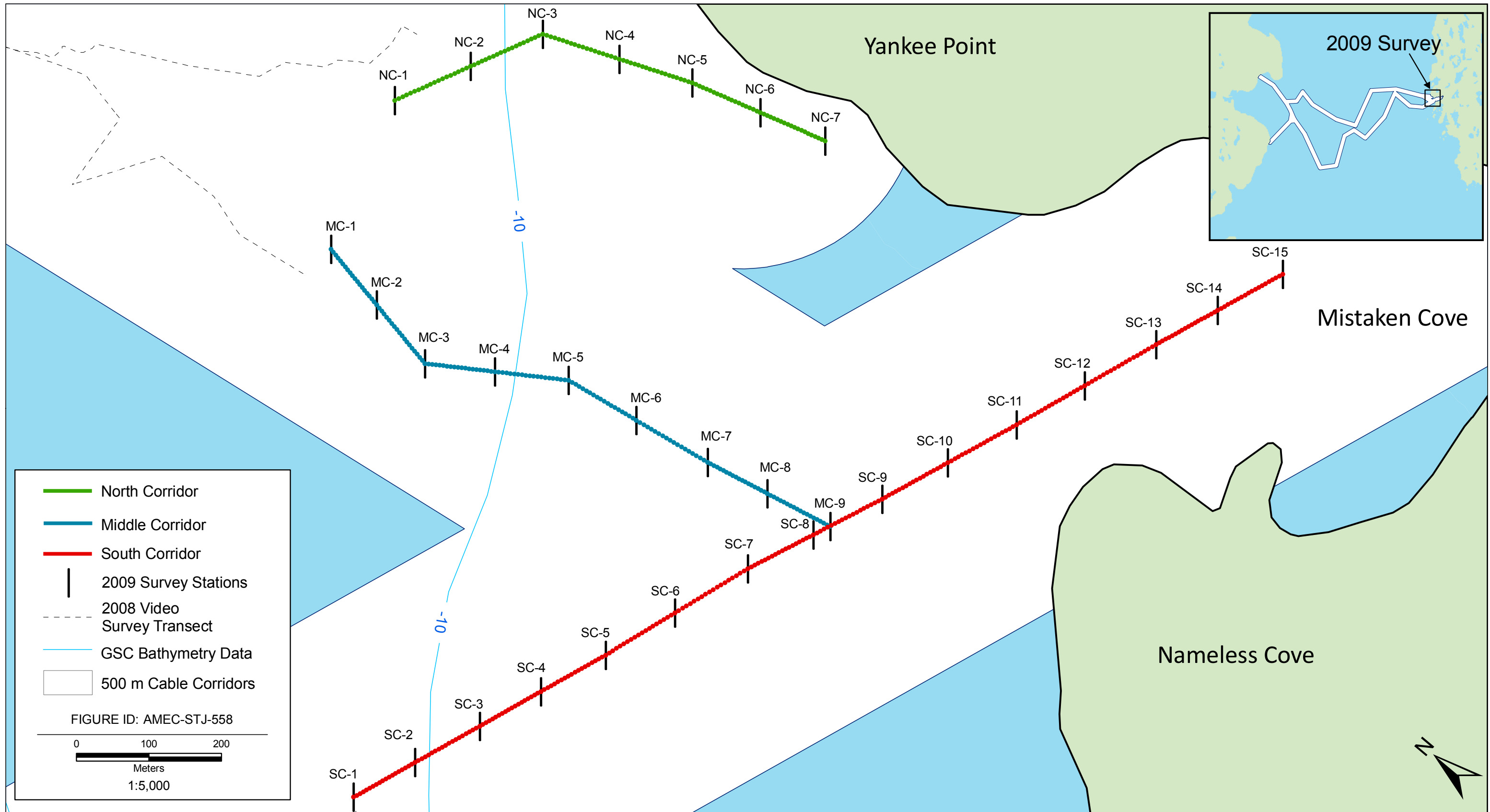


Figure 2.2

Marine Survey for the **Strait of Belles Isle Subsea Corridors - 2009**

2.4 Video Analysis (2008 and 2009)

As the methodology was different in technique and scale between the 2008 drop video survey and the 2009 diver survey (see Sections 2.2 and 2.3), the data from the two surveys were analyzed independently. All data in this report were rounded to the tenth decimal place for presentation but all calculations were performed on actual (unrounded) numbers.

Reaches

For the 2008 marine survey, each transect listed in Table 2.1 was further subdivided into reaches (subsections) based on dominant substrate in that reach. Each reach for the 2008 survey is defined by the substrate composition (e.g. cobble, boulder, rubble) and the proportions of each observed substrate type expressed as a percentage. A significant change in either the detailed substrate type and/or the percentage of substrate type over a given distance signifies the end of one reach and the start of another.

For the 2009 marine survey, each 100 m transect listed in Table 2.2 was further subdivided into reaches (subsections) based exclusively on distance (five metres) and not substrate. The beginning and end of a reach was indicated by tags every five metres on the 100 m transect line.

2.4.1 Substrate Distribution

Substrate distributions were determined based upon the percentage of each substrate found within the corresponding reach using the detailed substrate categories listed below:

- Bedrock
- Large Boulder (> 1000 mm)
- Small Boulder (250 – 1000 mm)
- Rubble (130 – 250 mm)
- Cobble (30 – 130 mm)
- Gravel (2 – 30 mm)
- Sand (0.06 – 2 mm)
- Mud/Silt (< 0.06 mm)
- Organic Detritus
- Shell

The detailed substrate composition was then used to assign each reach to a broad distribution (e.g. coarse-small, coarse-large) category, as outlined in Table 1.3. Both the broad substrate distribution and the detailed distribution were then integrated into a GIS database and mapped. To simplify interpretation of the data, the broad substrate categories (e.g. coarse-large, coarse-small) were used when comparing substrate to floral and faunal distributions.

2.4.2 Macrofloral and Macrofaunal Metrics

Macrofauna

Macrofaunal distributions were identified to the lowest possible taxonomic level and analysed for both percent occurrence (presence/absence) and abundance. Percent occurrence is defined as the percent total length of all the reaches where the taxon was present. This strictly indicates whether a taxon was present or absent within a

specific reach and does not account for abundance or density. The other macrofaunal metric is abundance. The ranking of each taxon within each reach with an abundance score provided an indication of how frequently the species occurred within each reach, although unquantifiable in many instances. The four abundance categories utilized are outlined below:

- **Abundant (A)** - Numerous (not quantifiable) observations made throughout the entire reach.
- **Common (C)** - Numerous (not quantifiable) observations made intermittently along the reach.
- **Occasional (O)** - Quantifiable observations made intermittently along the reach.
- **Uncommon (U)** - Quantifiable observations made infrequently along the reach.

This system of ranking the abundance of species into qualitative categories may result in a single taxon having its highest abundance within more than one depth or substrate category (e.g. a species may be ranked as having its highest abundance within bedrock and coarse-large substrates). Furthermore, reference to highest abundances refers to the location (station), the water depth or the substrate on which the highest abundance category of the taxon was encountered.

Macroflora

Similar to the macrofaunal distributions, macrofloral distributions were quantified for both percent occurrence (presence/absence) and abundance. For macrofloral abundance, percent coverage was used. Percent coverage represents percent of the surficial area of the reach covered by that particular macrofloral taxon.

Species of Concern

All macrofloral and macrofaunal species observed during the 2008 and 2009 survey were cross-checked with the species at risk public registry for special conservation status (SARA 2009) and the provincial registry of endangered species (NL Endangered Species Act).

2.5 2008 Shoreline Survey

Shoreline surveys were conducted at both the proposed and alternative Labrador and Newfoundland landing sites using the methods of DFO's *Development of a Coastal, Marine, Estuarine, and Deep Water Fish Habitat Classification System for the NL Region* (Lee and Teasdale 2008).

Surveys of the Labrador sites (Forteau Point and L'Anse Amour) were conducted on October 3 and 4, 2008 and surveys of the Newfoundland sites (Mistaken Cove and Yankee Point) were conducted on October 13, 2008 (Figure 2.3). Sites were subdivided into transects based upon changes in habitat, and representative photos taken. Substrate characteristics, flora and fauna present and field habitat descriptions were recorded. The field information together with aerial photos and marine charts were used to describe the ecosystem type, oceanographic environment, coastal type, shore unit classification, and zone characteristics as defined in Lee and Teasdale (2008).

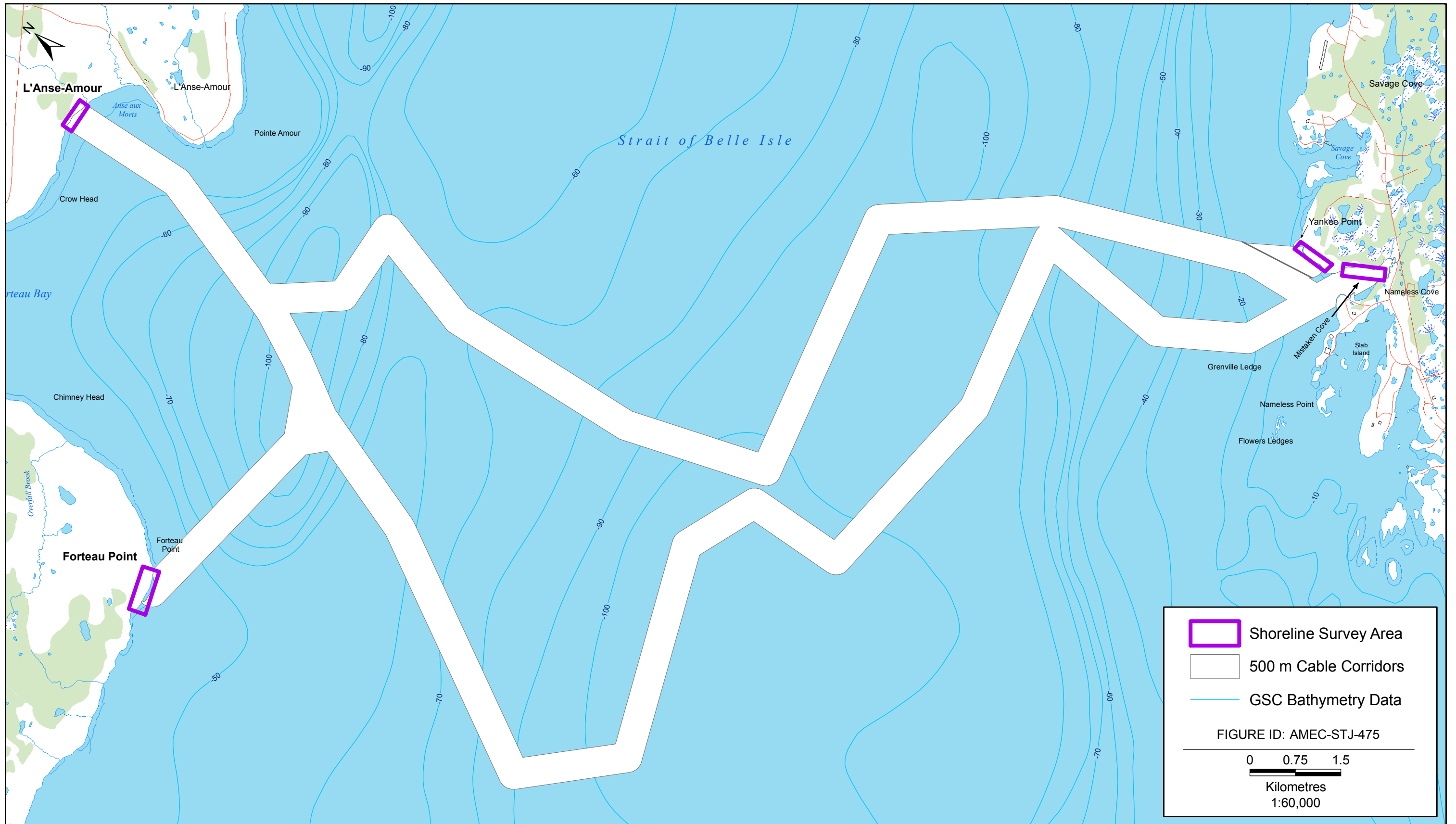


Figure 2.3

Shoreline Survey Areas for the
Proposed Submarine Corridors - 2008 Survey



3.0 RESULTS

The results of the marine video surveys and the shoreline surveys are presented and summarized below. The results are discussed in terms of the marine survey with a summary of the results for substrate, macrofaunal, and macrofloral distributions for the 2008 and 2009 survey followed by the shoreline habitat survey.

3.1 2008 Marine Survey

The results of the drop video analysis for 53 transects (and 277 subsections) ranging in length from 208 m to 3.6 km are presented in Appendix C and summarized below.

3.1.1 Substrate

For each video transect subsection (reach) the most dominant of the broad substrate categories is summarized in Table 3.1 and presented in Figure D-1, Appendix D. Depth/substrate distributions are summarized in Table 3.2. The broad substrates are further broken down into detailed substrate categories in Table 3.3 and mapped in Figure D-2, Appendix D. The following section presents information on both the broad and detailed substrate distributions. Representative photos of each substrate category are presented in Appendix E. The broad substrate categories are discussed in order of dominance, with the most dominant, coarse-small, discussed first and the least dominant, fines, discussed last.

Coarse-Small

The most common broad substrate category encountered along the submarine corridors in the 2008 marine survey was coarse-small (gravel and cobble, 2 mm – 130 mm) which was dominant in 123 subsections with a linear distance of 27,648 m representing 53.1% of the total area surveyed (Table 3.1). Given the ubiquitous distribution of coarse-small substrate there was no discernable depth-related or geographical distribution pattern (Table 3.2; Figures D-1 and D-2, Appendix D). Reaches categorized as coarse-small substrate were cumulatively composed of 60.2% coarse-small substrates (30.8% cobble and 29.4% gravel) as illustrated in Figure D-1 and D-2 (Appendix D) and Table 3.3. The remainder of the area dominated by coarse-small substrate was composed of shell (13.6%), rubble (12.4%), small boulder (4.8%), sand (4.6%), silt/mud (2.8%), large boulder (1.3%), and bedrock (0.3%), (Table 3.3).

Coarse-Large

The second most common broad substrate category encountered along the submarine corridors in the 2008 marine survey was coarse-large (rubble and boulder, >130 mm) which was predominant in 101 subsections with a linear distance of 15,927 m representing 30.6% of the total area surveyed (Table 3.1). Although there was no geographical distribution pattern, subsections predominated by coarse-large substrates were mainly restricted to depths greater than 60 m (Table 3.2; Figure D-1 and D-2, Appendix D). Reaches categorized as coarse-large substrate were cumulatively composed of 57.1% coarse-small substrates (23.4% rubble, 21.6% small boulder, and 12.1% large boulder). The remainder of the area dominated by coarse-large substrate was composed of cobble (14.6%), shell (13.4%), gravel (10.2%), bedrock (2.6%), silt/mud (1.3%), and sand (0.8%), (Table 3.3).

Shell

Shell (calcareous remains of shellfish or other invertebrates containing shells) was predominant in only 34 subsections of the 2008 marine survey with a linear distance of 5,390 m representing 10.4% of the total area surveyed (Table 3.1). Subsections predominated by shell were restricted to depths greater than 60 m (Table 3.2; Figure D-1 and D-2, Appendix D). Geographically, subsections dominated by shell were primarily located within the western portion of the southern submarine cable corridor (Stations 155 – 169), (Figure D-1 and D-2, Appendix D). Reaches categorized as shell were cumulatively composed of 60.9% shell. The remainder of the area dominated by shell substrate was composed of gravel (12.0%), cobble (9.7%), small boulder (5.0%), rubble (4.8%), large boulder (2.9%), silt/mud (2.2%), sand (1.3%), and bedrock (1.2%), (Table 3.3).

Bedrock

Bedrock was sparsely distributed during the 2008 marine survey and was the predominant substrate type in only 16 subsections with a linear distance of 2,066 m representing 4% of the total area surveyed (Table 3.1). There was no geographical or depth-related pattern evident with respect to bedrock distribution (Table 3.2; Figure D-1 and D-2, Appendix D). Reaches categorized as bedrock were cumulatively composed of 57.3% bedrock. The remainder of the area dominated by bedrock substrate was composed of cobble (9.3%), small boulder (8.9%), gravel (7.2%), rubble (6.7%), shell (3.4%), sand (3.3%), large boulder (3.0%), and silt/mud (0.9%), (Table 3.3).

Fine

Fine substrate (silt/sand >0.06 mm – 2 mm) was rarely encountered in the 2008 marine survey, and was the predominant substrate type in only 3 subsections with a linear distance of 1,006 m representing 2% of the total area surveyed (Table 3.1). Subsections predominated by fine substrate were encountered only in depths less than 50 m and were located within approximately 0.75 km of the L'Anse Amour shoreline and 1.5 km of the Mistaken Cove shoreline (Table 3.2; Figure D-1 and D-2, Appendix D). Reaches categorized as fine were cumulatively composed of 85.3% fine substrate (64.8% sand and 20.5% silt/mud). The remainder of the area dominated by fine substrate was composed of gravel (6.6%), shell (3.4%), cobble (3.2%), rubble (1.1%), and small boulder (0.4%), (Table 3.3).

Table 3.1: Dominant Substrate Summary by Reach for the 2008 Marine Survey

Substrate	Reaches (#)	Distance (m)	Coverage (%)
Coarse-small	123	27,648.2	53.1
Coarse-large	101	15,926.9	30.6
Shell	34	5,390.2	10.4
Bedrock	16	2,066.0	4.0
Fine	3	1,006.0	1.9
Total	277	52,037.4	100.0

Table 3.2: Depth/Substrate Category Summary for the 2008 Marine Survey

Depth Substrate Category	Reaches (#)	Distance (m)	Coverage (%)
90 - 130 m Coarse-small	65	13,419.2	25.8
90 - 130 m Coarse-large	69	10,457.3	20.1
60 - 90 m Coarse-small	31	6,523.0	12.5
< 30 m Coarse-small	23	5,790.9	11.1
60 - 90 m Coarse-large	27	5,027.7	9.7
90-130 Shell	18	3,457.0	6.6
30 - 60 m Coarse-small	5	1,987.3	3.8
60-90 m Shell	16	1,933.2	3.7
60 - 90 m Bedrock	8	1,122.6	2.2
< 30 m Bedrock	6	855.0	1.6
< 30 m Fine	2	516.7	1.0
30 - 60 m Fine	1	489.3	0.9
< 30 m Coarse-large	4	369.7	0.7
90 - 130 m Bedrock	2	88.3	0.2
Total	277	52,037.4	100.0

Table 3.3: Broad and Detailed Substrate Summary for the 2008 Marine Survey

Dominant Substrate (broad)	Total distance (m)	Percent Area (%)	*Detailed substrate	Cumulative Area (%)
Coarse-small (mostly cobble and gravel)	27,648.2	53.1	Bedrock Large Boulder Small Boulder Rubble <u>Cobble</u> <u>Gravel</u> Sand Silt/Mud Shell	0.3 1.3 4.8 12.4 30.8 29.4 4.6 2.8 13.6
Coarse-large (mostly large and small boulders and rubble)	15,926.9	30.6	Bedrock <u>Large Boulder</u> <u>Small Boulder</u> <u>Rubble</u> Cobble Gravel Sand Silt/Mud Shell	2.6 12.1 21.6 23.4 14.6 10.2 0.8 1.3 13.4
Shell (mostly shell)	5,390.2	10.4	Bedrock Large Boulder Small Boulder Rubble Cobble Gravel Sand Silt/Mud Shell	1.2 2.9 5.0 4.8 9.7 12.0 1.3 2.2 60.9
Bedrock (mostly bedrock)	2,066.0	4.0	Bedrock Large Boulder Small Boulder Rubble Cobble Gravel Sand Silt/Mud Shell	57.3 3.0 8.9 6.7 9.3 7.2 3.3 0.9 3.4
Fine (mostly sand and silt/mud)	1,006.0	1.9	Bedrock Large Boulder Small Boulder Rubble Cobble Gravel <u>Sand</u> <u>Silt/Mud</u> Shell	0.0 0.0 0.4 1.1 3.2 6.6 64.8 20.5 3.4

Dominant Substrate (broad)	Total distance (m)	Percent Area (%)	*Detailed substrate	Cumulative Area (%)
Totals	52,037.4	100.0	Bedrock	3.3
			Large Boulder	4.9
			Small Boulder	10.2
			Rubble	14.6
			Cobble	22.1
			Gravel	20.2
			Sand	4.1
			Silt/Mud	2.5
			Shell	17.9

*Underlining indicates the detailed substrate category for which the broad category is based upon

Sediment Sampling

Of the 25 stations where sediment sampling was attempted, sediment samples were only collected at two stations, an area between stations 160 and 161 and an area between stations 162 and 163. Shell and gravel were the most dominant detailed substrate category at these stations.

For the remaining 23 stations, sediment sampling was unsuccessful. At these stations gravel and cobble sized substrates prevented either grab (van Veen or Shipek) from sealing completely. Therefore, any fine material (smaller than gravel/cobble) taken during grab sampling would have been washed out while retrieving the grab through the water column. The manufacturer recommends that either grab should not be used to sample particles greater than 2 to 5 cm in diameter (Envco 2009).

3.1.2 Macrofauna

A total of 35 macrofaunal taxa identified within the submarine corridors are listed in Table 3.4. Sample photographs of the taxa are provided in Appendix E.

Table 3.4: Macrofaunal Taxa Observed in 2008 Marine Survey

Rank*	Percent Occurrence	Common Name	Taxon	Category
1	90.0	Starfish	<i>Asterias sp.</i>	Echinoderm
2	83.7	Starfish	<i>Crossaster sp.</i>	Echinoderm
3	80.8	Pale urchin	<i>Strongylocentrotus pallidus</i>	Echinoderm
4	77.4	Hydroids	-	Cnidarian
5	73.1	Sea anemone	-	Cnidarian
6	69.6	Toad crab	<i>Hyas sp.</i>	Crab
7	62.6	Stalked sea squirt	<i>Boltenia sp.</i>	Tunicate
8	62.3	Bryozoans	-	Colonial
9	60.1	Barnacle	<i>Balanus sp.</i>	Mollusc
10	57.2	Deep sea scallop	<i>Placopecten magellanicus</i>	Shellfish
11	55.7	Soft coral	<i>Gersemia sp.</i>	Colonial
12	55.2	Icelandic scallop	<i>Chlamys islandica</i>	Shellfish
13	52.8	Sponge	Porifera	Colonial

Rank*	Percent Occurrence	Common Name	Taxon	Category
14	39.7	Brittle star	<i>Ophiuroidea</i>	Echinoderm
15	29.0	Starfish	<i>Solaster sp.</i>	Echinoderm
16	27.3	Sea squirt	Ascidiacea	Tunicate
17	25.0	Basket star	<i>Gorgonocephalus sp.</i>	Echinoderm
18	24.9	Snow crab	<i>Chionoecetes opilio</i>	Crab
19	16.4	Sea cucumber	<i>Cucumaria frondosa</i>	Echinoderm
20	8.2	Sculpin	<i>Myoxocephalus sp.</i>	Fish
21	7.3	Sand dollar	<i>Echinarachnius parma</i>	Echinoderm
22	6.6	Atlantic cod	<i>Gadus morhua</i>	Fish
23	6.1	Alligatorfish	<i>Aspidophoroides monopterygius</i>	Fish
24	4.6	Blue mussel	<i>Mytilus edulis</i>	Shellfish
25	4.3	Rock crab	<i>Cancer sp.</i>	Crab
26	3.4	Starfish (cushion star)	<i>Asterina sp.</i>	Echinoderm
27	2.3	Fan worm	Polychaeta	Other
28	1.6	Green urchin	<i>Strongylocentrotus droebachiensis</i>	Echinoderm
29	1.3	Unidentified fish	-	Fish
30	1.3	Whelk	<i>Buccinum sp.</i>	Mollusc
31	1.2	Stalked jellyfish	Stauromedusae	Cnidarian
32	1.1	Sea anemone	<i>Metridium sp.</i>	Cnidarian
33	0.2	Hermit crab	<i>Pagurus sp.</i>	Crab
34	0.1	Gastropod	-	Mollusc
35	0.1	Pycnogonid	Pycnogonida	Other

*Rank is based on percent occurrence, the percent total length of all the reaches where the taxon was present

Distribution maps for each individual taxon are presented in Appendix F. Table 3.5 provides a summary of macrofaunal distributions subdivided by percentage occurrence categories of 75-100%, 50-75%, 25-50%, 5-25%, and 1-5%. Table 3.6 provides a summary of the percentage occurrence and linear distances where macrofaunal species were encountered and their corresponding abundances.

Macrofauna distribution summary charts and data summary tables based upon percentage occurrences within depth categories (<30, 30-60, 60-90, and 90-130 m) and broad substrate categories (bedrock, coarse-large, coarse-small, fine, and shell) are presented in Appendix G. The macrofaunal species distributions are discussed in the order of dominant distribution with the most dominant, starfish (*Asteria sp.*), discussed first and least dominant, pycnogonid, discussed last.

Macrofauna Species Distribution (75-100%)

The most widely distributed macrofauna species with distributions of 75 to 100% included starfish (*Asterias sp.*), starfish (*Crossaster sp.*), pale urchin (*Strongylocentrotus pallidus*), and hydroids (numerous species), (Table 3.4 and 3.5).

Starfish (*Asterias sp.*)

Starfish (*Asterias sp.*) were observed throughout 90% (46.8 km) of the marine survey area with abundances ranging from uncommon (39.3%) to occasional (42%) to common (8.7%), (Table 3.6). Although distributed throughout all depth and substrate categories, the highest percent occurrence was in the 90-130 m depth category and within the coarse-small substrate category (Figure G-7, Appendix G). The highest abundances (common) for *Asterias sp.* were found from Station 146 to 147 and from Station 179 to 181 and were associated primarily with depths of 60 to 90 m and coarse-large substrates (Figure F-1, Appendix F).

Starfish (*Crossaster sp.*)

Starfish (*Crossaster sp.*) were observed throughout 83.7% (43.6 km) of the marine survey area with abundances ranging from uncommon (48.8%) to occasional (33.7%) to common (1.2%), (Table 3.6). Although distributed throughout all depth and substrate categories, the highest percent occurrence was in 90-130 m depth and within the coarse-small substrate category (Figure G-7, Appendix G). The highest abundances (common) for *Crossaster sp.* were found from Station 180 to 181 and from Station 155 to 156 (nearshore, Forteau Point) and were associated primarily with depths and substrates of < 30 m (coarse-small) to 90-130 m (coarse-large), respectively (Figure F-2, Appendix F).

Pale urchin (*Strongylocentrotus pallidus*)

Pale urchin were observed throughout 80.8% of the marine survey area with abundances ranging from uncommon (53.2%) to occasional (27.5%) to common (0.1%), (Table 3.6). Although distributed throughout all depth and substrate categories, the highest percent occurrence was in 90-130 m depth range over coarse-small substrates (Figure G-6, Appendix G). The highest abundances (common) for pale urchin were found from Station 161 to 162, Station 146 to 147 and Station 124 to 125 and were associated primarily with depths of 90-130 m, with the exception of 124 to 125 with < 30 m depth, and with coarse-small and coarse-large substrates (Figure F-3, Appendix F).

Hydroids (various species)

Hydroids were observed throughout 77.4% of the marine survey area with abundances ranging from uncommon (4.2%) to occasional (18.2%) to common (37.7%) to abundant (17.2%), (Table 3.6). Although widely distributed throughout all depth and substrate categories, the highest percent occurrence was in 90-130 m depths over coarse-small substrates (Figure G-3, Appendix G). The highest abundances (abundant) for hydroids were most commonly associated with depths of 60 to 130 m and coarse-small to coarse-large substrates. Hydroids were rarely encountered at depths less than 60 m or on fine, shell or bedrock substrates. The most abundant distributions were located between Stations 170 and 172 (Figure F-4, Appendix F).

Table 3.5: Macrofaunal Distributions by Percentage Occurrence Categories for the 2008 Marine Survey

75-100%	50-75%	25-50%	5-25%	<5%
Starfish (<i>Asterias sp.</i>)	Sea anemone	Brittle star (<i>Ophiuroidea</i>)	Sea cucumber (<i>Cucumaria frondosa</i>)	Blue mussel (<i>Mytilus edulis</i>)
Starfish (<i>Crossaster sp.</i>)	Toad crab (<i>Hyas sp.</i>)	Starfish (<i>Solaster sp.</i>)	Sculpin (<i>Myoxocephalus sp.</i>)	Rock crab (<i>Cancer sp.</i>)
Pale urchin (<i>Strongylocentrotus pallidus</i>)	Stalked sea squirt (<i>Boltenia sp.</i>)	Sea squirt (<i>Asciacea</i>)	Sand dollar (<i>Echinarachnius parma</i>)	Cushion star (<i>Asterina sp.</i>)
Hydroids	Bryozoans	Basket star (<i>Gorgonocephalus sp.</i>)	Atlantic cod (<i>Gadus morhua</i>)	Fan worm (<i>Polychaeta</i>)
	Barnacle (<i>Balanus sp.</i>)	Snow crab (<i>Chionoecetes opilio</i>)	Alligatorfish (<i>Aspidophoroides monopterygius</i>)	Green urchin (<i>Strongylocentrotus droebachiensis</i>)
	Deep sea scallop (<i>Placopecten magellanicus</i>)			Fish - unidentified
	Soft coral (<i>Gersemia sp.</i>)			Whelk (<i>Buccinum sp.</i>)
	Icelandic scallop (<i>Chlamys islandica</i>)			Stalked jellyfish (<i>Stauromedusae</i>)
	Sponge (<i>Porifera</i>)			Sea anemone (<i>Metridium sp.</i>)
				Hermit crab (<i>Pagurus sp.</i>)
				Gastropod
				Pycnogonid (<i>Pycnogonida</i>)

Table 3.6: Macrofaunal Species Distribution Summary with Relative Abundances for the 2008 Marine Survey

Taxon	Total (all abundance categories)			Abundant			Common			Occasional			Uncommon		
	Area (%)	Reach (#)	*Distance (km)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)
Starfish (<i>Asterias sp.</i>)	90.0	235	46.8	-	-	-	8.7	21	45,210.0	42.0	92	21,871.9	39.3	122	20,431.8
Starfish (<i>Crossaster sp.</i>)	83.7	205	43.6	-	-	-	1.2	2	630.4	33.7	61	17,513.8	48.8	142	25,413.9
Pale urchin (<i>Strongylocentrotus pallidus</i>)	80.8	208	42.1	-	-	-	0.1	4	71.9	27.5	60	14,316.3	53.2	144	27,663.8
Hydroid	77.4	226	40.3	17.2	59	8,960.9	37.7	99	19,626.5	18.2	52	9,494.9	4.2	16	2,172.4
Sea anemone	73.1	190	38.0	0.1	1	54.4	5.1	16	2,637.9	31.2	78	16,261.0	36.6	95	19,069.4
Toad crab (<i>Hyas sp.</i>)	69.6	179	36.2	-	-	-	3.6	6	1,891.6	25.8	56	13,402.2	40.2	117	20,928.2
Stalked sea squirt (<i>Boltenia sp.</i>)	62.6	164	32.6	0.2	1	119.1	2.5	10	1,325.2	18.6	49	9,696.3	41.2	104	21,447.9
Bryozoans	62.3	173	32.4	0.1	1	60.0	6.7	28	3,484.1	32.7	93	17,024.1	22.8	51	11,856.7
Barnacle (<i>Balanus sp.</i>)	60.1	155	31.3	0.6	1	334.7	7.6	17	3,934.1	27.3	67	14,208.9	24.5	70	12,774.7
Deep sea scallop (<i>Placopecten magellanicus</i>)	57.2	141	29.8	-	-	-	9.2	13	4,763.9	24.4	60	12,704.6	23.6	68	12,295.8
Soft coral (<i>Gersemia sp.</i>)	55.7	153	29.0	1.3	4	681.4	14.4	26	7,484.8	20.0	60	10,385.7	20.1	63	10,437.3
Icelandic scallop (<i>Chlamys islandica</i>)	55.2	120	28.7	-	-	-	1.3	3	662.6	8.7	20	4,538.3	45.2	97	23,536.6
Sponge (Porifera)	52.8	143	27.5	1.0	4	543.3	7.6	20	3,936.0	12.6	45	6,559.7	31.6	74	16,433.2

Taxon	Total (all abundance categories)			Abundant			Common			Occasional			Uncommon		
	Area (%)	Reach (#)	*Distance (km)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)
Brittle star (<i>Ophiuroidea sp.</i>)	39.7	90	20.7	0.8	3	416.9	9.8	26	5,112.1	19.3	45	10,023.0	9.8	16	5,100.4
Starfish (<i>Solaster sp.</i>)	29.0	51	15.1	-	-	-	-	-	-	4.2	4	2,209.2	24.7	47	12,876.8
Sea squirt (<i>Ascidiacea sp.</i>)	27.3	66	14.2	-	-	-	0.6	1	297.6	1.2	2	613.5	25.5	63	13,285.8
Basket star (<i>Gorgonocephalus sp.</i>)	25.0	80	13.0	1.3	4	670.9	4.7	17	2,421.3	4.3	17	2,219.2	14.8	42	7,697.9
Snow crab (<i>Chionoecetes opilio</i>)	24.9	55	12.9	-	-	-	-	-	-	0.6	2	301.5	24.3	53	12,645.1
Sea cucumber (<i>Cucumaria frondosa</i>)	16.4	35	8.5	-	-	-	-	-	-	0.5	1	249.4	15.9	34	8,290.0
Sculpin (<i>Myoxocephalus sp.</i>)	8.2	14	4.3	-	-	-	-	-	-	-	-	-	8.2	14	4,267.2
Sand dollar (<i>Echinarachnius parma</i>)	7.3	14	3.8	-	-	-	0.0	1	6.8	2.3	5	1,207.0	4.9	8	2,562.3
Atlantic cod (<i>Gadus morhua</i>)	6.6	15	3.4	-	-	-	-	-	-	-	-	-	6.6	15	3,418.2
Alligatorfish (<i>Aspidophoroides monopterygius</i>)	6.1	16	3.2	-	-	-	-	-	-	-	-	-	6.1	16	3,150.2
Blue mussel (<i>Mytilus edulis</i>)	4.6	4	2.4	-	-	-	-	-	-	-	-	-	4.6	4	2,403.9
Rock crab (<i>Cancer sp.</i>)	4.3	10	2.2	-	-	-	-	-	-	0.8	2	418.7	3.5	8	1,804.5
Cushion star (<i>Asterina sp.</i>)	3.4	6	1.8	-	-	-	-	-	-	-	-	-	3.4	6	1,764.3
Fan worm	2.3	2	1.2	-	-	-	-	-	-	-	-	-	2.3	2	1,190.2

Taxon	Total (all abundance categories)			Abundant			Common			Occasional			Uncommon		
	Area (%)	Reach (#)	*Distance (km)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)
(Polychaeta)															
Green urchin (<i>Strongylocentrotus droebachiensis</i>)	1.6	3	0.82	-	-	-	0.8	1	400.7	0.4	1	196.6	0.4	1	221.1
Fish - unidentified	1.3	3	0.69	-	-	-	-	-	-	-	-	-	1.3	3	693.3
Whelk (<i>Buccinum sp.</i>)	1.3	1	0.66	-	-	-	-	-	-	-	-	-	1.3	1	660.6
Stalked jellyfish (Stauromedusae)	1.2	4	0.62	-	-	-	-	-	-	-	-	-	1.2	4	618.3
Sea anemone (<i>Metridium sp.</i>)	1.1	2	0.60	0.8	1	400.7	-	-	-	0.4	1	196.6	-	-	-
Hermit crab (<i>Pagurus sp.</i>)	0.2	1	0.13	-	-	-	-	-	-	-	-	-	0.2	1	125.9
Gastropod	0.1	1	0.06	-	-	-	-	-	-	-	-	-	0.1	1	57.6
Pycnogonid (Pycnogonida)	0.1	1	0.05	-	-	-	-	-	-	-	-	-	0.1	1	45.9

*Distance is total length of all reaches combined where taxon was observed

Macrofauna Species Distribution (50-75%)

Macrofauna species with distributions ranging from 50 to 75% included sea anemone (non *Metridium* species), toad crab (*Hyas sp.*), stalked sea squirt (*Boltenia sp.*), bryozoans (various species), barnacle (*Balanus sp.*), deep sea scallop (*Placopecten magellanicus*), soft coral (*Gersemia sp.*), Icelandic scallop (*Chlamys islandica*), and sponge (Porifera), (Table 3.5 and Table 3.6).

Sea anemone (non *Metridium* species)

Sea anemone were observed throughout 73.1% of the marine survey area with abundances ranging from uncommon (36.6%) to occasional (31.2%) to common (5.1%) to abundant (0.1%), (Table 3.6). Although widely distributed throughout all depth and substrate categories, the highest percent occurrence was at depths of 90-130 m over coarse-small substrate (Figure G-3, Appendix G). Anemones were rarely encountered at depths less than 60 m or upon shell, fine, or bedrock substrates. The highest abundances (abundant) for sea anemone were located between Stations 164 and 165 at a depth of 60-90 m on coarse-small substrate (Figure F-5, Appendix F).

Toad crab (*Hyas sp.*)

Toad crab were observed throughout 69.6% of the marine survey area with abundances ranging from uncommon (40.2%) to occasional (25.8%) to common (3.6%), (Table 3.6). Although widely distributed throughout all depth and most substrate categories, the highest percent occurrence was at depths of 90-130 m and coarse-small substrates (Figure G-5, Appendix G). Toad crabs were rarely associated with depths less than 60 m or upon bedrock substrates. Toad crabs were not encountered on fine substrate. The highest abundances (common) for toad crabs were located between Stations 175 and 178 at a depth of 90-130 m on shell, coarse-small, and coarse-large substrates (Figure F-6, Appendix F).

Stalked sea squirt (*Boltenia sp.*)

Stalked sea squirt were observed throughout 62.6% of the marine survey area with abundances ranging from uncommon (41.2%) to occasional (18.6%) to common (2.5%) to abundant (0.2%), (Table 3.6). Although widely distributed throughout most depth and substrate categories, the highest percent occurrence was in 90-130 m and coarse-small substrates (Figure G-12, Appendix G). The most abundant (abundant) distributions of stalked sea squirts were at depths of 90 to 130 m with coarse-large substrates. Stalked sea squirts were rarely encountered at depths less than 30 m or upon shell or bedrock substrates. Stalked sea squirts were not encountered between depths of 30 to 60 m or upon fine substrate. The highest abundance (abundant) of sea squirts was located at Station 171 at a depth of 90-130 m on coarse-large substrate (Figure F-7, Appendix F).

Bryozoan

Bryozoans were observed throughout 62.3% of the marine survey area with abundances ranging from uncommon (22.8%) to occasional (32.7%) to common (6.7%) to abundant (0.1%), (Table 3.6). Although widely distributed throughout most depth and substrate categories, the highest percent occurrence was in 90 to 130 m and coarse-small substrates. Bryozoans were rarely encountered at depths less than 60 m or upon shell or bedrock substrates. Bryozoans were not encountered upon fine substrate (Figure G-4, Appendix G). The highest abundances (abundant) of bryozoans were located between Stations 137 and 138 at a depth of 60-90 m upon coarse-large substrate (Figure F-8, Appendix F).

Barnacle (*Balanus sp.*)

Barnacle were observed throughout 60.1% of the marine survey area with abundances ranging from uncommon (24.5%) to occasional (27.3%) to common (7.6%) to abundant (0.6%), (Table 3.6). Although widely distributed throughout most depth and substrate categories, the highest percent occurrence was at depths of 90 to 130 m over coarse-small substrates. Barnacles were rarely encountered on shell or bedrock substrates or at depths less than 30 m. Additionally, barnacles were not encountered at depths between 30 and 60 m or upon fine substrate (Figure G-9, Appendix G). The highest abundance (abundant) of barnacles was located at Station 183 at a depth of 60-90 m upon bedrock substrate (Figure F-9, Appendix F).

Deep sea scallop (*Placopecten magellanicus*)

Deep sea scallop were observed throughout 57.2% of the marine survey area with abundances ranging from uncommon (23.6%) to occasional (24.4%) to common (9.2%), (Table 3.6). Although widely distributed throughout all depth and substrate categories, the highest percent occurrence was at a depth of 90 to 130 m on coarse-small substrates. Deep sea scallop were rarely encountered at depths less than 60 m or on shell or bedrock substrates and were not found on fine substrate (Figure G-11, Appendix G). The highest abundances (common) of deep sea scallop were located between Stations 139 and 140 and at Station 146, and was associated with depths of 60 to 130 m upon shell, coarse-small, and coarse-large substrates (Figure F-10, Appendix F).

Soft coral (*Gersemia sp.*)

Soft coral were observed throughout 55.7% of the marine survey area with abundances ranging from uncommon (20.1%) to occasional (20%) to common (14.4%) to abundant (1.3%), (Table 3.6). Although widely distributed throughout all depth and substrate categories, the highest percent occurrence was in depths of 90 to 130 m and coarse-small substrates. Soft coral were rarely encountered on shell or bedrock substrates or at depths less than 60 m. Soft coral were not encountered upon fine substrate (Figure G-4, Appendix G). The highest abundances (abundant) of soft coral were located between Stations 161 and 163, and at Station 166, and were associated with depths of 60 to 130 m upon substrates of coarse-small, coarse-large, and bedrock (Figure F-11, Appendix F).

Icelandic scallop (*Chlamys islandica*)

Icelandic scallop were observed throughout 55.2% of the marine survey area in abundances ranging from uncommon (45.2%) to occasional (8.7%) to common (1.3%), (Table 3.6). Although widely distributed throughout all depth and substrate categories, the highest percent occurrence was in depths of 90 to 130 m and coarse-small substrates (Figure G-11, Appendix G). Icelandic scallop were rarely encountered at depths less than 60 m or on fine or bedrock substrates. The highest abundances (common) of Icelandic scallop were located between Stations 143 and 144 and at Station 186, and were associated with depths of 60 to 130 m upon coarse-small substrate (Figure F-12, Appendix F).

Sponge (*Porifera*)

Sponge were observed throughout 52.8% of the marine survey area with abundances ranging from uncommon (31.6%) to occasional (12.6%) to common (7.6%) to abundant (1%), (Table 3.6). Although widely distributed throughout most depth and substrate categories, the highest percent occurrence was in depths of 90 to 130 m and coarse-small substrates. Sponges were rarely encountered at depths less than 60 m or on shell or bedrock substrates. Sponges were not encountered at depths of 30-60 m or on fine substrate (Figure G-4, Appendix G).

The highest abundances (abundant) of sponges were located at Station 163 and between Stations 180 and 181, and were associated with depths of 60 to 130 m upon coarse-large substrate (Figure F-13, Appendix F).

Macrofauna Species Distribution (25-50%)

Macrofauna species with distributions ranging from 25 to 50% included brittle star (Ophiuroidea), starfish (*Solaster sp.*), sea squirt (Ascidiacea), basket star (*Gorgonocephalus sp.*), and snow crab (*Chionoecetes opilio*), (Table 3.5 and Table 3.6).

Brittle star (*Ophiuroidea sp.*)

Brittle star were observed throughout 39.7% of the marine survey area with abundances ranging from uncommon (9.8%) to occasional (19.3%) to common (9.8%) to abundant (0.8%), (Table 3.6). Although widely distributed throughout most depth and substrate categories, the highest percent occurrence was in depths of 90 to 130 m over coarse-small substrates. Brittle stars were rarely encountered at depths of 30 to 60 m or on shell or bedrock substrates, and were not encountered on fine substrate (Figure G-6, Appendix G). The highest abundances (abundant) of brittle star were located at Station 178 and between Stations 142 and 143, and were associated with depths of 90 to 130 m upon coarse-large and coarse-small substrate (Figure F-14, Appendix F).

Starfish (*Solaster sp.*)

Starfish (*Solaster sp.*) were observed throughout 29% of the marine survey area with abundances ranging from uncommon (24.7%) to occasional (4.2%), (Table 3.6). Although widely distributed throughout most depth and substrate categories, the highest percent occurrence was at depths of 60 to 90 m with coarse-small substrates. *Solaster sp.* were less frequently encountered at depths less than 60 m or on shell or fine substrates, and were not encountered on bedrock substrate (Figure G-7, Appendix G). The highest abundances (occasional) of *Solaster sp.* were located between Stations 124 and 127 and near station 138 and were associated with depths of 0 to 90 m upon coarse-small and fine substrate (Figure F-15, Appendix F).

Sea squirt (*Ascidiacea*)

Sea squirt were observed throughout 27.3% of the marine survey area with abundances ranging from uncommon (25.5%) to occasional (1.2%) to common (0.6%), (Table 3.6). Although widely distributed throughout most depth and substrate categories, the highest percent occurrence was in depths of 60 to 130 m and coarse-small substrates. Sea squirts were less frequently encountered on shell and bedrock substrate. Sea squirts were not encountered at depths less than 60 m or on fine substrate (Figure G-12, Appendix G). The highest abundance (common) was located between Stations 175 and 176 and was associated with depths of 90 to 130 m and shell substrate (Figure F-16, Appendix F).

Basket star (*Gorgonocephalus sp.*)

Basket star were observed throughout 25% of the marine survey area with abundances ranging from uncommon (14.8%) to occasional (4.3%) to common (4.7%) to abundant (1.3%), (Table 3.6). Although basket stars were widely distributed through most depth and substrate categories, the highest percent occurrence was in depths of 90 to 130 m and coarse-small substrates. Basket star were not observed in depths less than 60 m and were rarely encountered on shell or bedrock substrates. Basket star were not encountered on fine substrate (Figure G-6, Appendix G). The highest abundances (abundant) of basket stars were located from Station 144 to 145 and

at Station 178 and were associated with depths of 90 to 130 m and coarse-large substrate (Figure F-17, Appendix F).

Snow crab (*Chionoecetes opilio*)

Snow crab were observed throughout 24.9% of the marine survey area with abundances ranging from uncommon (24.3%) to occasional (0.6%), (Table 3.6). Although widely distributed between all depth and substrate categories, the highest percent occurrence was at depths of 90 to 130 m over coarse-small substrate. Snow crab were also encountered at depths of less than 90 m on substrates of coarse-large, fine, shell, and bedrock (Figure G-5, Appendix G). The highest abundances (occasional) were located between Stations 140 to 141 and at Station 173 and were associated with coarse-small and coarse-large substrates at depths of 90-130 m (Figure F-18, Appendix F).

Macrofauna Species Distribution (5-25%)

Macrofauna species with distributions ranging from 5 to 25% included sea cucumber (*Cucumaria frondosa*), sculpin (*Myoxocephalus sp.*), sand dollar (*Echinarachnius parma*), Atlantic cod (*Gadus morhua*), and alligatorfish (*Aspidophoroides monopterygius*).

Sea cucumber (*Cucumaria frondosa*)

Sea cucumber were observed throughout 16.4% of the marine survey area with abundances ranging from uncommon (15.9%) to occasional (0.5%), (Table 3.6). Although widely distributed between all depth and all but two substrate categories, the highest percent occurrence was depths of 90 to 130 m over coarse-small substrate. Sea cucumber were infrequently observed at depths less than 90 m and on coarse-large and shell substrates. Sea cucumber were not encountered in association with fine or bedrock substrates (Figure G-6, Appendix G). The highest abundance (occasional) was located at Station 134 and was associated with a depth of 90-130 m over coarse-large substrate (Figure F-19, Appendix F).

Sculpin (*Myoxocephalus sp.*)

Sculpin were observed throughout 8.2% of the marine survey area in uncommon (8.2%) abundance (Table 3.6). Although distributed between all depth and most substrate categories, the highest percent occurrence was at depths between 30 to 60 m over coarse-small substrates. Sculpin were less frequently encountered at depths less than 30 m and on fine and bedrock substrates. Sculpin were not encountered in association with shell substrate (Figure G-8 Appendix G). Sculpin were encountered in uncommon abundances on 14 separate reaches (Figure F-20, Appendix F).

Sand dollar (*Echinarachnius parma*)

Sand dollar were observed throughout 7.3% of the marine survey area in abundances ranging from uncommon (4.9%) to occasional (2.3%) to common (0.01%), (Table 3.6). Although distributed across all depth and substrate categories, sand dollars were most frequently encountered within reaches where water depths were between 30 to 60 m and substrate was comprised of coarse-small substrates. Sand dollars were infrequently encountered at depths less than 30 m and on fine, shell, coarse-large, and bedrock substrates (Figure G-6, Appendix G). The highest abundance (common) was between Stations 124 and 125 (nearshore at L'Anse Amour) in association with a depth of less than 30 m and coarse-large substrate (Figure F-21, Appendix F).

Atlantic cod (*Gadus morhua*)

Atlantic cod were sporadically observed throughout the marine survey area in only uncommon abundance (6.6%), (Table 3.6). Atlantic cod were sparsely distributed across all depth categories and all but one substrate category, the highest percent occurrence were at depths of 90 to 130 m over coarse-small substrates. Atlantic cod were less frequently associated with depths between 30 to 60 m and bedrock or fine substrates. Atlantic cod were not encountered over shell substrate (Figure G-8, Appendix G). Although there were no areas with abundant or common distributions of Atlantic cod, there was an area between Sections 133 and 136 within which Atlantic cod were encountered within five separate reaches (uncommon distribution) within a depth regime of 90 to 130 m and substrates of coarse-large and coarse-small (Figure F-22, Appendix F).

Alligatorfish (*Aspidophoroides monopterygius*)

Alligatorfish were sporadically observed throughout the marine survey area in only uncommon abundance (6.1%), (Table 3.6). Alligatorfish were sparsely distributed between depths of 60 to 130 m, with the highest percent occurrence at depths of 60 to 90 m and associated with coarse-small substrates. Alligatorfish were less frequently associated with coarse-large, bedrock, and shell substrates. Alligatorfish were not encountered over fine substrate (Figure G-8, Appendix G). Although distributions were sparse (uncommon), alligatorfish were encountered seven times between Stations 166 to 169 within a depth regime of 60 to 130 m and over substrates of shell and coarse-small (Figure F-23, Appendix F).

Macrofauna Species Distribution (< 5%)

Macrofauna species that were rarely observed with distributions < 5% within the marine survey area include blue mussel (*Mytilus edulis*), rock crab (*Cancer sp.*), cushion star (*Asterina sp.*), fan worm (Polychaeta), green urchin (*Strongylocentrotus droebachiensis*), unidentified fish, whelk (*Buccinum sp.*), stalked jellyfish (Stauromedusae), sea anemone (*Metridium sp.*), hermit crab (*Pagurus sp.*), gastropod, and pycnogonid (Pycnogonida), (Table 3.5 and Table 3.6).

Blue mussel (*Mytilus edulis*)

Blue mussel were rarely observed (4.6%) throughout the marine survey area in uncommon abundances only (Table 3.6). Blue mussels were present at two locations within 2 km of the L'Anse Amour shoreline (between Stations 124 and 127) and at two locations within 2 km of the Mistaken Cove shoreline (Station 149 and Station 150), (Figure F-24, Appendix F). All locations were at depths of either < 30 m or 30-60 m and were characterized by coarse-small and fine substrates (Figure G-11, Appendix G).

Rock crab (*Cancer sp.*)

Rock crab were rarely observed (4.3%) in the marine survey area in abundances ranging from uncommon (3.5%) to occasional (0.8%) (Table 3.6). Rock crab were sparsely distributed in depth categories of less than 30 m (4.0%) and 90-130 m (0.3%) over coarse-small (3.4%), bedrock (0.5%), and fine (0.4%) substrates (Figure G-5, Appendix G). The highest abundances (occasional) of rock crab were between Stations 149 to 152 within 1-2 km of the Newfoundland (Mistaken Cove) shoreline at depths less than 30 m and in association with coarse-small and bedrock substrate (Figure F-25, Appendix F).

Cushion star (*Asterina sp.*)

Cushion star (*Asterina sp.*) were rarely observed (3.4%) in the marine survey area in only uncommon abundances (Table 3.6). Cushion stars were sparsely distributed in a depth range from 60 to 130 m over coarse-large (2.5%), coarse-small (0.4%), and shell (0.5%) substrates (Figure G-7, Appendix G). The most consistent distribution (uncommon) was located between Stations 134 and 135 at depths between 90 to 130 m and mainly on coarse-large substrates (Figure F-26, Appendix F).

Fan worm (*Polychaeta*)

Fan worm were rarely observed (2.3%) in the marine survey area in only uncommon abundances (Table 3.6), (Figure G-10, Appendix G). Fan worms were noted at only two locations; Station 156 (near Forteau Point) at a depth of 60 to 90 m over coarse-small substrate, and Station 188 (near Mistaken Cove) at a depth of less than 30 m over coarse-small substrate (Figure F-27, Appendix F).

Green urchin (*Strongylocentrotus droebachiensis*)

Green urchin were rarely observed (1.6%) in the marine survey area in common (0.8%), occasional (0.4%), and uncommon (0.4%) occurrences (Table 3.6), (Figure G-6, Appendix G). The highest distributions (common) were encountered from Station 155 to 156 in the nearshore environment near Forteau Point and were associated with a depth of less than 30 m over coarse-small substrate. The only other occurrence was at Station 188 near Mistaken Cove at a depth of less than 30 m and a mixture of coarse-small and fine substrates (Figure F-28, Appendix F).

Fish (unidentified)

Fish observed at insufficient resolution for identification were rarely encountered (1.3%) in the marine survey area with abundances classified as uncommon (Table 3.6), (Figure G-8, Appendix G). Unidentified fish were encountered only at Station 169 and between Stations 175 to 177 at depths of 90 to 130 m and in association with coarse-small and shell substrates (Figure F-29, Appendix F).

Whelk (*Buccinum sp.*)

Whelk were rarely observed (1.3%) in the marine survey area with their abundances classified as uncommon (Table 3.6), (Figure G-9, Appendix G). Whelk were noted at only Station 156 near Forteau Point at a depth of 60 to 90 m in association with coarse-small substrate (Figure F-30, Appendix F).

Stalked jellyfish (*Stauromedusae*)

Stalked jellyfish were rarely observed (1.2%) in the marine survey area and were only found in uncommon abundances (Table 3.6), (Figure G-3, Appendix G). Stalked jellyfish were noted between Stations 180 and 181, and at Stations 146, 148, and 149 at depths ranging from 30 m to 130 m over coarse-small and coarse-large substrates (Figure F-31, Appendix F).

Sea anemone (*Metridium sp.*)

Sea anemone (*Metridium sp.*) were rarely observed (1.1%) in the marine survey with abundances ranging from occasional (0.4%) to abundant (0.8%), (Table 3.6), (Figure G-3, Appendix G). Sea anemone (*Metridium sp.*) were encountered only within the nearshore environment of Forteau Point from Station 155 to 156 to a depth of 60 m and in association with coarse-small substrate (Figure F-32, Appendix F).

Hermit crab (*Pagurus sp.*)

Hermit crab were rarely observed (0.2%) in the marine survey area in only uncommon abundances (Table 3.6), (Figure G-5, Appendix G). Hermit crab was encountered only between Stations 140 and 141 at a depth of 90-130 m and in association with coarse-small substrate (Figure F-33, Appendix F).

Gastropod (*Gastropoda*)

Gastropod were rarely observed (0.1%) in the marine survey area in only uncommon abundance (Table 3.6), (Figure G-9, Appendix G). Gastropod were encountered only at Station 144 at a depth of 90-130 m in association with coarse-large substrate (Figure F-34, Appendix F).

Pycnogonid (*Pycnogonida*)

Pycnogonid were rarely observed (0.1%) in the marine survey area in only uncommon abundance (Table 3.6), (Figure G-10, Appendix G). Pycnogonid were encountered only at Station 180 at a depth of 90-130 m in association with coarse-small substrate (Figure F-35, Appendix F).

Species of Special Conservation Status

The Atlantic cod population as a whole is listed under Schedule 3 of SARA as a species of Special Concern. The area of the 2008 marine survey is adjacent to both the Newfoundland and Labrador population and the Laurentian north population of Atlantic cod. The Newfoundland and Labrador population has a COSEWIC designation of endangered and the Laurentian north population has a COSEWIC designation of threatened.

3.1.3 Macroflora

Nine macrofloral taxa were identified from the video in the 2008 survey and are listed in Table 3.7. Species photographs are provided in Appendix E.

Table 3.7: Macrofloral Taxa for the 2008 Marine Survey

Rank*	Percent Occurrence	Common Name	Taxon	Macrofloral Type
1	28.9	Coralline algae	Various species	Red algae
2	25.0	Crustose algae	<i>Lithothamnium sp.</i>	Red algae
3	8.3	Sea colander	<i>Agurum cribosum</i>	Brown algae
4	7.5	Red fern	<i>Ptilota sp.</i>	Red algae
5	6.7	Sour weed	<i>Desmarestia sp.</i>	Brown algae
6	3.1	Kelp	<i>Laminaria sp.</i>	Brown algae
7	1.2	Knotted wrack	<i>Ascophyllum nodosum</i>	Brown algae
8	0.4	Edible kelp	<i>Alaria sp.</i>	Brown algae
9	0.4	Rockweed	<i>Fucus sp.</i>	Brown algae

*Rank is based on percent occurrence, the percent total length of all the reaches where the taxon was present

Distribution maps for each individual taxon are presented in Appendix H. Table 3.8 provides a summary of macrofloral species encountered by percent occurrence categories of 20-30%, 5-20%, 1-5%, and storm toss. Table 3.9 provides a summary of the percentage occurrence and total linear distance of reaches where macrofloral species were encountered and their corresponding abundance ranges.

Macroflora distribution summary charts and data summary tables based upon percentage occurrence within depth categories (< 30, 30-60, 60-90, and 90-130 m) and substrate categories (bedrock, coarse-large, coarse-small, fine, and shell) are presented in Appendix G. Macroflora species are discussed in order of dominance, with the most dominant, coralline algae (various species), discussed first and the least dominant, rockweed (*Fucus sp.*), discussed last.

Table 3.8: Macrofloral Distributions by Percentage Occurrence Categories for the 2008 Marine Survey

20-30%	5-20%	1-5%	Storm Toss
Coralline algae (various species)	Sea colander (<i>Agarum cribrosum</i>)	Kelp (<i>Laminaria sp.</i>)	Kelp (<i>Laminaria sp.</i>)
Crustose algae (<i>Lithothamnium sp.</i>)	Red fern (<i>Ptilota sp.</i>)	Knotted wrack (<i>Ascophyllum nodosum</i>)	Red fern (<i>Ptilota sp.</i>)
	Sour weed (<i>Desmarestia sp.</i>)	Edible kelp (<i>Alaria sp.</i>)	Rockweed (<i>Fucus sp.</i>)
		Rockweed (<i>Fucus sp.</i>)	Sea colander (<i>Agarum cribrosum</i>)
			Sour weed (<i>Desmarestia sp.</i>)

Table 3.9: Macrofloral Species Distribution Summary for the 2008 Marine Survey

Taxon	Cumulative Distance* (m)	Percent Occurrence	Abundance (% Coverage)	Number of Reaches
Coralline algae (various species)	15,013.64	28.9	5-25	59
Crustose algae (<i>Lithothamnium sp.</i>)	13,028.5	25.0	2-80	48
Sea colander (<i>Agarum cribrosum</i>)	4,311.7	8.3	1-50	22
Red fern (<i>Ptilota sp.</i>)	3,916.8	7.5	2-25	21
Sour weed (<i>Desmarestia sp.</i>)	3,505.6	6.7	1-30	12
Kelp (<i>Laminaria sp.</i>)	1,623.3	3.1	5-50	7
Knotted wrack (<i>Ascophyllum nodosum</i>)	619.1	1.2	1-2	3
Edible kelp (<i>Alaria sp.</i>)	217.8	0.4	5	2
Rockweed (<i>Fucus sp.</i>)	202.8	0.4	1	1

* Cumulative Distance is total length of all reaches combined where species was observed

Macroflora Species Distribution (20-30%)

Macroflora species with occurrence ranging from 20 to 30% included coralline algae (various species), and crustose algae (*Lithothamnium sp.*), (Table 3.8 and 3.9).

Coralline algae (various species)

Coralline algae were encountered throughout 28.9% of the marine survey area in abundances ranging from 5 to 25% (Table 3.9). Although widely distributed throughout all depth and substrate categories except for fine, with the highest percent occurrence between depths of 60 and 130 m with coarse-small substrates. Coralline algae were rarely encountered at depths between 30-60 m or over shell substrate (Figure G-14, Appendix G). Coralline algae were not encountered on fine substrates. The highest abundances (25%) were located at station 136 in depths of 60-90 m and over coarse-large substrates (Figure H-1, Appendix H).

Crustose algae (*Lithothamnium sp.*)

Crustose algae were encountered throughout 25% of the marine survey area in abundances ranging from 2 to 80% (Table 3.9). Although widely distributed throughout all depth and substrate categories except for shell, the highest percent occurrence was at depths of < 30 m and coarse-small substrates. Crustose algae were rarely encountered at depths between 90-130 m or upon fine substrate (Figure G-14, Appendix G). Crustose algae were not encountered on shell substrate. The highest abundance (80%) was located in the nearshore near Mistaken Cove from Station 149 to 152, at a depth of < 30 m on coarse-small and bedrock substrate (Figure H-2, Appendix H).

Macroflora Species Distribution (5-20%)

Macroflora species with distributions ranging from 5 to 20% include sea colander (*Agarum cribrosum*), red fern (*Ptilota sp.*), and sour weed (*Desmarestia sp.*), (Table 3.8 and 3.9).

Sea colander (*Agarum cribrosum*)

Sea colander were encountered throughout 8.3% of the marine survey area in abundances ranging from 1 to 50% (Table 3.9). Although widely distributed throughout all substrate categories except for shell, the highest percent occurrence was at depths from < 30 m and coarse-small substrates (Figure G-14, Appendix G). The highest abundances (50%) of sea colander were located from Station 149 to 152, at a depth of < 30 m on bedrock substrate. Sea colander was only encountered in the nearshore area of Mistaken Cove (Figure H-3, Appendix H).

Red fern (*Ptilota sp.*)

Red fern were encountered throughout 7.5% of the marine survey area in abundances ranging from 2 to 25%. Although widely distributed throughout all depth categories except 60-90 m and substrate categories except for shell, the highest percent occurrence was at depths of < 30 m and coarse-small substrates (Figure G-14, Appendix G). The highest abundances (25%) of red fern were located around Station 150 at a depth < 30 m on coarse-small, coarse-large, and bedrock substrates (Figure H-4, Appendix H).

Sour weed (*Desmarestia sp.*)

Sour weed were encountered throughout 6.7% of the marine survey area in abundances ranging from 1 to 30% (Table 3.9). Sour weed was found in only one depth category (< 30 m) and two substrate categories (coarse-large and coarse-small), (Figure G-14, Appendix G). The highest abundances (30%) of sour weed distributions were found from Stations 127-133 on coarse-small and coarse-large substrates (Figure H-5, Appendix H).

Macroflora Species Distribution (<1-5%)

Macroflora species with distributions ranging from 1 to 5% included kelp (*Laminaria sp.*), knotted wrack (*Ascophyllum nodosum*), edible kelp (*Alaria sp.*), and rockweed (*Fucus sp.*), (Table 3.8 and Table 3.9).

Kelp (*Laminaria spp.*)

Kelp were encountered throughout 3.1% of the marine survey area in abundances ranging from 5 to 50% (Table 3.9). Kelp was only found close to the Mistaken Cove nearshore at one depth category (< 30 m) and two substrate categories (bedrock and coarse-small), (Figure G-14, Appendix G). The highest abundance (50%) of kelp was located at Station 191 at a depth < 30 m on bedrock substrate (Figure H-6, Appendix H).

Knotted wrack (*Ascophyllum nodosum*)

Knotted wrack were encountered throughout 1.2% of the marine survey area in abundances ranging from 1 to 2% (Table 3.9). Knotted wrack were only found at two depth categories (< 30 m and 30-60 m) and one substrate category (coarse-small), (Figure G-14, Appendix G). The highest abundances (2%) of knotted wrack were located at Station 149 at a depth of 30-60 m on coarse-small substrate (Figure H-7, Appendix H).

Edible kelp (*Alaria sp.*)

Edible kelp were encountered twice throughout 0.4% of the marine survey area in an abundance of 5% (Table 3.9). Edible kelp were only found at one depth category (< 30 m) and one substrate category (bedrock), (Figure G-14, Appendix G) and only in the Mistaken Cove nearshore. Both edible kelp occurrences were located at Station 150 (Figure H-8, Appendix H).

Rockweed (*Fucus sp.*)

Rockweed was encountered once at the L'Anse Amour nearshore area totalling 0.4% of the marine survey area in an abundance of 1% (Table 3.9). Rockweed were only found at one depth category (< 30 m) and one substrate category (coarse-small), (Figure G-14, Appendix G) at Station 128 (Figure H-9, Appendix H).

Macrofloral Storm Toss

Storm toss taxa included kelp, red fern, rockweed, sea colander, and sour weed. Storm toss were found across all depth and substrate categories. The most common species was sea colander which was encountered along 25.8% of the area surveyed (Figure H-10, Appendix H).

Species of Special Conservation Status

No macrofloral species of special conservation status were encountered during the 2008 survey.

3.2 2009 Marine Survey

3.2.1 Substrate

For each video transect subsection (reach) the most dominant of the broad substrate categories is summarized in Table 3.10 and presented in Figure D-3 (Appendix D). The broad substrates are further broken down into detailed substrate in Table 3.11 and Figure D-4 (Appendix D). Representative photos of each substrate category are presented in Appendix E. The substrates are discussed in order of dominance, with the most dominant, bedrock, discussed first and the least dominant, fine, discussed last. Shell was not present in any of the reaches in the 2009 survey.

Bedrock

The most common broad substrate category encountered along the submarine corridors in the 2009 marine survey was bedrock which was predominant in 286 five-metre subsections with a linear distance of 1430m representing 51.1% of total area surveyed (Table 3.10). The broad bedrock category accounted for 89.8%, 43.8%, and 38.6% of the northern, middle, and southern corridor, respectively. Looking at the detailed composition of the bedrock broad category (Table 3.11), it was largely composed of bedrock (92.9%, Figure D-3 and D-4, Appendix D) but did contain 2.9% small boulder, 1.9% cobble and 2.3% of the other detailed substrates (large boulder, rubble, gravel, and sand).

Coarse-Small

The second most common broad substrate category encountered along the submarine corridors in the 2009 marine survey was coarse-small (gravel and cobble, 2 mm – 130 mm) which was predominant in 173 subsections with a linear distance of 865 m representing 30.9% of the total area surveyed (Table 3.10). The broad coarse-small category accounted for 1.7%, 32.5%, and 42.5% of the northern, middle, and southern corridor, respectively (Figure D-3, Appendix D). Referring to Table 3.11, the detailed composition of the coarse-small category, it was largely composed of cobble (54.6%) and gravel (22.3%), (Figure D-4, Appendix D) but did contain 8.8% rubble, 5.1% small boulder and 9.2% of the other detailed substrates (bedrock, large boulder, and sand).

Coarse-Large

Coarse-large (rubble and boulder > 130 mm) was dominant in 100 subsections in the 2009 marine survey with a linear distance of 500 m representing 17.9% of the total area surveyed (Table 3.10). The broad coarse-large category accounted for 8.5%, 23.8%, and 18.6% of the northern, middle, and southern corridor, respectively (Figure D-3, Appendix D). Referring to Table 3.11, the detailed composition of the coarse-large category, it was largely composed of small boulder (29.8%) and rubble (33.9%), (Figure D-4, Appendix D). The other defining detailed substrate of coarse-large, large boulder only comprised 4.9%. The other detailed substrates present included bedrock (7.7%), cobble (15.6%), gravel (6.9%), and sand (1.2%).

Fine

The fine dominant substrate category (> 0.06 mm – 2 mm) was dominant at only single subsection in the 2009 marine survey with a linear distance of 5 m representing 0.2% of the total area surveyed (Table 3.10), (Figure D-3, Appendix D). This section was composed of gravel (40.0%) and sand (60.0%).

Table 3.10: Dominant Substrate Summary by Reach for the 2009 Marine Survey

Substrate	Reaches (#)	Distance (m)	Coverage (%)
Bedrock	286	1,430	51.1
Coarse-small	173	865	30.9
Coarse-large	100	500	17.9
Fine	1	5	0.2
Total	560	2,800	100.0

Table 3.11: Broad and Detailed Substrate Summary for the 2009 Marine Survey

Dominant Substrate (broad)	Total distance (m)	Percent Area (%)	*Detailed substrate	Cumulative Area (%)
Bedrock (mostly bedrock)	1,430	51.1	<u>Bedrock</u> Large Boulder Small Boulder Rubble Cobble Gravel Sand	92.9 0.1 2.9 1.1 1.9 1.1 0.1
Coarse-small (mostly cobble and gravel)	865	30.9	Bedrock Large Boulder Small Boulder Rubble <u>Cobble</u> <u>Gravel</u> Sand	3.1 2.9 5.1 8.8 54.6 22.3 3.2
Coarse-large (mostly large and small boulders and rubble)	500	17.9	Bedrock <u>Large Boulder</u> <u>Small Boulder</u> <u>Rubble</u> Cobble Gravel Sand	7.7 4.9 29.8 33.9 15.6 6.9 1.2
Fine (mostly sand)	5	0.2	Bedrock Large Boulder Small Boulder Rubble Cobble Gravel <u>Sand</u>	0.0 0.0 0.0 0.0 0.0 40.0 60.0
Totals	2,800	100	Bedrock Large Boulder Small Boulder Rubble Cobble Gravel Sand	49.2 1.9 8.5 9.4 20.9 8.8 1.3

*Underlining indicates the detailed substrate category for which the broad category is based upon

3.2.2 Macrofauna

A total of 20 macrofaunal taxa identified within the submarine corridors are listed in Table 3.12. Species photographs are provided in Appendix E.

Distribution maps for each individual taxon are presented in Appendix F. Table 3.13 provides a summary of macrofaunal species encountered by percent occurrence categories of > 50%, 25-50%, 5-25%, 1-5%, and < 1-0.4%, and single observances. Table 3.14 provides a summary of the percentage occurrence and linear distances where macrofaunal species were encountered and their corresponding abundances.

Macrofauna distribution summary charts and data summary tables based upon percentage occurrences within the broad substrate categories (bedrock, coarse-large, coarse-small, fine, and shell) are presented in Appendix G. Unlike the 2008 marine survey, all reaches were in the same depth category (< 30m). The macrofaunal species distributions are discussed in the order of percent occurrence with the highest, periwinkle, discussed first and the lowest, ocean pout, discussed last.

Table 3.12: Macrofaunal Taxa Observed in 2009 Marine Survey

Rank*	Percent Occurrence	Common Name	Taxon	Category
1	52.5	Periwinkle	<i>Littorina sp.</i>	Mollusc
2	44.1	Starfish	<i>Asterias sp.</i>	Echinoderm
3	11.3	Blue mussel	<i>Mytilus edulis</i>	Mollusc
4	10.2	Green urchin	<i>Strongylocentrotus dreobachiensis</i>	Echinoderm
5	5.7	Rock crab	<i>Cancer sp.</i>	Crustacean
6	4.1	Hermit crab	<i>Paragus sp.</i>	Mollusc
7	3.9	Whelk	Gastropoda	Mollusc
8	2.1	Barnacle	<i>Balanus sp.</i>	Mollusc
9	1.4	Limpet	Patellogastropoda	Mollusc
10	1.1	Sponge	Porifera	Other (Porifera)
11	0.9	Sculpin	<i>Myoxocephalus sp.</i>	Fish
12	0.7	Sea cucumber	<i>Cucumaria frondosa</i>	Echinoderm
13	0.5	Isopod	Isopoda	Crustacean
14	0.4	Grass shrimp	<i>Palaemonetes sp.</i>	Crustacean
**15	0.2	Brittle Star	Ophiuroidea	Echinoderm
**15	0.2	Cunner	<i>Tautogolabrus adspersus</i>	Fish
**15	0.2	Ribbon whelk	Gastropoda	Mollusc
**15	0.2	Sea anemone	<i>Metridium sp.</i>	Other (Cnidarian)
**15	0.2	Winter flounder	<i>Pseudopleuronectes americanus</i>	Fish
**15	0.2	Ocean pout	<i>Zoarces americanus</i>	Fish

*Rank is based on percent occurrence, the percent total length of all the reaches where the taxon was present

** All taxa ranked as 15 occurred within 0.2 % of the reaches (single reach)

Table 3.13: Macrofaunal Distributions by Percentage Occurrence Categories for 2009 Marine Survey

> 50%	25-50%	5-25%	1-5%	< 1% - 0.4 %	Single observance
Periwinkle (<i>Littorina sp.</i>)	Starfish (<i>Asterias sp.</i>)	Blue mussel (<i>Mytilus edulis</i>)	Hermit crab (<i>Paragus sp.</i>)	Sculpin (<i>Myoxocephalus sp.</i>)	Brittle star (Ophiuroidea)
		Green urchin (<i>Strongylocentrotus dreobachiensis</i>)	Whelk (Gastropod)	Sea cucumber (<i>Cucumaria frondosa</i>)	Cunner (<i>Tautogolabrus adspersus</i>)
		Rock crab (<i>Cancer sp.</i>)	Barnacle (<i>Balanus sp.</i>)	Isopod (Isopoda)	Sea anemone (<i>Metridium sp.</i>)
			Limpet (Patellogastropoda)	Grass shrimp (<i>Palaemonetes sp.</i>)	Winter flounder (<i>Pseudopleuronectes americanus</i>)
			Sponge (Porifera)		Ribbon whelk (Gastropod)
					Ocean pout (<i>Zoarces americanus</i>)

Table 3.14: Macrofaunal Distribution Summary with Relative Abundances for the 2009 Marine Survey

Taxon	Total (all abundance categories)			Abundant			Common			Occasional			Uncommon		
	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)
Periwinkle (<i>Littorina sp.</i>)	52.5	294	1,470	38.75	217	1,085	12.0	67	335	1.4	8	40	0.4	2	10
Starfish (<i>Asterias sp.</i>)	44.1	247	1,235	6.96	39	195	27.1	152	760	8.2	46	230	1.8	10	50
Blue Mussel (<i>Mytilus edulis</i>)	11.3	63	315	1.25	7	35	3.0	17	85	3.6	20	100	3.4	19	95
Green Urchin (<i>Strongylocentrotus dreobachiensis</i>)	10.2	57	285	0.71	4	20	6.3	35	175	2.0	11	55	1.3	7	35
Rock Crab (<i>Cancer sp.</i>)	5.7	32	160		0	0	0.2	1	5	1.8	10	50	3.8	21	105
Hermit Crab (<i>Paragus sp.</i>)	4.1	23	115		0	0	0.2	1	5	0.9	5	25	3.0	17	85
Whelk (Gastropod)	3.9	22	110	0.36	2	10	0.7	4	20	1.4	8	40	1.4	8	40
Barnacle (<i>Balanus sp.</i>)	2.1	12	60		0	0	2.0	11	55	0.2	1	5		0	0
Limpet (Patellogastropoda)	1.4	8	40		0	0	1.3	7	35		0	0	0.2	1	5
Sponge (Porifera)	1.1	6	30		0	0		0	0		0	0	1.1	6	30
Sculpin (<i>Myoxocephalus sp.</i>)	0.9	5	25		0	0		0	0		0	0	0.9	5	25
Sea Cucumber (<i>Cucumaria frondosa</i>)	0.7	4	20		0	0		0	0		0	0	0.7	4	20
Isopod (Isopoda)	0.5	3	15		0	0	0.5	3	15		0	0		0	0
Grass Shrimp	0.4	2	10		0	0		0	0	0.2	1	5	0.2	1	5

Taxon	Total (all abundance categories)			Abundant			Common			Occasional			Uncommon		
	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)	Area (%)	Reach (#)	*Distance (m)
<i>(Palaemonetes sp.)</i>															
Brittle Star (Ophiuroidea)	0.2	1	5		0	0		0	0		0	0	0.2	1	5
Cunner (<i>Tautogolabrus adspersus</i>)	0.2	1	5		0	0		0	0		0	0	0.2	1	5
Ribbon Whelk (Gastropod)	0.2	1	5		0	0		0	0		0	0	0.2	1	5
Sea Anemone (<i>Metridium sp.</i>)	0.2	1	5		0	0		0	0	0.2	1	5		0	0
Winter Flounder (<i>Pseudopleuronectes americanus</i>)	0.2	1	5		0	0		0	0		0	0	0.2	1	5
Ocean Pout (<i>Zoarces americanus</i>)	0.2	1	5		0	0		0	0		0	0	0.2	1	5

*Distance is total length of all reaches combined where taxon was observed

Macrofauna Species Distribution (> 50%)

The most widely distributed macrofauna species with distributions of > 50% included a single taxon, periwinkle (*Littorina sp.*), (Table 3.14).

Periwinkle (*Littorina sp.*)

Periwinkle were observed throughout 52.5% (1.47 km) of the 2009 marine survey area in abundances ranging from uncommon (0.4%) to occasional (1.4%) to common (12.0%) to abundant (38.8%), (Table 3.14). Although distributed throughout all substrate categories, except fine, the highest percent occurrence was on bedrock substrate category (Figure G-19, Appendix G). The highest abundances (abundant) were found along all three corridors surveyed in 2009 in bedrock, coarse-large and coarse-small substrate categories (Figure F-36, Appendix F).

Macrofauna Species Distribution (25-50%)

Macrofauna species with distributions ranging from 25 to 50% included a single taxon, starfish (*Asterias sp.*), (Table 3.14).

Starfish (*Asterias sp.*)

Starfish were encountered throughout 44.1% (1.23 km) of the 2009 marine survey area with abundances ranging from uncommon (1.8%) to occasional (8.2%) to common (27.1%) to abundant (7.0%), (Table 3.14). Although distributed throughout all substrate categories, except fine, the highest percent occurrence was over bedrock (Figure G-17, Appendix G). The highest abundances (abundant) were found along all three corridors surveyed in 2009 over bedrock, coarse-large, and coarse-small substrate categories (Figure F-37, Appendix F).

Macrofauna Species Distribution (5-25%)

Macrofauna taxa with distributions ranging from 5 to 25% included blue mussel (*Mytilus edulis*), green urchin (*Strongylocentrotus dreobachiensis*), and rock crab (*Cancer sp.*), (Table 3.14).

Blue mussel (*Mytilus edulis*)

Blue mussel were encountered throughout 11.3% (315 m) of the 2009 marine survey area in abundances ranging from uncommon (3.4%) to occasional (3.6%) to common (3.0%) to abundant (1.3%), (Table 3.14). Although distributed throughout all substrate categories, except fine, the highest percent occurrence was over bedrock (Figure G-19, Appendix G). The highest abundances (abundant) were found along the northern and middle corridors surveyed in bedrock and coarse-large substrates (Figure F-38, Appendix F).

Green urchin (*Strongylocentrotus dreobachiensis*)

Green urchin were encountered throughout 10.2% (285 m) of the 2009 marine survey area with abundances ranging from uncommon (1.3%) to occasional (2.0%) to common (6.3%) to abundant (0.7%), (Table 3.14). Although distributed throughout all substrate categories, except fine, the highest percent occurrence was on bedrock (Figure G-17, Appendix G). The highest abundances (abundant) were found along the northern corridor surveyed in bedrock and coarse-large substrates (Figure F-39, Appendix F).

Rock crab (*Cancer sp.*)

Rock crab were encountered throughout 5.7% (160 m) of the 2009 marine survey area with abundances ranging from uncommon (3.8%) to occasional (1.8%) to common (0.2%) (Table 3.14). Although distributed throughout

bedrock, coarse-large and coarse-small substrate categories, the highest percent occurrence was on coarse-large (Figure G-16, Appendix G). The highest abundances (common) were found along the southern corridor surveyed on coarse-large substrates (Figure F-40, Appendix F).

Macrofauna Species Distribution (1-5%)

Macrofauna species with distributions ranging from 1 to 5% included hermit crab (*Paragus sp.*), whelk (Gastropoda), barnacle (*Balanus sp.*), limpet (Patellogastropoda), and sponge (Porifera), (Table 3.14).

Hermit crab (*Paragus sp.*)

Hermit crab were encountered throughout 4.1% (115 m) of the 2009 marine survey area with abundances ranging from uncommon (3.0%) to occasional (0.9%) to common (0.2%) (Table 3.14). Although distributed throughout bedrock, coarse-large, and coarse-small substrate categories, the highest percent occurrence was on coarse-small (Figure G-16, Appendix G). The highest abundance (common) was found along the southern corridor surveyed over bedrock substrate (Figure F-41, Appendix F).

Whelk (Gastropoda)

Whelk were encountered throughout 3.9% (110 m) of the 2009 marine survey area in abundances ranging from uncommon (1.4%) to occasional (1.4%) to common (0.7%) to abundant (0.4%), (Table 3.14). Although distributed throughout bedrock, coarse-large, and coarse-small substrate categories, the highest percent occurrence was on bedrock (Figure G-19, Appendix G). The highest abundance (abundant) were found along two reaches on the northern corridor over bedrock substrate (Figure F-42, Appendix F).

Barnacle (*Balanus sp.*)

Barnacle were encountered throughout 2.2% (60 m) of the 2009 marine survey area in abundances ranging from occasional (0.2%) to common (2.0%), (Table 3.14) exclusively on bedrock substrates (Figure G-19, Appendix G). The highest abundances (common) were found along the northern corridor (Figure F-43, Appendix F).

Limpet (Patellogastropoda)

Limpet were encountered throughout 1.5% (40 m) of the 2009 marine survey area in abundances ranging from uncommon (0.2%) to common (1.3%), (Table 3.14) exclusively on bedrock substrates (Figure G-19, Appendix G). The highest abundances (common) were found along the northern corridor (Figure F-44, Appendix F).

Sponge (Porifera)

Sponge were encountered throughout 1.1% (30 m) of the 2009 marine survey area in a single abundance category (uncommon), (1.1%), (Table 3.14) in the middle and southern corridors (Figure G-20, Appendix G). Although distributed throughout bedrock, coarse-large, and coarse-small substrate categories, the highest percent occurrence was on bedrock (Figure F-45, Appendix F).

Macrofauna Species Distribution (< 1-0.4%)

Macrofauna species with distributions with < 1% occurrence included sculpin (*Myoxocephalus sp.*), sea cucumber (*Cucumaria frondosa*), isopod (Isopoda), and grass shrimp (*Palaemonetes sp.*), (Table 3.14).

Sculpin (*Myoxocephalus sp.*)

Sculpin were encountered five times throughout 0.9% (25 m) of the 2009 marine survey area in uncommon abundances (Table 3.14), (Figure G-18, Appendix G). Sculpin were observed once on bedrock and twice on both coarse-large and coarse-small in the middle and southern corridors (Figure F-46, Appendix F).

Sea cucumber (*Cucumaria frondosa*)

Sea cucumber was observed in four single occurrences; twice in the middle corridor over coarse-large substrate and twice in southern corridor over coarse-small and coarse-large substrates (Figure F-47, Appendix F, and Figure G-17, Appendix G).

Isopod (Isopoda)

Isopods were observed three times in common abundances on bedrock in the northern corridor (Figure F-48, Appendix F, and Figure G-16, Appendix G).

Grass shrimp (*Palaemonetes sp.*)

Grass shrimp were observed twice in common and uncommon abundances on bedrock in the southern corridor (Figure F-49, Appendix F, and Figure G-16, Appendix G).

Macrofauna Species Distribution (single observances)

Four taxa were observed in a single reach in the 2009 marine survey. A single brittle star (Ophiuroidea) was observed in the middle corridor on coarse-large substrate (Figure F-50, Appendix F), a single cunner (*Tautogolabrus adspersus*) was observed in the southern corridor over coarse-small substrates (Figure F-51, Appendix F), a single ribbon whelk (Gastropoda) was observed in the southern corridor over bedrock (Figure F-52, Appendix F), two sea anemones (*Metridium sp.*) were observed within a single reach in the middle corridor over bedrock (Figure F-53, Appendix F), a single winter flounder (*Pseudopleuronectes americanus*) was observed in the southern corridor over bedrock (Figure F-54, Appendix F), and a single ocean pout (*Zoarces americanus*) was observed in the middle corridor over bedrock (Figure F-55, Appendix F).

Species of Special Conservation Status

No macrofaunal species of special conservation status were encountered during the 2009 survey.

3.2.3 Macroflora

Seventeen macrofloral taxa were identified from the video and are listed in Table 3.15. Sample photographs are provided in Appendix E.

Table 3.15: Macrofloral Taxa for the 2009 Marine Survey

Rank*	Percent Occurrence	Common Name	Taxon	Macrofloral Type
1	83.8	Crustose algae	<i>Lithothamnium sp.</i>	Red algae
2	68.0	Kelp	<i>Laminaria longicuris</i>	Brown algae
3	53.8	Coralline algae	<i>Corallina officinalis</i>	Red algae

Rank*	Percent Occurrence	Common Name	Taxon	Macrofloral Type
4	45.7	Crustose algae	other than <i>Lithothamnium</i> sp.	Red algae
5	35.0	Sea colander	<i>Agarum cribrosum</i>	Brown algae
6	34.5	Sour weed	<i>Desmarestia</i> sp.	Brown algae
7	23.0	Red fern	<i>Ptilota</i> sp.	Red algae
8	14.8	Rockweed	<i>Fucus</i> sp.	Brown algae
9	13.9	Edible Kelp	<i>Alaria</i> sp.	Brown algae
10	3.8	Brown filamentous algae	Phaeophyceae	Brown algae
11	3.6	Green filamentous algae	Archaepplastida	Green algae
12	1.4	Dulse	<i>Palmaria palmata</i>	Red algae
13	0.9	Kelp	<i>Laminaria digitata</i>	Brown algae
14	0.9	Unidentified brown algae	---	Brown algae
15	0.4	Knotted wrack	<i>Ascophyllum nodosum</i>	Brown algae
16	0.2	Sea lettuce	<i>Ulva</i> sp.	Green algae
17	0.2	Cord weed	<i>Chorda</i> sp.	Green algae

*Rank is based on percent occurrence, the percent total length of all the reaches where the taxon was present

Distribution maps for each individual taxon are presented in Appendix H. Table 3.16 provides a summary of macrofloral distributions subdivided by percentage occurrence categories of 50-100%, 25-50%, 10-25%, 1-10% and < 1%. Table 3.17 provides a summary of the percentage occurrence and linear distances where macrofloral species were encountered and their corresponding abundance ranges.

Macroflora distribution summary charts and data summary tables based upon percentage occurrences within broad substrate categories (bedrock, coarse-large, coarse-small, fine, and shell) are presented in Appendix G. The macroflora are discussed in order of dominance, with the most dominant, crustose algae (*Lithothamnium* sp.), discussed first and the least dominant, cord weed, discussed last.

Table 3.16: Macrofloral Distributions by Percentage Occurrence Categories for the 2009 Marine Survey

50-100%	25-50%	10-25%	1-10%	< 1%	Storm Toss
Crustose algae (<i>Lithothamnium</i> sp.)	Crustose algae (other than <i>Lithothamnium</i> sp.)	Red fern (<i>Ptilota</i> sp.)	Brown filamentous algae (Phaeophyceae)	Kelp (<i>Laminaria digitata</i>)	Red fern (<i>Ptilota</i> sp.)
Kelp (<i>Laminaria longicuris</i>)	Sea colander (<i>Agarum cribrosum</i>)	Rockweed (<i>Fucus</i> sp.)	Green filamentous algae (Archaepplastida)	Unidentified brown algae	Kelp (<i>Laminaria</i> spp.)
Coralline algae (<i>Corallina officinalis</i>)	Sour weed (<i>Desmarestia</i> sp.)	Edible kelp (<i>Alaria</i> sp.)	Dulse (<i>Palmaria palmata</i>)	Knotted wrack (<i>Ascophyllum nodosum</i>)	Sea colander (<i>Agarum cribrosum</i>)
				Sea lettuce (<i>Ulva</i> sp.)	
				Cord weed (<i>Chorda</i> sp.)	

Table 3.17: Macrofloral Species Distribution Summary for the 2009 Marine Survey

Taxon	Cumulative Distance* (m)	Area Present (%)	Abundance (% Coverage)	Number of Reaches (#)
Crustose algae (<i>Lithothamnium sp.</i>)	2,345	83.7	1-40	469
Kelp (<i>Laminaria longicruris</i>)	1,905	68.0	1-100	381
Coralline algae (<i>Corallina officinalis</i>)	1,505	53.7	1-30	301
Crustose algae (other than <i>Lithothamnium sp.</i>)	1,280	45.7	1-35	256
Sea colander (<i>Agarum cribrosum</i>)	980	35.0	1-70	196
Sour weed (<i>Desmarestia sp.</i>)	965	34.5	1-80	193
Red Fern (<i>Ptilota sp.</i>)	645	23.0	1-10	129
Rockweed (<i>Fucus sp.</i>)	415	14.8	1-90	83
Edible Kelp (<i>Alaria sp.</i>)	390	13.9	1-70	78
Brown filamentous algae (Phaeophyceae)	105	3.8	2-15	21
Green filamentous algae (Archaeplastida)	100	3.6	1-20	20
Dulse (<i>Palmaria palmata</i>)	40	1.4	1-4	8
Kelp (<i>Laminaria digitata</i>)	25	0.9	2-5	5
Unidentified brown algae	25	0.9	2-5	5
Knotted wrack (<i>Ascophyllum nodosum</i>)	10	0.4	1-2	2
Sea lettuce (<i>Ulva sp.</i>)	5	0.2	1	1
Cord weed (<i>Chorda sp.</i>)	5	0.2	1	1

* Cumulative Distance is total length of all reaches combined where species was observed

Macroflora Species Distribution (50-100%)

Macroflora taxa with distributions ranging from 50 to 100% included crustose algae (*Lithothamnium sp.*), kelp (*Laminaria longicruris*), and coralline algae (*Corallina officinalis*).

Crustose algae (*Lithothamnium sp.*)

Crustose algae (*Lithothamnium sp.*) were encountered throughout 83.7% (2,345 m) of the marine survey area in abundances ranging from 1 to 40% (Table 3.17) on bedrock, coarse-large, and coarse-small substrate categories (Figure G-24, Appendix G). The highest percent occurrence occurred on bedrock and the highest abundance (40%) occurred in the southern corridor also on bedrock (Figure H-11, Appendix H).

Kelp (*Laminaria longicruris*)

Macroflora species with distributions ranging from 50 to 75% included a species of kelp (*L. longicruris*), (Table 3.17). Kelp were encountered throughout 68.0% (1905 m) of the marine survey area in abundances ranging from 1 to 100% (Table 3.17) on bedrock, coarse-large, and coarse-small substrate categories (Figure G-22, Appendix G). The highest percent occurrence was on bedrock and the highest abundance (100%) was on bedrock, coarse-small, and coarse-large substrates (Figure H-12, Appendix H).

Coralline algae (*Corallina officinalis*)

Coralline algae (*C. officinalis*) were observed throughout 53.7% (1,505 m) of the marine survey in abundances ranging from 1 to 30% (Table 3.17) in bedrock, coarse-large, and coarse-small substrate categories (Figure G-24, Appendix G). The highest percent occurrence was on bedrock and the highest abundances (30%) were on bedrock in the northern corridor (Figure H-13, Appendix H).

Crustose algae (other than *Lithothamnium sp.*)

Crustose algae were observed throughout 45.7% (1,280 m) of the marine survey in abundances ranging from 1 to 35% in bedrock, coarse-large, and coarse-small substrate categories (Table 3.17), (Figure G-24, Appendix G). The highest percent occurrence was on bedrock and the highest abundances (35%) were on bedrock in the northern corridor (Figure H-14, Appendix H).

Macroflora Species Distribution (25-50%)

Macroflora taxa with distributions ranging from 25 to 50% included sea colander (*Agarum cribrosum*), and sour weed (*Desmarestia sp.*).

Sea colander (*Agarum cribrosum*)

Sea colander were observed throughout 35% (980 m) of the marine survey area in abundances ranging from 1 to 70% (Table 3.17) in bedrock, coarse-large, and coarse-small substrate categories (Figure G-22, Appendix G). The highest percent occurrence occurred on coarse-small substrates and the highest abundance (70%) occurred in the middle corridor on coarse-small substrate (Figure H-15, Appendix H).

Sour weed (*Desmarestia sp.*)

Sour weed were observed throughout 34.5% (965 m) of the marine survey in abundances ranging from 1 to 80% (Table 3.17) on bedrock, coarse-large, coarse-small, and fine substrate categories (Figure G-22, Appendix G). The highest percent occurrences were on coarse-small and the highest abundance (80%) was on bedrock in the northern corridor (Figure H-16, Appendix H).

Macroflora Species Distribution (10-25%)

Macroflora taxa with distributions ranging from 10 to 25% included red fern (*Ptilota sp.*), rockweed (*Fucus sp.*) and edible kelp (*Alaria sp.*).

Red fern (*Ptilota sp.*)

Red fern were observed throughout 23.1% (645 m) of the marine survey in abundances ranging from 1 to 10% (Table 3.17) in all four substrate categories (Figure G-24, Appendix G). The highest percent occurrence was on coarse-small substrate and the highest abundances (10%) were in coarse-large and coarse-small substrates in the middle corridor (Figure H-17, Appendix H).

Rockweed (*Fucus sp.*)

Rockweed were observed throughout 14.8% (415 m) of the marine survey in abundances ranging from 1 to 90% (Table 3.17) on bedrock, coarse-large, and coarse-small substrate categories (Figure G-22, Appendix G). The highest percent occurrence was on bedrock and the highest abundances (90%) were on coarse-small substrates in the southern corridor (Figure H-18, Appendix H).

Edible kelp (*Alaria sp.*)

Edible kelp were observed throughout 13.9% (390 m) of the marine survey in abundances ranging from 1 to 70% (Table 3.17) on bedrock, coarse-large, and coarse-small substrate categories in all three corridors (Figure G-22, Appendix G). The highest percent occurrence was on bedrock and the highest abundance (70%) was on bedrock in the northern corridor (Figure H-19, Appendix H).

Macroflora Species Distribution (1-10%)

Macroflora taxa with distributions ranging from 1 to 10% included brown filamentous algae (Phaeophyceae), green filamentous algae (Archaeplastida), and dulse (*Palmaria palmata*).

Brown filamentous algae (Phaeophyceae)

Brown filamentous algae were observed throughout 3.8% (105 m) of the marine survey in abundances ranging from 2 to 15% (Table 3.17) in bedrock, coarse-large, and coarse-small substrate categories in the northern but mostly southern corridor (Figure G-22, Appendix G). The highest percent occurrence was on coarse-large substrate and the highest abundances (15%) were on coarse-small, coarse-large, and bedrock substrates in the southern corridor (Figure H-20, Appendix H).

Green filamentous algae (Archaeplastida)

Green filamentous algae were observed throughout 3.6% (100 m) of the marine survey in abundances ranging from 1 to 20% (Table 3.17) in bedrock, coarse-large, and coarse-small substrate categories in the northern and southern corridors (Figure G-23, Appendix G). The highest percent occurrence was on coarse-large substrates and the highest abundance (20%) was on coarse-large substrates in the southern corridor (Figure H-21, Appendix H).

Dulse (*Palmaria palmata*)

Dulse were observed throughout 1.4% (40 m) of the marine survey in abundances ranging from 1 to 4% (Table 3.17) on bedrock and coarse-small substrates (Figure G-24, Appendix G). It was observed in all three corridors. The highest percent occurrence was on bedrock and the highest abundance (4%) was in bedrock in the northern corridor (Figure H-22, Appendix H).

Macroflora Species Distribution (< 1%)

Macroflora taxa with distributions < 1% included kelp (*Laminaria digitata*), unidentified brown algae, knotted wrack (*Ascophyllum nodosum*), sea lettuce (*Ulva sp.*), and cord weed (*Chorda sp.*).

Kelp (*Laminaria digitata*)

Kelp (*L. digitata*) were observed five times (0.9%, 25 m) during the 2009 marine survey. It was predominantly observed on bedrock substrates, with one occurrence on coarse-small substrate (Figure G-22, Appendix G). Kelp (*Laminaria digitata*) was observed on four occasions in the northern corridor, on one occasion in the southern corridor, and was not at all in the middle corridor (Figure H-23, Appendix H).

Unidentified brown algae

During the 2009 diving survey, there were two species of brown algae that were observed in low quantities and with resolutions that were not suitable for proper identification. These species were observed a total of five times (0.9%, 25 m), and were only observed in the southern corridor and only on bedrock substrate (Figure H-24, Appendix H and Figure G-22, Appendix G).

Knotted wrack (*Ascophyllum nodosum*)

Knotted wrack were observed twice (0.4%, 10 m) during the marine survey in abundances ranging from 1 to 2% in the southern corridor on coarse-large and coarse-small substrates (Figure H-25, Appendix H and Figure G-22, Appendix G).

Sea lettuce (*Ulva sp.*)

Sea lettuce were observed once (0.2%, 5 m) during the marine survey in an abundance of 1% in the southern corridor on coarse-small substrates (Figure H-26, Appendix H and Figure G-23, Appendix G).

Cord weed (*Chroda sp.*)

Cord weed was observed once (0.2%, 5 m) during the marine survey in an abundance of 1% in the southern corridor on coarse-small substrates (Figure H-27, Appendix H and Figure G-23, Appendix G).

Macrofloral Storm Toss

Storm toss for the 2009 survey included red fern (*Ptilota sp.*), kelp (*Laminaria spp.*), and sea colander (*Agarum cribrosum*). Storm toss was encountered very infrequently across all corridors.

Species of Special Conservation Status

No macrofloral species of special conservation status were encountered during the 2009 survey.

3.3 2008 Shoreline Surveys

The results of the four shoreline surveys (Forteau Point, L'Anse Amour, Mistaken Cove, and Yankee Point) conducted in 2008 are presented below. Shoreline transects were not always to scale when imprinted on the aerial photographs due to the limited accuracy of the handheld GPS unit and loss of resolution of aerial photographs due to digitization.

The results are divided into intertidal (the area between the normal low tide and normal high tide) and backshore of the shoreline surveys (the area landward of the normal high-tide zone).

3.3.1 Forteau Point (Labrador)

The results of the shoreline survey of Forteau Point are presented and illustrated in Figures I-1, I-2, I-3, and I-4, and Table I-2, Appendix I.

Intertidal

The intertidal area consisted of three laminate layers composed of (1) bedrock (Figure I-4a, Appendix I), (2) bedrock with sand deposits (Figure I-4b, Appendix I), and (3) boulder field (Figure I-4c). The bedrock layer ranged from 5-40 m in width, ranged from -1° to 30° in slope (slope measured from waters edge facing toward the backshore), and extended along the shoreline in shore units 1 and 2 where it tapered off as it became increasingly covered by sand (Figure I-3). The bedrock with sand deposits layer was located directly behind the

bedrock layer, ranged from 15-34 m in width, ranged from 6° to 15° in slope, was present throughout shore unit 1, 2, 3, and 4, and terminated on a grassy mound located a few metres past transect 5 (Figure I-4d, Appendix I). The shoreline was dominated by a boulder field east of the mound that was 10 m wide and had a 10° to 40° slope (Figure I-4e, Appendix I, shore unit 5). The only fauna observed were occasional marine birds (ducks, gannets).

Backshore

The backshore survey area ranged from 10-55 m in width with a -7° to 40° slope. Vegetation types within the backshore included (1) areas of grasses (Figure I-4f, Appendix I), (2) areas of grasses, lichens, and mosses (Figure I-4g, Appendix I), and (3) areas with grasses, shrubs, and trees (Figure I-4h, Appendix I). Substrate beneath the grass was a mixture of fine and coarse sands and mud. The backshore typically terminated at the base of a cliff (Figure I-4h, Appendix I).

3.3.2 L'Anse Amour (Labrador)

The results of the shoreline survey of L'Anse Amour are presented and illustrated in Figures I-5, I-6, I-7, and I-8, and Table I-3 in Appendix I.

Intertidal

The intertidal area consisted of single layers of sand and gravel (Figure I-7, Appendix I). The intertidal area was a beach that changed in substrate from mostly sand (Figure I-8a, b, Appendix I) on the western section of shore unit 1 to mostly gravel/cobble (Figure I-8c, Appendix I) on the eastern section of shore unit 2. The width of the beach ranged from 4.2-13.8 m and the slope ranged from 5° to 18°. The sandy area had dunes that had become covered in moss and grass in the backshore area (Figure I-8d, Appendix I). No transect was taken at the end of shore unit 4 due to safety concerns but this area was categorized using pictures taken in the field and the aerial photos. The only marine flora observed were brown algae that had washed up on the shore and the only marine fauna observed were several marine birds (ducks, gannets, sanderlings).

Backshore

Vegetation types in the backshore area included (1) areas of grass (Figure I-8e, Appendix I; 5-22 m width, 5° to 20° slope), (2) areas of grass and shrubs (Figure I-8f, Appendix I; 16.5-19.7 m width, 0° to 9.1° slope), and (3) areas with grass, shrubs, and trees (Figure I-8g, Appendix I; 20 m width, 1° slope). The substrate beneath the grass was fine sands. The western end of the backshore terminated at the base of a cliff (Figure I-8h, Appendix I).

3.3.3 Mistaken Cove (Newfoundland)

The results of the shoreline survey of Mistaken Cove are presented and illustrated in Figures I-9, I-10, I-11, I-12, I-13, and I-14, and Table I-4 in Appendix I.

Intertidal

The intertidal area consisted of two laminate layers of (1) exposed bedrock (Figure I-14a, Appendix I) and (2) sand/gravel (Figure I-14b, Figure I-14c, Appendix I). The exposed bedrock area had a width ranging from 3.6 to 16.1 m, a 0° slope, and spanned the shore units 1-3 (Figure I-11 and I-13). The sand/gravel areas were found in

shore units 4-10, ranged in width from 4 m to > 50 m and had a slope ranging 0° to 25°. In shore units 1 and 6, green and brown algae were observed in quantities of occasional and common, respectively (Figure I-14d, I-14e, and Table I-4, Appendix I). The only fauna observed were occasional barnacles in shore units 3 and 6 (Table I-4, Appendix I).

Backshore

The backshore survey area ranged from 2-10.7 m in width with a 0° to 18° slope. Vegetation types in the backshore included (1) areas of grasses (Figure I-14f, Appendix I) and (2) areas of trees/tuckamore (Figure I-14f, Appendix I). The substrate located beneath the grass was mud.

3.3.4 Yankee Point (Newfoundland)

The results of the shoreline survey of Yankee Point are presented and illustrated in Figures I-15, I-16, I-17, and I-18, and Table I-5 in Appendix I.

Intertidal

The intertidal area consisted of two laminate layers of (1) bedrock with gravel and pebbles (Figure I-18a, Appendix I) and (2) gravel (Figure I-18b, Appendix I). The bedrock with gravel and pebbles spanned all five shore units and ranged from 2.5 to 35 m in width with no discernable trend in width moving north to south. The slope ranged from 0° to 15° with a general trend of becoming more flat moving from north to south. The gravel area also spanned all four shore units and ranged from 6.2-31 m in width and 10° to 30° in slope with no discernable trend in width or slope moving north to south. The flora observed were red, green, and brown algae in the general area of shore units 4 and 5. The alga ranged in numbers from abundant to occasional and were found in the general area of transect #5 (Figure I-18c and Table I-5, Appendix I). The fauna observed were occasional marine birds (eider ducks) seen throughout the survey, and occasional amphipods in tide pools in shore unit 5 (Figure I-18d and Table I-5, Appendix I).

Backshore

The backshore survey area ranged from 28.9-174 m in width with a 2° to 15° slope. The two vegetation types in the backshore included (1) areas of grasses (Figure I-18e, Appendix I) with patches of tuckamore immediately behind the survey area (Figure I-18f, Appendix I). Substrate beneath the grass was mud. A stone quarry was located behind the survey area.

4.0 DISCUSSION AND SUMMARY

General summaries are presented below for substrate, macrofauna, and macroflora distributions and for the shoreline survey results. More detailed information is available in previous report sections, and associated appendices.

4.1 2008 Marine Survey

4.1.1 Substrate

The following substrate distributions are based upon the combination of substrate data collected within individual transect subsections (reaches). Within a single reach, there can be significant variability with all five substrate categories (coarse-small, coarse-large, shell, bedrock, and fine) present in various percentages (Appendix C, Figures D-1 to D-2, Appendix D).

Substrate distributions within the proposed submarine corridors in the 2008 marine survey predominantly fell within the categories of coarse-small (gravel and cobble, 2 to 130 mm diameter) and coarse-large (rubble and boulder >130 mm) which constituted 53% and 31% (84% total) of the marine survey area respectively. Coarse-small substrates were distributed throughout all depth categories (< 30 to 130 m) and geographical areas. Coarse-large substrate however, was mostly restricted to depths greater than 60 m and were thus encountered primarily within the central deeper portion of the Strait of Belle Isle, outside of the nearshore areas on both the Labrador and Newfoundland coastlines.

Shell (calcareous remains of shellfish or invertebrates containing shells) was the dominant substrate category in 10% of the marine survey area. Transects dominated by shell were restricted to depths greater than 60 m and were encountered primarily in two geographical areas. These included a small zone in the center of the Strait of Belle Isle and a larger zone located in the western portion of the Strait that was primarily restricted to the southern submarine corridor.

Bedrock was rarely encountered and was the dominant substrate in only 4% of the marine survey area. Its distribution was neither depth nor geographically restricted. Bedrock was usually encountered (though not exclusively so) in relation to the edge zone of a trench.

Fine (silt/sand > 0.06 to 2 mm) was the dominant substrate in only 2% of the marine survey area, and was restricted to depths of less than 60 m. From a geographic perspective fine substrates were dominant at two locations: within approximately 0.75 km from the L'Anse Amour shoreline (Labrador) and within 1.5 km of the Mistaken Cove shoreline (Newfoundland).

The lack of areas with fine substrates was further corroborated by the lack of successful sediment samples despite the numerous attempts. Sediment sampling was largely unsuccessful since samples were only obtained

from two of the 25 sample stations where sediment sample collection was attempted. The lack of successful sediment grab sample collection is likely due to two reasons. Firstly, many of the areas originally identified as sand from the 2007 sonar data (Figure 1.2), and subsequently chosen as sampling sites, contained predominantly gravel and shell substrate based on observations from the drop video (Figure D-2 in Appendix D). When grab samples were collected from the seafloor the finer sample material was presumably washed out during retrieval through the water column as gravel- and cobble-sized substrates prevented the grab from sealing completely shut. Secondly, areas that were classified as mostly fine substrate also had a proportion of larger substrates (Table 3.3), namely small boulder (0.4), rubble (1.1), cobble (3.2) and gravel (6.6). Again, these larger substrates may have prevented the samplers from sealing properly resulting in finer substrate components being washed from the sampler upon retrieval. In addition, sediment grabs were also attempted in areas originally classified as coarse-small but these grabs were not successful for similar reasons. The lack of successful sediment samples further validates the substrate distributions analysis made from the drop video.

4.1.2 Macrofauna

Thirty-five macrofaunal taxa were identified within the 2008 marine survey area (Figures F-1 to F-35, Appendix F and Figure G-1, Appendix G).

75-100% Percent Occurrence

Taxa with the highest distributions included starfish (*Asterias sp.*), (90%), starfish (*Crossaster sp.*), (84%), pale urchin (81%), and hydroids (numerous species), (77%). All taxa were encountered in association with all depth substrate categories and were found throughout the entire geographical range of the study area. With respect to the highest distributions (common and abundant) species having an affinity for coarse-large substrates included starfish (*Asterias sp.*) and pale urchin. Starfish (*Crossaster sp.*) and hydroids were also encountered in high numbers in association with both coarse-small and coarse-large substrates. Hydroids were rarely encountered at depths less than 60 m or on bedrock, fine or shell substrates.

50-75% Percent Occurrence

Macrofauna taxa with distributions ranging from 50 to 75% included sea anemone (non *Metridium sp.*), toad crab, stalked sea squirt, bryozoans, barnacle, deep sea scallop, soft coral, Icelandic scallop, and sponge.

Sea anemone, toad crab, deep sea scallop, soft coral, and Icelandic scallop, were encountered in association with all depth and most substrate categories and were found throughout the entire geographical range of the study area. All species were most commonly associated with depths of 60 to 130 m and coarse-small to coarse-large substrates.

25-50% Percent Occurrence

Macrofauna taxa with distributions ranging from 25 to 50% included brittle star, starfish (*Solaster sp.*), sea squirt, basket star, and snow crab.

Brittle stars, starfish (*Solaster sp.*), sea squirts, and basket stars were most commonly associated with depths ranging from 60 to 130 m and coarse-small and coarse-large substrates whereas snow crab were most commonly associated with depths ranging from 90 to 130m and coarse-small substrates.

5-25% Percent Occurrence

Macrofauna species with distributions ranging from 5 to 25% included sea cucumber, sculpin, sand dollar, Atlantic cod, and alligatorfish.

Sea cucumbers and cod were most commonly associated with depths ranging from 90 to 130 m and coarse-small substrates. Sculpin were most commonly associated with depths greater than 30 m over coarse-small and coarse-large substrates. Sand dollars were commonly associated with depths ranging from 30 to 130 m and both coarse-small and fine substrates. Alligatorfish were most commonly associated with depths ranging from 60 to 130 m and coarse-small substrates.

> 1-5% Percent Occurrence

Taxa within the > 1-5% distribution range were encountered rarely and in many cases, with very small numbers (as low as one to several individuals for some taxa).

Macrofauna taxa that were rarely encountered with distributions < 5% within the marine survey area included blue mussel, rock crab, cushion star, fan worm, green urchin, unidentified fish, whelk, stalked jellyfish, sea anemone, hermit crab, gastropod, and pycnogonid.

Blue mussels were only encountered at depths less than 60 m (nearshore) in association with coarse-small and fine substrates in the vicinity of both L'Anse Amour (Labrador) and Mistaken Cove (Newfoundland).

Rock crab were primarily associated with depths less than 30 m and coarse-small and bedrock substrates. Rock crab were most commonly encountered in the nearshore environment in the vicinity of Mistaken Cove (Newfoundland).

Cushion stars were primarily associated with a depth range of 60 to 130 m and coarse-large substrates.

Fan worms were associated with a depth range of <30 and 60 to 90 m and coarse-small substrates.

Green urchins were most commonly associated with the nearshore in depths less than 30 m and coarse-small and fine substrates. The greatest numbers were found in the nearshore environment in the vicinity of Forteau Point.

Whelks were rarely encountered, in the nearshore environment of Forteau Point at depths of 60 to 90 m, and in association with coarse-small substrate.

Stalked jellyfishes were encountered at depths ranging from 30 to 130 m in association with coarse-large and coarse-small substrate.

Sea anemones (*Metridium sp.*) were only encountered in high numbers in the nearshore environment adjacent to Forteau Point. They were associated with a depth range of < 30 m and 30 to 60 m in association with coarse-small substrate.

Hermit crabs and pycnogonids were rarely encountered, in a depth range of 90 to 130 m, and in association with coarse-small substrates.

Gastropods were encountered at a single station with a depth range of 90 to 130 m in association with coarse-large substrates.

Three unidentified fish were observed at a depth of 90 to 130 m in association with coarse-small and shell substrates.

Species of Special Conservation Status

Of all the macrofaunal species encountered during the 2008 survey, one, Atlantic cod, has a special conservation status. The Atlantic cod population as a whole is listed under Schedule 3 of SARA as a species of Special Concern. The area of the 2008 marine survey is adjacent to both the Newfoundland and Labrador population and the Laurentian north population of Atlantic cod. The Newfoundland and Labrador population has a COSEWIC designation of endangered and the Laurentian north population has a COSEWIC designation of threatened.

4.1.3 Macroflora

Nine macrofloral taxa were identified within the marine survey area; these were subdivided by percentage occurrence categories of 20-30%, 5-20%, 1-5%, and storm toss (Figures H-1 to H-10 Appendix H, Figure G-14, Appendix G).

20-30% Percent Occurrence

Macroflora taxa with distributions ranging from 20 to 30% included coralline algae (various species) and crustose algae (*Lithothamnium sp.*).

Coralline algae were encountered in 28.9% of the marine survey area with abundances ranging from 5 to 25% throughout all depth and substrate categories except for fine. The largest percent coverage (25%) was associated with a depth of 60 to 90 m and coarse-large substrates.

Crustose algae were encountered in 25% of the marine survey area with abundances ranging from 2 to 80%. Crustose algae were distributed throughout all depth and substrate categories except for shell and was most commonly associated with depths of < 30 m and coarse-small substrates. The largest distributions (50-100%) were associated with nearshore stations with depths less than 30 m and coarse-small and bedrock substrates in the vicinity of L'Anse Amour and Forteau Point (Labrador) and in the vicinity of Mistaken Cove (Newfoundland).

5-20% Percent Occurrence

Macroflora species with distributions ranging from 5 to 20% included sea colander, red fern, and sour weed.

Sea colander were encountered in 8.3% of the marine survey area with abundances ranging from 1 to 50%. Although widely distributed throughout all substrate categories except for shell, sea colander was only encountered at depths less than 40 m primarily in association with coarse-small substrates. Distributions were restricted to the nearshore environment near Mistaken Cove (Newfoundland).

Red fern were encountered throughout 7.5% of the marine survey area with abundances ranging from 2 to 25%. Red fern was widely distributed throughout all depth categories except 60-90 m and all substrate categories except for shell.

Sour weed were encountered throughout 6.7% of the marine survey area in abundances ranging from 1 to 30%. Sour weed distributions were restricted to coarse-small and coarse-large substrates and were found in all depth categories less than 30 m. Sour weed were noted on both the Labrador and Newfoundland sides of the Strait of Belle Isle.

> 1-5% Percent Occurrence

Macroflora species with distributions ranging from 1 to 5% included kelp, knotted wrack, edible kelp, and rockweed.

Kelp were encountered throughout 3.1% of the marine survey area in abundances ranging from 5 to 50%. Kelp were noted only on the Newfoundland side of the Strait of Belle Isle in the nearshore environment at Mistaken Cove within depths less than 30 m and only on bedrock and coarse-small substrates.

Knotted wrack were encountered throughout 1.2% of the marine survey area in abundances ranging from 1 to 2% within depths less than 60 m in association with coarse-small substrates on both the Labrador and Newfoundland sides of the Strait of Belle Isle.

Edible kelp were rarely encountered throughout the marine survey area with a percent coverage of 0.4%. Furthermore, edible kelp was found at depths less than 30 m in association with bedrock substrates in the nearshore environment near Mistaken Cove, Newfoundland.

Rockweed were encountered once (0.4%) within the L'Anse Amour nearshore environment, representing 0.4% of the marine survey area in abundance of 1% at a depth of less than 30 m in association with coarse-small substrates.

Storm Toss

Storm toss species included unattached portions of kelp, red fern, rockweed, sea colander, and sour weed. Storm toss was found across all depth and substrate categories. The most common species was sea colander

that was encountered along 25.8% of the area surveyed. Red fern storm toss was predominantly distributed on the Newfoundland side of the Strait of Belle Isle.

Special of Special Conservation Status

No macrofloral species of special conservation status were encountered during the 2008 survey.

4.2 2009 Marine Survey

4.2.1 Substrate

Substrate distributions within the proposed submarine corridors in the 2009 survey predominantly fell within the broad substrate categories of bedrock and coarse-small which respectively constituted 51% and 31% (82% total) of the marine survey area. Coarse-large was the dominant substrate category in 18% of the marine survey area. Fine substrate was rarely encountered and was the dominant substrate in only 0.2% of the marine survey area.

4.2.2 Macrofauna

A total of 20 macrofaunal taxa were identified within the submarine corridors and are listed below in order of their percent occurrence.

The most widely distributed macrofaunal species observed with a percent occurrence of > 50% included a single taxon, periwinkles. The highest percent occurrence was over bedrock and the highest abundances (abundant) were over bedrock, coarse-large, and coarse-small substrates.

Macrofaunal species with percent occurrence ranging from 25 to 50% included a single taxon, starfish (*Asterias sp.*). The highest percent occurrence was in bedrock and the highest abundances (abundant) were on bedrock, coarse-large, and coarse-small substrates.

Macrofaunal species with percent occurrence ranging from 5 to 25% included blue mussel, green urchin and rock crab. Blue mussels and green urchin had the highest percent occurrence in bedrock and the rock crab had the highest percent occurrence and highest abundances in coarse-large substrates. Blue mussels and green urchin had the highest abundances in bedrock and coarse-large substrates.

Macrofaunal species with percent occurrence ranging from 1 to 5% included hermit crab, whelk, barnacle, limpet, and sponge. All taxa in this group with the exception of hermit crabs had the highest percent occurrence on bedrock; hermit crab had the highest percent occurrence on coarse-small. All taxa in this group including hermit crab had their highest abundances on bedrock.

Macrofaunal species with percent occurrence with < 1% included sculpin, sea cucumber, isopod, and grass shrimp. Sculpin were observed on five single occasions on bedrock (once), coarse-small (twice), and coarse-large substrates (twice). Sea cucumber was observed on four occasions on coarse-large (three times) and coarse-small (once) substrates. Whereas grass shrimp and isopod were observed on bedrock substrate two and three times respectively.

Although it is difficult to draw conclusions from single observations, sea anemone, winter flounder and ocean pout were all observed on bedrock substrates. Whereas brittle star was observed over coarse-large and cunner was observed over coarse-small.

No macrofaunal species of special conservation status were encountered during the 2009 survey.

4.2.3 Macroflora

Seventeen macrofloral taxa were identified within the 2009 marine survey area. The macrofloral taxa encountered in the marine survey are listed below in order of their percent occurrence.

Macroflora taxa with percent occurrence ranging from 50 to 100% included crustose algae (*Lithothamnium sp.*), kelp (*L. longicruris*), and coralline algae (*C. officinalis*). All three taxa were found in bedrock, coarse-small, and coarse-large substrates and the kelp was found at an abundance of 100% coverage in all three substrate types. Both coralline and crustose algae had their highest abundances on bedrock.

Macroflora taxa with percent occurrence ranging from 25 to 50% included crustose algae (non *Lithothamnium sp.*), sea colander, and sour weed. All three taxa were found in bedrock, coarse-small, and coarse-large substrates. The highest abundances of crustose algae and sour weed were on bedrock substrates and the highest abundance of sea colander was on coarse-small substrates.

Macroflora taxa with percent occurrence ranging from 10 to 25% included red fern, edible kelp, and rockweed. These taxa were observed in bedrock, coarse-large, and coarse-small substrates but the highest abundance (70%) of edible kelp was on bedrock and the highest abundance (10%) of red fern was on both coarse-large and coarse-small substrates. Rockweed had the highest abundance (90%) on coarse-small substrate.

Macroflora taxa with percent occurrence ranging from 1 to 10% included brown filamentous algae, green filamentous algae, and dulse. Brown and green filamentous algae were found on bedrock, coarse-large, and coarse-small substrates, and dulse was found only on bedrock and coarse-small substrates. Brown filamentous algae were most abundant on coarse-small substrates, green filamentous algae were most abundant on coarse-large substrates, and dulse was most abundant on bedrock.

Macroflora taxa with percent occurrence of < 1% included kelp (*L. digitata*), unidentified brown algae, knotted wrack, sea lettuce, and cord weed. Taxa with < 1% occurrence found on coarse-small substrates included kelp (*L. digitata*), knotted wrack, sea lettuce, and cord weed. Taxa with < 1% occurrence found on bedrock included unidentified brown algae. Knotted wrack was also found on coarse-large substrates.

No macrofloral species of special conservation status were encountered during the 2009 survey.

4.3 2008 Shoreline Survey

4.3.1 Forteau Point (Labrador)

This shoreline area was categorized as a mixture of shoreline type as some bedrock was exposed but other substrates were present. The shore unit was categorized as a sand beach on narrow rock platform.

The intertidal area is a mixture of bedrock, bedrock with sand deposits, and boulder field whereas the backshore was a mixture of grasses, shrubs, and trees. Based on the available fetch data, the area was classified as exposed. The area of the shoreline surveyed was 500 m long and divided into five shore units based upon changes in habitat (Figures I-1 to I-4, Table I-2, Appendix I).

4.3.2 L'Anse Amour (Labrador)

This shoreline area was categorized as a sediment shoreline type as no bedrock was exposed. The shore unit was categorized as a wide sand flat as defined in Lee and Teasdale (2008).

The intertidal area is a mixture of sand, and gravel/cobble, whereas the backshore area was a mixture of grasses, large partially vegetated sand dunes, shrubs, and trees. Based on the available fetch data, this area was classified as semi-exposed. The area of the shoreline measured was 370 m long and divided into four shore units and four transects based upon changes in habitat (Figures I-5 to I-8, and Table I-3, Appendix I).

4.3.3 Mistaken Cove (Newfoundland)

This shoreline area was categorized as a mixture shoreline type as some bedrock was exposed but other substrates were present. The shore unit was categorized as a sand gravel beach on wide rock platform.

The intertidal area is a mixture of sand/gravel and bedrock whereas the backshore area was a mixture of grasses and trees/tuckamore. Based on the available fetch data, this area was classified as semi-protected. The area of the shoreline surveyed was 1.45 km long and divided into 10 shore units and 11 transects based upon changes in habitat (Figures I-9 to I-14, and Table I-4, Appendix I).

4.3.4 Yankee Point (Newfoundland)

This shoreline area was categorized as a mixture shoreline type as some bedrock was exposed but other substrates were present. The shore unit was categorized as a gravel beach on wide rock platform.

The intertidal area is a mixture of bedrock with gravel/pebbles and coarse gravel, whereas the backshore area was a mixture of grasses and tuckamore. Based on the available fetch data, this area was classified as exposed. The area of the shoreline surveyed was 567 m long and divided into four shore units and five transects based upon changes in habitat type (Figures I-15 to I-18, and Table I-5, Appendix I).

5.0 REFERENCES

- Envco Environmental Equipment Suppliers (2009). *Shipek Specifications* [webpage] (<http://www.envcoglobal.com/catalog/product/bottom-grabs/shipek-grab.html>), accessed January 2010.
- Fisheries and Oceans Canada (2008). *Interim Marine Habitat Information Requirements* DFO Marine Environment and Habitat Management Division.
- Lee, E and M. Teasdale, (2008). *Development of a Coastal, Marine, Estuarine, and Deep Water Fish Habitat Classification System for the NL Region*. DFO Marine Environment and Habitat Management Division.
- Newfoundland and Labrador Endangered Species Act. [webpage] (http://www.assembly.nl.ca/legislation/sr/tableregulations/tableofregulations_e10-1.htm), accessed January 2010.
- Species at Risk Public Registry (2009). List of species at risk in Canada [webpage] (<http://www.sararegistry.gc.ca/>), accessed February 2010.
- United States Environmental Protection Agency (2001). *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual*. Office of Water. Washington, D.C. EPA/823/B-01/002. October.