REGIONAL ASSESSMENT
NORTHERN GASPÉ

Regional Assessment
Northern Gaspé

Priority Intervention Zone 20A

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

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NOTE TO READERS

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We would also like to thank all those from the sectoral and regional offices of the departments concerned who were involved in reviewing this report.

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.

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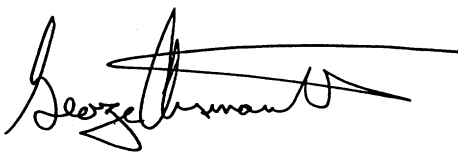

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Management Perspective

The ZIP program is a federal-provincial initiative involving stakeholders and shoreline communities in implementing measures to restore the St. Lawrence River. The program has three phases: producing a regional assessment report on the state of a specific area of the St. Lawrence, consulting shoreline partners in setting priorities for action, and developing an ecological rehabilitation action plan (ERAP).

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

The 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 offer 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 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 Northern Gaspé study area encompasses the part of the Gulf of St. Lawrence that stretches between Capucins and Cape Gaspé, along the north shore of the Gaspé Peninsula. This sector's biophysical and socio-economic characteristics are distinct from those of the Lower Estuary of the St. Lawrence and the Southern Gaspé–Chaleur Bay study area. The marine environment is characterized by a fairly straight coastline with steep banks that in some locations plunge more than 300 m into the sea, and by a powerful current that flows along the entire coast, carrying a huge volume of brackish, nutrient- and plankton-rich water from the Lower Estuary to the southern Gulf.

Owing to the virtual absence of sheltered coastal areas, there are no major intertidal marshes or eelgrass beds in the study area. As a result, very few geese and ducks use the area during their migrations or the breeding season. There are no islands or islets, a situation which is reflected in the small number of seabird colonies and seal haulouts.

The area's predominantly rocky foreshores are colonized by a limited abundance of plants and animals because of heavy ice scouring. However, below the low-tide mark, the rocky seabed is home to a richly varied and abundant plant and animal community, dominated by kelp, blue mussels, green sea urchins, whelks and sea cucumbers. Lobster is abundant only in the eastern part of the study area.

At greater depths, the coastal slope is overlain with sand and gravel and contains many rocky outcroppings where Islandic scallops and Snow crabs are found in relatively small numbers.

The bed of the Laurentian Channel at a depth of 300 m receives a continual rain of fine sediments. Muddy bottom areas contain fairly small aggregations of Northern shrimp, but large numbers of Greenland halibut.

The Gaspé Current contains the most productive waters in the Gulf of St. Lawrence, supporting high biomasses of copepods and euphausiids (krill), which are actively sought as a food source by pelagic fish and rorquals.

The main habitat alterations in the study area occurred as a result of the construction and repair of Highway 132, which runs for a long distance on the upper part of the shore. Fill work has taken place mostly on rocky shores.

Local sources of contamination by toxic chemicals are of minor significance. None of the industries in the area have been targeted under government programs seeking to reduce discharges of industrial effluents. However, only one of the 15 riverside municipalities had a sewage treatment system in operation in 1996. As a result, most of the coastal shellfish beds in the area are closed to harvesting due to bacterial contamination.

The sediments in some ports and fishing harbours are severely contaminated with heavy metals (nickel, copper and cadmium). So far, however, no sites have been identified as being heavily contaminated with organochlorine substances or PAHs.

The marine fishing industry is primarily dependent on resources harvested outside the study area, such as Northern shrimp, Snow crab and groundfish. The collapse of groundfish populations (Atlantic cod, Canadian plaice, redfish, White hake) in the Gulf in the early 1990s hit communities in the eastern part of the study area hardest, whereas the fisheries in the western sector have always focused mainly on resources whose present status is considered satisfactory.

Seaweeds, molluscs, crustaceans, fish and waterfowl in the Northern Gaspé are largely uncontaminated, and eating them poses no serious threat to human health. However, the molluscs in many coastal areas are contaminated with harmful micro-organisms from domestic sewage and often contain high concentrations of marine toxins produced by natural planktonic algae. These algae sometimes produce dense blooms called red tides, which can cause massive fish kills and render molluscs toxic to humans.

Résumé

Le secteur Gaspésie-Nord comprend la partie du golfe du Saint-Laurent située entre Capucins et le cap Gaspé, le long du versant nord de la péninsule de Gaspé. Ce secteur a des caractéristiques biophysiques et socio-économiques distinctes de celui de l'estuaire maritime du Saint-Laurent et du secteur Gaspésie-Sud–Baie-des-Chaleurs. Le milieu marin est caractérisé par une rive rectiligne et abrupte qui plonge directement dans la mer jusqu'à une profondeur de plus de 300 m et par la présence d'un courant intense et permanent le long de la rive qui transporte de l'estuaire maritime du Saint-Laurent vers le sud du golfe un énorme volume d'eaux saumâtres riches en éléments nutritifs et en plancton.

En raison de l'absence quasi complète de littoraux abrités, on ne retrouve pas de marais intertidaux et d'herbiers de Zostère marine importants dans le secteur. Celui-ci est donc peu utilisé par les oies et canards lors de leurs migrations ou en période de nidification. L'absence complète d'îles et d'îlots se reflète par la faible abondance de colonies d'oiseaux de mer et d'échoueries de phoques.

Les estrans du secteur sont surtout rocheux et colonisés par une flore et une faune peu abondantes en raison de la forte abrasion par les glaces. Par contre, sous le niveau des basses mers, les fonds rocheux abritent une flore et une faune abondantes et diversifiées, dominées par les algues laminaires, la Moule bleue, l'Oursin vert, le Buccin et le Concombre de mer. Le Homard n'est abondant que dans la partie est du secteur.

À de plus grandes profondeurs, le talus côtier est recouvert de sable et de gravier avec de nombreux affleurements rocheux où on retrouve des concentrations relativement faibles de Pétoncles d'Islande et de Crabes des neiges.

Le fond du chenal Laurentien à 300 m de profondeur reçoit une pluie continuelle de sédiments fins et, sur les fonds vaseux, on retrouve des concentrations relativement faibles de Crevette nordique et des concentrations importantes de Flétan noir.

Les eaux du courant de Gaspé sont les plus productives du golfe du Saint-Laurent et supportent des biomasses élevées de copépodes et d'euphausides (communément appelé « krill ») activement recherchés par les poissons pélagiques et les rorquals pour leur alimentation.

Les principales modifications physiques qu'a subi le milieu sont associées à la construction et la réfection de la route 132 qui occupe la partie supérieure de l'estran sur de longues distances. Les milieux remblayés sont surtout des estrans rocheux.

Les sources locales de rejets de substances chimiques toxiques sont peu importantes. Aucune industrie du secteur n'est visée par les programmes gouvernementaux de réduction des rejets industriels. Par contre, en 1996, une seule des 15 municipalités riveraines acheminait ses eaux usées vers une station d'épuration. Il en résulte que les bancs de mollusques littoraux du secteur sont majoritairement fermés à l'exploitation en raison de la contamination bactérienne.

Les sédiments de quelques ports et havres de pêche du secteur seraient fortement contaminés par des métaux lourds (nickel, cuivre ou cadmium) mais aucun site de contamination importante par les substances organochlorées et les HAP n'a encore été mis en évidence.

L'industrie des pêches maritimes dépend surtout de ressources exploitées à l'extérieur du secteur comme la Crevette nordique, le Crabe des neiges et les poissons de fond. Le déclin catastrophique des populations de poissons de fond du golfe (Morue franche, Plie canadienne, Sébaste, Merluche blanche) au début des années 1990 a surtout affecté les communautés de la partie est du secteur alors que les pêcheries de la partie ouest ont toujours été principalement basées sur d'autres ressources halieutiques dont l'état actuel est jugé satisfaisant.

La consommation d'algues marines, de mollusques, de crustacés, de poissons et de chair de sauvagine prélevés dans le secteur ne présente pas de risques importants pour la santé humaine en ce qui concerne les substances chimiques. Par contre, les mollusques littoraux sont à plusieurs endroits contaminés par les micro-organismes pathogènes provenant des eaux usées domestiques et contiennent souvent de fortes concentrations de toxines marines produites par des algues planctoniques naturelles. La floraison de ces algues peut produire des marées rouges, occasionner des mortalités massives des poissons et rendre les mollusques toxiques pour les humains.

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

Beginning in the 15th century, Basque, Breton, Norman and Portuguese fishers were attracted to the Gulf of St. Lawrence by the huge schools of cod and the pods of whales. The fishery became more sedentary in the early 18th century with the creation of commercial fishing posts in the natural harbours. During the latter half of the 18th century, the deportation of the Acadians and the arrival of American Loyalists marked the beginning of the colonization of Quebec's vast maritime region. Until then, the uses of the aquatic environment had hardly affected the resources of the Gulf of St. Lawrence, owing to its sheer size and the sparse population, but that was soon to change.

The first significant threats seem to have come from forestry development in the 19th century and the log booms established to supply the sawmills that sprang up at river mouths. The pace of change accelerated in the mid-1900s with the establishment of pulp and paper mills and ports to serve new mining operations, along with the intensive spraying of forests with DDT. During this period, the fishing industry experienced a profound change with the introduction of trawls, which increased the fleets' harvesting power tenfold. At that time, it was believed that the Gulf of St. Lawrence was impervious to pollution and that its resources were limitless.

Public awareness was sharply raised in the 1970s with the realization that the Northern gannets on Bonaventure Island were heavily contaminated with toxic substances which were threatening their survival and that several fish stocks had collapsed as a result of overfishing.

The general consensus today is that the Gulf of St. Lawrence is a fragile ecosystem and that its resources are limited. Despite its vastness and distance from large industrial centres, the integrity of this ecosystem is threatened by the unbridled exploitation of its resources, the presence of toxic substances and the destruction of wildlife habitats.

Most industrialized countries have agreed to redirect economic activities toward sustainable development. The profit motive alone can not govern human endeavour. Given the fragility of our environment and the limitations of our planet, sustainable development must provide for the multiple use of resources consistent with the quality of human life and the maintenance of biodiversity.

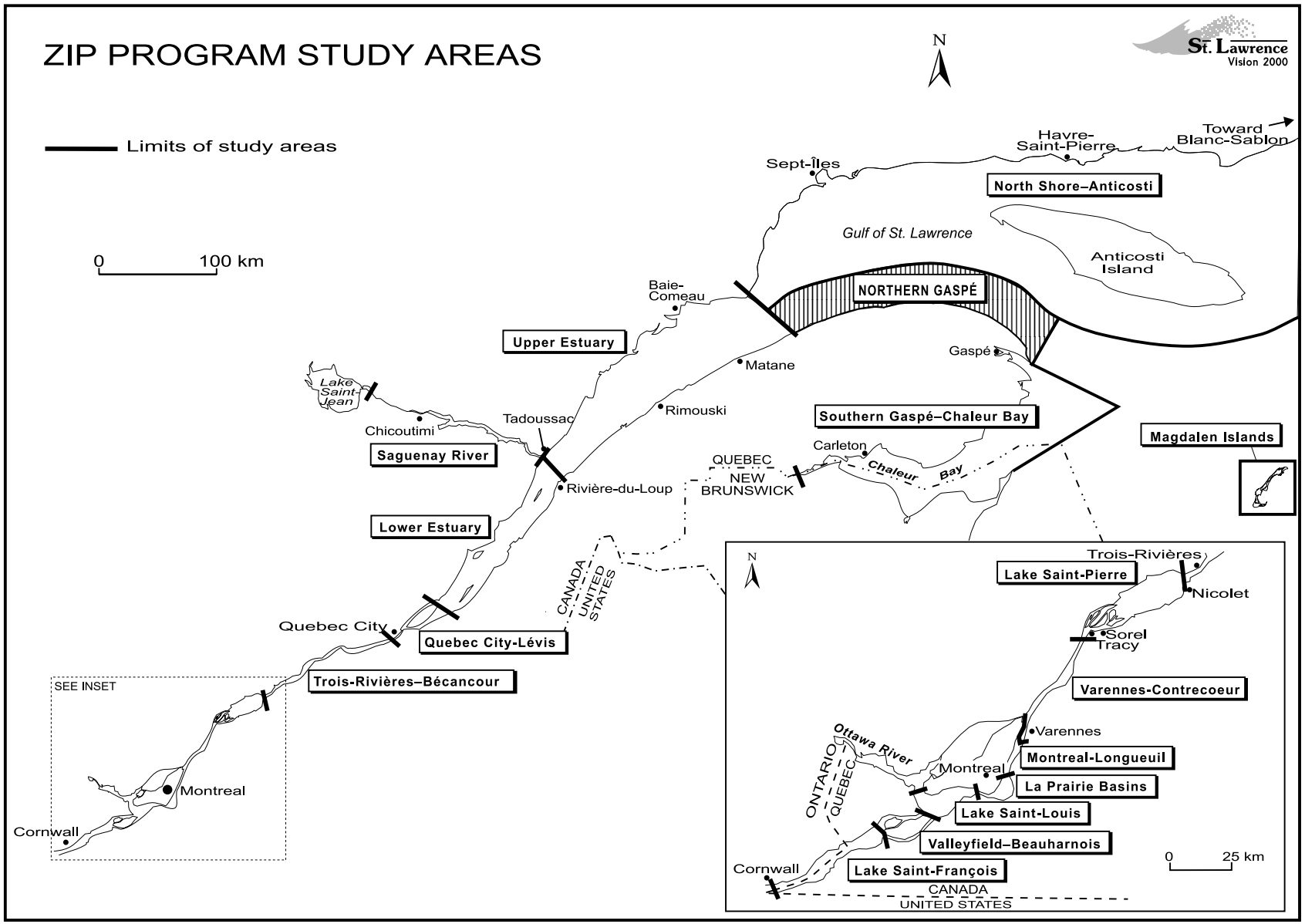
CHAPTER 2 The ZIP Program

Starting in the 1960s, growing public awareness of the degradation of the Great Lakes and the St. Lawrence and Saguenay rivers, along with the urgency of the situation, prompted governments to take concrete, joint action. This paved the way for the 1972 *Great Lakes Water Quality Agreement*. A 1987 amendment added a local use restoration program (Remedial Action Plan, or RAP). In 1988, the eight American states concerned and the provinces of Ontario and Quebec signed the *Great Lakes Charter* and an agreement to control toxic discharges into the Great Lakes Basin. In response to the poor quality of the waters of the St. Lawrence and its tributaries, the Quebec government launched its wastewater treatment program (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 St. Lawrence Vision 2000 (SLV 2000). One of the objectives of this action plan is to do local environmental assessments to encourage community stakeholders to work together to restore and protect the St. Lawrence and harmonize uses of the river (Figure 1). As part of the groundwork for public consultations, SLV 2000 partners review and synthesize current knowledge of the state of the environment in each study area.

This report presents the main points of the technical reports[1] and reviews current knowledge of the state of the resources and the present and potential uses of the Northern Gaspé sector (ZIP 20A).

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



Source: ZIP Program - SLV 2000.

Figure 1 ZIP program study areas

This effort to synthesize and analyse existing knowledge is meant to provide stakeholders with accessible, objective scientific data for use in establishing their priorities for action. This will make it possible to devise local and regional action plans wherein each partner will work within its sphere of responsibility, but in co-ordination with the other partners.

CHAPTER 3 Characterization of Northern Gaspé

The Northern Gaspé sector (ZIP 20A) encompasses the coastline extending from Capucins to Cape Gaspé, including the deeper waters and seabed of the Gulf of St. Lawrence situated offshore (Figure 2). From a socio-economic standpoint, the area covered in this report may include some municipalities located to the west or east of the sector's boundaries.

3.1 Physical Environment

The dominant feature of the bottom topography in the Northern Gaspé is the Laurentian Channel. This deep trough of glacial origin, delimited by the 200-m isobath (Figure 3), begins in the St. Lawrence Estuary, crosses the centre of the Gulf of St. Lawrence and the Cabot Strait and ends at the continental shelf break southeast of Newfoundland. In the study area, the channel has a maximum depth of 425 m, offshore from Rivière-au-Renard. The channel bottom is covered with silty sediment that is deposited at a rate of 1.5 mm per year.

Between the bottom of the Laurentian Channel and the shoreline, the absence of a coastal shelf distinguishes this area from other sectors of the Gulf and Estuary. There is, however, a fairly steep rocky slope covered with sand or gravel in the upper section and with sandy or gravelly silt in the lower section.

The shoreline in the study area is remarkably straight and is characterized by the absence of islands, islets or reefs and by a succession of small, unsheltered coves at river mouths. With the exception of these coves featuring coarse sand or gravel beaches, the riverbanks are dominated by cliffs and narrow rocky shores.

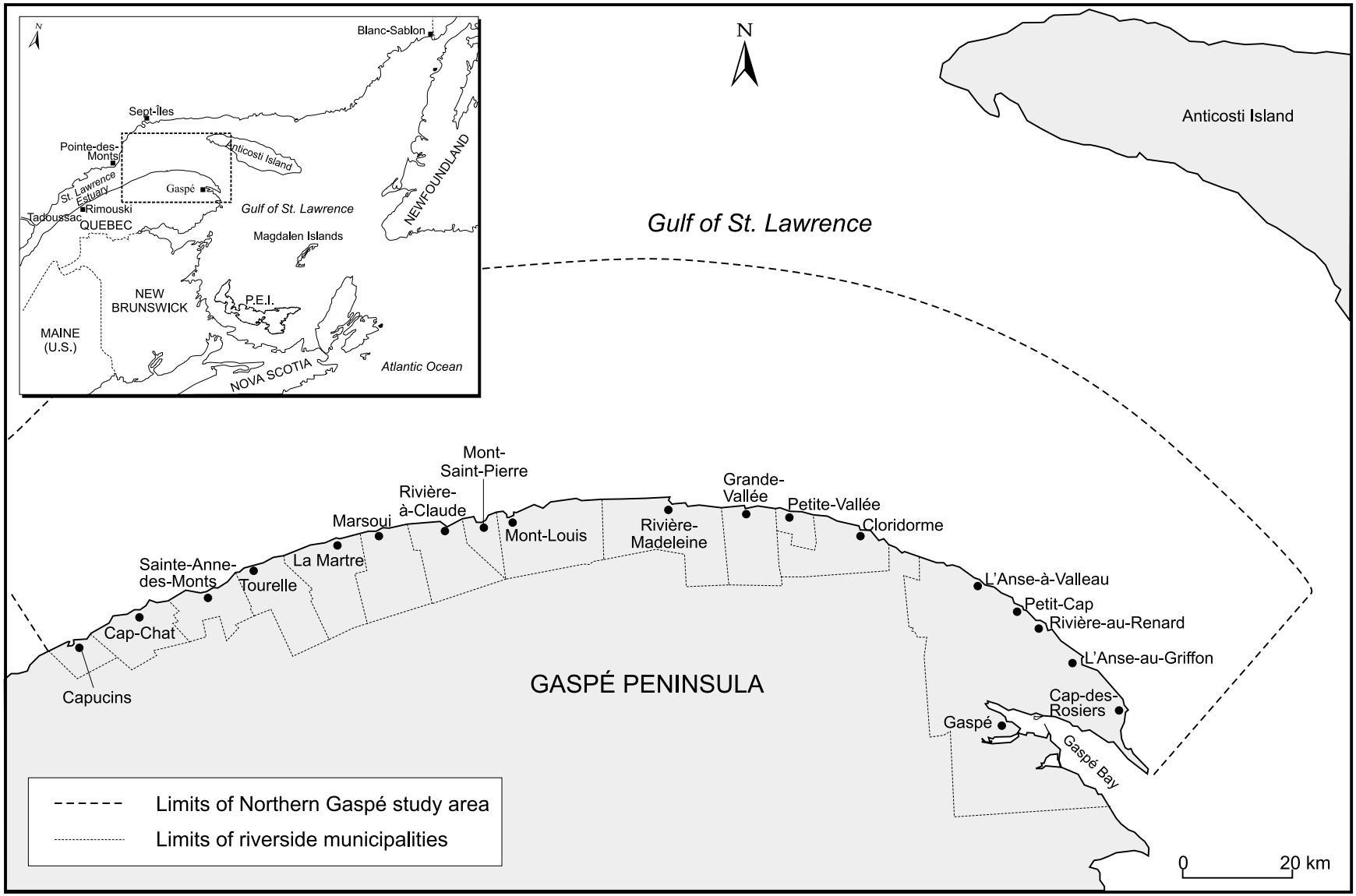


Figure 2 Limits of the Northern Gaspé sector and area riverside municipalities

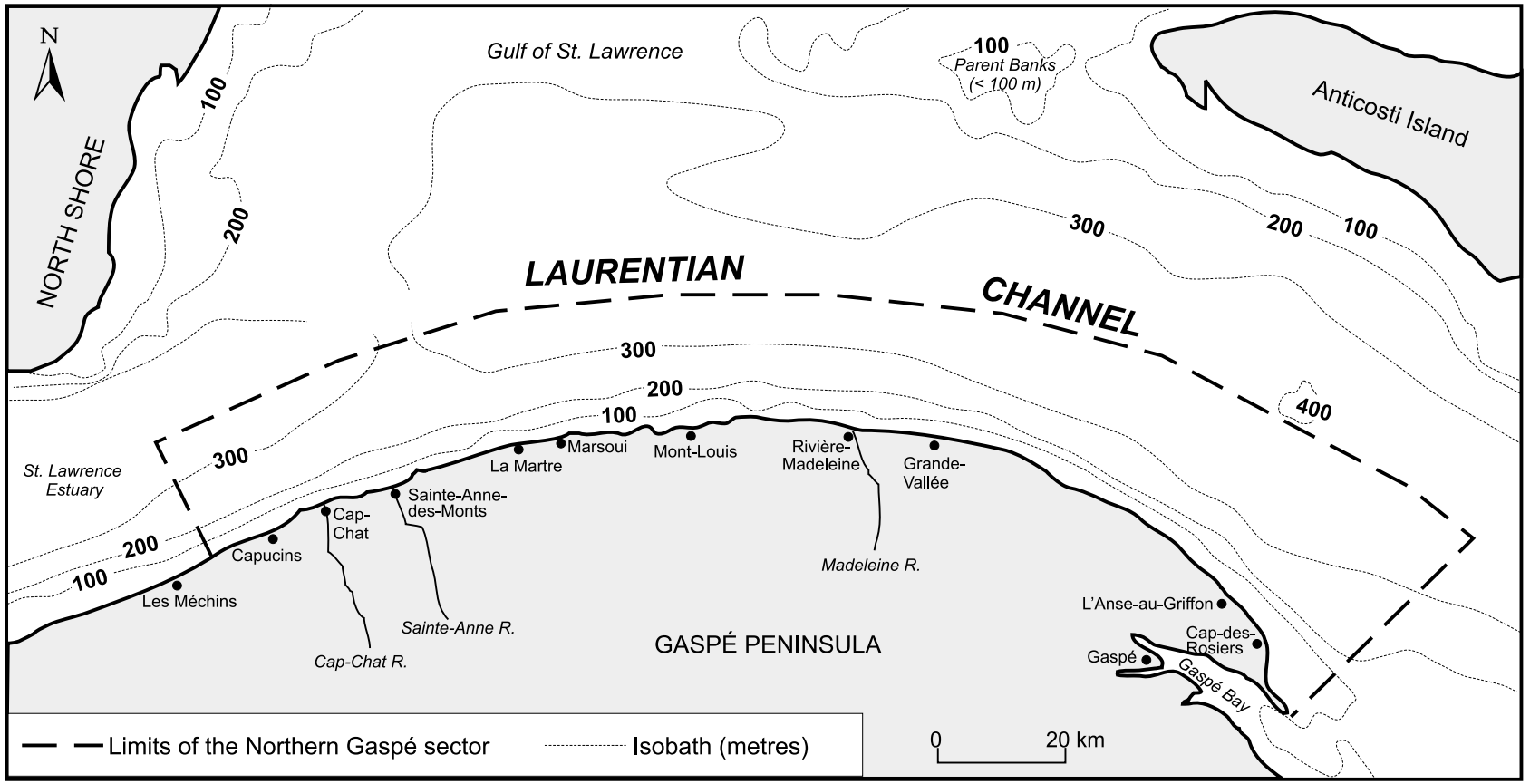
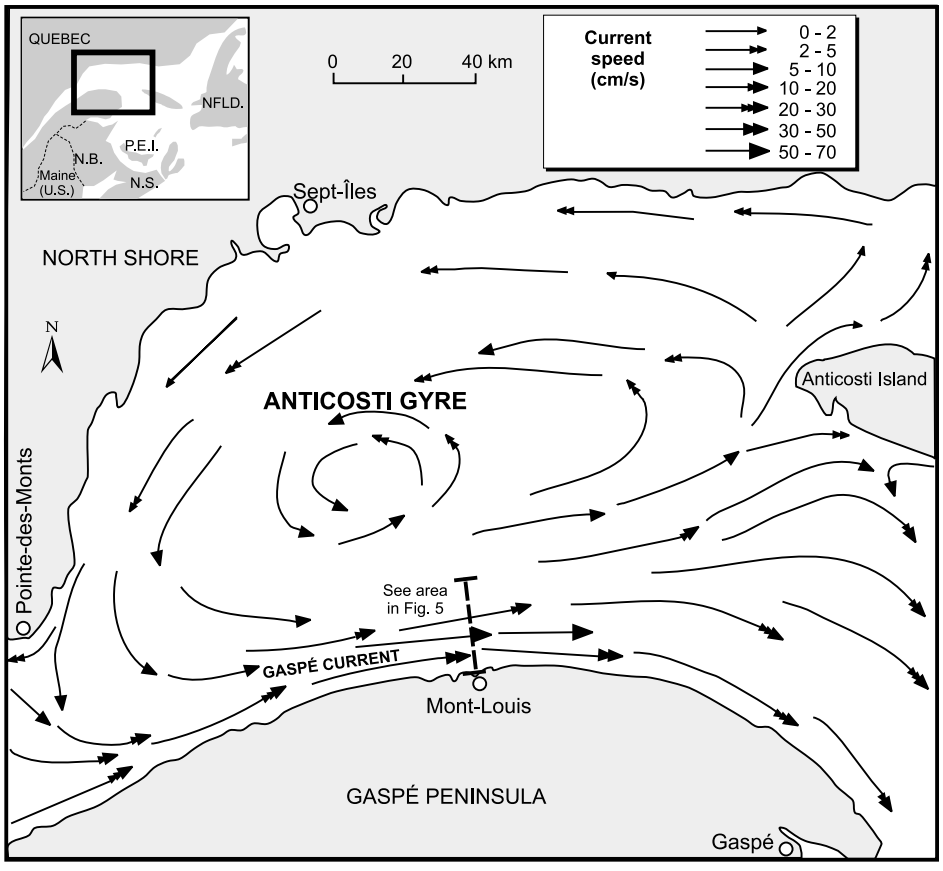


Figure 3 Physiography of the Northern Gaspé sector and the surrounding region

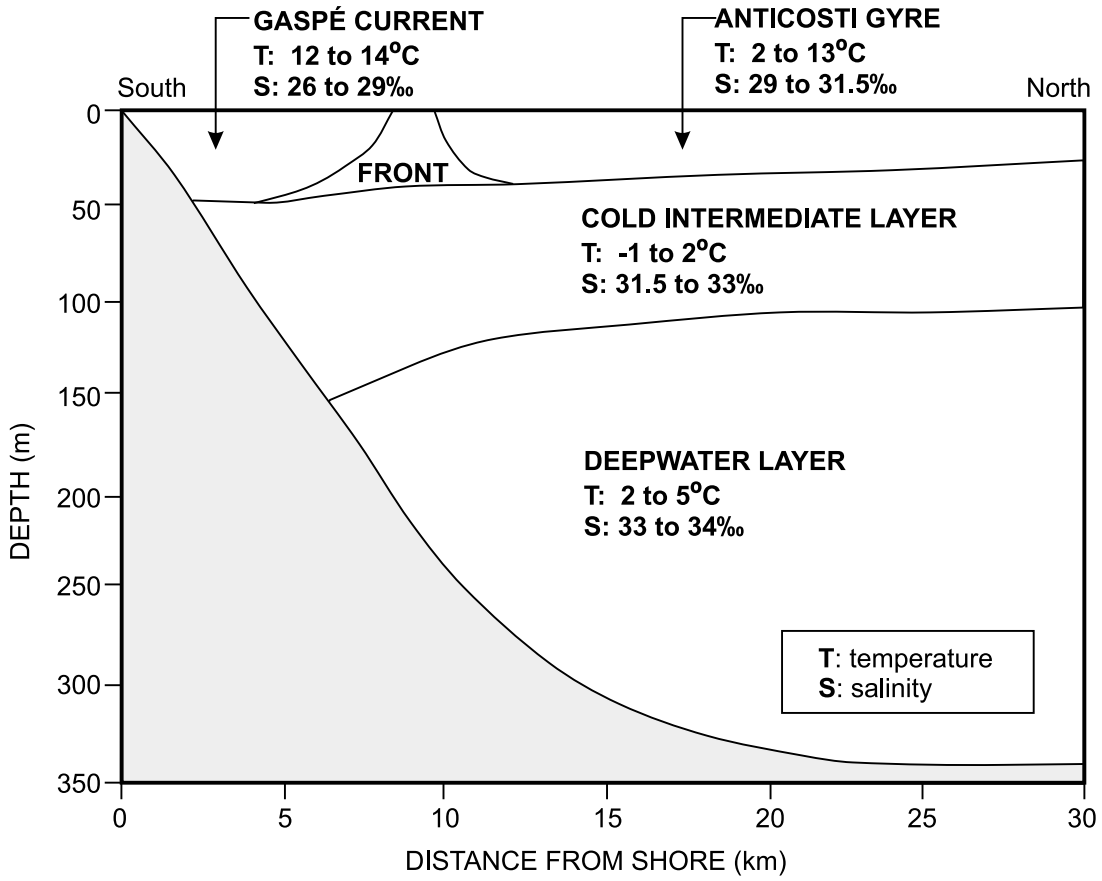
The main tributaries in the area are the Cap-Chat, Sainte-Anne and Madeleine rivers; their freshwater discharge does not affect the hydrodynamics of the marine environment as a whole. The tides are semi-diurnal (two high tides each day), with a range that changes every two weeks owing to the spring and neap tides. Mean tidal range increases moving in a westward direction, from 1.5 m at Rivière-au-Renard to over 2.5 m at Cap-Chat.

In the summer, there are four distinct water masses in the Northern Gaspé (figures 4 and 5): *1)* the waters of the Gaspé Current, *2)* the waters of the Anticosti gyre, *3)* the cold intermediate layer and *4)* the deepwater layer.



Source: Adapted from Sévigny et al., 1979.

Figure 4 Circulation of surface waters in the northwestern Gulf of St. Lawrence



Source: Adapted from Fortier et al., 1992.

Figure 5 Distribution of water masses in the sector in summer

The *waters of the Gaspé Current* occupy the upper part of the water column (depth range 0–50 m) in the coastal band (10–15 km wide) extending along the north shore of the Gaspé Peninsula. These waters are formed by the mixing of fresh water from the St. Lawrence with the salt water from the Gulf that flows seaward from the St. Lawrence Estuary along the south shore and is strengthened by the Anticosti gyre in the northwestern Gulf (Figure 4). In summer, these waters are warmer (12–14°C), less salty (26 to 29 parts per thousand, ‰) and more turbid (1 to 3 mg/L of suspended solids [SS]) than the other three water masses found in the sector, and they

are more nutrient-rich than the waters of the Anticosti gyre. The Gaspé Current is one of the most powerful permanent currents in the Gulf. It transports a huge volume of water (on the order of 300 000 m^3/s, or about 30 times the discharge of the St. Lawrence at Quebec City) from the northwestern part of the Gulf to the southern part. It reaches maximum velocity (about 100 cm/s) off Mont-Louis. Although a permanent fixture of the region, the Gaspé Current has a variable intensity and periodically meanders when fluctuations in freshwater inputs temporarily deflect it from the Gaspé coast.

The *waters of the Anticosti gyre* occupy the upper part of the water column (depth range 0–30 m) in the offshore area beyond the Gaspé Current. A front parallel to the shoreline separates these two water masses and is marked by upwellings of deep water. In summer, the waters of the gyre are colder (2–13ºC), saltier (29 to 31.5‰), less turbid (< 1.0 mg/L of SS) and less nutrient-rich than the waters of the Gaspé Current. The water in the gyre, which occupies the area between Pointe-des-Monts and Anticosti Island, circulates counterclockwise (Figure 4). In the spring, this counterclockwise circulation causes an upwelling of water from the cold intermediate layer in the middle of the gyre.

The *cold intermediate layer* forms in the Gulf in winter when the surface layer cools and mixes with the underlying layer of water. In summer, this cold intermediate layer occupies the water column at a depth range of 30–50 m or 125–175 m. This water is much colder (-1 to 2°C), saltier (31.5–33‰), less turbid (< 0.1 mg/L of SS) and more nutrient-rich than the two upper water masses. The cold intermediate layer moves upstream — that is, toward the Lower Estuary; this landward flow at depth balances the huge volumes of salt water that are carried seaward by the Gaspé Current.

The *deepwater layer***,** which is confined to the Laurentian Channel (> 175 m), is made up of waters from the northwest Atlantic, which flow landward to the head of the Laurentian Channel, near Tadoussac, at a speed of only 150 km per year (~ 0.5 cm per second). These waters are warmer (2–5 C), more saline (33 to 34‰), more turbid (0.1–0.5 mg/L of SS) and more nutrient-rich than the waters of the cold intermediate layer.

Ice floes reach the sector in early January and generally disappear by mid-April. Drifting ice from the estuary and storm waves during the ice-free period have a considerable impact on coasts in the study area, which are among the least sheltered in all of Quebec.

3.2 Habitats and Biological Communities

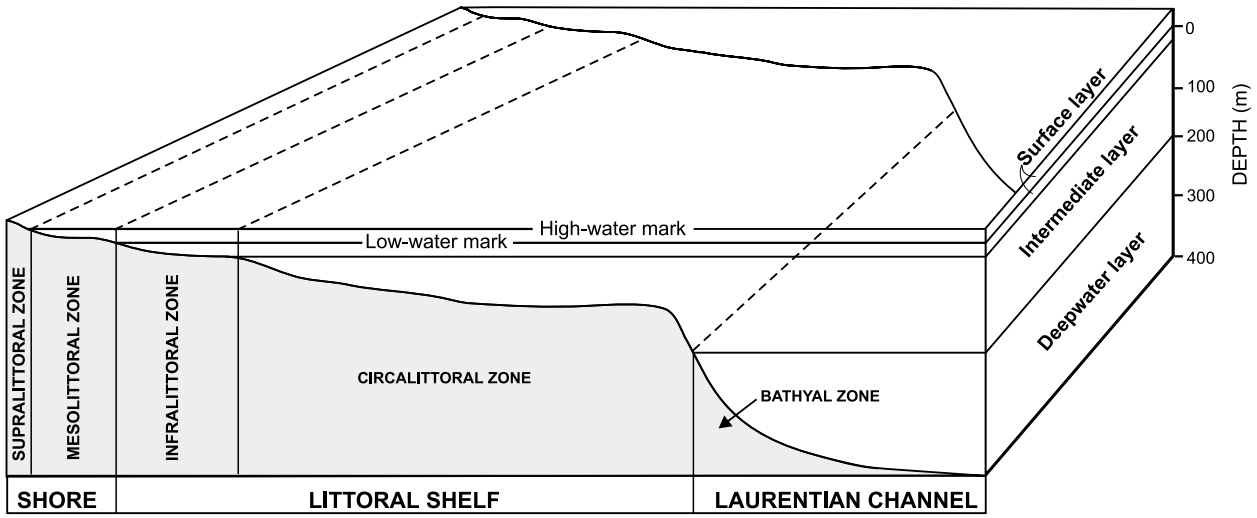
The study area contains a mosaic of aquatic habitats reflecting the many possible combinations of biophysical variables that determine the distribution and abundance of aquatic organisms. In order to more easily synthesize the multitude of information available on the subject, habitats have been divided into two main categories: the benthic and pelagic realms.

3.2.1 Benthic habitats

The benthic realm is generally subdivided into five horizontal bands based on tidal levels and the vertical stratification of water masses in the Gulf (Figure 6): *1)* the *supralittoral zone* is located above the high tide mark, *2)* the *mesolittoral zone* is covered and uncovered daily by the tides, *3)* the *infralittoral zone* comprises bottom areas permanently beneath the surface layer of the water (0–30 m deep); *4)* the *circalittoral zone* is associated with the cold intermediate layer and *5)* the *bathyal* zone comprises the slope and bottom of the Laurentian Channel.

Supralittoral habitats. Compared with other regions of the Gulf, the Northern Gaspé sector has very few islands, islets or reefs, which explains the low abundance of seals and small number of seabird colonies.

Mesolittoral habitats. Owing to the strong ice and wave action along the coast, there are no major intertidal marshes in the sector. The sand and gravel beaches that characterize coves are denuded of vegetation and have very little endobenthic fauna. These habitats are, however, used by shorebirds and gulls, which feed on organisms and detritus washed up on the beach, and by capelin during the spawning period. The beds of Softshell clams that occupy muddy sand foreshores are very small.

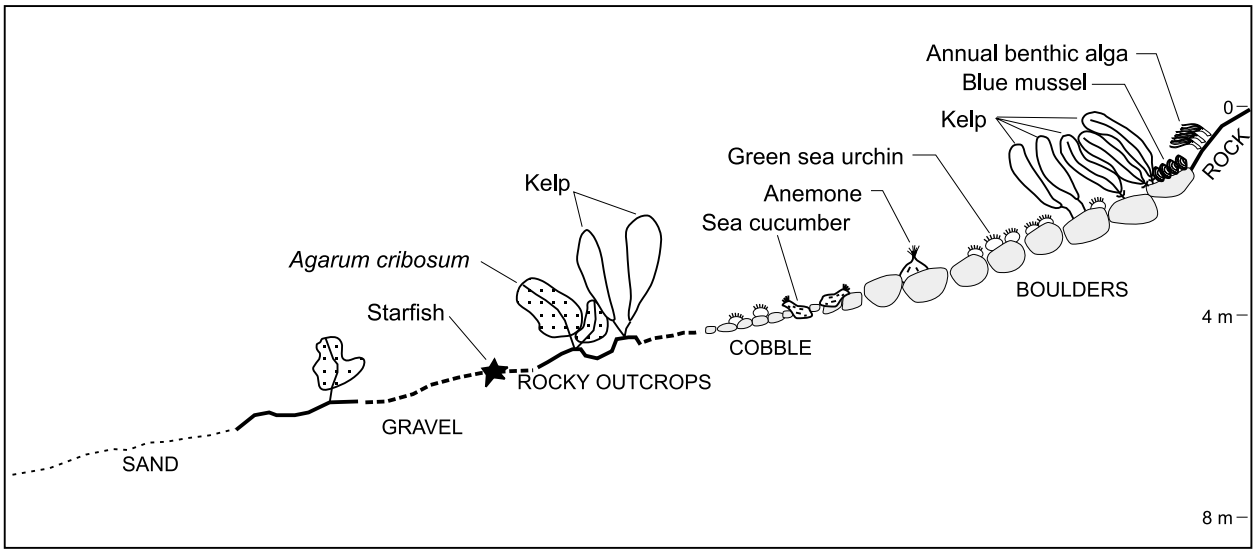


Source: Adapted from Brunel, 1991.

Figure 6 Division of the benthic realm in the Gulf of St. Lawrence based on tidal levels and water masses

On the many rocky coasts in the study area, the density and biomass of flora and fauna increase from the bottom to the top of the foreshore. On coasts that are regularly eroded by ice, the foreshore is colonized by filamentous algae and periwinkles, whereas large benthic algae, barnacles and mussels can only develop in sheltered depressions, crevices and rock faces. In areas sheltered from ice scouring, however, brown seaweed forms a continuous mat on the lower part of the littoral zone, which is inhabited by large numbers of periwinkles, mussels and gammarids. Shallow depressions are colonized by flora and fauna species that are normally found below the low tide mark. At high tide, a number of invertebrates and fish move into these areas in search of food.

Infralittoral habitats. Below the low tide mark, the following succession of materials of different grain sizes are typically found: bedrock, boulders, cobble, gravel and gravel or cobble beginning at a depth of 10–12 m (Figure 7). The benthic flora and fauna in this type of habitat generally form four distinct bands.



Source: Lavergne and Himmelman, 1984.

Figure 7 Typical distribution of benthic organisms in the infralittoral zone of the western Gulf of St. Lawrence

The uppermost band, at a depth of 0 to 2 m, is occupied by annual benthic algae and by gastropods which quickly colonize the ice-abraded surfaces. Below this, at a depth of about 3 m, is a band of large *Laminaria* algae (kelp) that can form very dense beds with an abundance of fauna dominated by Blue mussels.

Large concentrations of green sea urchins characteristically occur at the base of these algal beds. At depths greater than 3 m, the vegetation thins out and is dominated by algae, such as sea colander (*Agarum cribosum*), which are resistant to grazing by Green sea urchins. This band is inhabited by Green sea urchins, Rock crabs, starfish and whelks. Anemones and ascidians are less abundant in the Northern Gaspé than in the St. Lawrence Estuary. On cobble and pebble substrates, which sometimes occur at depths of 15 to 25 m, Stimpson's surf clam is the dominant species and is found in association with Green sea urchins, sea cucumbers and bivalves such as Razor clams and Giant scallops. Between Capucins and Mont-Louis, there are some small beds of

Islandic scallops, at depths of 30 to 50 m. In this type of environment, plaice and eelpout are abundant, while lobster are plentiful only in the area east of Cloridorme.

There are few eelgrass beds in the sector, owing to the limited area suitable for their development (shallow and well sheltered sandy substrates).

Circalittoral habitat. The circalittoral habitat consists of a narrow band parallel to the coast that has a relatively steep slope and lies at a depth of 50 to 175 m. Here, not enough light penetrates to permit photosynthesis. The biological communities here are made up of predators and organisms that feed on organic particles that fall to the sea bottom. The Snow crab is characteristic of this habitat.

Bathyal habitat. The muddy bottom areas of the Laurentian Channel feature a fauna that is very different from that in the other zones. The best known species typical of the zone are Northern shrimp, Deepsea king crab, Greenland halibut (turbot) and redfish.

3.2.2 Pelagic habitats

The pelagic realm is home to phytoplankton (plants) and zooplankton (animals), pelagic fish species, seabirds and cetaceans. Microscopic algae (primary production) form the basis of the food chain in the surface layer of water. The pelagic environment in the study area can be divided into two separate habitats: the Gaspé Current and the Anticosti gyre.

Gaspé Current. Phytoplankton blooms in the waters of the Gaspé Current (Figure 4) occur later than in the other Gulf regions (late May), because the plankton cells are quickly transported toward the southern Gulf during spring runoff. However, primary production remains at a high level for a longer period because the nutrients in the waters of the Gaspé Current are continually replenished by the upwellings of cold, nutrient-rich waters that occur in the St. Lawrence Estuary, along the coasts of the northwestern Gulf and along the front between the Gaspé Current and the Anticosti gyre. Under certain conditions, blooms of the planktonic alga *Alexandrium tamarense* may occur, causing mass mortalities of fish and seabirds. Blooms of this

type, called “red tides,” were observed in the western part of the Gaspé Current in August 1996, following the heavy rains of July 1996.

The high level of primary productivity gives rise to large copepod and euphausiid (commonly called krill) biomass values. Several species use the pelagic environment intensively for spawning (cod, Canadian plaice, Fourbeard rockling), larval development (lance, capelin) and adult feeding (herring). Large rorquals actively seek euphausiid aggregations, which occur regularly along the coast above the 100 m isobath. The Gaspé Current also serves as a migratory corridor for anadromous fish species (Atlantic salmon and American shad), for American eels, and for the herring population that spawns in the St. Lawrence Estuary.

Anticosti Gyre. Phytoplankton blooms occur in this habitat in April after the ice cover has disappeared. Owing to the rapid depletion of nutrients in the surface layer, in June primary production drops back to much lower levels, which are sustained through the summer. Consequently, zooplankton are much less abundant here during the summer than they are in the Gaspé Current. Nonetheless, this environment is used by redfish larvae and by juvenile capelin for foraging.

3.3 Fishery Resources

Only a handful of the 67 species of marine algae, the thousand species of invertebrates and the hundred or so species of fish in the study area are harvested. The main species harvested commercially, in descending order of the 1990–95 landed value, are Northern shrimp, Greenland halibut (turbot), Atlantic cod, Atlantic halibut, Snow crab, Atlantic herring, lobster, Canadian plaice and redfish. Atlantic salmon is the key species targeted by the sport fishery in the study area. As we will see below, the vast majority of fishery resources landed at harbours in the Northern Gaspé are not caught locally but rather in other areas of the Estuary and Gulf of St. Lawrence. The distribution and status of the marine populations harvested by local fishers are described briefly below.

Northern shrimp. Northern shrimp is an invertebrate that stays near the bottom in deep channels during the day but migrates toward the surface at night. The largest shrimp concentrations are found on muddy bottoms, at depths of 150 to 300 m, in the upstream part of the Laurentian, Anticosti and Esquiman channels. This resource is healthy at present. The abundance of Northern shrimp rose in the late 1980s and early 1990s when the large 1984–87 year-classes entered the fishery. Abundance subsequently declined in 1992 and 1993. The strong year-classes of 1990 and 1991 permitted an increase in abundance in 1994 and 1995.

Greenland halibut. This flatfish, commonly called "turbot," overwinters in the deep waters of the Cabot Strait area, where it spawns. In summer, the species migrates toward the northwestern Gulf and the Lower Estuary, remaining at depths greater than 200 m. The abundance of the Gulf population has been low since the early 1990s, but has risen in recent years with the strong 1988–1990 year-classes entering the fishery.

Cod. The main species harvested in the study area from the beginning of colonization until 1993, cod has been under a fishing moratorium since 1993. The local fleets used to harvest the populations from the southern and northern Gulf of St. Lawrence. These populations spend the winter outside the Gulf and in the spring migrate toward their spawning and feeding grounds, which are mainly concentrated in the western part of the Gulf. The harvestable biomass of these stocks reached a record low level in the early 1990s due to a very sharp drop in recruitment that began in the mid-1980s. This decline is attributable to overfishing and the abnormally cold water temperatures that have prevailed in the Gulf since 1989. Recent data show that the stocks are rebuilding but their present status does not warrant re-opening the fishery completely as this might endanger them.

Atlantic halibut. Atlantic halibut is a large flatfish species that is found in low abundance at depths greater than 180 m over the slope of the Laurentian Channel. The status of the Gulf population is not known. However, since the stock's reproductive potential may be affected by the harvesting of immature fish, a proposal was being considered which would make it compulsory in 1997 for fishers to throw back halibut smaller than 81 cm.

Snow crab. Snow crab is a benthic crustacean that abounds on muddy and sandy mud bottom substrates at depths of 50 to 200 m. The main concentrations are located along the North Shore, the south shore of the St. Lawrence Estuary and in the southwestern Gulf. Since 1994, this species has been harvested in an exploratory fishery conducted in the eastern part of the study area. In 1996, 181 tonnes of Snow crab was caught in this region. The species' abundance is affected by major natural fluctuations on a cycle of about eight years. The population in the southwestern Gulf peaked in the mid-1980s and in 1994, and reached an all-time low in the late 1980s. Although the stock is currently of average size, the biomass is expected to begin increasing in the year 2000. The Snow crab population of the southern Gulf is heavily harvested and annual landings essentially depend on the strength of the year-class recruited to the fishery each year.

Atlantic herring. Atlantic herring is the main pelagic fish species harvested in the study area. Local fleets fish for herring in the spring and fall in the southern Gulf of St. Lawrence. These stocks undertake distant migrations between their wintering grounds in the eastern Gulf and their spawning and feeding areas in the southern Gulf. One of the species' main feeding grounds is located in the downstream part of the Gaspé Current. Herring populations were overfished and declined rapidly during the 1970s, but have since gradually recovered. Herring abundance in the southern Gulf has been high since 1988 as a result of the strong 1987 and 1988 year-classes. No strong year-classes have since been produced, however.

Lobster. This benthic crustacean is found in large numbers on rocky infralittoral substrates (depths of less than 35 m). The species migrates toward deeper waters in winter. Lobsters occur along coasts in the eastern part of the study area, but they are much less abundant there than in the southern Gulf.

Canadian plaice. Canadian plaice is the primary flatfish species harvested in the sector, in terms of landed volume. The stock harvested by Gaspé fleets overwinters in the Laurentian Channel and migrates to the shallower waters of the Magdalen Shelf to spawn in the spring and feed in the summer. The harvestable stock is in poor condition because of low

recruitment since the mid-1980s, which is attributable to the large number of small plaice being caught and thrown back. In 1995, the stock's biomass reached its lowest level since 1997. There are currently signs of improvement (fewer discards of small plaice), although the biomass remains low. The fishery directed at this species has been restricted considerably since 1993.

Redfish. This species overwinters in deep waters in the vicinity of Cabot Strait and then disperses in spring toward the slopes of deep channels in water 200 to 350 m deep. The main concentrations are generally found on both sides of the eastern part of the Laurentian Channel and in the Esquiman Channel—that is, outside the study area. The Gulf population has been in decline since the early 1990s and the redfish fishery has been closed since 1995. There are no signs at present that the stocks are rebuilding.

Atlantic salmon. There are four salmon rivers in the study area. In order of importance based on the number of spawners that move upstream, they are the Madeleine, Mont-Louis, Sainte-Anne and Cap-Chat rivers. Salmon has not been fished commercially along coasts in the sector since 1971, and local Indian bands do not fish the four rivers. Upstream migration by salmon in the rivers has been quite steady since 1987, with a total of about 3300 spawners per year.

3.4 Birds

Breeding. A total of 137 bird species are known to breed near the riverside municipalities in the study area. Only a handful of these species are directly associated with the sector's coastal and marine habitats.

Compared with other sectors in the Gulf and St. Lawrence Estuary, there are few seabird colonies in the region. Outside Forillon Peninsula, in the easternmost part of the sector, there is only one Herring gull colony and there are six Black guillemot colonies on the cliffs, numbering 705 individuals. On Forillon Peninsula, there are seven species with over 12 000 breeding pairs that nest on the cliffs, including a large colony of Black-legged kittiwakes (10 600 pairs). The other species that nest in colonies there are, in descending order of number of

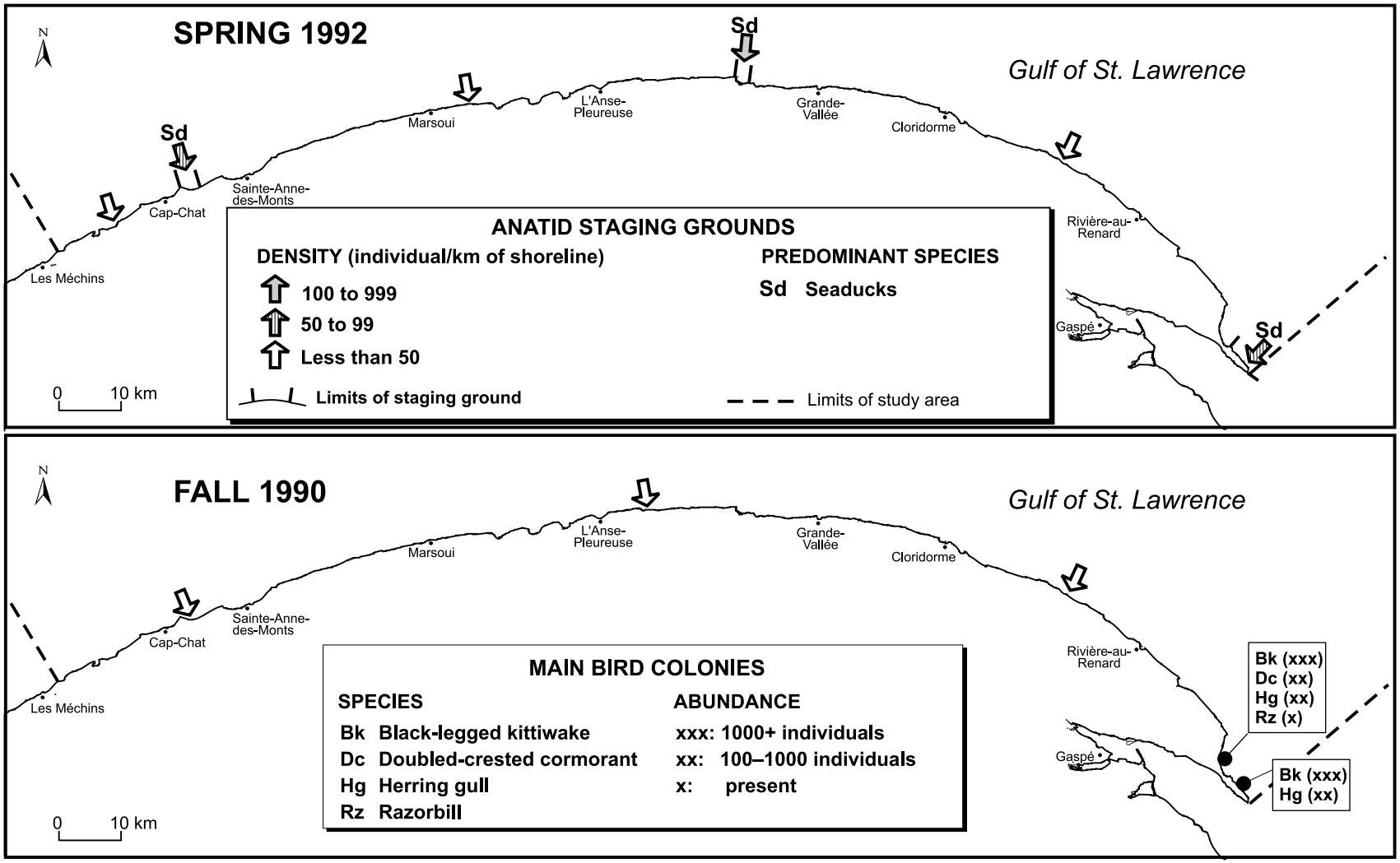
individuals, the Black guillemot, Herring gull, Double-crested cormorant, Razorbill, Great black-backed gull, and the Common eider. The total number of colonial seabirds in the Gaspé, with the exception of the Herring gull, increased greatly from 1979 to 1989. The decline in groundfish stocks may explain this phenomenon, since groundfish compete with seabirds for prey fish species (capelin, lance).

In addition to colonial species, one goose, five dabbling duck, three diving duck, two sea duck and three shorebird species that breed in isolated pairs in the study area were surveyed. There have been no recent reports of nesting by herons, Bald eagles, Golden eagles or Peregrine falcons in the study area.

Spring and fall migrations and overwintering. The coasts of the study area are not considered an important stopover area for waterfowl during spring and fall migration, nor do they represent a major overwintering ground. The only location where more than 100 geese or ducks have been observed per kilometre of shoreline is Madeleine-Centre, in the spring (Figure 8). The main species observed in the Northern Gaspé in spring are scoters and Oldsquaw, whereas Common eiders stop over in the fall. Shorebirds do not visit the area often when flying over the Gulf during their fall migration. The most heavily visited area is Anse-à-Percé. Of the 13 shorebird species surveyed, the Semipalmated sandpiper is the most abundant.

3.5 Marine Mammals

Thirteen species of marine mammals have been observed in the study area. The most abundant or frequently sighted species are the Harbour seal, Grey seal, Harbour porpoise, Atlantic white-sided dolphin, Fin whale and Minke whale. Belugas, White-beaked dolphins, Atlantic pilot whales, Northern bottlenosed whales, Killer whales, Blue whales and Humpback whales visit the area irregularly or rarely. The main Harbour and Grey seal haulouts are located along Forillon Peninsula.



Source: MEF, 1995; Chapdelaine and Brousseau, 1992; Hudon and Fortin, 1978.

Figure 8 Location of the main bird colonies and staging areas for anatids in the Northern Gaspé sector

3.6 Species at Risk

Eighteen rare plant species, five fish species, four bird species, four marine mammal species and one terrestrial mammal species surveyed in the study area are listed as priority species in need of protection under the SLV 2000 action plan (Appendix 1).

Four of the *priority plant species* are endemic to the Gulf of St. Lawrence, one is endemic to the Estuary and Gulf of St. Lawrence, and three are endemic to northeastern North America. Griscom's arnica is now designated as threatened; *Draba peasi*, Gaspé Peninsula arrowgrass and Pendantpod locoweed are at risk. The decline in the locoweed, which was once abundant at Mont-Saint-Pierre, may have been caused by the construction undertaken to widen Highway 132. Most of the rare species in the study area are associated with cliffs.

The *priority fish species* are American shad, Atlantic sturgeon, Rainbow smelt, Atlantic tomcod and American eel. These species are considered at risk as a result of their declining populations in the St. Lawrence Estuary; this may not apply to the populations in the study area, whose status is not known.

Of the *priority bird species*, two are migrants (Peregrine falcon and Loggerhead shrike), one is a probable breeder (Blue-winged teal) and one a confirmed breeder (Harlequin duck). With regard to the Harlequin duck, the population in Eastern Canada is designated as endangered because it is considerably reduced and vulnerable to toxic substances. Hunting of this species has been banned in Quebec since 1990. The decline in the Blue-winged teal population has been linked to a loss of nesting habitat and overhunting in Mexico during the winter.

The four *priority marine mammal species* that frequent the study area are the Harbour porpoise, the Fin whale, the Harbour seal and the Beluga whale. Harbour porpoises are abundant in the Gulf, but a large number die every year after becoming entangled in fishing nets. While the Fin whale population is recovering, Harbour seal populations in the Gulf have been declining since the 1970s as a result of disturbance from human activities and the species' sensitivity to toxic substances. The Beluga frequents the western part of the study area only occasionally in winter, and though it is endangered, it is not considered a priority species in the study area.

3.7 Land Use

In 1991, 33 000 people lived in the 15 riverside municipalities in the study area (including Gaspé), which cover an area of 2850 km^2 (Figure 9). Aside from the town of Gaspé, much of whose territory is not included in the sector, Sainte-Anne-des-Monts is the only municipality with over 5000 residents (pop. 5652). In the easternmost and westernmost parts of the sector, shoreline areas are devoted to urban and rural uses, while the rest of the territory is mainly forest land. The only riverside areas that are protected under federal, provincial or municipal acts and regulations are Forillon National Park and three provincial wildlife habitats intended to protect coastal concentrations of seabirds, near Capucins, Sainte-Anne-des-Monts and Cap-des-Rosiers.

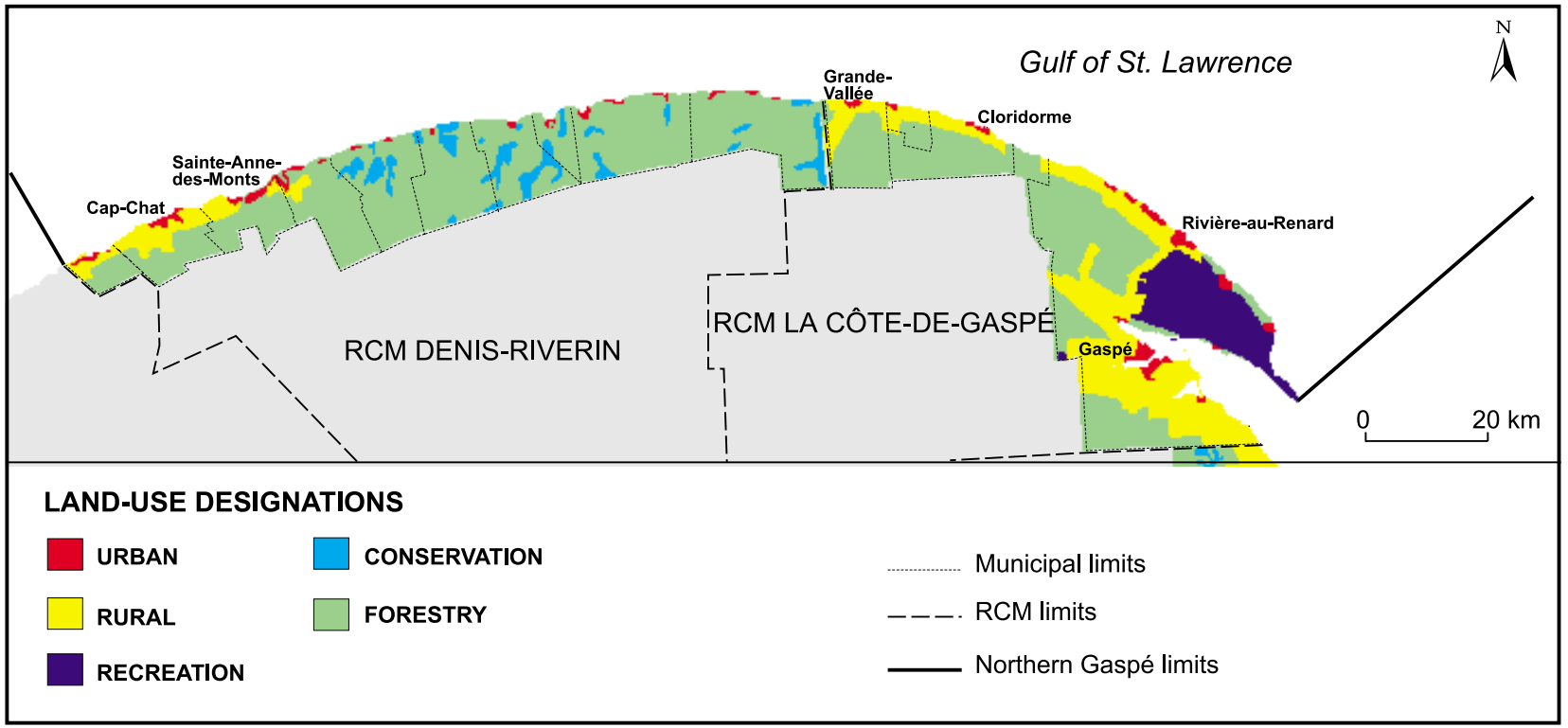
3.8 Developed Uses

3.8.1 Hydro-electric production and water supply

None of the rivers in the study area have been harnessed to produce hydro-electricity. In addition, none of the municipalities or industries, with the exception of a few seafood processing plants, draw water from the marine environment. Groundwater use by the municipalities of Cap-Chat and Sainte-Anne-des-Monts totalled 1109 and 7200 m^3 per day, respectively, in 1994. The town of Gaspé drew part of its water (7269 m^3 per day in all) from a lake.

3.8.2 Commercial shipping and port activities

Two ports in the study area are used for commercial activities: Sainte-Anne-des-Monts (5200 tonnes transshipped in 1993) and Mont-Louis (43 200 tonnes transshipped in 1993). Beginning in 1994, ferry service linked the shores of the Gaspé (Rivière-au-Renard), Anticosti Island (Port-Menier) and the North Shore (Havre-Saint-Pierre). This service has since been discontinued.



Source: RCM Denis-Riverin, 1986; RCM La Côte-de-Gaspé, 1987.

Figure 9 Major land-use patterns in the RCMs in the Northern Gaspé

3.8.3 Harvesting of biological resources for commercial and subsistence purposes

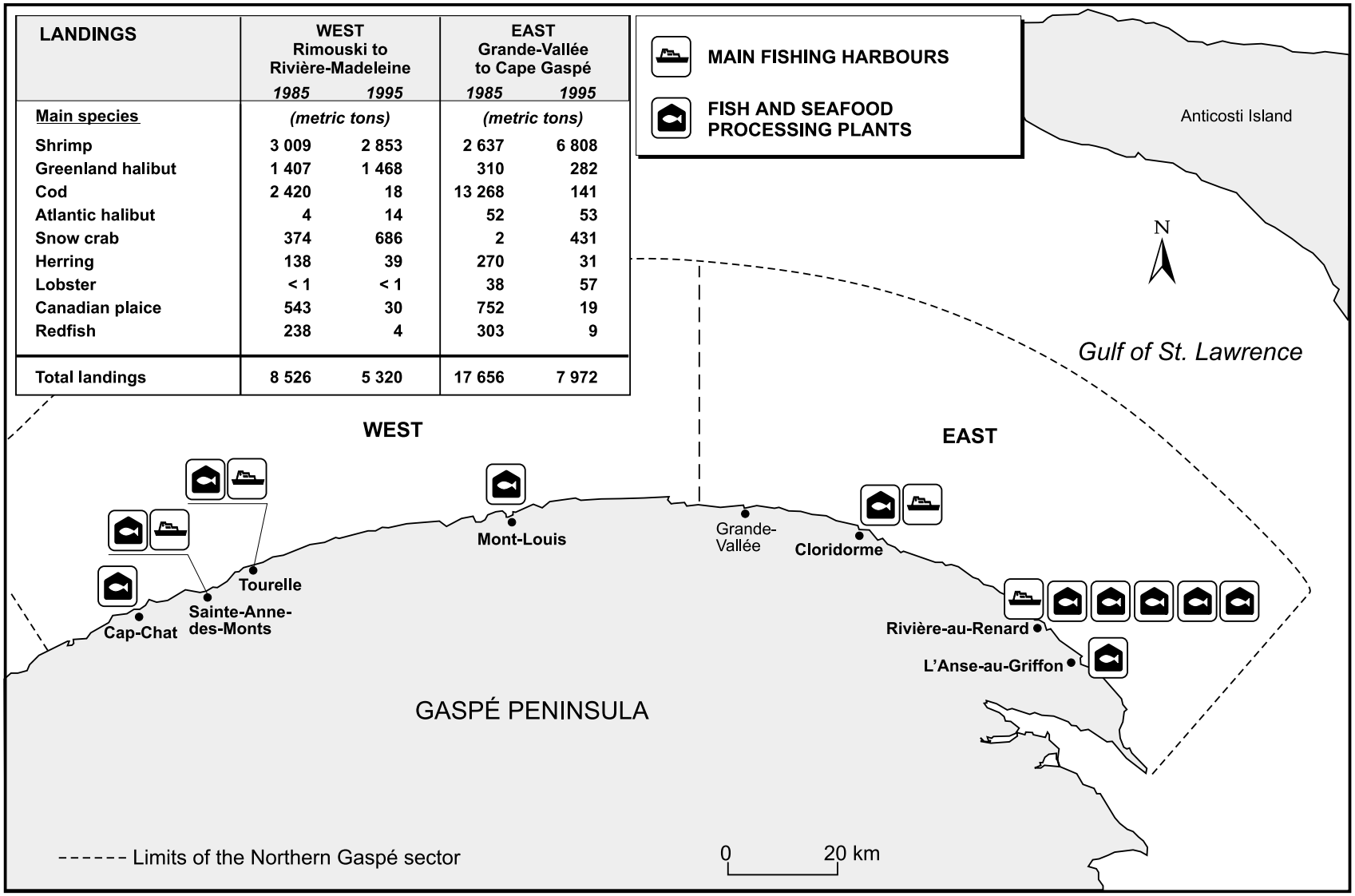
Commercial fishing. The marine environment in the Northern Gaspé is not an important commercial fishing area. Nonetheless, several major fishing harbours and seafood processing plants are located there (Figure 10). Rivière-au-Renard (municipality of Gaspé) is one of the two main fishing harbours in Quebec in terms of landed volume. The other large fishing harbours are Sainte-Anne-des-Monts, Tourelle and Cloridorme.

In the western part of the study area, the fishing industry has long depended on the harvest of Northern shrimp and Greenland halibut. In the eastern part, however, the industry was much more diversified and was hit harder by the collapse of the groundfish populations in the Gulf (cod, Canadian plaice, hake and redfish). Although the landed volume of groundfish other than Greenland halibut dropped by 98% between 1985 and 1995 in the western sector, the total volume of landings declined by only 38% and landed value rose by 77% during the same period. In the eastern area, landings of groundfish other than Greenland halibut fell by 98%; total landings decreased by 55% and their value increased by only 51% between 1985 and 1995.

The current status of this economic sector can be summarized as follows: *1)* traditional resources are either in poor condition or are still being harvested at a maximum rate; *2)* overcapacity exists in both the harvesting and processing sectors; *3)* fishing is not a profitable activity for a large number of fishers; *4)* fishers and processing plant workers are undereducated and highly dependent on government transfers; *5)* the population of fishers is ageing considerably; and *6)* the state of public finances no longer allows for substantial government support.

Other types of harvesting. There are no aquaculture operations or Aboriginal food fisheries, nor are benthic seaweeds harvested or marine mammals hunted in the study area.

LANDINGS	WEST Rimouski to Rivière-Madeleine		EAST Grande-Vallée to Cape Gaspé	
	1985	*1995*	*1985*	*1995*
Main species	*(metric tons)*		*(metric tons)*	
Shrimp	3 009	2 853	2 637	6 808
Greenland halibut	1 407	1 468	310	282
Cod	2 420	18	13 268	141
Atlantic halibut	4	14	52	53
Snow crab	374	686	2	431
Herring	138	39	270	31
Lobster	< 1	< 1	38	57
Canadian plaice	543	30	752	19
Redfish	238	4	303	9
Total landings	8 526	5 320	17 656	7 972



Source: DFO, 1985; 1996.

Figure 10 Landings of the main fishery resources at Northern Gaspé harbours, and location of the main fishing harbours and seafood processing plants in the study area

3.8.4 Recreational and tourist activities

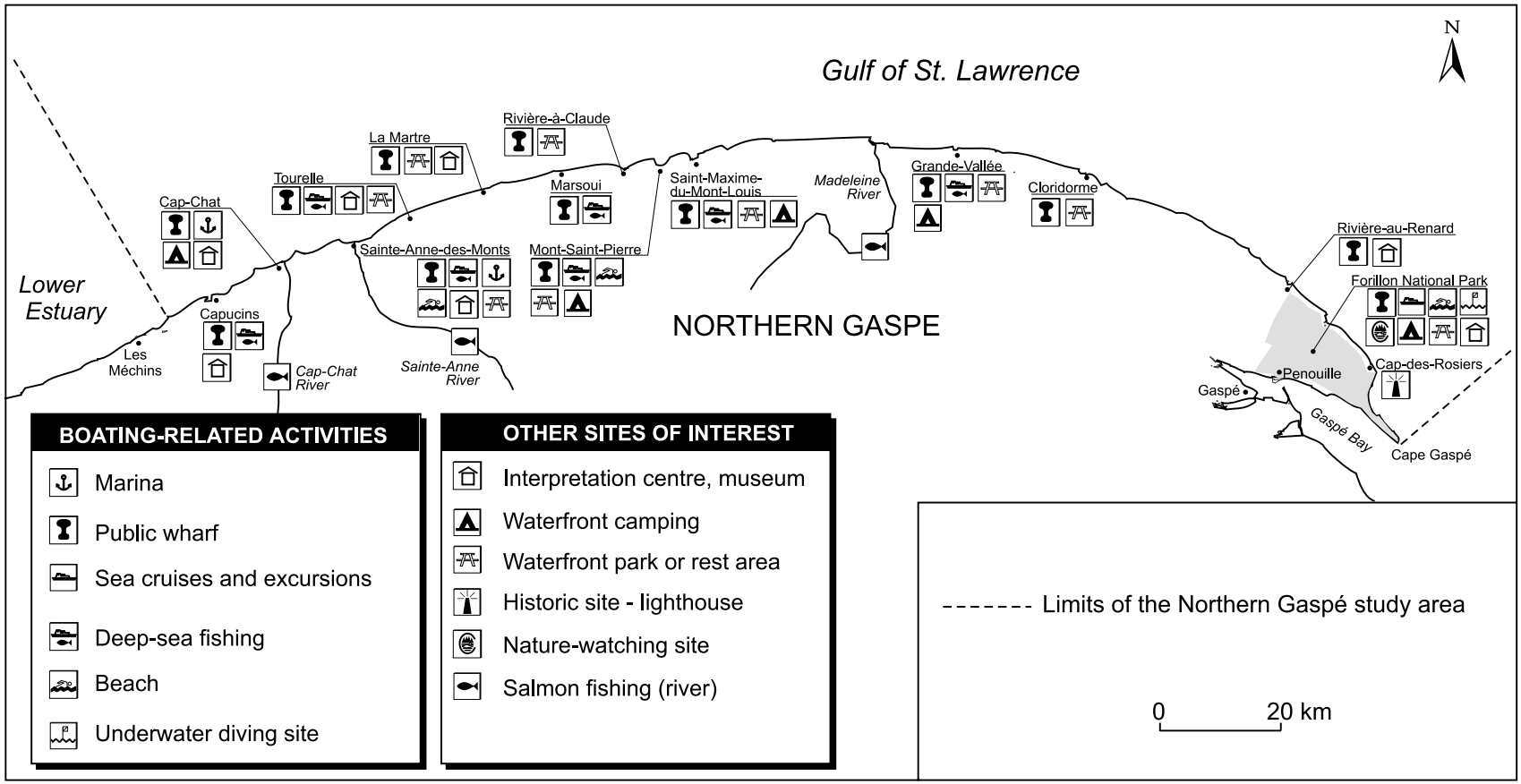
The Gaspé has long been recognized as a popular spot for tourists and cottagers. Every year, nearly 500 000 visitors tour the Gaspé and use its accommodation and recreational and tourism facilities.

Access to the shoreline. In general, the sector has the most accessible shorelines in the maritime region of Quebec, since most of Highway 132 runs directly along the shore. This highway offers magnificent panoramas of the marine and coastal landscapes, together with direct access to a number of roadside rest areas, fishing harbours, beaches and riverside parks (Figure 11).

Accommodations and resorts. Accommodation infrastructures are concentrated in the western- and easternmost parts of the sector (Cap-Chat–Sainte-Anne-des-Monts region in the west, Gaspé region in the east). The total accommodation capacity is 703 rooms in various establishments (1401 including the municipality of Gaspé), 787 camping sites and 584 secondary cottages (932 including the municipality of Gaspé).

Swimming and windsurfing. None of the beaches in the study area was part of the MEF's beach environment program in 1996. The extent to which beaches there are used is not known. Swimming is not a very popular activity in the region owing to the cold water temperatures (maximum of 12 to 15ºC, depending on the location).

Nature and marine heritage interpretative facilities. Forillon National Park is a focal point for these types of interpretation activities. Visitor attendance there ranges from 160 000 to over 200 000 people annually. The park offers a number of interpretation activities focusing on the marine fauna, bird colonies, cliffs and marine heritage. There are interpretation centres at several locations: Capucins (Centre d'interprétation de la Baie-de-les-Capucins), Cap-Chat (interpretation of wind and sea), Sainte-Anne-des-Monts (sea "explorama"), Tourelle (traditional fishing centre), La Martre (exhibit on lighthouses) and Rivière-au-Renard (contemporary fishery interpretation centre).



Source: Gaspé Regional Tourism Association, 1995; Québec Yachting, 1995.

Figure 11 Boating and recreational activities in the Northern Gaspé

Sport fishing. From 1990 to 1994, sport fishers caught 963 salmon per year, on average, in three of the salmon rivers in the study area, representing an annual fishing effort of more than 2900 fishing days. The Sainte-Anne River is the most used river, followed closely by the Madeleine River. After a sharp drop in 1991 and 1992, sport fishing on the three rivers reached a record high level of 3400 fishing days in 1995.

Fishing for smelt and mackerel from wharfs is a popular, albeit declining, activity in the study area. Mackerel and especially cod can also be caught during deep-sea fishing trips that leave from Capucins, Sainte-Anne-des-Monts, Tourelle, Marsoui, Mont-Saint-Pierre, Grande-Vallée and Forillon. Two of the largest companies running this type of operation had nearly 4000 clients per year in the early 1990s. There are no known Rainbow smelt icefishing areas in the study area.

Waterfowl hunting. There are no recent data on waterfowl hunting in the study area. From 1977 to 1981, 6900 geese and ducks were taken annually in the Gaspé (excluding Chaleur Bay). This corresponds to less than 2% of all birds taken along the St. Lawrence downstream from Cornwall. The main species taken are Black duck, Green-winged teal and Canada goose.

Birdwatching. The primary sites for birdwatchers are Capucins Bay, Cap-Chat, Goémon and Sainte-Anne points, the coastline between Rivière-à-Claude and Anse-Pleureuse, Gros-Morne Cape, Cap-des-Rosiers and Cape Gaspé (Forillon National Park). There is a Gaspé region birdwatching club.

Boating. The only marina in the Northern Gaspé is at Sainte-Anne-des-Monts harbour (42 moorings, including wharfside). However, there are about 20 small craft harbours and wharfs, used mainly by fishers, and many boat launching ramps along the coast.

Boat tours. In the vicinity of Forillon National Park, three companies run scenic boat tours of the coastal scenery and bird and marine-mammal watching operations. A number of other operators located between Capucins and Grande-Vallée provide offshore fishing trips.

Deep-sea diving. There is a deep-sea diving service at Cap-aux-Os (Gaspé). It is situated near the main deep-sea diving site in the region (Cape Gaspé).

CHAPTER 4 Human Activities and their Main Effects on the Environment

4.1 Physical Modifications

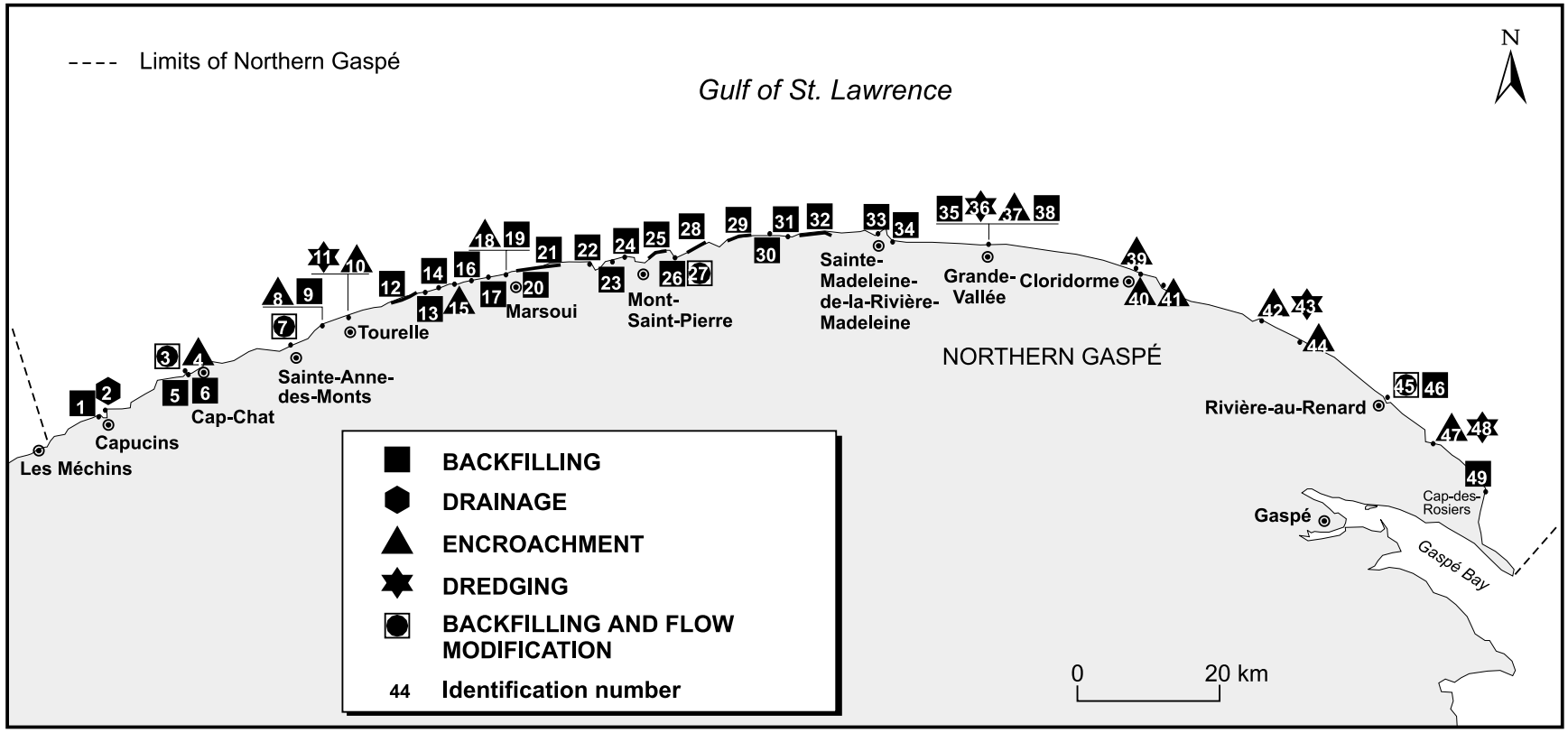
This section describes the changes in the physical characteristics of the water (i.e. temperature, salinity, suspended sediments, circulation), seabed (bathymetry, sediment grain size) and shoreline (geomorphology) caused by human activities in the study area.

Large-scale changes. The construction of hydro-electric dams in the St. Lawrence basin has substantially reduced freshwater inputs into the Gulf during spring runoff (June) and increased them in the winter. Because of a lack of oceanographic data covering the first half of the 20th century, the impact of harnessing the St. Lawrence River on the Gulf's marine environment is not known.

Since the late 1980s, the Gulf of St. Lawrence and a large part of the Canadian Atlantic coast have experienced marked climate cooling, resulting in a major increase in the extent and duration of ice cover in winter and a cooling of the cold intermediate layer in the Chaleur trench and the other trenches of the Magdalen Shelf. Although the relationship between this cooling and the flora and fauna is not yet well established, specialists believe that these abnormal conditions may have affected some populations of invertebrates and fish, especially cod, by altering their distribution and migration patterns, curbing the growth of individuals, and increasing mortalities of eggs, larvae and even adults.

Local changes. Between 1945 and 1988, 900 hectares (ha) of shoreline habitat in the study area were physically altered, with impacts ranging from changes in the current regime to loss of such habitat through filling (Figure 12). This figure does not include the infralittoral and circalittoral zones disturbed by the disposal of dredged material or the use of mobile fishing gear.

Filling, particularly to build and repair Highway 132 between Tourelle and Rivière-Madeleine, is the main cause of these disturbances (848 ha). The habitats lost to filling were mainly rocky shores (785 ha).



INITIAL HABITATS. **Swamp**: sites 1. **Salt marsh**: site 34. **Mudflats**: sites 2, 36. **Sandy-gravelly shores**: sites 6, 15, 18, 19, 41 to 46. **Rocky shores**: sites 7, 8, 10 to 12, 14, 16, 17, 20 to 33, 35, 39. **River estuaries:** sites 3 to 5, 9, 13, 37, 38, 40, 47 to 49.

Source: Marquis et al., 1991.

Figure 12 Coastal sites in the Northern Gaspé that were physically altered between 1945 and 1988

Commercial ports and fishing harbours in the area must be dredged on a regular basis to maintain an adequate depth for boats. From 1985 to 1994, 22 sites were dredged at least once. The main dredging sites and offshore dredge disposal zones during the period were at Cap-Chat (28 300 m^3 total), Anse-au-Griffon (25 200 m^3), Tourelle (21 500 m^3), Rivière-au-Renard (14 300 m^3) and Marsoui (13 800 m^3). Dredging volumes in the area have declined greatly since 1990.

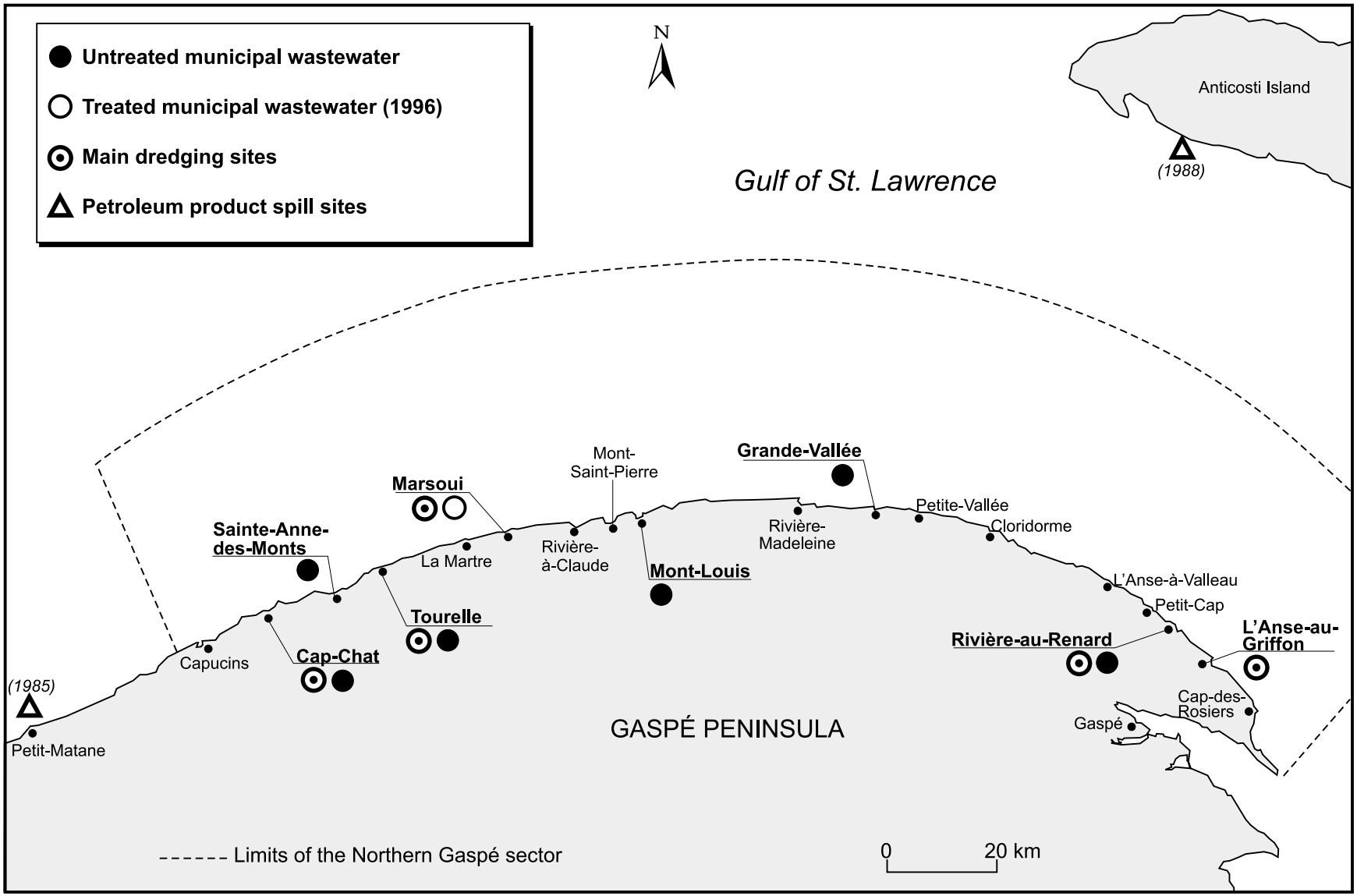
4.2 Pollution

The terms “contamination” and “pollution” do not mean the same thing. When the concentration of a substance in water, sediment or living organisms is higher than the naturally occurring background level, this constitutes contamination of the environment or aquatic organisms. Only when the concentration reaches a level where living organisms or developed uses are adversely affected is the term “pollution” used.

Some contaminants such as easily degradable organic matter, bacteria and nutrients (nitrates and phosphates) are not persistent, and environmental quality improves rapidly with distance from the discharge point, as it does when releases of those pollutants cease. However, other contaminants that are persistent in the environment are transported over great distances in the drainage basin or the atmosphere and tend to accumulate in sediments and living organisms. These include polychlorinated biphenyls (PCBs), organochlorine pesticides (DDT, dieldrin and mirex), polycyclic aromatic hydrocarbons (PAHs), dioxins, furans and mercury.

4.2.1 Main sources of contamination

Sources of contamination can be divided into two broad categories: local sources and distant sources. *Local sources* are found in the riverside municipalities of the study area, in the watersheds of tributaries or in the water (dredging, shipping) (Figure 13). The pathways through which contaminants reach the study area from *distant sources* are the currents (water inputs), atmospheric deposition and migratory fish. These chemical substances persist in the environment.



Source: Bibeault et al., 1997.

Figure 13 Main existing and potential sources of contamination of the marine environment in the Northern Gaspé

4.2.1.1 Local sources

Municipal wastewater. As of September 30, 1996, of the 15 riverside municipalities in the Northern Gaspé, Marsoui was the only one discharging its wastewater to a treatment facility. This means that only 1.4% of the total population in the municipalities, including Gaspé, was served by a treatment plant. By December 1998, two additional plants will be brought on stream in the municipality of Gaspé (including one in the Rivière-au-Renard district), providing wastewater treatment for 25.5% of the total population of waterfront municipalities. Those municipalities equipped with sewer systems and yet not treating their wastewater in 1998 are, in order of size, Sainte-Anne-des-Monts, Cap-Chat, Mont-Louis, Tourelle and Grande-Vallée. In the riverside municipalities, a variable percentage of the population discharges its wastewater into septic tanks and cesspits which, if not properly maintained, can constitute sources of contamination for the marine environment.

In 1994, the performance of the facility at Marsoui, which uses aerated ponds to treat wastewater, was assessed. Standards for BOD_5 were not respected, but those for fecal coliform bacteria and percentage of overflows during dry weather were. Aerated ponds generally eliminate nearly 90% of the BOD_5 and SS loads in effluents. Overflows can, however, constitute major sources of contamination for the aquatic environment following heavy rainfall.

Industrial wastewater. There are no industries targeted under the provincial and joint federal-provincial industrial discharge abatement programs in the study area. Seafood processing plants are the primary potential sources of organic waste discharges in the study area; No data are available, however, on contaminant loads discharged to the sea by these plants. Discharges of this type are subject to the environmental assessment requirement set out in Part IV of the *Canadian Environmental Protection Act.*

Hazardous waste sites. The only hazardous waste disposal sites located on or near the shoreline that were officially listed by the provincial and federal governments in the 1980s were the dump at the Cape Gaspé lighthouse, which contained used oil, and a site at Forillon National Park that has hydrocarbon-contaminated soil owing to leaks from above- and underground storage tanks. These two sites do not pose a direct threat to the marine environment.

Shipping and port activities. Shipping represents a potential source of pollution from marine accidents, ballast flushing and the discharging of hold contents directly into the sea, as well as from the transshipment and storage of goods at port.

The waters off the north shore of the Gaspé are an important national and international transport route. Several thousand vessels pass through the area every year. In recent decades, there have been no serious spills of toxic substances near the coasts in the study area, although there have been major oil spills on its periphery, along the shores of Anticosti Island (*Rio Orinoco* in 1989) and off Matane (*Pointe-Levy* barge in 1985). Accidental spills of toxic substances are a much more frequent occurrence during transshipment operations in port.

Busy ports and marinas are sites that are likely to be contaminated with organo-tins. These highly toxic compounds come from the antifouling paints used on the hulls of boats and submerged port infrastructures. The creosote-treated wood used in some wharfs is a source of PAH contamination.

Dredging. Maintenance dredging of ports, fishing harbours and marinas can contribute to contamination by resuspending toxic substances that would otherwise remain isolated from the aquatic environment in deep sediment layers, or confined to sites away from general circulation. A considerable amount of dredged material has been deposited offshore in the study area. In most cases, the sediment dumped at these sites is moderately contaminated with heavy metals. Dredging operations declined steadily during the period 1985–1994.

Agriculture. Coastal sites can become contaminated through inputs of organic matter, fertilizers, bacteria and toxic substances (pesticides) from agricultural activities. In 1991, 67 farmers had a total of 1744 ha of land under cultivation in the riverside municipalities, primarily in the Cap-Chat and Gaspé areas. From 1981 to 1991, the cultivated acreages decreased by 26%, and the area of land treated with chemical fertilizers by 40%. However, the area of land exposed to pesticide use increased more than fivefold between 1986 and 1991. Dairy farming and livestock production are very limited in the study area.

Forestry. The backcountry forests are regularly sprayed with insectides (to control spruce budworms and other insect pests), and with herbicides to optimize the harvest of selected

tree species for the pulp and paper industry. Fenitrothion, a chemical insecticide that is not very persistent, is being used less and less, whereas the biological insecticide, *Bacillus thuringiensis*, is coming into ever greater use. DDT is a highly persistent chemical insecticide that was used until the mid-1970s; its degradation product, DDE, can still be found in the local fauna (see Section 4.2.2.3).

4.2.1.2 *Distant sources*

Contaminants from distant sources are persistent chemical substances that are transported to the Gulf through three main pathways: the water, the atmosphere and migratory fish.

Water inputs. The Gaspé Current carries all the fresh water from the Great Lakes Basin, the St. Lawrence River, the Estuary and the Saguenay River toward the southern Gulf of St. Lawrence. Although for many decades large quantities of persistent toxic substances were discharged into the freshwater rivers draining the surrounding regions, only a small fraction of the substances reached the Gulf. The Great Lakes, the Saguenay Fjord and the Lower Estuary of the St. Lawrence are natural sinks in which a very large portion of the fine sediments to which toxic substances adhere are deposited. For example, it is estimated that, between 1950 and 1990, only 3% of the mirex (an organochlorine pesticide) discharged into the Great Lakes was transported all the way to the Gulf of St. Lawrence and that the amount of PCBs that settled out in the Lower Estuary is 100 times greater than the quantity in the entire Gulf. In the case of most toxic substances, particularly mercury, lead, PCBs and DDT, inputs from the Great Lakes and the St. Lawrence have declined since the 1970s.

Atmospheric inputs. Atmospheric inputs from vapour and precipitation in the Gulf of St. Lawrence are a major source, if not the main source, of several toxic contaminants, notably mercury, lead, PCBs, PAHs, dioxins and furans, found in the sediments of the Laurentian Channel downstream from Pointe-des-Monts.

Migratory fish. The eels that migrate toward the Atlantic Ocean in the fall represent a major pathway for the transportation of toxic substances from the upper basin of the St.

Lawrence. Eels that swim downstream from Lake Ontario are heavily contaminated with PCBs, DDT, mirex and mercury. The migration of these eels is a primary mechanism for mercury transport to the Gulf. Although the contamination level of eels from Lake Ontario has decreased considerably over the past 10 years or so, it still remains high.

4.2.2 Effects of contaminants on resources and uses

The criteria and guidelines that can be used to determine to what extent contaminants found 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 the water*

Data on the contamination of water by toxic substances in the study area are virtually non-existent. In other regions of the Gulf, measured concentrations are typical of coastal waters that receive terrigenous inputs and do not exceed the most stringent water quality criteria established for the most worrisome substances.

Contamination of water in the Gulf by oil residues was monitored from 1971 to 1979. In general, pollution by oil residues decreased by 25 to 30% during this period. Before the mid-1970s, the main sources of oil residues in the Gulf were associated with shipping (accidental spills and ballast tank flushing). The various measures adopted to reduce oil spills and discharges definitely helped to reduce this type of pollution significantly because, in the 1980s, the contamination level was comparable to that reported for other environments in the northwest Atlantic and in northern Canada. At present, atmospheric deposition appears to be the main source of oil residues in the study area.

Bacteriological analyses of water quality were conducted at about ten coastal sites to determine the salubrity and safety of shellfish beds. In 1997, shellfish harvesting was banned at these sites because of the poor bacteriological quality of the water, with the exception of two areas located near Cap-des-Rosiers. The main contaminant sources are municipal wastewater, isolated homes, fishing harbours, campgrounds and nonpoint sources.

4.2.2.2 *Contamination of sediments*

Sediments are considered contaminated when they contain heavy metals or certain organic compounds (PAHs, for example) in quantities exceeding the naturally occurring, pre-industrial levels of those substances. The concentrations become cause for concern when they are high enough to harm organisms living in or near sediments and dependent on them for their survival. This is 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 in four categories:

- Uncontaminated: the concentrations are below the NET.
- Slightly contaminated: the levels lie between the NET and the MET.
- Moderately contaminated: the levels are between the MET and the TET.
- Heavily contaminated: the concentrations are higher than the TET.

Bottom of the Laurentian Channel. The silty sediments at the bottom of the Laurentian Channel off the north shore of the Gaspé are moderately contaminated with mercury, chromium and arsenic and somewhat or not at all contaminated with cadmium, lead, nickel, zinc, copper, DDT, mirex, PCBs, PAHs, dioxins and furans. For most of these substances, the observed contamination level is much lower than in the Lower Estuary, where a large percentage of the inputs from the St. Lawrence River are deposited.

Analyses of sediment cores from the Lower Estuary and the eastern Gulf of St. Lawrence showed that contamination of Laurentian Channel sediments by mercury, lead, zinc, copper, DDT, PCBs, dioxins and furans has declined over the past few decades. However, PAH inputs appear to be constant and come above all from naturally occurring phenomena such as forest fires.

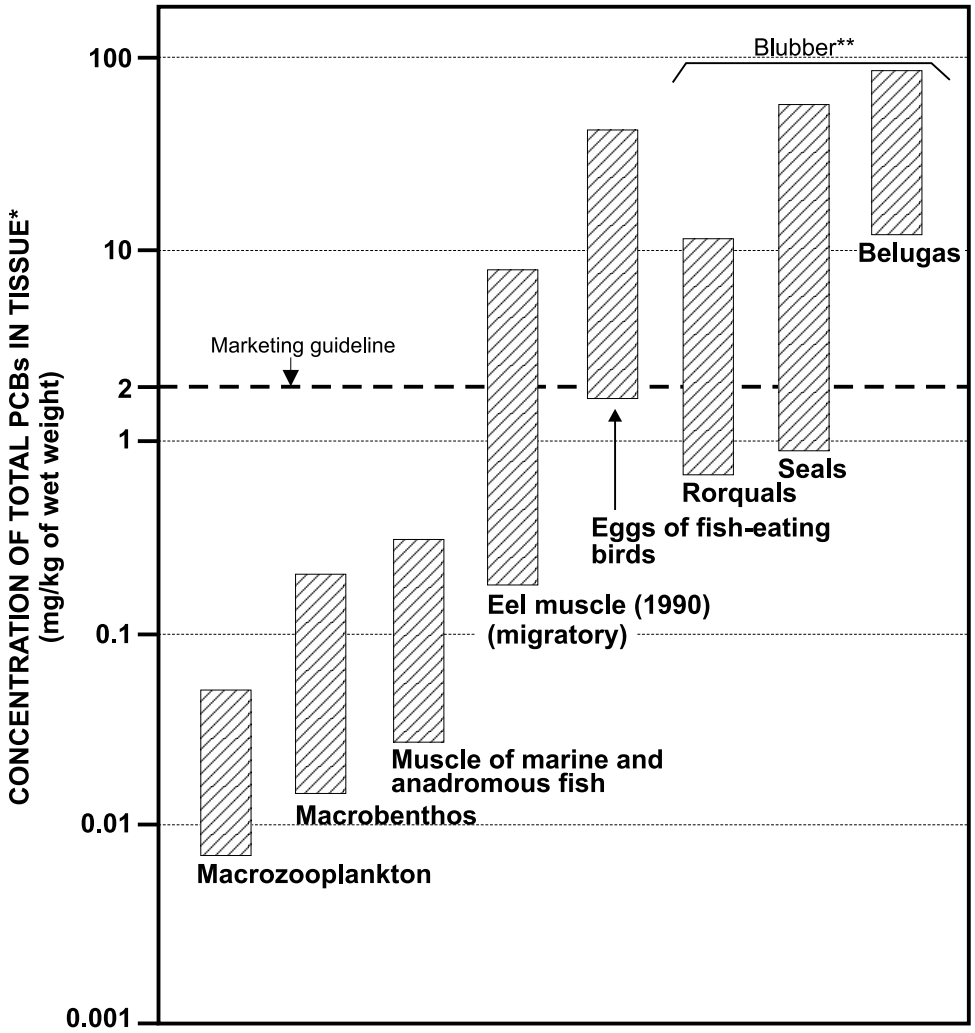
Slope of the Laurentian Channel. No recent data are available on contamination of the slope of the Laurentian Channel. Data from 1961 to 1973, the period when channel sediments

had the highest contaminant levels, show that the upper layer of sediment was not severely contaminated with heavy metals (Hg, Cd, Ni, Zn, Pb, Cu).

Coastal zones. Sediment quality in many of the harbours and ports in the sector was evaluated during the 1980s and 1990s during environmental screenings of proposed dredging operations. Sediments heavily contaminated with nickel were found at Cap-Chat (1987), Rivière-à-Claude (1992), Marsoui (1992) and Anse-à-Valleau (1992), whereas the sediments in Rivière-au-Renard harbour were heavily polluted with copper (1986) and sediments at Cloridorme (1985) with cadmium.

4.2.2.3 *Contamination of the food chain*

Aquatic organisms tend to accumulate certain toxic substances in their body tissues at concentrations much higher than those found in the ambient water and sediments (*bioconcentration*). *Bioaccumulation* of a contaminant occurs when the rate of assimilation of the substance exceeds the rate of elimination. Hence, concentrations of the contaminant in an organism's tissues increase as it grows older. Since most aquatic organisms, except for shellfish, are able to regulate the heavy metal concentrations (except for mercury) in their bodies and also quickly metabolize PAHs, 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 become concentrated at every level of the food chain, thus reaching much higher levels in vertebrates than in invertebrates. This phenomenon, called *biomagnification*, has been documented for the St. Lawrence Estuary food chain with respect to PCBs, mirex and mercury. For example, PCB levels are 100–1000 times higher in the blubber of Harbour seals than they are in benthic or planktonic invertebrates living in the same environment (Figure 14).



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

* The figure shows the scope of concentrations measured in organisms in the Estuary and Gulf.

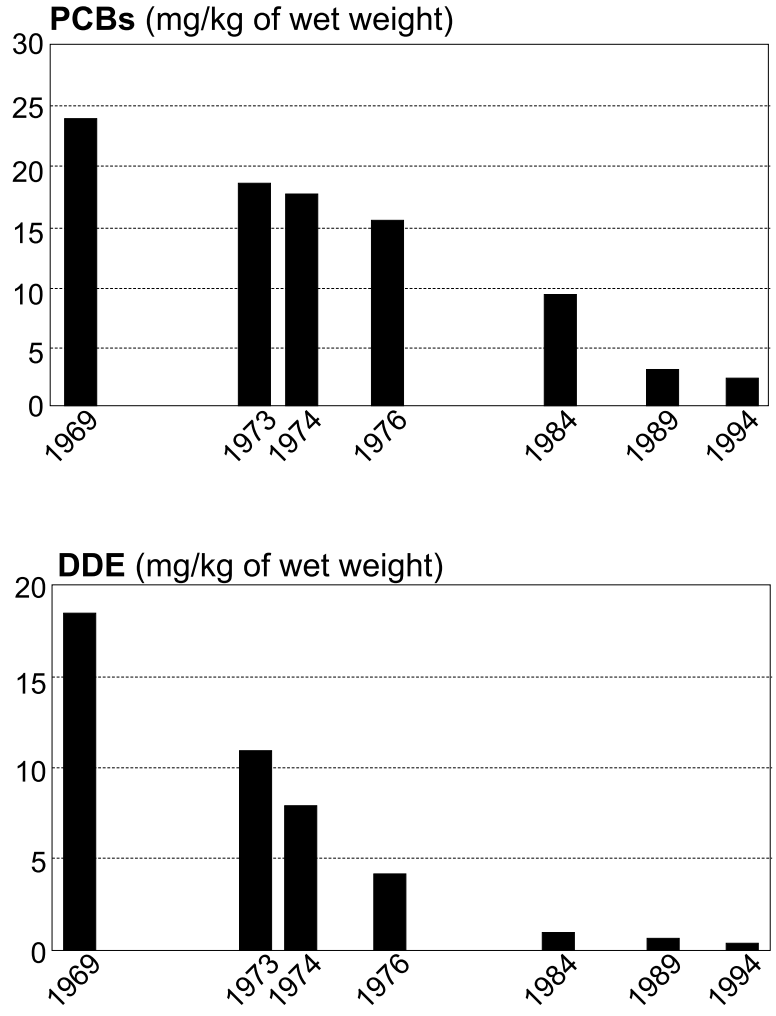
** Concentrations of PCBs are much higher in blubber than in muscle.

Figure 14 Biomagnification of PCBs in the food chain of the Gulf of St. Lawrence and St. Lawrence Estuary

The extent to which marine organisms are contaminated with biomagnified substances depends on their trophic position and the time they spend in contaminated areas. For example, Fin whales are much less contaminated than are Harbour seals because they feed primarily on herbivores (euphausiids) and they frequent the Gulf only in summer, whereas Harbour seals eat mainly carnivorous organisms (fish) and live in the Gulf year-round.

Invertebrates and fish. The available data indicate that invertebrates and fish in the Gulf of St. Lawrence do not contain toxic substance loads exceeding the established marketing guidelines. However, fish-eating birds and marine mammals, especially seals and toothed whales, are much more highly contaminated owing to the phenomenon of biomagnification.

Birds. Overall, the level of contamination of seabird eggs in the Gulf is three times lower than that of the Great Lakes and comparable to the level found on the Canadian Atlantic coast. Contamination from heavy metals is moderate and has no apparent effects on the health of birds. Contamination from organochlorines, however, is more worrisome. Monitoring of Northern gannet eggs on Bonaventure Island, a colony near the easternmost limit of the study area, revealed particularly high concentrations of PCBs and DDE (a derivative of DDT) in the eggs in the late 1960s, followed by a rapid decline in the case of DDE, and a somewhat slower decline for PCBs (Figure 15). The period in which high concentrations of organochlorines were found in the eggs coincided with eggshell thinning, a decreased hatch rate and a decline in the gannet population beginning in 1966. The decrease in contamination of eggs coincided with a significant increase in the hatch rate and the growth of the gannet population, which, by 1984, had recovered to its 1966 level, and has since continued to expand. The low hatch rate was associated with high concentrations of DDE. The elimination of DDT in forest spraying programs aimed at eradicating the spruce budworm greatly decreased DDE inputs to the marine environment in the study area.



Source: Adapted from Noble, 1990, and CWS, 1997.

Figure 15 Temporal trends in PCB and DDE concentrations in the eggs of Northern gannets on Bonaventure Island from 1969 to 1994

The lead shot used in hunting rifle shells is a major source of contamination in seabirds that frequent intensive hunting areas. These pellets are ingested by bottom-feeding geese and ducks and can cause serious lead poisoning (saturnism). The use of nontoxic shot has been compulsory within 200 m of a water body since 1997 and will become mandatory throughout Quebec as of 1998.

Marine mammals. Only sketchy data are available on the contamination of marine mammals in the study area. Overall, seals and Harbour porpoises in the Gulf are more highly contaminated from toxic substances than are whales (rorquals), but less contaminated than St. Lawrence belugas. However, many pathologies identified in the belugas have not been observed in other species.

Among Harp seals in the Gulf, which seldom or never visit the study area, DDT concentrations in blubber have fallen markedly since the 1970s, while PCB concentrations have decreased 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 the north shore of the Gaspé in the 1920s to 1940s. The species' expansion is believed to have been favoured by abnormal water level fluctuations, ice scouring, shoreline alterations and livestock grazing. The plant is considered a veritable nuisance in some parts of Canada and the United States because it reduces the diversity of marshland plant communities.

Exotic organisms in ballast water. The ballast water of commercial ships may contain large numbers of planktonic and benthic organisms, and ballast discharging is a potential vector for introducing exotic species into the marine environment. Some introduced species can have harmful effects on the ecosystem, as is the case with the Zebra mussel in fresh water. Toxic

planktonic algae released in ballast water pose a serious threat for coastal areas and fishery resources.

4.4 Harvesting of Fishery Resources

Harvesting of fishery resources often tends to reduce the biomass of harvested populations and the average size of the individual fish taken. These normal phenomena do not jeopardize stocks as long as their potential for renewal is maintained. The decline in Gulf of St. Lawrence cod populations in the late 1980s and early 1990s has been attributed to the fact that the fishing effort was too high at a time when environmental conditions were particularly unfavourable for stock rebuilding. As a result, the reproductive potential of the cod populations was considerably reduced during the period. Other major resources in the area, such as Northern shrimp, Snow crab and Greenland halibut, are highly vulnerable to unfavourable oceanographic conditions at present because of the high harvest rate.

CHAPTER 5 Human Health Risks

The technical report on health issues is intended to raise awareness among users of the Gulf of St. Lawrence–Chaleur Bay area and riverside residents of the human health risks associated with using the water and resources of the Gulf and Chaleur Bay. In the present chapter, the report is summarized to address the specific needs of the Northern Gaspé population.

5.1 Consumption of Fish, Crustaceans and Molluscs

Chemical contamination. In general, fish, crustaceans and molluscs in the Gulf of St. Lawrence are not very contaminated by chemicals. Concentrations of most of the main contaminants investigated (mercury, PCBs, DDT, mirex, dioxins and furans) are below the guidelines set for marketing fish and seafood.

Several studies, including one conducted on fishers on the Lower North Shore, have nevertheless revealed that a population whose consumption of fish and seafood is high is more exposed to the contaminants present in these organisms than a population whose consumption is low.

This is confirmed by the data available on the uptake of contaminants by Northern Gaspé residents (assessment of exposure of newborns via the umbilical cord and breastfeeding). These data indicate that mercury uptake is higher than in the rest of Quebec, whereas the levels of lead, PCBs and DDE are comparable. Nonetheless, the rate of uptake remains well below the allowable levels. Health risk estimates for the population of the Lower North Shore tend to reveal that risks are low for the majority of residents. Since exposure of the Northern Gaspé population to mercury seems comparable to that of Lower North Shore residents and exposure to organochlorines seems to be lower, the health risks that these contaminants pose for the Northern Gaspé population can also be considered low.

The consumption of fish and seafood does not pose any risks. In addition to providing a good source of protein, vitamins, minerals and polyunsaturated fatty acids (particularly omega-

3s), fish and seafood offer some protection against certain diseases, particularly cardiovascular disorders. Moreover, for pregnant and nursing women, the fatty acids ensure the development of the nervous system in the fetus and child in the first few months of life.

Lastly, to minimize the quantity of organochlorines (PCBs, DDE, etc.) ingested, certain precautions can be taken when preparing fish. Since these substances tend to accumulate in the fat, it is best not to eat the skin, viscera or fatty parts of the fish, or the cooking juices.

Bacteriological contamination. Discharges of municipal wastewater, nonpoint-source agricultural pollution, cesspits, and the presence of seabirds can lead to bacteriological contamination of the water and, consequently, affect the quality of edible molluscs. Bacteriological contamination of the water at harvest sites is a major problem in the Gulf of St. Lawrence, especially in the Northern Gaspé region. In 1997, Cap-Bon-Ami was the only site that was open to harvesting during the summer. All the other harvesting areas were either closed or had conditional approval only.

The consumption of contaminated molluscs can cause digestive and intestinal problems. Since 1990, the Gaspé–Magdalen Islands Public Health Branch has reported five cases of poisoning related to the consumption of shellfish in the region. The extent of the problem nevertheless remains unknown because of under-reporting of intestinal problems, since most cases require neither a visit to the doctor nor hospitalization.

Molluscs should only be harvested in areas authorized by Fisheries and Oceans Canada. Using data collected through Environment Canada's *Shellfish Water Quality Protection Program*, the Department advises harvesters on shellfish safety at the various sites. Molluscs that are purchased do not pose any danger since they are systematically inspected.

As for bacteriological and parasitic contamination in fish, most parasites pose no threat to human health. The following preventive measures are recommended, however: avoid eating the skin and viscera and cook the flesh thoroughly. These precautions eliminate the risk of microbiological and parasitic contamination. It is also recommended that fish with obvious external anomalies (e.g. ulcers, growths on the skin, injuries, etc.) not be eaten.

Contamination by toxic algae. The microscopic alga *Alexandrium* sp. (the main species of toxic algae found in the Gulf) produces a biotoxin that, when ingested by humans, can cause serious symptoms of poisoning (called paralytic shellfish poisoning, PSP), and even death. The toxin is transmitted to humans when they eat contaminated bivalve molluscs (Softshell clams and mussels), although the molluscs themselves are not affected by the toxin. This toxin is also found in the hepatopancreas of lobster (tomalley), as well as the liver of cod, mackerel and other fish that inhabit the Gulf.

This alga occurs in nearly all areas of the Gulf of St. Lawrence. The Northern Gaspé is the region most affected by toxic algae. Biotoxin concentrations exceeding the allowable level of toxicity are often detected in local molluscs, particularly between May and November. As mentioned above, five cases of poisoning linked to toxic shellfish consumption have been reported in the Gaspé since 1990.

The best way to avoid health problems is to comply with the restrictions on shellfish harvesting imposed by Fisheries and Oceans Canada. To avoid ingesting the biotoxins potentially contained in lobster, the Department advises that not more than two hepatopancreases be eaten per day. The concentrations in fish liver, however, are too small to constitute a health hazard and the toxin is not present in the flesh. Cooking does not completely eliminate the toxin.

5.2 Seaweed Consumption

There is no commercial harvest of edible seaweed in the Gulf of St. Lawrence region. However, seaweed is harvested for personal consumption and for use in local restaurants.

A study conducted on seaweed samples collected in the Gulf of St. Lawrence and the St. Lawrence Estuary, including two sampling stations in the Northern Gaspé (Sainte-Anne-des-Monts and Gaspé), showed the presence of several organic and inorganic contaminants. However, the levels observed were generally quite low and often below the detection threshold. Only the presence of iodine and cadmium in certain seaweed species could potentially pose a human health

risk if large quantities were consumed. Soaking and cooking the seaweed in water reduces the concentrations of iodine.

5.3 Waterfowl Consumption

On the basis of samples taken nationwide by the Canadian Wildlife Service, Health Canada has determined that the health risks associated with eating waterfowl meat are negligible. The concentrations of contaminants analysed in the various aquatic bird samples were generally low or below the detection threshold. It is nevertheless possible to reduce exposure to organochlorines to a minimum by using cooking methods that eliminate as much fat as possible, particularly in the case of fish-eating birds. Moreover, it is recommended that any lead shot in the flesh be removed.

The parasites found in waterfowl generally pose no risk to health. However, the meat should be cooked thoroughly to eliminate any risk of parasitic or microbiological contamination.

5.4 Recreational and Commercial Activities

5.4.1 Risks related to poor water quality

The bacteriological quality of the water at sites used for recreation in the Northern Gaspé region is highly variable. In 1992, a study on the water quality at several beaches in the area showed that, on at least one occasion in the summer, water quality at most of the sites was mediocre or polluted. The absence of wastewater treatment systems in riverside municipalities is likely the main cause of the pollution. Potential sources of contamination such as a polluted watercourse or sewage outfall were detected at all the sites where the beach water was found to be polluted or of mediocre quality.

The presence of pathogenic bacteria in water used for recreational purposes (swimming, windsurfing, water skiing, and personal watercraft use) can cause health problems such as dermatitis, ear infections, conjunctivitis and gastroenteritis.

Since only recent and regular analyses definitely show whether the water at a given site poses a danger for users, practising recreational activities in the Gulf is risky. Before practising a sport involving direct water contact, users should check whether the water quality is good by contacting local authorities (Ministère de l'Environnement et de la Faune, Public Health Branch, municipalities). Signs prohibiting shellfish harvesting and the proximity of a sanitary or storm sewer are possible indications of poor water quality. Caution should be exercised under these circumstances.

5.4.2 Risks related to physical dangers in the area

Swimming. For their own safety, people should use only supervised swimming areas. Lifeguards, buoys, rescue equipment and clear signs about the risks related to currents, tides and waves are minimal requirements to ensure the safe use of public beaches.

Other recreational activities. In 1995, 29 incidents occurred on the Gaspé Peninsula that required the assistance of the Coast Guard's Marine Rescue Centre, with mechanical failures accounting for most of the cases. Motorboats were the type of craft involved most often in these incidents. In general, serious accidents are caused by pleasure boaters' lack of training and knowledge and by alcohol consumption. Lifejackets are still not worn by many boaters.

Drownings, injuries, hypothermia and psychological problems resulting from accidents are the main risks associated with the boating activities carried out in the Gulf of St. Lawrence. One boating-related death occurred in the Northern Gaspé region in 1995.

Commercial activities. In 1995, the Coast Guard's Marine Rescue Centre provided assistance to 44 fishing vessels in the Gaspé Peninsula sector. This figure represents a decrease of 20% from the previous year, which is attributable to a decline in the number of boats in use and the excellent weather conditions. Mechanical failures are the main type of incident reported. It appears that inadequate maintenance of boats, associated with the economic hardships faced by groundfish fishers, is one cause of these incidents.

5.5 Environmental Accidents

5.5.1 Natural disasters

Since 1992, there have been eight natural disasters that resulted in material damage or necessitated evacuations in the Northern Gaspé. Six of these events were floods and the other two landslides. The majority of natural environmental disasters take place near rivers or streams that empty into the Gulf. However, when storms occur simultaneously with spring tides, the areas most at risk are near the seashore, which means that waterfront homes and highways are impacted.

Although physical health problems (primarily related to unsanitary conditions) do not necessarily arise after such events, the psychological and social effects associated with the property damage sustained and the forced evacuations are far from negligible.

5.5.2 Technological accidents

Until now, environmental accidents related to the transport of hazardous goods have had little impact on the health of waterfront residents in the Gulf region. There are still risks, however, given the difficult navigation conditions in the area (e.g. powerful tides, marine currents).

The great majority of spills occur at port facilities during transshipment operations. In general, emergency response plans contain provisions for limiting the population’s exposure to risks during such an event.

5.6 Decline in Fishery Resources

The reduction in fishery resources, moratoria on fishing and restrictions imposed by the international market could worsen the social disintegration that has been observed in coastal villages in the Gulf of St. Lawrence and increase health problems indirectly. Today, it is recognized that populations experiencing chronic unemployment are more affected by certain

health problems, particularly mental health problems, which can also affect physical health. Initiatives that foster the sustainable development of resources are therefore recommended for all waterfront communities in the Gulf.

CHAPTER 6 Toward the Sustainable Development of the Northern Gaspé Sector

Sustainable development of the Northern Gaspé sector involves reclaiming and preserving for future generations the biodiversity of plant and animal life, their manifold uses and the quality of life associated with these uses. Activities must ensure economic development while guaranteeing resource sustainability and environmental quality. Among the means advocated to achieve sustainable development are:

- Reducing pollution
- Protecting sensitive habitats and species
- Preserving and rehabilitating disturbed habitats and resources
- Managing marine fisheries effectively
- Reconciling recreational and tourism development with environmental protection.

Here, we attempt to identify the main environmental issues in the sector and to describe some of the existing programs and activities that foster sustainable development (Table 1). This review is in no way exhaustive and only provides a starting point for discussions with local stakeholders who will have to establish local strategies and priorities for carrying out an environmental rehabilitation action plan (ERAP).

Table 1
The Main Issues of Sustainable Development in the Northern Gaspé Sector

Issues	*Assessment of present state relative to sustainable development goals*	*Present actions for sustainable development*
Pollution reduction		
• Treatment of municipal and household wastewater	Only 1.4% of the total population in the study area was served by a wastewater treatment plant in 1996. Many municipalities still do not have plans for wastewater treatment. In a number of coastal areas, bacterial pollution restricts shellfish harvesting and recreational activities involving water contact.	Uses related to the bacteriological quality of the water can only be reclaimed by treating waste water (effective treatment plants or septic facilities) and controlling overflows during rainstorms.
• Elimination of persistent toxic substances in the environment	Despite a significant reduction in the various sources of contamination in the St. Lawrence drainage basin and the distance of the main sources of contamination, aquatic organisms in the sector, particularly fish-eating birds and marine mammals, continue to be exposed to bioaccumulative toxic substances. In general, the chemical contamination of fishery products does not pose a threat to human health.	Gaining a better understanding of the dynamics and effects of these substances on marine organisms and human health is an important issue.
Protection of sensitive habitats and species		
• Protected areas	The study has few areas that are protected under current legislation or existing regulations.	Only a limited number of sensitive habitats require special protection measures.
• Priority species	The distribution and population status of numerous priority species in the sector are unknown.	Studies are currently being carried out on the rare plant species in the area.
• Protection from spills in the aquatic environment	The environment is less vulnerable than other sectors of the Gulf to oil spills owing to the small number of intertidal marshes, seabird colonies, seabird concentration areas, and seal haulouts. There is a spill response team in the area.	A regional emergency response team conducts drills on a regular basis.

Issues	*Assessment of present state relative to sustainable development goals*	*Present actions for sustainable development*
Restoration of disturbed habitats and resources		
• Ports	Some commercial ports and fishing harbours in the study area are severely contaminated with heavy metals.	A characterization of sediment quality at the Mont-Louis port is under way.
• Groundfish population	Cod, Canadian plaice, White hake and redfish populations in the Gulf have been in very poor condition since the early 1990s because of overfishing and unfavourable environmental conditions.	To promote the recovery of these populations, many measures have been implemented since 1993 to reduce fishing mortality, including a moratorium on fishing for cod, redfish and White hake.
Effective management of commercial fisheries		
• Groundfish	The commercial fishery in the Gaspé is going through the worst crisis ever, owing to the collapse of groundfish stocks. There are increasingly fewer jobs in this industry for riverside communities.	The government has begun a complete overhaul of the fisheries support system based on the guiding principles of resource conservation and species recovery.
Reconciliation of recreational and tourism development with environmental protection		
	Recreational and tourism activities in coastal and marine environments have expanded substantially; however, some are a threat to seabirds and marine mammals.	The impact of certain recreational and tourism activities on resources is currently under study.

6.1 Reducing Pollution

The Northern Gaspé is the only sector of the St. Lawrence where major efforts have not yet been made or are not currently planned for the treatment of municipal wastewater. In the case of most municipal effluent streams, a treatment system will not be in place by December 1998. The wastewater discharges will therefore continue to restrict certain uses (swimming, shellfish harvesting) because of the poor bacteriological quality of the water

Despite the study area's distance from the main sources of chemical contaminants, it remains exposed and vulnerable to the adverse effects of environmentally persistent toxic substances, as illustrated by the decline in the Bonaventure Island gannet population in the 1970s. Owing to the lack of recent data, it is not possible to delineate precise patterns of contamination in space or time, nor to determine the related impacts within the study area.

6.2 Protecting Sensitive Species and Habitats

Compared with other sectors of the St. Lawrence, the Northern Gaspé has few sensitive habitats (intertidal marshes, eelgrass beds, seal haulouts, bird colonies, congregating areas for seabirds and marine mammals). These habitats are concentrated on Forillon Peninsula and are protected by Forillon National Park, whose boundaries extend 150 m offshore from the mean low tide mark. This nearshore zone is particularly sensitive to oil spills. To limit mortalities of birds and seals in the event of an oil spill, the Canadian Wildlife Service has set up two cleaning centres: one at Mont-Joli, serving the western part of the Gaspé Peninsula, and one at Gaspé (Forillon), serving the eastern part. In addition, the Port of Gaspé has a response team and equipment for dealing with oil spills.

6.3 Restoring Disturbed Habitats and Resources

With the exception of some small areas in harbours and ports, and the rocky shores backfilled during the construction and repair of Highway 132, very few habitats have been disturbed by human activity, and there is little opportunity for action to restore disturbed local habitats and resources.

A number of measures have been adopted since 1993 to promote the recovery of groundfish populations in the southern Gulf of St. Lawrence. Most of them are aimed at reducing fishing mortality. In the case of cod, a moratorium has been in effect since 1993. Other measures, such as increasing the mesh size in fishing gear, installing a fish release system in shrimp trawls, closing fishing areas when cod by-catches exceed a certain percentage, and lowering fishery quotas, have helped to reduce cod catches considerably in fisheries directed at other species. In the case of Canadian plaice, a major reduction in the allowable catch and the use of more selective fishing gear are the main measures that have been implemented to promote stock rebuilding. To improve the state of lobster populations, the use of escape vents that allow small lobsters to escape from the traps has been compulsory since 1994. Furthermore, since 1993 berried females have been marked and, since 1994, thrown back into the water.

Existing knowledge of the mechanisms responsible for natural fluctuations in animal populations remains fragmentary. To ensure the sustainable development of fishery resources, it will be necessary to identify the critical developmental stages for species and the physical and biological factors with the greatest influence on the survival, growth and reproduction of individuals.

6.4 Managing Marine Fisheries Effectively

The recovery and conservation of fishery resources must be accompanied by new approaches aimed at ensuring the survival of the commercial fisheries. In view of this, the federal

government has undertaken a complete overhaul of the fisheries support system. The guiding principles are as follows: priority must be given to the conservation of resources over all other considerations; a balance must be established between the industry's capacity and the tolerance level of the resource; fishing must be carried out by professionals to ensure the fishery's effectiveness; each enterprise should hold several different fishing licences, as this will help to make the industry more responsive to resource fluctuations; a closer and more effective partnership must be established between the industry and government; and Aboriginal rights must be respected. The Groundfish Licence Retirement Program (voluntary) and a new licence fee system based on landed value, are among the main initiatives implemented since 1993. Industry stakeholders have also established certain priorities to ensure the sustainability of the industry. They recognize the importance of increasing the harvesting of underutilized marine species (Sea urchin, Deepsea king crab, Spiny dogfish, skate, Harp seal, etc.), helping Quebec penetrate new markets, encouraging technological innovation, providing labour force training, supporting aquaculture development, increasing the added value of products sold, giving young people the opportunity to participate at all levels of the industry network so they can eventually take the reins, and stopping the exodus of young people to other regions and sectors of activity.

6.5 Reconciling Recreational and Tourism Development with Environmental Protection

In the past few years, recreational and tourism activities have expanded in the Northern Gaspé, both along the coast and offshore. One of the major challenges will be to ensure sustainable development by protecting wildlife resources and their habitats, along with the landscapes that provide a backdrop for recreational and tourism activities. Among other things, it will be necessary to limit disturbances to birds and marine mammals from increasing human pressure on habitats that, until recently, were not accessible to the general public.

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Appendices

1 St. Lawrence Vision 2000 (SLV 2000) Priority Species Present in Northern Gaspé

Common or scientific name	*Type of distribution or local status*
Plants (17 of the 110 priority species)	
Common dandelion	Endemic (northeastern North America)
Cutleaf daisy	Disjunct
Dense whitlowgrass	Endemic (Gulf of St. Lawrence)
Draba peasei	Endemic (Gulf of St. Lawrence)
Gaspé Peninsula arrowgrass	Endemic (northeastern North America)
Griscom's arnica	Endemic (Gulf of St. Lawrence)
Holboell's rockcress	Disjunct
Indian milkvetch	Disjunct
Longleaf arnica	Disjunct
Northern hollyfern	Disjunct
Pendantpod locoweed	Disjunct
Purple reedgrass	Disjunct
Rockdwelling sedge	Endemic (northeastern North America)
Sandberg bluegrass	Disjunct
Shy wallflower	Endemic (Gulf of St. Lawrence)
Smooth rose	Endemic (Lower Estuary and Gulf of St. Lawrence)
Sticky locoweed	Disjunct
Reptiles (none of the six priority species)	
Fish (5 of the 13 priority species)	
American shad	Coastal migrant
American eel	Coastal migrant and present in tributaries
Atlantic sturgeon	Coastal migrant
Atlantic tomcod	Status unknown
Rainbow smelt	Status unknown

Common or scientific name	*Type of distribution or local status*
Birds (4 of the 19 priority species)	
Blue-winged teal	Probable breeder
Harlequin duck	Confirmed breeder
Loggerhead shrike	Migrant
Peregrine falcon	Migrant
Mammals (all 5 priority species)	
Beluga whale	Occasionally present in winter
Fin whale	Regular in spring, summer and fall
Harbour porpoise	Regular 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 body of water without treatment) (MENVIQ, 1990, rev. 1992)	To reduce the risk of infection and treatment costs for drinking water.
	Contamination of aquatic organisms (MEF, 1996)	To protect human health from the risks asociated with consumption of aquatic organisms.
	Aquatic life (chronic toxicity) (MENVIQ, 1990, rev. 1992)	To protect aquatic organisms and their progeny and the wildlife that feed on them.
	Recreational activities (primary contact) (MENVIQ, 1990, rev. 1992)	To protect human health in the practice of recreational activities in which the whole body is regularly in contact with the water (e.g. swimming, windsurfing).
SEDIMENT	No effect threshold (NET) (SLC and MENVIQ, 1992)	Contaminant levels are below that at which any effects on benthic organisms are observed.
	Minimal effect threshold (MET) (SLC and MENVIQ, 1992)	Contaminant levels exceed those at which minor but tolerable effects are observed in most benthic organisms.
	Toxic effect threshold (TET) (SLC and MENVIQ, 1992)	Contaminant levels exceed those at which harmful effects are observed in most benthic organisms.
AQUATIC ORGANISMS	Fish marketing guidelines (Health and Welfare Canada, 1985)	Maximum acceptable contaminant levels in the tissues of fish, shellfish and crustaceans sold for consumption.
	Fish consumption guidelines (MSSS and MENVIQ, 1993)	To prevent harm to human health from eating contaminated fish, shellfish and crustaceans.

3 Glossary

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

Benthos: All organisms living in contact with the bottom of a body of water, 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 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 migrate to the sea to reproduce.

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

Discharge: Volume of water carried by a watercourse, conduit, etc., in a given unit of time, generally expressed in cubic metres per second (m^3/s) or, in small watersheds, as litres per second (L/s).

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

Drainage basin: The entire continental land area drained by a river system; that is, the total precipitation catchment and drainage area. Also called *watershed*.

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

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

Effluent: Any liquid released from a source of pollution, whether a residential area (domestic outfall) or industrial plants (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 plant species whose range is limited to a well defined area.

Foreshore: That part of the shore lying between the high and low water marks. Also called *mesolittoral* or *intertidal*.

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

Haulout: Stretch of shoreline where seals come out of the water to rest.

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

Minimum flow: Lowest level of water flowing in a watercourse.

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 substance absorbed by plants and used in photosynthesis. Basic nutrients are nitrates, phosphates and silicates.

Plankton: Animal (zooplankton) and plant (phytoplankton) organisms that live suspended in oceans and 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 regime: Set of streamflow characteristics that influence sediment transport, deposition and erosion.

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

Spawning ground: Place where fish gather to breed.

Suspended solids: Small particles of solid matter (> 0.45 m) floating in a liquid. Also called *suspended sediments* (see Sediment).

Terrigenous: Refers to substances originating on dry 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 term for ducks and geese.

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

Year-class: All of the fish in a stock that were born in a particular year.

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