REGIONAL ASSESSMENT REPORT
NORTH SHORE–ANTICOSTI

Regional Assessment Report

North Shore–Anticosti
Priority Intervention Zone 19

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Edited by Jean Burton
St. Lawrence Centre
Environment Canada – Quebec Region

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NOTICE TO READERS

Reports on Priority Intervention Zones (ZIP) are published as part of the St. Lawrence Vision 2000 action plan by the St. Lawrence Centre of Environment Canada, in conjunction with Fisheries and Oceans Canada, Health Canada, the Ministère de la Santé et des Services Sociaux du Québec and its partners, and the Ministère de l'Environnement et de la Faune.

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Preface

In April 1994, the governments of Canada and Quebec approved a four-year action plan to carry on the work of the St. Lawrence Action Plan.

The goal of St. Lawrence Vision 2000 (SLV 2000) is to conserve and protect the St. Lawrence River and the Saguenay River so that people living along their shores can reclaim use of these rivers in a manner compatible with sustainable development.

The Priority Intervention Zones program — better known by its French acronym ZIP (zones d'intervention prioritaire) *— is a major element of the Community Involvement component of the St. Lawrence Vision 2000 action plan.*

Through the ZIP program, riverside communities are invited to play an active part in achieving the objectives aimed at restoring the St. Lawrence and Saguenay rivers.

The program enables various community partners, non-governmental organizations and citizens committees to work together to identify common priorities for the conservation and restoration of the St. Lawrence River.

We are pleased to present this assessment report on the uses, resources and main environmental problems specific to this area. It has been prepared using all the data available from the various federal departments and provincial ministries involved in SLV 2000.

We hope it will prompt a more enlightened debate based on information that is as objective as possible, and that the debate will help the different partners involved to draw up and implement an action plan for the restoration of the area in question.

Management Perspective

The Priority Intervention Zones program (known as the ZIP program) is a federal-provincial initiative involving riverside communities in implementing measures to restore the St. Lawrence River. The program has three phases: production of a local-level assessment report on the St. Lawrence, consultations with riverside partners and identification of intervention priorities, and development of an ecological rehabilitation action plan, or ERAP.

The regional assessment report is a synthesis of four technical reports on the biological, physico-chemical, socio-economic and human health aspects of the study area. These reports are prepared by the federal and provincial partners of the St. Lawrence Vision 2000 action plan, as part of its Community Involvement component.

This process of gathering and analysing data area by area has never before been undertaken for the entire St. Lawrence. The technical reports go a step further, assessing our knowledge of the current state of a given area based on known quality criteria.

The challenge, then, is to advance a scientific opinion based on the available information. The pitfalls are numerous: the data were collected for other purposes, the geographic and temporal coverage is less than ideal, and the chemical analysis methods are not standardized, to name but a few.

The ZIP work team remains nonetheless convinced that an enlightened and thoughtful overview of each study area can be presented without further delay. This initial assessment is therefore intended to be a discussion paper that will serve as a starting point for the shoreline partners in each study area.

Perspective de gestion

Le programme des Zones d'intervention prioritaire (ZIP) relève le défi de la concertation entre les gouvernements fédéral et provincial et de l'implication communautaire des partenaires riverains, en vue de mettre en oeuvre des mesures de réhabilitation du Saint-Laurent. Ce programme comporte trois grandes étapes, soit l'élaboration d'un bilan environnemental sur l'état du Saint-Laurent à l'échelle locale, la consultation de partenaires riverains, avec l'identification de priorités d'intervention, et l'élaboration d'un plan d'action et de réhabilitation écologique (PARE).

Un bilan régional est établi à partir d'une synthèse des quatre rapports techniques portant sur les aspects biologiques, physico-chimiques, socio-économiques et sur la santé humaine du secteur étudié. Ces rapports sont préparés par les partenaires fédéraux et provinciaux du plan d'action Saint-Laurent Vision 2000, dans le cadre du volet Implication communautaire.

La cueillette et l'analyse des données existantes à l'échelle locale constituent une première pour l'ensemble du Saint-Laurent. Les rapports techniques vont plus loin encore, en proposant un bilan des connaissances sur l'état actuel d'un secteur à partir de critères de qualité connus.

Le défi consiste donc à poser un jugement scientifique fondé sur l'information disponible. Les embûches sont nombreuses : les données ont été recueillies à d'autres fins, la couverture spatiale ou temporelle n'est pas idéale, les méthodes d'analyses chimiques ne sont pas uniformes, etc.

L'équipe de travail ZIP demeure convaincue qu'il est possible de poser, sans plus attendre, un regard éclairé et prudent sur chaque secteur. Cette première évaluation constitue un point de départ et un document de base rédigé à l'intention des partenaires riverains de chaque secteur d'étude.

Abstract

The North Shore–Anticosti study area includes all of the gulf coast of the St. Lawrence between Pointe-des-Monts and Blanc-Sablon, as well as the coasts of Anticosti Island. The area is not influenced directly by the waters of the St. Lawrence and, despite the presence of several large rivers, oceanographic conditions here are wholly marine, the water being very salty, cold and only slightly turbid.

The shores of the Middle North Shore (Moyenne-Côte-Nord) are characterized by the presence of vast sandy deltas at the mouths of rivers, whereas those along the Lower North Shore (Basse-Côte-Nord) are rocky and very indented. Small intertidal marshes are found in areas sheltered from the disruptive effects of waves and ice. The benthic fauna of the rocky coasts are characterized by the low abundance of American lobster, which has led to the pullulation of Green sea urchin and whelks.

The largest waterfowl overwintering grounds in the St. Lawrence system are found here, with sea ducks being the main visitor. They nest in northern Quebec and Labrador, and congregate in winter in ice-free areas where they feed on benthic invertebrates. Colonial sea birds and rorquals frequent this area of the St. Lawrence more than any other, feeding on banks of krill, lance and capelin in summer.

Supported by the coastal landscapes and fishery resources of the study area, the economy has grown since the early 1980s with the expansion of commercial and sport fishing, coastal tourism and sea bird and marine mammal watching.

The impact of the crash of groundfish populations in the gulf (Atlantic cod, Canadian plaice, White hake, redfish) in the early 1990s has not been felt as severely in the Middle North Shore as in other sectors of the gulf because the area’s fishing industry is primarily based upon the harvest of invertebrates (i.e. Snow crab, Pink shrimp, Iceland scallops), whose status is judged satisfactory at present. On the other hand, the fishery of the Lower North Shore is now in crisis

due to the cod-fishing moratorium imposed in 1994 and the decline of other secondary resources such as Giant scallop and Snow crab.

Except for a few sites situated near point sources of pollution, the water and sediment in the study area are relatively uncontaminated by toxic substances. The only known hot spots are at the fishing harbour of Sept-Îles, which was highly contaminated by mercury in the mid-1980s, and the Pointe aux Basques harbour, also at Sept-Îles, highly contaminated by iron from iron ore transshipping operations.

Despite the limited number of local sources of contamination and the distance to urban or industrial centres, fish-eating birds and seals in the area are exposed and vulnerable to the harmful effects of toxic substances biomagnified in the marine food chain (mercury and organochlorine substances). For example, the eggs of sea birds in the Lower North Shore contain elevated concentrations of PCBs. Overall, the contamination of the marine food chain by such substances does not appear to have changed since the late 1960s, except for DDT, whose levels have generally dropped in the gulf.

Prior to 1994, none of the area municipalities treated their wastewater. In 1996, only 2% of the entire riverside population of the study area was served by a wastewater treatment plant. This number will rise to 60% by the end of 1998 when six new treatment plants will come on stream, including those for Port-Cartier and Sept-Îles.

The consumption of seafood, fish and waterfowl taken from the study area poses no major risk to human health from chemical substances. However, the bacterial contamination of coastal shellfish in many areas, and the presence of elevated levels of marine toxins in shellfish from the western end of the study area have severely restricted their harvest. It is recommended that consumers reduce their intake of seal liver and meat or refrain from eating them altogether, along with the eggs of sea birds, due to the high concentrations of heavy metals and organochlorine substances they contain.

Résumé

Le secteur Côte-Nord-Anticosti comprend l'ensemble des côtes du golfe du Saint-Laurent entre Pointe-des-Monts et Blanc-Sablon ainsi que les côtes de l'île d'Anticosti. Le secteur n'est pas sous l'influence directe des eaux du fleuve Saint-Laurent et malgré la présence de nombreuses rivières importantes, il présente des conditions océanographiques franchement marines avec des eaux très salées, froides et peu turbides.

Les rives de la Moyenne-Côte-Nord sont caractérisées par la présence de grands deltas sableux à l'embouchure des rivières alors que celles de la Basse-Côte-Nord sont rocheuses et extrêmement échancrées. Des marais intertidaux de petite superficie sont retrouvés dans les endroits abrités des effets perturbateurs des vagues et des glaces. La faune benthique des côtes rocheuses du secteur est caractérisée par la faible abondance du Homard d'Amérique, ce qui aurait favorisé le pullulement de l'Oursin vert et du Buccin.

On retrouve dans le secteur les principales aires d'hivernage de sauvagine du système du Saint-Laurent. Il s'agit surtout de canards de mer qui nichent dans le nord du Québec et au Labrador et qui s'attroupent en hiver dans les zones libres de glace où ils s'alimentent d'invertébrés benthiques. Le secteur est aussi le principal secteur du Saint-Laurent utilisé par les oiseaux de mer coloniaux et par les rorquals qui exploitent les bancs d'euphausides (« krill »), de lançons et de capelans en été.

Les paysages côtiers et les ressources halieutiques du secteur supportent des activités économiques qui ont connu une expansion importante depuis le début des années 1980, notamment la pêche commerciale et sportive, le tourisme en rive et l'observation des oiseaux de mer et des mammifères marins.

L'impact de l'effondrement des populations de poissons de fond du golfe (Morue franche, Plie canadienne, Merluche blanche, Sébaste) au début des années 1990 n'a pas été ressenti aussi sévèrement sur la Moyenne-Côte-Nord que dans les autres secteurs du golfe, parce

que l'industrie de la pêche dans cette région est principalement basée sur l'exploitation d'invertébrés (Crabe des neiges, Crevette nordique, Pétoncle d'Islande) dont l'état actuel des populations est jugé satisfaisant. Par contre, les pêches sur la Basse-Côte-Nord sont présentement en crise en raison du moratoire imposé depuis 1994 sur la pêche à la morue et du déclin d'autres ressources secondaires (Pétoncle géant, Crabe des neiges).

À l'exception de quelques sites situés à proximité de sources ponctuelles de pollution, l'eau et les sédiments du secteur sont peu contaminés par les substances toxiques. Les seuls « points chauds » connus sont le port de pêche de Sept-Îles qui était fortement contaminé par le mercure au milieu des années 1980 et le port de la pointe aux Basques (Sept-Îles), fortement contaminé par le fer provenant du transbordement du minerai de fer.

Malgré le nombre restreint de sources locales de contamination et l'éloignement des grands centres urbains et industriels, les oiseaux piscivores et les phoques du secteur sont exposés et vulnérables aux effets néfastes des substances toxiques bioamplifiées dans la chaîne alimentaire marine (mercure et substances organochlorées). Par exemple, les oeufs d'oiseaux de mer de la Basse-Côte-Nord contiennent des concentrations élevées de BPC. Dans l'ensemble, la contamination de la chaîne alimentaire marine du secteur par ce type de substances semble ne pas avoir varié depuis la fin des années 1960 à l'exception du DDT qui a connu une baisse générale dans le golfe.

Avant 1994, aucune municipalité du secteur ne traitait ses eaux usées municipales et, en 1996, seulement 2 p. 100 de la population totale des municipalités riveraines étaient desservis par une station d'épuration. Ce pourcentage passera à 60 p. 100 avec l'entrée en fonction d'ici la fin de 1998 de six nouvelles stations, dont celles de Port-Cartier et Sept-Îles.

La consommation de fruits de mer, de poissons et de chair de sauvagine prélevés dans le secteur ne présente pas un risque important pour la santé humaine en ce qui concerne les substances chimiques. Par contre, la contamination bactérienne des mollusques littoraux dans plusieurs zones ainsi que la présence de concentrations élevées de toxines marines dans les mollusques de la partie ouest du secteur imposent des restrictions importantes à l'exploitation de ces ressources. On recommande aussi de s'abstenir ou de réduire la consommation de foie et de

chair de phoque et d’oeufs d’oiseaux marins en raison des concentrations élevées de métaux lourds ou de substances organochlorées qu’on y retrouve.

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CHAPTER 1 The Gulf of St. Lawrence, Then and Now

As early as the 15th century, Basque, Breton, Norman and Portuguese fishers began coming to the Gulf of St. Lawrence to fish the rich cod banks and hunt whales. This activity became a settled way of life in the early 1700s, with the establishment of commercial fishing stations in natural harbours. In the latter half of the 1700s, the deportation of the Acadians and the arrival of United Empire Loyalists from the United States marked the beginning of a true colonization of Quebec's extensive coastline. Until that point, the low population density and very size of the gulf had meant that human use of the aquatic environment had had virtually no impact on its resources. But things would soon change.

The first major impact seems to have been caused by the development of the forest industry in the 19th century and the holding of log booms for sawmills at the mouths of rivers. The pace of change accelerated in the mid-20th century, with the construction of pulp and paper mills, ports to serve new mining operations, and the intensive spraying of forests with DDT. The fishery underwent profound change as trawlers that increased fishing capacity tenfold were introduced. However, it was still thought that the Gulf of St. Lawrence was safe from pollution, and its resources inexhaustible.

The public suffered a rude awakening in the early 1970s when it was realized that the Northern gannet population of Bonaventure Island was severely contaminated by toxic chemicals that endangered its survival, and that fish stocks were collapsing as a result of overfishing.

There is now virtually unanimous agreement that the Gulf of St. Lawrence ecosystem is fragile and that its resources are limited. Despite its vast size and distance from major industrial centres, the integrity of the ecosystem is threatened by unchecked resource exploitation, the presence of toxic substances, and the destruction of wildlife habitats.

Most industrialized countries have now agreed to base their economic activities on sustainable development. The profit motive alone can no longer govern human activity. Given the fragile nature of our environment and the limitations of our planet, sustainable economic development must provide for versatile use of scarce resources, take into account the quality of human life and promote respect for biological diversity.

CHAPTER 2 The Priority Intervention Zones (ZIP) Program

Starting in the 1960s, growing public awareness of the degradation of the Great Lakes and the St. Lawrence and Saguenay rivers, along with the evident urgency of the situation, prompted governments to take concrete, joint action. This paved the way for the 1972 *Great Lakes Water Quality Agreement*, which was amended in 1987 to add a local use restoration program (remedial action plans or RAPs). In 1988, Ontario, Quebec and the eight American states concerned signed the *Great Lakes Toxic Substances Control Agreement*, and the *Great Lakes Charter*. Out of concern for the poor quality of the water of the St. Lawrence and its tributaries, the Quebec government launched its own wastewater treatment program (Programme d'assainissement des eaux – PAEQ) in 1978.

In 1989, the federal and Quebec governments decided to combine their efforts under the St. Lawrence Action Plan, which was renewed in 1994 as the St. Lawrence Vision 2000 (SLV 2000) action plan. One of the objectives of the plan is to draw up a comprehensive state of the environment report to which local stakeholders will be able to refer as they work together to restore and protect the St. Lawrence and reconcile the uses of this resource (Figure 1). As part of the groundwork for public consultations, the SLV 2000 partners review and synthesize current knowledge of the state of the environment in each study area.

This report presents the highlights of the technical reports[1] and reviews current knowledge of the state of the resources and the present and potential uses of the North Shore–Anticosti study area (ZIP 19).

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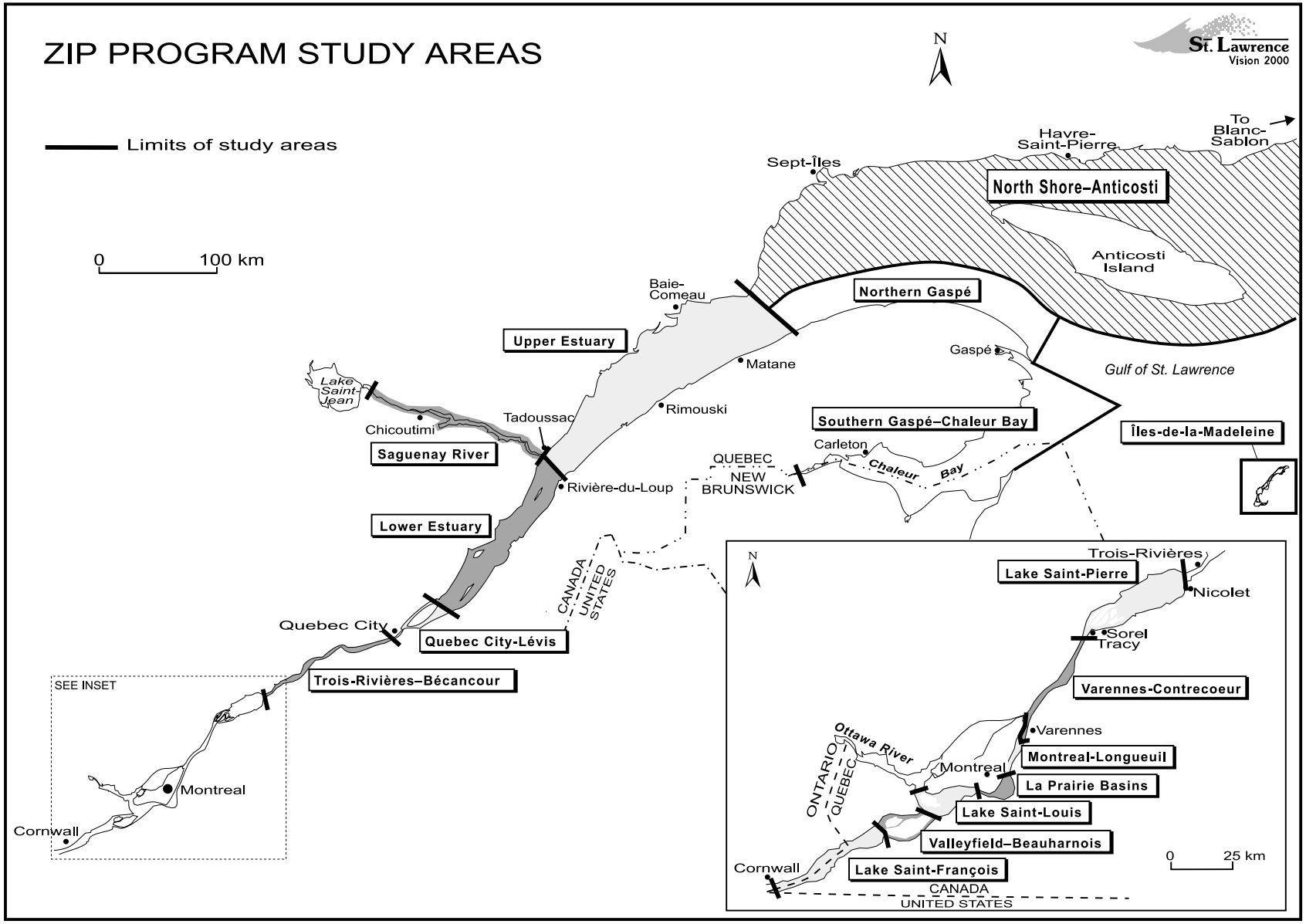
[1] The technical reports deal with the physico-chemical properties of water and sediments (Gagnon et al., 1997), biological communities (Mousseau et al., 1997), relevant socio-economic aspects (Bibeault et al., 1997), and human health (Duchesne et al., 1997).



Source: Priority Intervention Zones (ZIP) Program – SLV 2000

Figure 1 ZIP program study areas

This effort to synthesize and analyse existing knowledge is meant to provide the various riverside stakeholders with accessible, objective scientific data for use in setting their priorities for action. They will then be able to draw up and implement local and regional action plans wherein each partner will act within its sphere of responsibility, but in concert with the other partners.

CHAPTER 3 Characterization of North Shore–Anticosti

The North Shore–Anticosti study area encompasses the north coast of the Gulf of St. Lawrence between Pointe-des-Monts and Blanc-Sablon, the shores of Anticosti Island, and the deep water and sea bottoms off these coastlines (Figure 2). The area, which is designated Priority Intervention Zone 19, is subdivided into three sections: the *Middle North Shore* between Pointe-des-Monts and Natashquan, the *Lower North Shore* between Natashquan and Blanc-Sablon, and *Anticosti Island*.

3.1 Physical Environment

The underwater topography of the study area is dominated by three troughs more than 200 m deep which are connected to each other and to the Atlantic Ocean (Figure 3). The Laurentian Channel originates in the St. Lawrence Estuary, crosses the gulf along the south shore of Anticosti Island, continues toward the Cabot Strait, and terminates on the edge of the Continental Shelf southeast of Newfoundland. The Anticosti and Esquiman channels are branches of the Laurentian Channel that start in the Jacques Cartier Strait and the northwestern part of the gulf, respectively.

Between the deep channels and the shoreline lie underwater shelves of varying width and relief, some of which consist of a parallel series of plateaus, shoals and islands separated by longitudinal and transverse depressions.

The coastline of the study area extends over a distance of almost 5000 km (including about 3000 km of island shoreline) and presents a wide variety of forms. The Middle North Shore is characterized by an abundance of sandy shores associated with the deltas of large rivers, while the Lower North Shore has a rocky and highly indented coast.

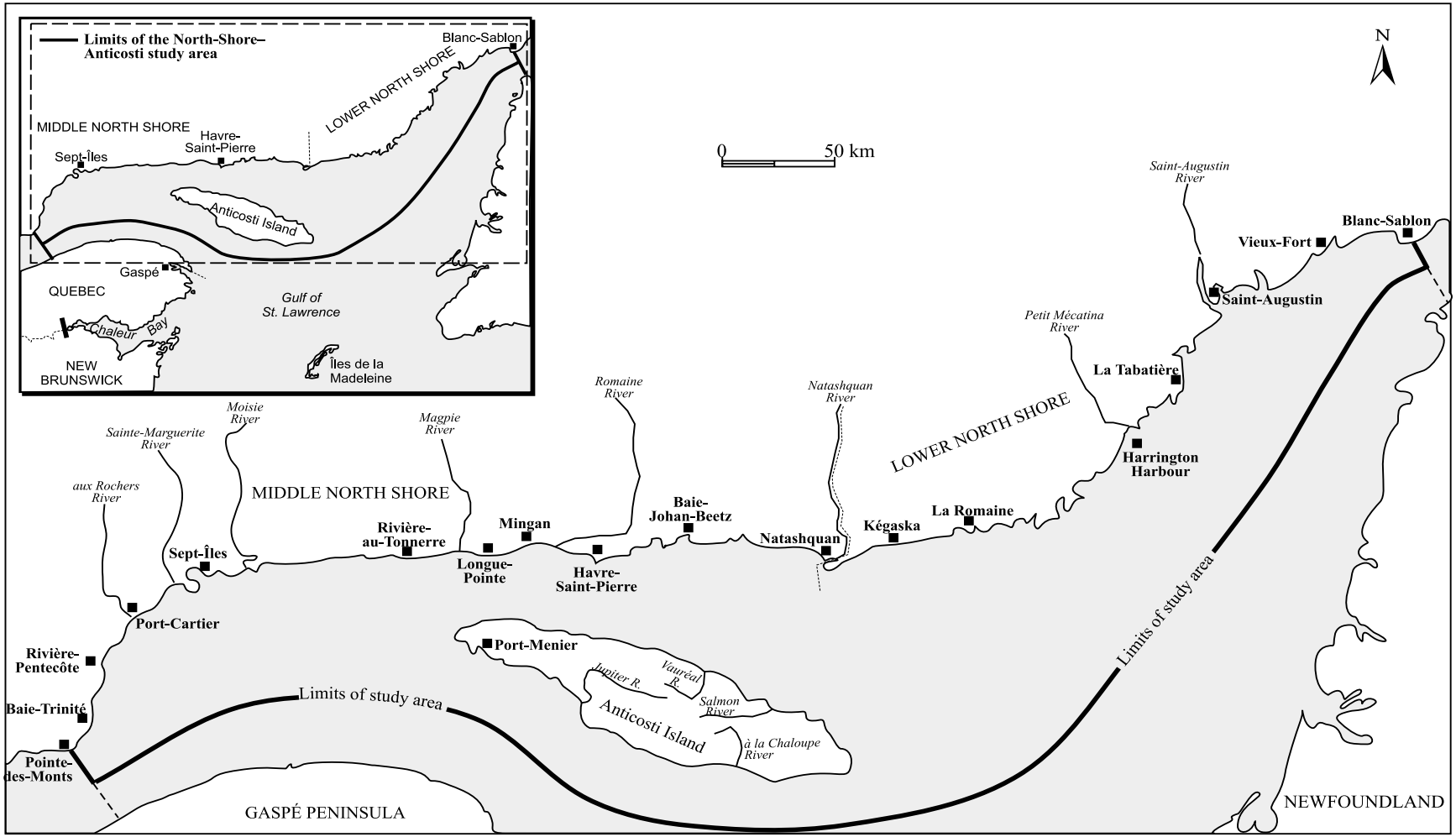


Figure 2 Limits of the North Shore–Anticosti study area

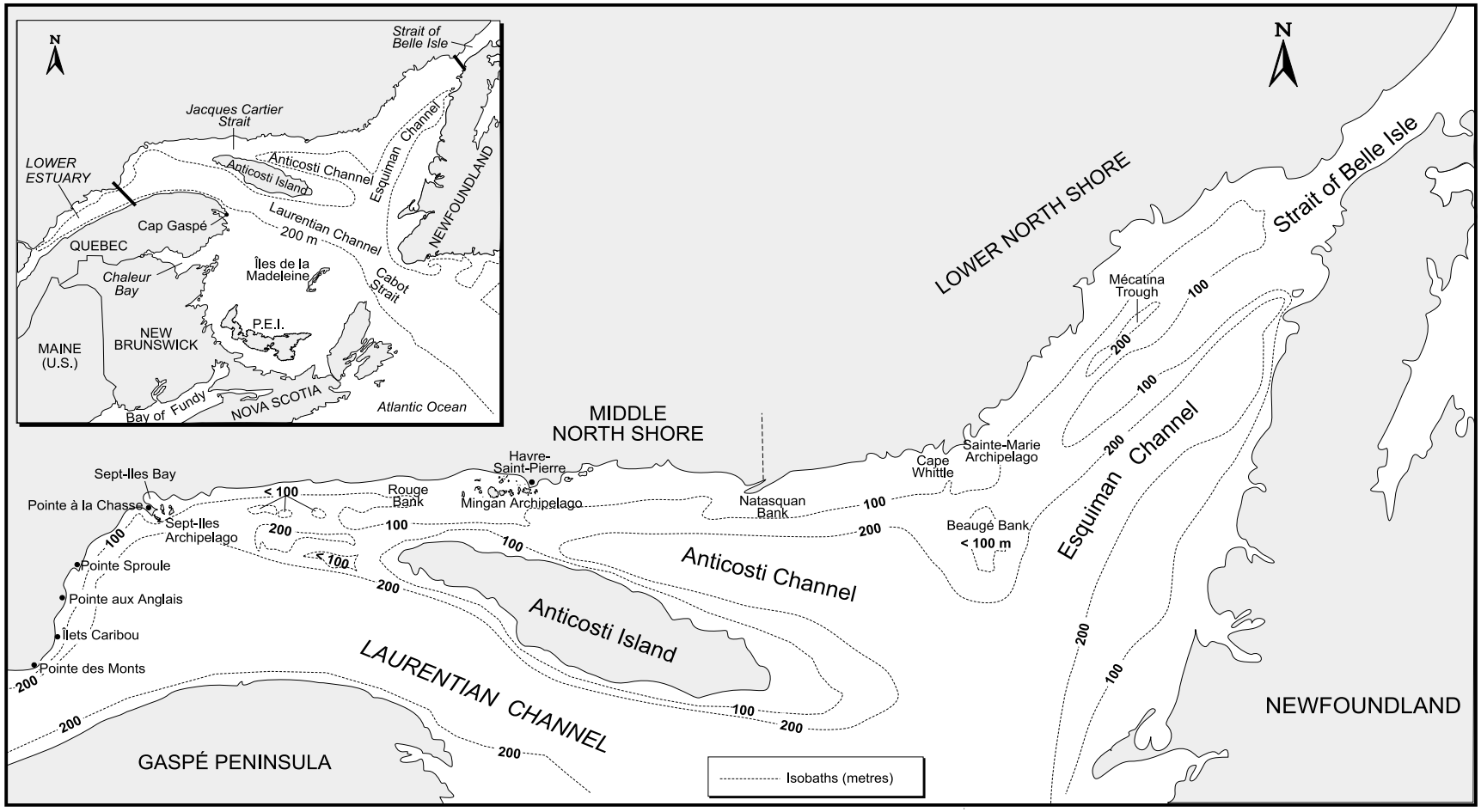


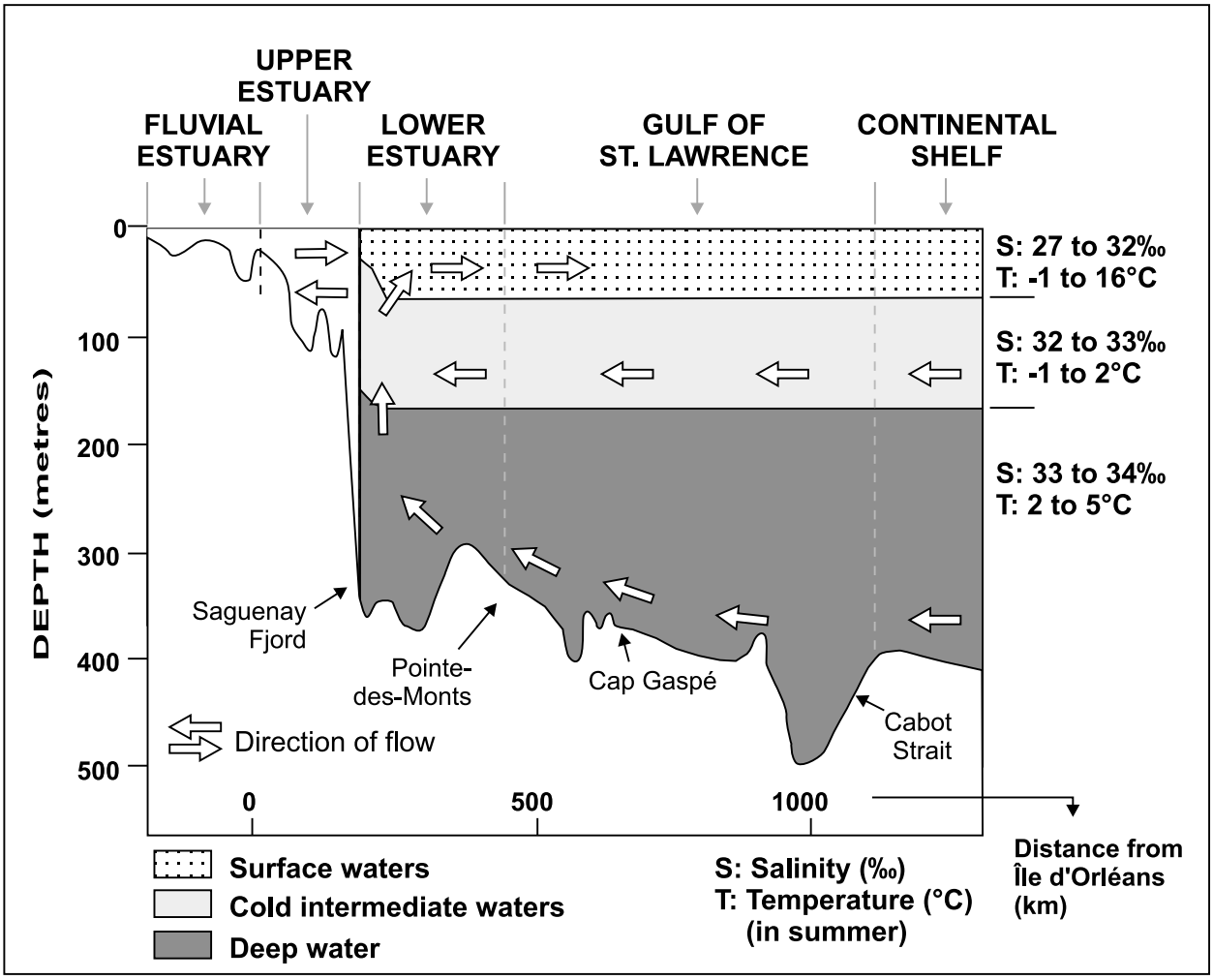
Figure 3 Physiography of North Shore–Anticosti

Rivers flowing into the study area have a combined annual discharge of about 2600 m^3 per second (equal to about 16 percent of the freshwater flow of the St. Lawrence River at Pointe-des-Monts). These rivers are flooded in June and their low-water period is in March. In decreasing size of flow, the main tributaries are the Petit Mécatina, Moisie, Natashquan, and Romaine rivers.

Tides in this part of the gulf are semi-diurnal (two cycles a day) and their amplitude varies following a twice-weekly cycle (spring tide/neap tide). The mean tidal range decreases from west to east along the Middle North Shore, falling from 2.5 m at Pointe-des-Monts to about 1.0 m at Cape Whittle and the eastern tip of Anticosti Island. Along the Lower North Shore, the mean tidal range varies from 1.1 to 1.6 m and is greatest at La Tabatière.

In summer, gulf waters stratify into three water masses of distinct formation and characteristics (Figure 4). They are, *1*) a relatively warm (12–15°C), barely salty (29–31‰) surface water layer, 30 to 50 m deep, formed by the mixing of fresh and salt water; *2)* an icy cold (-1 to 2°C), saltier (31.5–33‰) intermediate water layer extending from 30–50 m deep to about 125 m, formed by surface water cooling in winter and Labrador coastal waters transported into the gulf through the Strait of Belle Isle; and *3*), a deeper layer confined to the Laurentian, Anticosti and Esquiman channels that is warmer (2–5°C) and saltier (33–34‰) than the intermediate layer and comes from the Atlantic Ocean through Cabot Strait. In winter, the surface and intermediate layers mix and form a single mass of ice-cold water (< -1°C) from the surface to a depth of about 125 metres.

Water circulation in the area is dominated by a westerly current moving along the Lower and Middle North Shore and by the presence of a counter-clockwise gyre (eddy) between Pointe-des-Monts and the western tip of Anticosti Island (Figure 5). The study area is not influenced by the waters of the St. Lawrence Estuary. These waters instead form the Gaspé Current, which flows along the Gaspé Peninsula and empties into the southern part of the Gulf.



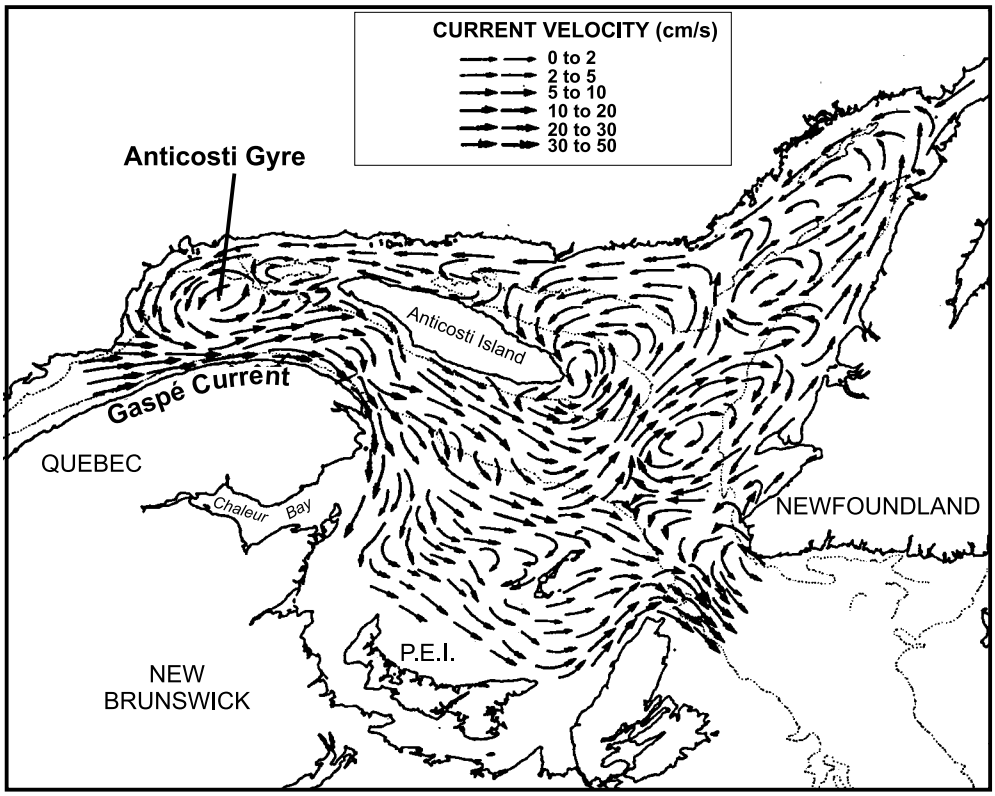
Source: Adapted from Koutitonsky and Bugden, 1991.

Figure 4 Vertical stratification of Gulf of St. Lawrence waters and of water masses

Currents produced by tides are weak (less than 30 cm per second) except in the western end of Jacques Cartier Passage, which acts as a bottleneck where surface and intermediate waters mix intensively during spring tides. Ice-free zones are usually found here in winter. On average, ice appears at the end of December in the northwest and far northeast. Ice formation advances nearing the centre of the area and covers it completely by the end of January.

The ice begins to disappear along the Middle North Shore starting at the end of March, while the Lower North Shore remains congested with ice until May.

Rivers in the study area do not transport large amounts of suspended solids (SS). As a result, its surface waters are much less turbid than waters of the St. Lawrence Estuary and the Gaspé Current. Sediments on the coastal shelf floors come mainly from local reworking of glacial deposits, while those on the deep channel bottoms result from the deposition of fine particles originating from watercourses, bank and bottom erosion, and pelagic biological production.



Source: Adapted from El-Sabh, 1976.

Figure 5 Surface currents in the Gulf of St. Lawrence in August

3.2 Biological Communities and Habitats

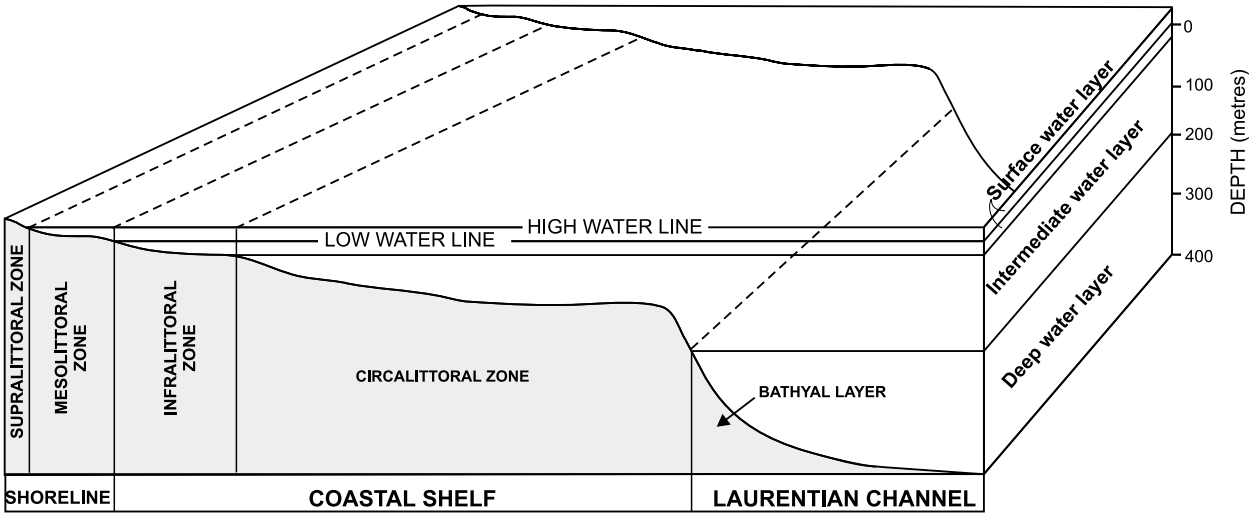
The study area contains a mosaic of aquatic habitats reflecting the many possible combinations of biophysical variables that determine the distribution and abundance of aquatic organisms. To help summarize the extensive knowledge available on the subject, two broad types of environment can be distinguished: benthic and pelagic.

3.2.1 Benthic habitats

The *benthic environment* is generally divided into five zones based on tidal reach and the vertical layering of water masses in the gulf (Figure 6): *1*) a *supralittoral* level above the high tide line, *2*) a *mesolittoral* zone subject to regular flooding and exposure by tides, *3*) an *infralittoral* zone consisting of sea bottoms permanently covered by the surface water layer (0–30 m deep), *4*) a *circalittoral* zone associated with the ice-cold intermediate water layer, and *5*) the *bathyal* zone consisting of the bottom of the Laurentian Channel more than 125 m deep.

Supralittoral habitats. Upper littoral habitats of interest are the cliffs, small islands and islets that support rare plants and are used by aquatic birds and seals as breeding and resting sites. Unlike the southern part of the gulf, the study area is characterized by a very large number of small islands, islets and reefs.

Mesolittoral habitats. Intertidal marshes are found on muddy substrates at the mouths of certain rivers and the bottoms of sheltered bays. They cover only 1300 hectares (ha) of the study area, or three times less marsh area per kilometre of shoreline than on the southern gulf shore (Quebec part) and even less than in the St. Lawrence Estuary. This explains the scarcity of geese and dabbling ducks visiting the area during the spring and fall migration or nesting periods. The largest marshes are found in Sept-Îles Bay and along the coast between Mingan and Cape Whittle. The only large marsh on Anticosti Island is found on the south shore of Grand Lac Salé. Saltwater herbaceous vegetation, submerged only by the equinox tide, largely dominates these marshes. Sept-Îles Bay is the only area with a small expanse of Saltwater cordgrass marsh that is immersed by each tide.



Source: Adapted from Brunel, 1991.

Figure 6 Zonation of the benthic habitat in the Gulf of St. Lawrence, by tidal zone and water mass

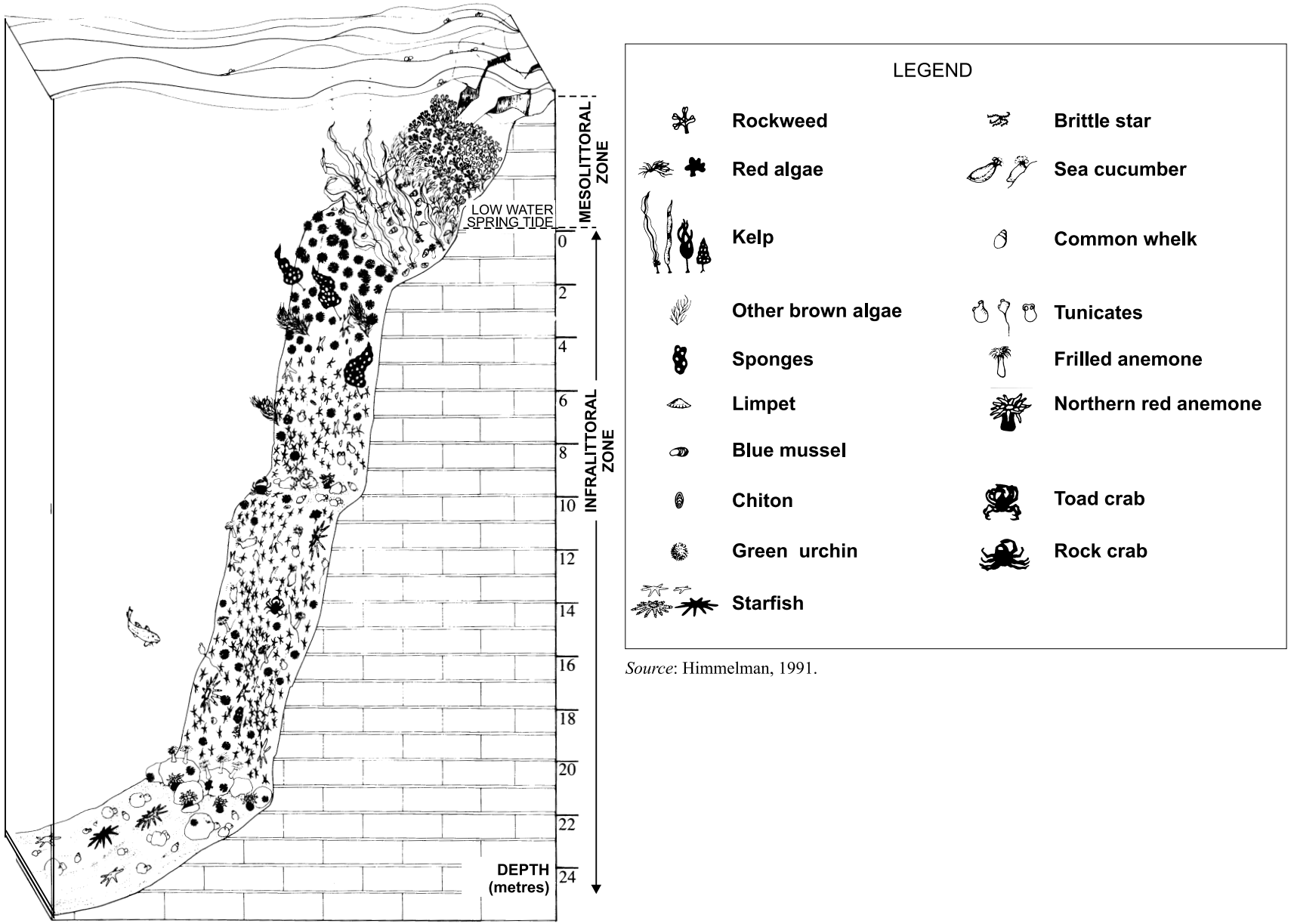
The large beaches found on the deltas of Middle North Shore rivers and surrounding coves consist of sand bare of vegetation. Where the sand is coarse, it is very poor in endobenthic fauna. However, this type of habitat is attractive to shorebirds (such as sandpipers, plovers) and laridae (gulls, kittiwakes and terns) that feed on organisms and detritus washed ashore by waves, and to capelin that come here to spawn. On beaches more protected from waves, sand mixed with finer sediment supports beds of Soft-shell clams and the marine worms actively sought by Winter flounder.

On the ubiquitous rocky coasts of the study area, the density and biomass of plant and animal life increases moving from the upper to the lower foreshore. On coastlines regularly eroded by ice, the foreshore is colonized by filamentous algae and periwinkles, with large benthic algae, barnacles and mussels able to grow only in basins, crevices and sheltered rocky walls. By contrast, in zones free from the disruptive effects of ice, brown algae (commonly called rockweed) form an unbroken carpet sheltering large numbers of periwinkles, mussels, and

gammarids on the lower foreshore. Basins here contain flora and fauna that normally occur below the low sea water mark. Taking advantage of high tide, many species of invertebrates, fish and sea ducks (especially the Common eider) come to feed in these habitats.

Infralittoral habitats. The lower littoral zone is never exposed by tides and is therefore protected from the disruptive effects of waves and ice. Sandy bottoms here are bare of vegetation and support a limited range of fauna dominated by the Sand dollar. There are also several species of large bivalves such as the Razor clam, Iceland cockle, and Stimpson's clam. By contrast, the rocky bottoms of the lower littoral support an abundant and diverse flora and fauna (Figure 7). In the Mingan archipelago, plant and animal communities generally form four distinct strips defined by water depth: *1*) a first starting at the low water spring tide mark and dominated by opportunistic algae that colonize surfaces denuded by ice; *2*) a second starting 1–2 m below the low water mark, dominated by large kelp and Blue mussels, the width of which varies depending on the slope and degree of exposure of the shore to waves; *3*) a third dominated by the Green sea urchin, a very efficient grazer which wipes out most of the benthic algae and invertebrate larvae in this strip, and *4*) a final zone hosting only algae capable of resisting grazing by the Green sea urchin (such as sea colander and encrusting lime-secreting alga) and a wide variety of filter feeders (sea cucumbers, anemones, tunicates). The main predators in this type of habitat are Northern starfish and whelks. The lack of lobsters around the Mingan Islands is partly responsible for the very high number of sea urchins and whelks found in this type of habitat.

Circalittoral habitats. In the circalittoral zone, at depths exceeding 30 m, light penetration is insufficient to permit photosynthesis. Biological communities in this zone consist of organisms that feed on organic particles that settle on the bottom and predators. Few studies have been done on the fauna of this habitat in the study area. However, we do know that muddy, sandy bottoms here are the preferred habitat of the Snow crab, while rocky bottoms (found mainly in intense mixing zones) are colonized by the Icelandic scallop and constitute the preferred habitat of the Atlantic cod.



Source: Himmelman, 1991.

Figure 7 Typical zonation of flora and fauna on underwater cliffs

Bathyal zone habitat. The muddy bottoms of the Laurentian, Anticosti and Esquiman channels support fauna that are very distinct from the other zones. The best known characteristic species here are Northern shrimp, Northern stone crab, and Greenland halibut.

3.2.2 Pelagic habitats

The pelagic environment is populated by phytoplankton (plants), zooplankton (animals), pelagic fish, sea birds and cetaceans. The food chain here is largely based on the production of microscopic algae (primary production) in the surface water layer.

Phytoplankton blossom in the study area in April, followed by the rapid decline in production and biomass. They remain at much lower values all summer except in zones of deep water upwelling, where primary production is maintained at a high level by the periodic transport of nutrients from deep water layers to the surface.

Zooplankton comprise many types of animals that drift passively with the current. They include organisms that live their whole life in the pelagic environment (copepods, euphausiids) as well as the eggs and larvae of benthic organisms and fish. Zooplankton in the study area are dominated numerically by large copepods of the genus *Calanus* and in terms of biomass by euphausiids (commonly called *krill*). Krill are mainly concentrated along the slopes of deep channels and migrate vertically between deep water in daytime and the surface at night. Several species of commercially harvested fish use the pelagic domain for spawning (cod) as well as for feeding by larvae and juveniles (lances, cod, redfish, herring, capelin) and adults (lances, mackerel, smelt). This in turn attracts sea birds (puffins, guillemots, razorbills) and cetaceans (rorquals and dolphins).

3.3 Fishery Resources

Only a few of the approximately 100 species of marine algae, 1000 invertebrate species and 80 fish species in the gulf are exploited by humans. In descending order of value of landings in area ports from 1990 to 1995, the main commercial species are Snow crab, scallops

(giant and Icelandic), Northern shrimp, Northern lobster, Atlantic cod, Atlantic salmon, whelks, Atlantic herring, Greenland halibut, and capelin. The main species taken for sport, recreation and subsistence in the area are Atlantic salmon, Rainbow smelt, capelin, Atlantic cod, and the Soft-shell clam. Below is a brief description of the distribution and present condition of these resources in the study area.

Snow crab. The Snow crab is a benthic invertebrate that frequents the muddy sea bottom at depths of 50 to 200 metres. It is abundant along all coastlines in the study area. The largest concentrations occur along the Middle North Shore, where abundance varies following a cycle of about eight years. Three consecutive years of low abundance of young individuals (1977–79, 1985–87, 1993–94) are usually followed by five years of medium to high abundance (1980–85, 1988–1992). The abundance of juveniles has a pronounced effect on catches about ten years later. The strong year classes of 1988–1992 are therefore expected to affect catches in coming years. On the Lower North Shore, the only strong year class to appear since 1985 was in 1991, so forecasts are rather bleak for stocks in this zone.

Scallops. In the study area, the Giant scallop is confined to shallow waters in sheltered bays along the Lower North Shore, while the Icelandic scallop is abundant at many locations along the North Shore and Anticosti Island at depths of 35 to 80 metres. The largest Icelandic scallop beds are found near Havre-Saint-Pierre. We have recently observed a drop in catches per unit of effort. On the Lower North Shore, Giant scallops are in a precarious state as a result of massive mortality in 1993 and weak year classes in recent years. This situation is thought to be related to abnormally cold climatic conditions in the area for the past several years, combined with a high rate of harvesting. Icelandic scallop beds on the Lower North Shore are not expected to be able to withstand the fishing pressure formerly exerted on the Giant scallop population.

Northern shrimp. The Northern shrimp is an invertebrate species that swims near the bottom of the deep channels during the day and migrates toward the surface at night. The largest concentrations of shrimp occur on muddy bottoms at depths of 150 to 300 m, in the upper parts of

the Laurentian, Anticosti and Esquiman channels. The population in the study area is presently in good condition. Its abundance rose at the end of the 1980s and the early 1990s due to the arrival into the fishery of the strong year classes from 1984 to 1987, then fell in 1992 and 1993. The strong year classes of 1990 and 1991 resulted in an increased abundance in 1994 and 1995.

Northern lobster. The North Shore is the lobster's northern distribution limit. The species is present along all coastlines on rocky bottoms less than 35 m deep, but in much fewer numbers than in the southern gulf. The largest concentrations are found along the south shore of Anticosti Island.

Whelk. The whelk is a gastropod abundant along all coasts in the study area on all types of bottoms from the low sea level mark up to a depth of 25 metres. A high proportion of individuals harvested do not seem to have reached sexual maturity, putting at risk the reproductive capacity of heavily-exploited populations.

Atlantic cod. The Atlantic cod population that frequents the study area (northern gulf population) winters off the southwest coast of Newfoundland, then disperses along the west coast of Newfoundland and the North Shore of Quebec in summer to reproduce and feed. This stock is in very poor condition; in 1993–94, fish biomass reached the lowest level since first estimated. Furthermore, the growth rate of individuals has been falling constantly since the late 1970s and the condition of individuals has deteriorated to the point where massive natural mortality occurred in the winter of 1993–94. The poor condition is probably due to the fact that the gulf climate has been colder than usual since the late 1980s. A moratorium on cod fishing was declared in 1994 because of the poor state of the resource. The stock is now showing signs of rebuilding, but in its current condition, the fishery could not be fully reopened without putting stocks in danger.

Atlantic salmon. There are 22 salmon rivers on the Middle North Shore, 24 on Anticosti Island, and 22 on the Lower North Shore. The main rivers, in descending order of the sport and subsistence catch from 1984 to 1995, are the Moisie, Natashquan, Saint-Jean, de la Trinité, Saint-Paul, and Étamamiou. In rivers for which chronological data exist on spawning

runs (mainly Anticosti Island), the number of breeders that swam upriver to spawn declined from the mid-1980s until 1992–93, then rose to an intermediate level in 1996. Sport fishing success in terms of salmon catch per day showed similar variations overall. The weakness of the spawning runs was attributed to poor oceanographic conditions in the Northwest Atlantic that would have reduced survival of the smolt in the ocean.

Atlantic herring. Atlantic herring that frequent the study area overwinter off the eastern coasts of the gulf and approach study area shores to feed and spawn in spring or at the end of summer. Spawning grounds have been reported around Pointe-des-Monts, Sept-Îles, Havre-Saint-Pierre, Harrington Harbour and La Tabatière. Populations seem in good condition now, with young individuals continuing to dominate landings and scientific surveys in recent years.

Greenland halibut. The Greenland halibut is a flatfish that winters in deep water near the Cabot Strait where it spawns. In summer, it migrates towards the northwestern part of the Gulf and Lower Estuary of the St. Lawrence on sea floors more than 200 m deep. Abundance of the gulf population has been weak since the beginning of the 1990s, but it has grown in recent years with the arrival of the strong year classes of 1988–1990 into the fishery.

Capelin. The capelin is a pelagic fish that winters off the North Shore and comes to spawn on the sand and gravel beaches of the study area from mid-May to mid-June between Pointe-des-Monts and Sept-Îles, from early June to mid-July between Sept-Îles and Natashquan, and from mid-June to the end of July on the Lower North Shore. It is said to “roll”. Capelin abundance is high in the north part of the gulf. However, variations in its abundance are not well understood.

Rainbow smelt. Smelt is an anadromous fish that winters at the mouths of rivers, spawns in spring in the rivers, and spends the rest of the year in salt water. It spawns in most rivers of the Middle North Shore. A small commercial smelt fishery has been reported in Sept-Îles Bay, along with ice fishing at the mouths of the des Rapides (Sept-Îles Bay), Asley, Piashti and Natashquan rivers. There is no data on the state of populations in the study area.

Soft-shell clam. The Soft-shell clam is a bivalve mollusc abundant on sandy, muddy floors of the lower part of the mesolittoral zone up to a depth of 10 m. The largest clam beds in the area are located near Sept-Îles and Havre-Saint-Pierre. The condition of local beds is not known.

3.4 Birds

A total of 341 species of birds have been observed along the North Shore (between Tadoussac and Blanc-Sablon) with 236 species on Anticosti Island. These birds come to breed (174 species along the North Shore and 117 species on Anticosti Island) and raise their young, feed during the spring and fall migration, to overwinter, or they may appear only occasionally or rarely.

Breeding. The area hosts 85 of the 115 breeding species directly associated with riparian and aquatic environments of the St. Lawrence, including 21 species that nest in colonies (eight of the Laridae family, five Alcidae, two cormorant species, two heron species, one Anatidae and three miscellaneous species). There are more than 550 bird colonies in the area inhabited by almost 140 000 breeding pairs. On the Middle North Shore, the largest colonies are found in the Sept-Îles archipelago and on the Mingan Islands and the principal species are of the Laridae family (the Herring gull, Ring-billed gull, Black-legged kittiwake, Common tern, Double-crested cormorant and Common eider). On Anticosti Island, the Falaise aux Goélands colony of Black-legged kittiwakes contains the majority of colonial birds on the island. The Lower North Shore is characterized by a great abundance of Alcidae colonies (guillemots, Atlantic puffins, Razorbills), the largest of which are located in four migratory bird sanctuaries. The study area has the distinction of hosting the only known colony of Caspian terns in Quebec (at Île à la Brume). It also hosts one of the two known Common black-headed gull colonies in Quebec and one of the three known Northern gannet colonies.

Chronological data are available on the size of colonies in the area's eight migratory bird sanctuaries. They contain most of the Alcidae colonies, but only some of the colonies of

other species. Over the past 20 years, there has been a spectacular increase in Alcidae numbers, with the population in the eight sanctuaries rising from 29 500 in 1977 to 86 300 in 1993. In 1993, the murre population reached its highest level since sanctuaries were created in 1925. This increase was a result of increased surveillance and educating local residents who hunt these birds and gather their eggs. Another factor would be the increase in stocks of small fish (capelin, Sand lances) on which these birds feed, due to reduced numbers of groundfish that compete with them for such forage fish.

By contrast, Herring gull and Black-legged kittiwake numbers have declined in the sanctuaries. This reflects a general trend in Quebec that could be related to the reduced groundfish fishery, for which discards at sea provided an abundant food source for these opportunistic birds. An unexplained decline has been observed in the case of the Common tern and the Arctic tern, but it may be only an apparent decline due to out-migration from the sanctuaries.

In addition to the colonial species, an inventory of the study area recorded one species of goose, seven species of dabbling duck, six species of diving duck, two species of sea duck and seven species of shorebird (sandpipers, plovers and other waders) that nest in individual pairs in riparian habitats. Of these, the Common eider (also a colonial nester) and the Black duck are the most abundant. The vast peat bogs of Anticosti Island support the greatest concentrations of nesting Canada geese in southern Quebec. The island is also one of the four most important breeding grounds for the Bald eagle in North America, and the most important in Quebec, with 20 nests counted.

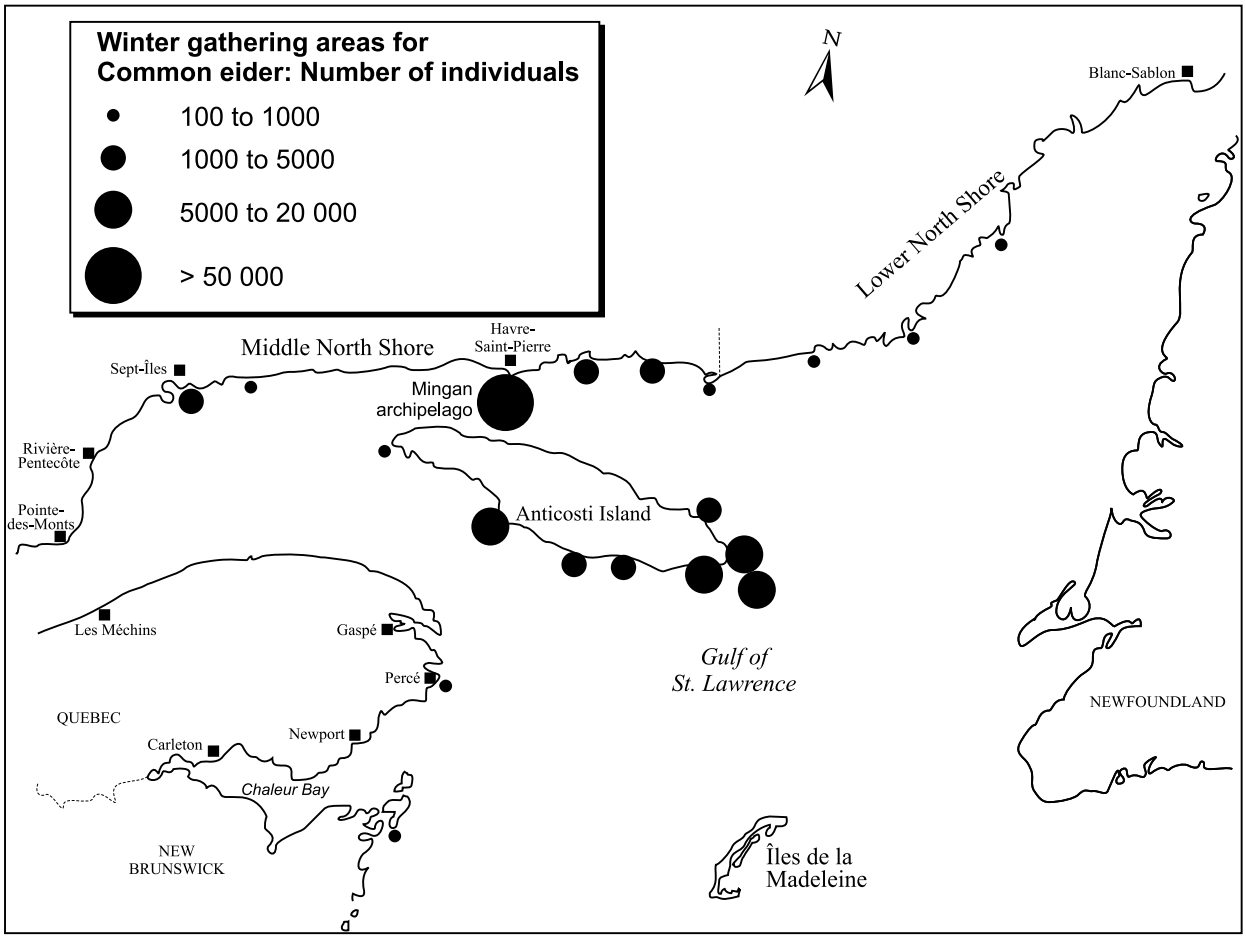
Spring migration. The Middle North Shore is the main gathering area in the Gulf of St. Lawrence for waterfowl migrating between their southern wintering grounds and nesting areas in the Far North. From 1974 to 1978, an annual average of close to 150 000 geese and ducks visited the Middle North Shore in spring, mostly in May. Because of the limited area of intertidal marshes, dabbling ducks and geese are scarce. Almost 95 percent of individuals counted are sea ducks (principally Common eider, Black scoter and Surf scoter). Migrating eiders gather mainly

around the Mingan Islands and the eastern portion of Anticosti Island, where they frequent the shallow muddy and rocky bottoms to feed mainly on herring roe and marine worms. Scoters gather mainly between Pointe-des-Monts and Pointe aux Anglais as well as between Pointe Sproule and Pointe à la Chasse west of Sept-Îles Bay. The main migratory staging grounds for Oldsquaws and goldeneyes in the Gulf of St. Lawrence is also located on the upstream section of the Middle North Shore.

Fall migration. Inventories conducted in fall show 4.5 times fewer migrating geese and ducks than in spring along the North Shore. Common eiders represent 82 percent of individuals counted along the Middle North Shore. This zone contains the main migratory staging area in the Gulf of St. Lawrence in autumn for eiders, Oldsquaws and goldeneyes. The eiders are concentrated around the Mingan Islands, below the Caribou islets and downstream from the mouth of the Moisie River.

Shorebirds (sandpipers, plovers and other waders) also frequent the shores of the study area in large numbers during their fall migration (about 6000 individuals). The main species observed are the Red knot, Red-necked phalarope, Semipalmated sandpiper and Least sandpiper. The largest concentrations are found on the shores of the Mingan Islands.

Overwintering. The study area contains the main overwintering areas in the St. Lawrence system for the Common eider and goldeneyes (Figure 8). Nearly 100 000 eiders gather around the Mingan archipelago where there are ice-free zones and abundant benthic invertebrates (mussels, urchins). About 50 000 eiders gather in ice-free zones off Anticosti Island, in particular along the south shore and the eastern tip of the island. Individuals that winter here belong mainly to the sub-species that breeds in northern Labrador and in the vicinity of Hudson Strait, and not to the sub-species that breeds in the area. Large numbers of Oldsquaws also overwinter in the area, but in fewer numbers than on the southern side of the gulf.



Source: Bourget et al., 1986.

Figure 8 Main winter gathering areas for Common eiders in the Gulf of St. Lawrence

3.5 Marine Mammals

Fifteen species of marine mammals have been observed in the study area, including six species of toothed whales, four species of baleen whales, and six species of seals.

Toothed whales. The study area is the main region of the gulf where it is possible to observe the Atlantic white-sided dolphin, White-beaked dolphin and Killer whale. However, the second species is far less abundant than the first and the Killer whale is seen only occasionally

(Natashquan, Sainte-Marie islands, Strait of Belle Isle). The Beluga whale population that summers in the St. Lawrence Estuary regularly visits the coast between Pointe-des-Monts and Sept-Îles in winter. The Harbour porpoise is abundant in all regions of the gulf. In the study area, it appears to be most abundant along the south shore of Anticosti Island and along the Lower North Shore. The Pilot whale visits the gulf only occasionally during its summer migration between the south and north Atlantic.

Except for the Beluga, which is a permanent resident of the St. Lawrence, toothed whales visit the gulf only in summer to feed on small fish (capelin, lance, herring).

Baleen whales. The study area is the main region of the gulf where baleen whales can be sighted. In descending order of abundance in the gulf, species observed include the Minke whale, Fin whale, Humpback whale, and Blue whale. These species visit the Gulf of St. Lawrence only in summer to feed on euphausiids and small fish such as capelin, lances and herring. The principal zones frequented by these great whales are the Laurentian Channel slope between Pointe-des-Monts and Sept-Îles, the Banc Rouge and Mingan archipelago, the Natashquan shoals, the Sainte-Marie islands area, and the Lower North Shore between the Saint-Augustin River and the Strait of Belle Isle.

Seals. The Grey seal breeds in winter in the southern gulf and then disperses along the gulf shores to feed. Their main haulouts in the gulf are currently located around Anticosti Island where the species, which is sensitive to disturbance, finds greater quiet. Grey seal numbers in eastern Canada have been rising since the early 1960s.

The population in the gulf was estimated at 61 000 in 1995. The Harbour seal breeds in small colonies scattered throughout the gulf. Gulf populations appear to have declined sharply since the 1970s. As a result, haulouts that were identified in the upstream part of the Middle North Shore in 1973 were not observed in 1996. Part of eastern Canada’s Harp seal population breeds in the gulf in winter and disperses along the coasts to feed before returning to the Far North at the end of spring. One of the two whelping grounds in the gulf is located on the ice off the Lower North Shore. In 1994, 57 000 pups were born there, amounting to 22 percent of total

births counted in the gulf and 8 percent of total births for the population in eastern Canada. Their numbers have risen steadily since 1973, increasing from under two million individuals in 1973 to 4.8 million in 1994. Hooded seals, Ringed seals, Bearded seals and walrus are seen occasionally along the Lower North Shore.

3.6 Species at Risk

The study area contains 29 rare plant species, 4 fish species, 10 birds, 4 marine mammal species and 1 land mammal identified as priority species in need of protection under the St. Lawrence Vision 2000 action plan (Appendix 1).

Among priority plant species, eight are endemic to the Gulf of St. Lawrence and four are endemic to northeastern North America. Two of the rarest endemic species, the Sparrow-egg lady's slipper (*Cypripedium passerinum* var. *minganense*) and the Elk thistle (*Cirsium foliosum* var. *minganense*) have been found in the Mingan archipelago and their populations are being studied. The Fernald's milk-vetch (*Astragalus robbinsii* var. *fernaldii*) is found in Quebec only in the Blanc-Sablon area.

The priority fish species are Rainbow smelt, Atlantic tomcod, American eel, and Atlantic herring. The priority status of the first three species is due to the poor state of their populations in the St. Lawrence Estuary and may not be applicable to study area populations, whose condition is not known. The condition of Atlantic herring populations in the study area has gradually improved since the end of the 1970s and can now be considered good.

Of the 10 priority bird species, seven nest or have nested in the study area. They are the Northern pintail, Blue-winged teal, Harlequin duck, Barrow's goldeneye, Piping plover, Caspian tern, and Bald eagle. The first two duck species have suffered a marked decline in abundance in Quebec over the past 30 years. The causes of the pintail's decline are unknown, while the teal's decline is blamed on loss of breeding habitat and overhunting in Mexico in winter. The Harlequin duck breeds on the Lower North Shore. Its numbers have fallen appreciably throughout this century and hunting it has been prohibited since 1990. The species is

sensitive to toxic substances and oil spills. The Piping plover has previously nested on the Lower North Shore (in 1986). Quebec's only Caspian tern colony has existed for more than a century on the Lower North Shore near Île à la Brume. In 1894, the colony contained 200 pairs. Its numbers have declined over the 20th century due to egg-collecting by coastal residents, and there were fewer than 20 individuals in 1988. It has grown slightly to reach 32 individuals in 1995. The Bald eagle has suffered a significant population decline in eastern North America since the 1950s due to contamination by DDT and other organochlorine substances (see Section 4.2.2.2). However, sightings have become more common all over Quebec since DDT was banned in 1972.

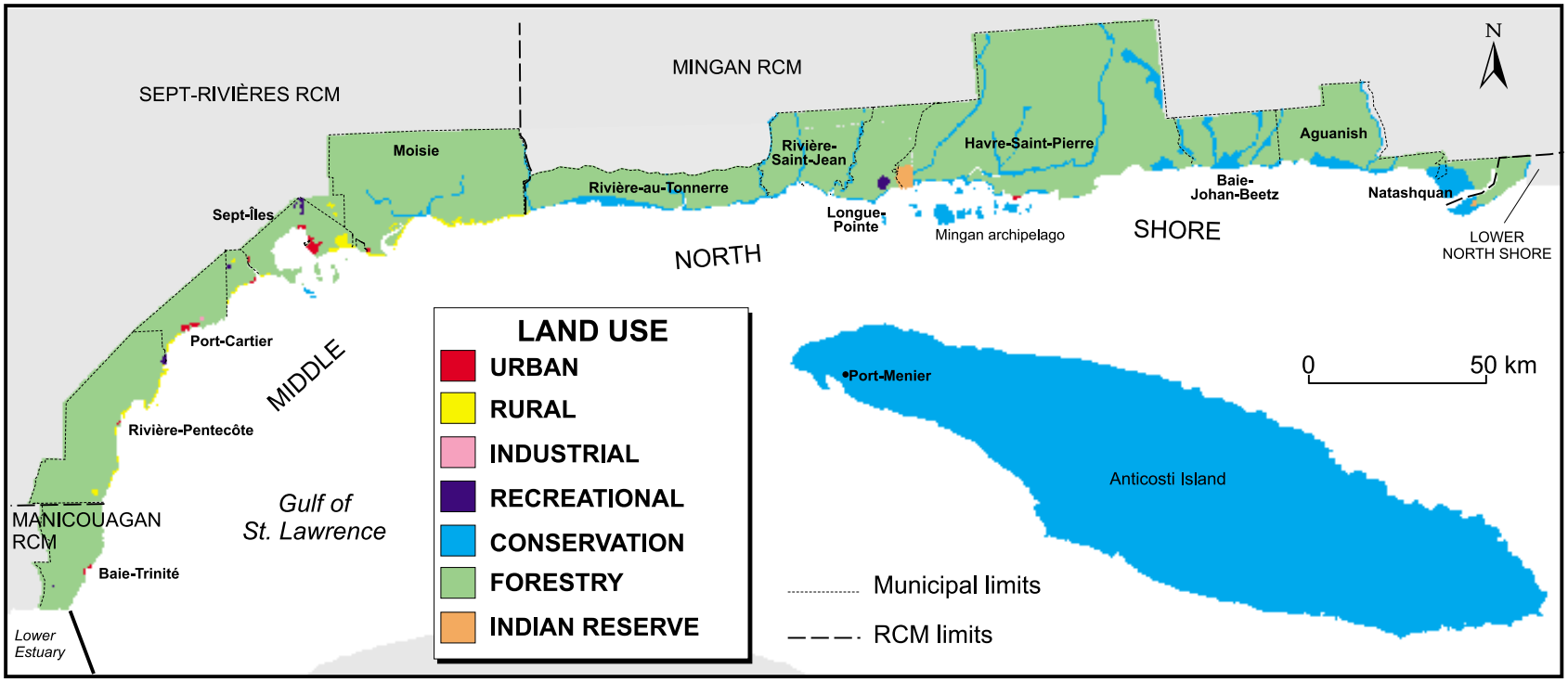
The three priority species of marine mammals in the study area are the Beluga whale, Harbour porpoise, Fin whale, and Harbour seal. The Harbour porpoise is abundant in the gulf, but large numbers perish every year after becoming tangled in fishing nets. The Fin whale population is making a recovery, while Harbour seal numbers have been down throughout the gulf since the 1970s because of human disturbance and its sensitivity to toxic substances.

3.7 Land Use

3.7.1 Land-use divisions

The 19 municipalities and 4 Indian reserves in the study area occupy an area of 25 200 km^2 inhabited by nearly 48 500 residents in 1991 (Figure 9). More than 74 percent of the area's population is concentrated in Sept-Îles (24 848 residents) and Port-Cartier (7383 residents). Sept-Îles is an industrial service centre and port city, while Port-Cartier is an industrial port city.

Most of the land in Middle North Shore riverfront municipalities is set aside for forestry. A narrow coastal strip in the western part of the Middle North Shore is designated rural, while in the eastern part, a large proportion of gulf and river shoreline as well as all of Anticosti Island is set aside for conservation.



Note: Land use has not been defined for the Lower North Shore as the area is not part of an RCM.

Source: Manicouagan RCM, 1987; Sept-Rivières RCM, 1986; Minganie RCM, 1987.

Figure 9 Broad land-use divisions in coastal RCMs of the Middle North Shore–Anticosti

3.7.2 Areas protected by federal, provincial or municipal acts and regulations

Mingan Archipelago National Park Reserve. This 15-km^2 reserve was created in 1984 to protect 800 islands and islets stretching along 175 km of Middle North Shore between Longue-Pointe and Aguanish.

Provincial conservation park. On Anticosti Island, planning for a conservation park incorporating the Vauréal River is under way.

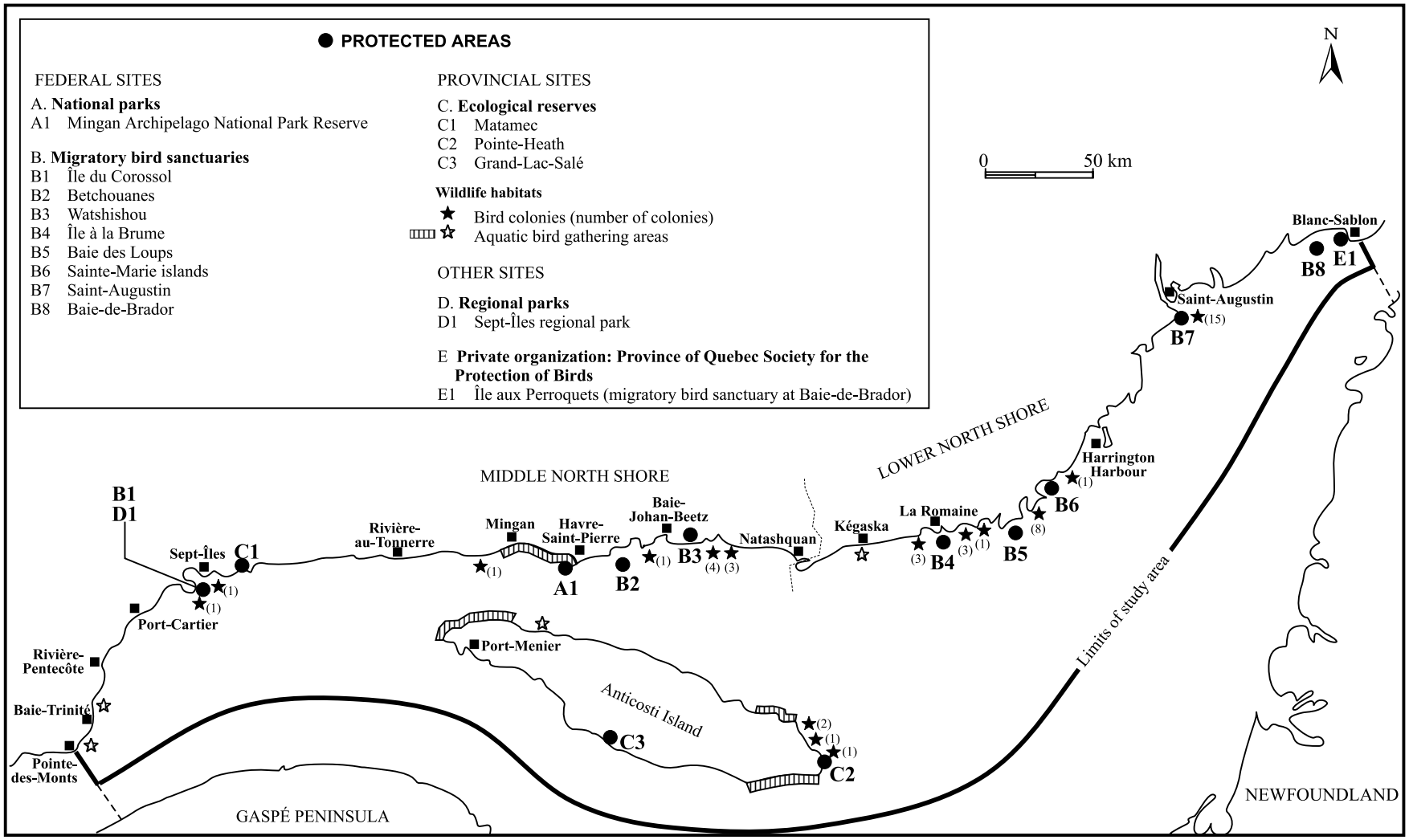
Ecological reserves. There are three ecological reserves under provincial government jurisdiction in the study area. The Matamec ecological reserve near Sept-Îles was created in 1995 to protect the drainage basin of the Matamec River. At this point, only the southern part of this basin (186 km^2) has the status of ecological reserve. The Pointe-Heath ecological reserve on Anticosti Island was created in 1978 to protect the characteristic peat bogs of the Anticosti–Minganie region. This reserve also protects one of North America's largest colonies of Black-legged kittiwakes (at Falaise aux Goélands). The ecological reserve of Grand-Lac-Salé, created in 1996, protects the largest lagoon and the largest saltwater marsh on Anticosti Island.

Migratory bird sanctuary. Eight migratory bird sanctuaries covering a total of 310 km^2 and under the jurisdiction of the Canadian Wildlife Service are distributed throughout the archipelagos of the Middle North Shore and the Lower North Shore. They protect the major bird colonies of the study area (Figure 10).

Wildlife habitats. A total of 57 small wildlife habitats have been created by the Ministère de l'Environnement et de la Faune to protect 11 aquatic bird gathering areas and 46 bird colonies (Figure 10).

Salmon rivers. Under provincial law limiting development projects, the 68 salmon rivers in the area enjoy a special form of protection not given to other watercourses.

Municipal parks. The only regional park in the area is on the Sept-Îles archipelago. Under the jurisdiction of the city of Sept-Îles, this park covers the entire archipelago. Sept-Îles also has two municipal parks on the shore of Sept-Îles Bay.



Source: Boucher, 1992; Saint-Onge, 1996; UQCN, 1993; MLCP, 1993.

Figure 10 Protected areas in the North Shore–Anticosti study area

3.8 Developed Uses

3.8.1 Hydro-electric power generation and water supply

There are three private hydro-electric generating stations in operation and two Hydro-Québec generating stations under construction in the area. Two of the private stations are located on the Sainte-Marguerite River and the third on the Magpie River. Hydro-Québec is now building a third generating station on the Sainte-Marguerite River and another on the Lower North Shore (Lake Robertson). The latter station will soon replace the production of three diesel-fueled thermal generating stations.

No large town or company draws water from the gulf because of its salinity level. Sept-Îles draws water from a lake. Port-Cartier takes water from a river and Havre-Saint-Pierre pumps groundwater. In 1994, these three municipalities took a total of almost 20 000 m^3 of water. In 1991, Quebec Cartier Mining Company (Port-Cartier) drew 8 300 000 m^3 of water from a river, while Wabush Mines (Sept-Îles) took 2 300 000 m^3 from a lake.

3.8.2 Shipping and port activity

Port-Cartier and Sept-Îles are Quebec's two largest ports in terms of tonnage handled (about 20 million tonnes a year each) and the port of Havre-Saint-Pierre ranks seventh, with 2.5 million tonnes handled in 1992. Almost 90 percent of total cargo handled in these three ports is iron ore (Port-Cartier and Sept-Îles) and ilmenite ore (Havre-Saint-Pierre). More than 50 percent of ship movements in the port of Sept-Îles were international. From Havre-Saint-Pierre, ilmenite ore is shipped to Tracy on the St. Lawrence River. In 1995, 385 000 tonnes of fuel oil and gasoline were transshipped at the port of Sept-Îles.

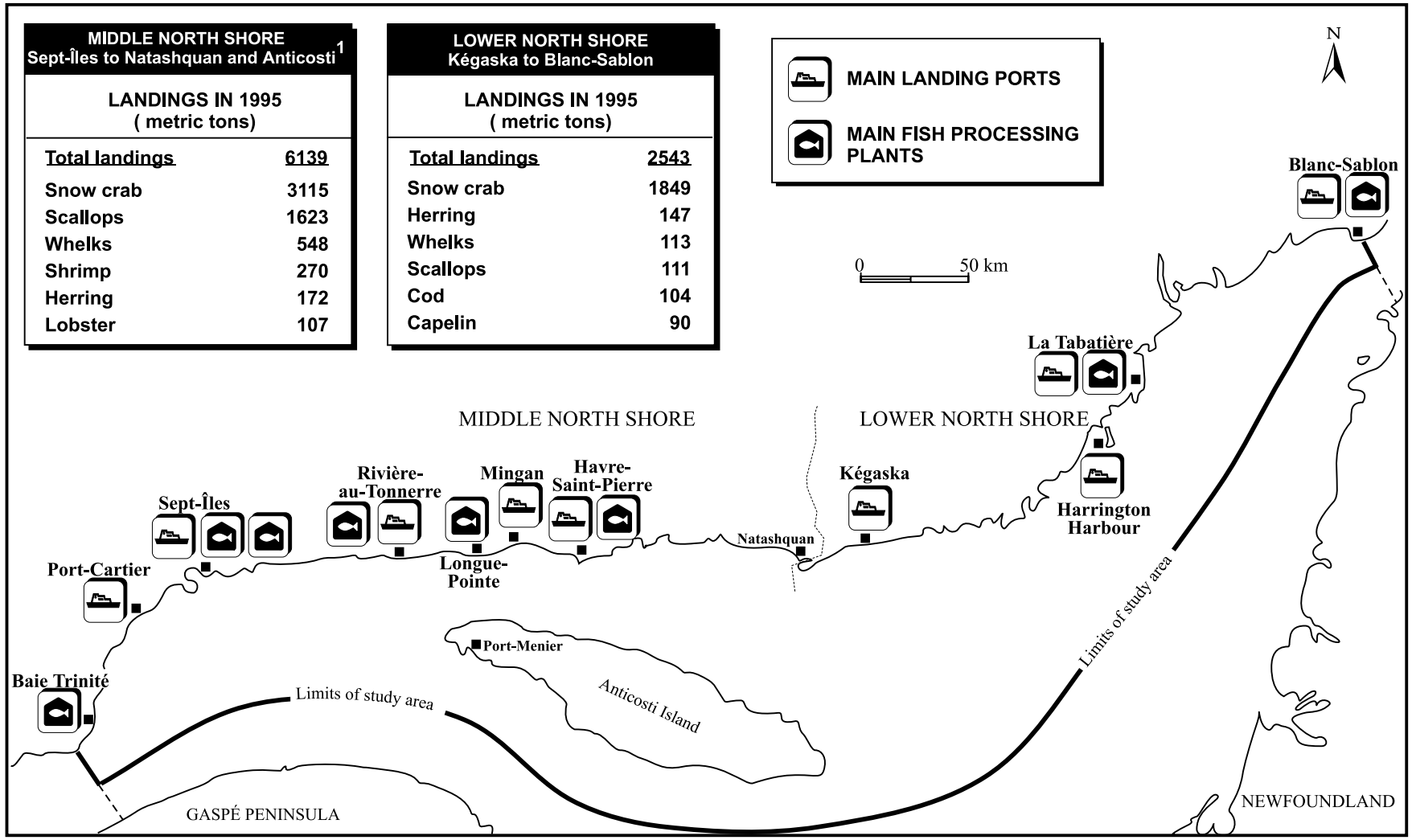
East of Havre-Saint-Pierre, about ten small commercial ports are used to supply general cargo, fuel oil and gasoline to isolated communities along the Middle and Lower North Shore. Marine transport is the only way of supplying those places east of Havre-Saint-Pierre (before 1996) and Natashquan (since 1996). The largest of these ports are at Blanc-Sablon and La Tabatière, which handled 16 000 tonnes and 9700 tonnes of merchandise, respectively, in 1993.

3.8.3 Harvesting of biological resources for commercial or subsistence purposes

Commercial fishing. In 1995, commercial fishing in the study area provided 1484 full-time and part-time jobs for fishers working on 646 licensed fishing boats in the area. The eight fish processing plants (Figure 11) in the area employed hundreds of people. The main landing ports for marine products in the study area are Sept-Îles (seventh in Quebec in 1994) and Havre-Saint-Pierre (eighth in Quebec).

The profile of the Lower North Shore fishery differs greatly from that of the Middle North Shore, and Anticosti Island has only one small lobster fishery. The Middle North Shore fishery has always revolved around harvesting shellfish and crustaceans, particularly Snow crab, Northern shrimp, and scallops (Figure 11). As a result, the collapse of gulf groundfish stocks did not have as big an impact on the region as it did on the Lower North Shore, in Gaspé and on Îles-de-the-Madeleine. In fact, while groundfish landings declined by 97 percent from 1985 to 1995 on the Middle North Shore, overall landings declined only 8.5 percent and their value more than tripled over the period.

The situation is very different on the Lower North Shore, where cod was always the principal fish resource until the end of the 1980s. From 1985 to 1995, cod landings on the Lower North Shore fell by 98 percent and overall landings declined by 71 percent. On the other hand, high Snow crab prices in recent years resulted in an increase in the total value of landings over the same period. The Lower North Shore is the only region in Quebec where commercial fishing of Atlantic salmon is still permitted. Landings of this species reached 42 tonnes, or about 14 000 salmon.



Source: Fisheries and Oceans Canada, 1996; MAPAQ, 1995.

1. In 1994, the only marine products landed at Anticosti Island were 40 tonnes of lobster.

Figure 11 Landings of main fishery resources in North Shore–Anticosti ports in 1995 and location of main fishing harbours and fish processing plants in the study area

Harvesting shore molluscs. Coastal inhabitants harvest Soft-shell clams for their personal consumption. This practice is mainly limited to shellfish zones where the bacterial quality of the water and toxicity of the clams are monitored. In 1996, 11 of 36 shellfish zones in the area were either closed in summer or closed permanently because of poor bacteriological water quality, another 11 were closed because they were no longer being monitored, and 14 zones remained open permanently. While marginal to the economy, this activity has major implications for human health (see Section 5.1).

Aquaculture. Aquaculture is not an important activity in the area. There were only two producers in 1996: Blue mussels were cultivated in the Blanc-Sablon region and scallops near Saint-Augustin.

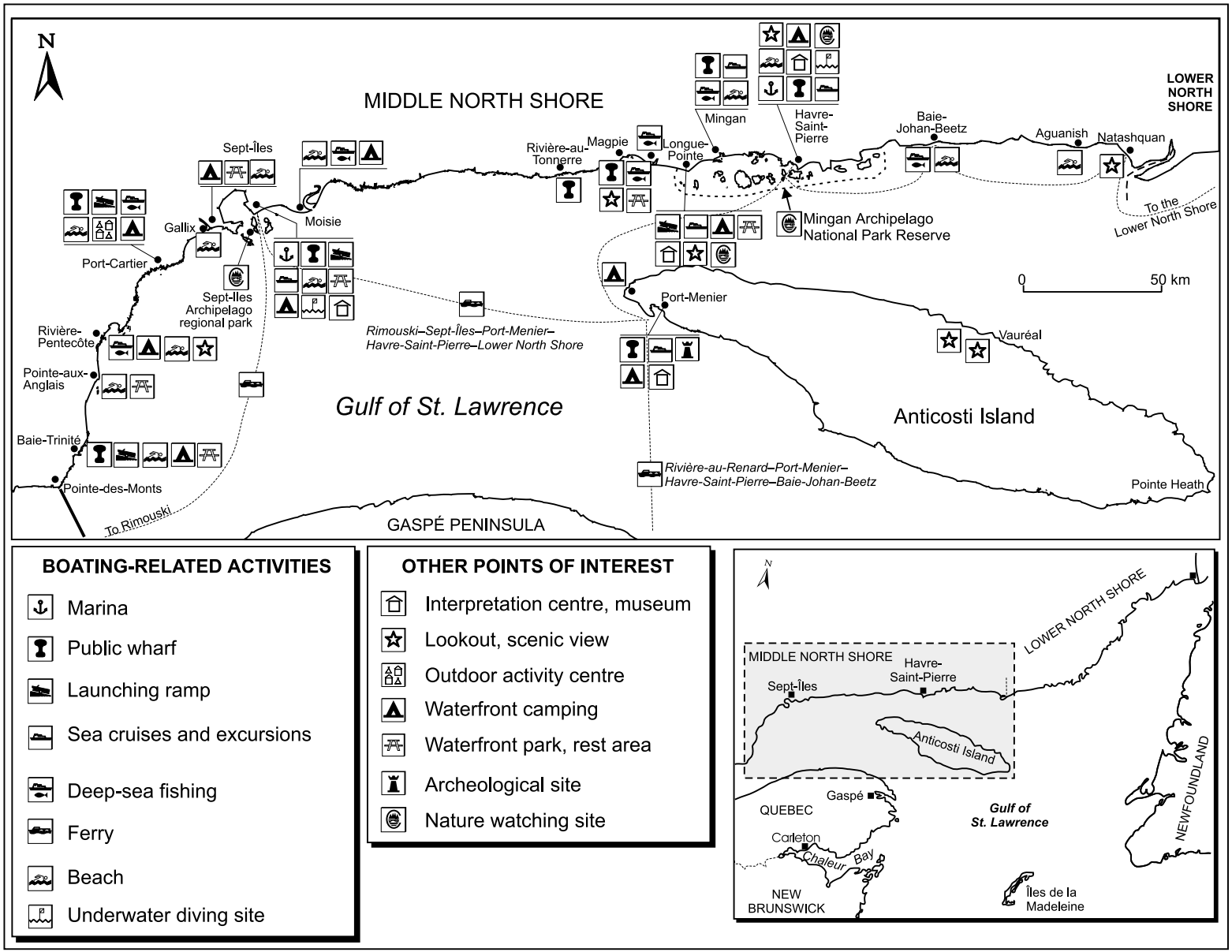
Native food fishing. Native bands catch salmon in the Moisie, Mingan, Natashquan and Saint-Augustin rivers for food. In 1995, a total of 1338 salmon were taken.

Marine mammal hunting. Only the Grey seal and Harp seal may be hunted in the Gulf of St. Lawrence. In 1995, 952 hunting permits were issued in the area. In 1994, 1725 Harp seals and 429 Grey seals were taken. Whale hunting has been prohibited in Canada since 1979.

3.8.4 Tourism and recreation

Only in recent years has the North Shore become recognized as an important tourist region. The tourism industry is based on the attraction of the coast, islands and sea. Events that strongly boosted tourism development in the study area were the creation of the Mingan Archipelago National Park Reserve in 1984, the introduction of a Gaspé–Anticosti Island–Mingan ferry link in 1994, and the extension of Highway 138 from Havre-Saint-Pierre to Natashquan in 1996.

Access to the shore. The coast between Pointe-des-Monts and Havre-Saint-Pierre and, since 1996, between Havre-Saint-Pierre and Natashquan, is easily accessible. The main road (Highway 138) runs along the shore for long stretches and allows direct access to many public parks, rest areas, public wharfs, scenic lookouts and beaches (Figure 12). The coastline on the Lower North Shore is much less accessible due to the lack of roads.



Source: Regional Tourism Associations of Manicouagan and Duplessis, 1995; Québec Yachting, 1995.

Figure 12 Boating and recreational activity along the Middle North Shore

A ferry takes over from Highway 138 in this region and shuttles between coastal villages. In winter, a well-maintained snowmobile trail provides access to these villages. Anticosti Island is linked to the Gaspé and the North Shore by seasonal ferry. More than 10 000 passengers used this connection in 1995.

Accommodations and cottaging. Coastal communities in the study area had an overall accommodation capacity of 958 rooms in establishments (1994) and 184 camping sites (1995). There are also 1394 secondary residences (cottages) in the area. More than half the rooms are in Sept-Îles and almost 75 percent of the campsites were around Havre-Saint-Pierre–Mingan. The great majority of cottages are situated in the Gallix–Sept-Îles–Moisie region.

Beaches and swimming. The two area beaches registered under the MEF's *Environnement-Plage* (beach environment) program are not situated along the gulf. However, there are vast beaches of fine sand along the Middle North Shore. No data exists on the use of these beaches, where swimming is limited due to the cold water temperature.

Interpretation of coastal, island and marine environments. The main interpretation centres are the Mingan Archipelago National Park Reserve and the Sept-Îles Archipelago regional park. Access to the Mingan archipelago and its surrounding marine environment is provided by shuttles and cruise boats based at Longue-Pointe, Mingan and Havre-Saint-Pierre (total capacity of 513 passengers in 1995). Interpretation activities are mainly focused on marine mammals, sea bird colonies, and the distinctive plants and spectacular land formations of the Mingan Islands. The number of visitors to the archipelago is growing. In 1995, more than 22 000 visitors went on sea and island excursions.

Two companies in Sept-Îles offer excursions and shuttles to the seven islands of Sept-Îles (total capacity was 75 passengers in 1995). Other interpretation sites are found at Sept-Îles and Port-Menier.

Interpretation of marine heritage. Several archeological sites are located along the North Shore and on Anticosti Island. Among cultural assets and districts subject to Quebec's *Cultural Property Act* are two prehistoric sites near Blanc-Sablon bearing witness to the first occupation of the North Shore by Native peoples, the old Trinity Bay lighthouse, and the fishery station at Room's Point. Sites in the Mingan Archipelago National Park Reserve include the remains of Basque ovens (Île Nue) and fishery stations dating from the French Regime (Havre-de-Mingan Island) and the English Regime (Mingan).

Sport fishing. Sport fishing for salmon in the 21 Middle North Shore rivers where it is permitted amounted to an average fishing effort of 12 163 days fished per year between 1988 and 1995, with an average catch of 2540 salmon per year. The Moisie and Trinité are the main salmon rivers. Fishing in Middle North Shore rivers has remained rather stable in recent years. In Anticosti Island rivers, the average annual fishing effort from 1989 to 1995 was 1414 days fished, for an average annual catch of 365 salmon in the 18 rivers fished. Fishing in island rivers has declined in recent years (1994–95). The Jupiter, à la Loutre and de la Chaloupe rivers are the most heavily used. On the Lower North Shore, 17 salmon rivers were fished between 1989 and 1995. Over this period, an annual average of 2768 days fished and a catch of 1404 salmon were recorded. Fishing in Lower North Shore rivers has been rather stable since 1989. The Saint-Paul, Etamamiou and Olomane rivers were the most heavily fished in 1995.

Sport fishing for cod at sea can be arranged from several towns and villages in the area (Rivière-Pentecôte, Port-Cartier, Moisie, Magpie, Rivière-Saint-Jean, Mingan, Baie-Johan-Beetz). Ice fishing for Rainbow smelt is done at the mouths of the Rapides (Sept-Îles Bay), Asley, Piashti and Natashquan rivers. However, no records are kept on these two kinds of fishing, nor on fishing from area wharfs.

Waterfowl hunting. There is no recent data on this activity. From 1977 to 1981, an average of 5900 ducks and geese were taken on the Middle North Shore. Hunting here takes place traditionally in winter. In the Mingan Archipelago National Park Reserve, an annual average of 2640 ducks were shot in winter in 1984–85 and 1989–1990, mostly eiders and Oldsquaws. The

impact of this activity on park resources overall is deemed negligible. On the Lower North Shore, an annual average of only 139 ducks and geese were reported killed over the same period. However, this is probably an underestimate (see Section 4.5).

Sailing. The area has two sailing clubs (Sept-Îles and Havre-Saint-Pierre). It is dotted with wharfs and fishing harbours.

Undersea diving. There are underwater diving centres at Sept-Îles and Havre-Saint-Pierre, both of which are close to the main diving sites.

CHAPTER 4 Human Activities and their Main Effects on the Environment

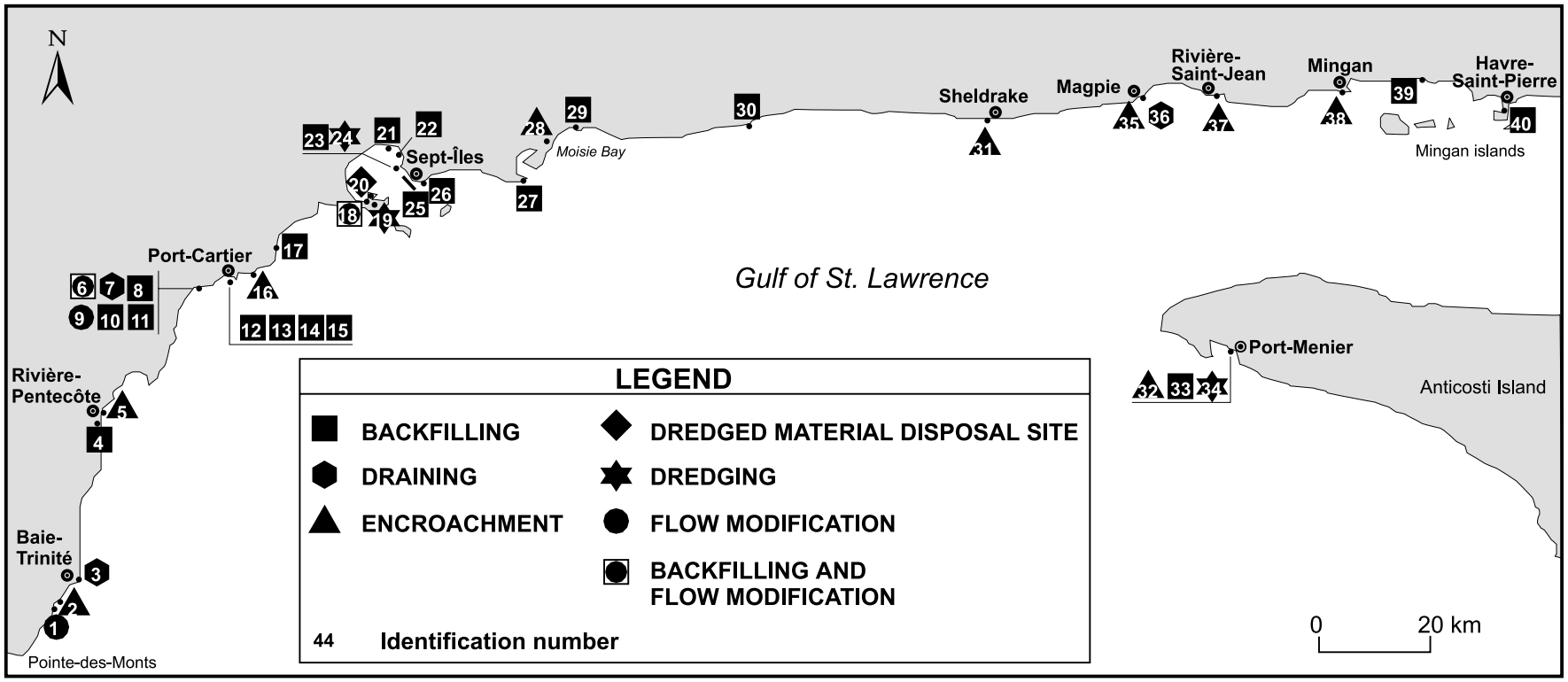
4.1 Physical Modifications

Physical modifications are changes that human activity produces in the physical properties of water (temperature, salinity, suspended solids, circulation), sea bottoms (depth, size of sediment particles) and shorelines (land forms).

Large-scale modifications. The construction of hydro-electric dams in the St. Lawrence drainage basin has greatly reduced freshwater flow into the gulf during the flood period (June), but raised it in winter. Since we lack oceanographic data from the first half of the 20th century, the impact of harnessing the St. Lawrence River on the Gulf of St. Lawrence marine environment is not known.

Since the end of the 1980s, the Gulf of St. Lawrence has experienced a marked climatic cooling along with much of Canada's Atlantic coast. This has led to a significant increase in the extent and duration of the winter ice cover and a cooling of the ice-cold intermediate water layer that covers the coastal undersea shelves. Although the relationship between this cooling and the flora and fauna is not well established, experts think the abnormal conditions could have affected certain invertebrate and fish populations (particularly Atlantic cod) by modifying their distribution and migration patterns, slowing the growth of individuals, and increasing the mortality of eggs, larvae and even adults.

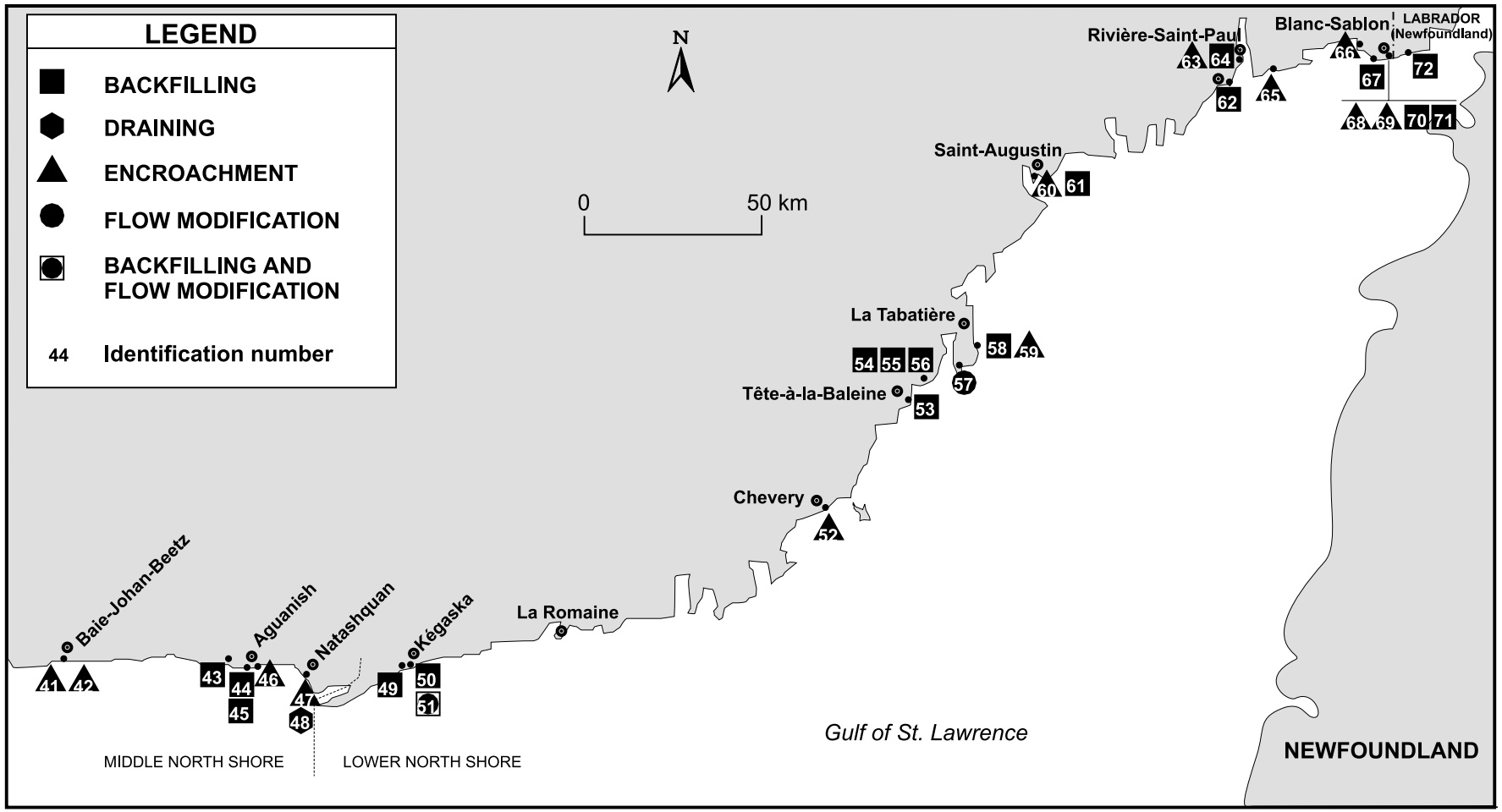
Local modifications. From 1945 to 1988, about 650 ha of coastal environment in the study area has undergone change in physical features ranging from modified current dynamics to outright eradication through backfilling (Figures 13a and b). The affected area, which does not include environments disturbed by harnessing the river or using mobile fishing gear, is small compared to the immensity of the territory.



ORIGINAL HABITATS: Swamp: site 36. **Salt marsh:** sites 3, 39. **Muddy foreshore:** sites 14, 21 to 24. **Sandy-gravelly foreshore:** sites 25, 38, 40. **Rocky foreshore:** sites 2, 5, 11 to 13, 15 to 19, 26, 31 to 35. **Estuarine barachois:** site 27. **River estuary:** sites 1, 4, 6 to 10, 28 to 30, 37. **Deep water:** site 20.

Source: Marquis et al., 1991.

Figure 13a Physical changes to aquatic and shoreline habitats recorded in the western part of the study area from 1945 to 1988



ORIGINAL HABITATS: Salt marsh: sites 48, 70. **Muddy foreshore:** sites 45, 49, 53 to 55, 58, 62, 63, 65. **Sandy-gravelly foreshore:** sites 50, 60, 61, 69. **Rocky foreshore:** sites 41, 42, 46, 47, 51, 52, 56, 57, 59, 66 to 68, 71, 72. **River estuary:** sites 43, 44, 64.

Source: Marquis et al., 1991.

Figure 13b Physical changes to aquatic and shoreline habitats recorded in the eastern part of the study area from 1945 to 1988

Backfilling has eliminated 378 ha of coastal habitat. The largest losses occurred with the construction of port facilities at Port-Cartier, Pointe-Noire and Pointe aux Basques in Sept-Îles Bay. Losses in these areas affected mainly rocky habitats. The Pointe-Noire development required the dredging of 835 000 m^3 of sediment in 1984.

Except for the port of Sept-Îles, ports and harbours in the area do not require frequent maintenance dredging to maintain sufficient water depth for ships. Nearly 20 000 m^3 of sediment had to be dredged on three occasions in the port of Sept-Îles. The dredged material was dumped in deep water in Sept-Îles Bay. The only dredging at Havre-Saint-Pierre was done in 1990, when 5200 m^3 of sediment was removed.

The effect of mobile fishing gear (dredges, trawl nets, purse seines) on the marine environment has provoked a great deal of controversy. Some argue that this gear, by scraping the bottom, is responsible for destroying benthic habitats. Others suggest instead that it improves the productivity of the fishery by increasing the availability of food for desirable species.

4.2 Pollution

Easily degradable organic matter, bacteria and nutrients (nitrates and phosphates) are not persistent, and environmental quality improves rapidly once discharges cease or as distance from the contamination source increases. On the other hand, substances that are persistent in the environment are transported over long distances in the hydrographic network and the atmosphere and tend to concentrate in sediments and living organisms. These substances include polychlorinated biphenyls (PCBs), organochlorine pesticides (DDT, dieldrin and Mirex), polycyclic aromatic hydrocarbons (PAHs), dioxins, furans and mercury.

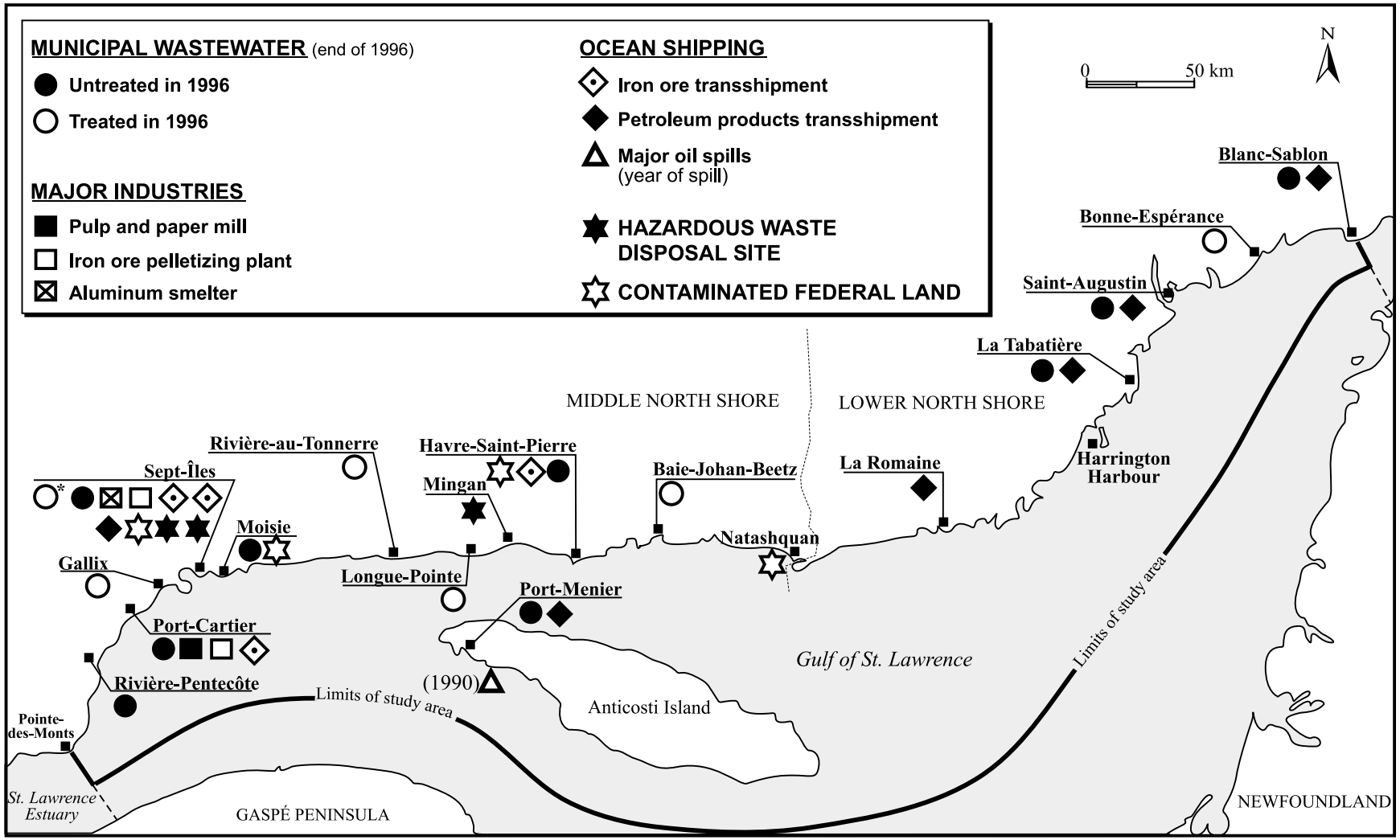
4.2.1 Principal sources of contamination

Sources of contamination fall into two broad categories: local and distant. *Local sources* are situated in coastal communities of the study area, the watersheds of rivers that empty into the area, or in the water body itself (from dredging and shipping) (Figure 14). Contaminants from *distant sources* are transported by currents (waterborne) and atmospheric deposition, and are usually environmentally persistent chemical compounds.

4.2.1.1 *Local sources*

Municipal wastewater. Prior to 1994, no municipality on the North Shore treated its wastewater. In late 1996, two treatment plants at Sept-Îles (Clarke district) and Gallix handled the wastewater of a mere 4 percent of the total population of coastal communities in the study area. The startup of plants in Port-Cartier, Sept-Îles, Rivière-au-Tonnerre, Longue-Pointe, Baie-Johan-Beetz and Bonne-Espérance by March 1998 should bring water treatment service to close to 44 percent of the population — 60 percent if we include the Port-Cartier plant, planned for 1998. The performance of existing plants has not yet been evaluated. Aerated ponds normally remove nearly 90 percent of easily degradable organic matter and suspended solids from wastewater. However, sewer systems are not usually designed to handle large water volumes, so untreated wastewater spills into the aquatic environment during heavy rains. The municipalities of Rivière-Pentecôte, Havre-Saint-Pierre, Natashquan, and Saint-Augustin are equipped with sewer systems, but have not yet signed agreements to build wastewater treatment plants.

Furthermore, varying numbers of households in each community are not connected to the municipal sewer system. Instead, they discharge their wastewater into individual septic tanks and cesspools that may constitute sources of contamination of the marine environment if they are not properly maintained.



Source: Gagnon et al., 1997.

*At Sept-Iles, only the municipal wastewater of the Clark sector was treated in 1996.

Figure 14 Location of the main current and potential sources of contamination of the marine environment in the study area

Industrial wastewater. Six industrial plants on the North Shore have been targeted for priority action under provincial (PRRI) and joint federal-provincial (SLV 2000) industrial effluent reduction programs. They include four mining companies (Quebec Cartier Mining Co., Wabush Mines Inc., Iron Ore Company of Canada, QIT-Fer et Titane Inc.), a paper mill (Uniforêt Port-Cartier) and an aluminum smelter (Aluminerie Alouette Inc.).

Quebec Cartier Mining Company extracts iron ore at Mount Wright at the head of the Moisie River watershed and transports it by rail to company-owned port facilities at Port-Cartier. The ore is either loaded directly on ships, stacked for future shipment, or processed in a pelletizing plant. The facilities have an annual capacity of eight million tonnes of pellets and eight million tonnes of ore concentrate.

In 1993, the company launched a five-year program to reduce wastewater discharge into the gulf. Process water from the pelletizing plant and runoff water from waste and raw material storage areas receives primary treatment (settling) before being released into the sea. Sanitary wastewater from the plant is treated by aerobic digestion and chlorination. Since starting to treat process water in 1995, the mill has reduced its effluent flow rate by 33 percent and its iron content by 50 percent. Environmental standards are 99 percent satisfied, iron content standards having been slightly exceeded during the heavy rains of July 1996. Further projects are planned for 1998, including the recycling of conveyor washwaters (currently untreated) and process water. This will reduce suspended solid levels by 96 percent and iron levels by 90 percent.

Wabush Mines Inc. mines iron ore in Labrador and transports concentrate by rail to the port of Pointe-Noire (Sept-Îles Bay), owned by Transport Canada. A certain amount is loaded on ships and the rest goes through a pelletizing plant with an annual capacity of six million tonnes. The pelletizing process does not generate wastewater. However, the washwaters of conveyors, transfer towers, and plant floors are laden with raw materials. Some of this washwater is channeled to thickeners, where the iron solids can be recovered and reintroduced into the process, and the water can be reused. However, sporadic overflows from the thickeners are

directed into Sept-Îles Bay. Sanitary wastewater from the different buildings is piped to septic tanks with outfalls emptying into the bay. Runoff water from storage areas is not treated before being discharged. Between 1993 and 1995, the flow rate and the load of iron remained stable.

The **Iron Ore Company of Canada** mines iron ore and pelletizes a portion of it in Labrador. Iron concentrate and pellets are transported by rail to port facilities at Pointe aux Basques in Sept-Îles. After the company shut down its Sept-Îles concentrator and pelletizing plant in 1981, the main activity at this seaport has consisted of loading ore and pellets onto ships. In 1995, the port handled 15 million tonnes of cargo. We have no information on the port's discharges into the gulf as it is not a priority under the SLV 2000 action plan.

QIT-Fer et Titane Inc. mines ilmenite ore at Lake Tio in the Romaine River watershed and transports it by rail to the port of Havre-Saint-Pierre, where it is loaded onto ships. In 1993, 2.9 million tonnes of goods were handled in this port. The port is not a priority establishment under the SLV 2000, and there is no information on its discharges into the gulf.

Uniforêt (formerly known as Cascades Port-Cartier Inc.) has operated a pulp and paper mill in Port-Cartier since 1994. Since autumn 1996, process wastewater has been treated by activated sludge (secondary treatment). We have no data on the firm's ocean discharges since this is not a priority mill under the SLV 2000 action plan.

Aluminerie Alouette Inc. of Pointe-Noire (Sept-Îles) has produced aluminum ingot and pig as well as prebaked anodes used in the smelting process since 1992. The smelter employs the Hall-Héroult electrolytic process using prebaked anode cells connected to gas scrubbers. The process produces almost no atmospheric emissions of PAHs, unlike the Söderberg technology used in certain older smelters. It also does not produce wastewater, which is all recycled or evaporated. Rain water is treated in a settling tank before being discharged into Sept-Îles Bay. Sanitary wastewater is conducted to the city of Sept-Îles's aerated ponds and discharged into the bay through the same outfall as rain water. The company respects the standards prescribed in the authorization certificate issued in 1992.

Hazardous waste sites. Five hazardous waste disposal or storage sites were identified near the study area coastline during official inventories by the provincial and federal governments in the 1980s.

At Port-Cartier, two dumps were used for household garbage, septic tank sludge and industrial waste until 1978. The exact nature of the waste is unknown. These sites are a potential source of contamination of the aux Rochers and Vachon rivers, but pose no real threat to public health. Restoration work at the site led to its removal from the provincial inventory in 1996.

The Wabush Mines dump at Pointe-Noire contained 4300 drums of grease used as a lubricant. Hydrocarbons leaked from damaged drums were carried in runoff water to Sept-Îles Bay. Restoration and cleanup of the site began in 1988 and was completed in 1995. As a result, this site has been removed from the provincial inventory.

The soil at Sept-Îles Airport is contaminated by PAHs and heavy metals from the storage and accidental spillage of petroleum products and from old dumps, and fire department training activity. The site does not directly threaten the marine environment. A cleanup project is under way.

Prior to 1990, a dump with 2000 drums that once contained asphalt was located on the banks of the Manitou-Nord-Ouest, a tributary of the Mingan River, and represented a potential source of contamination for the river. Most of the drums were removed from the site in 1987 and 1990, and leveling and revegetation work has been completed.

Shipping and port activity. Shipping represents a potential source of pollution from marine accidents, bilge pumping and ballast flushing, and cargo transshipment and storage in ports.

The study area has not yet experienced a catastrophic chemical spill. The largest oil spill occurred when the *Rio Orinoco* ran aground on the south shore of Anticosti Island in October, 1990, leaking 100 tonnes of fuel oil and diesel fuel and contaminating about 10 km of shoreline near Port-Menier. The shoreline was cleaned and restored shortly after the incident and

the ship was refloated in 1991. Most of the one to five tonnes of fuel oil that escaped during the refloating was recovered.

Hydrocarbon spills are much more common during transshipping operations in port. The main ports for petroleum products in the study area are Sept-Îles, La Romaine, La Tabatière, Blanc-Sablon and Port-Menier.

Ore handling operations in the ports of Port-Cartier, Sept-Îles and Havre-Saint-Pierre are a source of contamination of the marine environment by washwater and runoff water from the loading equipment and storage areas, as well as dust generated by port operations.

Busy ports and marinas are likely sources of organo-tin contamination. These highly toxic compounds come from anti-fouling paint applied to boat hulls and underwater port structures. Creosote-treated wood used for some wharfs is a source of PAH contamination.

Dredging. Maintenance dredging of ports, fishing harbours and marinas constitutes a source of contamination when it resuspends toxic substances that otherwise would be isolated from the aquatic environment in deep layers of sediment or else limited to sites removed from general circulation. Dumping zones for dredged material are found offshore near dredged ports and harbours. In most cases, sediment submerged at these sites is only moderately contaminated by heavy metals. Moreover, this sediment must be managed in accordance with the *Canadian Environmental Protection Act* (Part IV).

Snow disposal. There is no data on the ocean dumping of snow removed from streets in the study area. Since 1996, all Quebec municipalities have been required to prepare a snow disposal plan that avoids dumping it directly into the water. Sept-Îles has submitted a management plan with the Ministère de l'Environnement et de la Faune. Further information is needed before it is approved.

Agriculture. No agricultural activity has been noted in the study area since 1981.

Forestry. The hinterland forests are regularly sprayed with insecticides against the spruce budworm and other harmful insects, and phytocides to optimize the harvest of selected species for pulp and paper. Fenitrothion, a chemical insecticide with low persistence, and

Bacillus thurigiensis, a biological insecticide, are being used more and more. Until the mid-1970s, forests were sprayed with DDT, a chemical insecticide that is very persistent in the environment. DDE, a product of the degradation of DDT, is still found in gulf fauna (see Section 4.2.2.3).

4.2.1.2 *Distant sources*

Waterborne. The study area is not subject to the influence of fresh water from the St. Lawrence River watershed. Contaminants transported by the river are mostly deposited in the St. Lawrence Estuary, while the remainder are carried to the south side of the Gulf of St. Lawrence by the current that sweeps the north shore of the Gaspé Peninsula (Gaspé Current). The St. Lawrence is therefore not a significant source of persistent toxic substances for the study area.

Airborne. Atmospheric deposition in the form of fog and precipitation in the Gulf of St. Lawrence constitutes a major, if not the largest, source of many persistent substances found in the sediments of the Laurentian Channel and presumably the Anticosti and Esquiman channels. This is true for mercury, lead, PCBs, PAHs, dioxins and furans.

4.2.2 Effects of contaminants on resources and uses

The criteria and guidelines used to determine the extent to which contaminants in the water, sediments and organisms pose a threat to aquatic organisms and human health, and also limit certain uses, are described in Appendix 2.

4.2.2.1 *Contamination of water*

Information on water contamination by toxic substances in the study area is very limited. Off the coasts, contaminants from local and distant sources are diluted by the mixing of fresh water with slightly contaminated saltwater. Measured concentrations are typical of coastal

waters under the influence of terrestrial inputs and probably do not exceed the most stringent quality criteria for all substances of concern.

The contamination of gulf waters by oil residue was monitored from 1971 to 1979. In general, oil-related pollution declined from 25 to 30 percent during this period. Before the mid-1970s, the largest source of oil residue in the gulf came from shipping (accidental spills and ballast flushing). Measures adopted to reduce oil spills and discharges have clearly contributed to a significant decline in this type of pollution, as contamination levels in the 1980s were the same as levels in other northwestern Atlantic and northern Canadian environments. Atmospheric deposition now appears to be the largest source of petroleum residue in the study area.

The bacteriological quality of water in shellfish areas was monitored at 24 shoreline sites in the study area to determine the salubrity of shellfish beds. In 1995, 14 of the 24 sites had a good enough bacteriological quality rating to permit shellfish harvesting in summer. The closure of shellfish sites is usually due to contamination by municipal effluent, defective septic tanks or, sometimes, by bird colonies.

4.2.2.2 *Contamination of sediment*

Sediments are considered contaminated when their concentration of heavy metals or certain organic compounds (e.g. PAHs) exceeds natural, pre-industrial levels. The levels become cause for concern when they are high enough to harm organisms that live in or near the sediments and depend on them for their survival. This is called the *apprehended* pollution level. To assist in evaluating sediment quality, three contamination thresholds have been established for the most worrisome substances: the no effect threshold (NET), the minimal effect threshold (MET), and the toxic effect threshold (TET). These thresholds can be used to classify sediments into four categories:

- Unpolluted: levels below NET
- Slightly polluted: levels between NET and MET
- Moderately polluted: levels between MET and TET

- Heavily polluted: levels above TET.

Deep channels. The Laurentian Channel is the principal deposition zone for toxic substances introduced into the St. Lawrence system downstream of Cornwall. Concentrations of toxic substances in the muddy sediments of this trough are generally higher than in shallower sedimentation zones, with the exception of harbour areas.

In considering the Laurentian Channel, it is important to distinguish between the Lower Estuary and the gulf sections. Most toxic substances carried by the St. Lawrence River are in fact deposited in the Lower Estuary, at the head of the Laurentian Channel, and do not reach the Gulf. This is true for mercury, zinc, Mirex and PCBs. Downstream of Pointe-des-Monts, inputs from the St. Lawrence River decline rapidly and airborne input becomes important. The deep channels in the gulf are therefore much less contaminated than the upper part of the Laurentian Channel.

Sediments in the deep gulf channels contain little or no cadmium, nickel, zinc or copper contamination. They are slightly polluted by mercury, lead and chromium, and moderately polluted by arsenic. Although data is lacking on many other contaminants, the spatial distribution of contamination in the Lower Estuary suggests that the gulf channels are only slightly polluted by DDT, Mirex, PCBs, dioxins, furans, PAHs and petroleum residue.

Port areas. The majority of harbours for which we have data are moderately polluted by heavy metals, but none are heavily polluted by PCBs or PAHs. According to the most recent data (1987), sediments in the Sept- Îles fishing harbour are heavily polluted by mercury and to a lesser degree, by copper and lead. The ports of Aguanish and Saint-Augustin are heavily polluted by cadmium and Havre-Saint-Pierre by nickel.

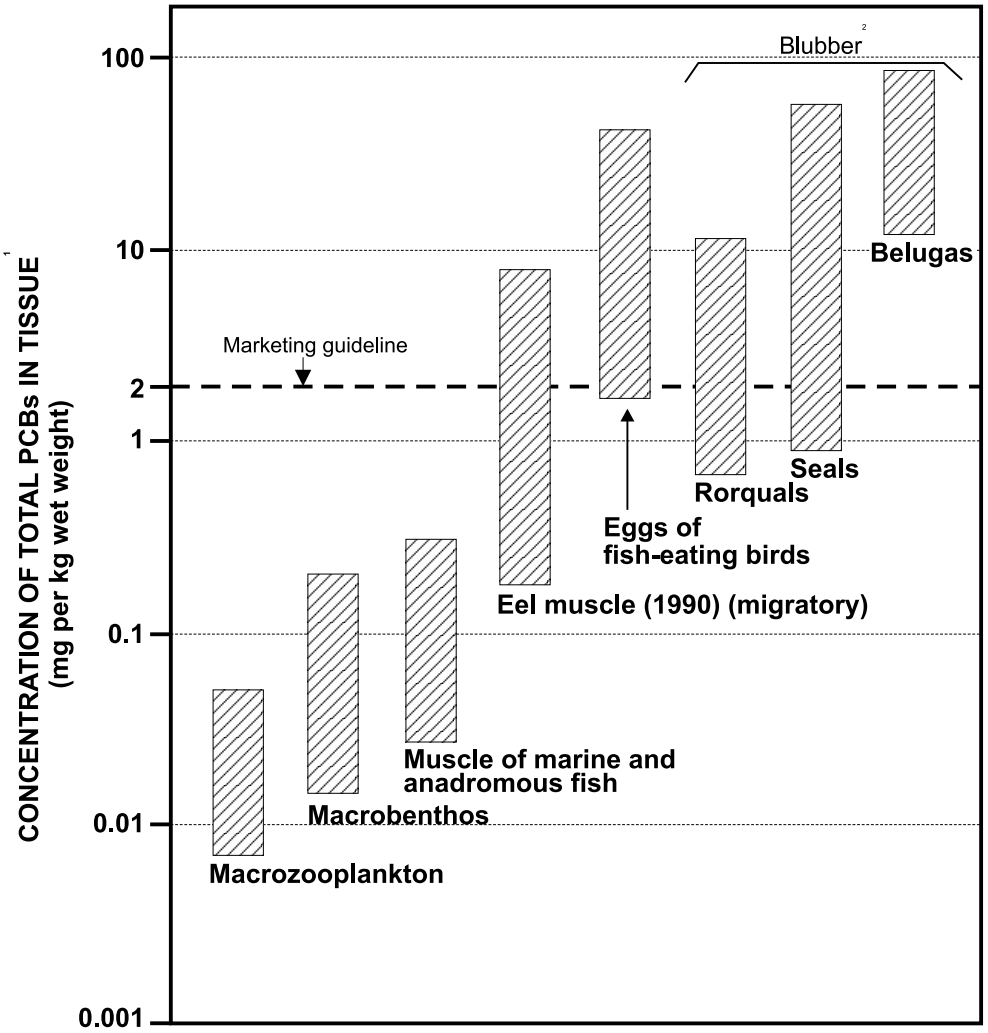
Although iron is not counted among the toxic heavy metals usually considered a cause for concern in the aquatic environment, it should be stressed that extremely high concentrations of it have been found in sediments at the IOC company port. This high level of contamination can be attributed to iron ore transshipping operations.

4.2.2.3 *Contamination of the food chain*

Aquatic organisms tend to accumulate certain toxic substances to much higher concentrations than are found in surrounding water and sediments. This phenomenon is called *bioconcentration. Bioaccumulation* of a contaminant occurs when the rate of assimilation of the substance exceeds the rate of elimination, resulting in an increase in contaminant load as the organism ages. Most aquatic organisms, with the exception of shellfish, can regulate their body burdens of heavy metals (except mercury) and quickly metabolize PAHs, so they do not bioaccumulate these substances. However, most living organisms are unable to eliminate or quickly metabolize mercury and organochlorine compounds such as PCBs, DDT and Mirex. As a result, these substances build up through each link in the food chain and reach much higher concentrations in vertebrates than in invertebrates. This phenomenon, called *biomagnification*, has been documented in the food chain of the St. Lawrence for PCBs, Mirex and mercury. For example, PCB levels are 100 to 1000 times higher in the blubber of Harbour seals than they are among benthic or planktonic invertebrates found in the same environment (Figure 15). The extent of contamination of marine organisms by biomagnified substances depends on their position in the food chain and the amount of time they have spent in contaminated zones. For example, Fin whales are much less contaminated than Harbour seals because they eat mainly herbivores (euphausiids) and frequent the gulf only in summer, while Harbour seals feed mainly on carnivorous fish and live year-round in the gulf.

Invertebrates and fish. Based on sketchy available data, invertebrates and fish in the study area do not appear to be contaminated with toxic substances in concentrations that exceed marketing guidelines. However, fish-eating birds and marine mammals, particularly seals and toothed whales, are much more contaminated due to the biomagnification phenomenon.

Birds. Overall, the level of contamination of sea bird eggs in the Gulf of St. Lawrence is three times less than that in the Great Lakes and is similar to levels on the Canadian Atlantic coast. Contamination by heavy metals is moderate and has no apparent effects on the health of the birds. Contamination by organochlorine compounds is a greater concern.



Source: Béland et al., 1992; Gagnon et al., 1990; Hodson et al., 1994; Hodson et al., 1992; Muir et al., 1990; Wagemann et al., 1990.

1. The chart shows the range of concentrations measered in the organisms in the Estuary and Gulf of St. Lawrence.

2. PCB concentrations are much higher in blubber than in muscle tissue of the same individual.

Figure 15 Biomagnification of PCBs in the food chain of the St. Lawrence Estuary and Gulf

Monitoring of organochlorines in the eggs of Bonaventure Island gannets (Southern Gaspé) found particularly high levels of PCBs and DDE (a compound derived from DDT) in the late 1960s, followed by a rapid decline in DDE levels and a slower drop for PCBs. The period during which high organochlorine concentrations were found in eggs coincided with thinning eggshells, lower hatch success rates, and a decline in Northern gannet numbers starting in 1966. The low hatch success rate was associated with high DDE levels. DDE inputs into the marine environment declined considerably after DDT was eliminated from spruce budworm forest spraying programs.

After contaminant levels in eggs declined, a significant rise in hatch rates was recorded. In 1984, the Bonaventure Island gannet population recovered to 1966 levels and has continued growing ever since. In Herring gull and Razorbill eggs in the gulf, organic contamination levels varied little between 1969 and 1984 with three exceptions: DDE levels fell generally on the North Shore, while heptachlor epoxide and oxychlordane levels rose.

Lead shot in hunting rifle cartridges is an important source of contamination of aquatic birds that frequent areas of intensive hunting. The pellets are ingested by bottom-feeding geese and ducks and can cause serious lead poisoning (saturnism). The study area is the least contaminated area of the St. Lawrence in this regard. The use of non-toxic shot became mandatory throughout Quebec in 1997.

Marine mammals. Only sketchy data is available on the level of contamination of marine mammals who frequent the study area. Overall, Gulf of St. Lawrence seals and Harbour porpoises are more contaminated by toxic substances than are whales (rorquals). However, they are less contaminated than Belugas of the St. Lawrence Estuary, which exhibit many pathologies not seen in other species. Bioaccumulated DDT levels in the blubber of Harp seals in the gulf has declined clearly since the 1970s, while PCB concentrations have fallen less rapidly.

4.3 Introduced or Expanding Species

Purple loosestrife. Purple loosestrife is a European plant that has invaded the freshwater marshes of the St. Lawrence River. It first appeared on Anticosti Island in 1920–1940, but does not seem to occur on the North Shore. The expansion of this species has been aided by abnormal water-level fluctuations, ice erosion, shoreline alterations, and cattle grazing. Purple loosestrife is considered a nuisance plant in parts of Canada and the United States because it reduces species diversity in marshland plant communities.

Exotic organisms in ballast water. Ballast water from freighters can contain a large number of planktonic and benthic organisms in varying stages of development. The ports of Sept-Îles and Port-Cartier are areas where exotic species may potentially be introduced with ballast water. Some introduced species can have harmful effects on the ecosystem, as is the case with the Zebra mussel in upstream portions of the St. Lawrence and in the Great Lakes. The introduction of toxic planktonic algae poses a serious threat for coastal areas and fishery resources.

4.4 Overfishing

Fishing always reduces the biomass of the target species and the average size of individuals in the population. These phenomena do not jeopardize stocks as long as their potential for renewal is not affected. The decline in Atlantic cod stocks in the Gulf of St. Lawrence at the end of the 1980s and beginning of the 1990s was attributed to the fact that the fishing effort was sustained at a time when environmental conditions were particularly unfavourable to renewal of the resource; this greatly reduced the reproductive potential of the population at the time. Other major local resources such as Northern shrimp and Snow crab are now highly vulnerable to unfavourable oceanographic conditions because they are heavily exploited. However, present conditions appear favourable for both species.

4.5 Sea Bird Exploitation

Sea bird hunting and egg collecting have been widely practised on the Lower North Shore, with serious negative effects on bird populations, such as the extinction of the Labrador duck and the extirpation of Northern gannets from the area. Only sea duck hunting is allowed, sea bird hunting and egg collecting having been illegal since 1916. Nevertheless, they have continued until the present day. For example, an estimated 98 000 sea birds were taken annually on the Lower North Shore in the early 1980s, including a legal species (Common eider) and several illegal species Alcidae). Since 1988, an improved conservation program at certain migratory bird sanctuaries and the introduction of an education and awareness program for coastal communities has helped reduce the disturbance caused by poaching. In addition, the consumption of sea bird eggs has been identified as the main source of PCB contamination among the local population (see Section 5.2).

CHAPTER 5 Human Health Risks

5.1 Consumption of Fish, Crustaceans and Shellfish

This chapter looks at the constraints imposed on North Shore–Anticosti residents by chemical and bacteriological contamination and the presence of marine toxins in fishery resources of the Gulf of St. Lawrence.

Chemical contamination. Fish, crustaceans and shellfish in the Gulf of St. Lawrence generally show little contamination by chemical compounds. Concentrations of most contaminants of greatest concern (mercury, PCBs, DDT, Mirex, dioxins and furans) are below the marketing guidelines for fish and seafood.

However, fishers on the Lower North Shore are known as heavy seafood consumers (eating about seven times as much as the overall Quebec population). As a result, they are more exposed to contaminants than southern Quebecers. Recent studies have shown that despite the low contamination levels of aquatic organisms in the gulf, fishers there had blood organochlorine levels that were among the highest in Quebec. Along with eating sea bird eggs, heavy seafood consumption is evidently a significant factor in exposing them to organochlorine compounds and mercury.

The health consequences of this overexposure (long-term effects, subtle effects) remain difficult to pin down. However, risk estimates tend to prove that it apparently does not pose a significant risk for most fishers. There is also no present indication that organochlorine levels in the blood of the umbilical cord and in mother's milk can have toxic effects in newborns and nursing children on the North Shore. Moreover, organochlorine levels have shown a declining trend in recent years.

The health risks involved in eating aquatic organisms from the gulf are therefore considered negligible compared to the possible health benefits. Fish and seafood are good dietary sources of protein, vitamins and minerals, and also provide a degree of protection against certain diseases such as cardiovascular disease (mortality due to cardiovascular disease is in fact 20 to 30 percent lower on the Lower North Shore than elsewhere in Quebec). Moreover, for pregnant and

nursing women, these organisms are a good source of polyunsaturated fatty acids (especially omega-3s) and nutrients needed for nervous system development in the fetus and child in the first months of life. A slightly prolonged gestation linked to eating marine products rich in omega-3 has recently been observed in a group of newborns on the North Shore. The levels of omega-3 fatty acids measured in umbilical cord blood of these newborns was 3.3 times higher than levels observed in southern Quebec. This could partly explain why North Shore babies weigh more at birth than the Quebec average.

The amount of organochlorines ingested can be reduced by taking certain precautions when cooking fish. Since these substances accumulate in fatty matter, one should avoid eating the skin, internal organs, and fatty parts of fish, as well as the cooking juices.

Bacteriological contamination. Bacteriological contamination of shellfish is a major problem in the Gulf of St. Lawrence. Along the Middle and Lower North Shore, municipal wastewater is the main factor affecting the quality of edible shellfish. However, because harvest sites are often far from inhabited regions, they are less subject to closure than sites in other maritime regions of Quebec.

The consumption of contaminated shellfish can lead to digestive and intestinal problems. Two cases of bacterial poisoning by streptococcus have been reported on the North Shore since 1988. However, the extent of the problem remains poorly understood and is likely underestimated due to underreporting of intestinal problems, since most cases do not involve a doctor’s visit or hospitalization. Shellfish harvesting should therefore be confined to zones authorized by the Department of Fisheries and Oceans Canada. Using data collected under Environment Canada’s Shellfish Water Quality Protection Program, the department advises harvesters on shellfish safety at different harvest sites.

As for bacteriological and parasitic contamination in fish, most fish parasites are not a danger to human health. However, preventive measures are recommended, including not eating the skin or internal organs, and cooking the flesh well. This eliminates the risk of microbial and

parasitic contamination. It is also advisable to avoid eating fish displaying external anomalies (e.g. ulcerative dermatitis, oral lesions, etc.).

Contamination by toxic algae. The microscopic alga *Alexandrium* sp. (the main genus of toxic algae found in the gulf) produces a biotoxin that can cause serious poisoning symptoms and even death (also called paralytic shellfish poisoning, or PSP) if ingested by humans. The toxin is transmitted to humans mainly through the ingestion of shellfish contaminated by the alga. The mollusc itself is not affected. This toxin can also be found in the digestive gland of lobsters (the liver, or green tomalley) as well as the livers of cod and other gulf fish.

The problem in the study area occurs mainly on the Middle North Shore. A few cases of poisoning linked to eating shellfish infected by toxic algae have been reported in the region. Five cases were counted at Sept-Îles between 1974 and 1980, and one at Havre-Saint-Pierre in 1979. Fortunately, no one died.

The best way to avoid poisoning by shellfish infected by toxic algae is to obey shellfish harvesting restrictions issued by Fisheries and Oceans Canada. The Department operates a program that monitors toxin levels in filter-feeding shellfish. As for toxins in lobster, it is advisable to eat no more than two servings of tomalley a day. Fish liver contamination is too low to pose a risk for consumers, while fish flesh is free of toxin. It should be noted that cooking never destroys the toxin.

5.2 Consumption of Sea Bird Eggs

Gathering sea bird eggs to eat is a very popular tradition among the fishing people of the Lower North Shore. However, considering the results of analyses of egg contamination and chemical absorption in the bodies of the fishing population, it is advisable to abstain from eating the eggs, particularly as there are no known health benefits linked to the habit.

PCB concentrations in these eggs are 45 times higher than levels found in fish. As a result, eating five eggs is estimated to introduce as much PCB contamination as an entire year’s

consumption of fish. PCB levels in the blood of fishers who consumed 15 eggs a year were 2.3 times higher than among fishers who ate no eggs.

5.3 Consumption of Seaweed

There is no commercial harvest of edible seaweed in the study area. However, a small-scale harvest is carried out for personal consumption or for local restaurants.

A study based on seaweed samples collected in the St. Lawrence Gulf and Estuary, including at a sampling station on the Middle North Shore (Sept-Îles), detected the presence of several organic and inorganic contaminants. However, levels were generally very low and often below the detection threshold. Only the presence of iodine and cadmium in certain seaweed species could present a risk to human health, if seaweed consumption were heavy.

5.4 Consumption of Game

Waterfowl consumption. Based on nation-wide sampling by the Canadian Wildlife Service, Health Canada has concluded that the health risk of eating waterfowl meat is negligible. Contaminant levels measured in assorted sea birds sampled were generally low or below detection thresholds. Organochlorine exposure can nonetheless be reduced to a minimum by using cooking methods that remove as much fat as possible, especially with fish-eating birds. Also, to avoid lead-related health problems, care must be taken to remove lead shot from the flesh.

Parasites found in waterfowl do not generally pose a health threat. However, all risk of parasitic and microbial contamination can be eliminated by cooking the meat well.

Seal meat consumption. There is little recent data on chemical contamination in seals for the Gulf of St. Lawrence as a whole. However, the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ) operates an analysis program to evaluate the safety of Harp seal meat on the Îles de la Madeleine. The analyses revealed relatively high

concentrations of mercury and cadmium in seal liver and flesh. Seal meat consumption is therefore a not-insignificant source of exposure to heavy metals. On the other hand, concentrations of organic contaminants measured in different tissues are low and well within fish and seafood marketing guidelines.

As a result, MAPAQ recommends not eating the liver of Harp seals taken from the Îles de la Madeleine and limiting consumption of adult seal meat to one meal a week. There are no restrictions on eating the meat of young seals. In the absence of recent data on seal contamination in the study area, it would be advisable to apply these same restrictions.

5.5 Recreational and Commercial Activity

Contamination. Climate and water temperatures in the study area greatly limit the recreational use of gulf waters. Despite the risk of hypothermia, however, many public beaches on the North Shore are used for bathing and other water-contact activities (windsurfing, seadooing, water skiing).

The main health risks arise from germs introduced into the water mainly through municipal wastewater discharge. Contact with polluted water can cause dermatitis, ear infections, conjunctivitis, and gastroenteritis.

In 1996, no coastal beach on the gulf was monitored by the MEF's *Environnement-Plage* (beach environment) program. Since regular up-to-date analysis is the only way to know for certain that water at a given site is not a health risk to users, caution is advised before using gulf waters for recreation at unmonitored sites. Before engaging in activities involving contact with water, water quality in the area should be checked with local authorities (MEF, Direction de la Santé Publique, municipalities). Notices prohibiting shellfish gathering or the proximity of a sanitary or storm sewer outfall are indications of a possible water quality problem. Caution should be exercised when these signs are present.

Injuries. In 1995, there were 16 incidents involving pleasure boats (mainly motor boats) on the Middle and Lower North Shore that required assistance from the Canadian Coast

Guard's Marine Rescue Centre. Mechanical breakdowns and disabled boats (loss of control) were the main reasons assistance was required. In general, serious accidents are due to lack of training and knowledge by boaters, alcohol consumption, and the fact that life jackets are still rarely worn. Drowning, injury, hypothermia and psychological troubles resulting from an accident are the main risks related to boating activities in the Gulf of St. Lawrence. One death occurred in 1995 on the Middle North Shore.

In 1995, the Canadian Coast Guard Marine Rescue Centre went to the assistance of seven fishing boats on the Middle North Shore and four on the Lower North Shore. The closure of certain fishing zones and good weather was responsible for a 67 percent decline in incidents from the previous year. Mechanical breakdown was the main type of incident reported. One cause of this would appear to be groundfish fishers failing to maintain their boats due to economic hardship.

5.6 Environmental Accidents

Natural accidents. Landslides and floods are potential health threats for gulf coast communities, especially along the Middle North Shore. Certain high-risk zones have been demarcated on the land-use plans of local RCMs. They are mainly located along tributaries of the St. Lawrence, but some coastal sections are also affected by the dynamics of gulf waters (beach areas at Sept-Îles, Havre-Saint-Pierre and Port-Menier). Since 1992, natural accidents recorded on the North Shore, mainly landslides, have all occurred along rivers and streams. The flooding of July 20, 1996, is a striking example of the impact (property damage and loss of life) of overflowing watercourses.

Although physical health problems do not necessarily result from each of these events, the psycho-social impacts of property damage and evacuation are far from negligible.

Technological accidents. Since the St. Lawrence River is the main gateway into the interior, large amounts of dangerous cargo are shipped over gulf waters. In 1992, an estimated 10.4 million tonnes of hazardous materials were transported past the ports of Port-Cartier, Sept-

Îles and Port-Menier. To date, such environmental accidents (e.g. the wrecks of the *Rio Orinoco* and *Haltren I*) have had little impact on the health of coastal residents on the gulf. The risk remains, however, given the difficult navigation conditions in the area.

The vast majority of spills happen in port during transshipping operations. At Sept-Îles, the largest port on the North Shore, 83 incidents involving hazardous materials have been recorded in recent years. However, no noteworthy health impacts were reported following these incidents. The ports of Sept-Îles and Havre-Saint-Pierre have strategies and response equipment to limit damage to health and the environment in the event of a technological accident.

5.7 Crisis in the Commercial Fishery

The reduction in fish stocks in the Gulf of St. Lawrence has resulted in the social disintegration of coastal villages along the Lower North Shore and, indirectly, an increase in health problems among residents. It is recognized today that unemployment leads directly to illness — an increase in psychiatric admissions, suicides, cardiovascular disease, lowered immune resistance, and so on. Measures to promote development in a context of sustainable use of resources is therefore highly desirable for all coastal communities on the gulf.

CHAPTER 6 Toward Sustainable Development of the North Shore–Anticosti

Sustainable development in the North Shore–Anticosti study area involves reclaiming and conserving for future generations the biological diversity of plant and animal life, the many uses of area resources, and the quality of life associated with them. Any action taken must promote economic development while at the same time guaranteeing resource sustainability and the quality of the environment. Among the means favoured to achieve sustainable development:

- Reducing pollution
- Protecting sensitive habitats and species
- Restoring disturbed habitats and resources
- Managing marine fisheries efficiently
- Reconciling tourism and recreational development with protection of the environment.

This exercise is an attempt to identify the main environmental issues in the study area and describe some existing programs and actions that foster sustainable development (Table 1). This review is by no means exhaustive and is meant to serve only as a basis for discussion among local stakeholders who must establish local strategies and priorities for action as part of their ecological rehabilitation action plans (ERAPs).

6.1 Reducing Pollution

Major efforts are being made in the 1990s to reduce local inputs of pollution to the North Shore–Anticosti study area, particularly from municipal and industrial wastewater. With the startup of a number of water treatment plants by 1998, the wastewater of more than 60 percent of the area's total population will be treated. However, it is too soon to say whether this will be enough to solve the problem of bacteriological contamination of coastal zones.

Table 1

Main issues of sustainable development in the North Shore–Anticosti study area

Issue	*Assessment of current situation relative to sustainable development goals*	*Progress toward sustainable development*
Reducing pollution		
Treatment of municipal and household wastewater	Wastewater from some 60% of the area population will go to a treatment plant by late 1998. However, many communities still have no plans to treat their wastewater. Bacterial pollution limits shellfish harvesting and recreation in certain areas.	Uses related to bacterial water quality can be reclaimed only by treating wastewater (treatment plants or properly-functioning septic tanks) and controlling overflows in rainy weather.
Treatment of mining company effluent	The two mining companies that process iron ore in the area have greatly reduced their discharges of iron and suspended solids into the marine environment.	Further work is planned and ongoing to reduce contaminant discharge even more.
Treatment of paper mill effluent	The only pulp and paper mill in the study area began secondary treatment of its effluent in 1996.	Wastewater disposal by pulp and paper companies is monitored by law.
Hazardous waste dump sites	The main hazardous waste dumping sites in the area have been cleaned up or are now being restored.	Restored sites are monitored for contaminant leaks.
Persistent toxic substances in the environment	Despite a considerable reduction in the various contaminant sources in the St. Lawrence watershed and remoteness from the main contamination sources, local aquatic biota, especially fish-eating birds and sea mammals, are exposed to bioaccumulative toxic chemicals. In general, contamination of fish by chemical substances does not present a human health hazard.	A better understanding of the dynamics and the effects of these substances on marine organisms and human health is a major issue for the area.
Protecting sensitive species and habitats		
Protected areas	The study area includes many areas protected by law and regulation. However, many sensitive habitats have no legal protection.	Many other sensitive habitats deserve protection.
Priority species	The distribution and the condition of many priority species in the study area is unknown.	Studies on several species are now under way.

Issue	*Assessment of current situation relative to sustainable development goals*	*Progress toward sustainable development*
Sea bird colonies	Illegal sea bird hunting and egg collecting has declined since the end of the 1980s.	Education and awareness programs must be continued in Lower North Shore communities.
Protection against spills in the aquatic environment	The environment is sensitive to oil spills because of the many bird colonies, aquatic bird gathering areas and seal haulouts. There is an emergency response team in the area.	A regional spill response team holds regular simulated exercises.
Rehabilitating disturbed habitats and resources		
Harbour areas	Some commercial ports and fishing harbours are heavily contaminated by toxic substances.	No plans currently exist to restore these zones.
Groundfish stocks	The cod population in the northern Gulf has been in very poor condition since the beginning of the 1990s due to unfavourable climate conditions and overfishing.	Several measures have been taken since 1994 to re-establish cod stocks, including a fishing moratorium to reduce mortality attributable to fishing.
Efficient management of the commercial fishery		
Groundfish	Commercial fishing on the Lower North Shore is now going through the worst crisis in its history due to the collapse of groundfish stocks. The fishery is less and less able to provide jobs in coastal communities.	The government has undertaken a thorough reorganization of the fishery support sector, the main guiding principle being resource restoration and conservation.
Crustaceans and shellfish	Stocks of Northern shrimp, Snow crab and scallops in the area are heavily exploited and vulnerable to unfavourable environmental conditions.	Strict controls must be placed on the harvest of these resources.
Reconciling tourism and recreational development with environmental protection	Growth in tourism and recreation in the marine environment has been spectacular, but some activities threaten sea birds and mammals.	The impact of certain recreation and tourism activities on resources is now being studied.

For one thing, several municipalities equipped with sewer systems have not yet expressed any intention of treating their wastewater. Moreover, a large proportion of the population sends its wastewater to septic tanks or cesspools whose condition is unknown. And the overflow systems of existing treatment plants are sources of pollution in rainy weather.

Despite its distance from major sources of toxic contaminants, the study area remains exposed and vulnerable to harm from environmentally persistent toxic substances carried in the atmosphere, as evidenced by the high organochlorine levels in sea bird eggs on the Lower North Shore. A lack of recent data makes it impossible to identify precise patterns of this contamination in spatial and temporal terms, or understand its impact.

6.2 Protecting Sensitive Habitats and Species

Although the study area contains several protected sites, there are many others representing important plant and animal habitats that deserve protected status. This is true of the Baie-Johan-Beetz marsh, for example. Local organizations are taking initiatives to provide some form of protection for certain sites.

Many sites in the area are especially sensitive to spills of petroleum products. These include gathering sites for aquatic birds in spring, fall and winter, haulouts used by Harbour seals and Grey seals, and zones surrounding sea bird colonies. In order to limit sea bird and seal mortality, the Canadian Wildlife Service set up a bird cleaning centre at Baie-Comeau that is responsible for the entire North Shore. In addition, the ports of Sept-Îles and Havre-Saint-Pierre have emergency response teams and equipment in case of oil spills.

Illegal hunting and egg collecting has threatened the sea bird colonies of the Lower North Shore and even eliminated some populations. Since the end of the 1980s, education and awareness programs in communities have made it possible to reduce poaching.

The distribution and condition of populations of several priority plant and animal species under St. Lawrence Vision 2000 are unknown in the study area. Certain species (rare plants, Rainbow smelt) are now under study.

6.3 Restoring Disturbed Habitats and Resources

Several measures have been taken since 1993 to rebuild groundfish populations in the northern Gulf of St. Lawrence. Most seek to reduce mortality caused by fishing. In the case of Atlantic cod, a fishing moratorium has been in place since 1994. Cod by-catches by other fisheries have been greatly reduced through measures such as increasing the mesh size of fishing nets, installing an escape system for fish on shrimp trawling nets, closing fishing zones when accidental cod catches exceed a certain threshold, and reducing fishing quotas.

Our understanding of the mechanisms governing natural cycles in animal populations remains incomplete, however. To have a sustainable harvest of ocean resources, we must identify the critical development stages of the species and determine what physical and biological factors most affect the survival, growth and fertility of individuals.

Toxic waste dumps on land have been cleaned up or are currently being restored. However, there are at present no plans to restore heavily contaminated harbour areas.

6.4 Managing Marine Fisheries Efficiently

Along with restoring and conserving fishery resources, new approaches are required to secure the survival of commercial species. To this end, the federal government has undertaken a thorough reorganization of the fisheries support sector. Its guiding principles affirm that resource conservation is essential and overrides all other considerations, that industry catch capacity must be balanced with what the resource can bear, that professional status be introduced for fisherman, that operators hold several licences to adapt easily to changes in resources, that a closer partnership exist between the industry and the government, and that Native peoples's rights be respected. Some of the main steps taken since 1993 have been the voluntary Groundfish Licence Retirement Program and the imposition of new fishing fees based on value of landings. The industry has also adopted certain priorities to ensure resource survival. These include recognizing the importance of expanding the harvest of underexploited marine species (urchin, Rock crab, Spiney dogfish, skate, Harp seals), penetrating the Quebec market, technological

innovation, labour-force training and aquaculture development, increasing the valued-added of products sold, and strengthening the presence of young people at all levels of the system to ensure succession and halt their exodus to other businesses and regions.

6.5 Reconciling Tourism and Recreational Development with Protection of the Environment

In recent years, tourism based on the attraction of the coastal and marine environment has been growing in the area. A major issue for the study area will be to ensure sustainable development by protecting wildlife resources and their habitats, as well as the landscape upon which tourism is based. Among other things, it will be necessary to limit the disturbance of birds and marine mammals caused by the growing human presence in habitats that were not previously accessible to the general public. Though ecotourism may need to be controlled, it remains an important avenue for the development and enhancement of local resources and landscapes.

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Appendices

1 St. Lawrence Vision 2000 (SLV 2000) Priority Species present in North Shore–Anticosti

Common or Latin name	*Type of distribution or local status*
Plants (29 of the 110 priority species)	
Alaska rein orchid	Disjunct
American spurred-gentian	Disjunct
Anticosti aster	Endemic (Gulf of St. Lawrence)
Arctic bladderpod	Disjunct
Boreal fescue	Disjunct
Common dandelion	Endemic (northeastern North America)
Elk thistle	Endemic (Gulf of St. Lawrence)
Erigeron lonchophyllus	Disjunct
Fernald's milk-vetch	Endemic (Gulf of St. Lawrence)
Fleshy dandelion	Endemic (Gulf of St. Lawrence)
Fourpart dwarf-gentian	Disjunct
Gaspé Peninsula arrowgrass	Endemic (northeastern North America)
Golden whitlow-grass	Disjunct
Host sedge	Disjunct
Hyssopleaf fleabane	Endemic (Gulf of St. Lawrence)
Iowa moonwort	Disjunct
Island fringed-gentian	Disjunct
Longleaf arnica	Disjunct
Low braya	Disjunct
Mackenzie’s sweet-vetch	Sporadic
Monarch lady's-slipper	Endemic (northeastern North America)
Needle beak-sedge	Peripheral
Northern holly-fern	Disjunct
Purple stonecrop	Disjunct
Rand's goldenrod	Endemic (northeastern North America)
Scirpus pumilus ssp. *rollandii*	Disjunct
Shy wallflower	Endemic (Gulf of St. Lawrence)
Sparrow-egg lady's-slipper	Endemic (Gulf of St. Lawrence)
Viviparous fescue	Peripheral
Reptiles and amphibians (none of the 6 priority species)	

Common or Latin name	*Type of distribution or local status*
Fish (4 of the 14 priority species)	
American eel	Present in tributaries
Atlantic herring	Migratory, spawns near coasts
Atlantic tomcod	Unknown
Rainbow smelt	Year-round resident, spawns in some tributaries
Birds (10 of the 19 priority species)	
Bald eagle	Confirmed nester
Barrow's goldeneye	Probable nester
Blue-winged teal	Confirmed nester
Caspian tern	Confirmed nester
Harlequin duck	Probable nester
Horned grebe	Visitor
Least bittern	Visitor
Northern pintail	Confirmed nester
Peregrine falcon	Visitor
Piping plover	Confirmed nester
Mammals (all 5 priority species)	
Beluga whale	Common in the upper part of the Middle North Shore
Fin whale	Common in spring, summer and fall
Harbour porpoise	Common in summer and fall
Harbour seal	Year-round resident
Pygmy shrew	Status unknown

2 Environmental Quality Criteria
(for assessing loss of use)

Ecosystem component	*Reference criterion*	*Objective*
WATER	Raw water (taken directly from a water body without treatment) (MENVIQ, 1990, rev. 1992)	Protect the health of people who both drink water taken directly from a water body and eat aquatic organisms caught there throughout their lives.
	Contamination of aquatic organisms (MEF, 1996)	Protect human health from the threat posed by consumption of aquatic organisms.
	Aquatic life (chronic toxicity) (MENVIQ, 1990, rev. 1992)	Protect aquatic organisms and their offspring and the wildlife that consume these organisms.
	Recreational activity (primary contact) (MENVIQ, 1990, rev. 1992)	Protect human health in activities where the entire body is regularly in contact with water, such as swimming and wind surfing.
SEDIMENT	No effect threshold (NET) (SLC and MENVIQ, 1992)	Contaminant levels below which no effects on benthic organisms can be observed.
	Minimal effect threshold (MET) (SLC and MENVIQ, 1992)	Contaminant levels above which minor but tolerable effects are observed in most benthic organisms.
	Toxic effect threshold (TET) (SLC and MENVIQ, 1992)	Contaminant levels above which harmful effects are observed in most benthic organisms.
AQUATIC ORGANISMS	Fish marketing guidelines (HWC, 1985)	Maximum acceptable contaminant levels in the flesh of fish, shellfish and crustaceans sold for consumption.
	Fish consumption guidelines (MENVIQ and MSSS, 1993)	Prevent harm to human health from eating contaminated fish, shellfish and crustaceans.

3 Glossary

Anadromous: Refers to fish which return from the ocean to fresh water to reproduce in the course of their life cycle.

Benthos: All organisms living in contact with the bed of a watercourse, divided into phytobenthos (plants) and zoobenthos (animals).

Biomass: Total mass of living organisms, taken either globally or in systemic groups, by surface or volume unit, in a given biotope at a given moment, e.g. plant, insect, herbivore, carnivore biomass.

Brackish: Refers to water with a salinity level between that of fresh water (0.3‰) and that of salt water (35‰).

Catadromous: Refers to fish that live in fresh or brackish water and who migrate to the sea to reproduce.

Community: All living organisms, both plant and animal, that occupy the same biotope.

Disjunct distribution: Refers to plant species found in an area or areas remote from its main range.

Ecosystem: An entire physical and chemical environment (biotope) and all living organisms populating it (biocenosis) and able to continue doing so indefinitely by virtue of matter and energy inputs.

Ecosystem productivity: Quantity of biomass produced annually and maintaining the equilibrium of animal and plant populations.

Effluent: General term for any fluid issuing from a source of pollution, whether a residential area (domestic outfall) or industrial installations (industrial outfall). Point-source effluents (sewers): outflow of liquid pollutants at a given place.

Endemic: Refers to a species that is confined to a particular area.

Endemic distribution: Refers to a species whose range is limited to a well-defined area.

Flow: Volume of water flowing in a watercourse, pipe, etc., in a given time. Generally expressed in m^3/s, sometimes in L/s for small basins; *discharge*.

Foreshore: That part of the shore between the high and low water marks; *mesolittoral, intertidal area.*

Habitat: Ecological framework in which an organism, species, population or group of species lives.

Haulout: Coastal site where seals rest out of water.

Hydrophobic: Refers to toxic substances that show little tendency to dissolve in water.

Nonpoint-source pollution: Diffuse discharge of pollutants into a given environment. Agricultural runoff is nonpoint-source pollution since fertilizers and pesticides are spread over large areas.

Nutrient: Simple substances absorbed by plants and used in photosynthesis. The main nutrients are nitrates, phosphates and silicates.

Plankton: Animal (zooplankton) and plant (phytoplankton) organisms that live suspended on oceans or bodies of fresh water.

Primary production: Quantity of organic matter generated by autotrophic organisms in a given period.

Secondary production: Quantity of organic matter generated by heterotrophic organisms in a given period.

Sediment: Particles of soil and other substances formed by the weathering of rocks or other chemical or biological processes, transported or deposited by air, water or ice.

Sediment regime: Set of watercourse flow characteristics that influence sediment transport, deposition and erosion.

Spawning ground: Place where fish gather to breed.

Suspended solids: Small particles of solid matter (> 0.45 µm) floating in a liquid; *suspended matter*.

Terrigenous: Refers to substances originating on land.

Thermal stratification: Formation of layers of different temperatures in water bodies, with warmer water overlying colder water.

Tidal range: Vertical distance between high and low tides.

Turbid: Refers to water containing a high concentration of suspended matter.

Turbidity: Cloudiness of a liquid due to the presence of fine suspended matter (clay, silt or micro-organisms).

Waterfowl: Collective name for ducks and geese.

Water mass: Volume of water having relatively homogeneous physical and chemical characteristics.

Watershed: The entire continental land area drained by a watercourse, that is, the total precipitation catchment and drainage area; *drainage basin.*

Year class: All fish born or incubated in a given year. In the northern hemisphere, when spawning takes place in fall and incubation in spring, the astrological year of the

hatch generally serves to designate the year class (except normally in the case of salmon).

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