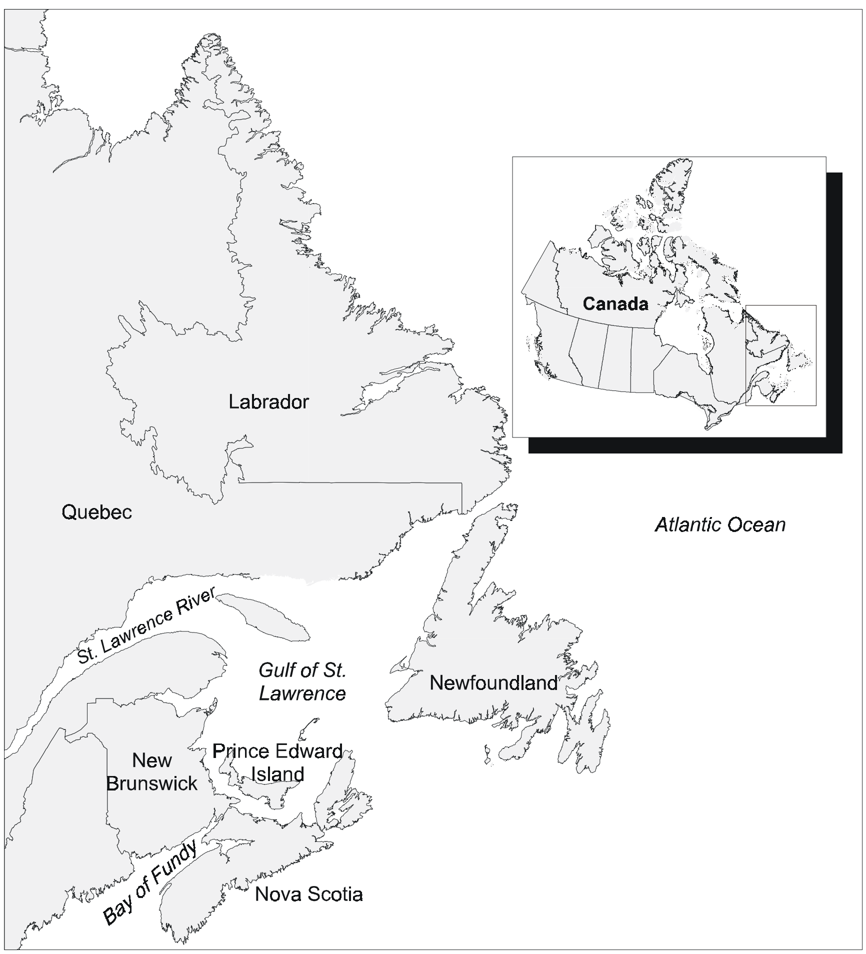
CHAPTER 7 ATLANTIC REGION

Introduction

The Atlantic Region of Canada includes Nova Scotia, Prince Edward Island, New Brunswick, and Newfoundland and Labrador (Figure 7-1). It is a diverse area with a wide range of physical, climatic and human settlement characteristics. The region includes a variety of ecosystems such as the Gulf of St. Lawrence, the Atlantic coast, the Bay of Fundy/Gulf of Maine and the Labrador Sea. The terrain ranges from the rolling fields of Prince Edward Island to the craggy peaks of the Torngat Mountains in Labrador. The 40 000 km of coastline has varied geomorphologic features such as deep fjords carved from granite in Newfoundland, high-energy rocky shores along southern Nova Scotia, vast marshes and barrier island systems, including the well-known red sandy beaches in Prince Edward Island, and vast mud flats in the Bay of Fundy. The 1.7 million km^2 of continental shelf is equally diverse with sandy shallows in the Gulf, and an outer continental shelf with basins, gullies and channels.

Figure 7-1 Atlantic Canada



This geomorphologic diversity creates a variety of habitats that support some of the most productive marine ecosystems in the world. The merging of the warm Gulf Stream and cold Labrador currents offshore and of the St. Lawrence and Saguenay rivers powers this high productivity. The Gulf of St. Lawrence is also the southern limit of many cold climate species and the northern limit of warm climate species, creating a unique and highly productive ecosystem with a wide variety of conditions, populations and pollution issues. Waters entering the Gulf of St. Lawrence drain from the most urbanized and industrialized areas of North America, such as the Great Lakes and St. Lawrence River watersheds. At the same time, the percentage of people living in rural areas in the Atlantic provinces is double that of the rest of Canada (Table 7-1).

The Gulf of St. Lawrence watershed area covers 1.6 million km^2, with a water surface area of 226 000 km^2 and a volume of 34 500 km^3. The mean depth of the Gulf of St. Lawrence is 152 m, and 25% of it is shallower than 75 m.

Table 7-1 Atlantic Region Rural-Urban Population Distribution, 1991

Province	Total population	Rural	Urban
Newfoundland	568 474	46 %	54 %
New Brunswick	723 900	52 %	48 %
Nova Scotia	899 942	46 %	54 %
Prince Edward Island	129 765	60 %	40 %
Atlantic Region Total	2 322 081	51 %	49 %
Canada Total	27 296 859	23 %	77 %

(Source: Statistics Canada, 1994)

The Northwest Atlantic marine ecosystem includes approximately 28 000 km of coastline. The area is characterized by a wide, shallow and highly productive continental shelf with strong currents and a large riverine input. There are also large areas of seasonal ice cover with strong storm-driven wave action.

The Bay of Fundy, a highly dynamic and diverse ecosystem, has very productive fisheries. Part of the Gulf of Maine ecosystem, the Bay of Fundy twice daily receives a tidal ebb and flow 2000 times the volume of the St. Lawrence River. It is funnel-shaped, 150 km in length, 100 km wide at its mouth and 45 km wide at the head. The average depth is 75 m. The tidal heights range from 4 m at the mouth of the Bay to 14 m to 16 m at the head.

The Gulf of Maine/Bay of Fundy ecosystem is the site of one of two pilot projects supported by the Commission for Environmental Co-operation (CEC) for the implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) in North America. The GPA is being implemented through a broadly based multistakeholder coalition named the Global Programme of Action Coalition (GPAC) for the Gulf of Maine. Members of the GPAC include the provinces and states that border the Gulf of Maine, federal agencies from both countries, First Nations, industry, environmental non-government organizations and community action groups. The implementation of the GPA in the Gulf of Maine is following the steps of the GPA, much as the National Programme of Action for the Protection of the Marine Environment from Land-based Activities (NPA) is in Canada. The two initiatives mesh through the common role played by Nova Scotia and New Brunswick. There is further integration through the involvement of Canadian federal agencies.

The Eastern Habitat Joint Venture is the Eastern Canada operational arm of the North American Waterfowl Management Plan. It is a partnership of the six eastern provinces, Environment Canada (Canadian Wildlife Service), Ducks Unlimited Canada and Wildlife Habitat Canada. The purpose of this program is to contribute toward the goal of returning North American waterfowl populations to early 1970s levels and it is being accomplished through the protection and conservation of wetlands and their surrounding uplands. Some activities include securement, promoting sustainable land-use practices in the agricultural and forest industries, wetland restoration and enhancement activities, and community projects. The program currently has in excess of 370 000 acres secured and under management, more than 3 million acres under stewardship agreements and at least another 1 million acres under the influenced category.

7.1 Identification and Assessment of Problems

7.1A Contaminants

Sewage

Sewage, principally untreated municipal wastewater, is one of the most prevalent problems facing nearshore coastal waters in Atlantic Canada. Point sources include municipal wastewater, industrial effluents and combined sewer overflows. Non-point sources consist of agricultural and urban runoff.

In the Atlantic Region, only a small portion of the population (approximately 25%) is served by wastewater treatment, with over 980 000 m^3 of wastewater discharged daily (Eaton et al., 1994). Many smaller point sources of sewage in the Atlantic Region now receive some form of treatment; however, there are still some large point sources that discharge raw sewage, namely Halifax, Saint John, St. John's and Sydney.

Prince Edward Island is fortunate in that 100% of its point source industrial and municipal wastewater is collected and treated in one way or another. With the exception of Charlottetown and Summerside, which have only primary municipal treatment plants, all other industrial and municipal facilities (except fish plants) treat at least to the secondary level. Approximately half the population of New Brunswick is serviced by municipal sewage treatment facilities. All municipal systems have secondary treatment except Moncton, where treatment is primary and chemically assisted. Nova Scotia's 250 sewage treatment facilities serve approximately 24% of the population, while an additional 45% of the population is served by on-site disposal systems. As a result, some 31% of the population (almost 300 000 people) still have sewage collection systems without treatment. Nova Scotia's two major cities, Halifax and Sydney, still discharge raw sewage into their harbours (Grant, 1998). In Newfoundland, the total discharge of wastewater has been estimated to be 100 000 m^3/day, of which 90% is discharged into coastal waters without any treatment. The terrain of Newfoundland, in some areas, is also unsuitable for septic systems as an on-site treatment alternative. Non-point sources of pollution have received only limited attention in the region. Most Atlantic provinces still use combined sanitary and storm sewer systems. These combined systems occasionally cause flooding and subsequent bypassing of treatment plant processing. In terms of shellfish closures and beach closures, the non-point sources and some of the smaller urban discharges are the most significant concern in this region.

Municipal wastewater is implicated as a contributing pollution source in over half of the closed shellfish areas in the Atlantic Region. In 1996, 35% of the classified shellfish growing area in the Atlantic Region was closed to harvesting of shellfish because of fecal bacteria pollution (Table 7-2) (Menon, 1998). The Department of Fisheries and Oceans estimates that income of over $8 million is lost every year due to closures of the soft shell clam fishery in southwest New Brunswick alone.

Table 7-2 Summary of Closures in Atlantic Region of Classified Shellfish Growing Areas, 1996

Province	**Closures**	**Closed (km^2)**	**Shoreline (km)**
New Brunswick	127	571	1 699
Newfoundland	81	425	1 019
Nova Scotia	278	939	3 314
P.E.I.	83	110	783
Atlantic Region Total	569	2 044	6 815

(Source: Menon, personal communication, 1998)

The problem of sewage is more acute in protected harbours and inlets where tidal flushing or ocean currents are less effective at dispersing effluents (e.g., St. John’s Harbour and Corner Brook in Newfoundland). In areas where sewage and industrial outfalls are in close proximity, such as in Pictou, Nova Scotia, and Bathurst, New Brunswick, this condition may become more problematic at times (Fairchild and St-Hilaire, 1998). Approximately half of all industrial discharges in the Atlantic Region are into estuaries (Eaton et al., 1994). A combination of microtidal amplitude and relatively low river flows also creates low flushing conditions in estuaries of eastern New Brunswick, Prince Edward Island and northeastern Nova Scotia.

Persistent Organic Pollutants

Persistent organic pollutants (POPs) in Atlantic Canada originate locally from incinerators, smelters, power generating stations, abandoned military bases, industrial and sanitary effluents, municipal wastewater, urban runoff, snow removal, pulp and paper mills, landfills, residues from current and past applications of pesticides to agricultural and forest lands, and antifouling paint used in marine industries.

POPs affecting Atlantic Canada also originate from distant sources. The atmosphere is a principal pathway for the transport of volatile chemicals. This is particularly significant for Atlantic Canada, which is in the downwind path of most weather systems that first pass through industrialized regions of North America (White and Johns, 1997). Atmospheric transport from distant sources is a major contributor of POPs as well as lead, mercury and cadmium.

Polychlorinated biphenyl (PCB) levels in plankton have dropped substantially from the early 1970s to the 1980s, but the decline has levelled off. A preliminary PCB budget for the Gulf of St. Lawrence demonstrates that most of the contamination in the pelagic ecosystem was present in the water column. Preliminary fluxes of PCBs in the Gulf of St. Lawrence indicate that atmospheric, riverine and oceanic inputs are approximately equivalent (Harding et al., 1997).

Agriculture is a major sector of the economy, and it includes the wide use of pesticides. The chemicals enter the aquatic and marine environment through runoff from treated locations. For example, in 1986, 850 000 kg of pesticides were applied on 200 000 ha of farmland in Atlantic Canada (4.25 kg/ha) (Environment Canada, 1991). The estimate does not include the amounts of pesticides used for household purposes, which are believed to be much smaller. Those pesticides are used intensively around households to control indoor pests as well as pests on ornamental and produce vegetation. However, the greatest amounts are used to control pests in lawns. Provincial regulations address the commercial application of such pesticides, and the largest municipality in the Atlantic Region (Halifax Regional Municipality) is in the process of establishing more restrictive requirements for homeowner use.

The Atlantic Region's most heavily used pesticides are bactericides: the region's water and sewage authorities use 1.2 million kg of chlorine gas and chlorine-based compounds each year to disinfect water supplies and to treat wastewater. Over-chlorination is common as plant operators strive for clean treated water, and it is especially prevalent at treatment plants that are not functioning properly, either because of age or mechanical breakdown (Garron, 1992).

Forestry use of pesticides is extensive as well, both for insect and vegetation control. New Brunswick's forest spray programme, the longest running and most extensive in the world, distributed more than five million kg of DDT over 10 million ha of forest between 1952 and 1968, mainly in its battle against the spruce budworm (Environment Canada, 1991). Wide-scale use of DDT was banned in 1972, but residues of DDT and its breakdown products (such as DDE) persist in the environment today. Forest insect infestations are cyclic and are currently at a low point. Consequently, biological pesticides (primarily *B.t.*, *Bacillus thuringiensis*) that pose minimal risk to marine systems are the primary control agents. However, when insect infestations are reported, all methods of control are considered.

The use of pesticides in finfish aquaculture has increased dramatically both in extent and intensity. Pesticides are used primarily to control sealice, although they are also used as disinfectants and fungicides. The sealice pesticides used so far (pyrethrin, dichlorvos, sodium hypochlorite, azamethiphos and cypermethrin) have varying toxicity to marine organisms, particularly crustaceans. Their release to the marine environment is suspected to present a definite risk to pelagic and benthic organisms.

Concentrations of DDE, PCBs and several other POPs declined rapidly in seabirds after their use was banned in Canada during the 1970s and early 1980s. However, since 1988, POP levels in seabirds in the Atlantic Region have remained fairly stable. Differences in POP levels between seabird species suggest that river inputs from land-based sources have declined the most since 1968, while atmospheric inputs have remained constant since the early 1980s. While POP levels were high enough in the late 1960s and early 1970s to impair reproduction in some seabirds, present levels appear to have no obvious impacts on seabird population numbers.

The use of tributyltin (TBT) as antifouling paint has been limited to boats more than 25 m in length and to aluminum hull boats in Canada since 1989. This step was taken after TBT was proven to be toxic for marine organisms and found to be an endocrine disrupter. Following a two-year monitoring programme in the Gulf of St. Lawrence (St-Jean et al., 1998), it appears that regulatory controls have brought decreases of TBT in sediments. However, in the Atlantic Region, sediment concentrations of TBT from large vessel harbours have increased since 1989 (Savard and Gray, 1998). Major input of TBT is related to the commercial fleet and is most apparent in marinas, dockyards and large ports. Tributyltin enters the marine environment from two main sources: (1) leaching from treated surfaces and (2) applying, removing or cleaning antifouling coatings. In the Atlantic Region, there are no provincial or federal regulations in place to address the containment and/or disposal of TBT residues, either in contaminated sandblasting grit or hydroblasting wastewater.

Tributyltin levels in biota (wild blue mussels, *Mytilus edulis*) for the southern Gulf of St. Lawrence seem to persist, and may be increasing, in ranges that are of environmental concern (St-Jean et al., 1998). The highest levels found in blue mussels (100-500 ng/g) are comparable with those found in moderately contaminated sites in other areas of the world. This is in a range that is considered to be chronically toxic to most susceptible marine organisms, confirming that regulations restricting the use of TBT have been only partially effective and that further controls are required (St-Jean et al., 1997).

The sources of concern for POPs have changed over the past years because of increased regulation and control of local sources. Point sources in the region are diminishing, while non-point sources continue to increase. In addition, the use of pesticides in agricultural operations in some portions of the region is of increasing public concern.

<u>*Radionuclides*</u>

Sources of radionuclides are quite limited in the Atlantic Region. There is one nuclear power generating station, Point Lepreau, located in southern New Brunswick along the Bay of Fundy. Radionuclides are also discharged in effluent from the fertilizer plant at Belledune, New Brunswick (Eaton et al., 1994). Radiation therapy, radiology facilities and military bases are other potential sources, although monitoring of visiting nuclear-powered vessels in Halifax Harbour has shown no releases. There are no identified problems in the marine environment in the Atlantic Region related to radionuclides.

Heavy Metals

Heavy metals in coastal areas originate locally from a variety of mining operations, including coal and base metal mining, stockpiles and storage of minerals at various harbours, metal plating, leachate from landfills, ash disposal from fossil fuel generating plants, industrial and municipal effluents, and land application of sewage sludge. Input from dredging and ocean disposal is well regulated. Local sources of metals have been identified in areas such as Belledune, Halifax and St. John's harbours. Metals are known to contaminate the sediments of these harbours and may be related to impacts on fish and shellfish. In addition, metals enter the region from external sources via long-range transboundary air pollution (LRTAP). Mercury is suspected of entering the region this way, since elevated levels are found in some freshwater ecosystems. Not enough data are yet available to quantify this issue in the marine environment.

The point source discharges of metals from mines, as well as industrial discharges, have decreased and are covered under *Fisheries Act* regulations. Point sources continue to pose a problem for a number of large harbours in the region (such as Halifax, Saint John and St. John's). However, long-range transport is suspected of contributing a larger proportion of the metals found in the marine environment, since local point sources are better controlled. There are a number of gaps in studies related to metals for the Atlantic Region, and no information is available on the long-range transport of metals in Newfoundland.

Elevated cadmium concentrations were identified in lobsters captured in Belledune Harbour, New Brunswick, in 1980. This is one instance where chemical contaminant concentrations have been considered elevated enough to be a human health problem, and a fisheries closure has been declared (White and Johns, 1997).

In recent years, interest has been expressed in marine mining for precious metals in the Baie Verte Peninsula area in Newfoundland and the Bay of Fundy in New Brunswick. Potential impacts on fish habitat of such activity have not yet been quantified.

Oils/Hydrocarbons

Land-based releases of hydrocarbons into the marine environment are linked to urban wastewater, stormwater and industrial discharges. These are primarily point sources. Some limited non-point sources are associated with storage, handling and transport of hydrocarbons in the region. Generally, individual releases of oil are limited. However, there is concern over cumulative impacts, particularly on coastal waterfowl and seabird populations, fish larvae and fish eggs. Heavier crude can smother fish habitats and have significant impacts on bird and marine mammal populations through both direct toxicity and sub-lethal effects. The bulk of oil contamination in sediments comes from chronic release sources such as stormwater runoff. There is a constant release of these oil contributors into the environment that, over time, dwarfs the contribution from spills (M.B. Davis, personal communication). All oil spills represent a risk to the aquaculture, tourism and fishing industry. The possibility of a large unpredictable oil spill is always present, as a number of important oil handling facilities are located throughout the Atlantic Region.

An emerging issue in the region is related to the use of Orimulsion ® in coastal power plants. Twenty thousand tonnes of

Orimulsion ® are shipped each year from Venezuela to the thermal power plant in Dalhousie, New Brunswick. This oil-in-water emulsion, in addition to having a high polycyclic aromatic hydrocarbon (PAH) content, may pose a high risk to benthic organisms, particularly filter-feeders. There is little information on the toxicity of Orimulsion ® to marine biota, especially at low temperatures. In addition, available spill control and recovery methodology is not effective with this type of product. Benthic communities and commercial scallop beds in Chaleur Bay would be particularly at risk in the event of a dockside spill (Alexander and Lee, 1998). Other habitats along the transit route to and from Chaleur Bay, via the Atlantic coast and the Gulf of St. Lawrence, are also at risk. Further research on the potential impact of this product in marine ecosystems is required.

Nutrients

Sources of excess nutrients (principally nitrogen and phosphorus) in the Atlantic Region include food processing, municipal and industrial wastewater, agricultural fertilizer runoff, nutrient-enriched groundwater, aquaculture operations, and soil erosion from agricultural and forestry practices.

Nutrients are released into the marine environment through point sources, such as municipal and industrial discharges, and through non-point sources associated with agriculture. In the southern Gulf of St. Lawrence, nutrients from agricultural sources present a significant problem, particularly where the flow pattern in estuaries has been disrupted by the construction of causeways. In a few local areas, effluent from pulp and paper mills has introduced a significant amount of organic matter to the local area. However, the pulp and paper sector is specifically regulated under the *Fisheries Act*, and most mills now comply with these regulations.

Another potential source for nutrient loading in the Atlantic Region is food processing plants. Table 7-3 identifies the federally registered plants in Atlantic Canada.

Table 7-3 Number of Federally Registered Food Processing Plants in Atlantic Canada

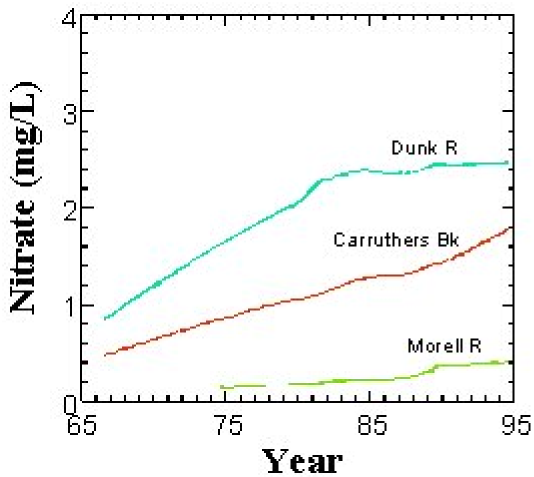
Province	Fish plants	Meat packing and processing plants	Dairy processing plants	Fruit and vegetable processing plants
Newfoundland	182	2	3	1
New Brunswick	157	4	2	3
Nova Scotia	289	7	6	5
P.E.I.	47	4	5	3
Atlantic Region Total	675	17	16	12

(Source: Bourque, personal communication, 1998)

The potential exists for eutrophication of coastal waters in all of the Atlantic Region. It is a particularly critical problem in coastal waters around Prince Edward Island, where the addition of agricultural fertilizers has led to enriched groundwater and eutrophication of upper estuarine waters. In New Brunswick, concern is focused on excess nutrients associated with soil erosion from agricultural and forestry practices.

Data show that nitrate levels in three Prince Edward Island river systems have increased several-fold over the past 30 years (Figure 7-2). Water quality in these systems is not influenced by point sources. The principal sources would be agricultural fertilizers and livestock manure. The report *Cultivating Island Solutions* expressed concern about the deterioration of the province's water resources from agricultural activities (Prince Edward Island Round Table on Resource Land Use and Stewardship, 1997).

Figure 7-2 Nutrient Loading Over Time in Three Prince Edward Island Estuaries



Prince Edward Island estuaries are known to be among the most productive shellfish growing areas in the world. However, excessive phytoplankton and macroalgal growth is causing serious water and aquatic habitat problems in many of these estuaries, promoted by the high availability of essential nutrients such as nitrogen and phosphorus.

The decay of massive quantities of plant material, particularly sea lettuce (*Ulva lactuca),* results in oxygen depletion and the production of toxic gases such as hydrogen sulphide and ammonia. In a report prepared for the Canada-P.E.I. Water Annex Agreement, Thompson (1998) listed nine major estuaries on the Island where eutrophic conditions were prevalent during the summer months. In all cases, land-use-related non-point sources were considered to be the main factor. Whitford and Lane (1990) determined that upper estuary systems on Prince Edward Island were very productive and had no residual capacity to assimilate additional nutrients and associated plant production. It was also concluded that nutrient additions from agricultural systems have reached unacceptable limits. In related work, Brylinsky (1998) evaluated the trophic status of two Prince Edward Island estuaries according to criteria established by the U.S. National Oceanic and Atmospheric Administration. It was determined that the Wheatley River was highly eutrophic while the Hunter River was in the high mesotrophic range. Anoxic conditions have been known to occur in the Hunter River in more recent years. Application of these criteria to other Prince Edward Island estuaries could establish whether they are eutrophic and susceptible to anoxic events.

The high nutrient levels in surface waters may be a major contributing factor in harmful algal blooms (HABs). Worldwide, HABs are increasing in frequency, severity, duration and geographic distribution to a degree that cannot be attributed simply to improved monitoring and awareness. Causes for this include increased use of coastal resources and eutrophication. Toxic algal blooms cause shellfish to become contaminated, resulting in illnesses and, in the worst-case scenario, human deaths. These incidents of contamination are cyclic in nature and occur, with varying levels of toxin production, throughout the coast of eastern Canada each year (see Figure 7-3). Periods of higher toxicity appear to coincide with an 18.6-year lunar tidal cycle (Bates, 1997).

Domoic acid contamination in Prince Edward Island during 1987, and an initial ban on fish and shellfish products, resulted in a drop in seafood demand by as much as 80% (Wessels et al., 1995). Total losses in eastern Canada were estimated at $8.4 million, including employment losses, hospitalization costs, costs of monitoring and testing, costs of public relations, losses to Canadian mussel growers for 1987-1988 and losses to other Canadian shellfish harvesters, wholesalers and retailers. (Wessels et al., 1995). Not all the economic losses were directly attributable to contamination, but rather to the perception that seafood was unsafe to eat. Without shellfish monitoring programmes, the human and economic cost attributed to HABs would be much higher.

In another example, the fishing industry in the mid-Atlantic states suffered millions of dollars in damage from a recently discovered toxic alga, the fish-killing dinoflagellate *Pfiesteria piscicida.* A tentative link has been made between both the distribution and severity of *Pfiesteria* blooms and eutrophication caused by effluents from pig and poultry farms. There is concern that this organism could be transported into the Gulf of St. Lawrence, causing adverse economic and environmental consequences. No such event has occurred in Atlantic Canada, but there is a need to closely follow the situation in the United States and to determine whether the dinoflagellate can survive in the colder waters of Atlantic Canada.

<u>Contaminated Sediments</u>

The Sydney Tar Ponds and the Coke Ovens Site in Cape Breton, Nova Scotia, are among the worst contaminated sites in Canada. After approximately 100 years of steelmaking, the contaminated sites are extensive and complex. The Sydney Tar Ponds contain approximately 700 000 tonnes of sediments contaminated with a complex mixture of chemical compounds. The Coke Ovens, closed in 1988, were the primary source of PAH contamination in Sydney Harbour. The Province of Nova Scotia, area citizens and environmental groups have joined the federal government to implement an effective solution to this environmental issue.

St. John’s Harbour in Newfoundland contains sediments contaminated with an array of domestic and industrial pollutants including heavy metals, PCB oils, hydrocarbons and other organic compounds. St. John’s Harbour ACAP (Atlantic Coastal Action Programme) took sediment samples from the harbour bottom at six locations on

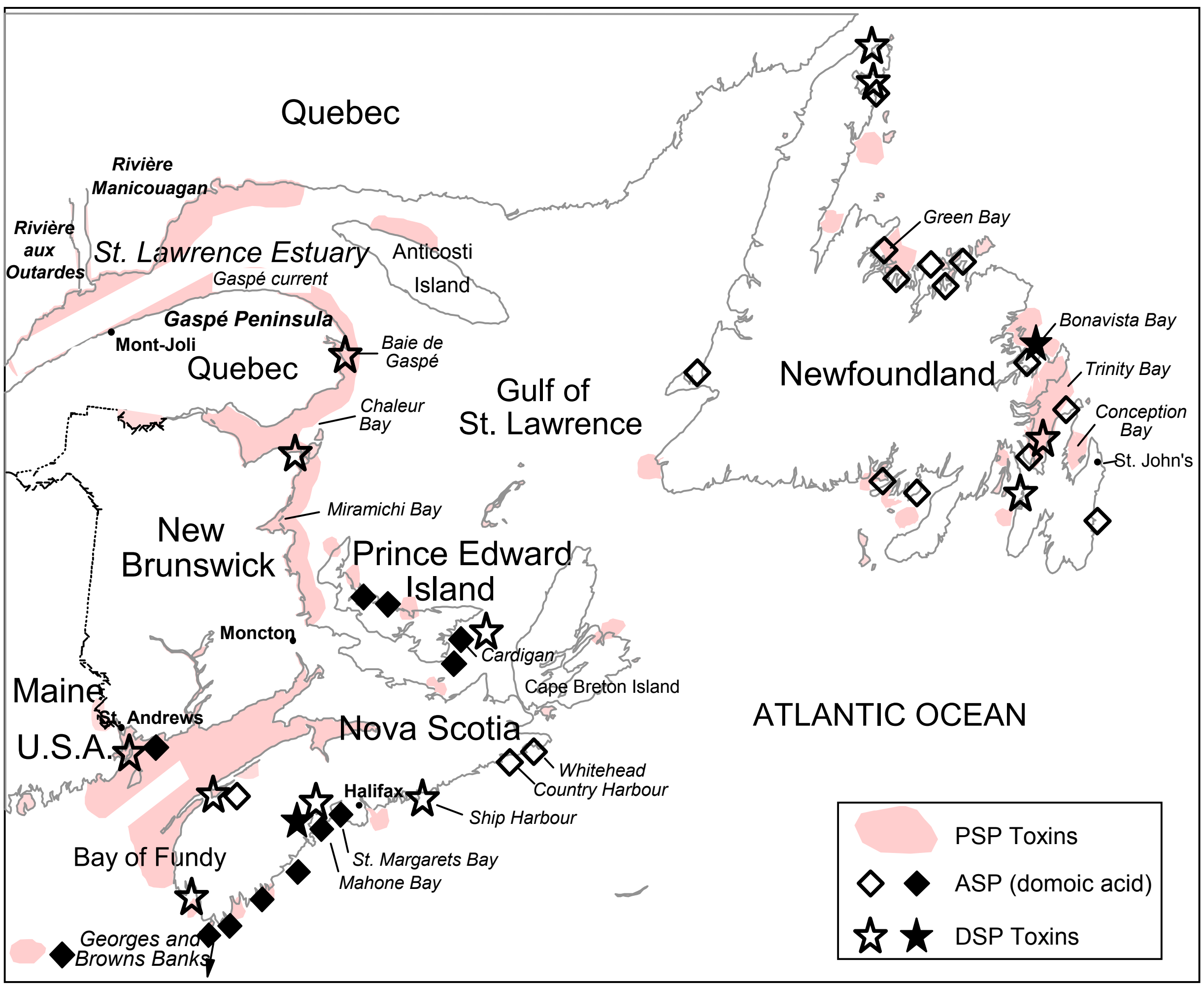
August 2, 1994. It was determined that the samples were highly contaminated.

Litter

Litter, or marine debris, is a common problem throughout the Atlantic Region. littering events, sewage outfalls, shore-side food kiosks, construction and repair sites and wharves. Litter is released from both point and non-point sources. Common sources are random

Tourism, particularly ecotourism, depends on unspoiled beaches, so the concerns over aesthetic impacts have led to communities bearing hidden costs for maintaining clean coastal areas. In certain areas, groups have been formed in response to the issue of litter in the marine environment. In Newfoundland, one such volunteer association, Ocean Net, is dedicated to the conservation of the marine environment and sponsors regular shoreline and nearshore clean-ups by scuba divers at selected sites.

Figure 7-3 Distribution of HABs in Atlantic Canada



(Adapted with permission from Bates, 1997)

The Clean Nova Scotia Foundation has co-ordinated the Moosehead Beach Sweep throughout three Maritime provinces for several years. There is growing interest in this type of initiative in the region.

7.1B Physical Alteration and Destruction of Habitat

<u>Shoreline Construction/Alteration</u>

Shoreline construction and alteration activities include coastal flood protection works, bridges, marinas, wharves, breakwaters and infilling associated with road construction, sewer works and other infrastructur-e. Impacts include loss of primary productivity and a long-term impact on local food production; harmful alteration, disruption or destruction of fish and wildlife habitat; changes in sedimentation regimes; and loss of economic opportunity. Both large-scale and small-scale projects have site-specific problems; however, they are addressed by current regulatory regimes. Apart from the aspect of physical alteration and habitat loss, marine shore-based infrastructure, such as wharves, docking facilities and marinas, often involve contaminant loading due to losses of toxic chemicals. This can result in localized water quality problems in the short term, as well as sediment quality problems in the long term. The need to better assess the cumulative impact of these projects at an ecosystem scale has been recognized and warrants further research.

In Newfoundland and Labrador, the Small Craft Harbours Branch of the Department of Fisheries and Oceans (DFO) currently administers 457 fishing harbours. These represent approximately 900 facilities including wharves, breakwaters and slipways. New Brunswick has 150 small vessel harbours, Nova Scotia has 150 and Prince Edward Island has 76. Each one of these facilities undergoes a number of maintenance activities each year, such as dredging and refitting. In addition, the region has a number of larger port facilities, such as Belledune, St. John's and Halifax, where this type of impact is larger.

<u>Inter-tidal and Sub-tidal Alteration</u>

Inter-tidal and sub-tidal alterations of fish habitat in the Atlantic Region are mainly linked to shoreline construction activities, the use of certain fish harvesting gears, marine plant harvesting and intensive finfish aquaculture. These activities can result in loss or degradation of shellfish and finfish habitats, including particularly sensitive spawning and nursery habitats.

Rockweed harvesting (*Fucus* sp. and *Ascophyllum nodosum*), an emerging industry on the south coast of Newfoundland, is an activity whose impact on the coastal ecosystem is poorly understood. It is also a traditional industry in New Brunswick and Nova Scotia, especially in the southwestern section. This industry is regulated by the provinces and operates on the principle of sustainable harvest. Rockweed provides an important microhabitat for many species, and its harvesting potentially affects many species dependent on that habitat. Products are being assessed for various commercial uses including as a food source for sea urchins prior to export. Other common macroalgae being harvested include Irish moss (*Chondrus crispus*), dulse (*Rhodymenia palmata*), kelp (*Laminaria* sp.) and Nori (see biological alteration, Section 7.1B).

The use of recreational vehicles in coastal areas is a concern at sensitive sites in the Atlantic Region. These sites include salt marshes and sand dunes in the Gulf of St. Lawrence and the south and southwest coast of Newfoundland, which are nesting sites for the endangered Piping Plover. The activity can also disturb seal populations in their summering habitats. The use of all-terrain vehicles (ATVs) on sand dunes can destabilize these fragile ecosystems and result in altered hydrodynamics. Regulations on the operation of ATVs vary by province and are difficult to enforce.

Mineral and Sediment Extraction/Alteration

Mineral extraction on beaches can have substantial impact on habitat. Public outcry over past practices has resulted in extensive controls. It is not currently a major problem in any jurisdiction in the Atlantic Region.

Harbour and channel dredging are major activities in the Atlantic Region. The dredging and disposal of sediment can have a substantial impact on habitat and are particularly critical for species that use substrate for spawning. These activities can also result in the re-suspension of sediment in the water column, resulting in diminished phytoplankton production and reduced feeding and respiration of fish (White and Johns, 1997).

Because the glacial till and sandstone coastline of Prince Edward Island erodes so easily, shoreline erosion is a very significant issue in most areas of the province, especially along the north and west coasts. As these vast quantities of sediment are introduced to the shoreline sediment transport system, accumulation near protruding coastal structures and sandbar barrier channels becomes a significant navigational issue. In many cases navigation by commercial fishers is seriously impeded, and human safety becomes an important consideration. Consequently, dredging and beach extraction, mostly of sand material around wharves, is an ongoing activity.

In Newfoundland and Labrador, as in the other Atlantic provinces, dredging in marine waters is conducted annually to facilitate vessel passage and access to port facilities. In 1998, there were as many as 50 small-scale dredging operations. Such operations are of short duration and typically involve removing a small volume of substrate infilled along existing navigation routes. Larger-scale operations occur in cases of critical need, perhaps once or twice a year. These operations remove substantial amounts of material that have infilled navigation channels. Similar operations are conducted in Nova Scotia, Prince Edward Island and New Brunswick in various harbours and estuaries. Where possible, longer-term solutions such as breakwaters and groynes are used for both minor and major activities.

Proposed dredging activities are often subject to a federal environmental assessment conducted pursuant to requirements of the *Canadian Environmental Assessment Act*. In addition, federal departments are obligated to conduct assessments prior to issuing specified regulatory approvals (e.g., an ocean disposal permit). Dredging projects that have no federal involvement are approved by provincial agencies. The level of review will depend upon the nature of the proposed project.

Wetland and Saltmarsh Alteration

Activities include infilling, draining, dyking and alteration of estuaries, wetlands and coastal areas for land expansion purposes. Additional activities are associated with cranberry bog creation and peat harvesting. The Atlantic Region has a long history of these activities, but present-day increases in the real estate value of coastal areas have resulted in more infilling of wetlands and saltmarshes. Impacts include the cumulative loss of significant habitats and reduced primary productivity.

The expansion of the peat industry in the Atlantic Region during the last 20 years has raised major concerns regarding its impact on the quality of coastal and estuarine ecosystems. High levels of peat fibres are released and transported from commercial peat bogs to fresh and marine waters. In modern peat operations, bogs are drained. The water collects in deep ditches and eventually flows toward the sea via a network of streams and rivers. Current legislation requires the installation of settling basins to reduce excessive peat runoff. A recent study examined the effects of peat on the biodiversity and health of aquatic habitats following the release of excessive peat in an estuary. It showed a negative modification of habitat in the vicinity of peat sediments (Ouellette et al., 1997). As the depth of peat sediments increases, the density of certain fish and shellfish species diminishes. Laboratory experiments demonstrated a definite avoidance of peat substrate when organisms are provided with a choice. This preliminary indication of habitat impact points to the need to study the long-term impacts of peat on aquatic biota. There is further evidence that peat bogs, through various natural enzymatic and microbial reactions known as biochlorination, synthesize dioxins and furans (Silk et al., 1998). All unique isomers of dioxins and furans typically found in bogs have been identified in crustacean hepatopancreas (tomalley) tissue in coastal areas.

<u>Marine Waters and Coastal Watershed Alteration</u>

Siltation is an issue in the Atlantic Region. Many land-use practices result in increased erosion and silt loads to the coastal environment. Silt is a major carrier of pesticides, heavy metals and nutrients from watersheds to coastal waters, where it settles into the sediment. Any disturbance of sediments can potentially release these toxic substances into the ecosystem.

The suspended sediment released in runoff and urban discharges causes further physical problems, such as clogging of fish gills, and adverse effects on water quality, light penetration and temperature. Water quality is also affected by damming, construction of causeways and tidal power plants, reduction of freshets, thermal change in habitat, stratification and increased biological oxygen demand (BOD). Such activities can also exacerbate nutrient enrichment of coastal waters by altering their flushing capacity. Barriers to water flow obstruct the migration of anadromous fish to their breeding habitats and have consequent impacts on population levels.

Sediment is derived from a number of sources. Along the southern Gulf of St. Lawrence, the sources are primarily non-point in nature. In areas where agriculture is extensive and where row cropping is used, very high erosion levels occur. In other parts of the region, urban wastewater is the major contributor of sediments, particularly in harbours associated with large urban areas. These harbours also have elevated sediment contaminant levels.

Sedimentation is currently the single most significant threat to water and habitat quality in Prince Edward Island surface water systems (Prince Edward Island Round Table on Resource Land Use and Stewardship, 1997). Recent work on the Wilmot River, conducted under the National Soil Conservation Erosion Monitoring Programme, found that a sub-watershed with 47% potato crop cover produced high suspended solids in the receiving water. The annual average suspended solids concentration was 977 mg/l, with a maximum peak concentration of 20 146 mg/l (Dehaan, 1994).

In the 1940s and 1950s, it was common practice on Prince Edward Island to replace span bridges with less expensive causeways. In many cases these causeways were constructed across major estuary systems and were equipped with very narrow openings. Often, water level control structures were added to stabilize water levels in the impounded areas. The natural tidal exchange was seriously impeded, causing significant water quality and ecosystem health problems. In these very productive environments, the high level of nutrient input has led to severely eutrophic situations. The province has made progress in its efforts to replace these causeways with bridges allowing a free flow.

In northern Nova Scotia and around the Bay of Fundy, erosion is common in areas with fine-grained soils that erode easily. These soils contribute to heavy sediment loading of the rivers leading to the Bay of Fundy and Northumberland Strait. Along the Atlantic coast of Nova Scotia, fine-grained sediments from drumlin structures are susceptible to erosion from forestry and urban development. In New Brunswick, land-based activities involving sloped terrain and soils that erode easily provide sources of sediment to marine waters. In Newfoundland the scale of sedimentation is relatively small when compared with other areas of Canada, but there is evidence of significant localized changes in sediment loading from activities along such urban rivers as the Waterford, emptying into St. John's Harbour.

Dams have been built on most of the significant rivers in Nova Scotia to provide head ponds for hydropower and public water supply and, to a lesser extent, to provide flood control. There are 25 water licences for hydropower generation in the province, along with 56 public surface water supplies. As many as 150 additional sites exist for private, community and agricultural water systems. Damming of rivers has impacts upstream and downstream because of interference with the transport of both water and waterborne sediments. Dams have also been major impediments to fish passage, while hydrology regimes have been affected by the construction of transportation corridors across rivers, estuaries and even the Canso Strait. Hundreds of individual culverts exist in coastal areas of the Atlantic provinces, restricting marine flow.

In Newfoundland and Labrador, hydroelectric development began in the early 1900s, when dams were constructed in the northeastern, eastern and southern portions of the province. Dams on larger rivers (the Humber and Exploits) were built to provide hydroelectric power for pulp and paper mills. In the 1960s and 1970s, there were large hydroelectric developments at Bay d'Espoir in Newfoundland and Upper Churchill Falls in Labrador, including the flooding of large areas. There is now the possibility of hydroelectric development on the Lower Churchill River. Currently, there are 42 hydroelectric systems of all sizes in the province, some of which have multiple dams and diversions.

Biological Alteration

The introduction of non-native aquatic species and human pathogens (e.g., viruses, bacteria, parasites) can modify ecosystem dynamics. Rainbow trout (*Salmo gairdneri*) have escaped from finfish aquaculture operations in the Bay d'Espoir area on the south coast of Newfoundland and there may be an impact on the local ecosystem and indigenous fish species. Both rainbow trout (*Salmo gairdneri*) and brown trout (*Salmo trutta*) were introduced as game fish in eastern Newfoundland, New Brunswick, Prince Edward Island and Nova Scotia in the late 1800s and 1900s. Since their introduction, brown trout have spread into waters beyond those to which they were first introduced. Successful sea-run or anadromous populations of brown trout occur in all of these provinces, except in Prince Edward Island (Scott and Scott, 1988). Other examples of documented introductions include goldfish (*Cyprinus auratus*), small mouth bass *(Micropterus dolomieui*), and chain pickerel (*Esox niger*) in Nova Scotia and New Brunswick.

There have been documented reports of Coho salmon (*Oncorhynchus kisutch*) and of Chinook salmon (*Oncorhynchus tshawytsha*) being caught in rivers in New Brunswick and Nova Scotia as a result of introduction in New England state rivers, including the St. Croix river between New Brunswick and Maine (Scott and Scott, 1988). There have been undocumented reports of exotic pet species released in coastal areas by their owners. Even the introduction of native species, such as Atlantic salmon, outside their natural range may have adverse impacts on wild populations by affecting gene pools or introducing parasites.

Regional/provincial introductions and transfer committees review all planned movements of invertebrates in Atlantic Canada, with the exception of lobsters (*Homarus americanus*). These reviews apply to species destined for openwater live holding, release, hatchery use or remote setting, and involve screening for parasites, pests and diseases. Canada currently has no federal regulations to prohibit or control the movements of marine plants.

Specific examples of the introduction of non-indigenous marine organisms in Atlantic ecosystems include the following:

Marine Plants

- Since 1995, there have been numerous reports of *Codium fragile* in Atlantic Canada's waters. It was first noticed in southern Nova Scotia and has been confirmed in the Gulf of St. Lawrence. There are indications that Malpeque Bay in Prince Edward Island is now colonized throughout, and that the plant is severely affecting, in equal measure, shellfish growing areas (substrate) and suspended culture gears. This alga quickly spreads to coastal areas and is not killed by air drying. One oyster lease, where the seaweed was first discovered in 1996 in Prince Edward Island, has become heavily colonized with a mat 0.2 m to 0.6 m thick covering much of the lease bottom. In the summer of 1997, more than 45 000 kg of this alga was removed from one oyster lease, without noticeably reducing plant volume. The presence of this alga has the potential to cause a significant economic burden on the shellfish industry (Campbell, 1998).
- The culture of the seaweed Nori (*Porphyra yezoensis*) from monospores (obtained from Maine hatcheries) has been approved in the Bay of Fundy, where the cold water conditions allow growth but prevent reproduction. With growing interest in the culture of this seaweed, there is concern that it could be moved to other areas in the Atlantic Region where it could successfully reproduce and compete detrimentally with other algae.

Viruses

- Since 1996, a severe disease condition has affected farmed Atlantic salmon in the Bay of Fundy. In the fall of 1997, the disease was confirmed to be infectious salmon anemia (ISA), a disease first identified in Norway in 1984. The finding of the ISA virus in New Brunswick represents the first time that the virus has been isolated outside Norway. In May 1998, the virus was also found in Scotland. The virus has caused severe economic losses in New Brunswick salmon farms and has led to the eradication of nearly 4 million salmon from the Bay of Fundy since 1997. In some cases, entire bays and farms have been stripped of salmon and left fallow for up to one year. It is estimated that the loss to the salmon aquaculture industry has reached $50 million (Nell Halse, personal communication, 1999). The ISA virus was also found in one lot of 1998 broodstock held in Nova Scotia; however, there were no signs of disease in these animals. In response to these events, comprehensive management measures have been implemented to control the disease in farms, and some of these measures have been successful in controlling the spread of the disease. The origin of the virus in New Brunswick and Nova Scotia is still unknown.

7.2 Establishment of Priorities for Action

7.2A Contaminants

<u>Sewage</u>

Sewage is the one of the most prevalent problems facing the Atlantic Region with the exception of Prince Edward Island, and it is therefore a **high priority**.

The impact of sewage on the emerging aquaculture industry, shellfish harvesting, commercial fish processing and marine recreation represents a significant regional concern. Restrictions on the use of the fisheries resource in these coastal ecosystems have had a direct impact on local residents and their access to food and income.

The Atlantic Region is increasingly dependent on the tourism industry, and expansion in this sector may be seriously limited by bacterial contamination, eutrophication and associated loss of aesthetic and recreational value. Sewage is also a public health issue where treatment is not available or the technology not adequate. There are two dimensions to this problem: first, the major point sources for sewage in this region are the large municipalities where harbours suffer from contaminated sediments, bacterial closures and aesthetics problems; second, non-point sources play a large role in the contamination of shellfish growing areas, particularly in the Gulf of St. Lawrence.

<u>*Persistent Organic Pollutants*</u>

Persistent organic pollutants have been assessed to have a **medium priority**. Local sources continue to diminish as controls come into place. However, atmospheric transport from other parts of North America increasingly contributes to ecosystem-wide impacts. There is more concern over the role of POPs as endocrine disrupters, and unregulated application of pesticides for non-commercial purposes is seen as one area where substantial improvements could be made.

<u>*Radionuclides*</u>

Radionuclides were given a **low priority**. Current regulatory mechanisms are effective and should continue to be enforced.

Heavy Metals

Heavy metals constitute a **medium to high priority** in the Atlantic Region. There are a number of individual contaminated sites in the region. These point sources are coming under increasing control. However, the discharges associated with urban wastewater continue to cause contamination in Atlantic harbours. There is rising concern about the level of mercury in certain areas. Further research on metals in the Atlantic Region is required.

Oils/Hydrocarbons

Oils and hydrocarbons were given a **medium priority**. When no major spill occurs, the sources of these contaminants are usually small spills, leaks or accidents. The cumulative effect and public perception generate the priority concern, along with the expansion of offshore oil and gas production and associated land-based facilities.

Nutrients

Nutrients are given a **medium priority**, with the qualifier that nutrients are a major concern in Prince Edward Island and may become a concern in certain areas of Nova Scotia and New Brunswick. Studies on the link between coastal eutrophication and HABs merit further research and continued monitoring.

Contaminated Sediments

Contaminated sediments are assigned a **medium priority** in the Atlantic Region. There are a number of contaminated sites, particularly several harbours in the region where sediments have been the recipient of municipal wastewater and industrial effluents.

Litter

Litter is given a **high priority**. It is a highly visible public issue throughout the region. Ecotourism, a growing industry in Atlantic Canada, relies on the perception of pristine beaches and coastal waters to attract its customers, making this an important environmental and economic issue.

7.2B Physical Alteration and Destruction of Habitat

Shoreline Construction/Alteration

Although shoreline construction and alteration practices are well regulated by the provincial and federal governments, this sector of activity can have a large-scale impact on habitat. It is therefore assessed at a **medium priority** to address, in particular, the need for further research on the cumulative impact of shoreline construction and alteration on coastal ecosystems. Further research on the adequacy of habitat compensation and mitigation measures is also required.

Inter-tidal and Sub-tidal Alteration

The growing inter-tidal and sub-tidal alteration activities, linked to the growth of the marine plant harvesting and aquaculture industry in the region, require continued monitoring. The existing provincial and federal legislation is adequate, explaining the **low priority** rating. This rating may need to be reviewed if the region continues to experience further expansion in this sector. More research is required on productivity associated with rockweed ecosystems and lobster nursery habitats before more expansion.

Mineral and Sediment Extraction/Alteration

Mineral extraction on beaches can have substantial impact on habitat. Public concern over past practices has resulted in extensive controls on this activity. It is not currently a problem in any jurisdiction in the Atlantic Region, thus it is given a **low priority**. Renewed interest in abandoned gold and copper mines, as well as potential interest in mineral and aggregate extraction in offshore waters, could affect this rating in the future.

Wetland and Saltmarsh Alteration

There is a long history of wetland and saltmarsh alteration in the region. The increasing real estate value of coastal areas may bring more infilling of wetlands and saltmarshes. The cumulative loss of these significant habitats and resulting effect on primary productivity call for improvement in the application of existing provincial and federal regulations. Further public education is also required. Expansion of peat mining activities in coastal bogs requires further assessment. This is given a **medium priority**.

Marine Waters and Coastal Watershed Alteration

The main Atlantic issue in marine water and coastal watershed alteration is siltation. Many land-use practices, although limited by existing provincial and federal legislation, result in increased erosion and silt loads to the coastal environment. This issue is given a **medium priority** to recognize the need to improve existing project review mechanisms and to address the need to develop habitat quality standards in coastal environments.

Biological Alteration

The Atlantic Region has been somewhat protected from the introduction of non-indigenous marine organisms, given its relatively cold and saline waters. The expansion of aquaculture, tourism and transport activities increases the likelihood of exotic species introduction. This raises the potential for serious social, economic and health consequences and therefore requires a **medium-high priority**.

7.3 Setting Goals and Management Objectives

Under the NPA, Canada's goals are to:

- protect human health;
- reduce the degradation of the marine environment;
- remediate damaged areas;
- promote the conservation and sustainable use of marine resources; and
- maintain the productive capacity and biodiversity of the marine environment.

The following are specific management objectives for each source category.

7.3A Contaminants

The general management objective for most of the contaminants is to reduce their presence in the marine environment, primarily through pollution prevention. Where contaminants are released to or occur in the marine environment, the management objective is to apply life-cycle management or remediation to address the problems.

Specific management objectives for each of the contaminants of concern at the national level are as follows.

Sewage — reduce contamination from sewage; maintain and improve estuaries, coastal water and marine ecosystem quality for all users; maintain and restore shellfish growing areas.

Persistent Organic Pollutants — reduce/virtually eliminate anthropogenic inputs; apply life-cycle management to remaining inputs.

Radionuclides — reduce inputs where they are likely to cause pollution; apply radiological protection.

Heavy Metals — reduce inputs where they are likely to cause pollution; apply life-cycle management.

Oils/Hydrocarbons — prevent spills and establish contingency plans; apply life-cycle management.

Nutrients — reduce inputs where they are likely to cause pollution.

Contaminated Sediments — reduce sediment contamination at source.

Litter — reduce the incidence of litter/debris found in the marine environment.

7.3B Physical Alteration and Destruction of Habitat

The primary management objectives are to mitigate or avoid harmful alteration and destruction of habitats, and to restore those habitats already degraded. For some categories of harmful alteration (e.g., mineral and sediment extraction or alteration; alteration of marine waters and coastal watersheds), it is also necessary to identify critical habitats to ensure such activities take place in areas of lesser environmental sensitivity or significance. Finally, there are some specific management objectives that apply to unique problems. For instance, the objective is to eliminate the accidental or deliberate introduction of exotic species to the marine environment from land-based activities.

Specific management objectives for each of the habitat categories of concern at the national level are as follows.

Shoreline Construction/Alteration — minimize habitat loss and balance these losses by restoring or creating equivalent replacement habitat.

Inter-tidal and Sub-tidal Alteration — identify critical habitats and prevent loss or degradation of these areas while restoring those areas already degraded.

Mineral and Sediment Extraction/Alteration — identify and protect sensitive habitats and marine resources.

Wetland and Saltmarsh Alteration — prevent any further loss or destruction of critical habitats and, where feasible, restore valuable areas previously drained or altered.

Marine Waters and Coastal Watershed Alteration — protect key habitats for all life stages of marine resources.

Biological Alteration — prevent all inadvertent or inappropriate introductions of alien species and pathogens and protect sensitive coastal ecosystems.

7.4 Strategies and Actions

7.4A Contaminants

Sewage

- Expand incentive programmes encouraging the installation or upgrade of municipal wastewater treatment systems.
- Facilitate the installation of waste management solutions adapted to small communities for collection and treatment of sewage.
- Promote a community-based approach to address point and non-point sources from agriculture and urban areas and develop

ownership and empowerment mechanisms for coastal communities.
- Promote the installation and better maintenance of septic systems by individual households and involve the septic maintenance industry in this process.
- Promote research and development of alternative approaches for small communities and those with special geographic/climatic features.
- Enforce existing regulations in cases of non-compliance.

Persistent Organic Pollutants

- Monitor indicator species to assess the long-term impacts of POPs on populations.
- Encourage efforts by industry to (a) switch to better management practices and life-cycle management of their products and (b) lower the input and ecological cost associated with the use of POPs.
- Develop domestic pesticide and integrated pest management awareness for homeowners, explaining alternative and practical measures to reduce household reliance on chemical pesticides.
- Produce a household pollution prevention audit and resource guide that will (a) include information on the safe storage and handling of household hazardous wastes and (b) propose substitutes for toxic household chemicals.
- Improve testing and control of chlorination and bromination to disinfect water supplies and treat wastewater.
- Study the scale and severity of the endocrine-disrupter effects attributed to POPs.
- Encourage better management practices in agricultural and aquaculture production.

Radionuclides

- Continue monitoring the Point Lepreau generating station.
- Continue monitoring Belledune effluents.

Heavy Metals

- Continue monitoring of known sources and efforts to clean up known sources of heavy metals.
- Continue efforts to solicit interest in the development of pollution prevention processes from U.S. and Canadian large industry.
- Study the endocrine-disrupter effects and other health effects of heavy metals.
- Develop codes of practice and certification programmes that meet pollution prevention guidelines for heavy metals.

Oils/Hydrocarbons

- Maintain centralized emergency spill reporting facilities.
- Update and maintain spill contingency plans and training.
- Encourage efforts by industry to switch to better management practices and lower the ecological cost associated with improper waste oil disposal.
- Conduct research on Orimulsion ®.
- Promote research and development of alternative non-hydrocarbon-based energy sources.

Nutrients

- Encourage industries to switch to better management practices and lower the input and ecological cost associated with eutrophication.
- Monitor the effects of intensive finfish aquaculture operations.
- Promote a community-based approach to address point and non-point sources of

nutrients and adopt watershed management.
- Prepare public education programmes to help communities reduce nutrient loads.
- Monitor indicator species.
- Promote research on the impact of nutrient application in agriculture on water quality.

Contaminated Sediments

- Continue monitoring of known sources of sediment contaminants.
- Encourage proper disposal of known or suspected contaminated sediments.
- Continue efforts to clean up contaminated sites such as the Sydney Tar Ponds.
- Minimize disturbance of known contaminated sites.

Litter

- Promote a community-based approach to reduce litter in coastal areas.
- Conduct awareness campaigns directed toward waste reduction and litter prevention.
- Promote the adoption by the fishing community of biodegradable gear.
- Continue efforts to equip marinas, wharves and ports with waste-disposal facilities.

7.4B Physical Alteration and Destruction of Habitat

Shoreline Construction/Alteration

- Promote a community-based approach to reduce shoreline construction and alteration in Atlantic communities.
- Build on existing government and community-based programmes to protect fish habitat.
- Monitor indicator species and key habitats.
- Prepare public education programmes.

Inter-tidal and Sub-tidal Alteration

- Promote a community-based approach to prevent damage to inter-tidal and sub-tidal habitats.
- Monitor aquaculture operations.
- Introduce ownership mechanisms where none exist (e.g., leases).
- Monitor indicator species and key habitats.
- Encourage shoreline rehabilitation by local groups.

Mineral and Sediment Extraction/Alteration

- Protect critical habitats.
- Monitor potential expansion in this sector of industry.
- Ensure development of adequate codes of practice for the industry.

Wetland and Saltmarsh Alteration

- Protect critical habitats through adequate impact assessment of projects.
- Promote a community-based approach to protect these critical habitats.
- Harmonize federal-provincial policies on activities related to wetland and saltmarsh alteration.
- Encourage efforts by the peat and cranberry industries to adopt better management practices.
- Continue to participate in the Eastern Habitat Joint Venture through securement, promoting sustainable land-use practices in the agricultural and forest industries, wetland restoration and enhancement activities and community projects.

Marine Waters and Coastal Watershed Alteration

- Encourage efforts by industry to adopt better management practices and lower the input and ecological cost associated with sedimentation.

- Adopt a community-based approach to increase public awareness of the effects of sedimentation.
- Build on existing government and community-based programmes to protect fish habitat.
- Promote integrated coastal zone management and land-use resource planning to protect critical habitats.
- Encourage co-operation in the assessment and approval of activities that may cause sedimentation.

<u>*Biological Alteration*</u>

- Encourage efforts by the aquaculture industry to prevent the introduction of non-indigenous marine organisms.
- Promote a community-based approach to protect critical habitats.
- Promote public education on the consequences of species transfers.
- Continue to identify and monitor the distribution of non-native aquatic species.

7.5 Next Steps

The steps below represent the types of initial actions in the Atlantic Region.

<u>*Promote the Adoption of Integrated Coastal Zone Management*</u>

- Nova Scotia continues to implement its overall approach to coastal zone management as developed in the Coastal 2000 concept.
- New Brunswick is actively developing its coastal zone management policy framework as proposed under the Commission on Land Use and Rural Environment (CLURE).
- The Government of Prince Edward Island is actively developing and implementing soil and land management and watercourse protection legislation in the province.
- The Atlantic Coastal Zone Information Steering Committee (ACZISC), established in 1992 by the Council of Maritime Premiers, is mandated to promote integrated coastal zone management in Atlantic Canada and to develop the prerequisite information infrastructure. ACZISC members include the four Atlantic provinces, seven federal departments, First Nations, academia and the private sector.
- Global Programme of Action Coalition (GPAC) for the Gulf of Maine: GPAC has identified priority issues and developed 16 strategies to address those issues.
- In November 1999, the founding meeting was held to establish this new multistakeholder coalition for the southern Gulf that addresses issues related to land-based impacts on the marine environment.

<u>*Promote Research and Monitoring Activities*</u>

- Gulf of Maine Council on the Marine Environment: the Council operates a monitoring programme in the Gulf of Maine/Bay of Fundy called Mussel Watch, which uses mussels as bioaccumulators in the environment to monitor for toxic chemical levels. This is an ongoing project.
- A number of large projects in the Atlantic Region have taken into consideration habitat compensation and mitigation measures. Studies are under way to examine the cumulative impact of projects that affect habitat, and the adequacy and effectiveness of mitigation measures.
- Bay of Fundy Ecosystem Project: this is a co-ordinated effort to identify science priorities around the Bay of Fundy and to develop linkages within the science community to address key issues.

Promote Education Programmes and Community Involvement

- Remediation and Protection of Shellfish Growing Areas — a demonstration project will continue until March 2001 to study the impacts of aquaculture activities at various sites in both the Bedeque Bay and Cardigan Bay watersheds in Prince Edward Island. As part of this project, certain shellfish growing areas will also be remediated.
- Twelve of the 13 ACAP sites supported in the Atlantic Region have developed comprehensive environmental management plans for estuary and coastal areas in all four Atlantic provinces. These sites continue to involve local communities in the implementation of those plans.
- Sustainable development projects in New Brunswick will continue to address and remediate issues related to land-based impacts such as bacterial contamination of shellfish areas.

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