Shifting Sands

STATE OF THE COAST IN NORTHERN & EASTERN NEW BRUNSWICK

Inka Milewski and Janice Harvey
with Sue Calhoun

A Report by the Conservation Council of New Brunswick

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Preface

The Conservation Council of New Brunswick marked the International Year of the Oceans – 1998 – with the launch of a very rewarding investigation. After eight years of working on issues of environmental quality and resource sustainability in the Bay of Fundy / Gulf of Maine, we began a comprehensive review of issues facing the coastal ecosystems of New Brunswick's northern and eastern coast.

Two years later, we have finished what turned out to be a much more ambitious effort than originally planned. As we delved deeper and deeper into the published literature, spoke with local people, and discovered many existing and new initiatives underway in local communities and watersheds, our report of this investigation grew accordingly.

Even so, and despite its length, ***Shifting Sands*** *is not exhaustive. We know there are other issues and local initiatives worthy of discussion. However, we finally had to call a halt to the research and writing, and get this report into the public domain where it can begin to be useful.*

This report serves two purposes. First, it provides a starting point for people who wish to learn more about this amazing, dynamic coast. It describes the physical and biological context for the communities located here, and the marine resources on which many of those communities depend. Through the historic literature and present-day interviews, it introduces the reader to people who live here and their perspective on the changes that have occurred in their lifetimes.

Second, it provides an analysis of the state of the coastal and marine environment. This analysis considers the links between marine species decline and habitat loss. That loss is characterized by physical damage to habitat and the stress of pollution. It also considers the impacts of land use in a coastal environment that is unstable and constantly changing. The report assesses the adequacy of existing government policy and law, and the enforcement of these, to prevent coastal decline and restore coastal ecosystems to health. Finally, it assesses what knowledge is and is not available to inform the development of new policies and regulations to protect this vital, sensitive region.

Over the next several years, the Conservation Council will focus on some priority issues that have emerged from this report. Our hope is that the report will also be useful to existing groups working throughout the region, and that it will encourage concerned citizens not now involved in efforts to protect their coastal zone to become engaged. It will only be through such a concerted, collective effort that we will reverse what is clearly a downward trend in ecosystem health in the Bay of Chaleur, Miramichi Bay and Northumberland Strait.

Conservation Council of New Brunswick 2001

Acknowledgements

Many people have come together over a two-year period to make Shifting Sands a reality.

The initial literature reviews and early coordination were ably and enthusiastically undertaken by Monique Breau, as Project Assistant for the Conservation Council's Save Our Seas Campaign (1998-99).

Over the same period, Roland Chiasson, Sabine Dietz, Cathy Carnahan and Jocelyne Gauvin contributed photographs and conducted interviews with 30 people who have lived long and productive lives in this region and willingly offered their memories and perspectives to enrich this report. They are listed separately since their volunteer contribution deserves special recognition.

Author and fisheries consultant Sue Calhoun provided the first cut at synthesizing the growing pile of information that the literature review and interviews provided. Paul Jordan, Research Associate with the Rural and Small Town Programme of Mount Allison University, and Dr. Jeff Ollerhead, head of the Geography Department of Mount Allison University, contributed information, photographs and comments. Staff and scientists from several provincial and federal government agencies provided data, photographs, and information.

Funding for this project was provided by the Conservation Council's Marine Conservation Program and the New Brunswick Environmental Trust Fund. The Premier's Round Table on Environment and Economy provided in-kind support in the form of translation of the English text into French.

As mentioned earlier, the foundation of this report is the stories told by the people who live along the northern and eastern shores of New Brunswick. They graciously let our interviewers into their homes and gave them permission to record their words. They told us far more than space in this report would allow and we hope they find their words faithfully transcribed and translated. For various reasons, photographs of some of the people were not available. We greatly appreciate their contribution to this report and would like to thank them for sharing their stories with us:

Stafford Anderson, Burnt Church
Madeline Augustine, Red Bank First Nation
John Barbery, Dalhousie
Ben Baldwin, Douglasfield
Zoël Breau, Néguac
Donald Clements, Pointe-du-Chêne
Flora Cormier, Cocagne
Émile Ferron, Lamèque
George Field, Bayfield
Andrée Frigault, Miscou Havre
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Jacques Nowlan, Bouctouche
Normand Ouellette, Cap-Pelé
Lincoln Palmer, Tabusintac
Herménigilde Robichaud, Val-Comeau
Pierrette Robichaud, Richibucto
Simonne Robichaud, Richibucto
Cédric Rousselle and Ben Rousselle, Haut-Rivière-du-Portage
Francis Sippley, Baie-Ste-Anne
Pierre Turbide, Baie-Ste-Anne
Theodore Williston, Hardwicke

Bringing such an ambitious project through to completion takes the combined effort and cooperation of many individuals and agencies. The Conservation Council and the report's authors are deeply grateful to everyone who has made a contribution, large or small. Still, we retain full responsibility for the contents of the report, including any errors or omissions. The opinions expressed in the report are those of the authors writing on behalf of the Conservation Council, and do not reflect in any way on contributors who are not affiliated with the Council.

Inka Milewski

Janice Harvey

CCNB Marine Conservation Program

New Brunswick
Your Environmental Trust Fund At Work


QUEBEC
Restigouche River
Dalhousie
Campbellton
Atholville
Eel River Crossing
Charlo
Jacquet River
Belledune
Chaleur Bay
Miscou Island
Pointe-Verte
Petit-Rocher
Nigadoo
Beresford
Nepisiguit Bay
Grande-Anse
Caraquet
Lamèque
Lamèque Island
Bas-Caraquet
Shippagan
Bathurst
Tracadie-Sheila
Val-Comeau
Nepisiguit River
GULF OF ST. LAWRENCE
Tabusintac
Northwest Miramichi River
Neguac
Burnt Church
Miramichi Bay
Bartibog Bridge
Miramichi
Baie-Sainte-Anne
Bay du Vin
Miramichi River
KOUCHIBOUGUAC NATIONAL PARK
PRINCE EDWARD ISLAND
Southwest Miramichi River
Richibucto
Cap-Lumière
Northumberland Strait
Buctouche
Shediac
Cap-Pelé
CONFEDERATION BRIDGE
Cape Tormentine
Port Elgin
Baie Verte
Baie Verte
N.S.

I. Introduction

I. Introduction

The eastern shore of New Brunswick stretches for nearly 1,700 kilometres from the Restigouche River at the Quebec border to Baie Verte at the Nova Scotia border. A journey along the coast from north to south begins at Campbellton. The city, at the mouth of the river, is a service centre for an extensive forest industry in Restigouche County. Dalhousie, the industrial centre of Restigouche County with two wharves and a deep-water port, sits at the mouth of the Restigouche estuary where it flows into Chaleur Bay. Along the southern shore of Chaleur Bay are the settlements of Eel River Crossing, Charlo, Jacquet River, Belledune, Pointe-Verte, Petit-Rocher, Nigadoo and Beresford.

Bathurst, the mining capital of New Brunswick, is built on the estuary of the Nepisiguit River, and is the urban hub for the Acadian Peninsula. From Bathurst, the coast veers northeast, up the peninsula past Grande-Anse and Caraquet to Lamèque and Miscou Islands at its tip. Then it turns southward again, past Shippagan, Tracadie and Tabusintac to Neguac at the mouth of Miramichi Bay.

The recently amalgamated towns of Newcastle, Chatham, Douglastown and Nelson-Miramichi, as well as other small villages, now comprise the City of Miramichi, which sits at the mouth of the Miramichi River. Along the southern shore of Miramichi Bay we find Bay du Vin, Baie-Ste-Anne and Escuminac, the fishing villages that lost 35 men and boys to a fierce June storm 42 years ago while they were drifting for salmon on Miramichi Bay.

Rounding Point Escuminac and turning southward, we enter the Northumberland Strait which separates New Brunswick and Prince Edward Island (PEI). Kouchibouguac National Park occupies the coast between Pointe-Sapin and Richibucto at the mouth of the Richibucto River. Bouctouche is midway between Richibucto and Shediac, its Parlee Beach the summer recreation destination for many thousands. Cap-Pelé is mid-way between Shediac and the world-renowned Confederation Bridge, the fixed crossing to PEI. The neighbouring communities of Bayfield and Cape Tormentine are struggling with the loss of the ferry terminal which brought jobs and services to their otherwise remote area. The Cape marks the northeasterly boundary of Baie Verte, from which the coast veers westward to the village of the same name, Port Elgin, and the Nova Scotia border.

For centuries, First Nations peoples depended on this shoreline, the rivers, estuaries and bays for food and medicines, wood for heat and shelter, and for spiritual sustenance. Later as European settlement began, the extent of the riches, not only the fishery but also the forests and the minerals, became apparent. These became the mainstay of the economy as a growing population settled along the coast.

The economy of the Acadian Peninsula has depended almost exclusively on fishing, although peat moss is a growing industry. Like the Restigouche, the Miramichi River's shores have been dotted by sawmills, logging operations, pulp and paper mills and mines. From Pointe-

Sapin south to Baie Verte, the economy has also largely depended on the fishery, although peat operations have been increasing, and tourism is expanding rapidly.

In his 1852 benchmark study of the New Brunswick fishery, Moses Perley noted that these waters had a great extent and variety of fishing grounds and abundant supplies of valuable fish.

Today, human activity has taken its toll. Chemicals from mining and forestry operations have been dumped directly into streams and rivers, contaminating not only the waters but the plants and animals that live there. Fish processing wastes, municipal sewage and agricultural run-off have infiltrated the rich clam and oyster beds, forcing closure of many. Beaches have been quarried; practices such as dragging for fish, dredging and coastal construction have disturbed and destroyed habitats. Increasingly, there is competition for use of coastal resources.

It is a serious situation that some would characterize prematurely as jobs versus the environment. The reality, however, is that people who live along this shore need a healthy coastal environment if they and their communities are to survive and thrive. It is not too late, although it is time to take stock as a community, to see where we are going and what needs to be done.

This report is a first step. It is an attempt to assess what we know about the coastal environment, and what needs to be known. It is also a description of what local people have to say about what the coast has meant to their lives, how it has changed, and what the future holds.

II. Natural Assets

"The coastal zone of Eastern New Brunswick is one of the most important resource assets possessed by the Province."

Beach Resources: Eastern New Brunswick, Airphoto Analysis Associates 1975

So began a 1975 report on the state of New Brunswick's eastern coast. The report was commissioned by the provincial Department of Natural Resources to examine the extent and impact of sand mining from beaches along the eastern coast. It concluded that adverse environmental impacts were associated with all quarry activities and that heavy industry, dredging, small boat harbours, artificial beach protection, and intensive recreational cottage development and recreational parks were also having a negative impact on the beach environment.

The 1975 report made 13 recommendations and identified eight policy initiatives to ensure coastal resources would be enjoyed by future generations. Included in the recommendations were calls to i) preserve salt marsh and estuary environments; ii) prepare environmental impact statements prior to modifying shorelines, major dredging and expanding small boat harbours; iii) acquire lands for preservation and/or management; iv) prepare detailed hazard land zoning and development criteria; and v) enforce a minimum 75 to 150-foot shore setback regulation.

(Paul Jordan)

Coastal land development is encroaching upon ecologically important habitat.

(Paul Jordan)

Cottage owners are subject to the forces of nature as the sand dunes at Cap-Bimet retreat inland.

Twenty-five years have passed since those recommendations were made. Were the recommendations acted upon? A few such as the restriction of beach quarry activities and environmental reviews for certain development activities were implemented. The majority of recommendations were ignored.

Has the state of coastal resources on the New Brunswick's eastern and north shore improved since that


(Jocelyne Gauvin)

Beach at Cap-Pelé.

time? If the 1993 report from the NB Commission on Land Use and the Rural Environment (CLURE) is any measure, the answer is no. Twenty-five years after the *Beach Resources* report was released, coastal areas continue to be degraded by sewage and industrial waste. There has been an increase in the loss of recreational shore lands due to commercial development. There has been an acceleration in the erosion and instability of beaches due to human activity. There are increased risks to existing shoreline dwellings due to inadequate setbacks. And, there have been dramatic declines in certain commercially important fish and shellfish species.

The 1993 CLURE report also made recommendations. It identified the need to establish minimum province-wide standards for the management and development of coastal lands. In response, the provincial government agreed to develop a coastal land use policy because, as they acknowledged, a number of coastal features "have been specifically identified by New Brunswickers as being important and worth protecting." Just what are those coastal features worth protecting? For the eastern coast of New Brunswick they include beaches, dunes, salt marshes, oyster reefs, eelgrass beds, and estuaries.

Sand, sand and more sand

> *Beaches, although they offer ideal recreational opportunities, are one of the more sensitive environments in the coastal zone.... The deterioration of beaches in Eastern New Brunswick is a major concern calling for immediate action to implement sound resource management.*
>
> *Beach Resources: Eastern New Brunswick*
> *Airphoto Analysis Associates 1975*

A plane ride up the coast of eastern New Brunswick offers a dramatic view of the most distinguishing features of this coastline. It is low lying, with a string of barrier islands stretching from Shediac to Miscou, and it has sand, lots of sand. It is not until you round the Acadian Peninsula and move into the Bay of Chaleur that the coast becomes more rocky and steep.

Beaches are more extensive in the Northumberland Strait where the coast is low-lying and


(NB Image Bank)

Aerial photo of Kouchibouguac National Park.

there is a large supply of sediment. Yet on the west coast of Miscou Island, there are more than 30 parallel dunes. Known as the "grand plain" to the islanders, the dunes are of different heights and are irregularly spaced. This entire dune system seems to be moving inexorably towards the ocean.

The barrier beaches, dunes, estuaries and sand spits of eastern New Brunswick owe their source of sand to the underlying geology of the region which is predominately sandstone. For hundreds of thousands of years, tides, winds, waves, currents and sea ice have weathered the sandstone and determined where the resulting sand and other sediments will be transported and deposited. The primary source of sediments in estuaries is rivers which carry and deposit silt and other material often from far distant and extensive drainage basins. Sand for dunes is mostly deposited by wind. Waves and offshore currents are the primary source of sand for barrier beaches, spits, and tidal gullies.

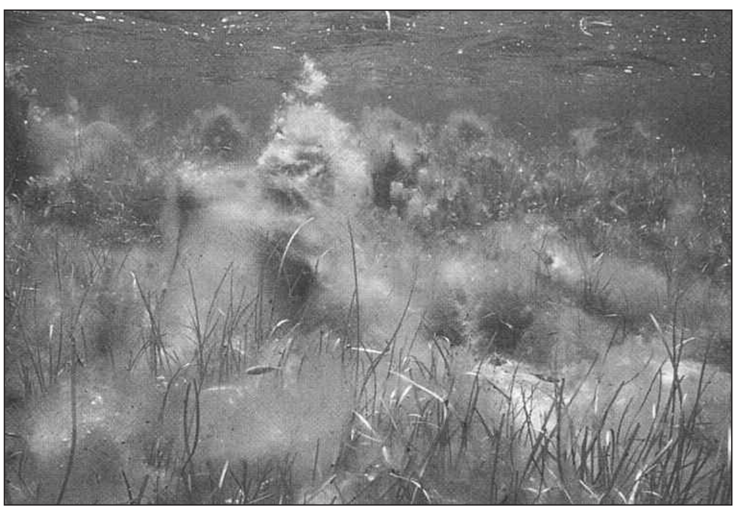
These sands are as characteristic and influential in defining the nature of the eastern coast of New Brunswick as are the tides in the Bay of Fundy. Like the dynamic and powerful tides of Fundy, the movement of sand shapes coastlines and determines the distribution of habitat and species. Just as changes to the natural flow of tides can have dramatic ecological impacts, altering the flow of sand can also have ecological consequences.

The sands of tidal gullies, barrier islands, beaches and spits are in dynamic equilibrium which means they are continually changing depending on the strength or weakness of the forces that shape them. There is a balance between the deposition of sand or sediment and the erosion of sand. As a result, these coastal features are very sensitive to disturbance. Unnatural removal of sand in one area could mean excess erosion or deposition of sand in another area. Tidal gullies, which are deep natural cuts through a coastal feature and an important ecological link for fish migrating between rivers and adjacent waters, are particularly sensitive to disturbance.

Saltmarshes, eelgrass beds and oyster reefs: nurseries and recycling centres

(N. Rask)

Healthy eelgrass bed.



(N. Rask)

Eelgrass smothered by algae as a result of nutrient loading.

Some of the most important marine habitats in the world are salt marshes, eelgrass beds and oyster reefs. Salt marshes and eelgrass beds are known to be important nursery areas for inshore and offshore fish, shellfish and birds. All three habitats are areas where nutrients for plants and animals are recycled. And all three habitats serve to stabilize sediments and reduce erosion.

The eastern coast of New Brunswick has all three habitat types. Salt marshes can be found in numerous areas along the coast including Heron Island, Miscou Island, Kouchibouguac, Bouctouche, Cocagne and Jourimain Island. Tabusintac, Kouchibouguac, Bouctouche, and Cocagne are also sites for eelgrass beds. Oyster reefs, protected by sand dunes, are found in Caraquet Bay, Miramichi Bay and Bouctouche Bay. The presence or absence or these habitats is due to a delicate balance between too much sediment and too little sediment.

Much is known about the function of salt marshes and eelgrass beds in the ecosystem. They are organic factories producing nitrogen, phosphorus and carbon that feed plants and animals (Kenworthy *et al*. 1982). They are traps for sediments and reservoirs for nutrients. During the summer they are generally net importers of nutrients when the grasses are growing; in winter they are net exporters (Valiela *et al*. 1978). They play an important role in providing food to filter-feeding bottom organisms like oysters, clams, mussels and quahogs

(Wildish and Kristmanson 1997). Eelgrass beds are thought to provide shelter and act as nursery areas for very young lobsters, scallops and quahogs. Salt marshes are shelter and nursery areas for young fish such as striped bass, as well as birds such as herons and ospreys.

Much less is known about the role of mollusc reefs in marine ecosystems. These are dense aggregations of oysters or mussels that, over long periods of time, have formed extensive intertidal (blue mussel) or nearshore subtidal (oyster) reefs. Despite the presence of oyster reefs along the eastern coast of New Brunswick and the long-standing importance of oysters and other molluscs to the economy of the area, no research has been done to determine their role in maintaining oyster populations or their contribution to local productivity. The construction of a channel through the Maisonnette sand dune in Caraquet Bay, however, has prompted government and university scientists to investigate the claim by local residents that the growth, mortality and recruitment problems in oyster populations in the area are linked to the channel construction (Landry *et al*. 1997).

Studies done elsewhere suggest that mollusc reefs increase the bottom roughness, thereby increasing turbulence and resulting in more food being brought from the water column to the bottom (Fréchette *et al.* 1989). It is also thought that oyster reefs link the bottom to the overlying water column resulting in material cycling between the two systems (Dame *et al*. 1980). The net result would be that oyster reefs help to retain nutrients such as nitrogen within estuaries (Dame and Libes 1993). Finally, there is some evidence that mollusc reefs can reduce the development of phytoplankton or algae blooms in estuaries subject to nutrient loading (eutrophication) (Officer *et al.* 1982; Nichols, 1985).

Estuaries: transfer stations

(Piper Project - Projet Siffleur)

Pokemouche estuary.

In addition to the sand beaches, salt marshes, eelgrass beds, and barrier islands, the coastal features of eastern and northeastern New Brunswick include a series of river systems, the largest being the Restigouche and Miramichi. Other rivers include the Nepisiquit, Richibucto, Bouctouche, Cocagne, Shediac and Scoudouc. At the mouth of these rivers, the outflowing fresh water mixes with the salt water of the coast to form estuaries. Estuary waters are not as salty as the open ocean or as fresh as the river upstream. Therefore, a different mix of plants and animals live there than you would commonly find further out to sea or upstream.

Many estuaries contain salt marshes. Even if there are no marshes present, estuaries support many of the same plants and animals as salt marshes, and so serve a similar function. Tides and winter ice sheets break up decaying sea and marsh grasses such as cord grass, salt meadow hay and eel grass and wash the plant particles into estuary waters. In addition, nutrients from the river banks upstream are carried by the rivers into the estuaries. There they mix with decaying seaweeds and algae to form a rich vegetarian feast for marine animals.

Estuaries are important transfer stations for anadromous fish, fish which spend part of their life cycle in fresh water. Each year and at staggered times, smelt, Atlantic salmon, sea trout, striped bass, gaspereaux and eels move through estuaries and into the rivers where they spawn, feed or mature.

According to Dr. Graham Daborn, Director of the Acadia Centre for Estuarine Research at Acadia University, "We've slowly come to realize the extent to which the productivity of our estuaries and particularly marshes [in estuaries] is not only very rich, it is comparable to some of the richest ecosystems.... They talk about coral reefs and tropical rainforests as if they were the only really rich environments left on the planet. In reality, productivity in estuaries is often in the same order of magnitude, and we didn't realize that until more recently".

Creating the marine food web

Complex biological processes combine with physical and oceanographic processes to create the marine environment. In any coastal environment, oceanographic forces such as tides and winds act on the physical environment - land boundaries and geological formations - to move things through water masses. Tides and tidal currents bouncing off the physical shoreline create local water currents. Winds affect ice movement and transport materials throughout the atmosphere. Oceanographic processes such as heat exchange and freshwater flow determine the availability of nutrients to marine life and as a result, where marine life is most abundant and diverse.

At the bottom of the marine food web are nutrients which come from a variety of sources like decaying plants and animals. Nutrients are important because the sun's energy combines with water temperature and nutrients to produce massive "blooms" of microscopic plants called phytoplankton on which equally small animals called zooplankton feed.

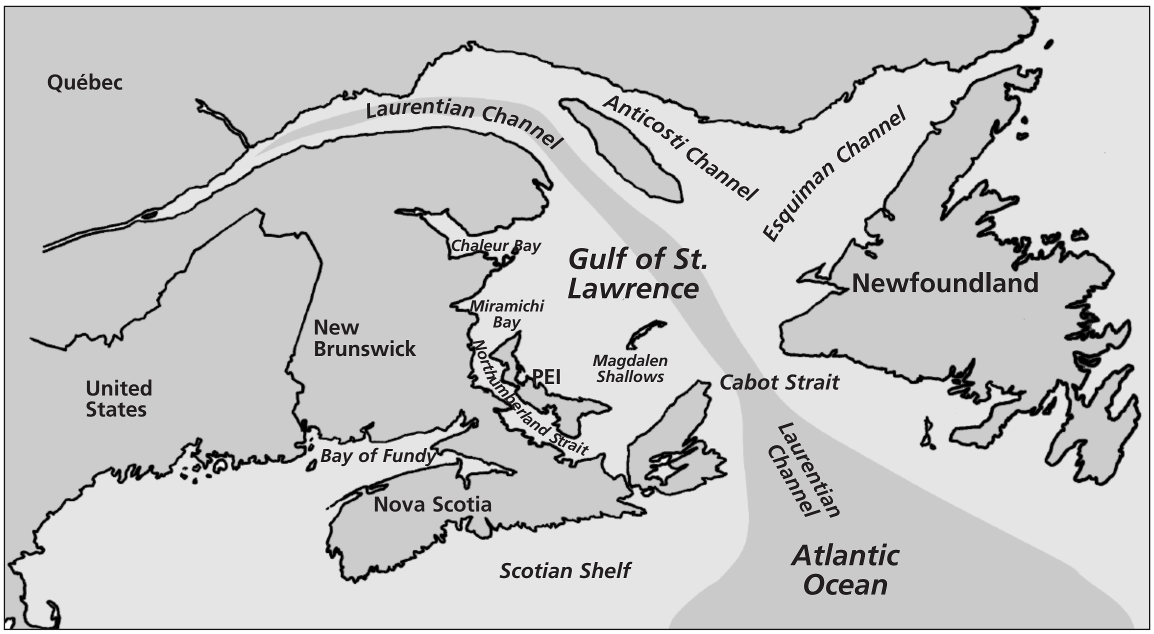
Together, phytoplankton and zooplankton are the food source - the building blocks, if you will - for all other species. Organisms living in water columns (called the pelagic environment) as well as those living in or on sediments and rocks on the bottom (called the benthic environment) depend on this food source, which is distributed throughout the marine environment by tides and tidal currents.

(While nutrients are important, an overabundance can produce toxic algae blooms which are poisonous to humans. Higher than normal inputs of nutrients usually indicate chemical or bacteriological pollution caused by human activity.)

Aside from plankton, the pelagic community includes large species such as fish, seals, whales and seabirds. The benthic environment includes seaweeds, crabs, lobsters, worms and sea stars. In both environments, changes in temperature, light and salinity throughout the water column and on the water surface are important factors which effect marine conditions.

Part of the whole: Southern Gulf of St. Lawrence ecosystem

The eastern coast of New Brunswick is part of the southern Gulf of St. Lawrence ecosystem where the various species, habitats and ecological functions are interconnected via ocean currents and tides. The Laurentian Channel separates the southern Gulf of St. Lawrence from the rest of the Gulf. This is a deep marine valley in the continental shelf which begins in the ocean beyond the Scotian Shelf and ends at Tadoussac in the St. Lawrence estuary, a distance of over 1,300 kilometres.



Southern Gulf of St. Lawrence (from White and Johns 1997)

The St. Lawrence River supplies an enormous volume of fresh water to the ocean, while the Laurentian Channel carries sea water to the Gulf and St. Lawrence River. Both carry nutrients and they meet and mix in the Gulf of St. Lawrence to create a unique marine environment. In fact, the Gulf of St. Lawrence acts in many ways like an estuary. Nutrients, fish and shellfish, their eggs and larvae, move along these ocean highways.

Directly south of the Laurentian Channel is the Magdalen Shallows, an area of 50,000 square kilometres where waters are warm and shallow. The Shallows is considered the most important physical feature of the southern Gulf. Here the currents weaken between the Laurentian Channel and PEI before leaving through the Cabot Strait. The warm waters of the Magdalen Shallows result in a higher diversity of phytoplankton and ichthyoplankton (eggs and larvae of fish) than other regions of the Gulf. These features combine to make the area, including its bays and inlets, an important spawning, feeding and nursery area for numerous fish species. Larval fish are more abundant in the Shallows than anywhere else in the Gulf.

Zooplankton biomass is highest in the western portion of the Magdalen Shallows, where the overall abundance is higher than in the adjacent Laurentian Channel. The rich summer zooplankton support the spawning and nursery areas for many commercial fish species, and provide a seasonal feeding ground for others. Most of the catches of herring, mackerel, crab and lobster in the Gulf of St. Lawrence are taken from the Magdalen Shallows (White and Johns 1997).

Tides reach the Gulf of St. Lawrence through the Cabot Strait, and circulate in a counterclockwise direction around the Gulf. In the southern Gulf, there is one low and one high tide per day while in the northern Gulf there are two low and two high tides each day. Tides in the Gulf are less dramatic than those in the Bay of Fundy, reaching an average height of three metres compared to five to 15 metres. Strong winds are frequent in the Gulf as a whole, especially in winter and spring, and storms tend to be large. Fresh water is a dominant influence in the southern Gulf, flowing into the Gulf from the many river systems, especially the St. Lawrence. Because of this, the entire Gulf is ice-packed from December to April, which in turn shapes the way people use these waters.

To fully understand the ecology of the southern Gulf of St. Lawrence, it is important to look at the entire food web: how species interact with one another and their environment, and the flow of energy and nutrients among subregions and in the system as a whole. Unfortunately, this isn't possible because of the lack of information. Phytoplankton species composition is poorly known. Jellyfish are probably an important component of the food web in the southern Gulf but little is known about their ecology. Distribution patterns of fish eggs and larvae are generally known but their diet, prey and predator-prey relationships are not. Thus the major factors affecting their growth and survival are poorly understood. The bottom environment (benthos) has only been described in a few isolated areas in the southern Gulf, particularly those areas important to the commercial fishery.

Clearly, there is still a lot of missing information when it comes to oceanographic and biological processes in the southern Gulf. Understanding these processes, however, is important because human activities often impinge on them. Fishing technology such as bottom trawls or draggers can stir bottom sediments, killing benthic species that are the food sources for bottom feeders such as cod. Large amounts of suspended sediment, caused by dragging or dredging, can affect benthic egg survival. Chemical and bacterial effluents hold great potential to destroy the marine food web at all levels although their effects on fish, marine and bird populations are relatively unknown.

III. An Epidemic of

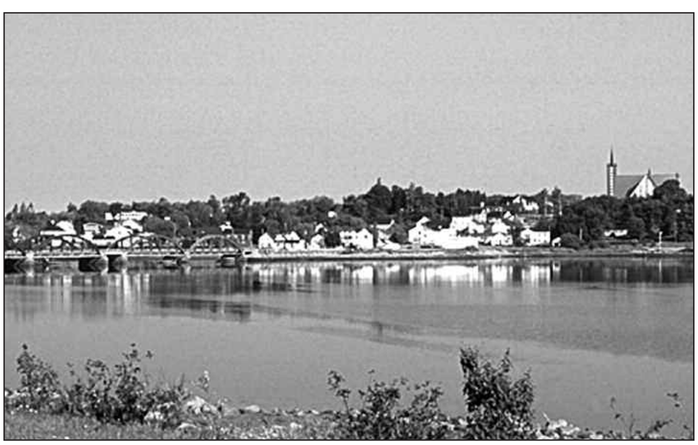
Development: Distress Signals

“A lot of people around here have this comment: ’do you remember when we went drifting salmon and jigging cod? Those were the days!’”
Zoël Breau, Néguac fisherman

Commercial fishermen who live along the north and eastern shore of New Brunswick haven't fished salmon since the commercial fishery was closed in 1984. Nor have they fished cod since a moratorium was put in place in 1993. For people whose livelihoods depended on these fisheries, these closures were a major economic blow. And today, despite innumerable studies on both species, scientists are still baffled about where exactly the fish have gone.

Fishermen are not the only ones to notice changes that have taken place in the area over the years. It is not just the reduction in such fish species as salmon and cod but changes in the environment itself: the closure of clam and oyster beds because of pollution, the change in water colour and quality, the loss of habitat, the erosion of the shoreline.

"Our people have been fishing this river for about 3,000 years," says Madeline Augustine, a community health worker at Red Bank First Nation reserve on the Little Southwest Miramichi. "I remember my father and grandfather talking about how narrow the river used to be and how deep. Because of that, everything was plentiful. We had all kinds of salmon, shad, sturgeon. Then people started clear-cutting by the river, and that is when our river banks started to erode. And they kept eroding over the years which made the river wide and shallow, preventing the sturgeon from coming up. Our river keeps getting wider and more shallow as the years go by."



(NB Image Bank)

Bathurst Harbour.

"The changes I have seen over the years since 1974, some are for the good and a lot of it is for the bad," says Ron Gauthier, a wildlife ranger with the provincial Department of Natural Resources and Energy in Bathurst. "In Bathurst Harbour, the pollutants were there prior to 1974 - such as Brunswick Mines, that was always there. And Little River which is a contributor to the Bathurst Harbour is in part totally polluted. And also the mill, it's been here since the 1920s, and they've always contributed to pollution. But they are improving on their pollution plans, because of public pressure. Also the city has developed a treatment plant in several key points in the Bathurst estuary. Now our water is a lot clearer and eelgrass is coming back on the banks which gives nutrients to the harbour when it breaks down and also benefits migratory birds."

Mildred Milliea is a mother, wife, researcher, translator and educator on the Big Cove First Nation reserve, New Brunswick's largest native reserve, on the Richibucto River. She has been married to her husband William for over 50 years. "Our shores are so badly polluted," she says, "that we have not been able to dig clams or oysters for about 30 years, and those were our vital diet in my childhood. In the summer, we lived on clams and my father earned a living fishing oysters. People used to enjoy fishing smelts as soon as the river froze. My mother used to send me down to the creek, which is right below where our home is now, to pick goose tongues. But today you can't touch anything on the shore. It is so badly polluted because the sewage flows right through the creek."


(Cathy Carnahan)

Mildred Milliea, Big Cove First Nation.

According to a 1975 report, threats to the eastern coast included: contamination and pollution from various industries and municipal and private sewage facilities; dredging and related disposal of dredge spoils; infilling of saltmarshes, wetlands and estuaries for the construction of causeways or land development; construction of boat harbours, slips and shore protection works; and cutting of coastal forests (Airphoto Analysis Associates 1975). These activities continue today.

A great deal of the pollution and damage has come from human neglect or ignorance. As recently as 1975, the provincial government allowed beach quarrying. It issued permits to companies to harvest sand in lower intertidal zones, which was then stockpiled on inland dunes and salt marsh areas to await shipment for use in highway construction or on railroad tracks. Only when a consultant was hired to carry out a three-year study of the coastal environment did provincial representatives realize that perhaps this kind of activity damaged the ecologically sensitive salt marsh areas and ruined the recreational value of these beaches. Much of the pollution of clam beds is attributed to agricultural run-off, non-existent or inadequate municipal sewage systems, and increasing construction of homes and cottages on the waterfront.

Pierrette Robichaud, who has lived in Richibucto all her life and has worked at Kouchibouguac National Park for 20 years, paints a vivid, almost haunting portrait of the way in which people along the shore did their spring cleaning. "I remember when everyone around the Richibucto and Rexton area would gather all their garbage together in the spring - old stoves, refrigerators, pots and pans - and set them on the ice in the river before it melted. My mother would tell us how lucky we were to have such a place. The sea takes away our garbage for free, and gets rid of it for us. We never see it again! This was routine, every winter, year after year!"

Marine bounty

In his report on the New Brunswick fishery prepared during the early 1850s, Moses Perley wrote in superlatives. He found "abundant" quantities of cod, herring and mackerel, which dominated the fishery along New Brunswick's shore, "prodigious" amounts of salmon in the Restigouche and Miramichi Rivers, as well as the rest of the rivers dotting the shore; lobsters, oysters, clams, mussels, whelks, razor-fish, crabs and shrimps, "in the greatest abundance and of excellent quality."

Today, the portrait is not as rosy. The fishery along New Brunswick's eastern coast has changed dramatically since Moses Perley's time, perhaps the most striking evidence being that both the commercial salmon and cod fisheries are now closed.

The commercial fishery includes three categories: fish, crustaceans (shrimp, crab and lobster) and molluscs (clams, oysters, mussels, scallops). Fish, in turn, are divided into groundfish (so-called because they live and feed on the ocean bottom; this includes cod, plaice, flounder, redfish) and pelagics (which live and feed in the water columns far above the bottom; the most important commercially are herring and mackerel). Salmon are considered pelagic although they are also called anadromous because they live in the ocean but return to the river of their birth to spawn.


(Provincial Archives of New Brunswick-PANB)

Smelt fishing in winter on the Miramichi River.

Fisheries in the southern Gulf were traditionally dominated by groundfish (cod and redfish), lobster and herring. In the last 20 years, however, a major shift has taken place. Crab and shrimp fisheries have greatly expanded, and the cod and redfish fisheries have closed.

A report by the Department of Fisheries and Oceans notes that "excessive harvest and poor fishing practices are clearly the main factors responsible for the decline of cod stocks, although other factors have also played a significant role." For reasons not yet clear to scientists, starting in early 1970s cod stocks were replenishing themselves at much lower rates than normal. At the same time exploitation was intensifying.

The decline in the cod population may, in fact, be partly responsible for the expansion of the shrimp fishery. Normally found in the northern Gulf, in recent years large concentrations of shrimp have been found towards the southeast in the Laurentian Channel, in areas where previously they were rare. Scientists speculate that this may be due to the absence of cod and redfish, known to be major predators of shrimp.

The Queen crab is also a relatively new fishery. It began in the late 1970s when the collapse of Alaska King Crab stocks on the west coast drove prices from 25 cents per pound to $2.50 almost overnight. People now call it Acadian Snow Crab because of the number of Acadians on the Peninsula who have become wealthy because of it. Since the fishery started, exploitation by the mid-shore fleet (vessels 20-30 meters) based on the Peninsula has been intense, however, and the snow crab biomass is currently at low to medium levels throughout the Gulf.

For the inshore fishery (vessels under 15 meters), historically lobster has been the most important fishery. Lobster live mainly on rocky bottoms near the coast. Landings along the

(Jocelyne Gauvin)

Donald Clements, Pointe-du-Chêne

Twenty years ago, fish processing plants like ours were doing a lot of groundfish. We used to have three filleting lines. We had people working for probably seven, eight, and nine months of the year on groundfish alone like cod, flounder, pollock, redfish. We don't process those fish anymore.

We also used to have a big business in the winter time, in January, February and March. We use to do a lot of herring for foreign countries such as herring fillets and marinated herring and headless and dressed herring. All that is gone. I don't know if we lost the markets on our own or if we just didn't bother to keep them up. I really don't know what happened there.

(Jocelyne Gauvin)

Normand Ouellette, Cap-Pelé

We make a living from the fish taken at sea, brought to the plant, processed and sold on international markets. This plant has been in operation for 35 years and I have been the owner for 25 years. Have there been changes in 25 years? We expect the market to be there for some time but we are not so sure about the fish stocks. Recently we have seen a great decrease in fish. There are conservation efforts being made but we still feel that in four to five years there could be a problem.

(NB Image Bank)

Crab boats on Acadian Peninsula.

southern Gulf coast increased steadily over 20 years until the early 1990s when catches started to decline. Reasons for the decline, again, are not clear.

In terms of pelagic fish, herring has traditionally been the most important. Moses Perley called it "one of the most prolific and most valuable fisheries of the Gulf," although he lamented that it wasn't being carried out properly. "Being caught in the very act of spawning, they are thin and poor, of little value as an article of food, whether fresh or salted...thousands of barrels are found of so little worth, that they are used to manure the land, or are left to rot upon the beaches." Herring biomass is currently decreasing from a peak reached in 1992.

The other important pelagic fish in the southern Gulf is mackerel, a summer visitor to the Gulf which winters on the edge of the continental slope off New England and Nova Scotia. Mackerel has always been considered an under-fished species, and scientific evidence suggests that mackerel biomass is currently high, although fishermen complain that they can never seem to catch it.

Molluscs such as scallops, clams, mussels and oysters either live directly on the bottom or buried in sediments. As a result, their presence depends on the nature of the ocean bottom. They are often found in localized, well-defined areas called beds. The most important commercial mollusc is scallops, of which the Giant Scallop is the most common species in the southern Gulf. Northumberland Strait, in particular, is a rich scallop area and most beds are exploited commercially. Indications are that they are fished heavily with gear that drags the ocean bottom. One researcher noted that in Chaleur Bay as many scallops were killed by dragging as were harvested.

Because of contamination, many parts of the eastern shore are closed permanently to harvesting of oysters, clams and mussels. Other areas are monitored and remain open as long as faecal coliform levels do not increase suddenly (because of heavy rains washing agricultural products or human and animal wastes into the watershed).

Sedimentation and contaminants

Sediments released into the water can clog the gills of fish and shellfish, reduce photosynthesis and the buoyancy of eggs and possibly larvae, smother bottom-dwelling organisms like oysters, scallops and clams and reduce oxygen levels in the water. With increased human activity along rivers, the amount of sediment deposited in coastal estuaries has increased dramatically.


(PANB)

Log drive down the Miramichi in the early 1900's.

Hundreds of years of harvesting timber in the watersheds of rivers such as the Miramichi, Restigouche, and Nepisiguit has resulted in increased erosion of forest soil and more silt being released into the rivers (Buckley,1995). The addition of saw mills and pulp and paper operations along rivers added a large new source of material in the water.

For example, between 1890 and 1950 the average pulp waste discharged into the Miramichi River from the Newcastle mill was about 2,500 tonnes per year. Between 1950 and 1977, the annual average discharge rose to 20,000 tonnes. Today, between 10 and 20 tonnes of suspended solids enter the Miramichi River from pulp mill operations every day. The total organic carbon accumulation in the Miramichi system is comparable to Halifax Harbour, a system identified as being highly contaminated (Buckley and Winters, 1992). Pulp mills in Bathurst, Dalhousie and Atholville also discharge large volumes of wastes into waterways. To a lesser extent, agricultural run-off also adds to the amount of organic material in rivers and estuaries.

Sediments also play a major role in the transport and fate of pollutants (Environment Canada 1996). Toxic chemicals can become attached or adsorbed to sediment particles and then transported to and deposited in other areas. Historic and current sources of some toxic chemicals in eastern New Brunswick include:

- pesticides such as DDT (and its breakdown products DDE and DDD), Fenitrothion, and aminocarbs (e.g. Matacil®) used in the aerial spruce budworm spray programs until the 1980s;
- pentachlorophenol (PCP) from wood preservative plants such as the Domtar plant in Newcastle;

- oil spills at ports such as Pointe-du-Chêne, Dalhousie, Cape Tormentine, and Newcastle;
- dioxins, furans, and other chlorinated organic compounds from the pulp and paper mill in Newcastle and Atholville;
- polycyclic aromatic hydrocarbons (PAHs) from thermal power plants, spills at tanker terminals, ports or harbours such Newcastle, Dalhousie, Belledune, Bathurst, Bouctouche or Pointe-du-Chêne, and leachate from wharves treated with wood preservatives;
- polychlorinated biphenyls (PCBs) from electrical transformers and spills of lubricants, hydraulic fluids, cutting oils at harbours and ports such as Newcastle, Belledune, Dalhousie, Pointe-du-Chêne and Bouctouche; and
- heavy metals such as cadmium, zinc, lead and copper from mining and smelter operations near Newcastle, Bathurst, and Belledune.

PAH levels in sediments are deemed unacceptable when they are greater than two parts per million (ppm) (Gearing *et al*. 1994). This is based on a judgement of the acceptability of risk of exposure to that level, not a measure of absolute safety. In the past 10 years or so, PAH levels over 2.5 ppm have been reported in marine sediment analysis at some sites in Pointe-Sapin, St-Edouard-de-Kent, Chockpish, Cap-des-Caissie, Les Aboiteaux and Sainte-Marie-sur-Mer (Environment Canada 1999).

High levels (over 0.1 ppm) of DDT, or its breakdown products DDE and DDD, have been reported in sediments at some sites in Chockpish and Pointe-Sapin. Lower, but still relatively high, levels of DDT, DDE, or DDD have been reported in the Tabusintac Gully and St-Edouard-

Persistent Organic Pollutants (POPs)

The United Nations Environment Programme has identified a dozen chemical compounds that are powerful threats to human and wildlife health. These chemicals belong to a class of compounds known as persistent organic pollutants - POPs. They accumulate in the food chain and can take up to centuries to fully degrade. Once released into the environment, they are transported around the world through air and water.

The effects of POPs on wildlife are very well documented. POPs can cause birth defects, various cancers, immune system dysfunction, and reproductive problems. In humans, the evidence is still being gathered. However, preliminary findings show that high levels of exposure over the long term may contribute to increasing rates of birth defects, fertility problems, greater susceptibility to disease, diminished intelligence and some types of cancers in certain regions of the world. Of particular concern is the effects of POPs on the developing fetus. POPs can accumulate in human tissue and pass through the placenta to the fetus. POPs have been detected in the breast milk of women throughout the world.

What makes POPs so deadly is their enormous biological potency, their ability to accumulate and concentrate in fatty tissues of organisms, and their persistence. POPs are organic compounds meaning they are built on a basis of carbon atoms - the basic component of all living things and processes. As a result, they have immense power to enter into the most vital processes of the body and change them in ways still not completely understood. Although levels of POPs in water and sediments may be very low, POPs accumulate in organisms and magnify in concentration as they move up the food chain. Once absorbed into body fat it is almost impossible to eliminate POPs.

A guide to some of the POPs

Type	No. of Related Compounds	Source	Status	Biological effects
DDT	DDD and DDE are breakdown products of DDT DDE is fat soluble and most persistent	a synthetic insecticide an estimated 5.7 million kg of DDT were sprayed annually on New Brunswick forest in the 1950s and 60s	registration of all DDT products was discontinued in 1985 but the use and the sale of existing stocks of DDT products were allowed until December 31, 1990	highly toxic to fish and can affect fish behaviour acutely toxic to birds and can impair embryo development and cause feminization and altered sex ratios in humans it may suppress the immune system, cause breast cancer and disrupt endocrine system
Dioxins and furans	75 different dioxins 2,3,7,8 - TCDD is one of the most toxic synthetic compounds in existence 135 different furans	pulp and paper mills using chlorine for the bleaching process municipal incinerators wood preservative (pentachlorophenol - PCP) Phenoxy herbicide 2,4,5-T and possibly 2,4-D.	PCP use is restricted to heavy-duty wood preservation such as wooden hydro and telephone poles, marine docking and railway ties 1992 Pulp and Paper Effluent Regulations (federal Fisheries Act) required pulp and paper mills to modify their processes to reduce releases of certain dioxins and furans to non-toxic levels 2,4,5-T is banned; 2,4-D is used widely.	for animals: wasting, skin changes, appetite loss, stomach lesion, liver damage; reproductive changes such as reduced sex organ weights and fertility in males and reduced litter size and fertility in females for fish: lethargic swimming, feeding inhibition; early life stages of fish are extremely sensitive to dioxin exposure for humans: fatigue, depression, liver dysfunction, hormone disruption dioxin acts like a hormone that is capable of producing lasting effects at very low doses
PCBs **Polychlorinated bi-phenols**	209 possible compounds	used in electrical transformers, lubricants, hydraulic fluids, cutting oils, paints, varnishes, inks, pesticides, plastics, certain types of paper	industrial producers of PCBs voluntarily cut back production in 1971 commercial, manufacturing and processing uses of PCBs were restricted in Canada in 1977 importation of electrical equipment containing PCBs was banned after 1980	main source of human PCB exposure is through food, especially through the consumption of fish; they accumulate and magnify as they move up the food chain may associate with organic component of soils, sediments, biological tissues, or with dissolved organic carbon in aquatic systems embryo deformities, abnormalities and mortality in fish, birds and mammals; reproductive dysfunction and mortality in adult animals; and endocrine/hormone disruption humans effects (especially in children) can include short-term memory deficits (visual, verbal, quantitative pictorial); growth and activity retardation considered human carcinogens and human endocrine disrupting compounds

de-Kent. High levels of PCBs (over 0.1 ppm) have been reported at some sites in Cape Jouriman, Pointe-du-Chêne, Chockpish, and Miramichi River.

Chemicals like DDT and PCBs are classed as persistent organic pollutants (POPs). This means they take many, many decades to break down into constituent parts (some of which may also be harmful) and they accumulate in the tissues of animals and humans. While water, sediments and species low on the food chain may have low levels of POPs, higher and higher levels accumulate in the tissues of predators higher up the food chain. For example, if the bioconcentration factor of a chemical in a fish is 5,000, then there is 5,000 times the amount of chemical in the fish as in the water.

Recent sampling of sediments suggests that levels of certain POPs, heavy metals, and other toxic chemicals are decreasing in some areas of eastern New Brunswick (White and Johns 1997). These declining levels can be explained in part by an increase in regulatory controls on local sources. Another explanation is that disposal of dredged material by ocean dumping or disposal on land has diluted and redistributed contaminated material. In some areas, POPs have increased. Since many POPs continue to be used in other parts of the world, it is thought that long range transport through the atmosphere is now the main route for their entry into New Brunswick waters.

In the past five years, concerns have been growing over impacts of a new class of chemicals called nonylphenol ethoxylates (NPEs). They are surfactants, chemicals that reduce the surface tension of liquids and bind compounds together. NPEs are of particular concern because they are found in so many commonly used products such as household detergents, cleaners, latex paints, cosmetics and in industrial processes including pulp and paper production, textile processing, and oil and gas production. Most NPEs are discharged in wastewater and ultimately end up in the municipal sewage system.

NPEs can effect all animals, including humans and fish. NPEs break down into the highly toxic and persistent by-product, nonylphenol (NP) which is widely detected in water samples, sediments, wastewater and sludge. Exposure to very low concentrations of NPs can disrupt endocrine or hormone function.

A recent study has determined that NPs are affecting the survival of salmon populations and possibly other anadromous species like blueback herring in New Brunswick (Fairchild *et al.* 1999). Dr. Fairchild, a scientist at Fisheries and Oceans Canada (DFO) in Moncton, and his colleagues have suggested a link between pesticides containing 4-nonylphenol (4-NP) used in the spruce budworm spray program in New Brunswick until the late 1980s and the number of salmon returning to rivers in northern New Brunswick. It appears 4-NP affects the smoltification process which enables salmon to make the transition from fresh to saltwater. This process is controlled by hormones. Dr. Fairchild and his team began new experiments in 1999 in the Miramichi estuary to determine where along the river salmon may be exposed to other endocrine disrupting compounds apart from those found in budworm sprays.

Dredging

The increase in sediments discharged into rivers and deposited into estuaries also increases the need and frequency of dredging of channels, harbours and ports. Dredging takes place in dozens of sites along the eastern coast. The impacts of dredging can include:

- destruction of the benthic (bottom) boundary layer or interface which is considered an area of high biological activity;
- release of sediment clouds that smother fish, shellfish, and bottom-dwelling (benthic) organisms and temporarily lower dissolved oxygen levels;
- increase in nutrients which can stimulate local toxic phytoplankton production;
- release of persistent toxic pollutants (POPs) which are attached or adsorbed to sediments; and
- fragmentation of benthic communities.

Dredging can also have several detrimental effects on the natural movement of sediments, currents and waves. Dredging channel mouths and gully inlets interferes with the natural wave energy environment. Depending on the extent and depth of dredging, there can be changes in the sediment erosion and deposition patterns of inshore tidal currents. Dredging can also cause saltwater seepage into the groundwater aquifers supplying coastal communities with drinking water.

Historically, dredge spoils were routinely dumped at sea. Environment Canada issues permits for such disposal under the Ocean Dumping regulation of the Canadian Environmental Protection Act (CEPA). However, if dredge spoils contain contaminants that exceed certain limits, land disposal is required. There has been a trend towards land disposal since 1994. Despite this, the NB Department of Environment and Local Government (DELP) does not have a specific policy for this, only guidelines for issuing certificates of approval for the 'utilization of waste for soil additives.' Records show there were at least 23 instances where dredge spoils were disposed of on land in the Acadian Peninsula between 1976 and 1985. In 1986, there were a total of nine dredging projects along the eastern coast and records do not show where the spoils were dumped. There is a gap in information on dredging projects from 1987-1990.

The NB Department of Natural Resources and Energy (DNRE) administers the Quarriable Substances Act under which permits are issued for quarrying within the "shore area" as long as the quarried material is also disposed of in the shore area. The shore area is defined as "that portion of land lying within three hundred metres above and three hundred metres below the ordinary high water mark of any pond, lake, river or body of water and includes any bed, bank, beach, shore, dune, bar, flat or mud flat lying in that portion of land." This provision is most often used to permit 'replenishment' of beaches, in particular Parlee Beach in Shediac. From 1991 to 1999, DNRE estimates that there have been approximately 30-40 instances where quarried material has been dumped on the beach or within the near shore area as a source of beach or dune replenishment (DNRE 1999 pers. com.).

The largest dredging operation on the eastern coast took place between 1981 and 1982 in the Miramichi River. A total of 7,716,000 cubic metres (m^3) of sediments were dredged from the river and re-distributed to three locations in the estuary. At the time, it was thought the sediments at the dump sites would remain in place and not disperse. In reality, one study suggested that 4,000,000 m^3 of dredge spoils were dispersed from the dumps sites (in particular the site in the central part of the inner Bay) over a five year period. Although sampling of sediments prior to dredging was limited, heavy metals such as cadmium and zinc, and chemical contaminants such as PCBs, DDT, and PAHs were present.

At the time of the 1981- 82 dredging, long-term impacts to the Miramichi River and Bay were not expected. However, earlier dredging (up to 1964) involving 75 percent less sediment removal has been implicated in changes to the shape of barrier islands in the eastern end of inner Miramichi Bay (Buckley 1995). The size and orientation of Portage Island has changed noticeably and the Portage Gully on the north end of the island has moved three kilometres south. Fox Channel at the southern end of Fox Island closed completely in 1974. The impacts of the 1980's dredging in Miramichi River on biological communities and natural sediment transport are still being evaluated.

Another sizeable dredging program took place during the construction of the Confederation Bridge joining PEI to New Brunswick. Approximately 148,000 m^3 of material was dredged and most of it was deposited in Amherst Cove, PEI.

Depending on the natural movement of sediment, waves and currents, smaller dredging operations can also have negative consequences. For example, in 1993 a dredging operation in a boat basin in Bouctouche had to be halted because silt generated from the operation was smothering oyster beds.


(Paul Jordan)

Countless sewage and industrial effluent pipes, like this sewage pipe in Shediac Bay, empty in coastal waters.

Sewage

Municipal sewage is the principle source of water pollution in Canada. A 1994 survey of 20 major Canadian cities revealed they collectively dump almost 500 billion litres of untreated effluent into our waters annually, enough to cover the entire Trans Canada Highway to a depth of nine metres. The daily total of 1.35 billion litres is roughly equivalent

Definition of sewage treatment technologies (Sierra Legal Defense Fund 1994)

Level and Type	Technology	Effects
1. No treatment	Collector lines, pipes to open water	Heavy loadings of bacteria, nutrients, biochemical oxygen demand (BOD), suspended solids (SS) and toxic chemicals into receiving waters. Also a major source of used products such as tampons and applicators, condoms and syringes which end up on area beaches.
2. Preliminary (or pre) treatment	Grit and solid material are screened out before sewage receives further treatment or is released into the environment. Cannot be considered "treated".	Usually no more than a process of making effluent less offensive visually. Does not significantly reduce SS, BOD, toxins or bacteria.
3. Primary treatment	A physical process in which sewage flow is slowed down and solids separated from liquids, largely through gravitation. Sludge is removed from bottom and disposed of in a variety of ways. Lagoons - a pond which relies on passive aeration (wind) to break down aerobic bacteria in the upper layers and anaerobic processes (without oxygen) to break down bacteria in bottom layers - provide effective sedimentation conditions. The process is slow and therefore requires a comparatively large pond area. If the process is chemically-aided, it may meet secondary treatment standards.	Generally removes 25-40% of BOD, 40-60% of total SS, and 45-55% of fecal coliform levels. Chemically-aided primary treatment (physico-chemcial) provides slightly higher removal of BOD and SS.
4. Secondary treatment	Oxygen is added to the sewage to encourage microorganisms to break down the sewage. If this is not done, when sewage effluent is discharged into the environment, dissolved oxygen in receiving waters will be depleted as sewage breaks down and aquatic life will suffer. Air-activated sludge and biological filters are two of many ways this is done. Liquid effluent, and sometimes treated sludge, is discharged into environment. Aerated lagoon - oxygen is added mechanically to the lagoon through pumps and beaters. It increases the effect on aerobic bacteria, decreases breakdown time, and reduces lagoon area required. Oxidation ditch - a modified lagoon, dug in the shape of a racetrack. Aerators push the sewage around the ditch. Extended aeration - a mechanical treatment plant which maximizes oxygen addition under controlled conditions. Activated biofilter - Water in a treatment plant is pumped upwards into a tower and then trickles down through a filter medium designed to further remove bacteria and nutrients.	Reduces BOD and SS by 85-95%, and coliform bacteria by 90-99%. Degradation of organic material before discharge reduces toxicity of the effluent to aquatic organisms. Because increased quantities of solids are removed, more sludge is produced than in primary treatment.
5. Tertiary treatment	Similar to but more thorough than secondary treatment, using additional clarifiers such as microstrainers or sand filters. Calgary's tertiary treatment uses activated sludge, clarifiers, digesters and phosphorus removal. An alternative to conventional tertiary treatment technologies is the use of wetlands, either naturally occurring or constructed. Micro-organisms, plants and insects purify the sewage flowing through the wetland. Disinfection occurs naturally as harmful bacteria die off.	Advanced reductions in BOD and SS. Nutrients (phosphorus, nitrogen and ammonia) may be removed. Some advanced forms of filtration can remove some metals, chemicals and other contaminants.
6. Nitrogen and phosphorus removal	This can be an additional component of the treatment process, usually at secondary or tertiary levels. When available in excess, these cause unwanted algal blooms in surface water. Ammonia, a form of nitrogen, is toxic to fish and other aquatic organisms. These can be removed from wastewater by biological and/or chemical processes.	Removes nutrients which create unwanted plant growth in water (algal blooms), causing oxygen depletion and eutrophication.
7. Disinfection	Effluent disinfects naturally as microorganisms die off in the environment and organic matter decays. However, the volumes of sewage discharged by larger communities prevent this from occurring rapidly enough to allow for swimming and other water recreation. Chlorination is the most common disinfection method. Ultraviolet treatment is an alternative to chlorine. It uses the energy of light to deactivate pathogenic organisms. It requires adequate lighting, large space, and relatively clear effluent to be effective. Also, the process is less effective when flow rates are variable. These factors make it more expensive than chlorination.	Chlorine kills off bacteria and microorganisms such as fecal coliform which can cause disease. It does not destroy viruses and other parasites. Chlorine is highly toxic to aquatic organisms. Even after dechlorination, organic compounds related to chlorine can form and aquatic life can be affected by long term exposure to these. UV treatment does not have a negative impact on the aquatic environment.

(CCNB)

Sewage lagoons are passive treatment systems.

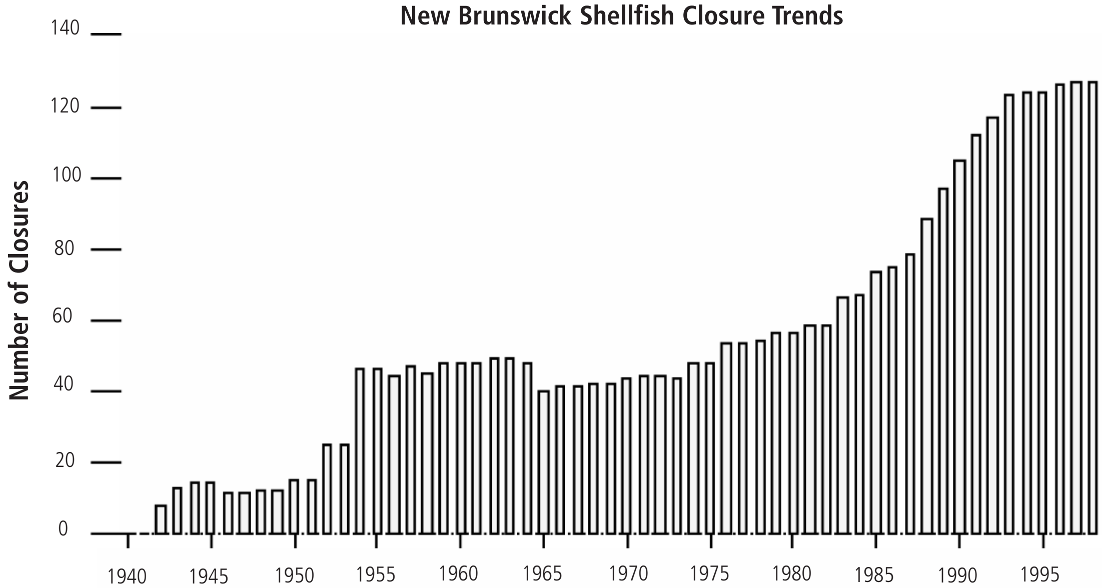
to 32 Exxon Valdez spills (Sierra Legal Defense Fund, 1994).

With New Brunswick's historic settlement and development along all of our coastline, sewage and effluent dumped into our coastal waters is an ongoing problem. Studies have shown that, besides bacteria and virus-laden human excrement, typical municipal sewage contains grease, motor oil, paint thinner, antifreeze, and many kinds of industrial waste, in all some 200 chemicals (SLDF, 1994).

Some municipal sewage is treated, some is not. No municipality in New Brunswick has tertiary sewage treatment, the highest level of sewage treatment which takes out nutrients (nitrates, phosphates), organic material (biochemical oxygen demand, BOD), and most bacteria (Environment Canada 1996).

The release of untreated or minimally treated sewage into coastal waters has had a direct impact on the livelihoods of some traditional fishermen. As a result of sewage and industrial contamination, the harvest of oysters, clams, mussels and quahogs in New Brunswick has

New Brunswick Shellfish Closure Trends



Municipal sewage treatment along the northern and eastern shore

Location	Treatment Process	Design Flow (m^3/day)
Chaleur Bay to Miscou		
Atholville	Lagoon	1455
Campbellton	Extended aeration	11800
Dalhousie	Aerated lagoon	7046
Eel River Crossing	Lagoon	909
Charlo	Lagoon	545
Balmoral	Lagoon	909
Pointe-Verte	Aerated lagoon	727
Petit-Rocher	Oxidation ditch	1364
Nigadoo	Aerated lagoon	?
Beresford	Oxidation ditch	1887
Bathurst	Activated biofilter	15150
Caraquet 1	Extended aeration	909
Caraquet 2	Lagoon	2273
Bas Caraquet	Lagoon	1590
Lamèque	Lagoon	796
South Shore, Acadian Peninsula		
Shippagan	Lagoon	3773
Tracadie-Sheila 1	Lagoon	728
Tracadie-Sheila 2	Lagoon	2273
Neguac	Lagoon	110
Miramichi Bay/Estuary		
Chatham	Oxidation ditch	3782
Loggieville	Lagoon	636
Nelson-Miramichi	Lagoon	1091
Newcastle	Aerated lagoon	11776
Northumberland Strait		
St-Louis-de-Kent	Aerated lagoon	682
Richibucto	Lagoon	1191
Rexton	Lagoon	1191
Bouctouche	Aerated lagoon	2364
Shediac	Aerated lagoon	3636
Dorchester Crossing	Lagoon	727
Scoudouc	Aerated lagoon	3636
Cap-Pelé	Aerated lagoon	727
Port Elgin	Lagoon	600

been severely restricted. The number of areas closed to wild shellfish harvesting has gone from no closures in 1940 to 127 closures in 1998, with the number of closures accelerating in the early 1980s. Today, 43 percent of all inshore waters classified for shellfish harvesting in New Brunswick are closed. The three largest closures are in the Bay of Chaleur, the Petiticodiac River and St. John Harbour. They represent 53 percent of the prohibited areas in New Brunswick.

The contamination of oysters or other shellfish by pathogens such as faecal coliform bacteria or toxic chemical compounds is only one of the problems associated with sewage discharges. Sewage also adds nitrogen and phosphorous to the environment and under the right conditions, their release can cause large localized blooms of algae, some toxic. Harmful algal blooms are often not harmful to shellfish. They can, however, accumulate in oysters or clams and if eaten by humans, they can have a toxic effect. In addition, toxic algal blooms can cause large fish kills.

Overloading coastal waters with nitrogen is a growing problem worldwide and it is a key contributor to the expansion of harmful algal blooms. Other sources of nitrogen and phosphorous include run-off from agricultural operations such as piggeries, dairy and beef farms, effluent from fish plants, waste from finfish aquaculture operations, and atmospheric deposition.

Given the importance of oysters, clams and mussels to the economy of New Brunswick, more effort should be put into sewage treatment and disposal, whether it is relocating private septic systems, upgrading municipal treatment facilities or controlling agricultural run-off. Shellfish closures have resulted in fisheries losses in the millions of dollars and they have contributed to increased unemployment in certain areas.

The oyster connection


(NB Image Bank)

Harvesting farmed oysters.

For the eastern coast of New Brunswick, the health of the marine environment can be measured by the health of wild oysters. Historically, wild oysters were one of the economic and social pillars of many communities, particularly in the Bouctouche and Caraquet areas. Oyster fishing supplemented a family's income. It was seasonal work, providing an income when other fisheries in the area were closed or experiencing a decline. Traditional oyster harvesting involved picking oysters from natural beds with a rake or tongs. When the bacterial (coliform) count rises because of runoff from a heavy rainfall, the beds are closed to harvesting. Today, most beds are permanently closed. Employment in the industry has dropped precipitously as a result. Decades ago, there were 400 fishermen in the Oyster Co-Op of Bouctouche. In 1989 there were about 160 members. Today, there are 20-25 members.

One possible explanation for the lack of progress in cleaning up sewage in eastern New Brunswick is the advances made in oyster culturing. Contaminated water or unsuitable bottom habitat are no longer key impediments to oyster culturing. Initially, fishermen found they could collect small oysters from natural beds and transfer them to new sites where oysters could be tended until harvest time. Today, culturing oysters is complex and each culturalist needs access to more and larger beds. Culturing involves re-laying oysters from site to site. The culturalist can harvest oysters from contaminated sites and place them in clean sites where the oysters can cleanse or depurate themselves of bacterial contamination. They can then be harvested and sold. Oysters can also be grown in suspension and can be readily moved to "clean" areas if an area is closed.

The transition from tending natural beds to cultivating or farming oysters has been gradual, like the increase and spread of contamination and closed areas. There has been no dramatic crisis to draw the public's attention to the problems in the oyster fishery. The infusion of federal and provincial funding to oyster cultivation has helped to maintain a certain level of employment. Thus oyster culturing to deal with poor water quality has defused a sense of urgency so that there is very little incentive for communities and government agencies to deal with the larger contamination issues facing the marine environment.

Coastal development

In a physical environment as sensitive and dynamic as the eastern coast of New Brunswick, the removal of every truckload of sand and the construction of every causeway, breakwater, boat harbour, and wharf has had some impact on the coastal environment.


(NB Image Bank)

Parlee Beach.

By the early 1970's, concerns were mounting about the impact of coastal development, particularly beach mining, on the eastern shores of New Brunswick. The 1975 Beach Resources report found the rate of removal of beach sands by quarrying had exceeded the rate of renewal, especially in the Shediac-Northumberland Strait region. For example at Parlee Beach historic sand quarries, infilling of salt marsh to create road access and parking lots, and heavy human visitation to the dunes had caused the shore to recede over 60 metres since 1945.

The 1975 report outlined a long list of impacts from the mining of beach sand. They included: rapid recession of sand bars; loss of protective sand barriers; unstable offshore bars, barrier and dunes; depletion of dunes; destruction and loss of salt marsh by inland migration of sand barriers; infilling of tidal estuaries with the formation of tidal gullies and deltas; migration of tidal gullies; and destruction of shore bird habitat. The report did not examine the impacts of quarrying on fish, mollusc or shellfish habitat. Although the report recommended an immediate stop to quarrying activities on the beach and coastal zone of eastern New Brunswick, quarrying still takes place at a reduced level.

While quarrying is less of a threat to the coastal zone than it was 25 years ago, other threats persist. The impact of each alteration to the coastline is not always immediately obvious nor are the consequences of each alteration always predictable.

(PEI Tourism)

Confederation Bridge from New Brunswick to PEI.

In 1995, scallop fishermen in the Cape Tormentine area raised concerns about a causeway required for the construction of the Confederation Bridge. They were concerned that siltation from the causeway would alter tidal patterns and cause massive siltation along the sea bed. Fishermen said the silt would smother scallop spat (larvae) and destroy the fishery. Studies done by DFO and the company building the bridge, Strait Crossing Inc., prior to the construction of the causeway concluded the causeway would have no lasting environmental effects. The causeway was built and then removed when the bridge was completed in 1997. Two years later, fishermen reported a 50 to 60 percent reduction in their scallop catch and the scallops being caught were smaller and did not look healthy.

The suggestion by fishermen that increased siltation as result of the causeway caused a failure in spat settlement is not unreasonable. Causeways are known to cause changes in tidal patterns and sediment transport. If the causeway built for the Confederation Bridge increased siltation and contributed to a failure of spat settlement, the impact of the settlement failure would not be noticed by fishermen until three to five years later when the spat matured to commercial size. Scallop spat settling in 1995-1996 in the vicinity of Cape

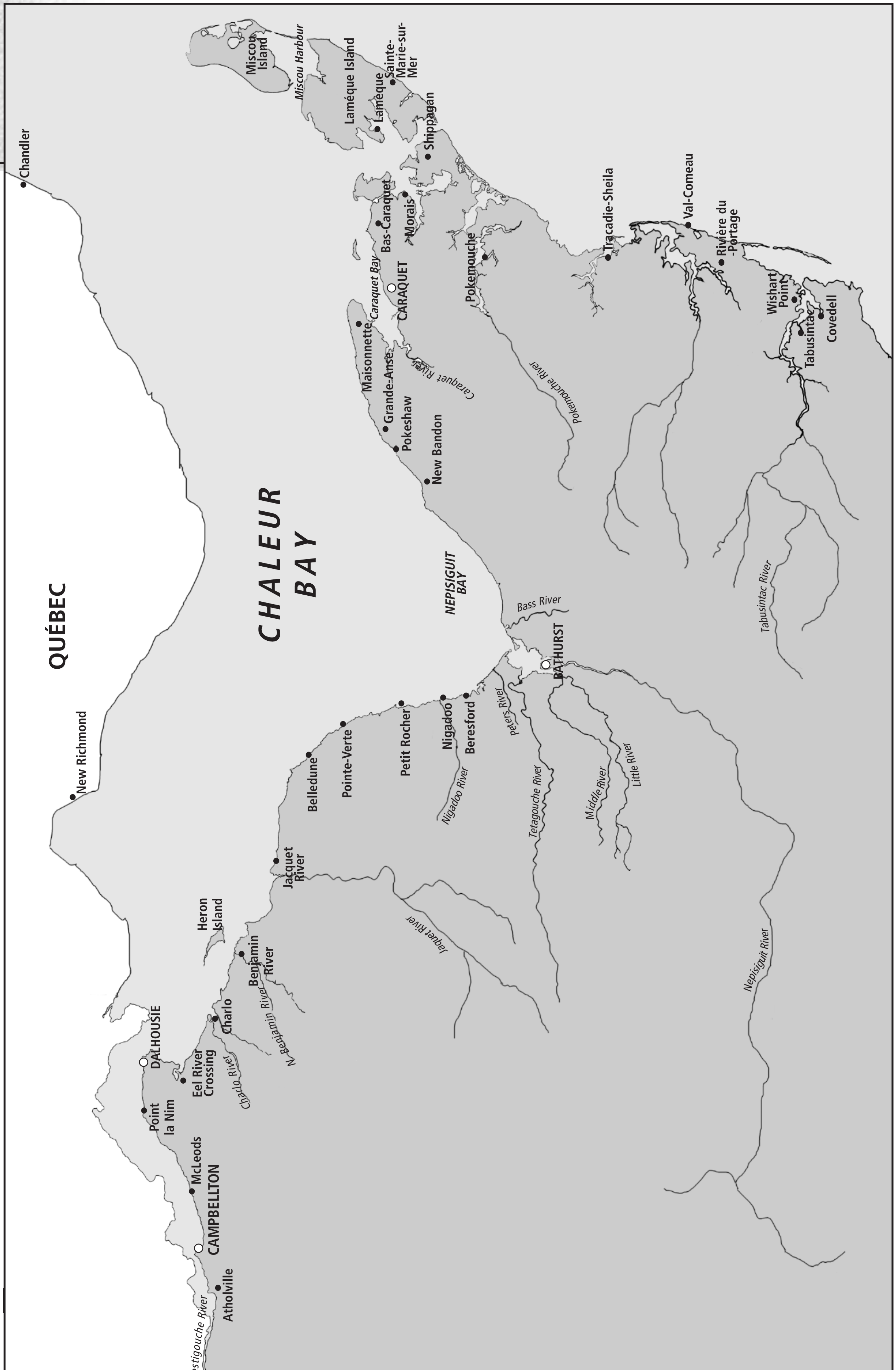
Tormentine should have been ready for the commercial fishery in 1998-99.

DFO was reported to be "surprised" by the decline in scallops and suggested overfishing was perhaps a more likely explanation for the decline. Yet, the timing of the causeway construction in 1995 and the decline in the scallop fishery in 1999 is difficult to ignore.

Overfishing has been a ready explanation for declines in commercial fisheries. While this may be true for some species and some fishing areas, the loss of coastal spawning areas, nurseries, refuges, and recruitment sites due to habitat changes, as well as the impacts of contaminants on reproduction and growth, have played an equally important role in the decline of local fish and shellfish populations.

The long-term and cumulative effects of hundreds of small and large coastal alterations over two hundred years of community-building and development can be, and have been, measured. The 1975 Beach Resources report documented and illustrated the negative impact of coastal development at countless sites along the eastern shore. They included places such as Val Comeau, Dupuis Corner Beaches, Point Escuminac, Belledune Point, Portage Creek, Grant's Beach, Shippegan Channel, Tracadie Gully, Jacquet River, Quinn Point, Lower Caraquet, Grande-Digue Bar, Parlee Beach, Jourimain Island, Youghall Beach and North Cove. The 1975 Report warned that in just a few years the natural forces that shape and modify the shoreline would be replaced by human forces and that the consequences of this shift would be a disruption in natural balances and reduction in the range of benefits people could receive from the coastal environment.

In the past five years, the provincial government has been aggressively promoting a tourist-based economic development strategy for the region. This means more commercial developments are being planned and more changes to the coastal environment can be expected. Boat marinas, marine service centres, restaurants, golf courses, cottage clusters, board walks, nature trails, and interpretation centres are either proposed, under construction or completed. The predicted shift from natural to human forces modifying the coastal zone has taken place. As a result, what was once considered good habitat for fish, birds, and oysters is now considered good habitat for tourists only. Have we robbed Peter to pay Paul?



QUÉBEC
CHALEUR BAY
NEPISIGUIT BAY
Chandler
New Richmond
Miscou Island
Miscou Harbour
Lamèque Island
Lamèque
Sainte-Marie-sur-Mer
Shippagan
Bas-Caraquet
Morais
Caraquet Bay
CARAQUET
Pokemouche
Tracadie-Sheila
Val-Comeau
Rivière du -Portage
Wishart Point
Tabusintac
Covedell
Maisonnette
Grande-Anse
Pokeshaw
New Bandon
Caraquet River
Pokemouche River
Tabusintac River
Bass River
BATHURST
Beresford
Nigadoo
Petit Rocher
Pointe-Verte
Belledune
Jacquet River
Peters River
Nigadoo River
Tetagouche River
Middle River
Little River
Nepisiguit River
Jaquet River
Heron Island
Benjamin River
N. Benjamin River
Charlo
Charlo River
DALHOUSIE
Eel River Crossing
Point la Nim
McLeods
CAMPBELLTON
Atholville
Restigouche River

IV. Bay of Chaleur and Acadian Peninsula

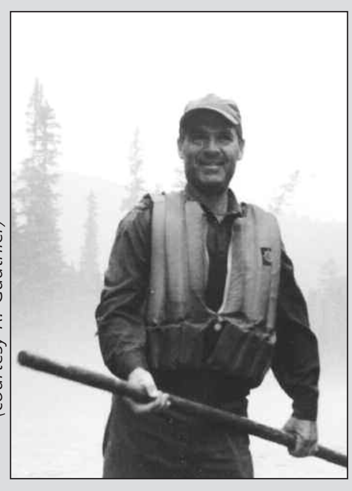
Setting the scene

Thirty years of experience as a forest ranger in northeastern NB has not diminished Ron Gauthier's enthusiasm and wonder at the environment that greets him each time he goes out the door of his Bathurst home. "What's always impressed me, New Brunswick is famous for its rivers. And we have all these estuaries which are so sensitive and so productive. They always remind me of a huge compost area where freshwater feeds it, like a beaver dam that holds all the siltation and all the nutrients settle there. And your tide comes in twice a day, bringing more nutrients, and that's why it's so productive. We really need to pay attention to them."

A ranger with the provincial Department of Natural Resources and Energy, Gauthier is like many people in northeastern NB, cautious when talking about the big companies in the area and the damage they've done to the environment. "Noranda has been a tremendous contributor to the lifestyle in Bathurst here. They've already started a program to restore the Little River, which is completely contaminated, there's no vegetation growing in it. And they're now working on a long-term program to clean up."

Ron Gauthier, Bathurst

...What we have here in Bathurst I haven't seen anywhere else. There's four river systems that come into the estuary. The Tetagouche, the Middle River, the Little River and the main Nepisiguit River, and directly to the south just out of the estuary, there's Bass River... and to the north we have Peter's River which is a beautiful long estuary. So this is kind of a concentration...and it might be 200 metres where this outlet goes out to sea and where the saltwater comes in.... If [the salmon] haven't flushed out in the fall after spawning, they'll winter in the river and they're on their way out in Middle River, Tétagouche and Nepisaguit, and they meet the incoming smelts that are coming up to spawn and they just gorge, which gives them a kick start to go back out to sea. And a lot of fish meet themselves that way including gaspereau which come in shortly after and then you get your shad coming in. They leave behind a tremendous amount of juvenile predator fish and they hold in the estuary and rear in the estuary. Sea trout...do their thing in the river later on in the fall and drop back in the estuary just because of that abundance.


(courtesy R. Gauthier)

IV. Bay of Chaleur and Acadian Peninsula

The economy of northeastern NB, from the Quebec border to Neguac at the bottom of the Acadian Peninsula, has been dominated by natural resources – forests, mines, and fisheries. For more than a century, logs have been driven down rivers and streams. Forests have been harvested along river banks. Effluent from pulp and paper mills, fish processing plants and, later, mines, a chlor-alkali plant and a smelter have been dumped directly into coastal waters. Municipal sewage has run untreated into estuaries and bays. Two decades ago, Chaleur Bay was considered one of the most contaminated areas in eastern Canada. Things have been cleaned up to a certain extent since, although problems remain.

Farther along the shores of Chaleur Bay to Miscou Island at the tip of the Acadian Peninsula, people are understandably preoccupied with the state of the fishery, since it has been the basis of the economy here for more than two centuries.

"Here at Bastien's Factory we didn't go out so far before," says Cédric Rousselle who was born in Portage River in 1922 and has had a varied career in road construction and running a garage and store. "Four or five strokes from the wharf and you could fish all the cod and mackerel you wanted. Now, if you tried to catch cod to eat, there are none. There are some mackerel not far from here, but it is not worth fishing mackerel."

(courtesy of A. Hébert)

Albert Hébert.

"When I was married for 25 or 30 years, when I wanted eel I went in the Bay and could take 40 or 50 in a night, spearing," says 80-year-old Albert Hébert from Baie de Petit Pokemouche. "Nevertheless, once they started exploiting the peat bogs, it eliminated all the molluscs, eels and small fish that were on that side. The moss is acid and it destroys the fish. There are no eels left in the bay."

Of course, the cod fishery has been closed here since the early 1990s, affecting not only the fishermen but also their wives and children who worked in the plants. For the Acadian Peninsula, and especially in the Shippagan and Lamèque areas, the change has been dramatic.

"When a community depends on a resource like cod and it stops one day to the next, it is evident that it will cause a lot of incredible pain," says Émile Ferron, a supervisor in industrial refrigeration for the fishermen's co-op in Lamèque. "I'll give you an example from the plant where I work. In the years 1982-85, the plant employed 1,500 people. In 1998, it can only employ 175-200 people. In 1982-85, production began in early April and finished around December 15th. Now, taking the example of snow crab, the production is done in four to six weeks."


(Piper Project-Projet Siffleur)
Andrée Frigault, Havre Miscou.

Andrée Frigault is a community and social activist who lives at Miscou Havre. "We live on an island, therefore water is very important for us. It represents life," she says. "When we were young, people lived off fishing and that was for many generations. People came on to the island by boat and sold their fish here. Fishing is still the island's principal industry. There are many young people who still buy boats, even though the resource has decreased, even with the danger of losing everything in a single moment because of a storm."

Three of her children have left the island to find work, but would return in a minute if there was a way for them to make a living. That's why she has been thinking about the development of tourism on the island. "Walking on the beach, the birds and bird watching brings peace. We take it for granted but the tourists help us discover how lucky we really are," she says. Still, she has concerns about what increased tourism would bring with it. "How do we protect the environment given that it's so delicate? How do we bring people on to the island and still conserve our birds and flowers? Before, people went on the peat bogs by foot and respected the habitat where the birds fed, because they wanted them to return to the area. They took the time to observe, and afterwards they hunted. That has not been passed on from one generation to another. And if the birds are not respected, they won't come back to feed. They'll go elsewhere."

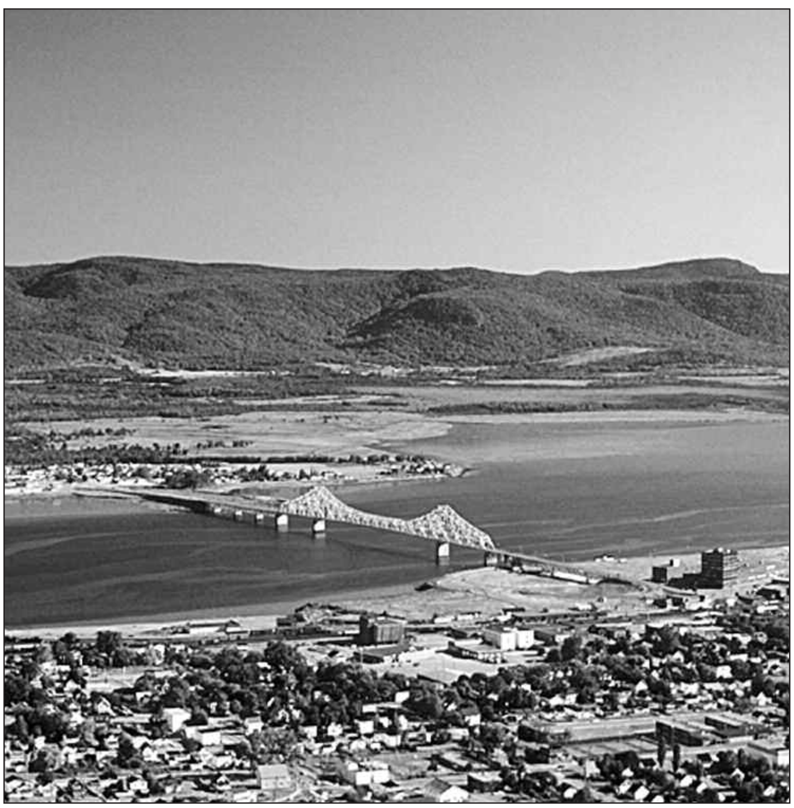
A major tourism attraction in the north is the Restigouche River, renowned for its salmon. With the downturn in salmon returns, the commercial fishery was closed in hopes of preserving the recreational fishery and the jobs associated with that industry. Despite the closure, however, the number of salmon returning to this and other rivers each year is still not close to historical levels.

Lincoln Palmer of Tabusintac, a former guide on the Tabusintac River, reflects on the future for guiding. "Well, without fish, there's no reason to guide. When I think even 50 years back, very seldom that you'd see a car going up [Gaythorne] road here, and now it's very seldom that you can't see a vehicle going up this road. There are more people. The river, the woods are more accessible. There's roads everywhere. It just seems that so much has changed, even the hunting. There's been so much clear cutting and fires that the forest is just not here any more to support it. The game and the fish – there's just not enough to go around. That's probably the biggest reason that the stocks are down."

Ecological processes, habitats and species

An elongated bay opening to the Gulf of St. Lawrence, the Bay of Chaleur separates the north shore of New Brunswick from the south shore of Quebec's Gaspé Peninsula. In an 1888 government report on fisheries, John Mowat described the bay:

> *The Bay of Chaleur, now so well known for its cod, lobster and salmon fisheries, extends some 200 miles inland nearly parallel with the St. Lawrence.... From being 30 miles wide at its entrance, it narrows to 3 at Dalhousie 180 miles inward. Above this point is the [Restigouche] estuary extending 20 miles to head of tide water. The great cod banks extend some 40 miles outside its entrance, and inward some 60 miles.... In Gloucester county on the south, we find the Nepisiguit, a noted river, although obstructed by insurmountable falls 20 miles from its mouth. The great Restigouche, with its branches, is its grand fresh water continuation extending north and west 140 miles, and giving a water surface or continuation of its tributaries on which salmon spawn, of nearly 400 miles, and is the nursery for the large proportion of salmon caught in the Bay (Mowat 1888).*



(NB Image Bank)

The Restigouche River at Campbellton.

Currents in the bay enter from the west along the Gaspé side and exit easterly along the New Brunswick shore. These two opposing currents result in the surface current pattern being dominated by what is called a gyre, a counter-clockwise circular or spiral motion that entraps anything that drifts passively with the water, such as fish larvae or chemical contaminants. Together, Lamèque Island and Miscou Island form a partial enclosure to Chaleur Bay as they protrude outward towards the Gulf of St. Lawrence.

The shoreline of the bay

consists of a mixture of sand bars, sandy beaches with rocky outcrops and rock beaches. Vertical red cliffs occur in many places along the bay. The type of nearshore sediment is influenced by a number of physical features in the bay including currents, rivers, natural and man-made harbours, land projections and the geological composition of the shoreline. Plant and animal life of the bay is typically marine. Estuarine conditions (where fresh and salt water mix) occur mainly in the upper section where the Restigouche River enters, and also in the vicinity of smaller rivers entering along the coast, such as the Nepisiguit at Bathurst and Jacquet River.

The Restigouche River is a major supplier of freshwater to the bay, with an estuary extending from Matapedia in Québec to Dalhousie. Its watershed drains an area of close to 8,000 square kilometres of mostly forested land. The river is tidal for about 40 kilometres of its length and navigable for ocean-going vessels for about 30 kilometres. At one time the Restigouche was a major producer of Atlantic salmon and today it is one of a very few rivers without serious concerns about salmon populations.

In 1998, a 55-kilometer span of the upper Restigouche, between Jardine Brook and Million Dollar Pool, was proclaimed a Canadian Heritage River. The goal of the Canadian Heritage Rivers System program is "to conserve the best examples of Canada's river heritage and to encourage the public to learn about and appreciate Canada's rivers." The designated portion of the Restigouche has been recognized for its relatively undeveloped and pristine state, its historic role as provider and major transportation route for the Mi'Kmaq people, its world-renowned salmon populations and the angling heritage that developed around the salmon. Future studies will determine whether that designation should be extended into the downstream reaches and out to Chaleur Bay.

Bathurst, 35 kilometres southeast of Belledune, is situated at the head of Nepisiguit Bay on the south shore of Chaleur Bay. Bathurst Harbour is the estuary of four rivers and is almost completely closed at its mouth by two major sand bars. Bathurst Harbour is the site of colonies of terns, great blue herons, ring-billed gulls, as well as herring and black-backed gulls. Most of these breed on artificial islands created by dredged materials. The wetlands in Bathurst Harbour are home to the endangered Maritime Ringlet Butterfly, its only known location.

Caraquet Bay, eight kilometres long and three kilometres wide, is a small, semi-enclosed tidal bay with a sandbar at its mouth which separates it from Chaleur Bay. Fresh water enters Caraquet Bay through the Northwest Caraquet and Southwest Caraquet Rivers and MacIntosh Brook. Caraquet Bay supports a rich natural oyster resource, with wild oyster beds situated in the inner part of bay. The bay is the northern limit for the American oyster. Privately leased areas near both the south and north shore are used for oyster culture. The bay is also used as a site for oyster spat collection, although it has been what the Canadian Shellfish Sanitation Program considers "conditionally approved" for more than two decades.

In 1906, William F. Ganong wrote, "The northeasterly part of New Brunswick extends a long angle out into the sea, and, undulating down beneath its surface, ends in a line of peninsulas and islands of which the ultimate is Miscou. An island curiously formed and forever in change, haunt of wild life and center of quiet scenic charm, storied of old, remote from progress, primitive in population, it appeals to our interest in many a different way." (Ganong 1906).


(NB Image Bank)
Miscou Island.

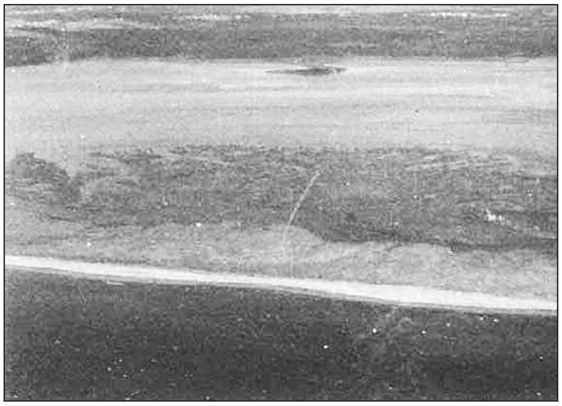
Miscou Island, named 'm'susqu' by the Mi'Kmaq people meaning "wet, boggy, low lying terrain", is located approximately 21 kilometres off the northeastern mainland. It is joined to Lamèque Island by a bridge which in turn is linked to the mainland at Shippagan by a causeway. Miscou has a variety of habitats - beaches, sand plains, salt marshes, bog barrens and forests which over time have been pushing towards the sand dunes and the sea - and a wide diversity of bird species. Despite its remoteness, Miscou has a long and fascinating history, including international fame in 1939 as an emergency landing spot for the first scheduled flight from Moscow to New York.

From Miscou Island south, a similar geography characterizes virtually the entire coastline. It is best described, and its spirit evoked, by William F. Ganong in a 1906 article in the Bulletin of the Natural History Society.

> *The eastern part of New Brunswick, from Miscou far to the southward, consists of a great low plateau sloping gently eastwards until it dips gradually beneath the sea. This plateau is drained by a series of ancient broad shallow valleys now occupied by rivers far smaller than those which originally formed them; and these valleys are separated by low-swelling ridges. Where land and water meet, there the ridges project as low headlands, while the valleys are entered by the sea in the form of markedly inbowed coves, cut in some place or other by the channel of the present river. It is across these coves, converting them into lagoons, that the sand islands extend, festooned from headland to headland in great curves inbowed by power of waves and wind, and cut here and there by the unstable and shifting gullies*

which give exit to the waters of the rivers. These islands, which are often peninsulas, are composed almost wholly of gray sand, derived from the wear of the sandstone headlands, but with some intermingled gravel, small cobbles, shells and sea-drift. Towards the sea, where they are endlessly pounded by the great billows, they present a moderate slope, smooth and hard, which above the high tide, gives place to loose sand easily moved by the wind, but prevented by the omnipresent beach grass from forming dunes of appreciable size. Landward the slope is more gentle, and is clothed above by the waving beach grass, lower by a close, fine, swale-like turf, still lower by a close salt marsh, whence, with a very irregular margin, it dips imperceptibly beneath the surface of the lagoon. This lagoon is varyingly shallow, with a bottom of sandy mud which supports a great growth of the salt-water eel grass, Zostera marina*, whose extreme abundance is a characteristic feature of these lagoons, and which is only wanting where salt marshes form in coves or angles, or where the river channels wind their sinuous ways to the gullies. These lagoons, partly because of their shelter and partly because of the calming effect of the eel grass, are always smooth and safe no matter how hard the winds may blow, or how roughly the sea is breaking upon the coast just outside. This safety make them great canoe routes for the Indians and led an early voyager (Smethurst, in 1761) to speak of them as "the finest conveniences possible for canoes." This is something of which I myself can assure the truth, for I have sailed my canoe upon them miles and miles in happy safety under a wind that strove to tear the sail from its fastenings and raised roaring surges upon the beaches outside. Somewhere the lagoon receives the river, up which the tide, here with a range of some five or six feet, runs as a quiet estuary or tideway for many miles, branching in places into many marshy coves and creeks.*

Taken as a whole, these islands, which the residents invariably call Beaches, are singularly uniform in the characters. Excepting Portage and Fox Islands [in Miramichi Bay], which are beaches of such immense development and special features as to deserve treatment in a separate note, they are quite treeless, closed only with the sparse Beach Grass, intermixed in sheltered places, with low clumps of the Wax Myrtle, Hudsonia, Dwarf Roses, Sweet Gale, and a few rarer plants of humble habit. This grass, with that of the salt marshes, is cut sometimes for hay, and sometimes is used as pasture for horses and cattle, whereby the Beaches yield a small tribute to man. But a richer harvest is gleaned from the fisheries, for salmon following the coast are here caught in nets, and lobsters are trapped just off the shores.... The low, gray line of distant Beaches, the weathered buildings shimmering on the water, the distant roar of billows on the outer beach, the murmur of wind in the Beach Grass, the screaming of the gulls over the still lagoon, a feeling of peace and content, these are the character-feelings of the Beach country.


(Piper Project-Projet Siffleur)

Aerial view of Tracadie Lagoon.

The first of these characteristic safe harbours past Miscou is Tracadie. Settled simultaneously by Acadians, the Irish and Scottish, many McLaughlins, McGraws and Youngs who live there today consider themselves Acadian. The Tracadie lagoon is an estuary fed by fresh waters from the Grande and Petite Rivière Tracadie. It is protected from open waters by a barrier island. The area is considered very rich biologically, with eel grass beds and salt marshes. It is an important staging area for waterfowl, Canada Goose and Brant. Nonetheless, it is under severe stress. Tidal gullies have been extensively altered and the natural tidal regime disturbed by dredging of sand barriers and infilling of tidal channels. The lagoon has been identified by Environment Canada's Canadian Wildlife Service (CWS) as a potential Ramsar site, under the United Nations 1975 Ramsar Convention on Wetlands of International Importance to which Canada is a signatory. However, it has not yet been designated as such.


(Piper Project-Projet Siffleur)

Dunes at Tabusintac.

The Tabusintac lagoon, just south of Tracadie, was designated as an international Ramsar Site in 1993. According to the Information Sheet on Ramsar Wetlands compiled by CWS, the area contains 3,800 hectares of estuarine flats, 200 hectares of salt marsh, 90 hectares of sand dunes and beaches, 10 hectares of salt ponds and 2 hectares of inshore islands. The system is mainly a shallow coastal estuary. One large river, the Tabusintac, empties into the lagoon. Navigation in the lagoon is complicated by constantly shifting underwater sand bars which sometimes block active channels.

The lagoon is protected from the Gulf of St. Lawrence by a 15 kilometre long natural barrier made up of shoals, beaches, islands and dunes. There are extensive eel grass beds in the lagoon, making up as much as 80 percent of the total area. This accounts for the high level of biological productivity in the area. Adjacent to the lagoon are the Tabusintac Blacklands, or peat bogs, which are commercially harvested. Approximately 124 hectares of the

Blacklands have been designated by the provincial government as an ecological reserve in an effort to protect the peat land ecosystems.

The Tabusintac sand bars are heavily used by clam diggers, picnickers and fishermen. The lagoon is also a major hunting area and an important coastal fishing harbour. Although the Ramsar site designation gives international recognition for the ecological value of this area, it provides no legal protection of its important features or species. Still, as a result of the Ramsar designation, there is an area closed to hunting, and private and public stewardship agencies have purchased land to protect it.

Bird life

(Piper Project-Projet Siffleur)

Black-crowned Night Herons (foreground) and Great Blue Heron, Shippagan.

(NB Image Bank)

Heron Island.

While much public attention is focused on the birds of the Bay of Fundy, the Bay of Chaleur and the Acadian Peninsula are renowned for shore and seabirds in their own right. The area of Restigouche estuary bounded to the west by McLeod's Siding east of Campbellton, and Dalhousie to the east, and then north to the Quebec border has recently been designated an Important Bird Area (IBA) in Canada. This relatively new program of the non-profit Canadian Nature Federation and Bird Studies Canada is the Canadian arm of a program begun in Europe by a group called Bird Life International. Nominations of IBA's are reviewed using scientific criteria that determine whether a geographic area is either nationally or globally significant as bird habitat.

The Restigouche site is globally significant, according to its IBA designation, as the single most important staging area in Atlantic North America for Black Scoters. As many as 150,000 of them use it from mid-April to the end of May. They feed on the submerged mudflats that contain mussels, clams and other species favoured by seabirds. Besides the Black Scoters, the estuary is used as a staging area by Surf Scoters, Red-breasted Mergansers and Common Mergansers.

Heron Island, a provincial park reserve just east of this site where the estuary widens into Chaleur Bay, has also received IBA status. It is nationally significant because of its large colony of Double-crested Cormorants (a 1986 survey estimated about 3,000 nesting pairs, or 3.3 percent of the Atlantic coast population). This is the second largest colony in New Brunswick and third largest in the Maritimes. Great Blue Herons and Black-crowned Night Herons historically bred on the island. Approximately 250 Common Eiders nest on the rocky islands along the south shore of Heron Channel. This is the only nesting colony between the St. Lawrence estuary population and Chignecto Bay in the inner Bay of Fundy, over 400 kilometres to the south.


(NB Image Bank)

Pokeshaw Rock.

Pokeshaw Rock, near Grand-Anse between Bathurst and Caraquet, also has an IBA designation. Its 1,371 nesting pairs of Double-crested Cormorants, 1.5 percent of the Atlantic coast population, makes it a nationally significant area for this species. The rock is a sea stack with steep, sheer cliffs that rise 16 metres from the sea to a flat cap, devoid of vegetation and only 1,200 square metres in area. It is on the cap and rocky ledges that the cormorants make their nests, safe from terrestrial predators and within easy range of food supplies.

The Tabusintac Lagoon has the IBA designation as a globally significant habitat for the endangered Piping Plover and Common Terns. Tabusintac Lagoon is important as migration habitat for waterfowl flocks in excess of 1000 individuals, and in particular scaup, Brant,

Protecting the Piping Plover

For over a decade, the Piper Project, associated with the New Brunswick Federation of Naturalists, has carried out environmental education and action around the protection of the endangered shorebird, the Piping Plover, and its habitats on the Acadian Peninsula. From their base in Tabusintac, co-directors Roland Chiasson and Sabine Dietz have gained a reputation as conservationists who are truly committed to working with local communities to raise awareness of the protection needs of the Piping Plover.


(Piper Project-Projet Siffleur)

The Piper Project has undertaken an astonishing range of activities to protect coastal environments and the Piping Plover. They have initiated Piping Plover surveys, monitoring and coastal guardian programs, dune restoration projects, a New Brunswick Atlas of Piping Plover Beaches (with the Canadian Wildlife Service), and educational programs regarding the Piping Plover and the coastal zone. Their advocacy has been successful in calling attention to the plight of the Piping Plover, not only on the Acadian Peninsula, but throughout its New Brunswick territory. The Piper Project provides an excellent example of how dedicated and knowledgeable individuals can make a difference to the way we all view the other species with which we share the world.

American Black Duck and Canada Goose. Freshwater ponds located in the Tabusintac Blacklands are used extensively by the Canada Goose.

The Tabusintac dune system supports 6,000 nesting Common Tern, the second largest colony in New Brunswick and the Atlantic region as a whole. A large Great Blue Heron colony was present at one time in the Covedell Peninsula, an area comprising 295 hectares of black spruce - jack pine forest. Ospreys nest in the uplands of the Tabusintac Blacklands.

Tabusintac is most known, however, for approximately 14 pairs of Piping Plovers which nest in this beach system. This represents approximately 20 percent of the provincial nesting population. The Piping Plover is a small shorebird which is endangered throughout its North American range. It is particularly sensitive to disturbance of its nests, which, in Atlantic Canada, are located on coastal beaches.

Other sites in this region of New Brunswick have been nominated as IBAs. Recently, the Baie et Plage de Pokemouche and Néguac sandspit were identified. Undoubtedly, there will be future designations as the nominations are moved through the system.

State of marine resources

> *The whole Bay (of Chaleur) may be considered one great harbour... During the summer, it literally swarms with fish of every description known on the shores of British North America....*
>
> *Moses Perley, The Sea and River Fisheries of New Brunswick,1852*
>
> *The Bay of Chaleur cod are more prized in the markets of the Mediterranean, and will at all times, sell there more readily and at higher prices, than any other. They are beautifully white; and being very dry, can withstand the effects of a hot climate and long voyage, than a more moist fish...*
>
> *Moses Perley, Report on the Fisheries of the Gulf of St. Lawrence, 1849*


(PANB)
Cod drying on flakes at Robin & Sons, Caraquet, 1895.

Moses Perley was understandably impressed with the fishery in northeastern New Brunswick, although even at the time of carrying out his study for the Province, he found that cod were already on the decrease. "There has been great complaint of late years, in the upper part of the Bay of Chaleur, of the falling off in the cod fishery, which is said to be every year decreasing," he reported to the Lieutenant Governor in 1849.

Perceptively, he looked for breaks in the marine food chain to explain the decline. It was attributed, he said, “to the wanton destruction of the proper and natural food of the cod – herring and capelin – which are taken in immense quantities; not for immediate eating, or for curing, or for bait – but for manuring the land! ...The lazy farmer," he wrote, "who thinks he can increase the fertility of his land by a single sweep of his seine, does so at the expense of the fisheries."


(DFO)

Sorting shrimp.

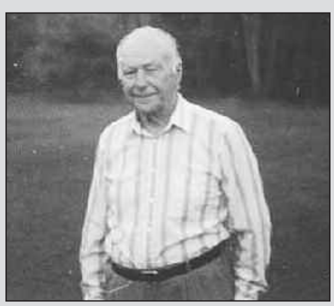
Lobster were also used to fertilize the land. So abundant were the latter that people in Shippagan and Caraquet drove their carts to the beach at low tide, filled them with lobsters left in shallow pools by the receding tide, and fertilized their potato fields. Perley found that crabs and shrimp of all sizes were abundant, although neither were caught.

Today, the fishery has changed, and is largely confined to the Acadian Peninsula. From being dominated by cod and herring 20 years ago, the fishery is now primarily shrimp and crab for the midshore fleet, and herring and lobster for the inshore. (There are several large herring seiners although their share of the catch represents 20 percent of the total quota compared to 80 percent 20 years ago, with the rest going to the inshore).

In terms of landed value of fish, Shippagan, located near the mouth of Chaleur Bay

Arthur William Landry, Grande-Anse

...There were so many [herring] that fishermen would give them away to people for free during the years around 1936. This resource served equally to fertilize the land which produced a great smell in the spring! In autumn we salted herring and we would have some for winter which helped us a lot during the crisis of 1929-39. Almost all the people from here during this period would eat salted herring and potatoes...almost three times a day.... A man from Portage, a Dugas, would say he had the trick to salting herring down so well that his kids would get up in the night to eat some!...


(Piper Project - Project Siffleur)

...There was [also] fresh cod and it was good. Here, we prepared cod stuffed or grilled and it was a treat in the region....Dried cod was also prepared for the winter. The cod was soaked while we waited to eat it...There was also “barbue” [hake] which resembled a cod but it was less tasty and not as good quality. We fished mackerel in the river. We cooked mackerel in a type of fricot with potatoes like what we make now with chicken....

There was also smelts in the spring....When I was at Maisonnette and at Morais I ate a lot of smelts fried in butter....There was also eel; they made dams in the river called “bougnes” [eel trap] or it was fished “à la fouine” [with a fork with a spear in the middle]. We ate eels so often even though it was a bit difficult to prepare. We ate it in the form of fricot too, and there was a lot of eels in that time.... As for oysters, we fished them at Maisonnette....We would collect them while walking in water and we would eat them like that... In the case of crab, nobody ate them when I was younger and I never found that crab was photogenic....

(PANB)

Historic fishing fleet at Shippagan.


(NB Image Bank)

Modern fishing fleet at Shippagan.

approximately 100 kilometres northeast of Bathurst, was traditionally the most important harbour in New Brunswick. That situation has changed in recent years, especially with the closure of the cod fishery in 1992. Still Shippagan, along with the harbours of Caraquet and Lamèque, are the three most important fishing ports on this coast. They are home to eastern New Brunswick's midshore fleet, vessels ranging from 65 to 100 feet that go out for a week or more at a time and are capable of fishing anywhere in the Gulf of St. Lawrence. (In contrast, inshore vessels stay close to shore and don't go out for more than 24 hours at a time). The crab fleet, the northern shrimp fleet, and what used to be eastern NB's groundfish fleet are based here.

From a low of $39 million in 1984, the landed value of all species on the Peninsula peaked at $141 million in 1995. Only two short years later it dropped by almost half to $72.5 million. Of this total, crab accounted for $36 million; lobster $23 million; shrimp $5.6 million; and herring $3.9 million. Crab values peaked in 1994 at $72.6 when total landed fish values represented $109 million. Crab values, too, have dropped by half.

Groundfish was not the only commercial fishery to be shut down, nor the first. The salmon fishery, which once dominated the Bay of Chaleur economy, was first closed to commercial fishermen in New Brunswick in 1972. Drift nets were also banned in 1972. After a limited reopening in 1981, it was closed again on the Miramichi and St. John rivers in 1984 and everywhere else in New Brunswick in 1985.

Since then, salmon returns to New Brunswick rivers have plummeted. The 1999 estimates put the entire population of Atlantic Salmon at only 80,000 individuals. In New Brunswick, the Restigouche, Miramichi and possibly the Tabusintac rivers are the only ones which have maintained salmon returns sufficient to meet conservation or renewability requirements, annual fluctuations notwithstanding. News in 1999 of higher than expected returns in the Miramichi generated calls for increased angling quotas; however, without an understanding of the factors contributing to the precarious position of the Atlantic salmon, DFO has taken a conservative approach and maintained current limits.

Historically, salmon catches were nothing short of phenomenal. Government agent Moses Perley reported in 1849, that "The quantities of salmon in the Rivers Restigouche and Miramichi, at the first settlement of the country, were perfectly prodigious". He complained, however, that "although many are yet taken annually, the supply diminishes from year to year." He wrote,

> *"many of the streams formerly frequented by salmon, are now completely shut against them, by mill dams without 'fishways,'...; that in branches of the large rivers, as also in the smaller rivers, nets are too often placed completely across the stream, from bank to bank, which take every fish that attempts to pass; that, "close time" in many of the rivers is scarcely, if at all, regarded; and that, besides the improper use of nets at all seasons, fish of all sizes are destroyed by the hundreds, in the very act of spawning, by torch light and spears, at a time when they are quite unfit for human food."*

Despite this widespread abuse, the catch statistics were mind-boggling. In the Bay of Chaleur, the 1887 catch was 1,021,400 lbs of salmon (Mowat, 1888). Of this, 50,000 lbs were caught by anglers. The rest were taken by nets. Tour operator and former commercial fisherman John Barbery has more recent stories of the demise of the salmon fishery:

> *"The [salmon] fishing was very good until the time when the American submarine went up around the north under the ice. They discovered that there was something hanging from the ice and they couldn't quite figure out what it was so they went up close enough that they could see and they realized that it was salmon, hanging, feeding underneath the ice. We always knew they went north, but where?....After that, of course, they came back and told the story of what they'd seen, and the Danish fleet went out with factory ships and what have you, and they started to fish the salmon and follow them....Anyway, they followed the fish down the coastline with nets. They were processing right at sea. They were using 12 miles of [drift] nets, there were 52 of them out there....*
>
> *After they got fishing them with the big trawlers at sea, the stock started going down. Then the cod fishery was starting to drop in Newfoundland. I think it was 1,200 or 1,400 more drifters to go out of Newfoundland which had never fished salmon before because cod fish in that area was a prime source of income....They increased the number of drifters down along the Northumberland Strait in that area, so being up here at the tail end of it, we were getting fewer and fewer fish, and the Americans [anglers] up river weren't getting them at all, so they eventually put us out of fishing. They put a ban on fishing and we weren't allowed to fish anymore."*

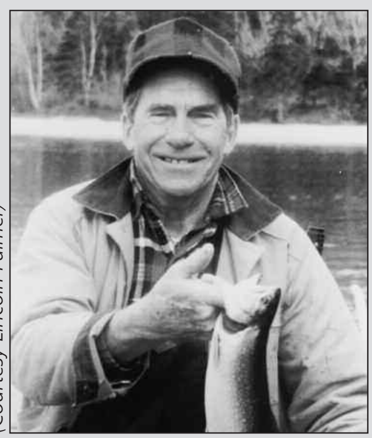
It wasn't just the commercial fishermen who suffered from the salmon decline. The outfitting industry was as much a part of the regional culture as those fishing in salt water.

Overfishing salmon on the high seas, and commercial fishing within Canadian waters had been fingered by recreational fishing interests as the primary contributors to the demise of the Atlantic salmon for years. However, despite a ban on drift nets and the steady closures and constraints on commercial fisheries throughout the North Atlantic, the salmon population has continued in a free fall. Perhaps too late, other factors besides fishing are finally starting to be considered as contributors to the decline.

The presence of dams, causeways and other blockages on spawning rivers, recognized as a problem 150 years ago by Moses Perley, has only recently been resurrected as a concern. Habitat loss due to siltation from forestry, peat operations and coastal development, and toxic and bacterial contamination from pesticides and industrial and sewage discharges are finally being considered as factors (see Miramichi section). The expansion of salmon aquaculture operations in Scotland, Norway, Atlantic Canada and New England is also under scrutiny. Researchers have identified competition for food and spawning habitat from farm

Lincoln Palmer, Tabusintac

My experience goes back 50 years ago. I can remember the first time I went guiding, salmon fishing.... At that time, it was anyone who was good at it that worked with the outfitter year after year. They would probably get between two and three months of employment at a time and it was really the best paying job there was in this area at that time. On top of that they got tips.... And that sometimes was as much as the pay you got, because these people were money people, most of them, or seemed to be, that came....The salary I remember then was more than I was making anywhere else at work.... I can still think of the people, the men that were guiding and they were all from the area here. The outfitter I was working for was George Wishart...so there would be at that camp alone, I would think, 12 or 15 guides for that spring fishing season. In addition to that here was another outfitter and there would be that many guides there as well, plus the cooks. I would think each of these outfitters would employ about 20 people for that month.... So they'd be there, I would think, close to a month in that spring season and then in the fall of course, they'd start shortly after the first of September and the season closed October 15. So there'd be easily four or five, maybe as must as six, weeks of work there in the fall. It was a joy to fish then, it was a joy to guide then, because you could still get fish. The pros, of course, would get more because they knew exactly where to go...



(Courtesy Lincoln Palmer)

...When the decline started, I really don't know. I know 50 years ago there was lots of fish there. And for the number of years that I fished after that, perhaps five or 10 years, in the fall when the salmon would come to the surface in those pools, you could snowshoe on them there were that many. You'd look at that and say - don't take me literally - if I could snowshoe over them...they would hold me up, because there were fish, fish, fish as far as you could see. Just masses of them in those pools. And when the tide starts to rise, the salmon will rise too, for a period; you could see them, the sun shining on their backs, and then they would go back down deep again. It was just unbelievable.

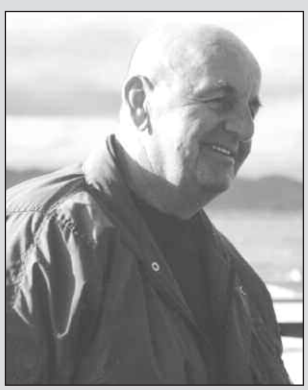
escapees, genetic dilution through breeding between wild and farmed salmon, and disease transmission from farms to wild salmon, as the primary issues related to this industry. Since all North Atlantic salmon (except for the inner Fundy stocks) appear to migrate to the same North Atlantic locations, these impacts could affect wild salmon whether or not they originate in rivers near aquaculture operations.

Salmon fishing is now confined to anglers and the First Nations food fishery. Anglers on the Restigouche are limited to a daily catch of four catch-and-release and two grilse, with a seasonal limit of eight grilse. On the Nepisiguit, the daily limit for anglers is four catch-and-release and one grilse, with the same seasonal limit of eight (this is the Miramichi daily limit as well). The Eel River Bar First Nation near Dalhousie takes salmon on the Restigouche estuary and river; the Pabineau First Nation fishes the Nepisguit River; and the Burnt Church First Nation fishes the Tabusintac. Recently, the NB Aboriginal Peoples Council received a communal license to fish a total allocation of 45 small salmon on a number of rivers, including the Jacquet and Restigouche Rivers. The Supreme Court's Marshall Decision, which asserts the Mi'kmaq treaty right to fish commercially will undoubtedly bring changes to the salmon fishery.

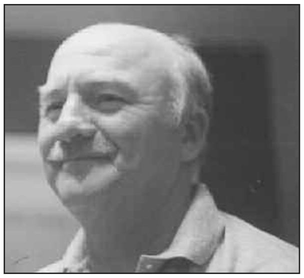
Everyone has a theory about what's happening to the commercial fishery. There is no doubt that a major culprit is industrialization of the fishery. Since World War II boats have gotten bigger and faster, with increasingly high-tech equipment capable of finding the proverbial needle in a haystack. Given the sophistication, especially of the midshore fleet, fish literally have no place to hide.

John Barbery, Dalhousie

I've lived in Dalhousie all my life. I'm the fourth generation living here. My dad was a fisherman, his father was a fisherman. Fish such as cod..., they were accidental or trash fish as far as we were concerned and we just threw them out or gave them away. The salmon fishing back in those years was very, very plentiful. There were three fish plants in the town of Dalhousie, and they brought in salmon from all around the local area.... In fact, there was another one in Charlo.... They brought in fish from as far away as Gaspé. There was a Gaspé trader, a ship that sailed up and down the bay here. They would sometimes unload all night using horses and, wagons to haul the fish away from the ship.


(Piper Project-Projet Siffleur)

Back when my grandfather was fishing, there was something like 120 people on each side of the Bay fishing. When they imposed the ban [1972], there was maybe 40 in this area....There was one fellow up here in Dalhousie Junction; back in 1864, if I remember the exact figure, he took 49,000 pounds of salmon that season. A fellow next to him and downstream who should have taken 50,000, took 11,000. So it varied from location to location....There's a story about the Fergusons who were some of the first settlers here in the area and lived up in Atholville and fished off that point. They said the first year they sent home 10,000 barrels of salt salmon.... There's another story that Cartier said, when he came into the Bay the ships were carried along with the fish. I can visualize that...in my short time of fishing salmon. I've seen us take 64 salmon out in one trap and there were 25, 30 or 40 pound salmon....



(Piper Project-Projet Siffleur)

Émile Ferron, Lamèque.

Says Lamèque fishermen's coop employee Émile Ferron, "In the past, cod was fished with hand lines. There were not many draggers, and it was fished also with trawls. Afterward in the coastal fishery, they began fishing with meshed nets. This took mainly larger cod and also females. What happened is that they caught a lot of females – that might have started the destruction of the cod. However, I think the greatest nuisance occurred with the dragger. They scraped the bottom. They picked up everything."

Some fishermen blame themselves and each other for not respecting the rules, for not respecting the resource and its environment, for being greedy.

"Two years ago my son who fishes crab bought himself a little boat for fishing cod with lines," says 80-year-old Albert Hébert. "We had the right to 10 cod at that time. We didn't follow those rules – in the time of an afternoon, we took up to 1,000 pounds. We didn't have the right and the authorities never warned us. We fished all summer. There are days that we fished for a thousand dollars. There were big and small cod. The [fisheries] minister would say that there were no cod and make restrictions, but we thought that was funny. Even the guys that fished with drags told us the same thing. There were places where the drags filled with cod."

It's obviously a sad state of affairs. One can barely go into stores on the Acadian Peninsula and buy fish these days. "As in Florida, oranges should cost less there than in New Brunswick," says Émile Ferron. "However, I go to Bathurst and I buy fish for less than here in Grande-Anse. It's a shortage that we've created – that's the beauty of capitalism, for we've taken something that was abundant and we've created a shortage."

Cédric Rouselle and Ben Rousselle, Haut-Rivière-du-Portage

"...Back then [1930s and 40s], there were no cod licences. For starters, we fished lobster all year with a little piece of paper that cost us 25 cents. With this paper you could fish everthing like cod and mackerel, but not salmon. It took a special licence to fish salmon and it cost one dollar per year. In the winter, the smelt cost nothing to fish. When the larger boats came, that's when the numerous fishing licences we had to buy were introduced....What destroyed the cod are the large draggers that took the small and the large fish, and they cleaned up. Now, when you go to buy cod, you only get 18-19 inch-long fish that iare not fresh and all soft. In the past, we had cod that was 3-4 feet long and now you can no longer get that. It's all small cod and it doesn't have time to reproduce.... It's like the scallops... The first year that we had fished scallops around here was in 1970. There were boats from Nova Scotia, PEI, and the Magdalen Islands. We were 150 boats and we were dragging....[Now] there are 100 [boats] in the southeast.... In Wishart Point and Val-Comeau there are 30 to 40 boats. However, now they fish a whole day catching 40-50 pounds of scallops, and before, we caught 200 pounds. One day I caught more than 200 pounds with a little drag of five feet.

State of the coastal environment

> *"It is generally accepted that the New Brunswick zinc-lead finding (in Bathurst) constitutes one of the world's greatest reserves. Beautifully located close to deep water for ocean shipping, this combination, historically, has been the basis for a diversified industry."*
>
> *Singmaster and Breyer, 1961. Report prepared for N.B. Premier Louis Robichaud*

Politicians typically earn their stripes by bringing jobs to a region. Louis Robichaud was no exception. As the report prepared for him in 1961 noted, this area was an ideal location for the development of heavy industry related to the natural resources in the region. As a result, Chaleur Bay is the most industrialized region along the eastern shore of New Brunswick. It is also one of the most polluted areas in the Atlantic provinces. An Environment Canada report described the bay as "seriously impacted by a combination of industrial and municipal sources of pollution... these areas represent some of the heaviest environmental contamination in the Atlantic region" (Hildebrand 1984).

When Mike Lushington came to the area in 1968 to teach, the industrial economy was booming; since then he's seen big changes. "The big thing in this area...was the pulp and paper industry....[At that time] the mill in Dalhousie employed something in the order of 1,200 to 1,300 people. It's now down to 200. It's rather a rare sight presently to walk down the main street of Dalhousie anytime from September through until May or June and run into very large numbers of young people between the ages of 19 and 25 or 30. They've had to leave.... The opportunities for young people in the traditional sectors are just about non-existent."

What does remain is the environmental legacy of Chaleur's full-blown industrial period. While five pulp mills present the most voluminous effluent streams into Chaleur Bay, various heavy metals from a chlor-alkali plant, smelter and several mines are the most persistent and toxic contaminants in the area. A 1997 report noted that heavy metal distribution in surface sediments of the southern Gulf of St. Lawrence are relatively low, the exception being Chaleur Bay where concentrations of mercury and cadmium were found to be high (White and Johns 1997).

(PANB)

The Bathurst Co. Pulp and Paper Mill.

Pulp mills

Early industrial activity in the Chaleur region was based on the forestry resource, and the assault on the watershed began over a century ago. In 1888, John Mowat wrote:

> *Quite a change has taken place on the dear old [Restigouche] river since 50 years ago. Islands have been swept away, others increased, alluvial flats on its banks where the wooded protection was cut down swept off by ice and water. The silt held in solution by the river in spring, increased by the lumbermen driving on the smaller branches and cutting through the alluvials in the brooks to float the lumber, when met at its mouth by the reaction of the tides, became deposited, creating middle bars and extending banks, closing up many channels (Mowat 1888).*

As the best timber became more and more scarce after a century of logging, the pulp and paper industry developed to take advantage of the lower quality trees that remained. In 1915, the Consolidated Bathurst pulp mill was established at the mouth of the Nepisiguit River in Bathurst. This was followed in 1928 by the Fraser mill at Atholville near Campbellton (now owned by Quebec-based Tembec and producing fibre for the textile industry). The New Brunswick International Paper mill in Dalhousie (then Canadian Pacific, Avenor and now Bowater), rounded out the pulp mill triad. Two other pulp mills in Quebec discharge into Chaleur Bay at New Richmond and Chandler.

For several decades, the liquid effluent from these pulp mills caused pollution problems related to biological oxygen demand (BOD) and suspended solids (SS), as well as other toxic contaminants. The Fraser mill, for example, produced 90,000 tonnes of pulp per year and discharged an average of 80,000 cubic metres of raw effluent daily into the tidal estuary. It wasn't until the federal Pulp Mill Modernization Program in the 1980s that the mills began to tackle their pollution problems. However, mill effluent continued to be toxic to fish, one of the prohibitions in the federal Fisheries Act. (No mills were ever prosecuted for violating the Fisheries Act in this regard).

In 1992, new federal regulations restricted the release of toxic dioxins and furans to non-detectable levels and removed the grandfather clause on BOD and SS for those mills. (Only new mills had been subject to federal standards for these pollutants). This prompted another round of pollution control upgrades, with an implementation deadline of 1995. Since then, the mills have been in compliance with the monthly requirements of the new regulations (there have been a few daily incidents of non-compliance) (Lindsay 1999, pers.com.). In 1999, the Quebec Department of Environment laid 263 charges against the mill in New Richmond. The majority of violations were daily exceedences of the suspended solids limits.

(CCNB)

Bowater Paper mill at Dalhousie.

Other adverse effects from pulp mill effluent include potential interference with the migration of Atlantic Salmon (they appear to avoid the effluent stream) and fouling of fishing gear from the build-up of wood fibre wastes on the bottom of the bay.

The issue on the horizon for pulp mills is now the presence of endocrine disrupting substances in their effluent, which may interfere with reproductive development in fish and other wildlife, as well as humans. Regulatory agencies are only beginning to sort out what they should be doing in this regard. The scope of the problem is not yet well understood.

Dalhousie

(CCNB)

Chlor-alkli chemical plant in Dalhousie.

Besides the Bowater pulp mill, Dalhousie is home to a chlor-alkali plant (formerly owned by CIL, now Pioneer Chemicals), a thermal generating station, and a deep water port. Each of these has left its mark on the area.

Chlor-alkali

ICI Ltd., a chlor-alkali plant, uses a mercury-based process to produce chlorine and caustic soda for the pulp and paper industry and thus is a source of mercury pollution. It is the only remaining mercury cell chlor-alkali plant operating in Canada.

Mercury is a toxic heavy metal that attacks the central nervous system in humans, and is particularly hazardous to children. Prenatal exposure to extremely low concentrations of mercury has been linked to cognitive and motor retardation in infants. Like all heavy metals, mercury is persistent (does not break down in the environment), and bioaccumulates (concentrations in living organisms such as fish are magnified as it moves up the food chain).

Although today the Dalhousie plant is well within the allowable mercury emission level (1.68 kgs per day), this wasn't always the case. Between 1963 when the plant was opened and 1972, mercury contaminated liquid effluent and untreated brine-sludge (until 1970) were discharged directly into the Restigouche estuary. Environmental monitoring in the intertidal zone near the outfall found clams (1971) and sediments (1974, 1976) with elevated levels of mercury. Between 1973 and 1987, mercury levels in plant effluent were reduced by 75 percent (Eaton *et al*. 1994).

In 1972, air monitoring found that the company was routinely emitting mercury into the air at levels high enough to threaten public health. A 1978 violation resulted in charges and a conviction on 14 counts of illegal emissions (Matheson and Bradshaw 1985). Between 1973 and 1989, mercury levels in emissions were reduced from 2,100 kg/year to 40 kg/year, a decrease of about 98 percent (Eaton et al. 1994). In 1996, total mercury emissions from the plant were 61 kilograms.

Despite reduced emissions, mercury pollution continues to present problems. For decades, mercury-contaminated sludge was dumped in an industrial landfill about 10 kilometers southwest of the plant. Monitoring by the provincial Environment Department shows the site to be leaching and groundwater has been contaminated with mercury. There is no clean-up plan for this dump.

In the late 1980s, ICI's waste water was toxic to fish according to Fisheries Act standards, not because of mercury but because of its chlorine content, up to 600 times higher than the level required to protect salmon. Environment Canada has ignored this problem in favour of getting the mercury problem under control (Lindsay 1999, pers. com.). Given this, chlorine discharges from the plant may well continue to be in violation of the federal Fisheries Act. Chlorine is a potent persistent organic pollutant.

Power generation

(Piper Project-Projet Siffleur)

NB Power Orimulsion Plant, Dalhousie.

The 300 megawatt Dalhousie generating station, when it was fueled by high-sulphur coal, was the second largest source of acid rain-causing sulphur dioxide (SO2) emissions in Atlantic Canada. It was also a source of nitrogen oxide (NOX) which causes acid-related damage to plants and trees, leaches toxic metals from soils, and is a major component of smog. The 54,000 tonnes of ash per year from the plant was landfilled and is a source of metal contamination. Metals were found in lichens several kilometers downwind of the plant.

In 1994, the plant was retrofitted to burn a cheaper fuel trade-named Orimulsion, imported from Venezuela. Orimulsion is bitumen (70 percent), a tar-like substance derived from huge tar bed deposits, mixed with water (30 percent), and a chemical to maintain the emulsion. This makes it transportable in a pipeline. Orimulsion is also a high-sulphur fuel, but scrubbers installed during the retrofit dramatically reduced SO2 emissions. Town officials and NB Power are very pleased with the improvements in air emissions brought on by the retrofit, as well as the reduced cost of the fuel.

Even so, Orimulsion brings with it a new set of problems. The additive nonylphenol, an

Unravelling the mystery of declining seabird populations

Peter Hicklin, wildlife biologist with Environment Canada's Canadian Wildlife Service, has a mystery on his hands and he is determined to solve it. Since 1971, the annual estimated harvest of three species of scoters (sea ducks) have declined. Indeed, between 1973 and 1991, there has been a consistent 45 percent decline overall in the estimated harvest in eastern Canada of scoters: Black, Surf and White-winged. Only Black and Surf Scoter are hunted in New Brunswick). This has occurred despite a presumed increase in hunting effort in the Atlantic Flyway, especially during the years 1961-1976 (see Kehoe, P. and D. Caithamer, *Status of Seaducks in the Atlantic Flyway,* 1994). In healthy populations of birds, increased hunting effort should result in increased takes.

Although little is known about the natural history of the three species of scoters, Hicklin has considered all possible variables in Atlantic Canada which are known and which could impact on scoter populations. He has now turned his sights to the possibility that toxic loadings in the birds are high enough to interfere with reproduction. His starting point is a new report by Environment Canada which says that scoters are contaminated with heavy metals such as selenium (Braune *et a*l, 1999). It is well known that birds' eggs containing very high levels of heavy metals do not hatch. The key to solving the mystery of the disappearing scoters, then, might be to find out if scoters are suffering this fate. New Brunswick's Chaleur Bay may be central to unlocking the mystery.

All three species of scoters (as many as 900,000 individuals) spend their winters in Chesapeake Bay, a heavily contaminated estuary, where they feed on blue mussels. From there, White-winged Scoters fly overland directly to their breeding grounds in Alaska. Black and some Surf Scoters, however, make their way to Chaleur Bay. There they feed in very muddy areas (probably on a species of clam), putting on fat for the long cross-continent journey to westsern subarctic breeding grounds extending from the northern Prairie Provinces (Surf and White-winged Scoters) to the State of Alaska (Black Scoters). So many scoters converge on Chaleur Bay every spring (from 60,000 up to 200,000 depending on the year) that the area is as significant to these species as the mudflats of the upper Bay of Fundy are to migrating shorebirds.

The question is, are heavy metals in Chaleur Bay concentrating in these birds way to such an extent that eggs in their Alaska nests one month after leaving New Brunswick do not hatch? The answer is not necessarily obvious or easily to come by. Chesapeake Bay is a likelyy source of contamination, and the White-winged Scoter which does not come to New Brunswick is suffering the same declines. Also, the data in the Environment Canada report which indicates heavy metal contamination in scoters is based on sampling done in the fall. Levels of contaminants in birds change quickly, so samples collected in the fall do not necessarily reflect levels present during spring nesting time, and naturally-occurring contaminants, like selenium, may have been picked up on the breeding grounds. Yet the knowledge that Chaleur Bay has been heavily contaminated, that scoters are contaminated in fall samples, that heavy metals are implicated in reproduction failure in birds, and that the populations of scoters are in serious decline, combines to form a plausible hypothesis that all this may be connected.

But this hypothesis must be tested and the Canadian Wildlife Service (CWS), along with a number of partners in Canada and the US, have started the process. In 1998 and 1999, Mike Lushington and other volunteers counted scoters in Chaleur Bay (there were between 65,000-85,000 in 1999), and mapped where they were feeding. Also in 1999, as part of this new developing partnership between both countries, a continential conservation initiative called "The Sea Duck Joint Venture" was officially launched. During the 1999 hunting season, scoters and other sea ducks were collected from staging areas across Atlantic Canada to identify distinct populations and examine tissues for the presence of contaminants. The results should be available by 2001-2002. Once these are known, CWS hopes to test samples of prey species (clams, worms, snails) from these foraging areas for heavy metals to further explain the results obtained by the birds themselves. Concurrently, researchers in Chesapeake Bay hope to test the birds for levels of contaminants just before they leave for New Brunswick. Scientists from both countries suspect that taken together, data from both areas will go far towards solving the mystery of the disappearing scoters.

endocrine disrupting chemical known to affect the reproductive ability of marine animals and potentially humans, is used to maintain the emulsion. In sea water, Orimulsion does not float on the surface like crude oil. Instead, it disperses through several metres depth, and thus cannot be physically skimmed to clean up spills. Because of this, a spill could have ecological impacts for many years. As well, air emissions are higher in very fine particulates than coal or oil; these cause respiratory problems when inhaled.

(Piper Project-Projet Siffleur)

Mike Lushington, Dalhousie.

Mike Lushington, a former school teacher and president of the Restigouche Naturalists' Club, is a self-described bird lover who has been pushing to develop bird watching for tourists in the Point la Nim area near Dalhousie. "I've been running a little bit of a battle with the local thermal plant because of some bad visual air pollution over the last couple of years. I had people stop me in the street and say, 'keep up the fight because if we want people to come here to see how beautiful it is, we can't have that kind of big black plume hanging over things.'"

Orimulsion, up to 800,000 tonnes per year, is brought by large tankers from Venezuela and then pumped to shore here at the wharves in Dalhousie. Lushington continues. "A spill in May with the aggressive tides that we have coming up and down the river could very seriously endanger...the Black Scoters, plus thousands of other birds that are in the estuary at the same time. I think this is the single biggest threat to us here."

While its arrival in Dalhousie went unopposed, Orimulsion has not had such an easy ride in other countries. Vigorous opposition to its introduction has been waged in Japan, Florida and the United Kingdom.

Belledune

When East Coast Smelting and Chemical Company Ltd. (now Brunswick Mining and Smelting) built the Belledune complex – a marine terminal, lead-zinc smelter (1966) and fertilizer plant (1968) approximately 45 kilometres southeast of Dalhousie – people welcomed the jobs. In 1989, 600 people were employed at Belledune. No one considered the potential for contamination of the environment.

The lead smelter (zinc refining was terminated in 1971) quickly became a source of cadmium pollution, a toxic heavy metal which is persistent in the environment. Lobsters in Belledune

Harbour became so contaminated they posed a human health risk. DFO closed the harbour to commercial fishing in 1980, after which 22,700 lobsters were caught and destroyed. Beyond Belledune Harbour a control zone of six square kilometers was established within which only the tails and claws of lobsters caught could be sold. The bodies and digestive glands (tomalley) were incinerated.

(Noranda)

Lead smelter at Belledune.

In response, Brunswick Mining and Smelting implemented major pollution controls which removed 97 percent of the metals from its waste water going into the harbour (Hildebrand 1984). Based on decreased cadmium levels in biota found in the harbour, the lobster fishery was reopened in 1985 under controlled conditions, but it wasn't to last. Cadmium levels increased again from 1986-88, attributed to run-off from a site in which metal-contaminated wastes were buried, and faulty piping in the smelter.

Despite efforts to rectify the problem, sediment sampling done in conjunction with major construction in the harbour area confirmed elevated cadmium levels in the inner harbour; however, levels outside the harbour quickly approach background levels. Meanwhile, the lobster fishery in Belledune Harbour remains closed, except for a rather bizarre arrangement. Two fishermen are allowed to fish lobsters in the harbour. Brunswick Mining and Smelting then buys the lobster at market price and incinerates them in the smelter (Lindsay 1999, pers. com.).

Water pollution is not Belledune's only problem. Air emissions from the smelter and fertilizer plant are sources of sulphur dioxide, lead and cadmium. SO2 emissions have routinely exceeded provincial limits. Rather than install pollution control equipment, the company attempts to control total emissions by adjusting production levels. Even with significant improvements in lead and cadmium emissions, metals have accumulated in soils and vegetation as far away as 10 kilometres. Dust from ore concentrate as it is transported to the smelter by train has contaminated soils and vegetation along the railway route between Bathurst and Dalhousie. Monitoring to determine the biological effects of these contaminated areas on wildlife and plants is not routinely done in the Belledune area, so the cumulative effects are not known (Pilgrim 1991).

The NB Power generating station at Belledune is the largest coal-burning power plant in the province with a generating capacity of 450 megawatts. This makes it the largest source of mercury pollution in the province and one of the most significant single sources of greenhouse gas emissions. Acid rain-causing sulphur pollution, usually a problem with coal plants, are relatively low because the Department of Environment forced NB Power to install a scrubber to remove SO2 from its airborne emissions following public outrage over plans to construct the power plant without such controls.

This power plant first generated electricity in 1993, burning a combination of high sulphur coal from Minto and imported low sulphur coal. It was to be the first of two power plants planned for the site, dedicated largely to export markets. When these markets failed to materialize, the second coal plant was shelved and electricity from the first was sold within the province. This contributed to a glut of electricity in New Brunswick, forcing the provincial government to cancel its plans to implement a major energy efficiency strategy.

The Conservation Council argued against construction of the Belledune power plant during the environmental impact assessment hearings, on grounds that it would impose a major burden at the point when New Brunswick would be required to reduce greenhouse gas emissions as part of a national strategy to combat climate change. NB Power argued at the time there were no such requirements. Canada had signed the international Climate Change Convention, but the Kyoto Protocol setting national reduction targets under the convention was not negotiated until 1997. Federal-provincial discussions on how to implement the greenhouse gas reduction target required by the Kyoto Protocol are now underway.

New Brunswick is party to the Mercury Action Plan of the Eastern Canadian Premiers and New England Governors which requires a 50 percent reduction in mercury emissions by 2003. Canada-wide standards for mercury emissions are still at the discussion stage among the provinces and Ottawa.

Bathurst

Bathurst is another industrial hub. Despite declining employment in the industrial sector, it has left a legacy of contamination that still plagues the area. Besides the Stone Consolidated pulp mill at the mouth of the Nepisiguit River since 1915, there have been extensive lead and zinc mining operations located upstream on the Little River and Nepisiguit River watersheds.

(Noranda)

Brunswick Mine.

Mining

The mining industry has been an economic cornerstone in the northeast for decades. Yet it has not been without cost. Environment Canada's 1994 report, *State of the Environment in the Atlantic Region*, includes a long list of problems associated with mining: turbidity and smothering of aquatic habitat, fish kills, reproductive and growth problems in fish, algal blooms and oxygen depletion in receiving waters, groundwater contamination, lowering of water table, destruction of vegetation and wildlife habitat, destruction or disturbance of threatened or endangered species, dust, contaminant emissions, noise, exclusion of an area from other uses, and disruption of communities (boom-and-bust syndrome). Certainly Bathurst has experienced many, if not all, of these.

Consider the Brunswick Mining and Smelting No. 12 lead-zinc mine. The No. 12 lead-zinc mine, located about 21 kilometres southwest of Bathurst, began production in the mid-1960s. Until about 1982, the mine discharged acidic heavy metal-contaminated wastewater into the south branch of the Little River which flows into the Bathurst Basin. This situation was vastly improved in the early 1980s when the company began treating the wastewater to remove the metals. Further improvements in No. 12 came in 1993 when a high density sludge treatment system was commissioned. Since then the mine effluent has routinely been in compliance with federal regulations and guidelines.

Yet Little River remains acidified and devoid of life because of contaminants called thiosalts. These are partially oxidized sulphur compounds generated in the milling process. While they are not toxic, thiosalts are biologically and chemically oxidized when released to the environment, forming large quantities of sulphuric acid. This acid depressed the pH of Little River and made it uninhabitable by fish and other aquatic organisms. At present, the bacteria that oxidize the thiosalts are the only living things left in Little River. Treatment methods to remove thiosalts from mine wastewater have proved expensive and not very effective. It is a particularly difficult problem to solve because the process of biological oxidation continues when even the treated wastewater is discharged into the river. (Eaton et al. 1994; Lindsay 1999, pers. com.).

(NB Image Bank)

Pabineau Falls on the Nepisiquit River.

In the 1950s and 1960s, sports anglers were catching 600 salmon a year on the Nepisiguit, the largest river flowing into the Bathurst Basin with a watershed that reaches Mount Carleton Provincial Park in the north-central part of the province. In 1969, salmon populations in the Nepisiguit collapsed, attributed by Environment Canada to mining activity on the river. In 1970, only two salmon were caught despite some of the highest angling pressure in 20 years. By the mid-80s, restocking programs brought the catch up to about one third its pre-1969 level (Hildebrand 1984).

The Brunswick No. 6 mine heavily contaminated Knights and Austin Brooks, tributaries of the Nepisiguit, through its 15 years of operation. After its shut-down in 1983, the brooks continued to be a source of toxic metal contamination to the main river, particularly through surface run-off from the contaminated site. Over the past five years, the site has undergone extensive remediation. Most of the tailings piles were removed and either dumped back into an open pit or underground at the No. 12 mine. Surface run-off is directed to an open pit and seasonally pumped to No. 12 for treatment before discharging to Little River (Lindsay 1999, pers. com.).

The Anaconda Mine on Forty Mile Brook, another Nepisiguit tributary, continues to be a serious source of metal pollution. It only operated for two years, but in that short time it rendered the brook uninhabitable for most fish species. The mine was taken over by Caribou Mines (CanZinco Ltd.) and has operated intermittantly for the past several years, processing ore from the underground Caribou Mine as well as the nearby open pit Restigouche Mine. Operations were suspended in August 1998 and by October 2000 zinc prices had not improved enough to warrant its reopening.

When Caribou Mines took over the mine, there were public calls for the company's expansion plans to be subject to an environmental impact assessment. This was rejected by the Environment Department. Instead, the new Certificate of Approval stipulated the company must remediate past sins at the site, treat mine water from the underground workings, and conduct environmental monitoring. Despite this, contaminated water from the waste rock piles and several old tailings ponds is still seeping into Forty Mile Brook. According to Environment Canada, "Although some site remediation has been done by Caribou, a lot of work remains to be done. As a result, Forty Mile Brook continues to be contaminated with zinc downstream from the mine" (Lindsay 1999, pers. com.).

The physical barrier formed by two large sand bars at the mouth of Bathurst Harbour, combined with a low tidal range, results in the estuary acting like a settling pond for large amounts of sediments and contaminants from mining and pulp mill effluents. Monitoring in 1982 showed sediments in most of Bathurst Basin and Bathurst Harbour to have elevated levels of cadmium. High levels of zinc and lead were found near the mouth of Little River (Lindsay 1999, pers. com.).

Bathurst Harbour was dredged for shipping on a regular basis for over 100 years. Dredged material was routinely dumped at a site northeast of the harbour. When fishermen complained this was damaging fishing grounds and fouling their nets, an alternate site in Nepisiguit Bay was used but it didn't solve the problems. Dredging in the harbour was finally halted in the 1980s because of fear of disturbing the metal-laden sediments. Today, there is little or no commercial shipping activity in the harbour.

Shellfish closure areas in Chaleur Bay and Acadian Peninsula as of August 1999 (not comprehensive)	Sewage treatment method	Fish plant present	Toxin present
all areas within 120 m of any wharf in New Brunswick	various	frequently	generally, no
Restigouche River and Bay of Chaleur from Tide Head to Charlo out to NB/Quebec border	lagoons, extended aeration, aerated lagoon, septic systems	no	no
foreshore & waters of Heron Channel, Blackland Brook & Benjamin River; foreshore and waters off New Mills; foreshore and waters off Heron Island	septic systems	no	no
Chaleur Bay at Nash Creek	septic systems	no	no
part of Jacquet River and Chaleur Bay	septic systems	no	no
Armstrong Brook and coastal waters off of A.B.	septic systems	no	no
inside Belledune Harbour to Belledune Pt; foreshore & waters off Belledune Pt. (120m); foreshore and waters off Little Belledune Pt.	industrial facilities; septic systems	no	yes
foreshore and waters off Duncan's Creek	septic systems	no	no
water around Trap Point and Quinn Point; foreshore and waters off Fournier Brook near Point-Verte	septic systems	no	no
foreshore and waters off brook in Devereaux	septic systems	no	no
waters off Petit-Rocher between Limestone Pt., Pointe-Rochette and Petit-Rocher-Sud	oxidation ditch	2 at Petit Rocher	no
Nigadoo River seaward and shoreward	aerated lagoon	1 at Nigadoo	no
Millstream Gully, its tributaries, foreshore and waters off Beresford Beach; foreshore and waters off Beresford	septic systems, oxidation ditch	no	no
Bathurst Harbour & all waters flowing into the harbour from a point on Youghall Beach seaward and then shoreward to Belloni Pt.	activated biofilter industrial facilities	no	no
waters off Dune de Maisonnette	septic systems	1 at Maisonnette	no
parts of Caraquet Harbour ; part of foreshore and tidal waters of Caraquet Bay, 300 m seaward; waters of Caraquet River inside Pointe-des-Deux Rivière to rue Pinet	lagoon, extended aeration, septic systems	7 at Caraquet & Bas-Caraquet	no
waters of Rivière à Brideau at Centre-St-Simon; St-Simon Bay to Petite-Passe inside Pokesudie Is. at Petite-Ile to Hy 11	lagoon; septic systems	1 at Saint-Simon	no
part of Shippagan Harbour; portion of Shippagan Bay along shore to 30 m seaward	lagoon, septic systems	5 at Shippagan	yes
part of Baie-de-Lamèque and Ruisseau Jean-Marie	lagoon, septic systems	3 at Lamèque	no
waters of Grand Batture near Ste-Cecile, Lamèque Island	septic systems	no	no
shore of Lamèque Is. at Campbell's Point	lagoon	no	no
Pokemouche River inc. South Branch & their tributaries; part of Baie de Pokemouche	septic systems	no	no
part of Baie de Tracadie & all waters flowing into the bay; foreshore and waters off Tracadie Beach within 120 m; Big Tracadie River & portion of Rivière-du-Portage; Rivière à Comeau from Foster Pt. to Pointe à Canache	lagoons, septic systems	4 at Tracadie-Sheila & Sheila	no
Riviere-du-Portage & tributaries in Northumberland Co.	septic systems	no	no
Tabusintac River from Wishart Pt to Highway 11 bridge; part of Tabusintac Bay; waters of French Cove	septic systems	no	no

Sewage and fish plants

Throughout eastern New Brunswick, coastal waters are contaminated by sewage and fish plant effluents. Environment Canada has identified human sewage as the primary contributor to bacterial contamination of coastal waters. This includes discharges from both treated and untreated municipal sewage, poorly operating septic systems, and direct discharges from boats and shorefront residences. Other sources include run-off from urban and agricultural areas, treated and untreated industrial wastes, and animals.

During the 1980s, most communities along the Bay of Chaleur and Acadian Peninsula installed sewage treatment facilities. The smaller communities installed lagoons which only provide for primary treatment. While 60 percent of suspended solids are removed before pumping waste water into the environment, levels of biological oxygen demand (BOD) are only reduced by up to 40 percent, and fecal coliform (bacteria) levels are only reduced by half. Toxins present in the sewage, of which there are many, are not removed with primary treatment. Lagoons are used in the following communities: Atholville, Eel River Crossing, Charlo, Balmoral, Caraquet (one of two facilities), Bas-Caraquet, Lamèque, Shippagan, and Tracadie-Sheila (both facilities).

Secondary treatment can reduce BOD and suspended solids by up to 95 percent and coliform bacteria up to 99 percent. Toxic substances are also removed to some degree, depending on the substance. Secondary treatment systems are found in Campbellton, Dalhousie, Pointe-Verte, Petit-Rocher, Nigadoo, Beresford, Bathurst, and Caraquet (one facility).

Just because a community has sewage treatment does not mean the plants perform to their theoretical capacity. Municipal sewage systems throughout New Brunswick are often undersized for the volumes of waste water they are expected to treat. This undermines the efficiency of the system. It also results in direct discharges to receiving waters when events such as heavy rainfalls overload the systems.

Further, the rural nature of New Brunswick means that only those living in communities of a certain size are hooked up to municipal treatment systems. Many use individual septic systems; many of these are poorly designed, built or maintained. These leach their contents into both groundwater and surface water. (For further discussion of sewage-related issues, see Chapter 3).

Environment Canada and DFO jointly run the Canadian Shellfish Sanitation Program, the purpose of which is to protect the public from shellfish (specifically clams, mussels, oysters and quahogs) contaminated with bacteria or toxic substances. To do this, coastal waters are monitored for bacterial contamination, normally on a three-year cycle (more frequently in areas where volunteer monitoring programs are in place). If there is an obvious source of contamination, shellfish areas are also monitored for toxic substances such as mercury, copper, zinc, dioxins and furans. When water does not meet certain standards, the area washed by those waters is closed to shellfish harvesting. According to Environment Canada, the major cause of contamination of shellfish areas is municipal wastewater discharges. They are the sole cause of approximately 20 percent of the closures in the Maritimes, and a contributing factor in another 50 percent of closures (Eaton *et al*. 1994).

Fish processing plant wastes also contaminate coastal waters and shellfish habitat. Discharges contain particles of fish, oil, blood, slimes, bacteria and other contaminants. They degrade water quality, deplete dissolved oxygen needed by marine animals, and contaminate sediments in harbours where they are located. The solids can accumulate as sediment on bottom, rendering an area uninhabitable to all but some marine worms that can tolerate low oxygen levels. In some cases, sediments can contain PCBs since most fish tissue contain small quantities of PCBs (other sources are paints and industrial oils). While fish plant effluents tend not to be particularly toxic compared to other industrial facilities, coliform and Salmonella bacteria are present and contribute to bacterial loadings in coastal waters (Eaton *et al*. 1994).

While cost is often cited as an excuse to avoid proper sewage and waste water treatment at small fish plants, this is never weighed against the economic losses suffered by shellfish harvesters, and potential benefits to the community of a clean coastline where people can swim and harvest shellfish both recreationally and commercially.

Making Progress

While problems in this region are extreme, especially industrial pollution and declines in fish stocks, there are some encouraging undertakings. Pollution from marine debris has probably been reduced in the past 10 years, thanks largely to a campaign by the Maritime Fishermen's Union to educate fishermen and the public about proper disposal of garbage.

(Piper Project-Projet Siffleur)

Herménigilde Robichaud, Val-Comeau.

"I remember when I was fishing scallops," says Herménégilde Robichaud, a longtime Maritime Fishermen's Union activist and fisherman from Val-Comeau. "There were still people throwing garbage in the water and especially in areas or at wharves that weren't close to their home. Fishermen would say, 'if you throw out garbage at sea it will go away.' The fishermen from Val Comeau were almost the only fishermen who were in search of garbage bins and the change came gradually ."

Progress has also been made on fisheries management. Mr. Robichaud says, "Since 1972, I have been involved a lot with associations...In

1977 we formed a fishermen's organization. All my winters, I spent in meetings attempting to improve the outcome of the fisheries a bit....We are trying to work with the scientific community a bit to understand the lobster so we don't repeat the same mistakes as with the cod. When you are a fisherman, you must have something as your baseline. We are ready to leave the large lobster [the big spawners]. We should have had some laws which prevented the capture of the larger cod....If we look at lobster, the catches have increased in the region because it took some time before understanding that the smaller individuals needed to be left on the bottom to reproduce. Besides that, we've done all that there can be done here in increasing the size of our traps and the number of traps, but we have given lobster a chance as well. How long this will last, I don't know."

Water quality-related projects have been initiated by the provincial Department of Fisheries and Aquaculture and funded by the New Brunswick Environmental Trust Fund: the Caraquet Bay Sustainable Development program, started in 1993; the Bathurst Sustainable Development Project, established in July 1995; the Shippagan Harbour Sustainable Development Project, started in April 1997. These programs have undertaken sanitary shoreline surveys, beach clean ups and septic surveys on various rivers and brooks. In addition, a lot of work has been done by local groups and committees to restore fish habitats and re-stock rivers with salmon and trout.

On the Quebec side of Chaleur Bay, the Comité ZIP Baie des Chaleurs, formed in 1992, is part of the province-wide Stratégies Saint-Laurent, a collection of committees around "zones d'intervention prioritaires" or priority intervention zones. The Chaleur Bay committee encompasses the southern coast of the Gaspé Peninsula and Percé to the Restigouche River, a surface area of 4,000 square kilometres. Its main purpose is to develop and promote an action plan for ecological rehabilitation and integrated management of the area.

In 1991, the five-year Tabusintac Stewardship Project, an undertaking of the provincial Department of Natural Resources and Energy, the Quebec-Labrador Foundation, The Nature Conservancy of Canada and Wildlife Habitat Canada, was launched. The focus of the project was the conservation of wetlands and coastal habitat through a combination of private stewardship by landowners, land acquisition, and public education. As a result a nature trail was developed, private stewardship agreements were signed by 11 landowners, 512 acres of habitat were acquired by conservation agencies, a designated area within the lagoon was closed to migratory bird hunting, and the Tabusintac Estuary and Lagoon was designated in 1993 as a Wetland of International Importance under the Ramsar Treaty (New Brunswick's third Ramsar Site and Canada's thirty-first). In 1996, a 125 hectare site within the Tabusintac Blacklands was designated as an ecological reserve under the provincial Ecological Reserves Act (Foley 1999).

While the Tabusintac project ended and its management committee disbanded in1996, the Nature Conservancy of Canada continues to pursue land acquisitions as opportunities arise, including 153 acres of the barrier beach and a 32 acre salt marsh. The Conservancy will also pursue private conservation easement agreements with landowners.

Further, the Tabusintac Watershed Association, a multi-stakeholder group intended to provide a community voice as conservation initiatives proceed, was formed in 1998. The group has received money from the Environmental Trust Fund to carry out water quality monitoring under the auspices of the water classification initiative of the provincial government. The goal of the project is to establish water quality standards for the Tabusintac watershed within two years, and to develop an action plan to achieve these standards.

As well, in areas such as Néguac, Pokemouche, Caraquet and Tracadie, community associations are rehabilitating rivers and streams. Slowly, as a result of all these activities and a general shift in societal values, attitudes about the natural environment are also changing.

This makes an expansion of non-traditional economic activity such as ecotourism a possibility, says Mike Lushington. "I really do think that there has been over the last 10 years, certainly over the last five, an enormous change in attitude towards this whole idea of environment and doing things to protect it.... [At] the Charlo River estuary three or four years ago we discovered that there is a very, very small population of breeding Harlequin Ducks and it's the only area in the Maritimes that has those. It was discovered by a couple of local people who pointed it out to a birder, who pointed it out to someone else and we started to talk about it. Every time I go down there just looking around, somebody or other who lives there is bound to come up and say, 'We should be doing something to get this area protected.' This is what I consider to be public support when they make those close observations spontaneously... Further down yet, at the mouth of the Benjamin River in Blacklands...people are saying, 'We don't want this messed up anymore; we've had our run with heavy industry, we've had our run with clear-cutting in the forest and we don't want to see that anymore.'"

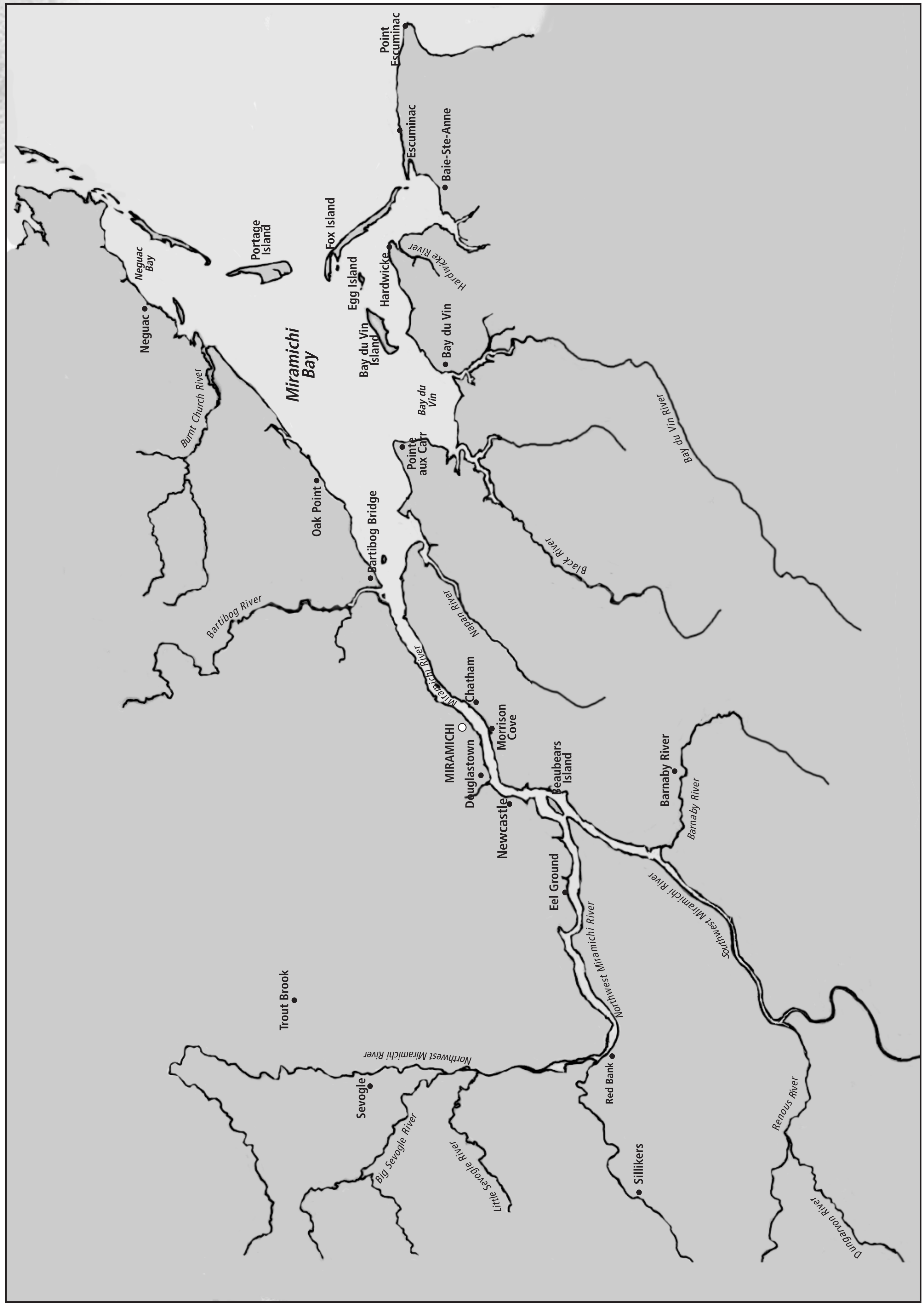
Everyone agrees that progress has been made, although the road ahead is still long. Miscou Islander Andrée Frigault is optimistic: "It takes time but I think there will be some action at the end of the line. Myself, I have faith in the hearts of people, that they want to do the right thing, although influences are very strong for money which takes away our fundamental values. Society has deviated, but we are coming back, we are making the balance."

Ron Gauthier, Bathurst

[Noranda] has started a program to restore Little River which is completely contaminated and where there's no vegetation growing in it.... They've done an awful lot of work and when they do close that Brunswick Mines and maybe hopefully start something else elsewhere, they will keep that restoration program going because that scar of the mines up there will be with us as long as your kids and their kids will be alive and that will continually contribute [contaminants] to the estuary here. The long term mending is going to benefit if they can keep it up.

Postscript:

In December 2000, the committee directing a project on the state of the environment of the Acadian Peninsula and its surrounding area released a report entitled, "Etat de l'environnement de la Peninsule Acadienne et ses environs." Developed as a working tool, it contains a description of the natural history, the resource-based economy, and potential impacts of human activities on the environment. In addition, this important document lists 21 associations and municipalities actively involved in environmental management, protection and education activities in this region. Clearly, the people of Chaleur Bay and the Acadian Peninsula have a strong commitment to protecting their natural heritage. Copies of the report are available from The Piper Project, 4800 Route 11, Tabusintac, NB E9H 1J6.


Point Escuminac
Escuminac
Baie-Ste-Anne
Fox Island
Portage Island
Neguac Bay
Neguac
Hardwicke River
Hardwicke
Egg Island
Bay du Vin Island
Bay du Vin
Miramichi Bay
Bay du Vin
Burnt Church River
Bay du Vin River
Pointe aux Carr
Oak Point
Bartibog Bridge
Black River
Bartibog River
Napan River
Miramichi River
Chatham
MIRAMICHI
Morrison Cove
Douglastown
Beaubears Island
Barnaby River
Newcastle
Barnaby River
Eel Ground
Southwest Miramichi River
Northwest Miramichi River
Trout Brook
Northwest Miramichi River
Red Bank
Sevogle
Big Sevogle River
Little Sevogle River
Renous River
Sillikers
Dungarvon River

V. Miramichi Bay

Setting the scene

(NB Image Bank)

Bay du Vin Island.

Like the Restigouche to the north, the Miramichi watershed has been witness to a number of changes over the years - some natural, some not so natural.

"One of the biggest changes I see here is the shoaling of the rivers and the bays due to silting," says Theodore Williston of Hardwicke who, at 67, has fished in the area since he began with his father at the age of four. "In the inside bay at Baie-Ste-Anne, the waters have shoaled since the First World War by at least six or eight feet. This is due, I guess, to civilization, the place building up as a residential area where one time it was just farming."

Williston describes how the smelt used to go up the little brooks from Baie-Ste-Anne to Napan to spawn in spring but can no longer because of heavy silt; how all the big trees that used to follow the coastline have been harvested; how, because of prevailing winds and tides, the islands are all shifting to the south.

"There is one gully here, Thibodeau's Gully, that I sailed through when I was just starting to fish," he says. "It's completely closed now. You wouldn't know there was ever a channel through there. There used to be two islands, Fox and Huckleberry Islands; now there's just one, Fox Island."

Williston's words are echoed by Francis Sippley Sr., also of Baie-Ste-Anne, who has fished the area for 40 years. Like most fishermen, decades of experience have taught him that everything is related. The lobster fishery has been good because the cod are gone, he says. "There's a lot of mackerel but you can't set nets for them because exploding populations of seals farther north in the Gulf have driven masses of them south into the Miramichi. The gaspereau fishery was good on the river until a peat moss operation was established. They were dumping right into the river, and all that silt from the peat moss drove the gaspereau right out," he says. "It's also choking the oysters and clams."

On the other hand, Sippley believes that the barrier islands at the mouth of Miramichi Bay have created a flushing action as the tide comes in and out that has kept populations of oysters and clams relatively clean of other contaminants.

Stephen Ginnish of Eel Ground First Nation on the Northwest Miramichi River can recall as a child watching annual spring log drives which, he says, virtually destroyed the habitat of the sturgeon. Sturgeon was always the main fish taken by the Mi'kmaq people. He also believes the forces that destroyed the salmon population in the river have upset the entire ecosystem. "Everyone is concerned about the protection of the Atlantic salmon and they should be," he says, "but all species are on the decline. Species like the trout, striped bass, eels, smelt, perch, whitefish, blue backs and shad are also dramatically decreasing in numbers."

In deciding to close the commercial salmon fishery in 1984, DFO fisheries managers made a choice between the value of the commercial fishery and the dollars that the recreational fishery could potentially bring to the area. The Miramichi is a world-renowned destination for wealthy anglers; the recreational fishery won. Since then, tourism has become a growing industry on the river, although its growth has not been without consequences.

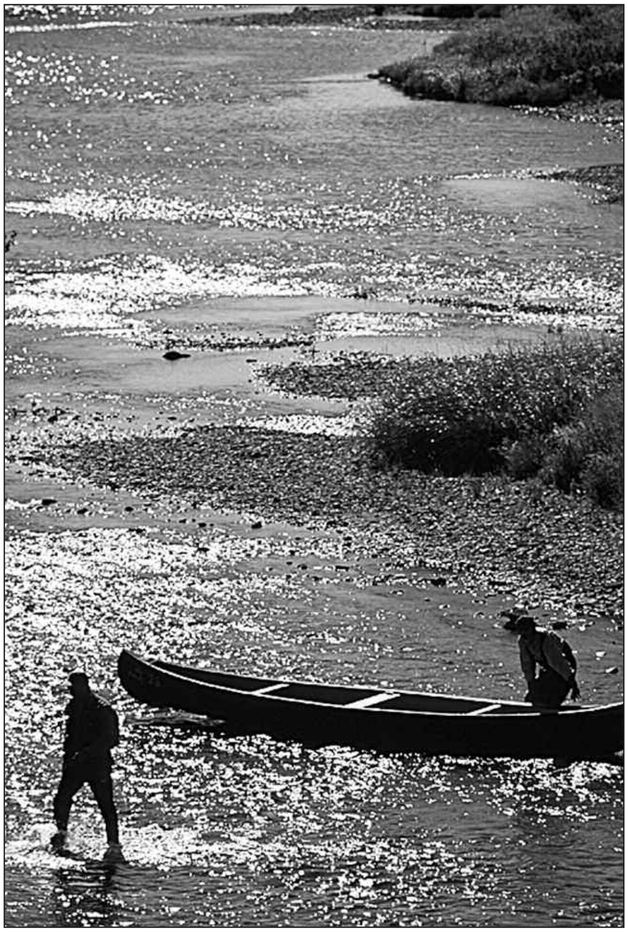
"Back 10 years ago," says Stephen Ginnish, "I would see the odd pleasure boat go by once every three or four days during the warm seasons. Today, unfortunately, I see 10 to 15 boats speeding upriver in a day. I watched how these new Sea-doos began to rule the river, with the ability to travel in low shallow sections, changing the environment through the disruption of natural fish nurseries and shoreline water nesting areas for waterfowl. In other provinces, these new types of water crafts have strict rules and regulations attached to their operation but not here."

Even those making a living from tourism recognize the problem. Debbie Norton who runs Upper Oxbow Outdoor Adventures at Sillikers believes that in many areas the river banks have been destroyed by lumbering or mining. "If you go canoeing to get away from the rat race, it is sort of self-defeating if you should come across these ugly scars on the land," she says.

Ginnish has also seen increased pollution. "I used to swim across this river in front of Eel Ground when I was a kid and didn't have to worry about catching a rash. Now, before anyone can go swimming, we must check into the bacteriological counts in the river because of raw sewage from increased residential development along the river, plus the added industrial and city waste water flushing into the river."

Stafford Anderson runs boat tours from Ritchie's Wharf in Newcastle. "There are comments [by tourists] on the colour of the water, and there are times you can actually smell the water when it's being churned up in certain areas," he says. "No one is actually going to complain about the [Newcastle pulp and paper] mill a whole lot because it's what I call a one-horse town. Everybody works at the mill, and even companies in town – construction companies, electrical companies – they all depend on contracts from the mill. It's all a spin-off, so that is actually why nobody is really coming onto the mill. Once that mill goes, it's going to be a dead town."

Ecological processes, habitats and species


(NB Image Bank)

Miramichi River.

In her classic book about the Miramichi, (a Montagnais word meaning 'country of the Mi'kmaq'), Esther Clark Wright (1944) described the Miramichi River as "hiding modestly behind a chain of sand islands such as is typical of the river mouths on the coastal plain of eastern New Brunswick." This apt description captures the three distinct parts of the Miramichi system: the river, the estuary and the bay.

The Miramichi River stretches from east to west for 190 kilometres with its headwaters in the central highlands of New Brunswick, and north to south for 95 kilometres (Chiasson, 1995). The river system consists of the river, two main branches (Southwest and Northwest) and several minor branches (Sevogle, Little Southwest, Northwest Millstream, Renous, Dungarvon, Barnaby, Bartholomew, and Cains) which in total drain an area of 14,000 square kilometres, the second largest watershed in the province.

The bay, shaped like a triangle, is approximately 45 kilometres along its north and south shores and 32 kilometres across at its mouth. It's surface area covers more than 300 square kilometers (Chiasson 1995). It is protected from the southern Gulf of St. Lawrence by a chain of barrier islands, and is shallow with depths ranging from three to five metres. A shipping channel is dredged to a depth of eight metres.

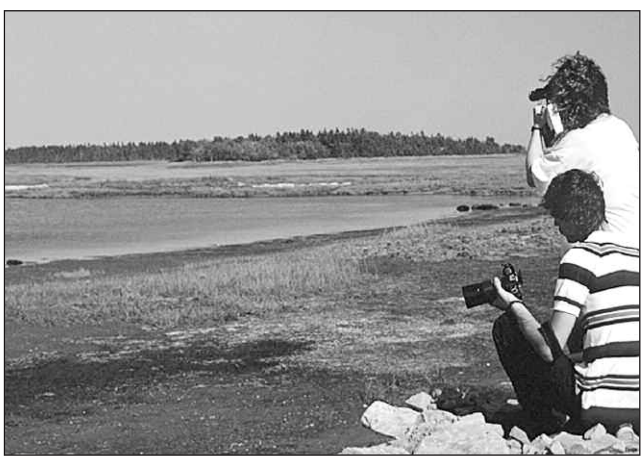
The estuary, sometimes called the Inner Bay, where fresh river water and salt bay water mix, is funnel-shaped, and stretches up past Beaubears Island into the main tributaries of the river. The head of tide is at the "Oxbow", an area about one kilometre upstream from the mouth of the Little Southwest Miramichi River. It is a microtidal estuary, with a mean tidal range of only one metre, and is very shallow (averaging 4-5 metres) with a navigation channel with an average depth of six metres running through the center (Chiasson 1995).

V. Miramichi Bay

A unique feature of the Miramichi estuary is a "salt wedge," formed by the effect of tidal movements on the lower layer of salt water in the estuary. In the spring, freshwater discharge from the vast Miramichi watershed pushes the salt wedge down the estuary to an area between Chatham and Gordon Point. When this discharge dissipates, the wedge migrates back upstream (LaFleur et al. 1995). This means the range of influence of the estuary actually changes throughout the year.

While the full effect of the salt wedge is not well understood, it may be essential to the productivity of the estuary. Usually, biologically productive marine environments are well mixed, ensuring a constant source of phytoplankton and nutrients to fuel growth of marine organisms. Such mixing is a function of tidal upwelling, which suspends bottom nutrients in the water column making them available to the food chain. Such upwellings are very prominent in the outer Bay of Fundy where tidal currents are strong. Wind rather than tide is the dominant mixing agent in the Miramichi estuary, and as a result its water layers (fresh on top, salt on bottom) remain essentially stratified. The salt wedge and its associated counter-current may serve to overcome this. They may act as a trap, preventing phytoplankton and nutrients from being flushed out of the estuary by freshwater discharge from the river (St-Hilaire *et. al.* 1995).

As with the entire eastern New Brunswick coastline, the erosion and deposition of sediments dominate the physical character of the Miramichi system. Based on this, Reinson (1976) has identified five major sedimentary environments: the river channel, the inner bay, the tidal-delta complex, the coastal barrier and the outer bay. Between 1964 and 1977, circulation and sediment patterns and flushing rates in the estuary changed significantly, apparently related to shifting and infilling of inlets between the barrier islands (Chiasson 1995).



(NB Image Bank)

Néguac Provincial Park.

From a total of five gullies at the mouth of the bay in 1837, only three remain. Between 1837 and 1974, Portage Gully superceded the Neguac Gully and became the only northern entrance to the Inner Bay. It had also moved 700 metres southward, while Neguac Beach was extended by four kilometres. Portage Island had moved three kilometres south and decreased in size by 175 hectares. Fox Gully separating Fox and Huckleberry Islands closed in 1972 while Huckleberry Gully shallowed considerably. Horse Shoe Shoal has stayed put for the past 140 years, but it has grown on the seaward side, including the growth of a large spit, thus shallowing the Inner

Bay. The channel axis has changed from a northwest-southeast orientation to an east-west orientation (Chiasson 1995).

Fishermen would be the most sensitive to this changing seascape. Francis Sippley of Baie-Ste-Anne observes, "The islands have eroded quite a bit because years ago we had two lighthouses and houses on Fox Island and where one of the houses used to be – it might have been 300 yards inland – now it's sitting maybe 50 yards on the beach.... Forty to 50 years ago, it was two islands....If you look on a map you can see Huckleberry Island and Fox Island, but it's only one now. Now there is only one gully, the big gully that comes into the bay, but back then there was a gully between the two islands... You don't even see the place where the gully was ....[T]he lobster fishermen could go in back and forth through that middle gully, so that doesn't exist anymore."

(Cathy Carnahan)

Miramichi Bay at winter's end.

Other features contribute to the diversity and variability of the system. The spring floods create a five-fold increase in fresh water input to the estuary over an average period of 40 days. Its total fresh water discharge represents about half of all the freshwater flowing into the southern Gulf of St. Lawrence, from the Bay of Chaleur south including PEI and up to the northern tip of Cape Breton (Chaput 1995).

This sudden flush of fresh water carries with it fully 80 percent of the annual movement of sediments (95,600 tonnes) into the estuary. This has included as much as 20,000 tonnes per year of organic matter from the wood processing mills. These sediments are deposited for a time in the estuary before being more gradually dispersed into the bay and Gulf of St. Lawrence. Spring floods also carry contaminants, primarily heavy metals like zinc, lead, copper, cadmium and mercury, from the watershed, and then deposit them in the estuary sediments. Some of these contaminants are then remobilized over the year. For example, 90 tonnes of zinc are discharged from the Miramichi estuary to the southern Gulf of St. Lawrence each year. Dredging through the 1980's moved six million cubic metres of sediment out of the shipping channel through the centre of the estuary to various dump sites within the system (Buckley 1995). It is unclear how stable these dump sites are; they may be an ongoing source of sediment deposits to certain areas of the estuary and bay.

The physical and oceanographic characteristics of the Miramichi system have been the focus of study for most of this century; indeed, the estuary is one of the most thoroughly studied in Canada. Less well understood are the complex ecological and biological processes of the system, how these interact with the physical environment to produce marine life, and how that marine life is affected by such human activity as toxic contamination and dredging.

State of marine resources

The Miramichi has been home to Aboriginal peoples for literally thousands of years. At 3,000 years old, Red Bank, now a First Nations reserve, is the oldest known occupied village in the Maritimes. Testimony from present residents of the First Nation reserves at Eel Ground and Red Bank reveals how important the river was to the sustenance and culture of their people.

Madeline Augustine of Red Bank First Nation recounts, "I think, sometimes, once our language is lost, we might lose the river somehow...The river was always...our place. Our ancestors always got medicines from the river...and at one point it was for survival....Actually, our ancestors used the river for survival, to fish in, for fish all year round. At one point in time, the river was a highway...using birch bark canoes for transporting from one point of the river to another, for getting foods and medicines. The river has always been our livelihood for the people here in Metepenagiag".

Madeline Augustine, Red Bank First Nation

Our people have been fishing this river for about 3,000 years, and we had all kinds of salmon, shad,…grilse and sturgeon. We used to have sturgeon come up our river to the turn of the century. Everything was plentiful. This, I think, was because the river was...narrow and deep. Once...there was so much salmon in the river that you would almost walk on the river on top of the fish.... Then people started clearcutting by the river...and that is when our riverbanks began to erode. And they kept eroding over the years which made the river wide and shallow, also preventing sturgeon from coming up our river. When William Davidson first came to the Miramichi back in the early 1800s ...he took a net and put it right across the river, which prevented the natives from Red Bank and Eel Ground from getting any fish. That is the first time that our people first saw that the salmon were not coming up our river at all because of the river being blocked. The Indians didn't like that. Instead of having a war, they sort of compromised, and the deal was that the settlers and Davidson were to fish on certain nights of the month and the Indians were to fish certain nights. But the Indians...had picked what nights to fish because they knew what nights were the best...


(Cathy Carnahan)

Steve Ginnish of Eel Ground First Nation echoes those sentiments. "I couldn't imagine living away from the Miramichi, since I have lived close to the river all my life. I spend much of my spare time on the water traveling up and down the river enjoying its beauty with my son and my family. I use the river in many ways, fishing for salmon, trout and eels, for recreation, for spiritual needs and to be with my father [a Mi'kmaq chief who died when Steve was 10]."

Approximately 300 years ago, European settlement began and the river has sustained increasing human development since. Today the population of the area is roughly 52,000 people, many of whom gain a livelihood from the waters of Miramichi Bay, estuary and river.

(DFO)

Gaspereau fishing boat on the Miramichi.

The Miramichi River and estuary system is the largest producer of diadromous fish (fish that migrate between sea and fresh water at some point in their life cycle) in Atlantic Canada. This is because of its size (second only to the St. John River) and its accessibility (no large dams or other physical barriers to fish passage). These diadromous species are: sea lamprey, American eel, alewife and blueback herring (both species of gaspereau), American shad, Atlantic salmon, rainbow smelt, Atlantic tomcod and striped bass. Of these, all but lamprey, salmon and striped bass are fished commercially. Atlantic sturgeon used to frequent the river but have not been present in recent times. Brook trout, a favourite species of the recreational fishery, can also be diadromous but little is known of its movement between fresh and sea water (Chaput 1995).

Some of these species are especially important ecologically. The Miramichi Estuary is the northernmost distribution limit of alewife, blueback herring, shad and striped bass, and the southernmost distribution limit for tomcod. Rainbow smelt is thought to be a keystone species in the system, that is, a species on which many others depend, particularly as an important food source for other fish (Chaput 1995).

The Miramichi estuary serves two functions for fish: as a nursery area for diadromous and estuarine species, and an overwinter refuge for diadromous and marine species. Winter spawners include Atlantic tomcod, Greenland cod and smooth flounder. Alewife, blueback herring, rainbow smelt and striped bass are spring spawners. American shad spawn in the fresh water and migrate to salt water in early autumn. Adult and juvenile striped bass overwinter in the upper estuary and fresh water. Adult smelt and tomcod enter the estuary in the autumn and spend the winter, as do smooth and winter flounder. While winter flounder spawn outside, the estuary is part of the inshore nursery for this species during the summer (Hanson and Courtenay 1995).

In total, 47 fish species from 27 families were collected in samples taken from the estuary between 1991 and 1993. Brown bullhead, yellow perch and white perch were found here, although they are fresh water species. Others include white sucker, white hake, Atlantic silverside, sticklebacks, American sand lance, sculpins, American plaice, yellowtail flounder, and Atlantic herring (Hanson and Courtenay 1995).

Despite the profile given the Miramichi salmon, this prized fish has low ranking in the system in terms of biomass and abundance (although its historic ranking is unknown). The highest ranking goes to rainbow smelt which comprises over 50 percent of fish biomass in the estuary, and is ten times more abundant than second place gaspereau. The two gaspereau species, blueback herring and alewife (the former being three times more abundant than the latter), comprise just over 40 percent biomass. Smelt is 20 to 30 times more abundant than tomcod, 100 times more abundant than eels, 1000 times more abundant than salmon and shad and 10,000 times more abundant than striped bass (Chaput 1995).

The outer bay is also important for fish production. There are herring spawning grounds in the Escuminac area in the southwest part of the bay. There are also productive lobster grounds off Fox Island and the shores of Escuminac. Egg Island, located south of the Miramichi Channel has one of the most productive oyster beds in Atlantic Canada. There are also productive clam flats on the barrier islands and shores.

Ben Baldwin, Douglasfield

I have vivid recollections of my grandfather fishing smelts in the winter time on the ice in a shanty a mile from here. I remember going there with a horse and sled and getting smelts. I think they were sold to somebody in Chatham but I can't remember that. I do remember bringing in the cull fish, or the tommy cod, and we'd cook them on an outside boiler here for the pigs. We'd use tommy cod for pig feed, and my brother and I would come home from school and we'd eat these tommy cods before supper. I also remember in the summer time my mother often sending me out on a bicycle (this would be about 1940) to the local fishing stand somewhere along the river where Billy Ramsay has his shop now... In any case, I would go out there and buy a salmon and bring it back for supper. I did that lots of times... It was readily available, and nobody ever thought they would decline. It was never discussed. It was accepted that these fish would be there forever.... So that's my main recollection of the fishing on the river. My grandfather, as I said, used to fish as part of his livelihood in the winter time, as many people did. Certainly smelts was the main species... It was a way of life... What is worrisome is that these changes, obviously, happened in one lifetime. This was going on in 1940 and, obviously, a very short time after that things started going to hell.


(Cathy Carnahan)

Although forestry and mining are more important, the commercial fishery makes a significant contribution to the regional economy. From Neguac to Escuminac and Pointe-Sapin (as well as smaller wharves scattered along the coast in between), commercial fishermen land smelt, gaspereau, eel, herring, mackerel, shad and lobster. Up until 1945, smelt constituted 50 percent of total landings. Gaspereau became more important after that point, and now makes up fully 80 percent of landings. Particularly since 1980, catches of other species are small relative to these two species. Lobster is the dominant fishery in terms of value, accounting for an estimated 70 percent of the fishermen's incomes. In recent years, fishermen have been involved in an experimental rock crab fishery in the outer bay and clams have been harvested recently with mechanical harvesters. Salmon and striped bass are important for the recreational and sport fishery.

The health of fish populations and thus the future of the commercial fishery is a major issue. In most other estuaries, the dominant species are those in which the adults spawn at sea and the larvae drift into estuaries where they spend their juvenile stage and then move back offshore. Not so the Miramichi. Here, most of the larval and juvenile fish found in the estuary originate from eggs laid there or in the river during winter and spring. Thus this estuary is critical habitat for the earliest stages of life of many species, including those caught commercially (Hanson and Courtenay 1995).

Theodore Williston, Hardwicke


(Cathy Carnahan)

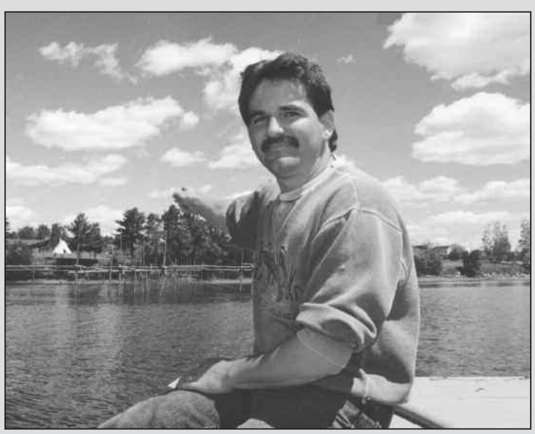
From when I started to fish, there has been a number of the species of fish eliminated completely from the commercial fishery. Some of these are due to lack of stock and some taken way from us and given to the sports fishery (I'm thinking of salmon as the chief one, and then there is bass). There are other species of fish, like shad and groundfish – cod, hake, flounders – that the [populations] are just not there now. Also, there is a reduction in oysters and clams and eels to what there was back then. Part of this is over fishing and part of it is due to pollution from especially the river system.... Some species stayed up remarkably well. Crabs and lobster seem to flourish in this area, in fact they are a lot healthier now than they were 15-20 years ago, although in lobsters we're fishing deeper water now. We never went out any more than 10 miles; now we're going out as far as 17 miles from Escuminac.... Another change is the smelts. Up until 1980, when they did the major dredging of the Miramichi at the head of the Horseshoe Bar in the mouth of Miramichi Bay, we enjoyed real good smelt fishing. We've taken as many as 3,500 pounds out of one net overnight. But since the dredging in 1983, we haven't been able to catch any smelts in that area. We've tried... and to no avail, and this is 15 years gone by. It might be just a coincidence, but I don't think so. We're switching from one type of fishing to another. We never fished rock crab here before, and now there is a fishery going on there

Tellingly, species that spend a lot of time in the Miramichi estuary at various life stages (e.g. rainbow smelt, Atlantic tomcod, American eel, striped bass, alewife, blueback herring) are declining in abundance (Hanson and Courtenay 1995). In some cases (but not all -- landings are also a function of fishing effort), this decline is reflected in commercial landings. The fisheries for shad, salmon and striped bass are all classified as "precarious" and smelt and tomcod are "declining" (Chaput 1995).

Smelt catches have declined steadily to about one third the level of the 1920s, leveling off at about 400 tonnes annually, a drop in the Miramichi contribution to total Southern Gulf landings from 40 percent to 30 percent. Tomcod landings (a by-catch of the smelt fishery) have declined in lockstep with smelt, from about 500 tonnes annually in the early 1900s to less than 50 tonnes. This is less than 50 percent of total southern Gulf landings, compared to an historic level of 75 percent. While gaspereau landings are up (just under 2,000 tonnes annually), this is still only between 20 and 45 percent of total southern Gulf landings compared to the historic level of 60 percent. Eel catches peaked between 1970 and 1972, and have since declined to about 40 tonnes, a drop from 30 percent to between 10 and 20 percent of the Gulf total catch (Chaput 1995).

Shad landings peaked in 1955 at 450 tonnes; by 1970 it had collapsed to 25 tonnes, an amount taken annually as a by-catch of the gaspereau trapnets. Declines in Miramichi shad have not been attributed to a particular factor, but lessons could be learned from the demise of the St. Lawrence shad fishery which was caused by a combination of pollution, over-fishing and impediments to migration (Provost et al. 1984).

Steve Ginnish, Eel Ground First Nation


(Cathy Carnahan)

[Currently] a new experiment on the large striped bass is being initiated. This spectacular species of fish may be lost because of unknown threats during the past five years. There is a stretch of shoreline approximately three kilometres in length, starting just below Eel Ground and traveling upriver to the Northwest Millstream where the last most northerly spawning population of stripers lay their eggs. This spawning population numbers 5,000 fish. Anglers from all communities participated in a recreational fishery but as of 1997, these stripers became protected under the federal Fisheries Act under the rules of conservation, and the recreational fishery was closed. Some research that has been published points to the effluent release by a local paper company but yet, this same industrial giant has been given approval to construct a new industrial waste site upstream from these spawning grounds. Why is this allowed to happen? The same is happening to our sea run trout, so when

While the striped bass fishery was never large, the Miramichi landings at one time constituted as much as 75 percent of total landings in the Southern Gulf of St. Lawrence. Now it is less than 50 percent (Chaput 1995). There is a spawning population of striped bass in the Miramichi River which is genetically distinct from those of the Bay of Fundy and the US eastern seaboard. This species is very susceptible to industrial pollution, and high levels of mercury have been measured in the muscle of Miramichi striped bass. Declines in populations in other maritime areas are attributed to combinations of low pH, aluminum, water hardness and salinity (Jessop 1990), conditions present in an acidified environment. Striped bass have been extirpated from the St. Lawrence River, probably due to dredging near spawning areas, water pollution and over-fishing (Beaulieu 1985).

In 1850, Moses Perley reported that the quantities of salmon in the Miramichi were "perfectly prodigious" and that during the 1840s, an average of 1,651 barrels of pickled salmon were exported from the Miramichi each year, compared to an average of 489 barrels from its nearest export rival, the Restigouche. Even so, at that early date the supply was already diminishing from year to year. Perley attributed the problem to residents stringing nets across streams to "take every fish that attempts to pass," and destroying fish by torch light and spears at a time when they are spawning and "quite unfit for human food."


(NB Image Bank)
Fisherman's Memorial Monument at Escuminac.

In the century that followed, the Miramichi developed a reputation as one of the greatest salmon fishing areas in the world, not just for recreational anglers on the river but also for commercial fishermen on the bay and waters further out. For years in this part of the province, salmon was the first commercial fishery of the season for inshore fishermen, and the first money to be made after a long hard winter. It was for salmon that the Baie-Sainte-Anne fleet had been drifting in June 1959 when a surprise storm took the lives of 35 men and boys in 22 boats. The price for salmon was high, the run good, and the need for money great, so much so that the risk of bad weather was deemed worth taking.

Commercial catches of Atlantic salmon peaked in 1924 at 571 tonnes. This decreased to less than 150 tonnes between 1955 and 1965; after increases in the late 1960s, landings decreased to less than 100 tonnes by 1971. Reported landings between 1971 and 1980 were the legal by-catch from other fisheries. By 1984 stocks had diminished to the point that the commercial fishery was closed.

Since then, returns to the estuary have increased to about 300 tonnes, but they have yet to reach the tonnage caught during the peak years, let alone what was present in the system

(Chaput 1995). The number of grilse (salmon returning to spawn after one year in the ocean) that returned to the Miramichi River in 1997 stood at 16,000 compared to a historical average of 80,000, and a theoretical river capacity of 200,000. Management measures limiting the recreational catch, as well as the commercial fishery closure, are factors in this increase (the daily recreational catch limit for salmon is four catch-and-release and one grilse, with a seasonal limit of eight grilse). However, human disturbance in the watershed is also a factor inhibiting the recovery of salmon and other fish populations. Besides the historic insults of pesticide spraying, fish passage blocked by pulpwood piles in the river bed, and base metal mine pollution, today's threats include accidental spills of toxic wastes and alteration of stream profiles by industrial forestry operations (Chaput 1995).

Fish population declines, especially in those species that spend a lot of time, or critical early life stages, in the estuary are likely due to a decline in habitat quality within the estuary (Chaput 1995; Hanson and Courtenay 1995). Contaminants from three wood fibre mills, a mine and municipal sewage systems are discharged into the river and estuary, settle out in the estuary, and are remobilized into the water column from the sediments. Since this is a nursery area for smelt, gaspereau, striped bass, tomcod and smooth flounder, these species are directly at risk. There is also evidence that industrial contamination in estuaries is related to the incidence of disease in fish, and the failure of fish eggs and larvae to survive (various

Debbie Norton, Trout Brook and Sillikers

...The current threat to the river, in my opinion, continues to be mankind and their greed.... One user group is afraid the other group is going to get more of the [salmon] resource than they are, so they go out and set upon themselves to try to make sure they're getting their fair share. In so doing, they often take more than what is their fair share. Some user groups feel the resource only belongs to their group rather than that it was put here for all of us to share.... I feel there has been considerable improvement in the last [few years]. Various conservation groups who are fighting hard to conserve the


(Cathy Carnahan)

Atlantic salmon have won some major battles in 1998. The commercial fisheries in Canada have closed and major concessions have been made internationally to reduce catches on the high seas. I think, if we continue to abide by these new measures, we'll continue to see an increase in the number of Atlantic salmon that return to our shores. The numbers this year were supposed to be down, [according to] forecasting made last year, and there was a lot of hoopla. However, the numbers at the counting fences that have come in in 1998 are double and triple what they were last year. And, matter of fact, they are well above the five-year mean.

references in Hanson and Courtenay 1995). It remains to be seen whether improvements in the contaminant levels of effluents entering the river and estuary will result in the recovery of fish species dependent on this system.

Besides problems with abundance, particularly in localized areas, fecal contamination of shellfish beds also puts pressure on the resource. All areas upstream of a line between Oak Point and Point aux Carr are closed to harvesting, as are Bay du Vin River, Black River, Eel River and Portage River, the area downstream of the lower Hardwicke River Bridge and around the Escuminac wharf, an area to the east and west of the mouth of Burnt Church River, around the Neguac wharf and the mouth of McKnight Brook in Lower Neguac (MREAC 1992). The economic cost of these closures must be significant, since many people depended on clams in particular to supplement their annual earnings from fishing.

Because of its high value, lobster comprises as much as 70 percent of the income of Miramichi commercial fishermen. Miramichi Bay is part of Lobster Fishing Area (LFA) 23, a unit of management established by the federal Department of Fisheries and Oceans which extends north around the Acadian Peninsula and encompasses the New Brunswick side of the Bay of Chaleur. There are 183 commercial lobster licences held in Miramichi Bay, with each licence allowed 300 traps (down from 350 a few years ago) making the total potential effort for the bay about 55,000 traps. According to a DFO official, 53,000 traps have actually been fished during the mid-May to mid-July season.

Landings in LFA 23 (like landings in all other LFAs in the Maritimes) increased steadily between 1982 (1,730 tonnes) and 1989, when tonnage peaked at an historic high of 4,529, an increase of 260 percent. Catches have been fluctuating since, down to 4,186 tonnes in

Shellfish closure areas in Miramichi region as of Aug 99	Sewage treatment method	Fish plant present	Toxin present
Portion of McKnight's Brook / Neguac Bay; waters east of Neguac wharf to Godin Brook and seaward; area of Rivière-des-Caches	Septic systems; lagoon	Yes	No
Portion of Burnt Church River; waters of Miramichi Bay at Burnt Church	Septic systems	No	No
Area of Black River and tributaries	Septic systems	No	No
Area of Bay du Vin River and tributaries	Septic systems	No	No
Foreshore and waters off McInnis Brook	Septic systems	No	No
Area of French River	Septic systems	No	No
Area of Eel River	Septic systems	No	No
Waters of Miramichi Bay around Escuminac	Septic systems	No	No
Foreshore and waters off Baie-Ste-Anne	Septic systems	3 plants	No
North and south shore of Egg Island, Miramichi Bay		No	No
Foreshore and waters of Inner Miramichi Bay within 300 m of shore between Oak Point and Swinging Point	Septic systems	No	Yes
All waters of Miramichi River west of a line between Point aux Carr and Oak Point	Septic systems, aerated lagoon, oxidation ditch, lagoon	No	No
Foreshore and waters within 300 m of Portage Island in Miramichi Bay		No	Yes

Francis Sippley, Baie-Sainte-Anne

I remember when we used to go clam digging [50 years ago]... After the lobster season was done, everyone would go clam digging, like all the women, kids and what have you. The lobster fishermen back then...would take all the dories – there might be 15-20 dories – and they would charge you a quarter per dory to haul you to (Fox) island and haul you back. I was six years old and I dug clams all summer and I made $16. We would get 25 cents a bag and 35 cents per 20 pound bucket, compared to what we get now - 10,12, 13 dollars a peck, or 15 pounds)... By the time I reached the age of 12, I could pretty well keep up with most men that fish the clam flats.

(Cathy Carnahan)

Maybe about 10 years prior to when I started, that is when they started [commercial] clam fishing. Before then, there was just the Indian who would go dig a feed, and local people would go and get a feed for the winter. Then it became big business because W. S. Loggie from Chatham and all them that were in the business had a fish factory. It wouldn't be uncommon to have five or six three-ton trucks, and there might be six, seven buyers buying clams, so they were all lined up along the shore. They each had their customers.... Where we used to dig clams 40-50 years ago, there are none there now. It probably took them 1,000 years to establish, so it's not a very good breeding area, and they are very easy to clean out. The only place now that we get clams, and they're very plentiful, is on those series of islands where it's fairly shallow and you get that tide that goes back and forth quite often... They are as good this year as I've ever seen them, and there are a lot more people at them so it doesn't hurt to fish them.... One species that has come around in recent years is bar clams. We never had them before – very, very few – but in recent years they have taken over on Portage Island, so anyone can go and get any amount of bar clams. And that is good, because years ago you would have to go to Cape Bald or down PEI...

Before my time, around 1935, the companies like W. S. Loggie and A. & R. Loggie set up [lobster] operations down at Escuminac Point and they built factories... and had about 15 each, maybe 30 lobster boats. There were no roads; it was just like a trail for horses to go. In the spring, they would bring all the people from the Baie Ste-Anne area and Big Cove [First Nation] and they would have boarding houses and people would stay there for two months [working in the lobster factories]. There was not enough labour in the area here because this was a new industry, so half of Big Cove would come down...

It's strange because we always had good relations. For us, we hadn't seen them for about 40 years, but then we got [a baseball team] organized, and the first time we went to Big Cove, it was like a homecoming. Everyone from the village showed up and they had sandwiches for us. It was just from stories they heard from their grandfathers, so the bond was still there...

Anyway, there were no regulations. You could bring any lobster – undersized lobsters, the females – they would can anything. That lasted for about 15 years, and when the Loggies had made their money (that's how they got rich), then Ade Theriault Sr. bought one of the shops and he kept it going... But by then local people started getting organized. They started getting their [own] lobster boats...and they built a breakwater at Escuminac. Then our local co-op got going too, and Fred Savoie was another outfit that had a mackerel boat and they were drifting for the same people... Then, the fish companies were done. That was the end of her, so for a good time it was just the co-op that was in operation, and they were trucking lobster all over the province. In recent years, Raymond O'Neill got organized and the co-op [and O'Neill] are the mainstay. They are very powerful now, O' Neill especially. They're probably the biggest in the Maritimes...

1992, up to 4,352 tonnes in 1993, and another drop to 4,003 in 1994. This remains far above the 1988 catch of 3,114 tonnes (FRCC 1995).

Some interpret today's record high landings as the sign of a well-managed, healthy fishery. Others see warning signs. The federally-appointed Fisheries Resource Conservation Council (FRCC) believes there is a resource conservation problem and says "we are taking too much and leaving too little." According to the 1995 FRCC report, "A Conservation Framework for Atlantic Lobster", the fishery is designed towards "high exploitation" (as high as 85 percent in many areas), harvests primarily immature animals, and results in low egg production (as low as 1-2 percent of what might be expected in an unfished population). The FRCC concludes, "although lobster stocks have traditionally been quite resilient, the risk of recruitment failure [the advancement of fish to a stage where they are commercially fished] is unacceptably high."

The FRCC restricted its analysis to the impacts of fishing effort on lobster stocks. It did not consider the additional pressure due to loss of habitat and contamination, both of which are factors in industrialized areas. Lobster habitat destruction is commonly associated with dredging and dumping of dredge spoils. Dredging also suspends contaminants lodged in sediments back into the water column, making them available once again for uptake by marine organisms at various points on the food web. Research has shown that the inner bay is a repository for vast amounts of sediments and associated contaminants as they flush through the river system. These are only slowly and partially exported to the adjacent marine environment (Buckley 1995).

Pierre Turbide, Baie-Sainte-Anne

(Cathy Carnahan)

...The threat to some of the fisheries around here is over fishing of certain species and 'a couldn't care less' attitude by the federal fisheries department. Like now, they are fishing oysters presently in Baie -Ste-Anne. I fished oysters. I bought oysters and I remember a buyer from Caraquet [who] used to buy oysters from Baie-Ste-Anne. The oysters that land up in Montreal with the name 'Caraquet' are really oysters from Baie-Ste-Anne. There are not many oysters up Laméque and Caraquet area because they over fished. He told me -- and I knew this because we were buying less and less – that the same thing was going to happen here... He said, 'Why don't you call a meeting?' I said, 'Well, the local people are not going to listen to me. They're going to say I'm crazy.' But I can see it now. They are finding less and less oysters because of different scenarios. One of them is... the oysters can be fished for seven weeks this year. Maybe they should only open [the season] for four weeks. I know back in Egg Island, one place where they fish, the weed has taken over. There are no more oysters there, so that puts a burden on the other areas around where they fish oysters.

High levels of dioxin, originating from the effluent of the bleach plant at the former Repap pulp and paper mill (the plant was sold to a Finnish company in 2000 and renamed UPM-Kymmene) in the estuary, have been found in lobster tomalley (hepatopancreas) and white sucker caught in the inner bay. Measurable levels of PAHs (polynuclear aromatic hydrocarbons) were also found in lobster tomalley (MREAC 1992). A health advisory was not issued by the government when the high level of dioxin was detected because, according to the government, tomalley is not eaten and therefore does not pose a human health risk. Unfortunately, this is not the case. While tomalley is not part of the processed lobster product sold commercially, it is indeed eaten by many local people, particularly lobster fishermen themselves. This portion of the population would appear to be at significant risk, since they would eat a much greater amount of lobster than the general population.

In October 1999, the national spotlight focussed on Miramichi Bay as the repercussions of the Supreme Court's Marshall Decision, which confirmed the aboriginal treaty right to make a living by fishing, hunting and gathering materialized. As members of the Burnt Church First Nation exercised their right by fishing lobster off the shore of their community, commercial fishermen from neighbouring communities responded by destroying a few thousand traps

Violence drifted ashore as a native vehicle was rammed sending three people to hospital; a school on the reserve and fish plants thought to be processing native-caught lobster were

Stafford Anderson, Burnt Church

[Lobster fishermen] fish out of four-foot wire traps now which are double-baited, double-headed, which out-fish a three-foot wire trap. Faster boats, more horsepower, bigger boats that can move traps from one area to another very quickly, and you're allowed to fish seven days a week which shouldn't be.... The fishermen themselves are at loggerheads with each other. They're trying to have their own jurisdiction on certain areas of lobster fishing, which shouldn't be, but it's all coming to a head. There is a lot of trouble between Tabusintac and Neguac at the moment, a lot of trouble. That was one of the reasons I got out because I don't mind work myself, but I certainly don't want a big pile of hassle on top of that to go to work.... Right now, they've cut back 25 traps a year [to 325 per licence] supposedly for the next two or three years. In my mind, that's not enough. It should, maybe, be cut back to 200 traps. And the four-foot wire traps, they should be classed as a trap and a half or two traps because they out-fish the normal trap. The fish can't keep up with the technology we have.


(Cathy Carnahan)

vandalized. A sacred structure used in pow-wows and other ceremonies was torched. Indians retaliated by burning two trucks left on the Burnt Church wharf and a vacant summer cottage. The aboriginal Warrior Society was called in to protect native boats and gear from further damage.

Although native fishing gear was only a fraction of the gear fished by commercial fishermen, the protests hinged around the fact that the DFO-licensed lobster fishery was closed at the time Burnt Church began its fishery. Licensed fishermen feared this new fishery would jeopardize their own catches the following spring, and demanded that DFO enforce the rules by which they fish on the Burnt Church fishery.

The Burnt Church First Nation rejected this, citing treaty rights to manage their own harvest. Over the course of the winter, they developed their own fishery management plan, set up a licensing system, and issued their own trap tags so they could enforce the trap limits set by the management plan. DFO refused to recognize the Burnt Church tags, and during the Spring 2000 fishery, began seizing traps not carrying DFO tags.


(NB Image Bank)

Lobster fishing.

In August 2000, tensions rose to the boiling point when Burnt Church fishermen launched their second fall fishing season. Over the course of two months, until Burnt Church closed its fishery in early October, DFO seized a few thousand traps and several boats, and there were several violent confrontations between DFO enforcement officers and native fishermen.

At issue is whether First Nations have the treaty right to manage their own resource harvesting. First Nations interpret the Marshall Decision as giving them this right as long as conservation measures are adequate to protect stocks. The federal government interprets the decision differently, asserting the Minister of Fisheries has the *de facto* right to impose regulations on native fisheries to ensure conservation. The federal government defended its interference with the Burnt Church fishery on the grounds that it was a threat to conservation.

Experts disagree on whether or not the low-intensity native fishery (5,000 traps) would have any appreciable impact on lobster stocks. The issue is confounded by allegations that non-native poachers took advantage of the fracas around the native fishery to set as many if not more traps than Burnt Church fishermen. The bottom line is, the intensity of the reaction to native fishing reflects the generally precarious state of fish stocks overall, and the shrinking resource base from which everyone is trying to make a living.

Zoël Breau, Néguac

Being in the fishery, the problems we went through were in the salmon when the commercial fishery was closed....Even after 15 years, the salmon really haven't come back, so many questions remain unanswered to this day... And the cod, in my view, was almost eliminated by [mismanagement] of this fishery with the vision that it would last forever and create employment for a lot of people.... In this area, the effects of the salmon and cod fishery had more effects on the cultural habits of the people. A lot of individuals have this comment: 'Do you remember when we went drifting for salmon and jigging cod? Those were the days.'


(Cathy Carnahan)

Economically, the fishermen were lucky that they were not depending only on salmon and cod. We had a lobster fishery in full expansion due to better catches and better prices which helped a lot.... We haven't been able to understand how much the resource can withstand the concentration of fishing capacity without affecting the stocks. The cost of operating has gone up, so more effort is put on the stocks. More hours and faster equipment and better technology makes the stocks more vulnerable because their cycle has not changed. We see more and more fishermen fighting over fishing grounds due to this problem.... But there are more discussions on the condition of the resource because fishermen have to fish shorter seasons, have size limits and trip limits. We are also looking to improve habitats and possibilities of enhancing wild stocks. We discuss more and more about the problem of the environment, what are the effects, and what can be done to help. We are putting together a committee to clean up McKnight River that washes down into Neguac Bay.... We need to sit down and discuss the different probabilities with all the people involved in the fishery. The probabilities of a stock collapse due to over fishing or environmental disaster is at everybody's door. The different participants in the fishery are fighting in different directions and for different interests. The stocks do not talk back.

State of the coastal environment


(Rachel Carson Homestead Association)

Rachel Carson (1907-1964).

Rivers of death

"So, in the summer and fall of 1953, the salmon of the river called Miramichi on the coast of New Brunswick moved in from their feeding grounds in the far Atlantic and ascended their native river. In the upper reaches of the Miramichi, in streams that gather together a network of shadowed brooks, the salmon deposited their eggs that autumn in beds of gravel over which the stream water flowed swift and cold.... These events repeated a pattern that was age-old, a pattern that had made the Miramichi one of the finest salmon streams in North America. But that year the pattern was to be broken".

Rachel Carson, Silent Spring. 1962

In the spring of 1954, clouds of DDT descended on newly hatched and one- and two-year old young salmon in the Northwest Miramichi River. DDT, a chlorinated organic pesticide, was being used to combat an extensive infestation of spruce budworm throughout eastern Canada.

According to the Fisheries Research Board of Canada, now called Fisheries and Oceans Canada, the effect of the 1954 DDT spray program on salmon in the Northwest Miramichi was devastating. None of the young salmon which had hatched that spring survived. Only one out of every six salmon that had hatched a year or more earlier survived. One third of the salmon ready to go out to sea died. The abundance of trout, eels and minnows was also affected.

Tragically, 1954 would not be the last year the life cycle patterns of fishes in the Miramichi River would be broken. DDT was used on New Brunswick's forest from 1952 to1967. The annual amount of DDT sprayed was 5,700 mt (12.5 million pounds) (Environment Canada 1991). Although the area of the Northwest Miramichi River was excluded from spraying, the main Southwest Miramichi was not.

Through her landmark book, *Silent Spring* (1962), Rachel Carson brought the world's attention to the toxic and persistent effects of pesticides like DDT on wildlife and humans. Not only did fish and insects die from immediate (acute) exposure to these chemicals but Carson identified their potential to cause long-term (chronic) effects on sexual development, cell division, and genetic replication. For her effort to draw attention to these problems, she was mercilessly attacked and vilified by the chemical industry. A short time after *Silent Spring* was published in 1962, US President Kennedy set up a special science advisory panel to study the problems associated with pesticide use. The panel's report a few months later confirmed Rachel Carson's findings. It would take another five years before aerial spraying of DDT would cease in New Brunswick and 28 years before the Canadian government would completely ban the use of DDT.

As evidence of the negative effects of DDT on wildlife grew, new pesticides were introduced to help combat continuing infestations of spruce budworm. Fenitrothion, an organophosphorus insecticide, was first used in New Brunswick in 1965. The province would become the greatest user of fenitrothion and favourite customer of the Japanese manufacturer. Between 1975 and 1985, a carbamate insecticide, Matacil®, was also used across New Brunswick. New Brunswick's budworm battle peaked in 1976 when spray planes blanketed 3.9 million hectares with four insecticides in 23 spray sorties. Responding to public opposition to chemical spraying, in 1984 the New Brunswick government undertook the first operational spraying of the biological insecticide, *Bacillus thuringiensus (Bt)*. By 1992, when spruce budworm spraying finally ended, Bt was the only pest control product being used against the budworm.

Large-scale aerial spraying of fenitrothion was restricted in 1985 following studies by Environment Canada's Atlantic-based Pesticides Issues Team that determined that large-scale

Table 1. Area of forested treated with pesticides in Canada, 1975 - 1986[1].

The area of the forest treated with pesticides each year varied greatly from one province or territory to another and over time with the cycles of target organisms.

	Area of pest control (hectare - ha)					
Province or Territory	1975-76	1976-77	1977-78	1878-79	1979-80	1980-81
British Columbia[A]	1,785	2,667	2,384	2,908	2,287	1,564
Alberta	0	0	0	0	0	0
Saskatchewan	0	0	0	0	0	0
Manitoba	0	0	0	0	0	0
Ontario	14,167	41,060	10,522	4,085	22,072	36,422[c]
Quebec	2,800,000	29,00,000	1,400,000	1,200,000	600,000	188,511
New Brunswick*	2,695,000	3,881,000	1,682,000	1,554,000	1,598,000	1,900,000
Nova Scotia	0	0	556	25,670	30,752	25,670
P.E.I.	0	0	0	0	0	0
Newfoundland	0	0	76,910	376,600	0	0
Yukon	0	0	0	0	0	0
N.W.T.	0	0	0	0	0	0
Canada	5,510,952	6,824,727	3,172,372	3,163,263	2,253,111	2,152,167

	Area of pest control (hectare - ha)					
Province or Territory	1981-82	1982-83	1983-84	1984-85	1985-86	Total
British Columbia[a]	3,830	0	3374	3,948	3,488	27,235
Alberta	0	0	0	0	0	0[B]
Saskatchewan	0	0	12	434	0	446
Manitoba	0	0	0	428	760	1,188
Ontario	22,477	28,685	43,770	47,280	10,339	28,879
Quebec	705,164	1,298,495	1,253,605	712,282	698,343	13,756,400
New Brunswick*	1,693,000	1,867,570	1,245,000	732,000	54,500	19,392,570
Nova Scotia	31,195	19,153	20,726	20,537	49,719	223,978
P.E.I.	0	0	0	0	0	0
Newfoundland	0	0	0	0	145,086	598,596
Yukon	0	0	0	0	0	0
N.W.T.	0	0	0	0	0	0
Canada	2,455,666	3,213,902	2,565,487	1,516,909	1,452,735	34,281,292

[A] Mainly dwarf mistletoe control, sanitation treatments, and spraying against western spruce budworm that began in 1983-84 using *Bacillus thuringiensis.*

[B] Does not include the control program stared in 1979 against the mountain pine beetle that was conducted over an area of 32,000 ha.

[C] All figures from 1980-81 to 1985-186 include insecticide and herbicides.

[D] Numbers in Parentheses are estimates.

Source: Kuhnke (1989) in Environment Canada, 1991. *The State of Canada's Environment* - 1991. Minister of Supply and Services Canada, Ottawa.

* Note: Does not include herbicides.

spraying of fenitrothion was environmentally undesirable (Environment Canada 1996). In January 1999, fenitrothion was finally de-registered by the federal government, although its use is permitted for small-scale treatment of woodlands and forests.


Aerial spraying for spruce budworm.

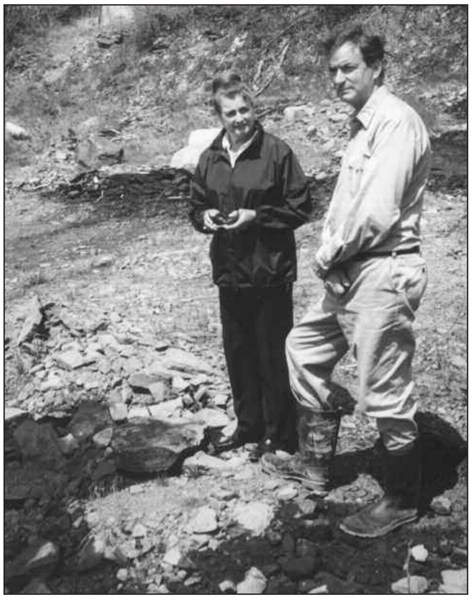
The New Brunswick spruce budworm spray program lasted forty years. It was the largest and longest-running aerial pesticide spray program in the world (Environment Canada 1991). Spray operations were conducted every year except 1959. A very conservative estimate of the amount of pesticides used between 1952 and 1990 to combat spruce budworm is 100,000 tonnes (220 million pounds). Between 1975 and 1986, a total of 19.4 million hectares of forests in New Brunswick were treated with pesticides (Environment Canada 1991). The only other province that came close to that figure was Quebec with 13.7 million hectares, followed by Newfoundland with 0.598 million, Nova Scotia with 0.22 million, and Ontario with 0.28 million hectares (Table 1).

Throughout those 40 years, the Miramichi River watershed, along with other rivers throughout New Brunswick, was exposed to repeated applications of these pesticides. Rachel Carson would call the Miramichi and other rivers affected by DDT “rivers of death”.

By 1984, the population of wild Atlantic salmon in the Miramichi River and throughout Atlantic Canada had reached very low levels. In an attempt to avoid a total collapse of the species, a moratorium on commercial fishing was imposed on New Brunswick, Nova Scotia, and Prince Edward Island. As time went on and despite the moratorium, Atlantic salmon populations continued to slide. Catch restrictions were placed on salmon anglers. Thousands of volunteer hours were dedicated to river/stream enhancement projects. Millions of salmon were released from hatcheries and millions of dollars dedicated to research. Still, the salmon continued to decline.

Emergence of other environmental issues

In August 1985, Bettina Whalen asked Ben Baldwin, a geologist who had recently returned to the Miramichi after a 30-year absence, to take a look at a tar-like substance oozing out of the ground and killing the vegetation in her farm field in Newcastle. Since the farm was located next to a Domtar wood-preserving plant built in the 1920s, Baldwin suspected it was the source of the ooze. The Whalens had already been in touch with provincial government and municipal officials, as well as Domtar, about the problem but to no avail. Baldwin suggested they go public.



(Ben Baldwin)

Bettina Whalen and Ben Baldwin inspect black ooze near Domtar (1986).

Drawing public and media attention to their situation was not a particularly appealing prospect for the Whalens. However in a very short time, the issue would not only become known to the rest of the Newcastle community, it would win the Milton F. Gregg Conservation Award, given by the Conservation Council of NB each year, for journalist Cathy Carnahan of the Miramichi Leader who reported extensively on the story. It would also become the subject of *The Underlying Threat*, a National Film Board documentary on groundwater contamination by New Brunswick film maker Kevin Matthews.

By the following year, Newcastle citizens were complaining about the smell, taste, and colour of their water. One of the two town wells was located about a mile from the Domtar plant and many people suspected the source of contamination was Domtar.

Studies done by the Department of Fisheries and Oceans (DFO) and Environment Canada years earlier identified the chemicals in the effluent from the Domtar plant as the constituent parts of the wood preservatives penta and creosote (Zitko and Carson 1969; Hoos, 1970; Baker and Matheson 1981). These included pentachlorophenols (PCPs), polyaromatic hydrocarbons (PAHs), dioxin, organic acid and oil, all extremely toxic. The studies also found that chemicals from the plant had contaminated land in Newcastle and nearby Strawberry Marsh, the plant's first dump site, and had migrated into the Miramichi River. In many samples, the chemicals were found in high concentrations and some of the substances were accumulating in the digestive glands (tomalley) of lobsters. These compounds are toxic to fish and wildlife, cause cancer and birth defects, and damage the immune system of humans. Seepage of these chemicals into the town's aquifer was a very real possibility.

A consultant's report released in March 1988 confirmed the suspicions of citizens (Golder Associate 1988). A plume of contamination from the Domtar plant had migrated in the groundwater approximately 150 metres offsite towards the south and about 500 metres along the southern boundary of the plant. The groundwater at the outer edge of the plume contained PCPs, a tell-tale wood preservative chemical. By the time the report was released, the second municipal well in Newcastle was closed because another tell-tale wood preservative chemical, PAH, was detected in its water.

Because of the public attention given the Domtar issue, in 1989 a steering committee was appointed by the provincial Environment Department to oversee a cleanup plan of the

Domtar site. Ten years later, the cleanup has not been completed and the provincial Environment Department still has the site on its list of contaminated sites. Pollution charges were never laid against Domtar, nor was the company ordered to pay damages. The taxpayers of New Brunswick paid for a new municipal water supply for the town of Newcastle.

What did emerge from the Domtar fiasco was a local citizen-based environmental group, the Miramichi Environmental Society (MES). According to the Society's first president Ben Baldwin, "During the Domtar investigation it became clear to me and many others in the community that there were broader environmental issues affecting the river and that the river could benefit from a formal environmental organization".

MES played a key role in exposing the contamination at the Domtar site, and over the next few years the Society would became involved in many issues. These included a proposed installation of an antimony sulphide concentrate roaster at Morrison Cove, air emissions from the plywood mill in Nelson, effluent discharges from the groundwood mill in Nelson, effluent discharges from Miramichi Pulp and Paper (now called Repap) in Newcastle, and leachate from the Repap (now UPM-Kymmene) dump site adjacent to the Eel Ground First Nation Reserve. Most of these industries still are located on the banks of the Miramichi River.

Rivers of science

In 1988, the pulp and paper giant Repap, with approximately $500 million from provincial and federal governments, completed an expansion of its pulp and paper mill in Newcastle. The mill was approved without an environmental impact assessment (EIA). In response to questions by the Miramichi Environmental Society about the lack of an EIA, the provincial government directed Repap to form a Committee of Public Information and Public Concerns. The chair of the committee was the manager of Repap, Joe O'Neill. The Miramichi Environmental Society remained concerned about the affect of the expanded mill on the River and pushed for the establishment of a Miramichi River Authority that would come under the aegis of the provincial government, not industry. What evolved instead was a multi-stakeholder organization, the Miramichi River Environmental Assessment Committee (MREAC). MREAC would later become a federally funded organization under Environment Canada's Atlantic Coastal Action Program.

In 1992, MREAC released a report on the state of the river. Although it was criticized by local citizens for poor coordination, poor communication, and lack of commitment to the Miramichi watershed in its emphasis (downplaying the scale of pollution problems from big industry, particularly Repap), it established the context for MREAC's assessment in this way:

The close friend, the Miramichi, the giver of so much, was sustaining one assault after another. Miramichiers were only too aware of the blackening of the river bottom and shore with bark and fibre from the two pulp mills, of the devastation of the Northwest Miramichi by mine discharges (from Heath Steele), of acid and oil spills, of the build-up of DDT, of ugly foam floating up and down with the tides, of inadequate sewage treatment...of the Domtar debacle, of alarming levels of metals in the river, of the callous disregard for small streams by woods contractors...

During the two-year period of the Miramichi study, 45 different sites were variously sampled for water analysis; to a lesser degree, sampling was also carried out on bottom-dwelling insects and other aquatic organisms, and for sediment analysis. As in other parts of the coast, bacterial pollution was identified as a severe problem on the Miramichi because of agricultural run-off and sewage. The worst offender has probably been Newcastle (now part of Miramichi City) which at the time of the MREAC study was discharging 40 percent of its sewage directly into the estuary without treatment.

As for toxic contamination, the list and quantity of pollutants that had entered the River was extensive – DDT, polychlorinated biphenols (PCBs), polyaromatic hydrocarbons (PAHs), pentachloraphenols (PCPs), copper, cadmium, zinc, dioxins, furans, resin acids – a veritable toxic soup. The sources of all these contaminants could be pinpointed. Some or all could be found in the sediment of the Miramichi River and estuary, the river water itself, or the tissue of mussels, oysters, lobsters, eels, striped bass, white suckers, flounders, shad, gaspereau and salmon. Contaminant levels were in some cases low enough to be almost non-detectable. In other cases, they were above levels safe for humans or wildlife.

The MREAC report noted that levels of copper and zinc on the Tomogonops River system from the Heath Steele mining operation were sufficiently high to kill all fish close to and below the mine. It also found levels of mercury in white suckers and striped bass above acceptable levels for children and pregnant women, and high levels of cancer-causing dioxin (from Repap pulp mill in Newcastle) in white suckers and lobster tomalley.

Although DDT was discontinued in the spray program almost thirty years ago, levels of DDT in fish tissue are as high today as they were 30 years ago. An ongoing source of contaminants to fish is sediments, which when dredged resuspend persistent metals and chemicals into the water column. The Miramichi estuary has been dredged on a regular basis since 1872. The largest dredging operation, the 1981-82 Miramichi Channel Dredging Project, removed about three times the amount of previous dredges. The MREAC report concluded that although “the river is in reasonable health considering the level of human development which has taken place on its shores,” this was more a result of the river’s “ability to absorb abuses, than to good management.”

Two years later, a meeting of scientists and the public was organized to provide an update on the 1992 report, as well as to address criticisms of it. The outcome was another publication, Water, Science, and the Public: The Miramichi Ecosystem (1995). This report also confirmed that over the past 50 years, the Miramichi River has been abused.

Forest industry impacts

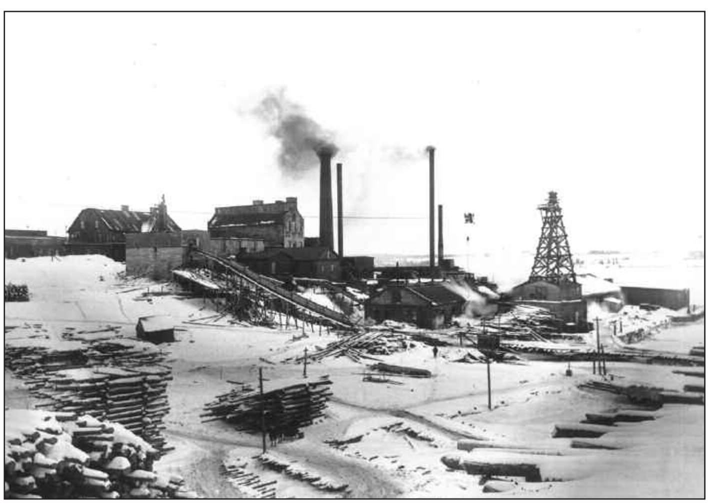
Perhaps the single largest impact on the Miramichi watershed has come from the forest


(CCNB)
Nelson Forest Products in Miramichi produces plywood.

industry. Besides the extensive aerial pesticide spray programs described earlier, the initial impact could have come as long as 300 years ago with siltation caused by cutting mature trees from the banks of the river and its tributaries. Saw mill operations began 200 years ago, and the pulp industry began operating in Newcastle 100 years ago. Today there are two pulp mills and a wafer board mill operating in the Miramichi Estuary. The former Repap kraft mill in Newcastle discharges 24.25 million cubic metres of effluent into the estuary every year. Repap's smaller groundwood mill in Nelson-Miramichi discharges 2.7 million cubic metres per year (1989 data) (Eaton *et al*. 1994). There are also several saw mills on the watershed.

According to Environment Canada, pulp mills produce more contaminated effluent than any other industrial source in the Atlantic region, and rank second only to sewage and urban and agricultural run-off as a source of pollution to coastal waters. There are three main components of this waste stream: dissolved organic compounds, suspended solids, and an inorganic component. Each can degrade water quality and aquatic habitat. Effluents are often lethal to fish (Eaton et al. 1994).

When dissolved organic material is digested by bacteria in receiving waters, the result can be a high biochemical oxygen demand (BOD), and thus depleted oxygen supplies for fish and other species. It can also create an increase in anaerobic (without oxygen) decomposition which results in the release of noxious gases such as methane, hydrogen sulphide and ammonia. Oxygen deficiency can cause fish kills, but it can also result in changes in fish behaviour, growth, swimming, respiration, fecundity, disease resistence and feeding. While these effects are harder to document, they may be more widespread and of more biological importance (Eaton et al. 1994)


(PANB)
At one time a pulp mill operated at Millerton along the Southwest Miramichi River.

Over the century, huge volumes of wood waste made up of cellulose fibres, wood particles, bark and lime mud, called organic matter, have been discharged into the Miramichi River and estuary. Between 1890 and 1950, the Newcastle pulp mill consistently discharged 2,500 tonnes of wood waste per year, constituting 2.6 percent of the discharge of total solids from the river to the estuary. Between 1950 and 1977 the scale of operation increased dramatically. Wood waste discharged rose to 20,000 tonnes annually, making up fully 20 percent of the total solids deposited in the estuary (Buckley 1995). The current standard for suspended solids discharged from the large Repap pulp and paper mill is approximately 6,700 tonnes per year (this figure is based on production levels) and the mill is well within that limit (Environment Canada 2000). Even so, the two pulp mills are the source of 99 percent of organic wastes released into the Miramichi estuary, with the larger mill making up about 90 percent. The balance is contributed by the municipal waste water for about 50,000 people (Chadwick 1995).

Core samples taken from the estuary between Newcastle and east of Chatham found an extremely organic-rich sediment layer ranging from 22 cm (8.5 inches) to 97 cm (38 inches) thick, indicating a high sediment accumulation rate (from one to four cm per year in the estuary). These wood solids cause significant problems in the estuary. Surface water becomes turbid and chemical oxygen demand increases, reducing oxygen levels in the water column. When the solids settle out onto the bottom, the resulting sediment layer is also high in chemical oxygen demand. Wood fibre sediment even migrates out into Miramichi Bay, where a two cm thick layer was detected (Buckley 1995).

According to Buckley (1995), this loading of organic material from pulp mill effluent probably has the most significant impact on the environmental quality of the estuary, particularly because of its volume and because it enters the river near the head of tide at the salt wedge and at a steady rate of about 10 tonnes per day. The solid particles create turbidity in surface water, block photosynthesis, and because predators and prey can't be seen, likely disrupt feeding activity and the early life history of about 20 species that live in the salt wedge. They settle out as black sediment which smothers benthic plants and animals, destroys bottom habitat used by shellfish, lobster and worms, and as it decomposes, reduces oxygen available to fish at a rate of about 12 tonnes per day (Chadwick, 1995). Methane, hydrogen sulphide gas, nutrients, acids and organic contaminants can also be released from the sediments (Eaton et al. 1994). Out of 100 other estuaries studied, only 10 percent have as high sedimentation rates and organic carbon content of sediments as the

Former Repap paper mill at the fork of the Southwest and Northwest Miramichi River.

Miramichi. In this regard, the Miramichi is similar to Halifax Harbour, which is considered a highly contaminated system (Buckley and Winters 1992).

The chemical component of pulp mill effluent is a toxic soup. It includes resin acids which, if untreated, are lethal to fish; fatty acids which are less toxic and degrade more quickly, and if chlorine bleaching is done (as it is at the Newcastle mill), chlorinated phenols at harmful levels. At risk from chemicals in pulp mill effluent are fish, sea urchins, brown algae, blue mussels and barnacles. Salmon and trout may avoid waters that contain pulp mill effluents if the flow conditions become low enough. These conditions may well occur in the Miramichi River, the Nepisiguit River (Bathurst) and the Restigouche River (Atholville) (Eaton et al. 1994).

By the mid-1980s, an alarm bell had been rung about the pulp bleaching process in those mills that used chlorine as a bleaching agent. This process was found to produce literally hundreds of what are known as organochlorine compounds, many of which are toxic, mutagenic (cause genes to mutate), persistent (break down very slowly or not at all in the environment) and which bioaccumulate (increase in concentration) in living organisms. Of particular concern were the families of dioxins and furans of which pulp and paper mills are believed to be the largest source in Canada (Eaton *et al*. 1994). Field studies at Canadian pulp mills revealed several chronic effects such as reproductive abnormalities, and biochemical and behavioural changes in aquatic organisms. Of the five New Brunswick mills which used the chlorine bleaching process, high levels of dioxins and furans were found only in the effluent of the pulp and paper mill in Newcastle (Eaton *et al*. 1994).

Environmental regulation is just now starting to catch up with the historic insult to waterways by the pulp industry. Reductions in suspended solids in pulp mill effluent were achieved under the federal Pulp and Paper Modernization Program of the 1980s, but old mills like the one in Newcastle were not subject to the 1971 federal Pulp and Paper regulations until 1992 when the grandfather clause was removed from the regulations. At that time, the federal government passed amendments to the Pulp and Paper Effluent Regulations under the Fisheries Act.

These amendments required mills using chlorine bleaching to reduce certain dioxins and furans in their effluent to below measurable limits by 1994. Most mills missed this deadline without penalty, but by 1996 most had complied with the new standard. The amendments also set new standards for the release of suspended solids and biochemical oxygen demand and the toxicity of effluents.

The new amendments also require pulp mills to undertake environmental effects monitoring on a three-year cycle to determine if fish, fish habitat and the fisheries resource are being protected by the new regulations. The results of the first round of monitoring were reported in April 1996. Results from the former Repap groundwood mill which at the time had only primary treatment of its effluent showed low overall diversity and abundance of benthic (bottom dwelling) organisms and the effluent caused sub-lethal toxicity to fish, invertebrates and algae. The Newcastle kraft mill monitoring revealed tomcod with heavier than normal gonads and livers, low diversity and abundance of benthic organisms, toxic effects in both algae and invertebrates, and trace levels of dioxin in tomcod tissue. As of summer 1999, New Brunswick mills appeared to be meeting the monthly requirements of the new regulations (Lindsay 1999, pers. com.).

The next round of monitoring reports were filed with Environment Canada in April 2000 and showed the Miramichi mills in compliance with suspended solids and BOD limits. Most monthly toxicity tests, but not all, were in compliance.

(Piper Project-Projet Siffleur)

Peat mining operation.

Peat industry impacts

A more recent entrant to the economic mix in the Miramichi Estuary and Bay is the peat moss industry. Peatlands cover about two percent of the land surface area of the province, equal to about 140,000 hectares. About half of this area, 70,000 hectares, is considered "developable"; 70 percent of this is Crown Land. Seventeen peat harvesting companies were active in New Brunswick in 1997 on 4,272 hectares, 81 percent of which were Crown. That year the industry was valued at $75.7 million and employed 150 full time and 853 seasonal workers. Most of the development is concentrated in the Acadian Peninsula and in the Baie-Ste-Anne region of Miramichi Bay (DNRE 1998).

There are environmental concerns relating to this activity. Peat is harvested by machines which clean and loosen the surface layer of large sections of a moss deposit. This loosened moss is left to air-dry in the field. When dry, it is harvested by a large vacuum and bagged. Winds can lift and deposit large volumes of fine peat particles into drainage ditches which eventually discharge into water bodies, or they are deposited directly into streams, rivers and estuaries. There they become saturated and are moved around by currents and tides. While current regulations require harvesting companies

(Piper Project-Projet Siffleur)

Winds can blow peat left to dry into nearby waterways.

to install settling basins to reduce excessive run-off, this has not proven effective. Peat fibre deposits in adjacent water bodies continue to pose problems.

A study into the effects of a large release of peat moss into Mill Creek which flows into the Richibucto River revealed a decrease in the number of fish, shrimp and clams, and habitat for bottom-dwellers was "modified" where peat depths are greatest (Ouellette et al. 1997). Oyster culturists believe that saturated peat moss particles in estuaries may be slowing the growth of their oysters and even killing them. Scientists hypothesize that the fine particles of moss suspended in the water column interfere with the free circulation of phytoplankton and thus the normal feeding and respiratory process of oysters and other bi-valves like clams, and possibly other invertebrates. Large amounts of peat settling out in the lower layer of the water column for long periods may result in oxygen depletion which can have deadly results for bottom-dwelling species of all kinds (Lavoie 1995).

Peat moss and the fishery

Francis Sippley, Baie-Ste-Anne: Years ago , we did real good at the gaspereau. I'd been salting gaspereau and shipping to the West Indies, Haiti, and places like that, but I wasn't really organized. So in 1981 I said, 'I'm going to build myself a shop', so we got going in '82... After that, the peat moss [operation] up the road here started getting big. They were...draining lakes and what have you, and all that silt – the peat moss on the river drove the gaspereau right out. And me, I got in a pinch because you know, you have to borrow, and the gaspereau weren't here for me.... It took me 15 years to get on my feet again, so the peat moss industry had a harsh effect on me.... Now the gaspereau are coming back, that's the thing. Now if they could keep a close watch on the peat moss industry, because it's getting big and it's going to get bigger because of money.... It needs to be monitored more closely.

Theodore Williston, Hardwicke: One thing I've noticed is the peat bog harvest that is going on in the area. There are seven companies in the immediate area, where it's a direct run-off into the rivers and bays.... In peat harvesting in Escuminac, there is very little buffer zone between the fields being harvested and the ocean. I don't think those fields should be open at all. It's going to hurt the environment for sure in the future.

Rivers of death revisited

It has been said the Miramichi Estuary has been the most thoroughly studied estuary in Canada (Buckley 1995). Well over 400 scientific reports dating back to 1918 have been published on a broad range of topics. Yet despite the fact that the river has served as a dump for industrial wastes since the late 1800s, none of these reports have addressed the long-term, cumulative effects of these discharges on fish, other wildlife, or humans. The first insight into the long-term effects of chemical exposure on wildlife would not come until 1999.

In January 1999, DFO issued a press release announcing that a study conducted by DFO and Environment Canada researchers had found that past chemical use may have had an effect on wild salmon populations in Atlantic Canada. Dr. Wayne Fairchild, Jacqueline Arsenault and Erin Swansburg from DFO's Gulf Fisheries Centre in Moncton, New Brunswick, and Dr. Scott Brown from Environment Canada's National Water Research Institute in Burlington, Ontario, had studied the historical relationship between aerial pesticide spraying in Atlantic Canada's forests and subsequent salmon returns to their local rivers during a ten year period from 1975 to 1985 (Brown et al. 1998).

Their concern was that during this time period one of the insecticides sprayed, trade name Matacil®1.8D, contained high concentrations of a compound called 4-nonylphenol (4-NP). Nonylphenol is not the active insecticide ingredient, rather it is the solvent for the active ingredient, aminocarb. The weight of 4-nonylphenol in the formulation was almost three times the weight of the active insecticide ingredient which is typical for most pesticides. Laboratory studies have shown that these nonylphenols, classified as endocrine disrupting chemicals (EDCs), are toxic to invertebrates and fish, and have strong effects on hormones. EDCs have been linked to disorders in human sexual development and reproduction and include such compounds as DDT, DDE, dioxin, furans, and PCBs. EDCs are potent at levels much lower than the allowable limits of exposure set by current government standards.

According to Fairchild, "What we found is that for one river, there was an association between the amount of Matacil®1.8D sprayed in 1977 and the number of salmon returning two years later. The more that was sprayed, the fewer fish returned." There was also a broader event of unusually heavy salmon smolt mortality in 1977. Preliminary laboratory tests revealed that nonylphenols can interfere with the process that allows salmon to make the transition from fresh to saltwater. Called smoltification, this process is known to be influenced by hormonal changes in the fish.

The researchers evaluated sixteen rivers in Newfoundland and New Brunswick, including the Miramichi, that were exposed to pesticide spraying between 1973 and 1990 (Fairchild et al. 1999). The results indicated a significant number of the lowest salmon catches coincided with Matacil®1.8D spraying. In 1980, Matacil®1.8D was replaced with Matacil®1.8F, a compound that did not contain 4-NP. There was no significant relationship found between spraying Matacil®1.8F and salmon returns. The study also found a decline coinciding with the use of Matacil®1.8D and blueback herring catches in the Miramichi commercial fishery.

The federal government researchers point out that Matacil® 1.8D is no longer used in forest spraying. The levels of 4-NP that were found in forest streams after its spraying, however, are currently found in today's discharges from sewage treatment plants and other industrial effluents, often as a breakdown product of nonylphenol ethoxylates (NPEs). NPEs are used in household and industrial cleaning products, paints, pesticides and in industrial processes such as pulp and paper, textile manufacturing, petroleum production and leather manufacturing.

In 1999, Dr. Fairchild and his team repeated laboratory experiments conducted on Atlantic salmon smolts a year earlier, plus they added a field component. In the laboratory, Fairchild exposed smolt in the latter stages of smoltification to levels of 4-NP and an estrogen compound (estradiol) one might expect to find in the environment. After exposure, the smolts' ability to withstand sea water and their subsequent growth were measured. In 1998, Fairchild found that 25% of the fish in both the 4-NP and the estradiol treatments exhibited impaired growth and survival rates versus 5% of the fish in the control (or non-treatment) experiment. The result of the laboratory experiments in 1999 confirmed the 1998 results and strengthened Fairchild's hypothesis that the 4-NP in the Matacil® 1.8D formulation may account for the observed declines in Atlantic salmon following spraying. The more intriguing results would come from his field experiment in the Miramichi River.

During the summer of 1999, Fairchild captured wild Atlantic salmon smolt from the Miramichi River. One group was held in a cage in the Northwest Miramichi River above the effluent plume from the pulp and paper mill and the city of Miramichi's sewage outfall. The other group was held down river in the Miramichi River estuary where the effluent from various sources mixes. Both groups were held in cages for five days and their subsequent growth and survival was monitored. Smolt held in the estuary had poor growth rates and eventually all the fish died. The survival rates of the fish above the effluent plume were significantly higher.


(CCNB)

The aerated sewage lagoon in Newcastle.

Fairchild is cautious in interpreting these results and is quick to point out some of the limitations of the field study which may have influenced the results such as higher than normal salinity levels in the estuary. And, he still needs to obtain the result of water analyses to see what, if any, levels of nonylphenols or estrogen-like compounds were in the estuary. The final results from the 1999 field trial won't be published until the spring 2001 but Fairchild and his team are already planning to repeat and improve upon the next field experiments in the Miramichi, as well as in other locations in New Brunswick. One thing is certain: nonylphenols do affect the survival of Atlantic salmon.

While many countries including Canada are looking at the levels of NPEs in the environment, an immediate alternative to NPE in these chemical products is unlikely because of their widespread uses. Nonylphenols are on the Priority Substances List II of the Canadian Environmental Protection Act and so may be subject to regulation in the future.

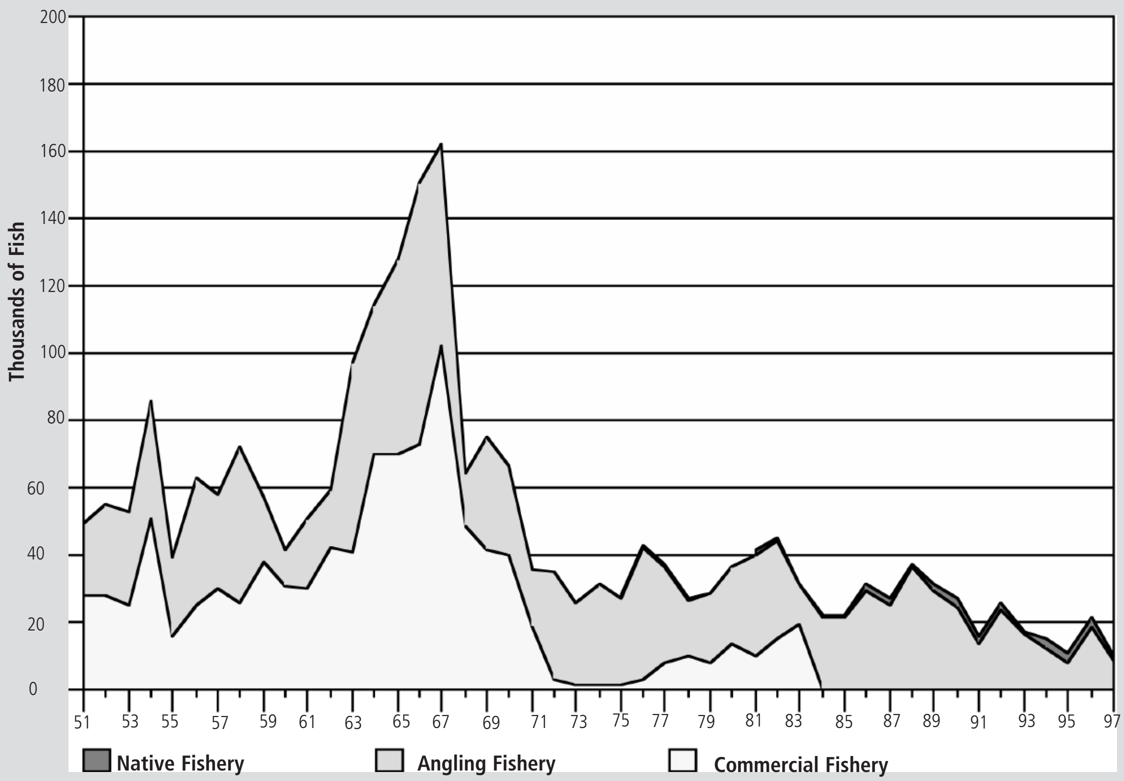
Prospects for recovery

To date, government agencies, salmon organizations, angling groups and politicians have focused on over-fishing by domestic and foreign commercial fishing fleets as the principal explanation for the decline in salmon populations in Atlantic Canada. Tighter and tighter angling restrictions have been imposed and some people have even suggested a complete moratorium on salmon fishing. Still, there appears to be no sign of recovery on the horizon.

Figure 1 illustrates commercial, recreational and Native catches of Atlantic salmon in the Miramichi River and Bay between 1951 and 1997. There are many ways to interpret the information in the graph and catch statistics alone are not the best indicators of overall population size or health. However, if the information on what is known about the effects of DDT, fenitrothion, and nonylphenols and the timing of their application is related to the catch data, an explanation other than over-fishing for the decline in Atlantic salmon populations presents itself.

Since fishes in their early life stages can be most vulnerable to pesticides, the full impact of spray programs on fish populations might not be seen until a year or two after the spraying when fish might be expected to enter the commercial or recreational fishery. For example, the impact of the first DDT spray program in 1952 can be seen in reduced catches in 1953. No spraying took place in 1953 and catches were up in 1954. Large-scale DDT spraying

Figure 1. Commercial recreational and Native harvest of Atlantic salmon in the Miramichi River and Bay between 1951 and 1997. (All numbers are in fish X 1000)



Source: Chaput G. et al. 1998. Stock status of Atlantic salmon (Salmo salar) in the Miramichi River, 1997. DFO Canadian Stock Assessment Secretariat Research Document 98/34.

resumed in 1954 and, as Rachel Carson documents so well in Silent Spring, the following year catches declined dramatically. Spraying took place in 1956, 1957 and suspended in 1959. Large-scale DDT spraying resumed in 1960 and 1961. From 1962 to 1965 spraying was greatly reduced. This was also the period salmon catches began to increase again.

From 1965 onward, fenitrothion was the pesticide of choice. Laboratory studies published in 1975 demonstrated that fenitrothion was acutely toxic to Atlantic salmon (Zitko and Cunningham,1975). An earlier study (Wildish *et al.*,1971) found some unusual swelling of the head as well as spinal deformities in Atlantic salmon fry exposed to fenitrothion in the laboratory. At the time, it was suggested that perhaps the acetone used to disperse the active ingredient could be the cause. Wells *et al.* (1978) reported that one of the solvents, Arotex 3470D, used in the spray formulation was half as toxic as the active ingredient itself. The spray formulation for fenitrothion consisted of fenitrothion, a solvent oil, and an emulsifier in a ratio of approximately 77:12:11 (Wildish *et al.* 1971). I965 was also the start of a long period of decline in salmon catches. The period between 1975 and the closure of the commercial salmon fishery in 1985 overlaps with the use of Matacil®1.8F.

Although the timing and subsequent effects of pesticide spraying for spruce budworm do not explain or account for all the variability in the salmon catch data, the coincidence between pesticide use in the Miramichi River watershed and the continual decline in salmon populations is hard to ignore. If we add to this mix the thousands of tonnes of contaminated industrial effluent discharged into the Miramichi River over the past 70 years, it is not difficult to imagine a connection between the broad-scale chemical contamination of the river and the subsequent decline in Atlantic salmon and other fish populations.

What does this mean for the future of Atlantic salmon and other fish species in the Miramichi River and estuary, not to mention humans? One question that will never be answered is - if the river had been free of pollutants, might the salmon populations have been able to withstand fishing pressure? As it is, salmon and other species in the Miramichi River continue to be exposed to an endless list of endocrine disrupting chemicals, a scenario that does not bode well for the recovery of the species.

The road ahead

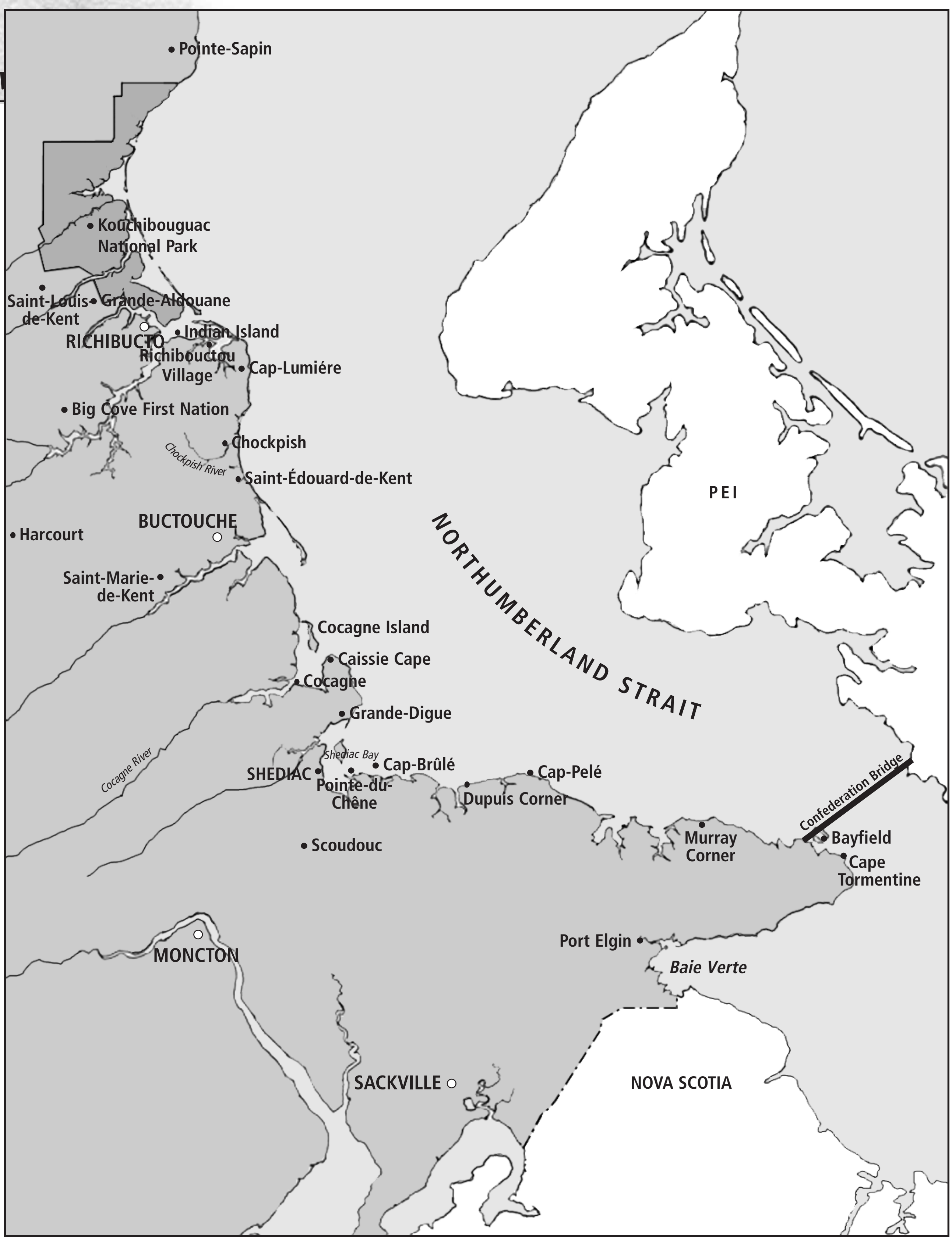
In 1994, the Miramichi River Environmental Assessment Committee developed an Environmental Action Plan which it continues to oversee. It carries out environmental monitoring and has set up River Watch programs to control waste disposal and protect fish habitats. People from communities along the river have established a watershed management committee and have been negotiating with the province to take over management of the recreational fishery. Groups such as the Miramichi Salmon Association as well as other river associations are restoring fish habitats and re-stocking the rivers with salmon.

Some people believe that attitudes are beginning to change. "Ten years ago, there was a real resistance to change of the status quo," says Ben Baldwin, a director of the Conservation Council, geologist and hobby farmer. "In other words, the [Repap] mill was great. We wanted bigger and better mills. We wanted bigger and better industry on the river. No thought was given to what it was doing to the river. But I think that may be changing a bit. People are becoming a little bit more worried about these things."

"When I was a kid," says Pierre Turbide, manager of the Baie-Ste.-Anne Co-op, "there was pollution and nobody would notice and nobody would care. I would say that in the last 10 to 15 years, things are better than they were. People began blowing their horn and saying, 'Hey, that's it. Enough is enough!' So I think it got better. And I think it can still be better because I think people are more aware of what's going on."

Perhaps the last word should go to Debbie Norton, owner of Upper Oxbow Outdoor Adventures:

> *In an ideal world... all user groups must work together. We must put behind our hidden agendas and selfish goals of serving ourselves first. Everyone must grasp hold of the broader picture of being stewards of the resources that we have been given to manage. I have to say so far in history, especially in the time period that I can remember, we haven't been very good stewards. If we manage renewable resources properly, they will continue forever. However, if we rape the environment and kill the last surviving member of a species, the species is lost forever. I believe, with hard work and a conscious effort, we can enjoy the beauties and the bounties bestowed upon us for as long as the world continues...*


Pointe-Sapin
Kouchibouguac National Park
Saint-Louis-de-Kent
Grande-Aldouane
Indian Island
RICHIBUCTO
Richibouctou Village
Cap-Lumiére
Big Cove First Nation
Chockpish
Chockpish River
Saint-Édouard-de-Kent
BUCTOUCHE
Harcourt
Saint-Marie-de-Kent
NORTHUMBERLAND STRAIT
PEI
Cocagne Island
Caissie Cape
Cocagne
Grande-Digue
Shediac Bay
Cocagne River
SHEDIAC
Cap-Brûlé
Pointe-du-Chêne
Cap-Pelé
Dupuis Corner
Scoudouc
Confederation Bridge
Murray Corner
Bayfield
Cape Tormentine
Port Elgin
Baie Verte
MONCTON
SACKVILLE
NOVA SCOTIA

VI. Northumberland Strait

Setting the scene

The Northumberland shore in eastern New Brunswick stretches from Point Escuminac to Baie Verte at the Nova Scotia border. In his 1850 study of the New Brunswick fishery, Moses Perley described this coastline as being low and sandy, with long narrow sand bars in front, thrown up by easterly gales. Between these bars and the shore, he wrote, there are a series of well-sheltered lagoons, "admirably adapted for boat navigation at all times," and broad shallow rivers. The environment, noted Perley, was in constant motion: sand bars shifting, gullies and lagoons filling up because of severe storms.

Today, the description is still apt, although changes in the environment are increasingly due to humans rather than nature. Now as then, the lifeline of the mostly Acadian population of this coast is the fishery. Fishermen here, as elsewhere, are very aware of the changes to their environment over the years.


(PANB)

Bouctouche waterfront in the early 1900s.

"Herring were very abundant at one time," says Normand Maillet of Bouctouche who fished for 32 years before retiring. "We ate it, we salted it, we used it for bait. The construction of the Canso Causeway (in 1954) was the death of the herring fishery for us in our area."

Normand Gallant agrees. "When I started fishing herring, it was different," says Gallant who fished for 46 years farther down the coast from Bouctouche at Grande-Digue. "We would use row boats and set nets right at the wharf. There was lots of herring right there but now we have to chase herring wherever it goes and you need sophisticated equipment. Last spring we were fishing in Murray Corner, not in Caissie Cape."

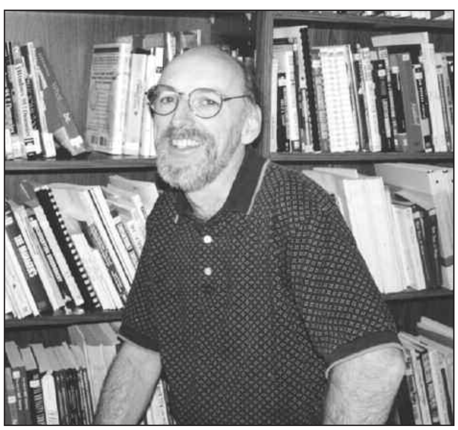
Herring has been one of the mainstays of this shore, as have been lobster, mackerel, scallops, smelt and shellfish such as oysters, mussels and clams. Moses Perley found an abundance of shellfish, noting that, of the whole coastline, Shediac had the best quality oysters. Today there is no oyster fishery in Shediac.

Many areas along the coast have been permanently closed to oyster harvesting, mussel gathering and clam digging because of pollution. Other areas, such as Bouctouche Bay, are what the Canadian Shellfish Sanitation Program calls "conditionally approved zones," which means they are generally open except after heavy rains which increase faecal coliform counts. At that point these zones, managed by the Department of Fisheries and Oceans, are closed and faecal coliform counts monitored by Environment Canada.

"We have over 240 acres of oyster beds that need to be worked but we can't go out before the official okay from DFO," says Jacques Nowlan, vice-president and long-time member of the Bouctouche Bay Oyster Growers Co-op. Everyone knows where the pollution comes from - agricultural run-off upriver, houses and cottages where sewage drains, intentionally or not, into the water system. "They did correct 40 septic tanks and that was good but not enough! All of a sudden when they decided to build a marina in front of the church, they were not even considering the fisheries!" says Nowlan. "My grandfather told me once that over 400 fishermen made a living from fishing here. That's many mouths fed! But there is no hope left in fishing."

By and large, the Northumberland shore does not have the forest and mining operations found further up the coast, although it does have a growing peat industry in the Pointe-Sapin - Richibucto area. It is predominantly a fishing region, with a proliferation of fish processing plants, some of which still deposit their wastes directly into bays and rivers.

Recreation and tourism are developing industries in the area, bringing their own set of issues to the traditional fishing communities. For example, marinas have been built to cater to a growing interest in water sports.



(Jocelyne Gauvin)

Claude Léger, Scoudouc.

"I have seen old writings describing the beaches at the shore below Shediac Inn," says Claude Léger, a DFO marine biologist who lives in the town. "The beaches have changed around the yacht club. The year after the marina went in, the traditional smelt fishing area had moved. I don't know of any scientific study that proves this but I am not the only one to have noticed it." Water quality has also changed. Areas around marinas such as Shediac's are closed permanently to shellfish harvesting because of pollution, or potential pollution, such as oil and gas discharges from boats.

Simonne Robichaud, a native of Richibucto, has also witnessed the changes. "I'll tell you, in the last 10 years, it's incredible the increase in the number of pleasure boats. I would say there has been an increase of 90 to 95 percent. Unbelievable!"

(NB Image Bank)

La Pays de la Sagouine.

Within the past decade, a number of tourism projects have been initiated along the shore. These include the Bouctouche Eco-Tourism Project; La Pays de la Sagouine also in Bouctouche; l'Aboiteau Park in Cap-Pelé; the Cape Jourimain Nature Centre near Cape Tormentine; the development of hiking trails on Shediac Island; and an expansion of the restaurant at Parlee Beach. These projects exploit the appealing natural assets of the area, but they also have the potential to put even more stress on the coast.

Perhaps the project with the most potential to affect the coastal environment is the Confederation Bridge which opened in June of 1997. George Field lives and fishes oysters in Bayfield, not far from where the bridge meets mainland New Brunswick. He says the fishermen have already noticed a change. "The tide's a lot stronger now than it was before. Fishermen have noticed that if they put a trap there and they don't have a lot of rocks in it, it's gone. Where fishermen used to set smelt nets along the edge of the shore, they can't do that now because the bottom has changed. There's no water, the direction of the currents has changed."

In the spring of 1999, scallop fishermen in this part of the Northumberland Strait experienced significant declines in their catches. While DFO was quick to blame overfishing, fishermen are convinced the bridge construction disrupted the settlement of scallop spat and resulted in declines in mature scallops a few years later.

Ecological processes, dominant habitats and species

New Brunswick's Northumberland shore rubs shoulders with Prince Edward Island; between them lies the Northumberland Strait. The Northumberland Strait is a shallow (between 20-30 metres), tidal body of water. Although the physical oceanography of the broader southern Gulf of St. Lawrence is generally understood, there is a lack of information about

The changing nature of the Bouctouche Dune

Since 240 [plus or minus 25] years ago, the rate of sediment accumulation at Buctouche Spit has apparently been falling. The accumulation rate between 1839 and 1945 was approximately 23,000 m^3 per year, less than half of the historic rate of approximately 56,000 m^3 per year. Since 1945, the distal [furthest] end of Buctouche Spit has not prograded/extended measurably. This is because Buctouche Spit's present vertical growth rate is, at most, equal to the rate of relative sea-level rise at the spit and may be as little as half of the rate of relative sea-level rise.

Buctouche Spit is now in a limited sediment supply situation and it has become a constrained spit. Sediment is being eroded from the centre section of the spit, transported to the distal end, and then carried away by ebb-tidal currents. The centre section of the spit will likely breach within the next hundred years. If a breach (or breaches) becomes permanently established in the centre section of the spit, the distal end will suffer significant erosion and may be destroyed. After this, the cycle of rebuilding and landward migration would likely start again at a new location landward of the present spit as relative sea level continues to rise. It is concluded that the key to understanding Buctouche Spit's long-term evolution is recognizing that it is migrating landward both by continuous process like overwash, and by the more discrete and catastrophic process of overstepping [barrier migration]. (Ollerhead and Davidson-Arnott,1995).

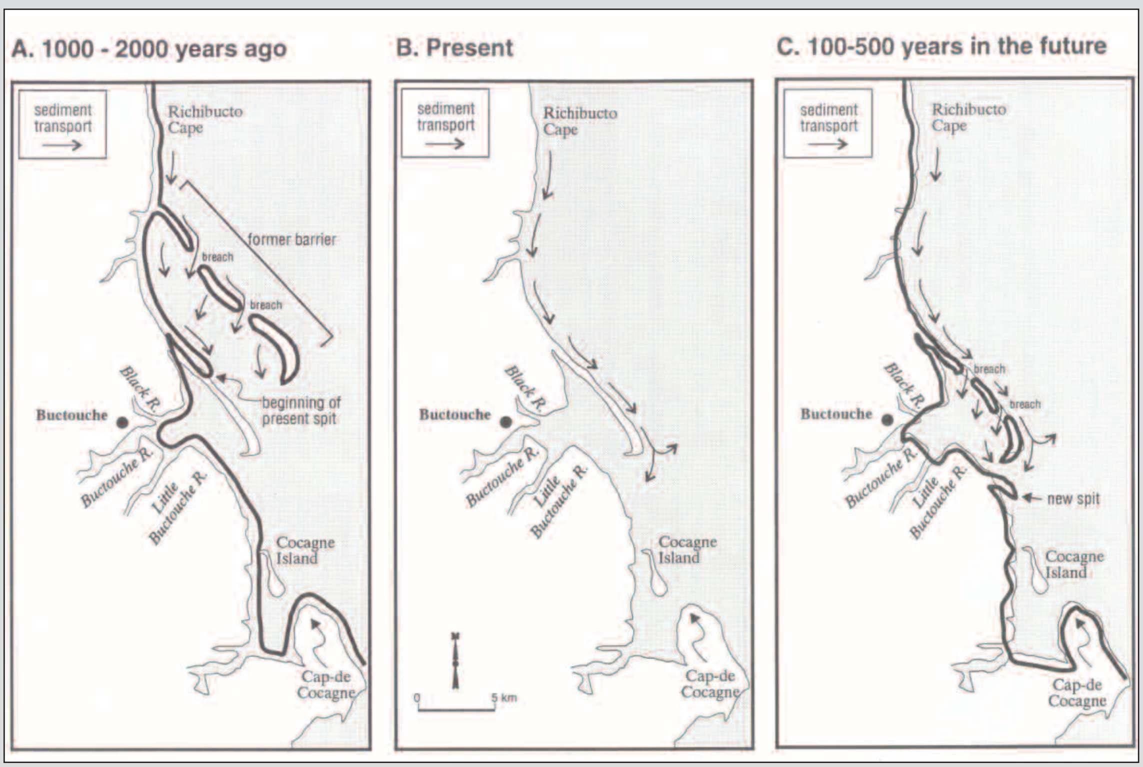


Illustration from Ollerhead and Davidson-Arnott 1995 with permission from The Canadian Geographer some essential processes in the Northumberland Strait (e.g. temperature and salinity) (White and Johns 1997).

During the winter, ice forms across the Strait. It begins in December with ice forming from the New Brunswick and PEI shores out towards the middle of the Strait (landfast ice); by the end of February the entire Strait can be iced in. In general, in the Gulf of St. Lawrence, the trend for last ice out is getting longer and extent of ice cover is getting larger (White and Johns 1997). The time of year when ice leaves the Strait has varied considerably over time. Over the last 30 years, it has been as early as the second week in March (1981) and as late as the third week in May (1972 and 1984) (Strait Crossing 1997a). As the ice breaks up, winds can force the ice to pile up into ice rubbles and ridges that can scour the bottom. Drifting pack ice can scour the bottom and bury or crush species. The extent of intertidal ice cover is an important factor in the distribution and survival of wild and cultivated oysters as well as other bottom-dwelling species.

Dominant among the coastal features between Point Escuminac and Cape Jourimain are the sandy barrier spits, islands and dunes lying just offshore. The most prominent of these barrier spits are in Kouchibouguac National Park and Bouctouche. Their shape and location have changed over time and will continue to change. They will shift, move, split and migrate in response to a number of controlling processes such as water level, sediment supply and wave climate (Ollerhead and Davidson-Arnott 1995). These features are, literally, a barrier between the sea and the mainland. They slow down the eroding action of waves on land-based structures and offer protection for harbours. They also provide habitat for a wide-range of species, and recreational opportunities for people.

According to a Parks Canada Technical Report, the barrier dune system in Kouchibouguac National Park is the most distinctive ecosystem in the park and the main attraction for visitors (Kalff 1998). Although the dunes comprise only two percent of the park, they receive 83 percent of the visitors. The park has three barrier dunes varying in length from 4.3 km to 7 km. They are home to a rare fungus, unique vegetation communities and a nesting area for a diversity of bird species including endangered Piping Plovers and the second largest North American breeding colony of Common Terns. One hundred and thirty-seven species of


(NB Image Bank)

Kouchibougac National Park.

vascular plants have been identified on the dunes, some unique, rare or endemic (found only in the Park).

The other major dune system along the Northumberland coast is the Bouctouche dune or spit. The 11-kilometer dune has been owned by JD Irving Ltd since the 1940's when it was purchased to extract sand resources for glass production. Fortunately, that enterprise never materialized. Recently, the dune was turned into a major tourism development (Irving Eco-Centre), attracting approximately 60,000 visitors per year.

(NB Image Bank)

Estuary in Kouchibouquac National Park.

In addition to its coastal sand features, the Northumberland Strait has a series of estuaries: Kouchibouguac, Richibucto, Bouctouche, Cocagne, Shediac and Scoudouc. While none are as large as the Miramichi estuary, they make important contributions to the productivity of local waters. The Richibucto River, estuary and bay comprise one of the largest watersheds on this part of the coast. Approximately 65 percent of the area is forested, another 20 percent is agricultural and 15 percent is wetlands.

As with all estuaries, the transition from fresh water to salt water provides a range of conditions and environments. Habitat diversity gives rise to species diversity. In addition, the mixing of fresh and salt water as a result of tidal action makes material derived from land through run-off available to estuarine algae, microbes, and plants, and can result in very high rates of primary production. This high productivity makes estuaries an attractive place for feeding and spawning fish and invertebrates and nesting birds. Since these estuaries are relatively shallow they provide sheltered habitat in comparison to open oceans. For this reason, many species of fish use the estuaries as nurseries for their vulnerable juvenile phases. Another benefit of estuaries is the filtering action of marshes and wetlands around the estuary that serve as a buffer between watershed run-off and wave action.

Historically, the estuaries of the Northumberland shore were home to significant numbers of Atlantic salmon, tomcod, eels, rainbow smelt, gaspereau (alewife), blueback herring and striped bass. In many cases, these species were part of seasonal commercial fisheries. Today, some populations have been reduced to very low numbers and only a few commercial fisheries (smelt, eel, gaspereau, blueback herring) remain (LeBlanc and Chaput 1991).

The warm, shallow estuaries and bays of the Northumberland shore also provide an excellent habitat for shellfish such as soft shell clams, quahogs, mussels, and, in particular, oysters. Bouctouche Bay has the historic reputation of being one of the richest oyster areas on the eastern coast of New Brunswick.

Unlike the Bay of Fundy with its large salt marshes, the Northumberland shore (as well as other parts of the eastern coast) has smaller salt marshes. Instead, the area supports large areas of extensive eelgrass beds (*Zostera marina*) which serve much of the same function as salt marshes. For many people, eelgrass is a nuisance. It can bind up a propeller and pile up on beaches, sometimes creating a rotting smell. However, a bed of healthy eelgrass is a sign of good water quality and high biological productivity and diversity.

Eelgrass ecosystems are high contributors to primary production - the amount of carbon added to the system from photosynthesis. For example, the maximum primary production from eelgrass ecosystems on the Atlantic shore of North America is estimated to be about 1500 grams of carbon per square meter per year. For the salt marsh grass (*Spartina sp.*) in the same area, the maximum production was approximately 897 grams of carbon per square meter per year (Mann 1973). Eelgrasses also play a role in the dispersal/recruitment of bivalve (ie. mussels, clams) larvae; they are a significant source of food (in the form of partially degraded plant material) for bivalves; they help to take up excess nutrients; and their roots stabilize sediments by reducing erosion due to wave action (Wildish and Kristmanson 1997).

As with other parts of New Brunswick's eastern coast, the Northumberland shore provides habitat for a wide variety of birds, although the number of birds per species is generally lower than the Acadian Peninsula. To date, there are no sites nominated as Important Bird Areas (IBAs) along the Northumberland coast as there are on the Acadian Peninsula. However, Kouchibouquac National Park is an area with a diverse bird population. Approximately 233 species of birds have been recorded within or offshore of the park (Kalff 1998). The barrier islands-lagoon area is important habitat for waterfowl and shorebird species. The spring and fall migration of waterfowl and shorebirds is spectacular. The Tern Islands support one of the largest Common Tern colonies in North America, while the dune beaches are used by nationally endangered Piping Plovers for nesting. The park is also used by osprey which has only recently been removed from the provincial endangered species list (Kalff 1998).

Cocagne Island is home to a colony of nesting Great Blue Herons. These birds are very sensitive to human disturbance. They will leave nests or chicks unattended and vulnerable to predators if humans approach their colonies. Environment Canada states that, as a general

(Courtesy of Ryette LeBlanc)

Cocagne Island.

rule, there should be no development within 300 meters of the edge of a heron colony and no disturbances in or near colonies from March to August. Great Blue Herons are migratory birds and are protected under the Migratory Bird Convention Act. Cocagne Island is also home to nesting Bank Swallows. These birds excavate tunnels in the sandy bank of the island. While the island has some habitat suitable for Piping Plovers, no nest sites have been found to date.

Cape Jourimain, the New Brunswick terminus of the 13-kilometer long Confederation Bridge to PEI located at the tip of the Cape Tormentine peninsula, is designated a National Wildlife Area (one of 45 in Canada) by the Canadian Wildlife Service because of its unique ecology. The 600-hectare Cape is a stop on the migration route of many birds flying between the Arctic and the eastern seaboard of North America and further south. It has a variety of wetlands, sand dunes and small inlets which make it attractive to migrating birds and other wildlife. The provincially endangered Bald Eagle occasionally visits Cape Jourimain, as do two nationally endangered species, the Peregrine Falcon and the Piping Plover. There are now plans underway to develop a Cape Jourimain Nature Centre which would encourage tourism in the area.

Flora Cormier, Cocagne

Certain writings of Nicholas Denys (1632) speak of the great oyster abundance. The Acadians would sell oyster which were shipped to Europe by boat. Cocagne oysters were some of the best in the world. During the 1960s a disease killed most of the oysters. They have not made a natural comeback. Some are cultivating oysters in Cocagne Bay with great hope and enthusiasm.

The sea is what made Cocagne survive. We had oysters [and] two naval construction sites on the river. This was during the first quarter of the 19th century. There was also wood export.

(Jocelyne Gauvin)

The arrival of fish plants in Cocagne brought a desperately needed economic boost to the area. The farms were no longer big enough for father and son, therefore work at the plant was welcomed. The fish plant allowed women to enter the work place. What a change. There are no longer any fish plants in Cocagne but local people still work in Cap-Pelé, Shediac, and Richibouctou-Village plants.

State of marine resources

Shellfish


(NBDAFA)

Traditional oyster harvesting involves tongs - long poles with rake-like teeth at the end.

Soft shell clams, quahogs, oysters and mussels are harvested recreationally and commercially along the entire Northumberland shore. Shellfish harvesting was traditionally an artisanal fishery that didn't require a licence. People peddled them door-to-door to supplement their income. More recently, as the export market for shellfish has increased and shellfish areas have become increasingly contaminated, the area of public shellfish grounds leased to private sector culture has increased. In New Brunswick, there are approximately 800 shellfish culture leases covering 2,200 hectares (Lavoie 1995). Public access to shellfish harvesting grounds is now very limited.

In recent years, shellfish restoration has been a priority for river and watershed associations as well as other community-based organizations. Some communities have had more success than others. Despite many efforts to improve sanitary conditions within the Bouctouche River and Harbour, an Environment Canada survey found that these efforts were not enough to allow unconditional harvesting with the harbour waters (Richard *et al.* 1999).


(NBDAFA

Oyster lanterns used in aquaculture.

The decline in the wild oyster fishery has precipitated a movement toward oyster farming. Oyster culture - the collection of wild "seed" transferred to natural beds - has a history dating back 100 years or more. Oyster farming or aquaculture is more recent, more sophisticated and requires more knowledge and equipment. Oyster farming involves growing oysters off-bottom or suspended, or, in a variation on suspended culture, in Vexar bags on bottom tables (Lavoie 1995). The advantage of this latter method is that it provides protection against predators, helps with inventory control, allows for efficient handling and harvesting, does not require flotation, and does not visually pollute the landscape.

Shellfish aquaculture does not have the same impact or footprint on the environment as salmon or other finfish aquaculture (e.g., pesticide and antibiotic use, large quantities of waste discharges, and destruction of bottom habitat). The issues surrounding shellfish aquaculture at this point, are more social or cultural than environmental in nature. Currently, many of the oyster leases are never used or are too small to sustain a viable culture operation. However, for many people the leases are considered family heirlooms that are passed from generation to generation. As interest in oyster farming grows, the need for large leases on suitable bottom will also grow. The possibility that the shellfish aquaculture industry will put pressure on the provincial government to raise the annual fee for leases, institute a mandatory surrender of unused leases, or establish a buy-back program as a means of making more area available for shellfish farming, will also grow.

The shift from wild oyster harvesting to farming has also served to shift research attention: from research on the restoration, recovery and ecological importance of natural oyster reefs or beds, to aquaculture-oriented topics such as oyster-seed supply, new seed-production technology, grow-out techniques, predator and disease control and point source reduction of bacterial pollution. For example, virtually no research has been done on the impact of oyster reef destruction on local marine productivity and species diversity, nor on the potential for oyster reef restoration. In fact, the role of oyster reefs in coastal ecosystems of eastern New Brunswick has been virtually ignored.

Research done elsewhere suggests the Eastern Oyster is a classic example of a “keystone” species, a species which influences the ecological composition, structure, or function of its community far more than its abundance would suggest. One study summarizes the value of oysters and oyster reefs as follows:

> *Structurally and functionally the oyster (individually and the reef it builds) strongly influences species diversity and productivity at the local scale. As a structure, reefs provide habitats that sustain an abundance and diverse range of species. As metabolic “hot spots”, oyster reefs form centres of production and absorption of nutrients. Oyster reefs also contribute to estuarine resilience and robustness, and serve as metacommunity habitats for species re-establishment after major physical disturbances. Alteration of these functional roles might have widespread consequences for migrating and estuarine-dependent species, as well as the ecology of the coastal zone. (Ray et al. 1997 p 364).*

Jacques Nowlan, Bouctouche

When I joined the Oyster Co-op I knew nothing of governments and politicians. I thought politicians were there to work with people and to help people. This is not true. The Bouctouche River should be treated as a river not a sewer. There are laws but no justice. The co-op fishermen have complained since 1989 that we are going to lose the river. Well, we lost our river, we lost our bay and if it continues we are going to lose our dune. We worked hard at getting people together to identify pollution sources in the Bouctouche watershed. We wanted the pollution problem remedied and we wanted to go back to fishing oysters. They did correct 40 septic tanks and that was good, but, not good enough.

This suggests that the recovery of coastal and estuarine ecosystems in general may depend on how well wild oyster reefs recover. Should the wild oyster beds disappear as the source of seed for oyster farms, this will have little impact on oyster farms as seed can be imported from many sources. However, what cannot be imported or replaced is the function oyster reefs play in the health and diversity of local ecosystems. To date, bacterial pollution from sources such as sewage and agricultural run-off has been considered the sole factor in oyster reef degradation. However, wild oyster recovery is also dependent on the impacts on their habitat of increased sedimentation from coastal land development and alteration, dredging and dumping of dredge spoils, and runoff.

Coastal and estuarine fisheries

The revenue from lobster, scallop and herring fishing (estimated to be worth $100 million per year) makes up the largest portion of total fisheries income in the Northumberland Strait. The lobster fishery alone, the season for which runs from mid-August to mid-October, accounts for at least 70 percent of most fishermen's incomes. There are, however, a wide variety of other coastal and estuarine species that contribute to overall fisheries revenue. A report on the landing of estuarine fishes in the Gulf of St. Lawrence between 1917 and 1988 illustrates how extensive and important these fisheries were (and many still are) to the fishermen along the entire coast of eastern New Brunswick , PEI, and Quebec (LeBlanc and Chaput 1991).

(Jocelyne Gauvin)

Normand and Annette Gallant, Grande-Digue

" Fishing is our living, our revenue. It's a way of life, our bread and butter. With all that we have now, fishing is not as hard work as it was before: fast boats, winches, fast everything. But I wouldn't change it for the world! With fishing times flies. You start in the spring and here you are in December... that quick. Between December and May, there is lots of work to keep the gear in fishing order. If you don't look after it, it won't fish for you.

(Jocelyne Gauvin)

George Field, Bayfield

"If you're a young fisherman now, basically you've got to have about three licenses to make a living in the Strait: lobster, herring and mackerel. In the spring, you fish herring or scallops, then rock crab in the summer, then you fish lobster in the fall.

If you are lucky enough to have three licenses with the gear and a decent boat, you've probably got an investment of $140,000 to $150,000. If you have to borrow that at today's interest rates that's tough and hard to pay back. I'm finding now that a lot of the older fishermen are not giving to their sons like they used to. They want to sell for their retirement."

The data for the Northumberland shore is reported by county and includes District 75 (from Northumberland County line to the south side of the St. Louis River), 76 (from south side of St. Louis River to Chockpish River), 77 (from south side of Chockpish River to Westmorland County line), 78 (from Kent County line to Broad Cove) and 80 (from lower Cap-Pelé to the Nova Scotia border). The species fished included anadromous fish such as alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), Atlantic shad (*Alosa sapidissima*), rainbow smelt (*Oxerus mordax*), striped bass (*Morone saxatilis*), American eel (*Anguilla rostrata*), and species which complete their life cycles within the estuary environment such as Atlantic tomcod (*Microgadus tomcod*) and Atlantic silverside (*Menidia mendidia*). Not all species are fished in all districts and some species were largely by-catch of larger fisheries. For example, smelt are fished in all districts but shad are only fished in districts 75, 76, and 78, and Atlantic tomcod is mainly a by-catch of the smelt fishery.

While the catches for each species (in terms of metric tonnes) are not large by offshore standards, fishermen can fish year-round. They catch gaspereau during the spring months (from April to June) and rainbow smelt during the fall and winter (under ice). Some supplement their income with oyster or clam harvesting. The data show that only the smelt and gaspereau (alewife) fisheries have maintained any kind of strength between 1917 and 1988.

Normand and Marie-Mai Maillet, Bouctouche

"With the construction of the Canso Causeway, it was the death of the herring fishery for us in our area. In 1957-58, the causeway was not completed; there were still herring that could enter via the south into the Northumberland Strait. Between 1961 and 1990, no herring in the Strait. The whole Strait fishery was dead. Fish would go around Cape Breton and enter the Strait at the north via Escuminac area. We tried to go fishing up north but the fishermen from that area did not want us to fish there. They wanted the fish. Since 1990, the herring are slowly making a comeback in the southern Strait. We could catch some in Cap-Pelè, Grande-Digue, Richibucto-Village.... But again, a problem — catch the fish but no buyers – no sale for our product! So we have to go back and dump it at sea. This would make me cry!


(Jocelyne Gauvin)

Another terrible thing with the herring: the first years after the causeway construction was completed, the herring would still arrive there. They would swim in mass numbers toward the causeway and not stop. It was a mass killing! They would collide with the structure and die there. It was awful. Then they decided to have big boats go fish out this herring as it arrived but this was no better. They would catch everything, clean everything out... nothing left. I don't agree with that at all. We must think much longer term, not just for today. We must get organized to have fish to make a living in the fishing industry....

Both the Richibucto and Bouctouche rivers have small salmon populations. These are still monitored on a regular basis because of their importance to the native food fishery for the Big Cove (Richibucto) and Bouctouche First Nations. In 1997, the Richibucto salmon stock was considered severely depressed with a poor outlook for recovery. On the Bouctouche River, returns of large salmon ranged from 95 to 244 fish between 1993 and 1999 (DFO 2000). According to a DFO stock status report, 1999 was the first in seven years of assessing the river that there were sufficient eggs deposited by large and small salmon to meet conservation targets (DFO 2000).

It may be tempting to attribute the decline in coastal and estuarine fisheries solely as the result of over-fishing. Yet declines in water quality, destruction of bottom habitat, and the loss of spawning and juvenile habitat are equally compelling explanations. It has been widely acknowledged that very little research has been done on habitat requirements and habitat changes of fish species. The focus of scientific research has been largely on fish distribution, migration patterns and trends in fish population size. Unfortunately, this information only indicates the location and (imperfectly) quantities of fish, and not the ecological requirements of fish populations (e.g., food, shelter, and reproduction) necessary to sustain a healthy population.

(NB Image Bank)

Wharf at Cap-Lumière.

For many fishermen living and working along the Northumberland shore, two major construction projects in the Gulf of St. Lawrence have had impacts on their fisheries - the Canso Causeway and the Confederation Bridge. In 1954, completion of the rock-filled Canso Causeway blocked the Strait of Canso which previously connected the waters of St. George's Bay in the southern Gulf of St. Lawrence with Chedabucto Bay on the southeast coast of Nova Scotia (Eaton et al. 1994). The causeway links the island of Cape Breton to mainland Nova Scotia.

The Strait of Canso was one of three openings to the Atlantic from the Gulf of St. Lawrence. The other two are the Strait of Belle Isle between Newfoundland and Labrador, and the Cabot Strait between Cape Breton and Newfoundland. These openings allowed species like herring and lobster and their larvae to migrate in and out of the Gulf of St. Lawrence. Shortly after the construction of the causeway, herring catches plummeted in the Northumberland Strait. Fishermen pointed a finger at the causeway. Meanwhile, the lobster fishery along the Nova Scotia coast from Chedabucto Bay west to Lunenburg declined drastically. The restricted flow of lobster larvae from the productive Gulf region has been offered as an explanation for the decline (Eaton *et al*. 1994).

VI. Northumberland Strait

In the 1990s, the herring came back to the Northumberland Strait, although their pattern of movement had changed completely. Now they enter the Gulf through the Cabot Strait, spawn at Point Escuminac, then head south counter-clockwise along the Northumberland shore and back out to the Atlantic. As Normand Gallant says, fishermen now have to chase them, but it remains an important fishery. Herring caught in the spring largely by gillnet go to the smoke houses in Cap Pelé to be turned into bloaters (dried, smoked herring) which are shipped mainly to Haiti and the Dominican Republic. Almost 100 percent of bloater production in Canada is in Cap Pelé (a shift from the late 19th - early 20th century when Grand Manan in the Bay of Fundy was the top producer).

In the last 20 years, a fall herring roe (egg) fishery has developed, feeding a Japanese market. After the roe is removed, carcasses, including those of male herring inevitably caught in the search for roe, are discarded. (In the Scotia-Fundy region), much of the roe fishery waste is diverted into the animal feed industry).

The other development believed to be having an impact on fisheries in the Northumberland Strait, particularly the scallop fishery, is more recent. The Confederation Bridge, completed in 1997, crosses the Northumberland Strait between Cape Jourimain and Borden, PEI. From the time an unsolicited proposal to build a fixed link to PEI was presented to the Mulroney government in the mid-1980s, one environmental study after another was carried out. The initial federal environmental assessment panel struck to evaluate the project identified several potentially harmful environmental effects from the project. The most serious was the possible delay in 'ice-out.' The panel concluded a one-to two-week delay in the ice leaving the Strait carried an unacceptable risk of physical interference with important fisheries and alteration of the coastal micro-climate upon which local agriculture depends. The assessment panel also raised concerns about scouring from bridge-induced nearshore ice with the risk of increased damage to spawning grounds. There could also be a possible loss of lobster production as a result of lower water temperatures due to delayed ice-out (Eaton *et al*. 1994).


(Jocelyne Gauvin)

Confederation Bridge.

In 1990, the panel concluded that "... the risk of harmful effects of the proposed bridge concept is unacceptable" and recommended the project not proceed (Federal Environmental Assessment Review Office 1990). Apparently, this was not the answer the federal government was looking for. Within months, the federal government appointed an expert ice panel to examine the ice issue more closely.

The new panel concluded a bridge was feasible and ice break-up might only be delayed no more than two days (Environment Policy & Law 1991)

Their report gave the federal government the go-head to reassess proposals to construct a bridge to PEI. Public Works Canada representatives stated at the second round of environmental impact assessment hearings that a bridge would have negligible effects on the production of plankton, although DFO representatives pointed out there had been no full seasonal studies of phytoplankton or zooplankton production in any area of the Northumberland Strait. Three years after the first environmental assessment panel recommended against the construction of the bridge, Strait Crossing Inc. of Calgary (Alberta) was awarded the contract to build the bridge.

The key environmental concerns with the bridge were the impact of piers on current dynamics and ice in the Northumberland Strait, and the dredging and disposal of sediment throughout the operational life of the bridge. If the bridge piers changed current patterns, this in turn could affect shoreline erosion, and sediment mobility and deposition. Changes in ice dynamics could delay ice-out, modify the extent of land-fast ice and increase scouring of the sea bed. Together, these physical changes could cause ecological changes such as changes in phytoplankton species composition and productivity, timing of fish spawning; fish egg and larval survival and development; timing of moult in lobster and crab; spawning habitat; and groundfish abundance (White and Johns 1997).

In response to ongoing environmental concerns, a Marine Environmental Effects Monitoring (MEEM) Program was established to monitor the effects of bridge construction activities and piers on what were referred to in the environmental assessment reports as 'valued ecosystem components' (VECs). An advisory committee comprised of representatives from government departments, consulting firms, fishermen's associations and environmental groups was appointed by Strait Crossing Inc. to ensure the program had scientific and statistical validity and that the monitoring was sufficient in scope.

(DFO)

Dragging for scallops,

The VECs included: ice climate, water quality and physical oceanography, shore erosion/sediment accretion, benthic habitat and communities, scallops, lobster and rock crab, herring spawn and winter flounder, phytoplankton, and marine mammals. Data on these VECs was gathered prior to construction (1993, 1994, 1995), during construction (1996, 1997) and one year post-construction (1998).

In June 1997 the bridge was opened to the public. After only one year of post-construction monitoring, the MEEM Program concluded that construction of the bridge had no negative impact on the VECs. In 1998, additional monitoring was done at study locations within

Abegweit Passage where the bridge spans the Strait, to obtain more data on shoreline erosion, the scallop fishery, and herring spawning habitat. According to the 1997 monitoring results, scallop landings for the area showed a decrease from 1993 to 1997 (Strait Crossing 1998b). The 1998 monitoring results confirmed this decline. The report explained the decline as a general trend "... which is consistent with anecdotal fisher information, of decreasing CPUE [catch per unit effort] over the course of each scallop fishing season." The report also proposed that "the largest source of anthropogenic [human] disturbance to the benthos [bottom] in the Abegweit Passage is the habitat alteration that occurs as a result of the continued raking during successive scallop fishing seasons" (Strait Crossing 1999).

As for sediment changes in herring spawning habitat, the monitoring indicated a plus or minus three-centimeter fluctuation in sediment over the seabed. The 1999 monitoring report stated these results were "well within the ranges that are expected to be occurring naturally in this area. Sedimentation at a level that could potentially bury herring eggs was not observed during the herring spawn habitat monitoring program" (Strait Crossing 1999).

Monitoring of shoreline erosion at Cape Jourimain found that no significant unexpected changes have occurred in the area as a result of the bridge construction. However, three areas of the southeast barrier are still receding at rates significantly higher than the longer-term average rates. One site is of particular interest as it is close to the bridge (Ollerhead 1998). One explanation offered for the higher erosion at these three sites is that the sediment held around the 1995 temporary work surface is still working its way through the local sediment transport system and that pre-bridge equilibrium should be reached in the near future (Strait Crossing 1999). There are no plans to monitor erosion at the Cape Jourimain site.

While the federal government will continue to monitor ice conditions and current flow in the Northumberland Strait, the MEEM Program is now ended. Concerns remain about the impact of the Bridge on scallop, lobster and herring populations but there are no specific plans to do any further monitoring to evaluate the effects of the bridge on these or other species over a longer period of time. Clearly, a one-year post-construction monitoring effort is not sufficient to detect or confirm trends that may or may not be attributed to the new bridge.

Not everyone is satisfied with the conclusions of the environmental monitoring program for the Bridge and not everyone is simply waiting to find out what time will tell. Fishermen from New Brunswick, Nova Scotia and PEI have developed a project to seed portions of the Northumberland Strait with scallops. Donna Murray, the wife of a Murray Corner scallop fisherman, conceived the project after reading about Japanese scallop aquaculture. It involves collecting young scallops (called spat) from waters off Richibucto, and transplanting them to specially designed nets. The spat are raised to a certain size and then seeded on the sea bed. Each year for the next six years, new scallop beds are to be seeded and after the sixth year, the scallops will be harvested on a rotational basis. In order to get the project off the ground and into the water, Ms. Murray applied and received support from the Atlantic Canada Opportunities Agency, Human Resources Development Canada and the provincial Department of Labour (Fishermen 1999). If it succeeds, the new scallop aquaculture industry will be worth $1.5 million a year.

State of the coastal environment

(NB Image Bank)

Caissie Cape.

The allure of the ocean in recent years has spawned a trend of population growth in coastal areas, and an increasing influx of seasonal visitors to seaside destinations. The warm, shallow, sandy beaches, close proximity to one of New Brunswick's fastest growing regions - the Moncton/Dieppe area, and an aggressive provincial tourism marketing program have combined to make the Northumberland shore one of the most popular tourism destinations in New Brunswick.

Simonne Robichaud, Richibouctou

I think government has put in a lot of money to beautify towns and villages along the coast, even in all the little villages. I feel it makes things nicer for the tourists - more things to see and more development. But, I remember about 30 years ago... I must have been 10 or 12 years old... Richibucto Harbour was very, very busy. There were big boats from Europe and different countries -- from Switzerland, from Norway. It was a huge port for wood. There were many small restaurants in Richibucto and I remember those times as being very busy times. There were always many trucks hauling wood. We would see all these trucks loaded with wood and unload on the big boats. In Rexton, there were big wharves along the river where big sailboats and other boats would come to be loaded with wood. Now all we see is one wharf in Richibucto and one little wharf in Mundleville

Pierrette Robichaud, Richibouctou

(Jocelyne Gauvin)

I remember the big steamer boats. Until December 1st 1969 when the last boat came -- there would be four boats at a time in Richibucto Harbour. We had three wharfs and the other boats would tie up next to the dune. Many little boats would also be in the harbour to guide the steamers. It was busy with steamer boats but now we see many pleasure boats. Many people have realized what a nice recreational activity this is. There were more animals before. I remember seeing seals come into the river and muskrats. Now there are houses and cottages everywhere and a lot less animals.

The Golf Stream

Cocagne Island lies just a few hundred meters offshore from the village of Cocagne in the Northumberland Strait. It is one of a chain of small islands that extends along the entire eastern coast of New Brunswick from Cape Tormentine to Miscou Island. The uninhabited island is about four kilometers long, one kilometre at its widest point, and approximately 100 metres at its narrowest point. The total area of the island is estimated to be 375 hectares (600 acres) at low tide.

Cocagne Island has long been recognized as a unique landscape. It supports a wide variety of habitats such as wetlands, tidal flats, a sand spit, dunes and beaches, sandstone bluffs and forested areas. As a result, it has a high diversity of plant and animal species. Hal Hinds, botanist and University of New Brunswick associate professor emeritus, conducted a botanical survey of the island in 1997 and identified 246 species of plants, not including marine species. Twenty-one of these species are uncommon or rare either in the province or in coastal areas in general.

The forest on Cocagne Island represents one of the last remnants of the Northumberland Strait Forest Complex which includes stands of oak, white pine, maple, fir, and white spruce. This rich assemblage of species is a stark contrast to the black spruce and fir that now dominate coastal forests. The marine waters surrounding the island are home to many commercial (oyster, quahog, lobster) and non-commercial species.

Swept up in the previous provincial government's golf development strategy, Cocagne Island has also been targeted for a proposed $17 million resort development by Les Entreprises Mapoma Ltée of Moncton. The citizens of Cocagne, led by community leader and environmentalist Henri LeBlanc, were concerned about such development on this pristine barrier island. They mounted an opposition to the project by forming an organization called Eco-Cocagne. They brought together experts in marine ecology, plants and birds, and held public information meetings to explain the ecological significance of Cocagne Island and Cocagne Bay. Eco-Cocagne also garnered the support of environmental groups from around the province, including the Conservation Council.

To respond to concerns raised by citizens, environmental groups, and Environment Canada, Les Entreprises Mapoma Ltée hired three consultants to do biological surveys of the island and surrounding waters. On November 7, 1997, the Telegraph Journal reported on the content of a letter from the Department of Environment to Les Entreprises Mapoma Ltée which questioned the scientific accuracy of the studies carried out by the developer's consultants. The letter stated, "Such an analysis requires scientific quantification and this has not been provided.... What has been offered is opinion, not a scientific biological assessment of the values and functions of the wetland." The DOE letter also raised concerns about the loss of wetland habitat due to the construction of a proposed bridge to the mainland, destruction of dunes due to road construction on the island, deterioration of water quality around the island as a result of increased boat traffic and bridge construction, and the effects on wildlife in the area.

For awhile, rumours swirled that Les Entreprises Mapoma Ltée might abandon the proposal for Cocagne Island. In March 1999, however, the company hired another consultant, SGE Group of Moncton, to draw up an environmental protection plan for the resort. Still, as of May 2000, the provincial Department of Environment had not received any further documentation on the project.

(Ryette LeBlanc)

Postscript *- Henri LeBlanc died suddenly on September 26, 1997. On July 28, 1998, then-provincial Minister of Fisheries and Aquaculture, Hon. Danny Gay, posthumously awarded Henri LeBlanc the Environmental Citizenship Award. The Award recognizes the contribution of an individual or group to sustainable development in the Bouctouche and Cocagne watershed areas. Henri LeBlanc was very civic-minded and deeply committed to maintaining the beauty and ecology of his native Cocagne so future generations could also enjoy the area. He was chairman of the Cocagne Local Service District, member of the Moncton Naturalists' Club and Conservation Council of New Brunswick, a representative on the Bouctouche Sustainable Development Working Group, and founding vice-president of Eco-Cocagne.*


(Paul Jordan)

This cottage owner saved a small plot of land from the natural erosion of the sea.

The result has been a boom in the construction of commercial cottages and cottage complexes, marinas, and eco-tourism projects. With only so much suitable coastline available, small salt marshes and streams have been filled in to make way for commercial development. Few municipalities or local service districts have provisions such as construction setbacks in their by-laws or planning statements to protect sensitive coastal features. At the provincial level, a development of less than two hectares does not trigger an environmental review, and a stream must show up on a 1:10,000-scale orthophoto map before it is considered a watercourse and subject to restrictions.

This is a real problem here, given the dynamic nature of the sandy, low lying coast of eastern New Brunswick. These areas are very sensitive to human-induced alteration. Even in protected areas like Kouchibouguac National Park where there are management plans, rules and regulations, certain ecosystems are showing signs of disturbance. Located about 100 km north of Moncton, Kouchibouguac has seen a rise in visitors from approximately 105,000 people in 1984 to 220,000 in 1995.

In 1998, as part of a program of the Atlantic Regional Office of Parks Canada, a report was prepared on the threats and stresses on Kouchibouguac National Park. It states that three of the park's ecosystems - the barrier dunes, estuaries, and Acadian Forest - show signs of disturbance. For example, intense use of the barrier dune system by visitors has damaged dune vegetation, particularly the ecologically important marram grass. Marram grass stabilizes dunes and is very sensitive to trampling. Without the grass, exposed sand is easily moved by wind. Channels form and these in turn are vulnerable to blowouts and washover during storms. According to the report, "While the boardwalk and snow fence are largely effective in controlling visitor travel across the dune to Kelly Beach, visitors exploring other portions of the dune system have created informal trails" (Kalff 1998). Informal trail development has been extensive on the northern tip of South Kouchibouguac Dune.

To remedy the problem, the Kouchibouguac assessment report recommends that the Park administration "examine and take into consideration the state of regional dunes to understand the role the park dunes play in protecting this rare ecosystem type and associated biodiversity." It also suggests that, "If regional dunes are subject to human use throughout the region, the park may have to adopt even stronger conservation measures to protect this representative feature."

(Paul Jordan)

Cottage in Robichaud damaged in the January 21, 2000 storm surge.

Natural disturbances can also have a devastating impact on human and biological communities of the dunes and coastline of the Northumberland shore. In January 2000, a combination of extremely high tides and high winds caused a storm surge, resulting in extensive flooding and property damage around Shediac and other areas along the coast. It had been decades since this combination of natural events occurred in the area with such effect. According to Dr. Jeff Ollerhead of Mount Allison University's Geography Department, it will happen again, especially as sea level rise and ongoing coastal erosion combine with storm surges. As predicted, another damaging storm hit the region in Fall 2000.

Ollerhead says people have two options to deal with these natural occurrences. One is to try to fight nature with infrastructure projects: build barrier structures and haul sand from one area to another. Ollerhead is quick to point out that world-wide these attempts have not only been costly, they have also failed to prevent damage and in many cases, they created new problems. The second option is take nature into account when planning development projects. This means using existing information about flood zones, areas hit by previous storm surges, and rates of coastal erosion to plan residential and commercial projects.

Although this information exists, it is not often used in the planning and approval process for construction projects subject to flood or erosion risk. Don Forgeron, the Atlantic Vice-President of the Insurance Bureau of Canada, recently waded into the issue by upbraiding officials of the Department of Municipalities and Housing (now Environment and Local Government) for not doing enough to stem the losses from increasing numbers of natural disasters. They should, he said, enact stricter policies and enforce existing by-laws. "There are municipalities where there are known flood zones that will still allow commercial development [in those zones]. What we're talking about is enforcing land-use bylaws, and enforcing them regularly" (Enforce 2000). Representatives of municipalities and planning commissions say their hands are tied until a provincial coastal lands policy, under development since 1996, is finalized and given the force of law by the Legislature.

Sewage

Permanent and seasonal human population growth along the coast has also increased the requirement for sewage treatment. Until quite recently, much of the sewage from seaside cottages and homes poured directly into the ocean. Today, this is a less acceptable practice and many residences have installed, replaced or upgraded private septic systems. However, such measures are not mandatory and not all homes and cottages have made the conversion. Sewage treatment plants in some municipalities are also outdated and are overloading their original design capacity. Recreational boating, which is rapidly increasing in this area, is another source of untreated sewage, since there is no mandatory requirement for sewage holding tanks on boats.

The problem with sewage loading is two-fold. First, it contains harmful bacteria that contaminate shellfish and make swimming areas unsafe. Second, it contains nutrients (nitrogen and phosphorus) that can cause eutrophication (excess plant growth and resulting oxygen depletion) and result in a decline in water quality. Depending on the volume and duration of nutrient loading and the ability of the environment to absorb the nutrient, the end result could be a fundamental shift in the ecology of an area. Increased nutrient input tends to shorten the number of trophic levels in food webs (Taylor 1997).

Shellfish Closure Areas in Northumberland Strait*	Household Sewage	Fish Plant Present
Kouchibouguac Bay, Black River, Kouchibouguac River	septic systems	
Baie de St. Louis, Kouchibouguac River	septic systems	
Riviére Kouchibouguacis (St. Louis-de-Kent), Aldouane Riviére (St. Charles), Little Aldouane Riviére (Grande Aldouane, Petite Aldouane)	aerated lagoon; septic systems	
Mooney's Creek, Richibucto River (Richibucto) - conditional closure	Lagoon; septic systems	2 at Richibucto
Richibucto River, St. Nicolas River (Rexton, Big Cove, Mundleville)	Lagoon; septic systems	
Baie du Village (Richibucto-Village)	septic systems	2 at Richibouctou-Village
Chockpish River (Ste-Anne-de-Kent, Chockpish, Cote-Ste-Anne, Caissie Village)	septic systems	1 at Ste-Anne-de-Kent
Bouctouche Harbour, Black River, Bouctouche River, Little Bouctouche River (Bouctouche, St-Jean-Baptiste, Collette-Village, St-Francois-de-Kent, Upper Bouctouche, St-Joseph-de-Kent, St-Thomas-de-Kent, Cormierville)	aerated lagoon; lagoon; septic systems	3 at Bouctouche
Cocagne Harbour, Cocagne River (Surette Island, Cocagne, Cote-d'Or, Notre-Dame, Cocagne Nord, Cocagne-Sud, Gueguen)	septic systems	2 at Cocagne
Shediac River, Shediac Harbour (Shediac Bridge, Shediac, Point-de-Chene, Cap-Brule, Cap- Birnet)	aerated lagoon; septic systems	3 at Shediac
Lac des Boudreau, Robichaud (Robichaud)	septic systems	2 at Robichaud
Cap Pele (Cap Pele)	aerated lagoon; septic systems	Approx. 20
Shemogue Harbour (Petit Cap, Shemogue)	septic systems	1 at Petit Cap
Cape Tormentine	septic systems	1 at Bayfield
Port Elgin, Baie Verte Creek, Baie Verte (Wood's Beach, Port Elgin)	lagoon; septic systems	

**as of July 2000 (not comprehensive)*

The result is "ecological simplification". Coastal environments that have been over-enriched with nutrients exhibit features such as:

- reduced species and habitat diversity
- a shift from large to small phytoplankton
- a shift in phytoplankton species composition from diatoms to flagellates
- increased incidence of undesirable phytoplankton blooms, including toxic blooms
- increased seaweed biomass
- loss of seagrasses
- a shift from filter-feeding to scavenger-type animals
- a shift from larger, long-lived animals to smaller, rapidly growing and shorter-lived species, and
- increased disease in fish, crabs, and/or lobsters.

Fish plants


(Mark Reid, Telegraph Journal)

Wastes from fish plants are piped into coastal waters.

Fish processing plants, and particularly fish meal plants, generate large quantities of effluent. There are two areas of high concentration of fish plants along New Brunswick's eastern coast, the Acadian Peninsula and the Northumberland shore. In the fall of 1999, several public complaints were lodged about discharges from fish plants in the Cap-Pelé area (*Polluted brook* 1999; *Fish waste* 1999). Residents cited the smell, oily water and fish remains on the beaches, and expressed concerns about the impact this would have on tourism in the area.

Provincial environment officials responded that fish plant effluent poses no threat to the environment and the problem is one of aesthetics. Nabil Elhadi, manager of assessments for the Department of Environment and Local Government. (DELG) at the time said, "It's image more than anything. It could be just an odour issue or something that was laying on the beach, such as fish parts"(*Fish waste* 1999).

Actually, the environmental impacts of fish plant effluent are well documented. While not a direct source of bacteria, fish plant effluent does provide a medium for the growth of bacteria already in the water, such as faecal coliforms or other disease-producing bacteria. Wastewater from fish plants contains particles of fish, oil, blood, slimes, and other contaminants (sometimes toxic) which degrade water quality, deplete dissolved oxygen and contaminate sediments in the small harbours and coves where they are typically located (Eaton *et al.* 1994). The solids in the waste can accumulate as a layer of anoxic (no oxygen) sediments, which smothers creatures living on the seabed and reduces the number of species living in the area.

The DELG regulates the discharge of effluent from fish plants by issuing permits which require only that effluents be screened to catch the largest solid components. No treatment is required for the remaining effluent which, depending on what other drains are hooked up to the effluent pipe, could include disinfectants, cleaners, and other chemical products. Yet even the minimum requirements are not ensured. DELG officials admit that, because of staff shortages, regular inspections are not done and they rely on public complaints to identify plants not complying with their permit (*Polluted brook* 1999).

Environment Canada has established fish processing liquid effluent guidelines which cover biological oxygen demand, suspended solids, oil and grease, but contain no standards for bacteria or chemicals. Still, these are only guidelines and are not legally enforceable. Even when processing plants do meet regulations or guideline limits, the sheer volume of effluent discharged can be great enough to cause environmental problems (Eaton *et al.* 1994).

Agricultural run-off


(CCNB)

Pig factory manure lagoon in Sainte-Marie-de-Kent.

Another major source of nutrients, as well as pathogens (disease-causing agents) and toxic chemicals in coastal waters is run-off from agricultural operations. The extensive use of chemical and natural fertilizers is a source of groundwater contamination (with potential human health implications) and pollution in rivers and estuaries. According to Environment Canada, agricultural run-off from livestock farms contributes to over 40 percent of shellfish harvesting area closures in the Atlantic region (Eaton *et al.* 1994).

Livestock agriculture is an important economic activity along the Northumberland shore, particularly along the Richibucto, Bouctouche, and Cocagne Rivers. Most of the farmers in these areas have a few hundred head of cattle or hogs. The run-off from these operations is sufficient to cause shellfish closures, particularly after heavy rainfalls and, in the spring, snow melt. Farmers are working to reduce these problems by developing better manure management systems, limiting animal access to streams, and through the creation of larger "green belt" buffer zones between the farms and watercourses.

Concentrated Animal Feeding Operations (CAFOs)

Concentrated animal feeding operations (CAFOs) are defined by the U.S. Department of Agriculture as an animal feeding operation with 1,000 or more animal units (AU). One animal unit is equal to 2.5 swine over 55 lbs, 0 .7 mature dairy cattle, 100 broiler chickens or 55 turkeys. CAFOs are known to cause environmental problems when they are located in watershed areas near streams, rivers, and coastal waters. Runoff from these operations adds nutrients and bacteria into watercourses and results in a decline in water quality. In Maryland and North Carolina, environmental officials say high concentrations of nitrates and phosphates in the manure from factory-sized chicken and hog operations are to blame for the surge of toxic algal blooms in coastal waters. In 1995, 22 million gallons of hog manure burst through a lagoon wall in North Carolina. The excrement swept across crop fields and a rural highway before spilling into a river. Fish were killed 20 miles downstream. The state of Missouri has imposed a moratorium on further factory farms and Iowa passed new more stringent regulations governing these farms.

In a September 1998 draft of a Unified National Strategy for Animal Feeding Operations, the U.S. Department of Agriculture and U.S. Environmental Protection Agency raised a red flag on CAFOs. The document identified CAFOs as a risk to water quality and public health and said these operations have a potential "to contribute pollutants such as nutrients (e.g., nitrogen, phosphorus), sediment, pathogens, heavy metals, hormones, antibiotics, and ammonia to the environment." The Draft Strategy stated, "pathogens [disease causing micro-organisms]...have been linked to impairments in drinking water supplies and threats to human health."

In addition to creating environmental and health problems, the establishment of livestock factories tends to drive family livestock farms out of business as volume-based production drives down the price. In Illinois, the fourth largest producer of hogs in the United States, 19,500 farms were raising hogs in 1985. By 1995, that number had declined to 9,600 according to the Illinois Agricultural Statistics Service.

In Canada, environmental problems have arisen in every province where CAFOs have been established (Quebec, Alberta, Manitoba, Ontario). The problems associated with CAFOs were so serious in Quebec that a group of 18 non-governmental organizations (NGOs) operating in the environmental sector lodged a complaint with the North American Commission on Environmental Cooperation (CEC) stating "the Quebec Government has failed, for many years, to enforce certain environmental protection standards regarding agricultural pollution originating from animal production facilities, mainly from hog farms."

The CEC, established as part of an environmental side agreement to the North American Free Trade Agreement, provides citizens with a mechanism (Article 14 and 15 of the Agreement) to make submissions to the CEC if they are of the opinion that an environmental law is not being enforced. Backed by supporting documents, the Quebec NGO submission stated that, among other environmental problems, "...pig slurries can pose serious health problems, including certain forms of cancer."

On October 29, 1999, the Secretariat of the CEC determined that the complaint warranted further investigation. The CEC's interest in the environmental impacts of large-scale hog operations was indicated prior to this. The North American Fund for Environmental Cooperation (NAFEC) administered by the CEC funded a two-day public hearing in June 1999 in Brandon, Manitoba, concerning pork production and processing and their impact on the environment and human health.

Nevertheless, on 16 May 2000, the Secretariat's recommendation to develop a factual record relating to hog farms in Quebec was voted down two to one by the CEC Council, made up of Environment Ministers from the three NAFTA signatories (Canada, US, Mexico). Apparently, the political level of the CEC does not wish to deal with the issue.

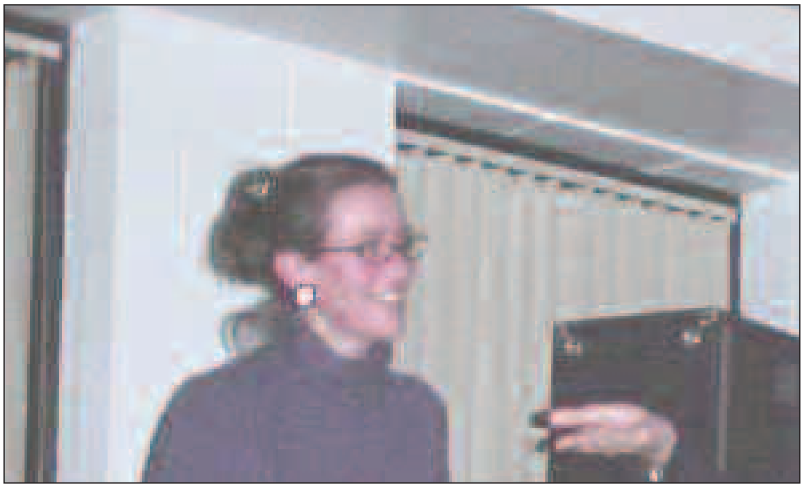
In July 2000, Manitoba launched a public hearing process into expansion of the hog industry in that province, responding to the outcry of citizens about the effects of hog CAFOs on air and water quality. Neither the New Brunswick government nor Ottawa has developed regulations to deal specifically with CAFOs and their potential impact on human and environment health.


(CCNB)
The hog factory in Sainte-Marie-de-Kent will produce 35,000 hogs and 5.5 million gallons of manure a year.

In August 1999, the NB Department of Agriculture and Rural Development (now Agriculture, Fisheries and Aquaculture, DAFA) issued a licence to Metz Farms to produce 35,000 hogs annually (from 10,000-15,000 on site at a time), the largest hog operation in Atlantic Canada. The 'concentrated animal feeding operation' or CAFO, as such large-scale operations are called, is located in Sainte-Marie-de-Kent, about 10 kilometres west of Bouctouche, 1.5 kilometres from Mill Creek, a tributary of the Bouctouche River, and about 5 kilometres from the Bouctouche River itself. The operation will generate 5.5 million gallons of liquid manure each year, to be stored in an open lagoon the size of a football field and spread on local fields.

For some time, local citizens and groups such as the Bouctouche Bay Ecotourism Project, the Southeastern Anglers Association and the Oyster Co-Op of Bouctouche, had been working with the Department of Fisheries and Aquaculture to improve the habitat and water quality of the Bouctouche River and Bay. This work had been part of the Province's effort to promote and develop eco-tourism and to protect and restore the oyster fishery in the area. Well aware of the existing problems with agricultural run-off in the area, and concerned about the additional nutrient load this CAFO would cause, local groups asked the government to withdraw its licence until a full environmental impact assessment could be done on the operation. Their request was backed by a petition signed by over 6,000 people from Sainte-Marie-de-Kent and surrounding communities.

DELG officials responded that the project was not of a sufficient size or scope to trigger a full environmental impact assessment. The DAFA maintained the new *Livestock Operations Act* would ensure the proper operation of the facility and protect the environment. There are, however, a number of key weaknesses in the *Livestock Operations Act* and the Manure Management Guidelines for New Brunswick. The *Act* only requires testing of manure for nutrient content; it does not require testing for heavy metals, antibiotics or pathogens. There are no requirements to consider proximity of manure lagoons to watercourses. The Act also does not require an assessment of the cumulative environmental impact of all sources of nutrients in an area; each livestock operation would be assessed separately, even though the addition of new and larger sources of nutrients to existing sources could overload the environment. Every natural system has a set capacity to absorb nutrients. Once this level is exceeded, the system functions improperly, or breaks down altogether.


(NB Environment Network.)

CCNB Vice-president Inka Milewski presents the Milton F. Gregg Conservation Award to the youngest members of the Association for the Preservation of the Bouctouche Watershed.

The citizens of Saint-Marie-de-Kent have not abandoned their concerns about the impact of the hog operation. As the Association for the Protection of the Bouctouche Watershed, they continue to draw attention to the inadequate monitoring program in place for large hog operations and the lack of an open and transparent process for citizen participation in the assessment and monitoring process. In November 2000, the Conservation Council of NB awarded the Association its Milton F. Gregg Conservation Award for their persistent efforts to protect this valuable ecosystem.

It is unlikely this will be the last CAFO licensed in New Brunswick. DELG's May 2000 Environmental Impact Project registry listed a much larger project by Quebec-based Acadian Pork and Pig Ltd. slated for the Acadian Peninsula. According to the registry, DOE is "awaiting additional info" from the proponent.

Chemical contaminants

Unlike the other two coastal regions of eastern New Brunswick, there are no heavy industrial installations such as smelters or pulp mills that would add significant quantities of chemical contaminants into the rivers and estuaries of the Northumberland shore. However, chemical contaminants such as DDT, PCBs (polychlorinated biphenyls) and PAHs (polycyclic aromatic hydrocarbons) have been found in sediment samples and the tissue of fish and shellfish.

For example, 1987 Environment Canada records show very high levels of PCBs - 1590 µg/kg (microgram/kilogram) - in harbour sediments at Pointe-du-Chêne, once a busy port and ferry terminal. (PCBs are one of the most persistent chemicals entering the environment and commercial, manufacturing and processing uses of PCBs were restricted in Canada in 1977). The source of these compounds could include small, local point-source discharges, land run-off, atmospheric deposition (the deposit of imported air-borne pollutants) or long range transport by ocean currents. Atmospheric transport and deposition into the oceans is a major source of a number of chemical contaminants (White and Johns, 1997).

It has been reported that PCB levels in the Northumberland Strait (12 µg/kg) and the


(RADARSAT)

Salvaged Irving Whale being transported to drydock.

Miramichi estuary are higher than background levels (0.1 µg/kg) in the Gulf of St. Lawrence (White and Johns 1997). One possible source of these PCBs is the Irving Whale, an oil barge which sank in 1970, 60 kilometers northeast of the northern tip of PEI (Gilbert and Walsh 1996). When the barge was brought to the surface on July 30, 1996, only 21 percent (1,600 kg.) of the initial volume of PCBs contained in the barge were recovered (White and Johns 1997).

Contaminant sampling is not done on a regular basis by either level of government. The principal source of information on contaminant levels in the marine environment, particularly marine sediments, is from applications made to Environment Canada for at-sea disposal of dredge spoils or from applications made to the NB DOE for on-land disposal of dredged material.

In 1986, an application was made to Environment Canada to dispose of dredged material at-sea from Sawmill Point Cove in Bouctouche Harbour. Sampling results showed that PCB levels ranged from 50.1 µg/kg to 123 µg/kg (OceanChem Group 1986). The 1986 results also noted "large concentrations of other unspecified chlorinated hydrocarbons." Historically, Sawmill Point Cove was the site of considerable wood milling and shipping activity. Currently, it is the site of a J.D. Irving Ltd bulk oil storage site. Possible sources of PCB contaminants at Sawmill Point Cove include spills of lubricants or hydraulic fluids. Had the application for ocean disposal not been withdrawn, based on the 1986 results an ocean dumping permit would not have been issued because of the PCB levels in the dredge spoils.

In 1998, the Bouctouche Bay Ecotourism Project proposed to develop a marina or boat basin at Sawmill Point Cove. The project required dredging the site. Prior to dredging, four sites in the cove were tested for PCBs and other contaminants. Four sediment sample holes were drilled, but sediment from only two holes could be retrieved for contaminant sampling. The results indicated the presence of PCB levels below 10 µg/kg, and PAHs associated with oil spills at tanker terminals, ports and harbours, at levels between less than 0.01 µg/kg and 0.25 µg/km. Some citizens in the area, familiar with the 1986 test results, raised concerns about the chemical contaminants levels in the dredged material and possible changes in sediment deposition that might arise from the construction of the barrier to protect the marina. The site was re-sampled for PCBs and PAHs and, again, levels were found to be low.

Where have the PCBs and PAHs found in earlier sampling gone? One possible explanation is the contaminants may have been taken up by fish and other marine animals. Organic and inorganic chemicals can bind to the surface of tiny solid particles. These particles can settle to the bottom where they are taken up by bottom-feeding animals; filter-feeders can feed on the particles before they settle out (White and Johns 1997). Another hypothesis is that the contaminated sediments have been re-suspended by propeller wash, dredging or storms and redistributed over a wider area. Yet another possibility is that the contaminants are still there, but the location and number of sites sampled in 1997 and 1998 were not adequate to fully evaluate the site. The sites sampled in 1997 and 1998 were not the same as the 1986 sites.

The road ahead


(Irving Eco-Centre)

Bouctouche Dune.

In the last decade, citizens, policy makers, and government agencies have recognized that ensuring the health of coastal environments requires managing both marine and land-based activities. This has led to the formation of watershed management programs and projects. In 1992, the NB Department of Fisheries and Aquaculture initiated the Sustainable Development Program funded by the NB Environmental Trust Fund. The goal of this program was to "facilitate local community, business and government interactions for the long-term mutual betterment of environmental quality, economic health and social well-being."

Along the Northumberland shore, the Bouctouche Bay watershed was one of the Sustainable Development Program sites. Using a multi-stakeholder planning process, the Bouctouche Bay Ecotourism Project engaged in a wide range of activities designed to conserve and restore the Bouctouche Bay watershed. Included in those activities were the development of the Dune Ecology Centre at the Irving Eco-Centre, the Bouctouche Boat Basin, and a multi-use trail.

The Sustainable Development Program ended in 2000. It was replaced by a program, also funded by the NB Environmental Trust Fund, which engages community groups in water classification on a watershed basis. Such projects are now underway in Shediac Bay and the Boutctouche-Cocagne area.

Community-Based Watershed Project in Shediac Bay, New Brunswick

Mount Allison University's Rural and Small Town Programme (RSTP) has spearheaded a project to conduct an environmental and cultural inventory of the Shediac Bay watershed. RSTP worked with local stakeholders and municipal, provincial, and federal governments to prepare a watershed management plan. The plan addressed the issues of water quality in both the freshwater and saltwater portions of the watershed, point and non-point sources of pollution, and intense coastal development in the form of primary residential housing and cottage development. The project was funded by the New Brunswick Environmental Trust Fund and the Department of Health and Community Services.

(David Ross)

Figure 1. Aerial view of Pointe-du-Chêne and Parlee Beach Provincial Park.

The watershed is located in southeastern New Brunswick along the Northumberland Strait and covers an area of approximately 400 km^2. At the heart of the watershed is the Town of Shediac with a population of approximately 5,000. Outside the municipality there are a number of rural communities with a variety of population sizes. Land use in the rural areas has become primarily linear strip housing mixed with agricultural and forestry uses. Along the 40 km coast there are also numerous clusters of single family primary residences and cottages. The communities of Cap Brûlé and Cap Bimet are good examples of cottage cluster communities. Figure 1 is an example of intense cottage and residential land uses along the coast in the community of Pointe- du-Chêne.

Some of the clusters were established in the early 19th century with few, if any, planning regulations to direct or control development and on-site septic services. Such development has led to land use and environmental issues for the community today. There are more than 200 point and non-point sources of pollution within the watershed. Many of these are related to land use activities such as fish processing, farming, and cottage and single family dwelling development along the edges of the bay and rivers. Other detrimental activities include dumping of waste by boaters in the bay, in-filling of salt marshes for residential development, and the destruction of valuable sand dunes. Figure 2 shows that coastal wetlands have been in-filled to provide land for residential development. Figure 3 shows a salt marsh in Pointe-du-Chêne that has received fill in preparation for future development.

(Paul Jordan)

Figure 2. Coastal wetlands are being infilled to make room for residential and recreational land use.

An issue facing the residents of the Shediac Bay watershed is maintaining water quality in the bay to meet the provincial standards for recreational water quality. The Shediac area is home to Parlee Beach Provincial Park which has great economic importance to both the local and regional economies. Thousands of visitors flock to the warm waters of Parlee Beach every summer. Addressing point and non-point sources of pollution today will ensure that water quality in Shediac Bay remains at a level that meets the standards for recreational water quality.

(Paul Jordan)

Figure 3. Valuable waterfowl habitat is destroyed from human land use.

In response to the community's need to address environmental issues, the RSTP has used Geographic Information Systems (GIS) to map the environmental and cultural assets of the drainage basin. Information has been mapped on such features as geology, forestry, point and non-point sources of pollution, water sample points, water courses, salt marshes, bogs, and various man-made land uses (residential, commercial, institutional, transportation and industrial). Data bases and photos are linked to maps to provide more detailed information.

Dr. Jeff Ollerhead of Mount Allison University's Geography Department, with the help of several senior students, has used GIS and Global Positioning System (GPS) to prepare a map that shows the amount of coastal erosion which took place between 1963 and 1996. Dr. Ollerhead also used GIS to prepare a map to show areas prone to flooding. In the winter of 2000, Dr. Ollerhead's flood predictions came true when a severe winter storm hit the coast and resulted in extensive flooding and property damage.

In the fall of 1999 the RSTP hired a number of consultants to collect more detailed information about the watershed. Henderson Consulting Ltd conducted a study on the factors which influence water quality in Shediac Bay. The Southeastern Anglers Association examined point and non-point sources of pollution on the Shediac and Scoudouc Rivers. Crandall Engineering Ltd prepared a preliminary design and cost estimate of extending the existing Greater Shediac Sewage Commission's sewage system along the coastline of the watershed. All of this information has led to increased knowledge about the watershed, how it works, and where the problems are.

RSTP helped to facilitate the establishment of the Shediac Bay Watershed Association, a community-based group working to solve water quality problems locally. The Association members are working together to help educate the residents of the area about watershed planning, causes and effects of point and non-point sources of pollution, and water quality issues. The Shediac Bay Watershed Association is receiving support and assistance from various federal, provincial, and local governments in their attempts to address and improve water quality.

RSTP worked with the community to help define some achievable goals for the watershed to address some of the most pressing issues. This has led to the development of a recommended watershed management plan with a time frame of five years. The goals and objectives are community-based with the primary focus on maintaining and improving water quality for recreational swimming. The community identified a number of secondary goals including protection of existing archeological sites, maintaining sensitive coastal salt marshes, and improving the community's awareness and understanding of environmental issues and assets. A key component of the management plan is an education program directed at increasing residents' awareness of watershed planning, environmental stewardship, local pollution issues, and local solutions. The management plan was presented to the Shediac Bay Watershed Association as a possible course for future actions by the association.

RSTP's role in the project was to provide project management, facilitate the development of a community-based watershed association (Shediac Bay Watershed Association), and help the community with collecting and analysing information to chart a future direction which is community-based and community-driven. RSTP assisted with building the community's capacity to solve environmental and development issues locally.

New life for a river: Université de Moncton project looks at ways to rejuvenate the Richibucto River

by Catherine Vardy, Moncton Times and Transcript (Feb. 02, 2000)

Decades ago, the Richibucto estuary used to provide habitat for lobster, salmon, trout, gaspereau, striped bass and eels.

Covering an area of about 1,300 square kilometres, the Richibucto River begins near Harcourt, about 40 kilometres north of Moncton, and stretches east through Kent County, eventually emptying into the Northumberland Strait at Richibucto Harbour. It is a mud-bottomed river with several tributaries. Communities along the river include Big Cove, Rexton, Indian Island and Petite and Grande Aldouane. But by 1995, water quality had deteriorated because of sewage and pollution from various sources such as agricultural runoff. Parts of the Richibucto River were closed to shellfish harvesting due to high levels of coliform bacteria. And residents were concerned their region was being ignored.

This is when Dr. Andrew Boghen, a biology professor at the Université de Moncton, appeared on the scene. With various colleagues, he put together the Richibucto Environment and Resource Enhancement Project (REREP). Backed by the Environmental Sciences Research Centre (ESRC) at the Université de Moncton, REREP's goal was to identify the factors that were causing the deterioration of the estuary, and offer potential solutions.

Boghen says the Richibucto has historically been neglected, compared to other river systems. One reason is that the region doesn't have a lucrative sport fishery, or as much industry as rivers such as the Miramichi. Another reason is the conflict between French, English and First Nations peoples.

"A divided community is easier to ignore," says Boghen. Because of this friction, he says, it continues to be easy for scientists and administrators to refuse to get involved in research and development, for fear of complications. But this attitude hasn't scared him and his colleagues away.

In 1996, Boghen and the other two directors of REREP, Dr. Simon Courtenay from DFO and Dr. André St.-Hilaire from the ESRC, held a series of public meetings to listen to residents' concerns. People came from Richibucto, Rexton, Big Cove and Indian Island. During these meetings, Boghen explained that REREP was willing to work with the communities to explore some of the environmental problems facing the region, and to the extent possible, offer suggestions for change. The scientists also had ideas for studies that could lead to improved fisheries or aquaculture harvesting. But they were clear about their conditions: people had to make an effort to live with their differences.

Boghen emphasized that it would not be possible for REREP to become involved if "people were going to be at each other's throats. If the communities didn't make an effort to work together, everybody would lose and the water system would deteriorate further. That was the philosophy we tried to promote."

Many projects were started. For example, Courtenay looked at the biology of striped bass in the Richibucto. In the past, there was a recreational fishery for striped bass in the river, and several communities wanted to see if it could be re-established. To figure this out, Courtenay needed to find out if striped bass spawned in the river, if they spent the winter there, and how many survived.

His research suggests that striped bass are not spawning in the Richibucto River, but probably migrate down the coast from the Miramichi River and into the Richibucto by mid-August each summer. Based on these results, Courtenay says the Richibucto estuary will have difficulty supporting a recreational striped bass fishery.

However, he found that white perch, a cousin of striped bass, are very abundant in the Richibucto. White perch don't migrate like striped bass, are tasty to eat and are considered to be a popular recreational fish for people using ultra-light gear according to a recently-published article in Eastern Woods and Waters. Courtenay is now optimistic that a white perch recreational fishery could be developed instead.

Another study looked at the possibility of using areas adjacent to Big Cove as a shellfish aquaculture site. Oysters occur there naturally, and Ph.D. student Erick Bataller reared 1,700 oysters in two different locations to see how well they would grow. One site had a high salinity (which oysters prefer) while the other, upstream near Big Cove, had a lower salinity.

Bataller also tested two different methods for growing oysters. By using buoys, four mesh platforms covered with oysters were kept suspended in the water column, about 40 cm below the surface. Four other platforms were anchored so they would rest on the bottom. Oysters were left suspended and resting on the bottom at the high- and low-salinity sites, from May until October.

When he pulled up the oysters and measured them in the fall, Bataller found that the largest oysters came from the suspended platform which had been in high-salinity water. However, the oysters that had been suspended in the low-salinity water also grew. They grew as much as those which had been on the bottom in the high- salinity water. Based on his results, Bataller concluded that it might be possible to use the low-salinity areas for growing oysters, depending on the method used.

Boghen adds that aquaculturists may not usually consider low- salinity sites as suitable, but they could ultimately be profitable. He says the next step is to test the economic viability of using these low-salinity areas.

St.-Hilaire, for his part, has been studying the physical characteristics of the water in the region. His work is relevant to all the researchers, because his findings allow them to better understand water currents, the movement of salt water wedges, fluctuating water depths and the relationship between water conditions and the presence of algae and phytoplankton (a microscopic food source for fish and shellfish). His findings also help explain the movement and distribution of fish species in the Richibucto.

"Everything is inter-connected," says Boghen. "It's difficult to assess the potential for aquaculture if you don't have people who are working on related sciences such as oceanography or shellfish ecology to complete the picture."

Indian Island, at the mouth of the estuary also offers potential for several projects. Beaches off the southern dunes are being tested to see if they can support species such as surf clams. But one of the limiting factors is the presence and varying thickness of ice in winter. Sometimes the ice goes right down to the bottom.

One study looked at the impact this ice has on potential sites for the aquaculture of surf clams. By comparing two cages installed in a "sheltered" site and two cages in an "exposed" site near the Southern Richibucto Dune, the researchers wanted to find out how the ice would affect the cages, and if the bar clams would survive during winter conditions. However, the ice wasn't thick enough to affect either of the cages that year, and the clams in the exposed cages died because of heavy silt which was carried by the current in early spring.

Boghen is quick to point out that preliminary studies like these often pose challenges, and more work needs to be done before they can draw any conclusions about the long-term suitability of raising bar clams in the region.


(Big Cove First Nation)

Big Cove First Nation.

Another possible project in collaboration with Big Cove is the development of a children's educational camp, related to the aquatic environment. Children from the three communities would be exposed to fishing and aquaculture techniques, and would have an opportunity to spend time with elders in the different communities. This would allow them to understand the role of aquaculture and fisheries for different cultures. Boghen says this approach could yield promising results.

"I think if you're going to bring about any kind of change you have to start with the young," he says. "We've observed this first-hand when students from the Université de Moncton worked alongside youth from Big Cove and Indian Island. It didn't take long for them to realize they had a lot in common, and they quickly learned to respect each other's culture."

The logo for REREP shows a fish, an oyster, a river, the sun and some trees. It also illustrates three figures holding hands surrounded by the words "Maoilogotimg, Travaillant ensemble, Working together." Representing the Native, Acadian and English communities involved, this logo symbolizes the cooperation needed to make the project a success.

"Many people will tell you that merging natural and social sciences shouldn't be my major concern," says Boghen. "My mandate is science, but I feel we have an obligation to go beyond that. Scientists are asked to be more visible. We have for a long time been asked to move down from our ivory towers, and I think more of us are making an effort to do just that.

"We are producing enough graduates and scientific papers to fulfill the technical side, now it's time to get on with the job of trying to improve people's lives if we can."

VII. Conclusion

Over the past one hundred years, more than the sands have shifted on the eastern coast of New Brunswick. The ecology and the economy of the region have shifted as well. It is tempting to think of these shifts as natural - the result of changes in technology or climate, increases in the scales of economies, changes in market demand, periodic fluctuations in wild populations, or the rise of globalization. Perhaps this is true for some industries or ecosystems. However, there is nothing natural about the incremental and systematic destruction of wild fish stocks and coastal habitat.

Despite constant warnings - some dating back 150 years - about the impacts of overfishing, using coastal waters as sewers and dump sites and altering coastal habitat, this report reveals those warnings have gone, and continue to go, unheeded. The results of ignoring those warnings have been the virtual elimination of many fish species from the commercial fishery, an increase in the number of areas closed to swimming and shellfish harvesting and an acceleration in the erosion and instability of the shoreline.

In 1993, the provincial government was presented with an opportunity to act quickly and decisively on recommendations made by the Commission on Land Use and the Rural Environment (CLURE). The Coastal Land Use Policy, which would establish development setbacks from coastal features among other protection measures, went out for public comment three years ago and hasn't been seen since, a victim of intense lobbying against it by coastal developers and landowners. A wetlands policy that would see salt marshes and eelgrass beds protected is stalled. A policy to manage human activities in coastal waters is even further back in the queue.

Since 1993, there has been an intensive scramble to develop as much of the province's coastline as possible before these coastal zone policies are implemented. Salt marshes have been filled in for cottage and business development. Ecologically sensitive areas are being proposed for conversion to golf courses. Channel mouths, gullies and bays have been dredged to make way for boat harbours and marine service centres. While most of these projects must be registered for screening under the provincial Environmental Impact Assessment regulation, many criticize the process as inadequate. In some cases, the assessments created more problems than they solved and resulted in further losses in coastal resources.

In June 2000, the Federal/Provincial/Territorial Advisory Committee on Canada's National Programme of Action (NPA) for the Protection of the Marine Environment from Land-based Activities released a report that identified national and regional priorities for action. The report is Canada's response to a commitment it and 108 other nations made in 1995 to protect the marine environment from land-based activities. Priorities for action were based on severity of risk and adequacy of control measures.

VII. Conclusion

Not surprising, the land-based activities that are ranked as high priority areas for action in Canada match the priorities for action identified in the 1975 report on Beach Resources of Eastern New Brunswick, the 1993 CLURE report and this publication. These include sewage discharges, shoreline construction/alteration and wetland and saltmarsh alteration. In addition, the NPA report identified litter reduction as a high priority, the reduction of heavy metals as a medium to high priority, and the reduction of persistent organic pollutants (POPs), oil/hydrocarbons, nutrients, and contaminated sediments as medium priorities.

The time for more studies and research is over. Clear priorities for action have been identified at national and provincial levels. As this publication illustrates, citizens and community-based organizations have been doing their part. They have been actively engaged in identifying, monitoring and addressing local coastal issues. All too often, however, they find themselves powerless to act when the legislation regulating certain activities is inadequate or not enforced, or when there is no legislation protecting certain habitats.

It is now time for the provincial and federal governments to step up to the plate with strong measures to reverse the decline in coastal ecosystems. They need to enforce existing policies and laws, and they need to develop and implement new policies and legislation to fill the regulatory gaps.

An epidemic of development continues to sweep over our coastal areas and it is threatening economic and ecological foundations. How much more stress can our coastal resources sustain? This is impossible to predict, but the symptoms tell us the patient is critically ill. There are no artificial life-support systems for this patient. There are no technological substitutes for the functions performed by salt marshes, eelgrass beds, dunes, tidal estuaries, oyster reefs, barrier beaches and islands. Only swift and immediate action will put this patient on the road to recovery.

Appendix I

"Portage Island", in Report on the Sea and River Fisheries of New Brunswick within the Gulf of St. Lawrence and Bay of Chaleur, Moses Perley, February 1850.

On the northern side of Miramichi Bay, at the entrance of the Miramichi River, is Portage Island, which on some of the older maps is called Waltham Island. It is about four miles and a half in length, and nearly a mile in width at its southwestern end, tapering gradually to its northeastern extremity, where it terminates in a long narrow sand-bar.

The island is yet ungranted. It is low and sandy, much cut up with marshes, swamps and small lakes; a portion of it only is wooded, with dwarf white birch, and scrubby pine and spruce trees.

Near the northeastern end of Portage Island, some buildings were erected about five years ago, with the necessary conveniences for putting up salmon and lobsters, in tin cases hermetically sealed. This station was occupied during the season of 1849, by Mr. William J. Fraser, of Chatham, who then for the first time set up "fish flakes," and undertook to dry and cure cod, and other fish, caught near this locality. (From 1643 to 1647, Jean Jacques Enaud, a native of the Basque Provinces of France, had an establishment on this Island for taking the morse or walrus, and for prosecuting the fur trade and fisheries). When this establishment was visited in August last, it was in charge of George Letson, who furnished the following information in relation to it.

The season for putting up salmon and lobsters was over. There had been twenty two thousand pounds of salmon, and four thousand pounds of lobsters, put up in tin cases, of one pound and two pounds each. The quantity of lobsters put up was much less than usual, owing to the prevalence of cholera in the United States, and the consequent want of a market there.

The salmon put up here were all taken around the Island, and were purchased of the fishermen by this establishment, at 3d. per pound, fresh caught, with a discount of ten per cent for cleaning, which was said to be equal to £3 5s. per barrel. The lobsters were chiefly caught by the French inhabitants of the neighbouring Neguac Villages, from whom they were purchased at 2s. 4d. currency, per hundred. They were very plentiful the past season, especially at Black Lands and Tabusintac Gully; and as proof of the ease with which they were taken, it was mentioned that one Frenchman (Victor Savoy) had, unassisted, caught 1200 lobsters in part of one day. There were from twenty to twenty five men employed at the preserving establishment during the season.

Up to the 18th August, there had been seven hundred quintals of cod, ling, and haddock, caught and cured at this "room," to which a considerable addition was anticipated before the close of the season. There were then thirty three boats engaged in fishing at this station, averaging three men to each boat; these were chiefly settlers from the neighbouring shores, who employed the period between seed time and harvest, in following the fisheries. One boat was owned and manned by three Micmac

Indians, from Burnt Church Point, and it was stated, that although their boat was an old one, worse rigged and provided than most of the others, yet these Indians would remain on the fishing ground in more severe weather than any other of the fishers, and never returned without a full load of fish.

In the early part of the season, the fishing boats here obtained their fares at no great distance from Portage Island; but as the season advanced, they had to go out, from ten to fifteen miles from land. In August, they were fishing near Point Escuminac, about twelve miles from Portage Island. These fishermen split and salted their fish in the boats, which usually came into the "room" about twice a week; they were using mackerel and clams as bait, but previously had used herrings. No capelin had come in on this part of the coast.

It was stated that early in July there were from twenty to thirty sail of American vessels fishing in Miramichi Bay, at the distance of five to ten miles from Portage Island; and that they all obtained full fares of No. 3 mackerel. One of these schooners entered the Miramichi River, and went up as far as Oak Point trading with the settlers for salmon. The master of this vessel exchanged two barrels of superfine flour for each barrel of salmon, but he neither entered, nor paid duties on what he landed. He took the dimensions of various nets in use, and told the fishermen he would furnish them next year with similar nets, at half the prices they had been accustomed to pay. These American fishing vessels have, during the last three years, traded at Fox Island, on the south side of Miramichi Bay.

On the bar, at the southwest point of Portage Island, was found a hovel occupied by a man and boy; they had been there a fortnight, with nets and lines, but had only caught a barrel and a half of mackerel. These were all mackerel which had been caught at this station during the season, by the New Brunswick fishermen, except such as had been used for bait. This man and boy had taken some fine fall herring, and a small quantity of gaspereaux, exceedingly fat – so fat that they were boiling the offal in a kettle to extract the oil, which appeared abundant. It was stated here that numerous shoals of large basse were then roving about Fox Island and along the coast, and that they could be, and were, readily taken, even in the day time, by a proper basse spear.

A quantity of coarse bent grass grows on the marshes and beaches of Portage Island; and certain French residents of the Neguac villages, under an old Minute of Council, claim a permissive right to cut and carry away this grass, paying the sum of £5 annually to the Crown.

Presuming upon the permission to cut grass, these parties have of late years, set up a claim to the fisheries of the Island, and during the past season, they actually leased the salmon fishing on its shores to various parties, at rents from £2 10s. upwards. Six of the persons to whom they leased are persons residing at or near Burnt Church, named Peter Morrison, George Logie, John Davidson, George Davidson, John Anderson, and Alexander Logie. These parties, during the past season, furnished the salmon for Mr. Fraser's preserving establishment. But the most extraordinary part of this affair is the fact that the *Act* regulating the fisheries in the County of Northumberland, (29th Geo. 3, c.5,) positively prohibits any net whatever being set off Waltham or Portage Island; and this salmon fishery has been carried on here in open defiance of the law, and as is alleged, much to the detriment of the salmon fishery of the Miramichi River generally....

References

Airphoto Analysis Associates. 1975. Beach Resources: Eastern New Brunswick. Toronto. 205 pp.

Baker, D.J. and R.A. Matheson, 1981. Dioxins in the vicinity of two Atlantic Region wood preserving operation. Environment Canada, Environmental Protection Service (Atlantic Region). EPS-5-Ar-81-2. 69 p.

Beaulieu, H. 1985. Rapport sur la situation du bar rayé (Morone saxatilis). Faune et flore à protéger au Québec. Association des biologistes du Québec, Publication No. 7. 53p.

Brown, S.B., K. Haya, L. Burridge, E.O. Swansburg, J.T. Arsenault, J.G. Eales, J. Sherry, D. Bennie, and W.L. Fairchild. 1998. Effects of water-bourne 4-nonylphenol on Atlantic salmon (Salmo salar) Smolts. Poster presentation at 25th Annual Aquatic Toxicity Workshop, Quebec City, Quebec. October 1998 and Poster presentation at SETAC 19th Annual Meeting, Charlotte, North Carolina. November 1998.

Buckley, D.E. 1995. Sediments and environmental quality of the Miramichi Estuary: New Perspective, p. 179-190. In E.M.P. Chadwick [editor]. Water, Science, and the Public: The Miramichi Ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123.

Buckley, D.E. and G.V. Winters. 1992. Geochemical characteristics of contaminated surficial sediments in Halifax Harbour: impact of waste discharge. Can. J. Earth Sci. 29:2617-2639.

Carson, R. 1962. Silent Spring. Houghton Mifflin, Boston, USA. 368 p.

Chadwick, E.M.P., editor. 1995. Water, Science, and the Public: The Miramichi Ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123. 300p.

Chaput, G., D. Moore, J. Hayward, C. Ginnish, B. Dube. 1997. Stock status of Atlantic salmon (Salmo salar) in the Miramichi River, 1997. Canadian Stock Assessment Secretariat Research Document 98/34. Fisheries and Oceans Canada, Ottawa. 86 p.

Chaput, G. J. 1995. Temporal distribution, spatial distribution and abundance of diadromous fish in the Miramichi River watershed. p 121-140. In E.M.P. Chadwick [editor]. Water, Science, and the Public: The Miramichi Ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123.

Chiasson, A.G. 1995. The Miramichi Bay and Estuary: An overview. p. 11-27. In E.M.P. Chadwick [editor]. Water, Science, and the Public: The Miramichi Ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123.

Colborn, T. D. Dumanoski and J. Peterson Myers.1996. Our Stolen Future: Are we threatening our fertility, intelligence, and survival? A scientific detective story. Dutton. New York. 306 pp.

Couturier, C., P. Dabinett, and M. Lanteigne. 1995. Scallop Culture in Atlantic Canada. pp 299-340. In A.D. Boghen (ed.) Cold-Water Aquaculture in Atlantic Canada. Second Edition. Canadian Institute for Research and Regional Development. Moncton, New Brunswick.

Dame, R., R. Zingmark, H. Stevenson, and D. Nelson. 1989. Filter feeder coupling between the water column and benthic subsystem, p. 520-526. In V.S. Kennedy (ed.) Estuarine perspective. Academic Press. New York.

References

Dame, R., and S. Libes. 1993. Oyster reefs and nutrient retention in tidal creeks. J. Exp. Mar. Bio. Ecol. 171:251-258.

Department of Fisheries and Oceans (DFO). 2000. Atlantic Salmon Maritime Provinces Overview for 1999. DFO Science. Stock Status Report D3-14(2000).

Department of Natural Resources and Energy (DNRE). 1999. Personal communications and information provided to Inka Milewski.

Eaton, P.B. , A.G. Gray, P.W. Johnson and E. Hundert (1994). State of the Environment in the Atlantic Region. Minister of Supply and Services (Ottawa). 457 p.

Enforce land-use bylaws, says insurance official. Telegraph Journal. January 15, 2000.

Environment Canada. 2000. Regulated effluent discharge report for mills in the Atlantic Region, 1999. Unpublished.

Environment Canada. 1999. Dredge permit results including dates, location, volumes of material, and sediment analysis for sites in eastern New Brunswick from 1984-1997. Obtained by Conservation Council of New Brunswick from Environment Canada, Dartmouth, Halifax.

Environment Canada. 1996. Conserving Canada's Natural Legacy: The State of Canada's Environment 1996. Ottawa.

Environment Canada. 1973. Letter from R.C.H. Wilson, Head, Biological Investigations, Surveillance and Analysis Division, EPS, Atlantic Region to Dr. R.N. Cook, Chief, Surveillance and Analysis Division, EPS, Atlantic Region. October 17, 1973. Subject: Toxicity Situation Still Poor at Domtar, Newcastle.

Environment Policy & Law. 1991. Northumberland Strait bridge: expert ice panel revives P.E.I. fixed link proposal. Environment Policy & Law. 2(2): 220.

Ernst, W.R., P.A. Pearce and T.L. Pollock, editors.1989. Environmental effects of fenitrothion use in forestry. Environment Canada. 166 p.

Fairchild, L.F, E.O. Swansburg, J.T. Arsenault, and S.B. Brown. 1999. Does an association between pesticide use and subsequent declines in catch of Atlantic Salmon (Salmo salar) represent a case of endocrine disruption? Environmental Health Perspectives 107(5): 349-358.

Federal Environmental Assessment Review Office. 1990. The Northumberland Strait Crossing Project. Report of the Environmental Assessment Panel. August

Fish waste runs unchecked into sea. Telegraph Journal. June 28, 1999.

Fisher, B.E. 1999. Most Unwanted: Persistent Organic Pollutants. Environmental Health Perspectives. 107(1): A18-A23.

Fisheries Resource Conservation Council (FRCC). 1995. A Conservation Framework for Atlantic Lobster. Report to the Minister of Fisheries and Oceans. FRCC 95.R.1. Minister of Supply and Services, Ottawa.

Fishermen pin hopes on scallop farming. Telegraph Journal, March 11,1999.

Foley, J. 1999. Tabusintac Lagoon Private Stewardship Project Final Report. Dept. of Natural Resources and Energy, Fredericton, NB.

Fréchette, M., C. A. Butman, and W. Rockwell Geyer. 1989. The importance of boundary-layer flows in supplying phytoplankton to the suspension feeder, Mytilus edulis L. Limnol. Oceanogr. 34: 19-36.

Ganong, W.F. 1906. On the physical geography of Miscou. Bulletin of the Natural History Society of New Brunswick. Bulletin V, no. XXIV.

Gearing, J.N., P.J. Gearing, M. Noël, and J. N. Smith. 1994. Polycyclic aromatic hydrocarbons in sediment of the St. Lawrence Estuary. In. R. Coillie, Y. Roy, Y. Bois, P.G.C. Campbell, P. Lundahl, L. Martel, M. Michaud, P. Riebel and C. Thellan (eds.) Proceedings of the Twentieth Annual Aquatic Toxicity Workshop. October 17-21, 1993. Québec City, Québec. Canadian Technical Paper of Fisheries and Aquatic Sciences No. 1989. pp 58-64.

Gilbert, M and G. Walsh (eds) (1996). Potential consequences of a PCB spill from the barge Irving Whale on the Marine Environment of the Gulf of St. Lawrence. Can. Tech. Rep. Fish. Aquat. Sci. 2113: xiii + 59p.

Golder Associates. 1988. Report to Domtar Chemicals Group: Remedial Alternative for Consideration, Domtar Wood Preserving Plant, Newcastle, New Brunswick. March 1988. Golder Associates. Mississauga, Ontario. 42 p.

Hanson, J.M. and S.C. Courtenay. 1995. Seasonal abundance and distribuiton of fishes int he Miramichi Estuary. p. 141-160. In E.M.P. Chadwick [editor]. Water, Science, and the Public: The Miramichi Ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123.

Hildebrand, L.P. 1984 An Assessment of Environmental Quality in the Baie des Chaleurs. Environmental Protection Service, Atlantic Region, Environment Canada.

Hoos, R. 1970. Domtar toxicity report Newcastle, New Brunswick. Canada Fisheries Service (Maritimes Region). Resource Development Branch. Manuscript report 70-7.

Jessop, B.M. 1990. The status of striped bass in Scotia-Fundy region. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 90/36: 22p.

Kalff, S. A. (1998). Cumulative Effects Assessment Study: Kouchibouguac National Park, New Brunswick. Parks Canada Technical Reports in Ecosystem Science, No. 009. 89 p.

Kenworthy, W.J., J.C. Zeiman, and G.W. Thayer. 1982. Evidence for the influence of seagrasses on the benthic nitrogen cycle in a coastal plain estuary near Beaufort, North Carolina (USA). Oecologia 54: 152-158.

Lafleur, C. , B. Pettigrew, A. St- Hillaire, D.A. Booth and E.M.P. Chadwick. 1995 . Seasonal and short-tem variations in the estuarine structure of the Miramichi. p. 45-71. In E.M.P. Chadwick [editor]. Water, Science, and the Public: The Miramichi Ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123.

Landry, T., A. Boghen and D. Booth. 1997 Impact of sand dune instability on oyster habitat and productivity. J. Shellfish Res. 16(1): 269

References

Lavoie, R.E. 1995. Culture of American Oyster, Crassostrea virginica. pp 189-224. In A.D. Boghen (ed.) Cold-Water Aquaculture in Atlantic Canada. Second Edition. Canadian Institute for Research and Regional Development. Moncton, New Brunswick.

LeBlanc, C.H. and G.J. Chaput (1991) Landings of Estuarine Fishes in the Gulf of St. Lawrence 1917-1988. Canadian Data Report of Fisheries and Aquatic Sciences. 842: 101 p.

Lindsay, G. 1999. Personal Communications from G. Lindsay from Environment Canada to J. Harvey.

Mann, K.H. (1973). Seaweeds: their productivity and strategy for growth. Science 182:975.

Matheson, R.A.F. and V.I. Bradshaw. 1985. The Status of Selected Environmental Contaminants in the Baie des Chaleurs Ecosystem, Environmental Protection Service, Environment Canada.

Menon, A. 1999. Environment Canada: Atlantic Shellfish Classification Inventory.

Miramichi River Environmental Assessment Committee (MERAC). 1992. Summary - Final Report 1989-1992. Miramichi, New Brunswick. 157 p.

Mowat, J. 1888. Chaleur Bay and its Products for 1887-8, with net and rod. Printed at the Miramichi Advance Office, Chatham, New Brunswick. 14 p.

Nichols, F. H. 1985. Increased benthic grazing: an alternative explanation for low phytoplankton biomass in north San Francisco Bay during the 1976-1977 drought. Est. Coast. Shelf. Sci. 21: 379-388.

Nonylphenol Ethoxylates: The New DDT. 1999. Eco Alert. Conservation Council of New Brunswick. 30:1.

OceanChem Group. (1986). Letter from OceanChem Group (Dartmouth, Nova Scotia) to Jacques, Whitford & Associates May 29, 1986 regarding analyses of four sediment samples from Bouctouche Harbour (Sawmill Point Cove). Letter and enclosed results obtained from Environment Canada.

Officer, C. B., T.J. Smayda, and R. Mann. 1982. Benthic filter feeding: a natural eutrophication control. Mar. Eco. Prog. Ser. 9: 203-210.

Ollerhead, J. (1998). Quantifying Nearshore Geomorphology at Cape Jourimain, New Brunswick: Progress Report 4. Prepared for Strait Crossing Development Inc. Strait Crossing 1999.

Ollerhead, J and R.G.D. Davidson-Arnott (1995). The evolution of Buctouche Spit, New Brunswick, Canada. Marine Geology 124: 215-236.

Ollerhead, J and R.G.D. Davidson-Arnott (1995). Canadian Landform Examples - 30: Buctouche Spit, New Brunswick, Canada. The Canadian Geographer, 39(3) 274-82.

Ouellette, C., A.D. Boghen, S.C. Courtenay and A. St-Hillarie. 1997. Potential environmental impact of peat moss harvesting on the Richibucto River in New Brunswick. Bulletin of the Auqaculture Association of Canada. 2: 81-83.

Perley, M. H. 1852. Reports on the Sea and River Fisheries of New Brunswick. Queen's Printer, Fredericton. 294 p.

Perley, M.H. 1849. Fisheries of the Gulf of Saint Lawrence. Queen's Printer. Fredericton.

Polluted brook perplexes cottager. Moncton Times & Transcript. September 11, 1999.

Pilgrim, W. 1991. Monitoring Heavy Metals Near Belledune Lead Smelter 1980-1991. Air Quality Section, NB Department of the Environment. Report No. ENB-AQ0001-91.

Provost, J., L. Verret, and P. Dumont. 1984. L'alose savoureuse au Québec: synthèse des connaissances biologiques et perspectives d'aménagement d'habitats. Rapp. manuscr. can. halieut. aquat. 1793: xi + 114p.

Ray, G.C., B.P. Hayden, M.G. McCormick-Ray, and T.M. Smith. 1997. Land-seascape diveristy of the USA East Coast coastal zone with particular reference to estuaries. pp 337-371. In R.F.G. Ormond, J.D. Cage, and M.V. Angel (eds.) Marine Biodiversity: Patterns and Processes. Cambridge University Press, UK. 449 p.

Reinson, G.E. 1977. Surficial sediment distribution in the Miramichi Estuary, New Brunswick, p. 41-44. In Geol. Survey Can. Report of Activities, Part C, Pap. 76-1C.

Richard, B., R. Robichaud and R. Gaudet .1999. Re-evaluation Report: New Brunswick Shellfish Growing Area 6-02-002 Bouctouche River & Harbour. Environment Canada, Environmental Protection Branch. Manuscript Report No. EP-AR-99-11.

Scallop fishermen blame bridge for collapse of catch in gulf. Telegraph Journal May 21, 1999.

Sierra Legal Defense Fund. 1994. National Sewage Report Card: Rating the treatment methods and discharges of 20 Canadian cities. Sierra Legal Defense Fund, Vancouver, B.C. 51 p.

Singmaster and Breyer. 1961. Mine and Smelter: Combined Investment. Proposed zinc-lead smelting plant in the Bathurst area of New Brunswick. Report prepared for Hon. Louis J. Robichaud. Premier, New Brunswick.

St-Hilaire, A. D, Booth, C. Bettignies, E.M.P. Chadwick, and S.C. Courtenay. 1995. Is the Miramichi a stratified estuary? p. 73-82. In E.M.P. Chadwick [editor]. Water, Science, and the Public: The Miramichi Ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123.

Strait Crossing (1997a). Northumberland Straits Bridge Project Marine Environmental Effects Monitoring Program 1996. Prepared for Northumberland Strait Marine Environmental Effects Monitoring Advisory Committee.

Strait Crossing (1998b). Northumberland Straits Bridge Project Marine Environmental Effects Monitoring Program 1996. Prepared for Northumberland Strait Marine Environmental Effects Monitoring Advisory Committee.

Strait Crossing (1999). Northumberland Straits Bridge Project Marine Environmental Effects Monitoring Program 1996. Prepared for Northumberland Strait Marine Environmental Effects Monitoring Advisory Committee.

Study suggest link between past chemical use and declines in wild salmon populations. DFO Press Release. January 7, 1999.

References

Taylor, J.D. (1997). Diversity and structure of tropical Indo-Pacific benthic communities: relation to regimes of nutrient input. pp. 178-200. in Ormond et al., eds., Marine biodiversity: patterns and processes. University Press, Cambridge (UK). 449 pp.

Valiela, I., J. M. Teal, S. Volkman, D. Shafer and E.J. Carpenter. 1978. Nutrient and particulate fluxes in a salt marsh ecosystem: tidal exchanges and inputs by precipitation and ground water. Limnol. Oceanogr. 23: 798-812.

Wells, P.G., R.A. Matheson, and D.A. Lord. 1978. Monitoring of the 1978 New Brunswick spray program, field sampling and aquatic toxicity studies. For. Pest. Con. Forum., Can. For. Serv., Ottawa, 12 p.

White, L. and F. Johns. 1997. Marine Environmental Assessment of the estuary and Gulf of St. Lawrence. Fisheries and Oceans Canada, Dartmouth Nova Scotia and Mont-Joli, Québec. 129 pp.

Wildish, D. and D. Kristmanson. 1997. Benthic Suspension Feeders and Flow. Cambridge University Press. New York. 409 pp.

Wright, E.C. 1994. The Miramichi: A study of the New Brunswick river and of the people who settled along it. Tribune Press. Sackville, New Brunswick.

Wildish, D.J. W.G. Carson, T. Cunningham, and N. J. Lister. 1971. Toxicological effects of some organophosphate insecticides to Atlantic salmon. Fish. Res. Board Can. MS Rep. 1157. 22 p.

Zitko, V. and W.G. Carson. 1969. Analysis of the effluent from the Domtar wood preserving plant at Newcastle. N.B. Fish. Res. Board Manuscr. Rep. 1024. 14 p, 5 figs.

Zitko, V. and T.D. Cunningham. 1975. Fish toxicity of s-methyl fenitrothion. Bull. Environ. Contam. Toxicol. 14:19-24.

Zitko, V. 1995. Fifty years of research on the Miramichi River, p. 29-41. In E.M.P. Chadwick [editor]. Water, Science, and the Public: The Miramichi Ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. 123.

About the Conservation Council's Marine Conservation Program

CCNB was established in 1969 as a non-profit membership organization with a mandate to protect and restore the bioregions that encompass our province. CCNB acts on this mandate through public education, policy research and development, and special programming. CCNB is a registered charity in Canada and is governed by a 24-member board of volunteer directors from all parts of New Brunswick and all walks of life. All directors are active volunteers, serving as spokespeople on issues where they have knowledge, and organizing conservation efforts in their communities. In 1990, CCNB was added to the United Nations Environment Programme's Global 500 Roll of Honour. In 1992-93, CCNB received the Gulf of Maine Council Visionary Award, and in 1999, the Orca Award from the New Brunswick Environment Network, for work on marine issues.

CCNB's Marine Conservation Program evolved out of a three-year Bay of Fundy Project (1990-1992), a joint initiative with the Huntsman Marine Science Centre. The MCP seeks to protect and restore marine ecosystems in the Maritimes, respecting the traditional use of these ecosystems by fishing communities that depend on them. The MCP's priorities are: 1) to develop a promote a community-based ecological alternative to conventional fisheries management; 2) to protect and restore fish habitat and marine ecological functions; 3) to promote policies that will lead to a sustainable aquaculture industry; 4) to reduce contaminant loadings into the marine environment; and 5) to promote land use policies that will protect sensitive coastal features. Specific projects that address these issues include the Musquash Marine Protected Area Campaign, a case study examination of the decline in Passamaquoddy Bay, efforts to restore tidal flow in estuaries, promotion of community-based fisheries management and pollution abatement in boundary waters, and a survey of coastal and marine issues in the Bay of Chaleur, Miramichi Bay and Northumberland Strait.

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