# ECOSYSTEM OVERVIEW OF THE SHEDIAC BAY WATERSHED IN NEW BRUNSWICK

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**Canadian Manuscript Report on Fisheries and Aquatic Sciences 2863**

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# Ecosystem Overview of the Shediac Bay Watershed in New Brunswick

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*Photographs provided by the Shediac Bay Watershed Association

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## PREFACE

Under Canada's Action Plan for Oceans (2005), the Oceans and Habitat Division of the DFO Gulf Region is facilitating the development of ecosystem overview reports (EORs) at the community coastal management area level. Local watershed / community groups are collaborating in the production of their respective ecosystem overview report. Several of these reports have been developed for coastal ecosystems located in the southern Gulf of Saint Lawrence. These overviews will serve as baseline tools for the integrated management process of these coastal zones. The present document is part of a series of reports produced to this effect.

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## ABSTRACT

**LeBlanc, C., Turcotte-Lanteigne, A., Audet, D. & Ferguson, E. 2009. Ecosystem Overview of the Shediac Bay Watershed in New Brunswick. Can. Manuscr. Rep. Fish. Aquat. 2863, x + 123 p.**

The Shediac Bay watershed is located in south-eastern New Brunswick draining directly into the Northumberland Strait. It is a shallow embayment with water temperatures exceeding 20 $^{o}$C during the warm summer months. The landscape is characterized as gently undulating slopes rising from sea to land reaching an elevation of 560 meters inland near Lutes Mountain. The in-flow of freshwater is supported by two main river systems: the Shediac and Scoudouc Rivers. The Shediac Bay watershed has many coastal features and natural attributes that provide essential habitats for a diversity of terrestrial and aquatic wildlife. The communities depend on the natural resources for their economy and livelihood. Manufacturing, fishing, forestry and agriculture are practiced in the watershed. Tourism is a major economic activity. As elsewhere, human activities have threatened and degraded the health of the ecosystem. The main issues of concern include poor water quality, shellfish closures, nutrient pollution, sediment loading in watercourses and the loss of important coastal habitats. This report is an important tool to help work towards the sustainable development of the watershed to ensure a healthy future for the Shediac Bay watershed.

## RÉSUMÉ

Le bassin versant de la baie de Shédiac est situé au sud-est du Nouveau-Brunswick et se déverse dans le détroit de Northumberland. C'est une baie peu profonde avec des températures s'élevant au-dessus de 20 $^{o}$C durant la saison estivale. Le relief du paysage est généralement caractérisé comme ondulé s'élevant doucement de la mer. L'élévation maximale est atteinte vers l'intérieur des terres à Lutes Mountain à près de 560 mètres de hauteur. Les rivières de Shédiac et Scoudouc sont les principales sources d'eau douce dans la baie. Les écosystèmes côtiers et terrestres offrent une variété d'habitats essentiels pour une diversité d'espèces de faune et flore. Les ressources naturelles de la région supportent l'économie locale. La pêche, la foresterie, l'agriculture et l'industrie manufacturière sont des activités économiques importantes qui se pratiquent dans le bassin versant. Le tourisme joue aussi un rôle important dans l'économie locale, car nombreux visiteurs fréquentent la région chaque été. Comme ailleurs, les activités humaines ont menacé et dégradé la santé de l'écosystème. D'ailleurs, plusieurs enjeux environnementaux tels que, la fermeture des zones coquillières, l'introduction de grandes quantités de matières organiques et de sédiments dans les plans d'eau et la perte d'habitats côtiers menacent la santé des écosystèmes. Ce rapport servira d'outil de base pour la gestion écosystémique du bassin versant de la baie de Shediac afin d'assurer une perspective de développement durable dans la région.

# 1. GENERAL INTRODUCTION

## 1.1. PROJECT DESCRIPTION

### 1.1.1. Purpose of the report

In 1996, Canada became the first country to implement a law on the oceans (Government of Canada 2002a). The Oceans Act gives the Department of Fisheries and Oceans (DFO) the responsibility of developing a strategy for the **integrated management**[1] of the estuarine, coastal and marine environments of Canada. The Oceans Strategy introduced in July 2002 meets the requirements of the above-mentioned legislation. It is aimed at increasing public participation in the management of marine activities through the implementation of a planning process for the integrated management of Canada's coastal and marine areas. The first step proposed in this integrated management process is to define and assess the territory to be managed so as to be able to take economic, ecological and social components into account in decision-making affecting this territory (Government of Canada 2002b).

Accordingly, DFO is in the process of developing comprehensive **Ecosystem** Overview Reports (EOR) on certain Large Ocean Management Areas (LOMAs) to achieve better management of large marine ecosystems such as the Gulf of St. Lawrence and the Scotian shelf. The DFO Gulf Region, in collaboration with its Area Offices, and in partnership with community organizations, is presently developing Ecosystem Overview Reports for community coastal management areas such as the present report for the Shediac watershed. These reports are aimed at defining and assessing the territory to be managed.

This report provides an overview of the coastal community area of Shediac Bay, located in southeastern New Brunswick. To the extent possible, it contains relevant information needed to understand the functioning of the Shediac Bay ecosystem as a whole. It also provides a picture of the pressures and threats presented by human activity in the coastal area and adjacent lands. It is a "living" document in that it can be modified and updated to integrate changes, new discoveries, etc.

[1] The words in bold character are defined in a glossary in chapter 10.

This overview report is a compilation of information gleaned from various sources including scientific, statistical, social and economic study reports, traditional and local information, etc. It will be used by managers, partners and stakeholders involved in the Shediac Bay integrated management process. It is not intended for public distribution.

### 1.1.2. Geographic area

The Shediac Bay is located in southeastern New Brunswick (46°15'00``N latitude and 64°30'00``E longitude) on the western side of the Northumberland Strait. The Shediac Bay watershed covers 419.1 km$^2$ of land area (Gregory et *al*. 1993) and stretches along approximately 36 km of coastline, from Cap de Cocagne to Cap Bimet (Figure 1). The watershed boundaries extend inland from Scoudouc to Lutes Mountain (Figure 2). The watershed is comprised of two major river systems which empty into the Shediac Bay: the Shediac River and the Scoudouc River. Numerous small tributaries connect with either one of these rivers or empty directly into the Shediac Bay. Shediac Island is a prominent feature in this shallow embayment (Gauvin & Poirier 2004).


Source : DFO

**Figure 1: Coastline from Cap de Cocagne to Cap Bimet**

The watershed boundaries are within Kent and Westmorland Counties and cross into both the Shediac and Moncton Parishes (Gauvin & Poirier 2004). The Town of Shediac is 10.82 km$^2$ in area and represents 2.5 % of the total surface area of the watershed. This urban area consists of light industrial, commercial and residential land (Jordan 2000). The Shediac Bay watershed also includes various communities such as Pointe du Chêne, Cap-

Bimet, Cap Brulé, Boudreau Office, Shediac Road, Shediac Cape, Shediac River, Shediac Bridge, Scoudouc, Irishtown, Saint-Philippe, McDougall Settlement, Grande-Digue, Caissie-Cape and the eastern portion of Cap de Cocagne.

Farmlands, forestry, fishing and tourism have shaped the natural environment and actual landscape (Jordan 2000) (Figure 3).

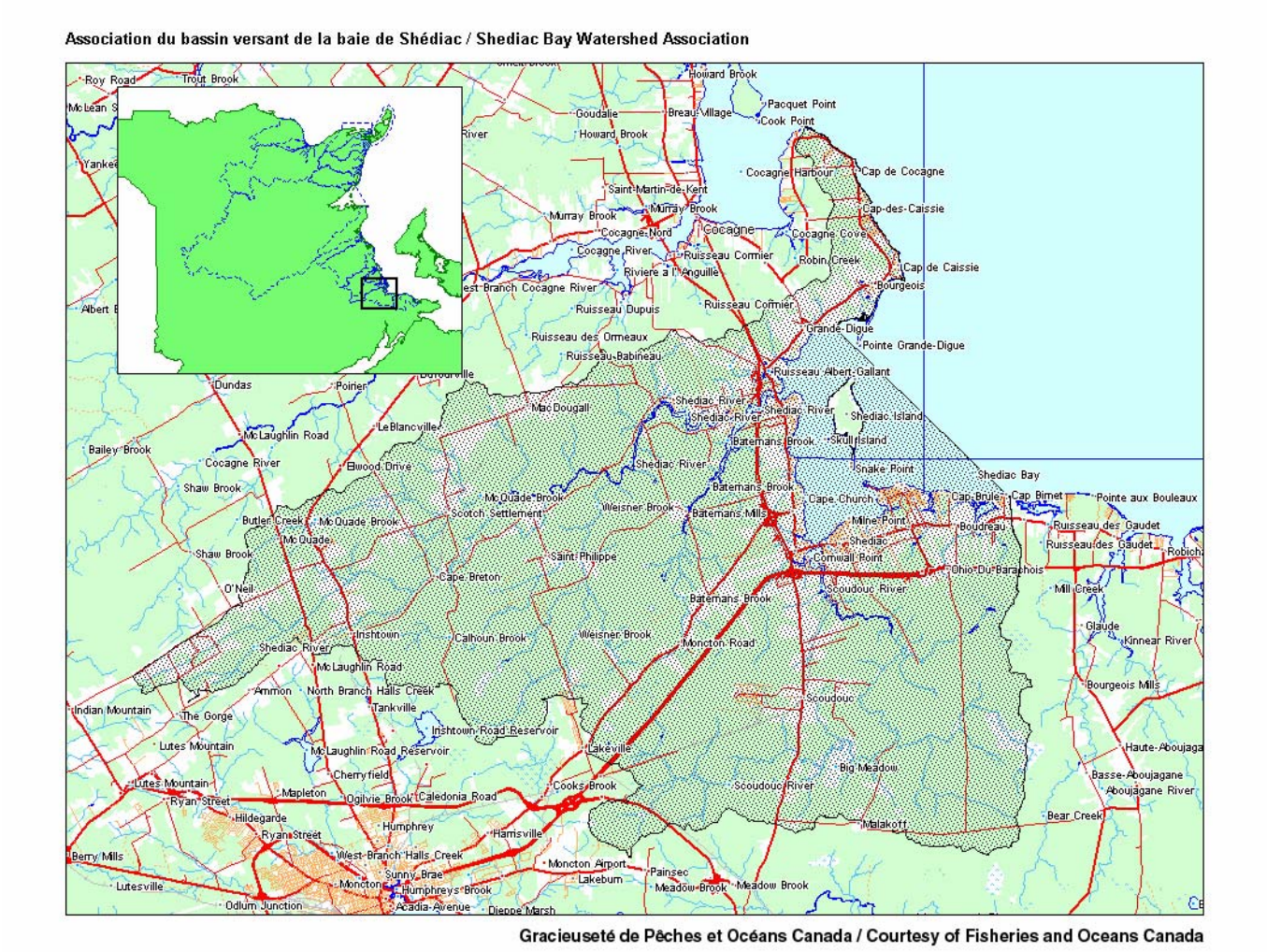



**Figure 2. Map of Shediac Bay watershed boundaries**

Sources of information:
NB Aquatic Data Warehouse
Province of New Brunswick
Fraser Papers Inc.
Fundy model forest
J.D. Irving
Shediac Bay Watershed Association

Grey area indicates the extent of the watershed boundaries

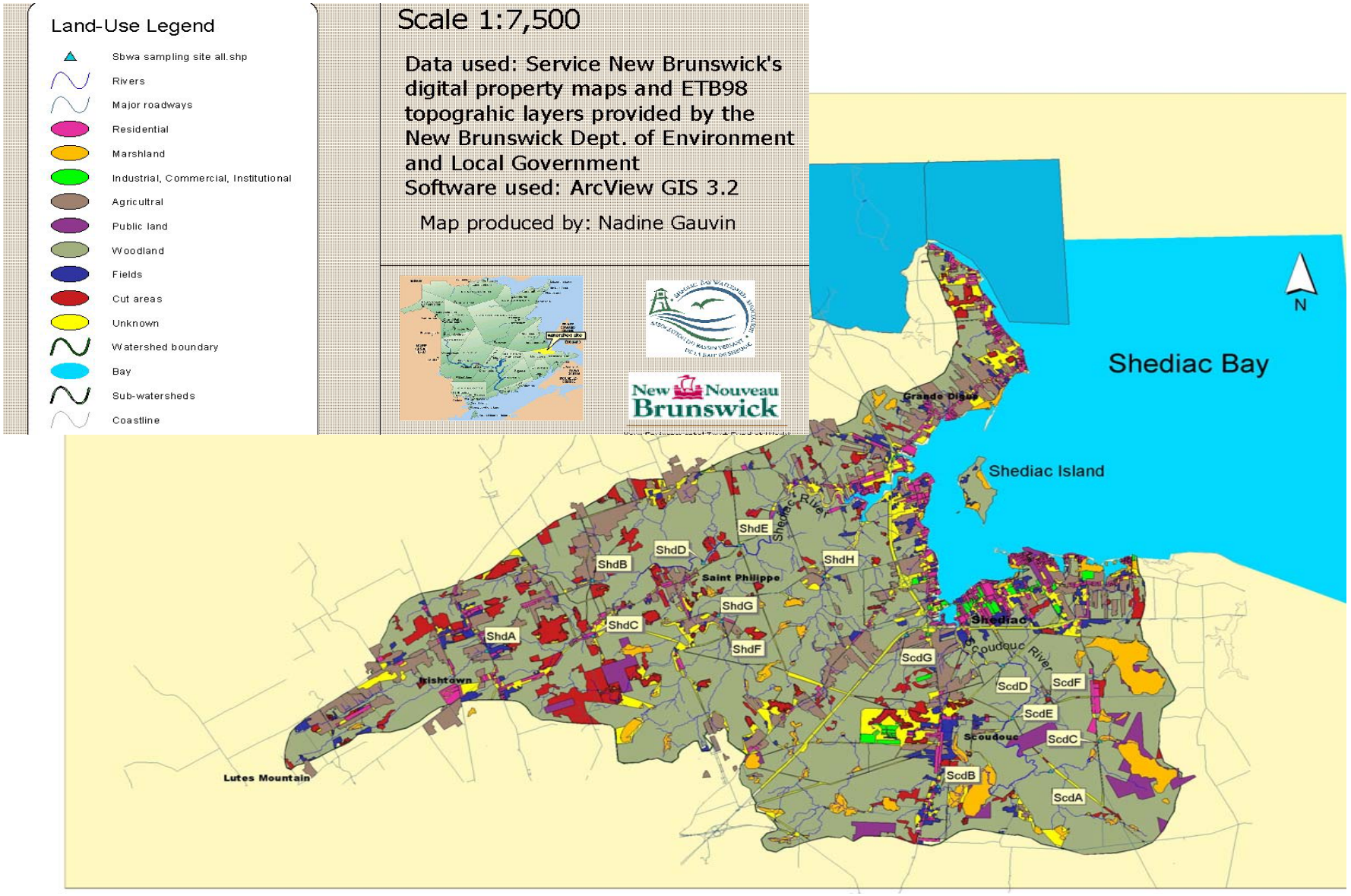



**Figure 3: Land use in Shediac Bay watershed**

## 1.2. METHODOLOGY

The preparation of this document includes a literature review that brings together pertinent data available from a variety of sources. The authors of this document attempted to discover all sources of pertinent literature available regarding geography and topic-specific information used in this overview report. Sources of literature include: government primary research publications, government policy and discussion papers, government grey literature (unpublished documents), academic journal articles, academic primary research documents (published and unpublished), proprietary consultant research documents (by permission), non-governmental organization reports, community group reports, personal communications with experts (cited with date of communication) and other sources deemed relevant and reliable (e.g. Traditional Fisheries Knowledge database). No primary research was undertaken specifically in support of this document.

The data collected was integrated into a generalized description of the ecosystem of the Shediac Bay watershed. The intent is to provide a descriptive overview of how the bay functions as an ecosystem. The document sets the stage for the future development of integrated management plans, protection of the environment, resource conservation or recovery strategies.

# 2. PHYSICAL SYSTEM

## 2.1. GEOLOGY AND GEOMORPHOLOGY

### 2.1.1. General formation

New Brunswick sits within the Appalachian Region of Canada (Rampton et *al*. 1984). The Shediac Bay watershed belongs to the physiographic division of the New Brunswick Lowlands and the New Brunswick Highlands (Dept. of Natural Resources 2005). The landscape is characterised as a generally flat surface rising gently from sea to land. The bedrock formation is underlain primarily by Pennsylvanian sedimentary sandstone (Figure 4) although shale, conglomerates and coal also occur (Rees et *al*. 1996). Based on a selection of well records, the depth of the bedrock varies from 2 feet to 75 feet within the study area (Henderson 1999).

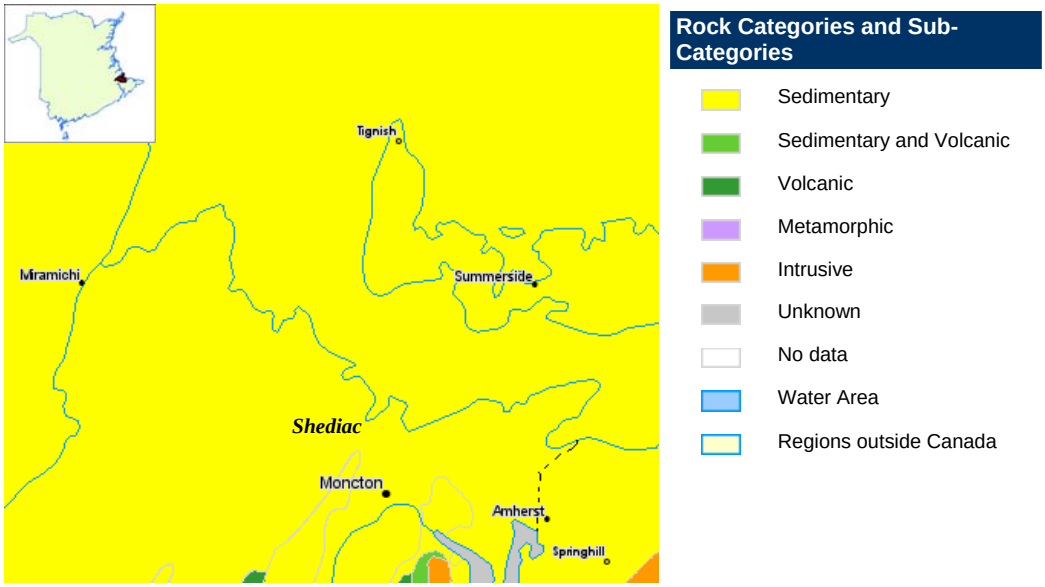



**Figure 4: Bedrock of study region**

Source: Natural Resources Canada (2008)

The formations of the soils are the result of physical, chemical and biological processes that have occurred over thousands of year. The soils are divided into mineral soils and organic soils. Mineral soils are comprised of mineral matter which is found in sands, silts, clays and rock fragments of gravels, cobbles, stones and boulders. Organic soils consist of peat deposits that have formed as a result of the accumulation of plant materials (Rees et *al*. 1996).

The landscape is dominated by **morainal till** of the type lodgement (basal) till and ablation till (Figure 5). There are very few **glaciofluvial deposits** in the study area. Marine and lacustrine sediments are encountered near the coastline and consist of sand, silt, minor clay and gravel generally 1 to 10 m in thickness. Alluvial deposits are present in the floodplains and marine alluvial materials are found near the tidal rivers which drain into the Northumberland Strait (Rampton 1984; Rees et *al*. 1996).

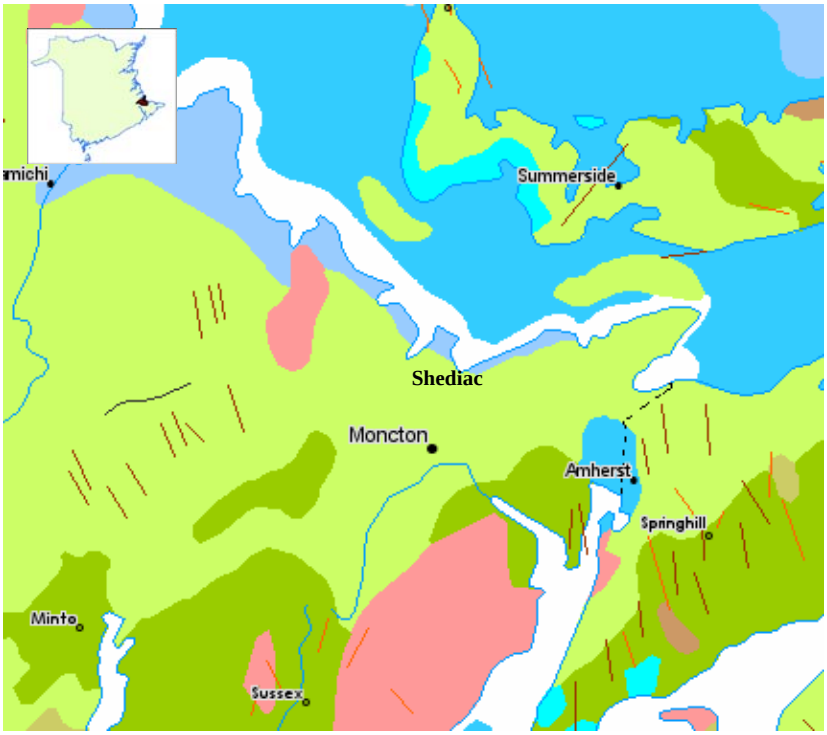
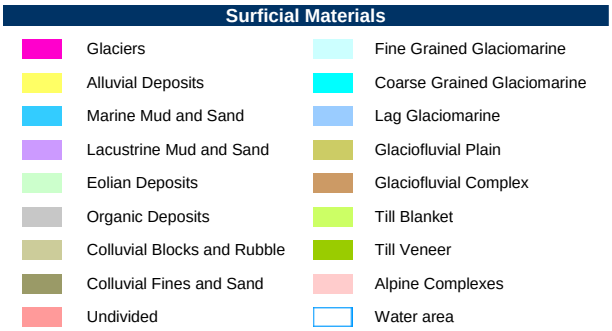



**Figure 5: Landscape surficial materials of the Shediac region**

Source: Natural Resources Canada (2008)




The Shediac Bay watershed is composed of three types of organic soils: bog, fen and swamp. These organic sediments are generally 1 to 5 m thick and are deposited in shallow basins and on poorly drained surfaces across the landscape (Rampton 1984; Rees et *al*. 1996).

The present day soils and landforms are the results of glaciation, marine submergence, **isostatic rebound** and coastal erosion (Rampton et *al*. 1984). Rees et *al.* (1996) state that during the last ice age a large proportion of New-Brunswick's landscapes was covered by ice. Following deglaciation approximately 10 000 to 12 000 BP (before present), the region was "subsequently subjected to a period of shallow marine submergence. Soil formation began with emergence of the landscape" (Rees et *al*. 1996 p.5). Vegetation covered poorly drained areas resulting in the formation of the present peat lands (Rees et *al*. 1996).

### 2.1.2. Topography and bathymetry

The topography of the region is characterised as gentle undulating slopes (Figure 6) with elevations ranging from sea level at the coast to just over 560 m in height inland near Lutes Mountain (Henderson 1999). Drainage patterns indicate fair to poor drainage in low lying areas. (Rees et *al*. 1996).

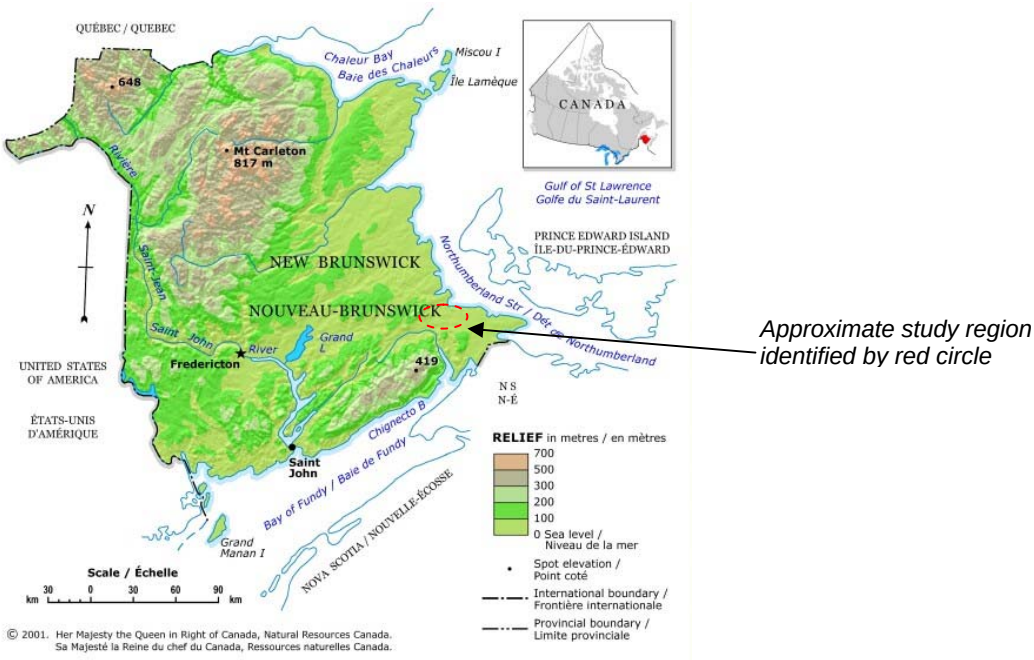



**Figure 6: Map of New Brunswick land topography**

Source: Natural Resources Canada (2008)

The Shediac Bay is characterized as a shallow embayment (Figure 7) with a general depth of 2 to 3 m (Henderson 1999) and a maximum depth of 6.7 m (Gregory et *al.* 1993). The slope of the coastal area is very flat and the depth slowly increases seaward (Henderson 1999).

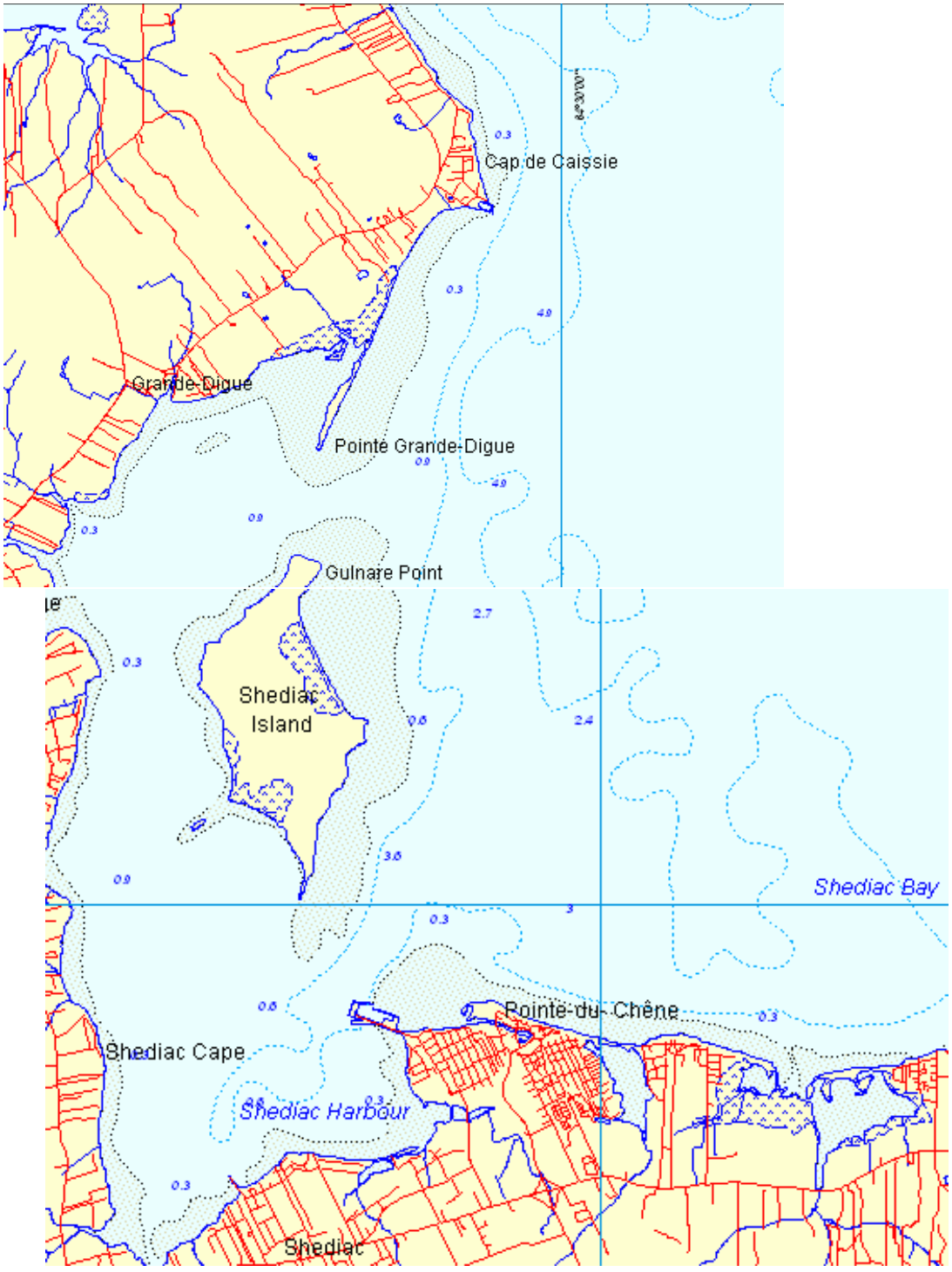



**Figure 7: Bathemetry of Shediac Bay**

Source: DFO (2005d): http://glfgeo.dfo-mpo.gc.ca/tfk-ctp/.

### 2.1.3. Coastal landscape

The coastline consists of a variety of coastal habitats such as sandstone cliffs, mud flats, salt marshes and **barrier beaches** (Jordan 1995). Kilometres of sandy beaches and renowned beautiful coastal sceneries make this area one of the most popular tourist destinations in the province (Henderson 1999). Shediac Island is also a prominent feature of the coastline.

The coastal landscapes play a vital role for wildlife and also for residents of the watershed. A diversity of ecosystems provides essential habitats and feeding areas for terrestrial and aquatic wildlife.

## 2.2. ATMOSPHERIC COMPONENTS

### 2.2.1. Air quality

From season to season the composition of the air changes and is strongly influenced by the local weather. Multiple effects can contribute to changes in the quality of air, such as regional and international factors, as well as natural events and human activities (Dept. of Environment and Local Government 2005b). Southern New Brunswick is more influenced by transboundary sources of air pollution than the northern part of the province. Air masses that have crossed heavily populated areas in central Canada and the United States can sometimes cause smog events (Dept. of Environment and Local Government 2005b).

The nearest monitoring station is located in the city of Moncton (approximately 20 km west) and is managed by Environment Canada. Results for the year 2003 revealed that good air quality was recorded for 98.6% of every monitored hour and the remainder proportion was qualified as “fair” (1.4%). The latest results were caused by high ozone gas ($O^3$) levels measured during August, when ambient temperatures were very high. The 2003 measurements also revealed elevated concentration of particulate matter ($PM^{2.5}$) in ambient air on few occasions (Dept. of Environment and Local Government 2005a).

### 2.2.2. Climate and seasonal particularities

The climate in coastal areas is strongly governed by the thermostatic properties of the water which act to moderate temperatures and climate. The climate of the eastern

shores of New Brunswick is therefore influenced by the proximity of the Gulf of St. Lawrence. Generally, colder waters from the Gulf produce a cool sea breeze during the warm summer months and a slight warming of the air in the fall season. It also slows down warming of the air in spring (Atlantic Climate Centre 2005). The shallow waters of the Northumberland Strait and Shediac Bay area also contribute to higher coastal water temperatures. This is even more pronounced in local inlets.

Along the south-eastern shore of New Brunswick, the mean temperature in January 2004 was -7.5 $^{o}$C (Atlantic Climate Centre 2005). Long term climate information collected at the Moncton weather station indicated that mean air temperatures ranged from a high of 18.7 $^{o}$C to a low of -8.1 $^{o}$C in July and January, respectively. Annual mean precipitation level in 2004 was 1123 mm (Figure 8), including 30% snow. Precipitation levels measured were relatively higher in the fall and early winter. In 1995, mean summer precipitation levels were 87.5 mm (Rees et *al*. 1996). The region enjoys between 225 to 243 hours of sunshine per month during the summer (EC 2008a). A four month frost-free season (approximately 114-124 days) extends along the Gulf coast. Wind speed is usually higher near the coast and diminishes as it extends inland (Atlantic Climate Centre 2005, Rees et *al*. 1996).

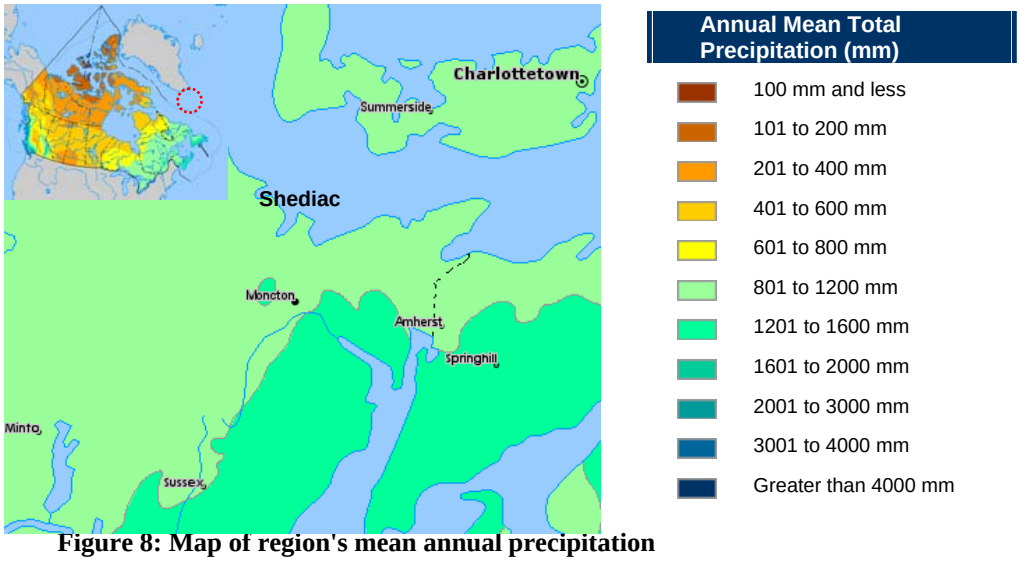



**Figure 8: Map of region's mean annual precipitation**

Source: Natural Resources Canada (2008)

Coastal storm surges are a growing concern in the Shediac Bay watershed. Such extreme events have the potential to cause severe coastal floodings and shoreline erosion. Strong winds accompanied by a low pressure system during a high tide period can create corresponding storm surges resulting in coastal floodings. Sea ice is an additional hazard

during the winter storms (Figure 9), as wind and waves move large pieces of ice on shore, creating potential damage to coastal infrastructures and residences (Ollerhead & Rush 2000).

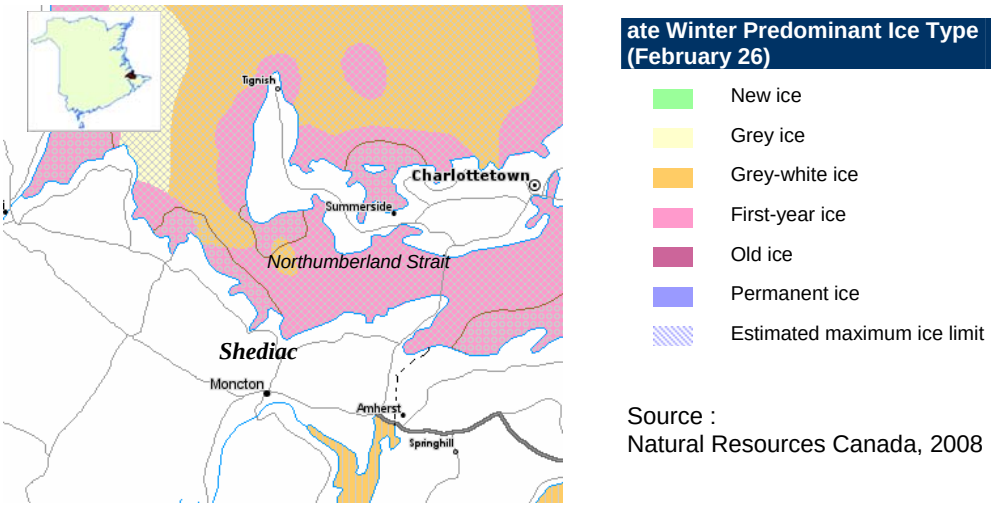



**Figure 9: Map of late winter ice cover**

## 2.3. AQUATIC COMPONENT

### 2.3.1. Hydrography and watersheds

Shediac and Scoudouc rivers are the two main fresh water sources for the Shediac Bay (Figure 10). A few other streams or sub-watersheds, located along the coastline, also drain directly into the bay. This embayment is part of the ecozone of the Northumberland Strait, located between New Brunswick and Prince Edward Island, which is an essential component within the greater Gulf of St. Lawrence ecosystem (Henderson 1999; Jordan 2000).

The Shediac River is characterized by **dendritic patterns** of small tributaries covering a watershed of 201.8 km$^2$ (Henderson 1999). The river is divided into two main branches which join together near Shediac River and empty into the northern part of the bay near Shediac Bridge. McQuade, Weisner and Calhoon Brooks form this first large branch of the Shediac River. McQuade Brook runs through the Scotch Settlement area and another tributary reaches inland as far as Lutes Mountain. The Weisner and Calhoon Brooks flow through and south of the Saint Philippe area and extend as far as Irishtown. The second large branch of Shediac River is Batemans Brook, which crosses towards the Batemans Mills area and runs past the Old Shediac Road (Route 134) and Highway 15

(Morrissey et *al*. 2003). According to Maillet (1996), discharge rates for the headwater tributaries of the main Shediac River range from 0.02 $m^3/s$ to 0.12 $m^3/s$. The overall dry weather discharge for the Shediac River is 0.5 $m^3/s$ (Coastal Ocean Associates Inc. 1999).

The Scoudouc River has a drainage area of 143.3 $km^2$ (Henderson 1999). The mouth of the Scoudouc River system is located in the Town of Shediac and stretches into the Scoudouc area. Various tributaries of the Scoudouc River branch towards the Malakoff area and out near Ohio Road (Morrissey et *al*. 2003). Water velocity is low due to the gentle regional elevation and the overall dry weather flow is approximately 0.4 $m^3/s$ (Coastal Ocean Associates Inc. 1999).

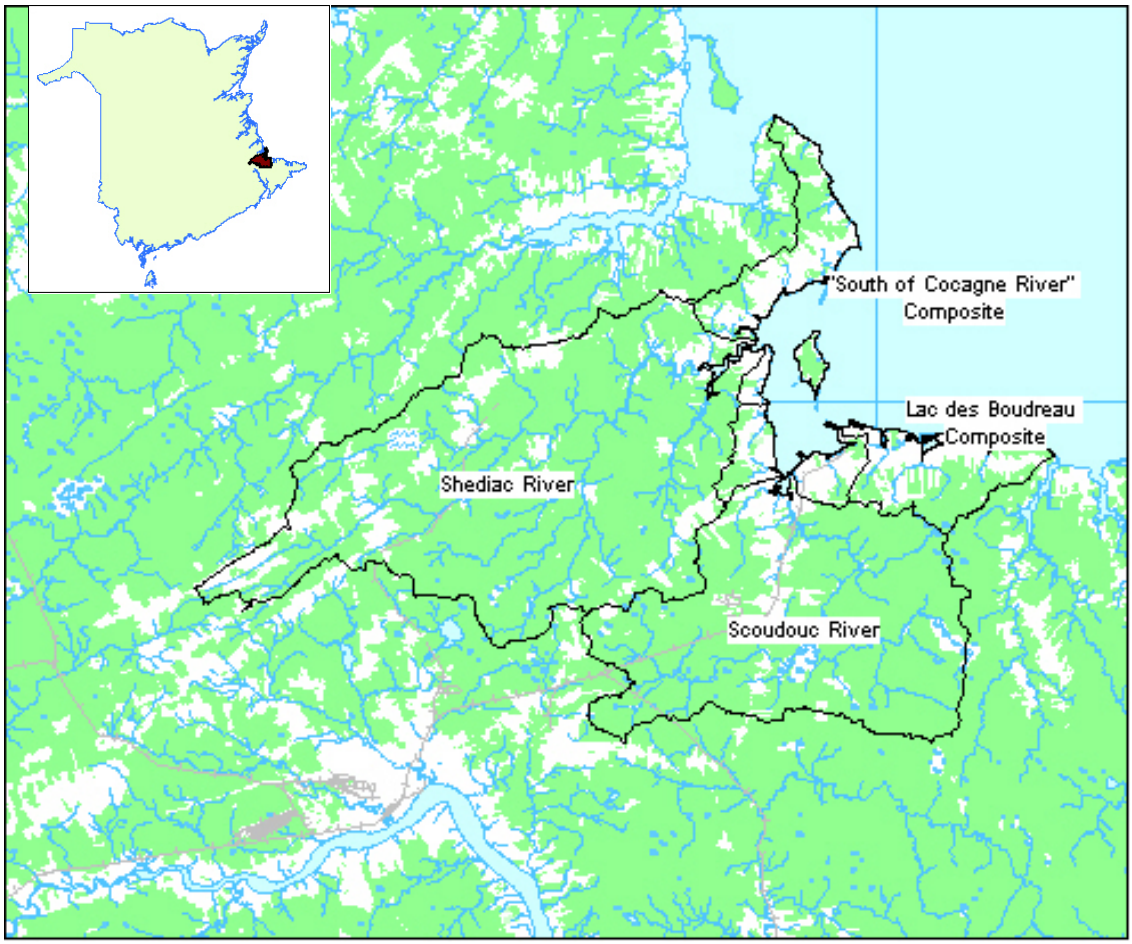



**Figure 10: Sub watersheds of Shediac Bay**

Source: NB Aquatic Data Warehouse, Province of New Brunswick, Fraser Papers Inc., Fundy Model Forest

### 2.3.2. Physical characteristics

#### 2.3.2.1. Residence time

The flushing-time of Shediac Bay is approximately a 41.2 hour period and the tidal / freshwater volume ratio is 167.95 (Gregory et al. 1993). High water mark surface area and volume measurements for Shediac Bay are 50.6 $km^2$ and 101,000.0 $km^3$ respectively (*ibid*).

#### 2.3.2.2. Freshwater, saltwater, brackish water and the mixing process

The freshwater discharge rate fluctuates according to seasonal conditions and appears to be more important in the spring when it reaches a mean rate of 31.1 ± 11.2 $m^3/s$ (Gregory et *al*. 1993). The late summer (September) and winter (January) periods are both characterised by low freshwater inputs of 2.4 ± 2.2 $m^3/s$ and 5.1 ± 4.7 $m^3/s$, respectively. Two major estuarine habitats are therefore present at the mouth of both rivers. The distance of the tidal influence on the Shediac River reaches approximately 6.5 km upstream. The same distance is observed for the Scoudouc River; however, the river bed is shallower. Salinity measurements decrease sharply upstream in both rivers and are variable near the head of tide (Coastal Ocean Associates Inc. 1999, Needler 1932b). Salinity and temperature values for Shediac Bay indicate **stratification** within the water column.

### 2.3.3. Physical-chemical properties of the water

#### 2.3.3.1. Seasonal temperatures, Salinity, pH, dissolved oxygen

The shallow **bathymetry** and weak tidal pattern of Shediac Bay contribute to the warm waters observed in this coastal area. Water temperatures tend to climb above 20 $^oC$ in the summer period (Needler 1932a). In July 1978, hydrographical data collected during an oyster status study in the Northumberland Strait region indicated that water temperature averaged 21.2 $^oC$ for surface temperature and 20.3 $^oC$ for bottom temperature (Bacon 1979). During the community aquatic monitoring program (CAMP) sampling in 2004 in Shediac Harbour (Scoudouc river estuary), water samples were taken at six sites on a monthly basis from May to September (Weldon et *al*. 2005). Three physical parameters were measured including temperature, salinity and concentrations of dissolved oxygen Results are presented in table 1.

**Table 1.Scoudouc River estuarine water quality properties in 2004**

| Month | Mean monthly temperature ($^{o}$C±SD) | Mean monthly salinity (ppt±SD) | Mean monthly Dissolved Oxygen (mg/l ±SD) |
|---|---|---|---|
| May | 14.5 ± 1.4 | 15.0 ± 0.9 | 8.7 ± 0.2 |
| June | 15.0 ± 1.4 | 25.3 ± 01.6 | 9.0± 0.2 |
| July | 20.3 ± 1.5 | 27.2 ± 0.6 | 8.8 ± 1.9 |
| August | 24.4 ± 0.6 | 28.6 ± 0.3 | 7.2 ± 1.1 |
| September | 19.4 ± 0.5 | 20.4 ± 3.3 | 7.3 ± 0.7 |

Weldon et al. (2005)

pH levels were found to be well within the guideline levels for the protection of freshwater aquatic life, ranging from 7.34 to 8.87 in the Shediac River drainage system in 1994 (Maillet 1996). Past water samples revealed similar results, with pH levels ranging from 7.63 to 8.48 in Shediac Bay (SEnPAq Consultants 1989). However, a wider range of pH levels was observed in freshwater systems during the 2000-2003 Water Classification sampling performed in both rivers (Morrissey et *al*. 2003). They are presented in Table 2.

**Table 2: 1999-2002 Freshwater physico-chemical characteritics**

| | Dissolved Oxygen (mg/l ±SD) | | pH | | Total Suspended Solids (mg/l ±SD) | |
|---|---|---|---|---|---|---|
| | range | mean | range | mean | range | mean |
| **Shediac River** | 8.70 - 14.70 | 13.04±1.81 | 6.89 - 8.58 | 7.75±0.37 | <15.00 – 60.00 | <15.43±4.00 |
| **Scoudouc River** | 10.60 - 13.80 | 12.20±1.61 | 5.04 - 8.20 | 7.06±0.81 | <15.00 | <15.00±0.00 |

Morrissey et *al*. (2003)

2.3.3.2. Suspended matter

Suspended matter is defined as particles suspended throughout the water column (Fisheries and Oceans Canada 2005b). High values of suspended matter can adversely affect light penetration in the water column. Light penetration, inversely proportional to depth, is important for primary production by phytoplankton and marine plants. November, May and June tend to have low light penetration as fall storms and spring run-off prevent suspended materials from settling on the bottom. Turbidity measured during the freshwater classification program within the Scoudouc and Shediac river systems ranged from 0.2-14.5 NTU and 0.1-77.6 NTU, respectively (Morrissey et al. 2003).

**Chlorophyll**-a is a photosynthetic pigment typically used to determine the total amount of cellular and acellular food available in the water column. This measurement is

proportional to the amount of phytoplankton present in the water. Total suspended solids are the total amount of organic and inorganic matter present in the water column (Bacon 1977). Chlorophyll-a and total suspended solids measurements taken during an oyster stock investigation in the Northumberland Strait area (Table 3) appeared to represent normal values (Bacon 1977).

Chlorophyll-a and total chlorophyll concentrations were also analysed during an oceanographic study on the eastern coast New Brunswick bays (SEnPAq Consultants 1989). The study revealed results ranging from 0.33 to 7.35 mg/$m^3$ of chlorophyll-a and 0.90 to 12.19 mg/$m^3$ of total chlorophyll. These results are comparable to what was earlier obtained by Bacon (1977). SenPaq Consultants (1989) suggested that a spring algal bloom began in April coinciding with ice melting and increasing water temperatures.

**Table 3: Shediac Bay water parameters 1977 and 1978 (mean monthly values)**

| Date | Chlorophyll-a (mg/$m^3$) | Total Phosphorus (mg/l) | Total $NO_3$ +$NO_2$ (mg/l) | Total Suspended Solids (mg/l) |
|---|---|---|---|---|
| July 1977 | 16.00 | 0.096 | < 0.01 | 33.00 |
| August 1977 | 2.60 | 0.060 | < 0.01 | 1.60 |
| September 1977 | 5.00 | 0.012 | < 0.01 | 5.10 |
| October 1977 | 2.20 | 0.045 | < 0.01 | 10.00 |
| May 1978 | 1.10 | 0.015 | 0.01 | 4.30 |
| June1978 | 8.20 | 0.043 | < 0.01 | 7.50 |

Bacon (1977, 1978)

#### 2.3.3.3. Nutrients

Nutrients, such as Nitrogen (N) and Phosphorus (P), are essential elements for aquatic plant growth. Human activities can increase the amount of nutrients present in the aquatic environment contributing to excessive plant growth in both aquatic and terrestrial ecosystems (Chambers et *al*. 2001).

Table 3 presents saltwater phosphorus, nitrate ($NO_3$) and nitrite ($NO_2$) concentrations measured in Shediac Bay in 1977 and 1978 (Bacon 1978). The Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQGPAL) do not indicate recommended values for nitrite and phosphates in saltwater; however they do recommend an interim limit of 16 mg/l for nitrate in marine waters (Canadian Council of Ministers of the Environment 2006). Bacon's study (1978) revealed levels of nitrates to be below these guideline values.

Freshwater nutrient levels measured during the Water Classification Program (Morrissey et al. 2003) in both the Scoudouc and Shediac rivers showed relatively normal levels. Sporadic high levels of $NO_3$ were measured in the Shediac River every sampling season. High concentrations of $NO_2$ were found in Shediac River (Table 4). The CWQGPAL recommend concentrations of $NO_2$ and $NO_3$ to be below 0.060 mg/l and from 1-5 mg/l respectively in freshwater. (Canadian Council of Ministers of the Environment. 2005) Occasional high phosphorus concentrations were observed in the Scoudouc River. Surface freshwater phosphorus levels are recommended to be below 0.030 mg/l.

#### 2.3.3.4. Organic carbon

Total organic carbon measures the presence of organic matter in water. Organic matter plays a vital role in aquatic ecosystems, contributing to the regulation of the carbon cycle in water systems. It can affect nutrient cycling, biogeochemical processes, biological availability, chemical transport and interactions (Barber II 2002). Total organic carbon levels are also an indication of **exogened** organic matter input.

Freshwater total organic carbon levels were measured during the Water Classification Program in both the Scoudouc and Shediac Rivers (Table 4). It was apparent that levels of total organic matter were greater in the Scoudouc River. The CWQGPAL recommend concentrations between 1-30 mg/l (Canadian Council of Ministers of the Environment 2005) and the results obtained rarely exceeded these guideline values (Morrissey et *al*. 2003).

**Table 4. Freshwater nutrients and organic carbon in the Shediac and Scoudouc River systems between 1999-2002**

| River | Total $NO_3$ (mg/l ±SD) | | Total $NO_2$ (mg/l ±SD) | | Total Phosphorus (mg/l ±SD) | | Total Organic Carbon (mg/l ±SD) | |
|---|---|---|---|---|---|---|---|---|
| | range | mean | range | mean | range | mean | range | mean |
| **Shediac** | 0.05 – 0.98 | 0.10±0.12 | 0.01 – 0.09 | 0.05±0.01 | 0.01 – 0.09 | 0.02±0.01 | 2.70 – 19.20 | 7.77±4.08 |
| **Scoudouc** | 0.05 - 0.11 | 0.05±0.01 | 0.05 | 0.05±0.00 | 0.01 – 0.05 | 0.02±0.01 | 3.42 – 32.60 | 17.73±7.52 |

Morrissey et *al*. (2003)

#### 2.3.3.5. Dissolved trace-metals

The Water Classification Program was conducted during a three year sampling period (Morrissey et *al*. 2003) to monitor water quality within the watershed. Fifteen sample sites were chosen throughout the main branches of the Shediac and Scoudouc Rivers and

along certain tributaries. Aluminium, Iron, Zinc, Calcium, *E. coli*, Copper, Cadmium, Phosphorus and Nickel are among the parameters investigated during the program (*ibid*).

Generally, mean levels of aluminium and iron along the Scoudouc and Shediac Rivers were higher than those recommended by the CWQGPAL. High levels of those elements can be attributed to their natural presence in the soils, sediments and bedrock. One site in the Scoudouc River had higher zinc levels than CWQGPAL. Calcium levels were high at least once for most sampling sites in both rivers. High levels of copper were found in half the sampling sites on the Shediac River. Cadmium levels were high at one sampling site per river (Morrissey et *al*. 2003). Please refer to Appendix 10.4 results of the Water Classification Program.

# 3. BIOLOGICAL SYSTEMS

## 3.1. NATURAL HABITATS

### 3.1.1. Terrestrial habitats

#### 3.1.1.1. Forests

The Shediac Bay watershed lies within the Acadian forest of the Eastern Lowland Region (Rowe 1992). The Acadian forest is described as a mixed assemblage of coniferous and deciduous type species. The forest provides habitat for a number of animals including moose (*Alces alces*), black bear (*Ursus americanus*), red fox (*Vulpes vulpes*), skunk (*Mephitis mephitis*), porcupine (*Erethizon dorsatum*), beaver (*Castor Canadensis*) and raccoon (*Procyon lotor*).

Acadian forest covers approximately 80% of the terrestrial landscape of the Shediac watershed (Gauvin 2003). This type of forest is also present on Shediac Island (Town of Shediac 2005b). In addition, a large portion of oak trees found on the Island create a unique forest (D. Audet, pers. comm., December 2005).

#### 3.1.1.2. Farmlands

Years of farming and logging have changed the natural landscape of the study area (Jordan 2000) and some forests have been replaced by farmlands and fields. Colonizing plants, adapted to these disturbed soils and open areas, have invaded these old farmlands (Smith 1980). Many species seek refuge and food within these open areas such as snowshoe hare (*Lepus americanus*), red squirrel (*Sciurus vulgaris*), ruffed grouse (*Bonasa umbellus*), northern harrier (*Circus cyaneus*) and white-tailed deer (*Odocoileus virginianus*) (*ibid*).

Agricultural lands are interspersed throughout the landscape (Figures 11) and are particularly present in the Grande-Digue area, along Scoudouc Road (Route 132), Old Shediac Road (Route 134), Saint-Philippe, Irishtown and towards Lutes Mountain. Agricultural lands represent approximately 10% of the land surface area of the Shediac Bay watershed (Gauvin 2003). Abandoned fields occupy 20% of the Shediac Island's land area (Town of Shediac 2005b)

**Figures 11: Agricultural / farm lands in the Shediac watershed**

#### 3.1.1.3. Cliffs

Cliffs are defined as an abrupt wall formed as a result of eroded substrate such as shale or sandstone. The fine materials which result from erosion are transported by wave action and are deposited in nearby low energy environments such as beaches or marshes (Campagne 1997). The Cap de Cocagne area is characterised by eroding till bluffs and is constantly exposed to the forces of the Northumberland Strait (Ollerhead & Rush 2000). Sandstone cliffs can also be observed along the Shediac Island shores.

#### 3.1.1.4. Dunes and Beaches

The majority of the coastline is comprised of dunes and beaches (Figure 12). Dunes are mounds of sand formed as a result of sufficient wind and sand. They are omnipresent along the coastline. Marram grass, (A*mmophilia breviligulata*) also called beachgrass, is the most important plant of the dunes. Its extensive root systems, called rhizomes, form a large network which holds the sand like a very fine mesh. It also stabilizes mobile sand and prepares the dune for colonization by other species (Campagne 1997).

**Figure 12: Beach in the vacinity of Pointe-du-Chêne**

The tidal range in the Shediac Bay area favours the formation of barrier-island and other associated environments such as longshore-bar formation, spit development and dune formation. Wave action such as wave swash, nearshore currents and storm waves also create an optimum environment for natural beach development (Henderson 1999). Many species of birds including shorebirds feed on small worms and crustaceans on the shoreline (Campagne 1997). The Pointe de Grande-Digue spit, located south of Cap de Caissie, also has sandy shores and is transgressing over time (Ollerhead & Rush 2000). Shediac Island is also surrounded by sandy beaches (Town of Shediac 2005b).

### 3.1.2. Wetlands

#### 3.1.2.1. Bogs

Bogs are wetlands that have formed over thousands of years as a result of a low lying landscapes becoming slowly filled with plant debris. Bogs are by definition both oxygen and nutrient-poor as well as highly acidic. Sphagnum moss, which lies on the surface, is the prevailing vegetation of peat bogs and is also responsible for creating an acidic environment. Peat is characterised as the partially decomposed plant material of bogs, consisting mainly of decaying sphagnum moss (Campagne 1997). Peat bogs can retain water up to 25 times their weight and can also influence the water table. Peat bogs can also capture atmospheric contaminants (e.g. pesticides and mercury) (Surette et *al*. 2002).

A dozen bogs, representing 1489 Ha of land surface area, are found within the watershed boundaries (Figure 13). They are generally concentrated inland on the east side of the watershed along the Scoudouc River system. Three small bogs are found near the Grande-Digue area on either side of Highway 11 (Gauvin & Poirier 2004). Peat is harvested on peat land #76 (Figure 13) south of the Town of Shediac (Dept. of Natural Resources 2005).

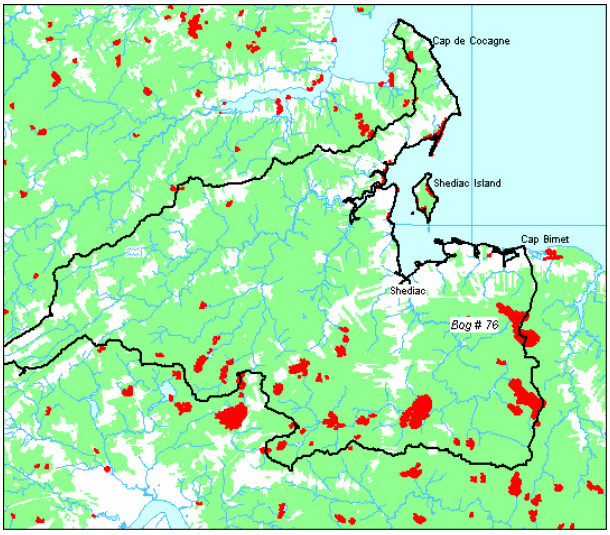
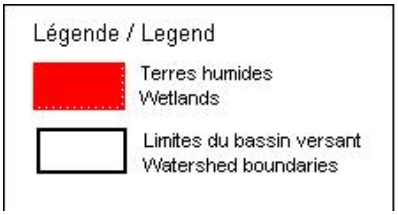



**Figure 13: Wetlands located within the Shediac watershed**

Sources :

NB Data Warehouse
Service NB
Keys & Henderson (1987)




### 3.1.2.2. Marshes

Salt marshes (Figure 14) are generally present near the mouths of rivers, and in bays. They are constantly affected by tides and are usually protected from wave action. Salt marshes have an important water filtering capacity (Therrien et *al*. 2000). Further, they are important spawning, nursery, feeding and resting habitat for a number of fish species and are vital waterfowl breeding areas *(ibid)*.

**Figure 14: Marsh in the Pointe-du-Chêne area**

There are numerous salt marshes along the coast within the watershed; Lac des Boudreau is classified as a large marsh created by a **barachois** (Figure 15). The Grande-Digue salt marsh located behind a barrier dune (Figure 15), is approximately 1904 $m^2$ (Gauvin & Poirier 2004). Approximately 20% of Shediac Island is composed of salt marshes and wetlands (Town of Shediac 2005b), an ideal habitat for biodiversity.

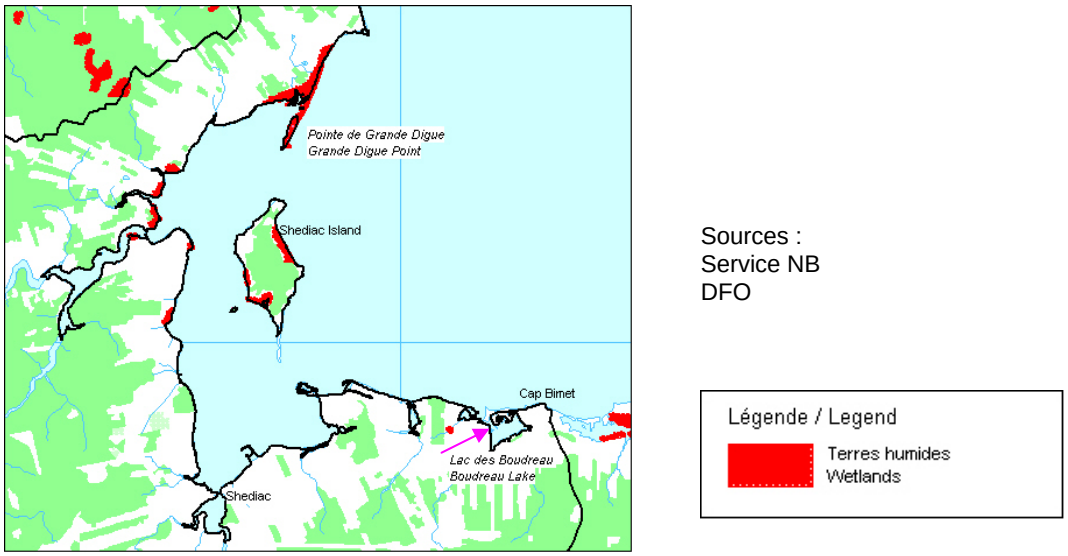



**Figure 15: Boudreau Lake and Grand Digue point**

A salt marsh bird survey was conducted in seven marshes during the summer 2000. These marshes were located in Cap Brûlé, Cap Bîmet, Belliveau Beach, Pointe-du-Chêne, Shediac Bridge, Shediac Island and Grande-Digue (Godbout 2000). Most coastal marshes studied showed signs of degradation and were threatened by ATV traffic and/or infilling for land development purposes (Godbout 2000). A comparison of aerial photos found that many salt marshes have disappeared over the last 20 years due to infilling.

Inland wetlands in the watershed appear to remain intact and undisturbed (Jordan 2000). Based on personal observations, the Big Meadow (part of the upper section of the Scoudouc River) is a unique ecosystem with a particular composition suggesting high biodiversity (V. Mallet, pers. comm., January 12, 2006).

### 3.1.3. Aquatic habitats

#### 3.1.3.1. Mudflats

Mudflats are characterised as an area of fine sediment and are located in calm slow moving waters. They are often exposed at low tide and are usually found near salt marshes, in estuaries or behind barrier beaches. Large numbers of shorebirds such as plovers, sandpipers and dowitchers congregate on mudflats to feed on marine worms and molluscs (Campagne 1997). Tidal flats (Figure 16) can extend up to 300 meters near Pointe-du-Chêne and 50 to 75 meters at Parlee Beach (Henderson 1999).

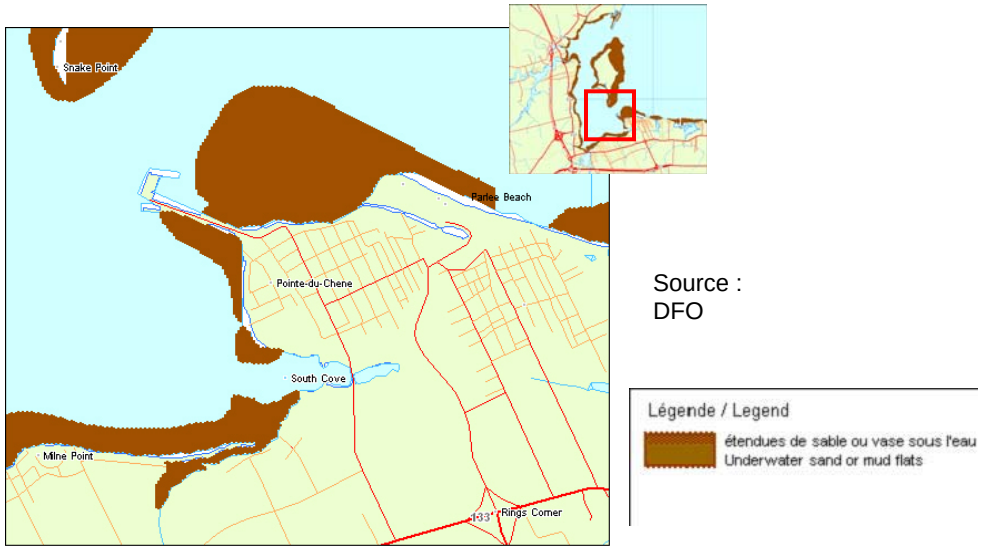



**Figure 16: Sand and mud flats in the Pointe du Chêne Parlee Beach area**

#### 3.1.3.2. Rivers

River drainage systems are referred to as a continuum of physical environments, from small streams to large rivers which connect aquatic and terrestrial communities. Downstream habitats receive continual replenishment of nutrients and food from upstream areas. Streamside vegetation provides protection from erosion, controls water temperatures and is a source of constant organic debris (Maser & Sedell 1994).

**Figure 17: Shediac River**

In 1995, the Southeastern Anglers Association conducted a survey of Shediac River (Figure 17) which was described as a stream with a variation of fine sand to silt substrate. Ledge bottoms also occur. Gravel and small rubble are found within the riffle areas. Its average width is 2-4 meters widening to 5-9 meters at the mouth. The study found that the Shediac River system had low population densities of both Atlantic salmon (*Salmo salar*) and brook trout (*Salvelinus fontinalis)*. Good habitat conditions for brook trout were observed in the Weisner Brook (Maillet 1996). The physical characteristics of the Shediac River and Weisner Brook are summarized in Table 5.

**Table 5. Physical characteristics of the Shediac River and Weisner Brook**

| Physical characteristics | Main Shediac River (20.1 km) | Weisner Brook (9 km) |
|---|---|---|
| Rearing area | 153 724.7 $m^2$ | 72 141 $m^2$ |
| Riffle area | 26 123 $m^2$ | 8 871 $m^2$ |
| Pool area | 15 002 $m^2$ | 25 527 $m^2$ |
| Run area | 112 482 $m^2$ | 37 747 $m^2$ |
| Ledge bottom stretches | 118 $m^2$ | - |

Maillet (1996)

#### 3.1.3.3. Estuaries and bays

The transition zone between a river and the sea is called an **estuary**. Estuaries are partially surrounded by mainland and usually open to the ocean. The mixture of freshwater and saltwater creates a unique environment. In these ecosystems, the salinity gradient can range from 30 ppt to 0.5 ppt. **Stratification** occurs within the water column. Water salinity varies within the water column and is usually higher in shallow areas because of a stronger evaporation effect. Estuaries are productive areas and are important spawning, nursery, rearing and feeding habitats. For example, salmon undergo physiological changes in the estuary in order to move from saltwater to the freshwater to spawn (Campagne 1997).

A bay is described as “a body of water partially enclosed by land but with a wide mouth, affording access to the sea” (The American Heritage® Dictionary of the English Language 2004). Some bays can be considered as estuaries where flowing rivers provide freshwater, which is the case for many embayments. Marine waters are divided into two zones: the benthic zone and pelagic zone. The benthic zone refers to the sea bottom and the pelagic zone refers to the water column (Campagne 1997).

Shediac Bay is characterised as a shallow bay with depths of less than two meters west of the Shediac Island and an open coastal area to the east of the Island that opens up to the Northumberland Strait. The substrate is comprised of fine sand and mud with extensive eelgrass beds. Sea lettuce can be found at the mouths of the Shediac and Scoudouc River (Coastal Ocean Associates Inc. 1999).

This shallow embayment provides habitat for an abundance of aquatic species including many invertebrate species such as shellfish and crustaceans.

## 3.2. TERRESTRIAL BIOTIC COMPONENTS

### 3.2.1. Forest, wetland and coastal flora

Red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), maple (*Acer sp.*), and yellow birch (*Betula alleghaniensis*) constitute the principal tree species found in Acadian forests (Dryade 1979). Farming and logging activities over the years have promoted the establishment of pioneer species such as grey birch (*Betula populifolia*), speckled alder (*Alnus rugosa*) and larch (*Larix laricina*) *(ibid)*.

Field vegetation consists of wild roses (*Rosa sp*.), blueberries (*Vaccinium sp*.), strawberries (*Fragaria ananassa*), myrica (*Myrica sp*.), alders (*Alnus sp*.), asters, goldenrods *(Solidago sp*.), horseweed (*Erigeron canadensis*) and orchids (*Orchidaceae sp*.). Fields provide habitat for insects, birds, and mammals (Smith 1980 as cited in Turcotte-Lanteigne 2000).

Sphagnum moss is the prevailing vegetation of peat bogs. This moss grows on the bog surface and is responsible for creating the acidic environment. Peat lands are important habitats for a variety of specialized plant species such as leatherleaf (*Chamaedaphne calyculata*), Labrador tea (*Ledum groenlandicum),* black spruce (*Picea mariana*), cotton

grass (*Eriophorum virginicum*), larch (*Larix laricina*) and carnivorous plants such as pitcher plants (*Sarracenia purpurea*) and round-leafed sundews (*Drosera rotundifolia*) (Gauvin & Poirier 2004).

Saltwater Cord-grass (*Spartina sp.*) is the predominant species in salt marshes. Once established, other salt-loving plant species such as sea-milkwort (*Glaux maritima*), glasswort (*Salicornia europaea*), rushes (*Juncus sp*.), seaside plaintain (*Plantago maritime*), seaside arrow grass (*Triglochin maritime*), sea blite (*Sueda sp.*), sedges (*Carex sp*.) and sea lavender (*Limonium carolinianum*) will follow. These **halophytic** plants have the unique ability to excrete excess salt and/or retain water (Campagne 1997). More than 40 plant species were identified during a saltmarsh survey performed within the Shediac Bay watershed in the summer of 2000 (Godbout 2000).

Very few plant species are adapted to grow on beaches and dunes. Harsh conditions (e.g. wind, salt, temperature and shifting sands) render these habitats as difficult environments for plant growth. Marram grass (*Ammophilia breviligulata)* is a specialized plant that is well-adapted to these conditions. Its large root system stabilizes the moving sands and form the base of the dunes. Sea rocket (*Cakile edentula),* beach pea (*Lathyrus japonicus),* American dune grass (*Elymus mollis*)*,* grove sandwort (*Arenaria lateriflora*) and Russian thistle (*Salsola kali*) are plants that can also be found in these coastal habitats (Campagne 1997; Godbout 2000).

### 3.2.2. Terrestrial Fauna

The Shediac Bay watershed offers a variety of habitats for wildlife. Shorebirds are found on mudflats feeding on invertebrates in the sand. Saltmarshes provide good waterfowl breeding habitat. White-tailed deer browse on leaves and tree saplings. Squirrels, sparrows and juncos consume large amounts of seeds and the ruffed grouse browse on fruits and tree buds. Snakes and frogs feed on invertebrate fauna on the forest floor (Sutton & Sutton 1998). Tables 6 and 7 provide a list of common species throughout the province of New Brunswick. Refer to Appendix 10.2 for scientific names.

**Table 6: Common mammals, reptilies and amphibian species of New-Brunswick**

| Large mammals (Big game species) | Furbearers (Small game species) & other small mammals | |
|---|---|---|
| Black bear<br>White tail deer<br>Moose | American mink<br>River Otter<br>Beaver<br>Bobcat<br>Common raccoon<br>Eastern coyote<br>Short-tailed weasel<br>Snowshoe hare<br>Red fox<br>Porcupine | Bat<br>Mouse<br>Vole<br>Shrew<br>Striped skunk<br>Woodchuck<br>Long-tailed weasel<br>Muskrat<br>Squirrel |
| **Reptile species** | **Amphibian species** | |
| Redbelly snake<br>Maritime Garter snake<br>Smooth green snake<br>Common snapping turtle | Redback salamander<br>Northern two-lined salamander<br>Yellow spotted salamander<br>Eastern newt or Red-spotted newt | Bullfrog<br>Green frog<br>Mink frog<br>Pickerel frog<br>Northern Leopard frog<br>Wood frog<br>American toad<br>Spring peeper |

Atlantic Canada Conservation Data Centre (2005) and G. Godin, pers. comm., (November 28th 2005)

**Table 7: Common bird species of Eastern New-Brunswick**

| Forest and open area birds | | Coastal/Shorebirds | Waterfowl & other |
|---|---|---|---|
| Sparrow<br>Warbler<br>Vireo<br>Waxwing<br>Thrush<br>American Robin<br>Chickadee<br>Jay<br>Crow<br>Swallow<br>Raven<br>Flycatcher | Redwinged Blackbird<br>American goldfinch<br>Hummingbird<br>Morning Dove<br>Great Horned Owl<br>Northern Harrier<br>American Kestrel<br>Merlin<br>Ruffed Grouse<br>Woodpecker | Plovers<br>Sandpipers<br>Yellowlegs<br>Belted Kingfisher<br>Common Tern<br>Gulls<br>Great Blue Herron<br>Ruddy Turnstone<br>Hudsonian Godwit<br>Osprey | Black duck<br>Teal<br>Eider<br>Scoter<br>Canada Goose<br>Cormorant<br>Mallard<br>Grebe<br>Merganser<br>Common Goldeneye<br>Scaup |

Atlantic Canada Conservation Data Centre (2005), Campagne (1997), Amirault (1997), R. Chiasson, pers. comm. (December 2nd 2005)

Common Tern *(Sterna hirundo*) and Great Blue Heron *(Ardea herodias)* colonies can be seen on Shediac Island, the Shediac Marina and in the Cap Brûlé area (J. Steward, pers. comm., January 6th 2006). Les amis de la nature du Sud-Est, the local naturalist club, visits many sites in the watershed. In 2000, 138 species were observed in the Cap Brûlé area alone (N. Belliveau, pers. comm., December 19th 2005).

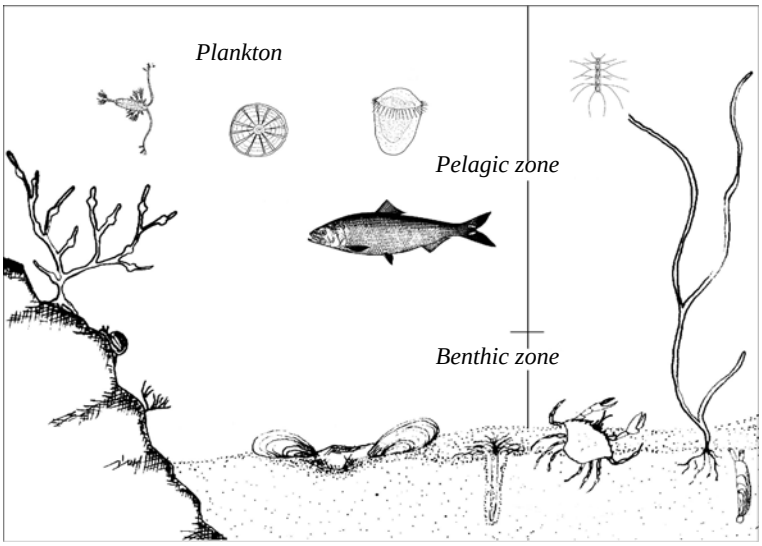
Salt marshes are an integral part of **coastal ecosystems**. Birds that require saltmarsh habitat can be particularly vulnerable to loss of coastal wetlands, which can contribute towards their decline in the Maritimes. In 2000 and 2001, Environment Canada performed an inventory of the bird populations in the saltmarshes along the

Northumberland Strait. Results showed Willets (*Catoptrophorus semipalmatus*) were more abundant in Pointe-du-Chêne and Cap Bîmet east marshes while Nelson's sharp-tailed Sparrows (*Ammodramus nelsoni*) were most abundant in Cap Brûlé and Cap Bîmet east marshes. These birds are of special interest because of their dependance on saltmarshes for breeding, food and shelter. It was also found that small saltmarshes are important habitat for Nelson's sharp-tailed Sparrow. Willets were relatively uncommon throughout the study area, likely as a result of lacking water pannes, which are important feeding areas for these birds (Environment Canada 2006).

## 3.3. AQUATIC BIOTIC COMPONENTS

### 3.3.1. Planktonic communities

Plankton consists of microscopic or near-microscopic organisms that inhabit fresh, brackish or salt water. They are known as primary and/or secondary producers. They are an important component of the food chain (Figure18) and serve as a vital source of food to many species. Plankton is comprised of three main groups: phytoplankton, zooplankton and ichthyoplankton. Phytoplankton consists mainly of microscopic algae. Zooplankton consists of micro and macroscopic animal species, while ichthyoplankton consists exclusively of the larvae of various fish species (Campagne 1997; R. Bernier, pers. comm., December 15 2005).




Source: Campagne (1997) module 1 p.36 "By the Sea"

**Figure 18: Aquatic community assemblage**

A phytoplankton **community** analysis was carried out during the summers of 1978-79 (Bacon 1979). Table 8 summarizes the results of this analysis.

**Table 8. Phytoplankton analysis results from samples taken in 1978-1979**

| Species | Aug-78 (#/$m^3$) | Sep-78 (#/$m^3$) | Oct-78 (#/$m^3$) | May-79 (#/$m^3$) | Jun-79 (#/$m^3$) |
|---|---|---|---|---|---|
| *Amphiprora alata* | | | | | 5,900 |
| *Amphora sp.* | | | | | 15,000 |
| *Anabaena sp.* | | | | | 21,000 |
| *Asterionella japonica* | | | | 17,000 | |
| *Chaetoceros debilis* | 280,000 | 180,000 | | 2,100,000 | |
| *Chaetoceros decipiens* | | | | 290,000 | |
| *Chaetoceros didymus* | | | | 120,000 | |
| *Chaetoceros scutellum* | 13,000 | | | | |
| *Chaetoceros socialis* | 1,000,000 | | | 690,000 | 18,000 |
| *Grammatophora marina* | | | 130,000 | | |
| *Gyrosigma sp. /Pleurosigma sp.* | 76,000 | 310,000 | 130,000 | | 9,000 |
| *Gyrosigma fasciola* | | | 68,000 | 17,000 | |
| *Leptocylindrus danicus* | | 5,300,000 | 13,000,000 | 260,000 | 3,000 |
| *Licmophora sp.* | 13,000 | | | | 15,000 |
| *Navicula sp.* | 38,000 | 91,000 | | | 220,000 |
| *Nitzschia sp.* | | | | | 3,000 |
| *Nitzschia closterium* | 26,000 | | 200,000 | 17,000 | 260,000 |
| *Nitzschia longissima* | 13,000 | | | | 51,000 |
| *Nitzschia sigma* | 25,000 | 180,000 | | 17,000 | |
| *Nitzschia tryblionella* | | | | | 3,000 |
| *Oscillatoria sp.* | | | | | 3,000 |
| *Peridinium depressum* | | 91,000 | | | |
| *Rhabdonema arcuatum* | | 46,000 | | | 3,000 |
| *Rhizosolenia frafilissima* | | | 3,400,000 | | |
| *Rhizosolenia hebetata* | | | | 290,000 | |
| *Rhizosolenia pungus* | 180,000 | | | | |
| *Rhizosolenia styliformis* | | 270,000 | | | |
| *Synedra sp.* | 13,000 | | | | 15,000 |
| **Total** | 1,677,000 | 6,468,000 | 16,928,000 | 3,818,000 | 644,900 |

Bacon (1979)

A zooplankton study (Citarella 1982) was carried out in Shediac Bay during the summer and fall of 1968. The results of this study are presented in Table 9. Seventy six species within 23 taxa categories were observed. Of these, 67 species were found for the first time in the Northumberland Strait. The bulk of the zooplankton (81%) was composed of copepods, with 20 species having been previously recorded. *Acartia tonsa* was the predominant species among the copepods (269,559 individuals per $m^3$) representing 29% of the biomass. Among copepods, *Oithona similis*, *Acartia clausi* and *Centropages hamatus* were also recorded representing 15%, 12% and 12% respectively. Also present were

abundant molluscan, echinoderm, cyphonaute and crustacean larvae in this shallow embayment. Zooplanktonic biomass trends varied seasonally, fluctuating with temperature, salinity and food distribution.

**Table 9: Shediac Bay zooplankton community analysis results**

| Taxa | Abundance % | Frequency % |
|---|---|---|
| Copepods | 81 | 100 |
| Lamellibranchs (veliger) | 8 | 73 |
| Echinoderms (larvae) | 5 | 44 |
| Bryozoans (cyphonautes) | 1.6 | 71 |
| Cirripeds (larvae) | 1.5 | 21 |
| Gastropods (veliger) | 1.2 | 78 |
| Decapods (larvae) | 0.5 | 89 |
| Cladocerans | 0.3 | 18 |
| Polychaetes | 0.2 | 26 |
| Jellyfish | 0.08 | 60 |
| Fish (ichthyoplankton) | 0.07 | 47 |
| Appendicularians | 0.054 | 10 |
| Trematods (larvae) | 0.049 | 23 |
| Mysids | 0.043 | 34 |
| Ostracods | 0.022 | 21 |
| Euphausiids (krill larvae) | 0.020 | 7 |
| Nematods | 0.010 | 2 |
| Amphipods | 0.003 | 31 |
| Chaetognaths | 0.001 | 23 |
| Forams | 0.0008 | 5 |
| Isopods | 0.0006 | 26 |
| Cumaceans (crustaceans) | 0.00002 | 5 |
| Pycnogonids | 0.00001 | 5 |
| Total *Holoplankton* | 82 | 100 |
| Total *Meroplankton* | 18 | 100 |

Citarella (1982)

### 3.3.2. Benthic communities

Benthic communities consist of bottom-dwelling organisms living on or in the seafloor. Table 10 identifies some benthic species found within the watershed.

**Table 10: Benthic species found within the Shediac Bay watershed**

| Common name | Latin name | Comments | Reference |
|---|---|---|---|
| **Aquatic Flora** | | | |
| Eelgrass | *Zostera marina* | Extensive eelgrass beds in the Shediac Bay; Eelgrass beds were observed during the CAMP project within the mouth of the Scoudouc River. | Henderson (1999) Therrien et *al*. (2000), Weldon et *al*. (2005) |
| **Macrophytes** | | | |
| Hollow green weed. | *Enteromorpha intestinalis* | Observations of hollow green weed at the mouth of the Scoudouc River during CAMP. | Weldon et *al.* (2005) |
| Sea lettuce | *Ulva sp.* | A great amount of sea lettuce was observed at the mouth of the Scoudouc River in July and near the fish plant outfall pipe. | Weldon et *al.* (2005) |

| | | | |
|---|---|---|---|
| Rockweed | *Fucus sp.* | Observations of rockweed at the mouth of the Scoudouc River during CAMP | Weldon et *al.* (2005) |
| Green filamentous | | Observation of green filamentous at the mouth of the Scoudouc River during CAMP | Weldon et *al.* (2005) |
| **Freshwater Benthic Invertebrates** (Order indicated) | | | |
| Ephemeroptera<br>Trichoptera<br>Coleptera<br>Plecptera<br>Odonata<br>Megaloptera<br>Hemiptera<br>Diptera<br>Lepidoptera | | Results from aquatic insect survey from 2001 in various freshwater tributaries of the Shediac Bay watershed; analysis was provided by Huntsman Marine Centre. The specimens collected were found in their larval stage. | D. Audet, pers. comm. (January 13th 2006) |
| **Molluscs** | | | |
| Bar clam | *Spisula solidissima* | Bar clams are found on sandbars located along the Grande-Digue barrier beach, Shediac Island toward the Northumberland Strait and from Pointe-du-Chêne to Barachois. | http://glfgeo.dfo-mpo.gc.ca/tfk-ctp/ DFO (2005d). |
| Razor clam | *Ensis directus* | Razor clams are found in the same areas as bar clams: located along the Grande-Digue barrier beach, Shediac Island toward the Northumberland Strait and from Pointe-du-Chêne to Barachois. | http://glfgeo.dfo-mpo.gc.ca/tfk-ctp/ DFO (2005d). |
| American oyster | *Crassostrea virginica* | Can filter up to 34 L/hr, enhancing water quality;<br>Reefs provide habitat for a variety of aquatic species;<br>Found in proximity to the mouth of Shediac River, in Shediac Harbour, around Shediac Island and Shediac Bay. | Bacon (1978), DFO (2005) Needler (1932b), Richard & Robichaud (2002) |
| Soft shell clam | *Mya arenaria* | Found in proximity to the mouth of Shediac River, in Shediac Harbour, around Shediac Island and Shediac Bay. | Richard & Robichaud (2002) |
| Northern quahog | *Mercenaria mercenaria* | Found throughout bay;<br>Prefer soft mud bottoms of the lower intertidal and subtidal zone;<br>8 000 quahogs were introduced at two sites in bay. | Therrien et *al*. (2000)<br>Witherspoon (1984)<br>Audet (2006) |
| Blue mussel | *Mytilus edulis* | A feasibility study on mussel culture identified good spat settlement within the Shediac Bay;<br>Mussels found in Shediac Harbour and Shediac Bay. | Bacon (1981a), Richard & Robichaud (2002) |
| Fresh water mussels | *Elliptio complanata*<br>*Margaritifera margaritifera*<br>*Alamisdonta varicose* | Fresh water mussels found in the Shediac river in the 1950's;<br>Shells of rare species were found in 2003;<br>Freshwater inventory did not find this species in 2005.<br>*See section 3.3.2.1* | Caissie (2006) |
| **Gastropods** | | | |
| Moonsnail | *Lunatia sp.* | Prefer soft bottoms where it searches for its favorite prey, clams | Campagne (1997)<br>L. Auffrey, pers. obs. (2003) |
| **Crustaceans** | | | |
| Grass shrimp | *Palaemonetes vulgaris* | Found in 2003-2005 during CAMP sampling | Weldon et *al*. (2005) |
| Sand shrimp | *Crangon septemspinosa* | Found in 2003-2005 during CAMP sampling | Weldon et *al*. (2005) |
| Rock crab | *Cancer* | Found in 2003 during CAMP sampling | Weldon et *al.* |

| | | | |
|---|---|---|---|
| | *irroratus* | | (2005) |
| Mud crab | *Neopanopeus sayi* | Found in 2003 and 2005 during CAMP sampling | Weldon et *al*. (2005) |
| Lobster | *Homarus americanus* | Perley (1852) mentioned that Shediac Bay was an area characterised with a high abundance of lobsters; Commercially harvested species of high economic interest; Records indicate that landings have decreased over the years. | Perley (1852), Therrien et al. (2000), DFO (2005a) |
| **Groundfish** | | | |
| Winter flounder | *Pleuronectes americanus* | By-catch in eel traps along Shediac River system;<br>Found in 2003-2005 during CAMP sampling | Maillet (1996), Weldon et *al.* (2005) |
| Smooth flounder | *Pleuronectes putnami* | By-catch in eel traps along Shediac River system;<br>Found in 2003-2005 during CAMP sampling | Maillet (1996), Weldon et *al.* (2005) |
| Flounder sp. | *Pleuronectes sp.* | Found in 2004-2005 during CAMP sampling | Weldon et *al.* (2005) |
| Sculpin sp. | | Found in 2005 during CAMP sampling | Weldon et *al*. (2005) |

#### 3.3.2.1. Research projects on benthic communities

##### American Oyster

Shediac Bay was once known as "La Batture" which means oyster bed in Acadian (Brun 1994). In fact, La Batture was located near the mouth of the Scoudouc River. In 1812, Mgr Plessis described oyster fishing with rakes during his visit to Acadie. Oysters were the first commercially exploited seafood. Before 1860, thousands of oyster barrels were sent by train and by boat toward urban areas like Boston, New York and Montreal (*ibid*). Unfortunately, by 1880, stock declines, likely due to over fishing, poor fishing techniques, introduction of sawdust in the Scoudouc River by local saw mills and/or pollution were observed (*ibid*).

In 1932, an oyster investigation carried out by Needler (1932) determined the area had poor spat production. He also mentioned that the population was therefore susceptible to severe depletion by over fishing. In the late 50's and early 60's, Malpeque Disease virtually decimated the valuable oyster resource of New Brunswick. Much effort was put into restoring the fishery through various oyster enhancement programs (Bacon 1979). Unfortunately, none prevailed to restore oyster populations as they once were in Shediac Bay (Brun 1994). Oyster investigations in the Northumberland Strait region in the late 70's early 80's showed large algal mats on oyster trays from June to August in Shediac Bay.

The study also noted that oysters in Shediac Bay exhibited the best growth rate over all sites as a result of optimal growth conditions in the Bay (Bacon 1981b).

In 2004, the Shediac Bay Watershed Association undertook a shellfish restoration project to restore oyster habitat within the bay (Audet 2004). The restored site was a former oyster bed. No live oysters were found on the site despite the deposition of a great amount of shell material to increase available substrate for oyster spat. Over 800 pounds of adult oysters were also introduced on the site (*ibid*). Despite ideal water temperatures and observations of spawned oysters, no oyster recruitment was found during larval settlement monitoring. These results indicate poor recruitment within Shediac Bay (*ibid*).

Quahog

Quahogs (*Mercenaria mercenaria*) are generally found in soft mud bottoms of shallow waters between lower intertidal and subtidal zones (Witherspoon 1984). Shediac Bay appears to be good habitat for this species as it tends to support quahog stock throughout the entire bay (Therrien et *al*. 2000).

In 2005, quahog reproductive sanctuaries were created in Shediac Bay by seeding large quahogs (>50 mm) (Audet 2006). They were seeded at a density of 100 large quahogs/$m^2$ in two 40 $m^2$ plots (total of 8,000 quahogs). These sanctuaries are expected to enhance quahog reproductive capacity thus increasing natural population growth (*ibid)*.

Lobster

Lobsters are found throughout Shediac Bay. They are closer to shore in the early season and tend to spawn on the eastern side of Shediac Island (Fisheries and Oceans Canada 2005d). Homarus Inc. is a non-profit organisation founded in 2001 that promotes projects related to the enhancement of lobster stocks and habitat in coastal waters. The Maritime Fishermen's Union oversees the projects carried out by the organisation. Over the course of the summer of 2005, artificial reefs made of concrete blocks were placed two kilometres off shore near Robichaud. A control site was created near Pointe-du-Chêne at Parlee Beach. This on-going initiative is among several research and development projects undertaken to find solutions to the continuing decline in lobster catches in the Southern Gulf of St.-Lawrence (M. Mallet, pers. comm., January 5$^{th}$ 2006).

Fresh Water Mussels

In 2005, the Shediac Bay Watershed Association, in partnership with the Southeastern Anglers Association, carried out a freshwater mussel inventory in the Scoudouc and Shediac Rivers systems in the summer and fall of 2005. Thirteen sites were inventoried. Results of this inventory are detailed in table 11. Three species were found: the eastern elliptio (*Elliptio complanata*), the eastern pearlshell (*Margaritifera margaritifera*), and the brook floater (*Alamisdonta varicose*) (Caissie 2006).

**Table 11: Number of freshwater mussel species recorded per river system in 2005**

| | **Shediac River system** | **Scoudouc River system** | **Total** |
|---|---|---|---|
| **Eastern Pearlshell** | 573 | 269 | 842 |
| **Eastern Elliptio** | 259 | 113 | 372 |
| **Brook Floater** | 103 | 19 | 122 |
| **Total** | 935 | 401 | **1336** |

Caissie (2006)

### 3.3.3. Pelagic communities

Pelagic fish are species that live in the water column. They include **diadromous** species, which live in fresh water at some stages of their lives and in salt water at others. The presence of various fish species is well documented. Table 12 presents a number of common species that have been identified in the course of various studies.

**Table 12. Pelagic species found within the Shediac Bay watershed**

| Common name | Latin name | Comments | Reference |
|---|---|---|---|
| **Cephalopod** | | | |
| Squid | *Illex illecebrosus* | By-catch in eel traps along Shediac River system | Maillet (1996) |
| **Pelagic Fish** | | | |
| Atlantic Salmon | *Salmo salar* | A few were found during electrofishing in the Shediac River, Weisner Brook. | Maillet (1996) |
| Striped Bass | *Morone saxatilis* | Present in Shediac and Scoudouc River in 1852;<br>A beach seine survey performed in 2000 was unsuccessful to capture Striped Bass, suggesting its potential absence or low numbers. | Perley (1852) |
| American Eel | *Anguilla rostrata* | Known to be abundant in Shediac Harbour in 1852;<br>Very few eels were caught in eel traps in the Shediac River during a by-catch survey;<br>Found in 2005 during CAMP sampling. | Perley (1852), Leonard (2000, 2002)<br>Weldon et *al*. (2005) |
| Gaspereau/Alewife | *Alosa pseudoharengus* | Present in Shediac and Scoudouc River in 1852;<br>Found in 2003 and 2005 during CAMP sampling. | Perley (1852), Weldon et *al*. (2005) |
| Smelt | *Osmerus mordax* | Smelt are fished during the winter season with fishing shanties;<br>Also fished during spring and summer at the mouths of rivers;<br>Abundant in Shediac Harbour in 1852;<br>Found in 2004 during CAMP sampling. | Perley (1852), Brun 1994, Weldon et *al*. (2005) |
| Mackerel | *Scomber scombrus* | Perley (1852) observed an abundant population of mackerel in the Northumberland Strait;<br>In 1870-80, mackerel was the third most important commercial species after lobster and herring. | Perley (1852), Brun (1994) |
| Herring | *Clupea harengus* | The Shediac Cap Pelé region was once known as "Cap Hareng";<br>A spring spawning ground is identified in the Shediac Bay. These are generally found in depths of less than 2 fathoms;<br>Found in 2005 during CAMP sampling. | Brun (1994), Therrien et *al*. (2000),<br>Weldon et *al.* (2005) |
| Mummichog | *Fundulus heteroclitus* | Found in 2003-2005 during CAMP sampling;<br>2004 data from CAMP showed that this species represented 46.5% of species inventoried. | Weldon et *al.* (2005) |
| Threespine stickleback | *Gasterosteus aculeatus* | Found in 2003-2005 during CAMP sampling;<br>In the 2004 CAMP data, this species represented 11.6% of the population inventoried. | Weldon et *al*. (2005) |
| Fourspine stickleback | *Apeltes quadracus* | Found in 2003-2005 during CAMP sampling. | Weldon et al. (2005) |
| Ninespine stickleback | *Pungitius pungitius* | Found in 2003-2005 during CAMP sampling. | Weldon et *al.* (2005) |

| | | | |
|---|---|---|---|
| Blackspotted stickleback | *Gasterosteus wheatlandi* | Found in 2003-2005 during CAMP sampling. | Weldon et *al*. (2005) |
| Atlantic silverside | *Menidia menidia* | Found in 2003-2005 during CAMP sampling. | Weldon et *al*. (2005) |
| Banded killifish | *Fundulus diaphanus* | Found in 2004-2005 during CAMP sampling. | Weldon et *al*. (2005) |
| Brook trout | *Salvelinus fontinalis* | Found on the Weisner Brook. | Maillet (1996) |
| Atlantic tomcod | *Microgadus tomcod* | By-catch in eel traps along Shediac River system;<br>Found in 2005 during CAMP sampling. | Maillet (1996), Weldon et al. (2005) |
| Capelin | *Mallotus villosus* | By-catch in eel traps along Shediac River system | Maillet (1996) |
| Cunner | *Tautogolabrus adspersus* | Found in 2003-2005 during CAMP sampling. | Weldon et *al.* (2005) |
| Arctic rockling | *Gaidropsarus argentatus* | Found in 2004 during CAMP sampling. | Weldon et *al*. (2005) |
| Sand lance | *Ammodytes americanus* | Found in 2005 during CAMP sampling. | Weldon et *al*. (2005) |
| Northern pipe fish | *Syngnathus fuscus* | Found in 2005 during CAMP sampling. | Weldon et *al*. (2005) |
| | | | |
| **Marine mammals** | | | |
| Harbour Seal | *Phoca vitulina* | Harbour seals are seen around Shediac Island. | Brun (1994), Town of Shediac (2005b) |

# 4. TRADITIONAL AND LOCAL KNOWLEDGE

## 4.1. TRADITIONAL KNOWLEDGE OF COMMERCIAL FISHERIES

In 1996-97, DFO's Gulf Region attempted to identify the main habitats of commercially harvested species throughout the southern Gulf of St. Lawrence using traditional knowledge of fish harvesters, fisheries officers, biologists and others. The information gathered was used to prepare an atlas of thematic maps. Table 13 provides details of significant habitats that were identified in the Shediac Bay region for some of these commercially harvested species (Fisheries and Oceans Canada 2005d).

**Table 13: Distribution of commercial fisheries resources within the Shediac Bay**

| Species | Latin name | Location and Comments |
|---|---|---|
| Soft-shelled clam (Figure 19) | *Mya arenaria* | Soft-shelled clams are especially abundant on mudflats; they are located all along the shoreline from Grande-Digue to Barachois; mouth of the Shediac and Scoudouc Rivers and along Shediac Island |
| Bar clam | *Spisula solidissima* | Bar clams are found on sandbars; located along the Grande-Digue barrier beach, Shediac Island toward the Northumberland Strait and from Pointe-du-Chêne to Barachois |
| Razor clam | *Enisis directus* | Razor clams are found in the same areas as bar clams; located along the Grande-Digue barrier beach, Shediac Island toward the Northumberland Strait and from Pointe-du-Chêne to Barachois |
| American oyster (Figure 19) | *Crassostrea virginica* | Within Shediac Bay; mouth of the Shediac and Scoudouc Rivers; along Shediac Island towards the Northumberland Strait and inside Barachois harbour |
| Quahog | *Mercenaria mercenaria* | Within Shediac Bay; mouth of Shediac River between Grande-Digue barrier beach and Shediac Island |
| Blue mussel (Figure 19) | *Mytilus edulis* | Within Shediac Bay, around Shediac Island and near Barachois harbour |
| American eel (Figure 20) | *Anquilla rostrata* | Present in Shediac Bay, Shediac River, near Shediac Island and in Barachois Harbour |
| Rainbow smelt (Figure 20) | *Osmerus mordax* | In Shediac Bay, Shediac River, near Shediac Island and shoreline from Grande-Digue to Barachois |
| Alewife | *Alosa pseudoharengus* | Within Shediac River |
| Atlantic mackerel | *Scomber scombrus* | Off-shore and along the Northumberland Strait shore |
| Atlantic herring | *Clupea harengus harengus* | Present in Shediac Bay and along the Northumberland Strait shore;Atlantic herring spring fishery in Shediac Bay; Important Atlantic Herring spawning grounds along the Northumberland Strait shore from Cap de Cocagne towards Cap-Pelé |

| | | |
|---|---|---|
| Winter flounder | *Pseudopleuronestes americanus* | Off-shore between Cap Brûlé and Barachois |
| Sea urchin | *Strongylocentrotus droebachiensis* | Along the Shediac Island shoreline |
| American lobster | *Homarus americanus* | Within Shediac Bay; Present in early season; present all season off-shore in deeper waters; spawning grounds off-shore from Shediac Island to Barachois; Fishing season from July to August |
| Rock crab | *Cancer irroratus* | Within Shediac Bay |

Fisheries and Oceans Canada (2005d)

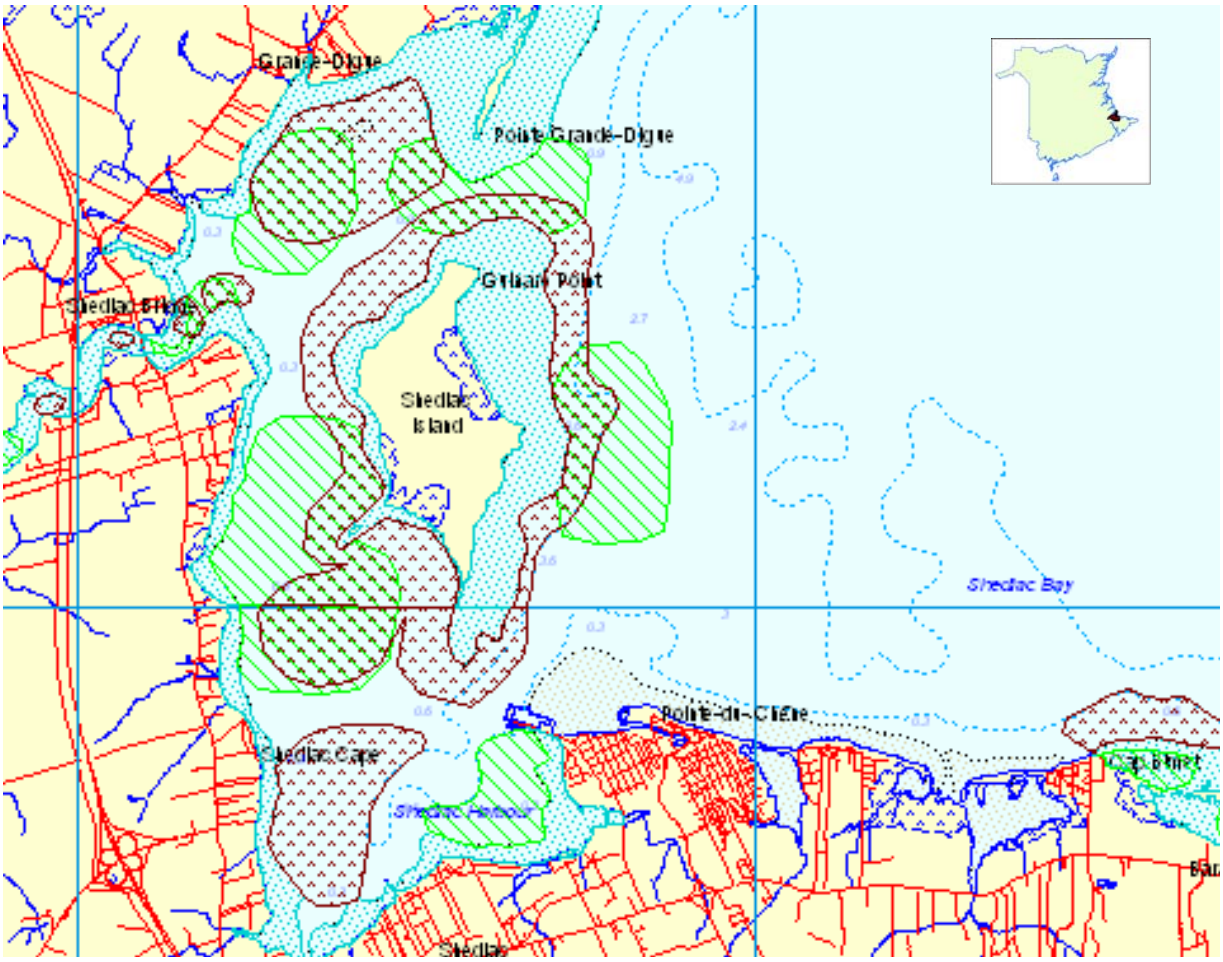



**Figure 19: General habitat distribution of selected molluscs**

Source: DFO (2005d) : http://glfgeo.dfo-mpo.gc.ca/tfk-ctp/.

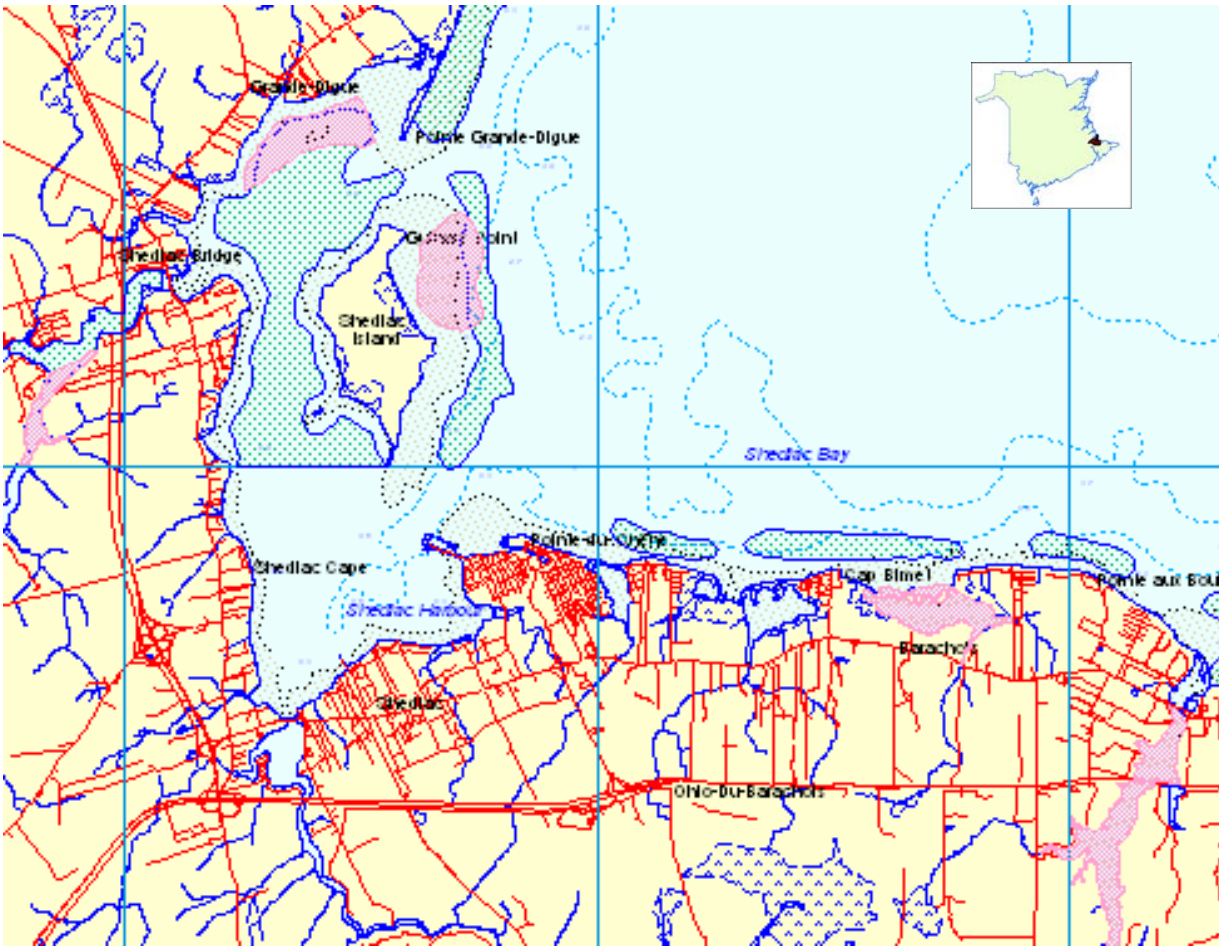



**Figure 20: General habitat distribution of American eel and Rainbow smelt**

Source: DFO (2005d) : http://glfgeo.dfo-mpo.gc.ca/tfk-ctp/.

# 5. ECOSYSTEM DESCRIPTION

All components of a community, including living and non-living, interact among each other and form a system of ecological relationships called an ecosystem (Sutton & Sutton 1998). The aim of this section is to present a general description of the Shediac Bay watershed ecosystem and explain the biological-physical linkage and interactions occurring in the watershed.

The Shediac Bay watershed is located in southeastern New Brunswick and drains directly into the Northumberland Strait. Its gently sloping landscape is composed primarily of sedimentary Pennsylvanian sandstone. Present day soils are the result of biological, chemical and physical processes that have occurred over thousands of years. Inland wetlands and bogs result from poorly drained soils where plant debris accumulated during the last deglaciation (Rees et *al*. 1996).

The in-flow of freshwater is supported primarily by two river systems: the Shediac and Scoudouc Rivers. The drainage patterns of the streams are fair to poor due to the low elevation of the landscape. Shediac River provides the largest freshwater discharge into the receiving bay with an increase of discharge from both rivers during the spring melt.

Shediac Bay supports a diversity of aquatic species within its coastal ecosystems. The in-flow of freshwater from both river systems provides constant nutrient and organic matter into the receiving bay. In turn, tides provide saltwater upriver. Because of the relatively flat terrain, the head of tide of the Shediac River system is approximately four miles from the mouth of the river. Tides in this bay are mostly diurnal with semi-diurnal tides occurring less frequently. Water exchange rate for the bay is approximately 41.5 hours.

Estuarine ecosystems, at the mouths of the rivers, are highly productive areas with abundant nutrients (Figure 21). They are important resting and spawning grounds for fish (Campagne 1997). Extensive eelgrass beds found in these estuarine areas provide habitat, food and shelter to a great number of aquatic species and also help retain the sediment and slow down the current. Because of their high **productivity**, eelgrass beds are an important element in the coastal food chain (Therrien et *al*. 2000).

Shellfish such as American oysters, blue mussels, soft-shelled clams and quahogs are part of the benthic community of the bay. Shediac Bay supports a number of other commercially important species such as lobster, rock crab and smelts. Small pelagic species also serve as food for seals and birds (Campagne 1997).

Although the Shediac Bay watershed supports a diversity of terrestrial and aquatic ecosystems, many of these features are vulnerable to human disturbances and alterations. Poor water quality, nutrient pollution, the introduction of sediments into watercourses and the loss of important salt marshes threaten the coastal features of this seaside destination and its various habitats for fauna and flora. Fragmentation of fish habitat, for example, is an issue pertaining to the migratory routes of certain fish species in the watershed.

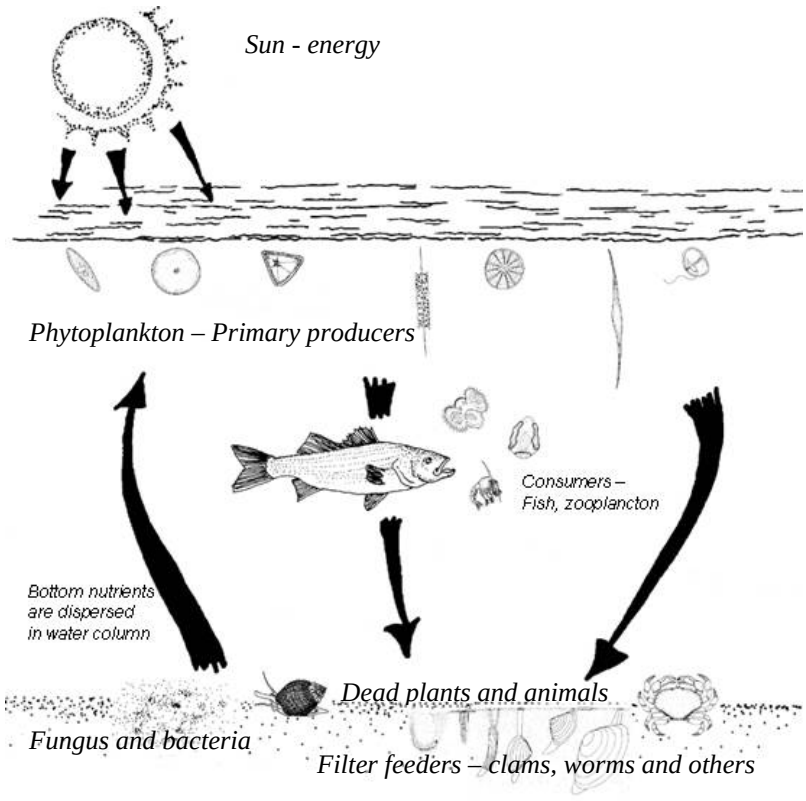



**Figure 21: Cycle of nutrients in the coastal zone**

Source: Campagne (1997) p. 47 “By the sea” module 1

# 6. HUMAN SYSTEM

## 6.1. HUMAN COLONISATION

The name Shediac comes from the Mi'Kmaq word "Es-ed-ei-ik" meaning "a stream between two lands" or "running far in". Shediac was the location of the most important Mi'Kmaq encampment of Westmorland County. The Shediac Harbour had many resources to offer Mi'Kmaq families such as abundant fish, molluscs, crustaceans and small and big game species (Brun 1994).

Acadians named the actual location of the Town of Shediac "La Batture" because of the abundance of oyster beds at the mouth of the Scoudouc River. The first Acadian families settled permanently in the area between 1798 and 1805. English families settled near Pointe-du-Chêne after 1855. By the begin of the 20th century, Shediac had a ferry service to Prince Edward Island, a wharf, a lighthouse, roads, houses and one school (Brun 1994). The first public provincial road was built between Shediac and Moncton in 1816. Shediac was once the location of the most important railway centre in the county. The first passenger railroad in the Maritimes was built around 1857 between Shediac and Moncton (Town of Shediac 2005a).

The local economy took advantage of the geographic location and its many forms of transportation by ship, train and public roads. Shipbuilding yards, steam sawmills, the timber industry, agriculture and seafood products were among the most important industries from the 19th to the beginning of the 20th century. The timber industry began in the mid 1800's when Britain was in search of large white pines to make ship masts. The first steam sawmill constructed in 1820 near the Scoudouc River gave a boost to the local economy. Many people were employed at sawmills, wharves and with the railway. Agriculture, specifically the potato industry, also played a major role in the economy and the development of Shediac. Potatoes were shipped by train and sea to markets in Bermuda, West Indies and the rest of Canada (Brun 1994; Town of Shediac 2005a).

Over the years, Shediac became famous for its lobster and eventually became known as the Lobster Capital of the World. The first lobster processing plant was constructed in 1861. By 1903, a large enterprise known as "Paturel" began processing and marketing

lobster. It was in production until it closed in 2007. Smoked herring was another seafood product that was exported to the Antilles via Shediac (Brun 1994).

Tourism began around the 1870's. Tourists would travel by train to take advantage of Shediac's sandy beaches and seafood. In 1876, there were 8 hotels for tourists (Brun 1994). Even today, thousands of tourists continue to visit the area during the summer months. Parlee Beach, an important tourist attraction, can receive up to 25,000 visitors during a warm summer day.

Shediac's economic development is comprised of diverse industries in tourism, retail and services, government services, manufacturing and information technology (Town of Shediac 2005b).

### 6.2. HISTORICAL SITES

Archaeological studies within the watershed discovered a 14th century A.D. Mi'Kmaq burial site on Skull Island (Figure 22) which is located just west of Shediac Island. Indian Point, another burial site (Figure 22), was later found at the mouth of Shediac River (Brun 1994; Leonard 2002).


**Figure 22: Sites of archeological interest**

Sources :
Brun (1994)
Leonard (2002)

*Sites identified with a red star

An archaeologist carried out a series of studies on Shediac Island and discovered hundreds of artifacts such as pottery dated between 1600 and 1300 years ago (Leonard 2000). Other artifacts found were glass, coal, iron, brass and bones. These materials suggest various activities carried out by diverse groups present on the island, including Mi'Kmaqs and Europeans.

## 6.3. GOVERNANCE STRUCTURES

### 6.3.1. Role of federal and provincial governments

Government agencies have a very important role to play as stakeholders in the integrated management of a coastal zone. They are the primary managers and decision-makers for the territory, since they develop and apply the acts and regulations used to manage it. The Policy and Operational Framework of Canada's Oceans Strategy (2002) promotes the involvement of all government levels in the integrated management of estuarine, coastal and marine environments in Canada. The concept of integrated management does present some challenges. There are various levels of governments with a multiplicity of jurisdictions and the responsibility of enforcing many acts and regulations. This can lead to overlapping mandates and conflicts in legislation. Government organisations will need to coordinate their activities and work together at all levels to harmonize their regulations so as to ensure the sound management of our oceans.

Since the list of management mechanisms used by various government stakeholders involved in the management of coastal areas can be very long and complicated, only the main management mechanisms are presented in table 14.

**Table 14: Federal and provincial governance mechanisms**

| Management mechanisms | Agency responsible | Application |
|---|---|---|
| **Federal mechanisms** | | |
| *Fisheries Act* | Fisheries and Oceans Canada<br>Environment Canada | Targets the conservation and protection of fish and the habitats they use at different stages of their lives.<br>Section 36(3) Polluting of fish habitats by the discharging of harmful substances into fish-bearing waters is applied by EC |
| Aboriginal Communal Fishing Licences Regulations | Fisheries and Oceans Canada | Regulations for issuing a communal licence to aboriginal organisations for fishing related activities |

| | | |
|---|---|---|
| *Navigable Waters Protection Act* | Transport Canada | Designed to protect the public right of navigation of Canadian waters for transportation, trade or recreational purposes. |
| *Oceans Act* | Fisheries and Oceans Canada | Management mechanism based on the sustainable development of natural resources, the integrated management of activities carried out in coastal and marine areas and a precautionary approach in decision-making |
| *Species at Risk Act* | Responsibility shared by government agencies, the main ones being: Environment Canada<br>Fisheries and Oceans Canada<br>Parks Canada<br>Natural Resources Canada<br>Transport Canada | Designed for the conservation of wildlife species, to prevent their disappearance from this country and the planet as a whole. This act prohibits the slaughter or harassment of wildlife species identified on the List of Wildlife Species at Risk by COSEWIC. It also protects the living habitats of these species. |
| *Migratory Birds Convention Act of 1994* | Environment Canada | Management mechanism for the protection of migratory birds and their nests. It calls for the establishment, monitoring and management of protection zones for these birds, among other measures. |
| *Canada Water Act* | Environment Canada | Mechanism to manage the implementation and use of Canada's water resources. |
| *Canadian Environmental Protection Act* | Environment Canada | Targets the prevention of pollution, the protection of the environment and human health and the sustainable development of natural resources |
| *Canadian Environmental Assessment Act* | Canadian Environment Assessment Agency and all other federal departments involved pursuant to federal legislation | Targets protection of the environment, human health and the application of the principle of prudence. It promotes sustainable development conducive to a healthy environment and economy |
| *Canadian Food Inspection Agency Act* | Canadian Food Inspection Agency | To insure the quality of food, the protection of plants and the health of animals |
| **Provincial mechanisms** | | |
| *Clean Water Act* | Department of the Environment (DOE) and Department of Health and | To maintain and improve water quality |

| | | |
|---|---|---|
| | Wellness (DHW) | |
| *Clean Air Act* | DOE and DHW | To maintain and improve air quality |
| *Clean Environment Act* | DOE | To protect and improve the health of the environment |
| *Aquaculture Act* | Department of Agriculture and Aquaculture (DAA) | To regulate aquacultural development |
| *Parks Act* | Department of Tourism and Parks (DTP) and Department of Natural Resources (DNR) | To create and manage natural spaces for public use |
| *Fish and Wildlife Act* | DNR | To protect and manage fish stocks and wildlife |
| *Community Planning Act* | DOE | Used to plan and control the use of the land |
| *Crown Lands and Forests Act* | DNR | To manage Crown lands |
| *Marshland Reclamation Act* | DAA | To manage the construction and reconditioning of marshland and to manage work carried out in marshes. |
| *Oil and Natural Gas Act* | DNR | To control the exploration and exploitation of oil and gas on freehold or Crown lands |
| *Protected Natural Areas Act* | DNR | To establish, maintain and manage unique natural spaces |
| *Quarriable Substances Act* | DRN | To control the extraction of substances such as peat, sand, gravel etc. on Crown Lands and all lands within 300 meters of either side of the coastline |
| Wetlands Conservation Policy | DNR | To preserve wetlands |
| Coastal Areas Protection Policy | DOE | To regulate coastal development |

Environment Canada (2003), Justice Canada (2005), Department of Justice and Attorney General (2005)

#### 6.3.1.1. Planning Commissions

New Brunswick's planning commissions are governed by the Department of the Environment and Local Government pursuant to the *Community Planning Act*. They work in cooperation with the province and municipalities to produce planning tools for proper land use and development. These tools may consist of municipal plans, rural plans and the various related by-laws, such as zoning, building and other by-laws. They also issue building permits and do building inspections. For the past several years, these commissions have been working to develop rural plans for the many local service districts (LSDs). These plans focus on the management of lands adjacent to municipalities. They are used to

identify or delimit lands for various uses, by establishing residential, recreational, industrial, commercial, agricultural, forestry, “protected” and other zones. There are three district planning commissions associated with the Shediac Bay watershed (Figure 23). For more details about municipal by-laws and plans for the watershed, contact one of the following District Planning Commissions:

For the Shediac Parish:

**BEAUBASSIN PLANNING COMMISSION**
815A, Bombardier Street
Route 15/Exit 37, Shediac, NB
Canada E4P 1H9
Telephone: (506) 533-3637
Fax: (506) 533-3639
Email: beaubassin@beaubassin.nb.ca
Site: http://www.beaubassin.nb.ca/

For the Dundas Parish (Grande Digue area):

**KENT DISTRICT PLANNING COMMISSION**

25-145 Boulevard Cartier
Richibouctou, NB
E4W 3W7
Telephone: (506) 523-1820

211 Irving Boulevard, C.P. 370
Bouctouche, NB
E0A 1G0
Telephone: (506) 743-1490
Fax: (506) 743-1491

For the Moncton Parish:

**GREATER MONCTON PLANNING DISTRICT COMMISSION**
655 Main Street
Moncton, NB
E1C 1E8
Telephone: (506) 857-0511
Fax: (506) 859-2683

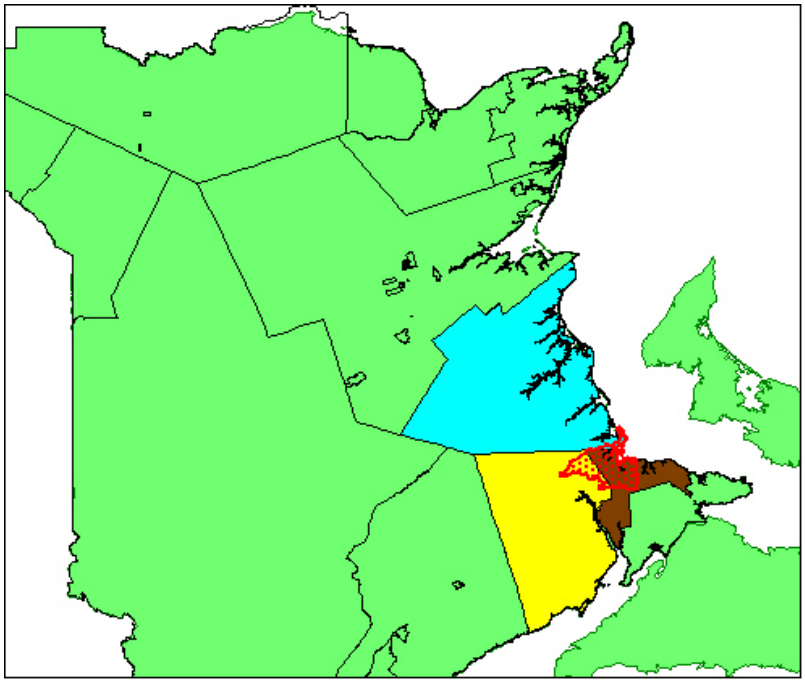
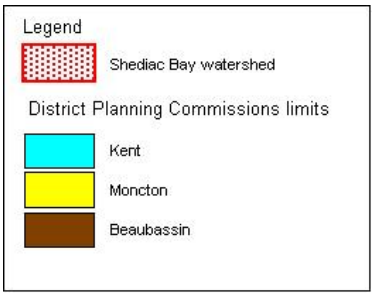


**Figure 23: District Planning Commissions within Shediac Bay watershed**

Sources :
Service NB
NB Aquatic data Warehouse




### 6.3.2. Local and municipal governance

The Shediac Bay watershed boundaries stretch across the Westmorland and Kent Counties (Figure 24) and are included in the Shediac and Moncton Parishes. Approximately 15,000 people live within the study area (Audet 2005). The Town of Shediac constitutes 2.5 % of the land surface area (Jordan 2000) and has a population of 4,892 residents (Letemplier 2001). The Shediac Parish consists of a population of 4,292 people and the Moncton parish has a total of 8,743 residents (Letemplier 2001; Statistic Canada 2005). The Grande-Digue area has a population of 2,109 and Shediac Bridge/Shediac River has a total of 950 residents (Government of New Brunswick 2006). South East Enterprise (2005) indicates that the population in both the Town of Shediac and Shediac Parish has increased by 5% from 1996 to 2001. The communities within the watershed boundaries are listed in Table 15.

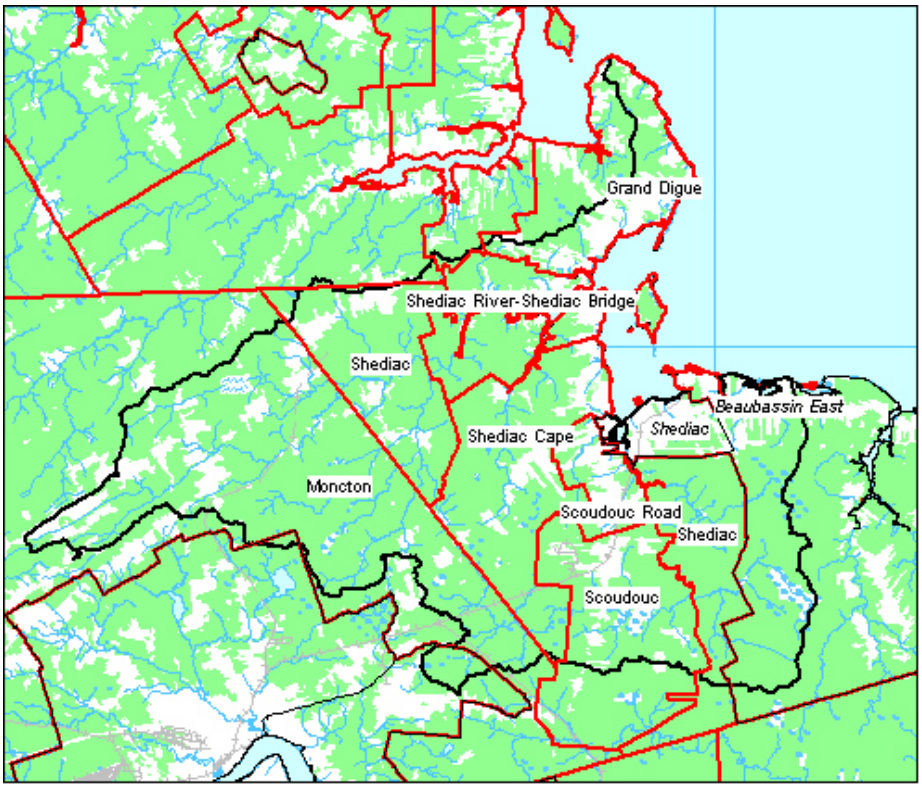



**Figure 24: Shediac Bay watershed LSDs and municipalities**

Sources: Service NB, NB Aquatic Data Warehouse

**Table 15. Communities in the Shediac Bay watershed**

| Communities | |
|---|---|
| Bateman's Mill | MacDougall Settlement |
| Boudreau Office | Old Shediac Road |
| Caissie-Cape | Pointe du Chêne |
| Cap Bîmet | Scotch Settlement Road |
| Cap Brûlé | Scoudouc |
| Cape Breton Road | Shediac Bridge |
| Cap de Cocagne (eastern portion) | Shediac Cape |
| Grand Barachois | Shediac River |
| Grande-Digue | Saint-Philippe |
| Irishtown | Shediac Road |
| Indian Mountain | Town of Shediac |

Audet (2005)

The Government of New Brunswick introduced *Bill 11* with the intention of promoting the creation of new rural communities in the province's rural regions. The goal of this initiative is to improve local governance and decision making within rural communities. In February 2004, three local service districts, Grande-Digue, Shediac Bridge/Shediac River and Cocagne demonstrated an interest in the establishment of a rural community. The first public consultation meetings were held in June and in October 2005. During these sessions, residents and businesses voiced their concerns on the issue. If local support is sufficient, the concerned local service districts will be incorporated as a rural community (Government of New Brunswick 2006).

## 6.4. SOCIO-ECONOMIC COMPONENTS

### 6.4.1. Municipal and coastal development

The Shediac Bay watershed is part of the region managed by the Beaubassin Planning Commission (Rees et *al.* 1996), Kent District Planning Commission (Dundas Parish) and the Greater Moncton District Planning Commission (Moncton Parish) (Figure 23). Each commission provides planning services of all aspects related to the development of the communities which includes the issuance of appropriate permits for the construction of dwellings, development of lots, new roads and commercial buildings (Beaubassin Planning Commission 2005).

The major coastal development areas within the watershed, including the Town of Shediac, Pointe-du-Chêne and Shediac Cape, are part of the municipality of Shediac and the Beaubassin West Planning Area. The area has seen an increase in coastal and housing development. Tables 16 and 17 list the number of permits issued, lots created, number of new public streets, future streets and private accesses. The total value of the new constructions is also available.

**Table 16. Development activities in the Town of Shediac**

| **Shediac** | **2000** | **2001** | **2002** | **2003** | **2004** |
|---|---|---|---|---|---|
| # permits issued | 179 | 132 | 163 | 183 | 164 |
| # created lots | 23 | 46 | 90 | 62 | 54 |
| # New public streets | 2 | 1 | 6 | 6 | 1 |
| # Future streets | 0 | 1 | 1 | 2 | 0 |
| # New private accesses | 0 | 0 | 1 | 0 | 0 |
| Total Value | $5,694,380 | $10,748,480 | $9,444,888 | $12,547,198 | $11,462,466 |

Beaubassin Planning Commission (2005)

**Table 17. Development activities in the Beaubassin West Planning Area**

| Beaubassin East | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|
| # permits issued | 164 | 162 | 169 | 144 | 152 |
| # created lots | 53 | 30 | 35 | 27 | 38 |
| # New public streets | 1 | 0 | 0 | 0 | 0 |
| # Future streets | 0 | 0 | 0 | 0 | 0 |
| # New private accesses | 6 | 2 | 7 | 4 | 2 |
| Total Value | $5,387,795 | $5,359,500 | $6,367,740 | $6,124,793 | $9,551,650 |

Beaubassin Planning Commission (2005)

Since the 1900's, this seaside destination has attracted many visitors. People became increasingly interested in this coastal area especially near Pointe-du-Chêne due to the proximity of Parlee Beach. It resulted in an important cottage community in Atlantic Canada'' (Black & Jordan 2000). Coastal and housing developments continued to grow rapidly over time and some areas are now near their limit of development because of limited space (Black & Jordan 2000; Jordan 2000).

#### 6.4.1.1. Sewage treatment facilities

Approximately 14 km of coastline, including the Town of Shediac, is serviced by a municipal wastewater collection and treatment system managed by the Greater Shediac Sewerage Commission. The entire system accommodates 5,192 units, which include single-family and multi-family dwellings, commercial and industrial infrastructures and seasonal residences (R. Boudreau, pers. comm., January 9th 2006). Located at Cap-Brûlé, the sewage facility consists of an 8.1 Ha two-cell aerated lagoon and a polishing pond (Figure 25). The lagoon system was upgraded in 1995-96 to improve aeration and to prolong retention time. From June 1 to the end of October, the final effluent is chlorinated and discharged into Lac des Boudreau via a small stream. Eighteen lift stations are included in the collection system and are present throughout the Town of Shediac, Pointe-du-Chêne and Cap Brûlé area (Crandall Engineering Ltd. 2000; Richard & Robichaud 2002). A small section of 158 units in the community of Scoudouc (R. Boudreau, pers. comm., January 9th 2006), is serviced by a primary sewage treatment facility (Jordan 2000). The Greater Shediac Sewerage Commission intends on expanding its current treatment system to Cap-Bîmet and Boudreau West in the near future (R. Boudreau, pers. comm., January 9th 2006).

**Figure 25: View of the sewage treatment lagoon in the Cap Brulé region**

The Scoudouc Industrial Park is serviced by an independent wastewater collection and treatment system that extends to 26 acres. The system services the 14 industries of the industrial park. The Scoudouc Industrial Park system is composed of a three cell aerated system with two blowers and a settling pond. Afterwards, the treated wastewater is diverted to an artificial wetland that was constructed in 2000. Water quality testing results indicate very low bacteria and suspended solids in the final effluent from the wetland (S. Bourque, pers. comm., January 6th 2006).

Bay Vista Lodges in Shediac Cape are serviced by a private sewage system and lagoon. The effluent from the lagoon of this 12 cabin facility is discharged into a small creek that flows towards the shoreline (Richard & Robichaud 2002).

### 6.4.2. Activities based on terrestrial resources

#### 6.4.2.1. Mining

***Pits and quarries:*** **Pit**s and **quarries** are scattered throughout the watershed. They are designated as areas where excavation work is carried out to remove quarriable substances such as ordinary stone, building or construction stone, sand, gravel, peat, clay and soil.

The Atlas of Granular Aggregate Resources (Dept. of Natural Resources and Energy 1987) states that approximately 40 pits and 15 quarries can be found within the watershed boundaries. Nine quarries and five pits are located near the mouth of the Shediac River. No current information is available on pits and quarries, thus the information may not be applicable today.

Quarries on Crown Lands are regulated under the provincial *Quarriable Substances Act;* however, the majority of the watershed is composed of private lands (M. O'Donnell, pers. comm., January 12th 2006).

***Peat exploitation:*** Peat lands cover approximately 2 % of the province's land surface area. Peat lands are limited within the Shediac Bay watershed boundaries covering 1,489.00 Ha (Keys & Henderson 1987). Beausejour Peat Moss Inc is the only company mining the peat resources in the area. It exploits peatland #76 near the Scoudouc River system (Figure 26). The peatland crosses the boundary between the Shediac Bay watershed and the Cap Pele watershed. The company exports its product (processed, baled or concentrated peat moss) to Japan and the United States (Industry Canada 2005).

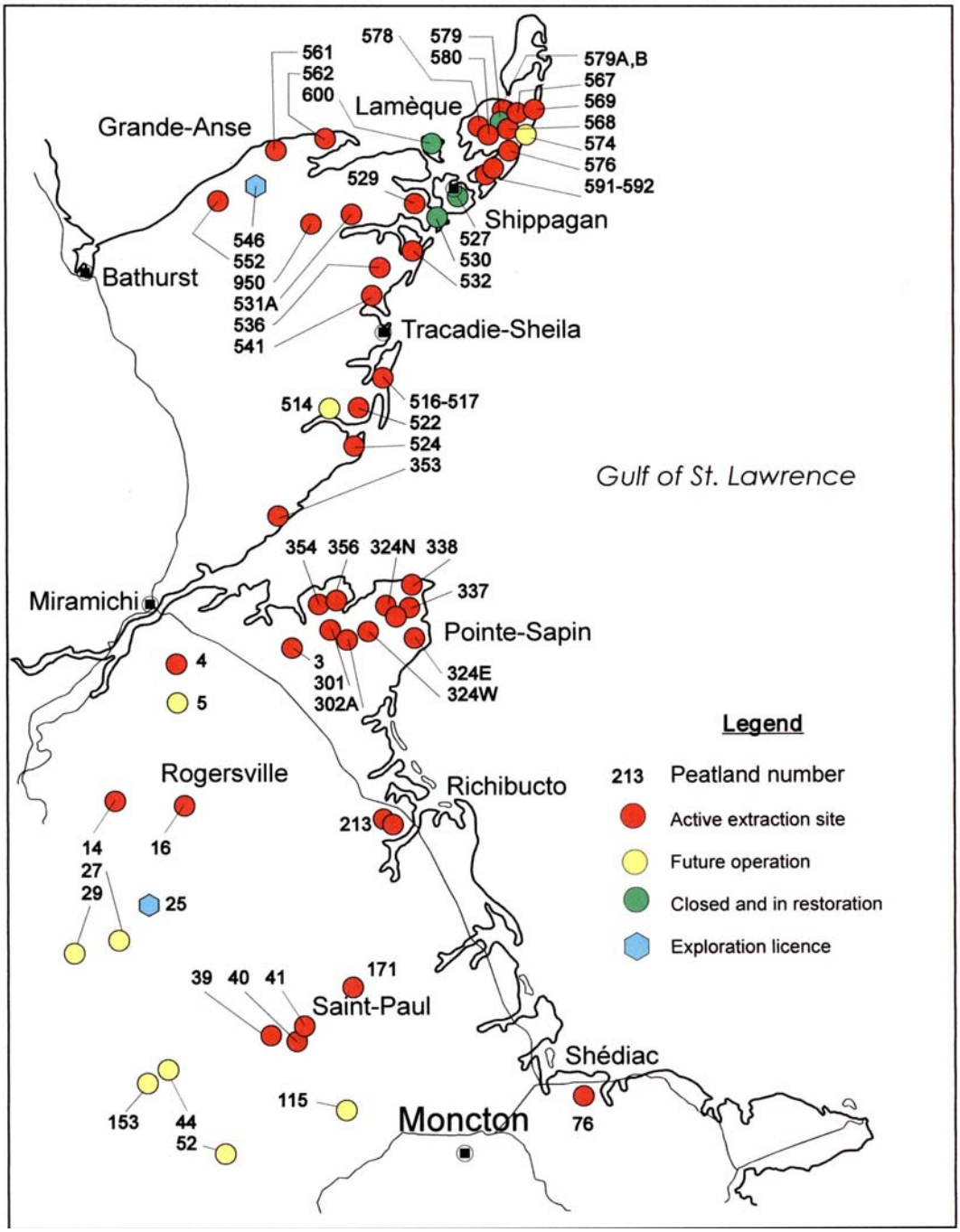



**Figure 26: Peat industry of New Brunswick**

Source: Dept. of Natural Resources (2008)

#### 6.4.2.2. Forestry

Forestry and forest related activities were of economic importance in the early 19th century. During the Napoleonic Wars, Britain sought timber and turned to New Brunswick,

with its vast forest reserves, as a wood supplier. The region became an ideal location for the import and export of wood cargo towards Europe because of the accessible port and wharf. During this time, sawmills were constructed to supply the demand in timber for shipbuilders, ship masts and other wood products. By the end of the 19th century, forestry activities began to falter due to better foreign markets and the launch of the steel ship (Brun 1994).

Today, forest operations still occur in the watershed. Logging activities take place on private woodlots and Crown lands in all parts of the territory. However, the majority of the territory is privately owned land. Private woodlot owners do not report their annual harvesting plans to the Department of Natural Resources; they simply supply their information to the local wood marketing board (G. Watling, pers. comm., January 12th 2006). The Southeastern Wood Marketing Board is a commission linking the government and the industry with wood lot owners and producers. They provide services such as up-to date information on current markets and promote good management practices through various programs. Their territory covers both Westmorland and Kent counties and Rogersville Parish. In 2004/05, the South East New Brunswick Woodlot Marketing Board carried out 686 acres of thinning, planted 24,000 tree seedlings and prepared 31 management plans (M. Maillet, pers. comm., January 11th 2006). Most of the private lands have been treated for silviculture (thinning) (G. Watling, pers. comm., January 12th 2006).

New Brunswick Crown Lands are divided into 10 geographic regions managed by timber licensee companies. The watershed is part of region 7, which is leased to Irving Pulp and Paper Ltd. According to the Department of Natural Resources, there are less than 100 hectares of timber harvesting planned within the next 10 years on Crown lands. Moreover, there has been minimal harvesting in the past 10-20 years (G. Watling, pers. comm., January 12th 2006).

#### 6.4.2.3. Agriculture

In the late 19th century, the Shediac region saw a boost in its economy with the development of the potato industry. The Chesley Tait Company began to export potatoes by train and ship to foreign markets in Bermuda and the West Indies. During this time, the company encouraged local growers to produce potatoes on a larger scale. Thousands of barrels of potatoes were exported over the first twenty years of the early 20th century (Brun 1994).

Today, the agri-food sector along the Southeastern coast of the province, from Richibouctou to Shediac, is recognised for its diversified industry consisting of raising livestock and crop production. Agriculture is a fairly major economic activity in the Shediac Bay watershed. Farms produce fruits, berries and vegetables such as apples, strawberries, blueberries, rasberries, potatoes, corn, lettuce, cucumbers and tomatoes. Livestock production consists of dairy, beef, hog, sheep and poultry. These farms, although not numerous, are scattered throughout the watershed primarily in rural areas. Numerous grain and hay fields as well as pastures are also present in the landscape. (N. Williams, pers. comm., January 4th 2006). One local producer, Les Digues, is part of the *Eco-Logik* program, which promotes the growth of local fruits and vegetables under quality and safety standards while maintaining environmentally responsible practices (La récolte de chez-nous 2006).

#### 6.4.2.4. Hunting

The Shediac Bay watershed is located within Wildlife Management Zones 19 and 25 (Figure 27). The boundaries between the two zones follow along the Scoudouc River. Fur harvesting and trapping are permitted in these zones. Rabbit, coyote, fox, weasel, raccoon, mink, muskrat, otter, beaver, fisher, skunk, squirrel and bobcat are among the small game species that are trapped or snared. Provincial guidelines are available at http://www.gnb.ca/00078/fw/huntsum.pdf# pagemode=bookmarks. Deer and moose hunting are also permitted in the management zones.

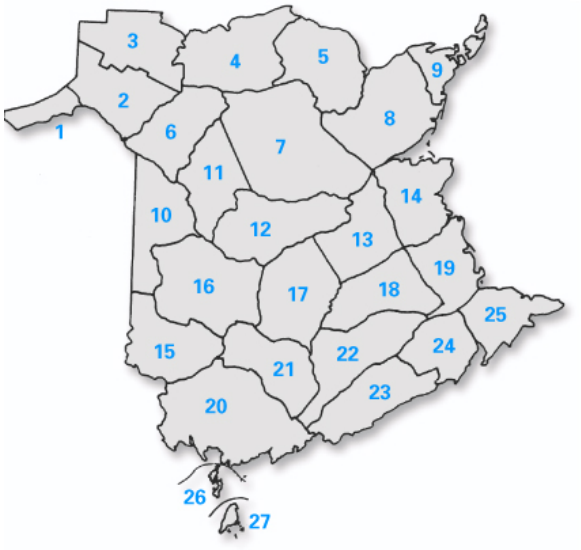



**Figure 27: Provincial wildlife management districts**

Source: New Brunswick. Dept. of Natural Resources (2005)

#### 6.4.2.5. Tourism

The railway played a major role in the Shediac tourism industry. Every summer, thousands of people would depart from Moncton on the train and flock to the beaches of Shediac (Brun 1994). Today, the tourism industry is an important economic sector for the region. Known as Lobster Capital of the World, Shediac attracts more visitors than any other region in the province (Enterprise South East 2005). The population almost doubles during summer months. More than one million visitors are attracted to the sandy beaches and warm waters of the Parlee Beach Provincial Park *(ibid*). This site features kilometres of sandy beaches (Figure 28) and some of the warmest waters north of the Carolinas. Over 25,000 people can visit the beach during a hot summer day *(ibid)*.

**Figure 28: Parlee Beach Provincial Park**

The region features other attractions such as amusement parks, restaurants, campgrounds, golf courses and boat tours. The Shediac Lobster Festival, Great Shediac Duck Race and the Shediac Fine Art Festival are a few of the local annual events (Enterprise South East 2005). Shediac also proudly presents the largest lobster in the world (Figure 29), a sculpture weighing over 90 tons, 11 meters in length and 5 meters in height. This tourist attraction is located in the Shediac Rotary Park and attracts over 300 000 people annually (Town of Shediac 2005b). Other activities include sailing, canoeing, kayaking in the bay and boat excursions to Shediac Island. There are many sidewalk-restaurant bars on the ocean front, and various trails for walking, cycling and snowmobiling.


**Figure 29: Lobster sculpture in Shediac Rotary Park**

### 6.4.3. Activities based on aquatic resources

#### 6.4.3.1. Commercial fisheries

Coastal fishing has always been an important activity in the Shediac region. In fact, oysters were the first commercially exploited seafood. Thousands of barrels of oysters were shipped by train and by boat to major cities across North America. Lobster fishing was also a major species of interest as important lobster processing plants were established along the coastline. The Shediac-Cap-Pelé region was also once known as “Cap Hareng”, because of the abundance of herring in coastal waters. Herring smoke houses are now scattered in the region with a major concentration in Cap-Pelé (Brun 1994).

Today, fishing activities still occur. Landings and values have fluctuated over the years. Eight species of fish, six species of shellfish and two crustaceans are fished in local coastal waters. Table 18 presents the landings and values of the fishing industry for the watershed from 2000 to 2004. Lobster is the commercial species with the greatest landings and value from 2000 to 2004. Alewives, mussels and rock crab also have important landings in this period. Table 19 lists the most frequently used fishing gears for various species.

**Table 18. Landings and values by species in the Shediac Bay watershed**

| ZONE 13: Shediac, Shediac Bridge, Pointe du Chêne | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Species | 2000 | 2000 | 2001 | 2001 | 2002 | 2002 | 2003 | 2003 | 2004 | 2004 |
| | Live Weight (kg) | Value ($) | Live Weight (kg) | Value ($) | Live Weight (kg) | Value ($) | Live Weight (kg) | Value ($) | Live Weight (kg) | Value ($)eurs |
| American Eel | 1,816 | 9,000 | 2,102 | 10,423 | 906 | 5,000 | 3,870 | 16,127 | 2,216 | 10,599 |
| Soft Shell Clam | 6,803 | 0,250 | 3,709 | 6,197 | 5,555 | 0,643 | 2,268 | 3,969 | 680 | 1,497 |
| Blue Mussel | 4,492 | 27,000 | 25,498 | 28,422 | 40,126 | 33,196 | 27,647 | 32,051 | 3,608 | 14,370 |
| American Oyster | | | 5,609 | 1,002 | 0,913 | 53,618 | 4,616 | 14,182 | 3,629 | 12,011 |
| Herring | 2,268 | 500 | 16,729 | 6,976 | 3,098 | 1,013 | 26,768 | 8,770 | 25,628 | 8,888 |
| Mackerel | 9,979 | 7,700 | 18,144 | 14,000 | 9,072 | 6,000 | 6,804 | 4,491 | 907 | 599 |
| Smelt | 4,592 | 4,415 | 1,360 | 1,500 | 2,750 | 3,647 | 6,885 | 7,023 | 2,472 | 2,475 |
| Quahog | 3,607 | 25,500 | 5,941 | 11,843 | 6,553 | 3,870 | 9,306 | 22,968 | 5,443 | 10,179 |
| Scallop | 4,068 | 8,640 | | | | | 1,453 | 2,413 | | |
| Lobster | 19,872 | 201,968 | 17,539 | 199,262 | 16,895 | 192,426 | 17,278 | 198,983 | 8,911 | 99,704 |
| Rock Crab | 24,966 | 18,856 | 24,876 | 23,715 | 25,791 | 19,736 | 24,939 | 17,155 | 20,273 | 15,610 |
| Tomcod | | | 1 | | 20 | 8 | 9 | 2 | | |
| Alewives | 30,759 | 7,575 | 168,624 | 47,520 | 8,415 | 12,729 | 36,242 | 7,907 | 33,369 | 10,696 |
| Bar Clam | 1,816 | 2,800 | 2,043 | 3,375 | 1,867 | 3,452 | 1,013 | 1,812 | 907 | 798 |
| Shad | | | 3 | 3 | | | | | | |
| Cod | 454 | 750 | 272 | 375 | | | | | | |
| Total | 145,492 | 324,954 | 292,450 | 374,613 | 171,961 | 355,338 | 169,098 | 337,853 | 118,043 | 187,426 |

Source: Fisheries and Oceans Canada Figures do not include data from the Cassie Cape wharf nor do they include unregistered landings that are sold directly to the public, to restaurants or used for bait.

**Table 19. Fishing gear used**

| Species | Fishing Gear Used |
|---|---|
| Alewives (gaspareau) | Trap net |
| Bar clams | Manual tools |
| Cod | Gillnet, Danish seine , trawl, handlines, longlines |
| Eels | Hoop net, spear, trap net |
| Herring | Gillnet, purse seine |
| Lobster | Traps |
| Mackerel | Gillnet, handline, purse seine |
| Mussels | Picked manually |
| Oysters (American) | Longhandled rakes, tongs, manual drag |
| Quahogs | Handtools, hydraulic gear |
| Rock crab | Traps |
| Sea scallop | Drag |
| Smelts | Gillnet, trap net, spear, bag net |
| Soft-shelled clams | Hand tools |
| Tomcod | Trap net |

M. Albert, DFO, pers. comm. (August 4th 2005)

#### 6.4.3.2. Recreational fisheries

Smelt fishing has always been a popular winter activity within Shediac Bay. Several sport fishermen haul “Shanties” on the frozen bay and fish smelts with spears (Brun 1994). Clam and mussel harvesting are also important recreational fishing activities (Turcotte-Lanteigne & Ferguson 2004a)

Brook trout and Atlantic salmon fishing is also an important spring activity within the rivers. The sport fishery is considered a significant economic asset (Melanson et *al.* 1998). Provincial licenses are required for fishing in rivers and streams.

#### 6.4.3.3. Aquaculture

Although the number of aquaculture leases is limited in Shediac Bay, shellfish aquaculture is an expanding industry in the province. Shediac Bay hosts 10 active leases covering 88.55 Ha of surface area Table 20 provides details on these leases. The American oyster is the predominant species cultivated although the quahog, bar clam and blue mussel are also species of interest. Lease owners cultivate the shellfish by bottom culture and off-bottom culture (C. Godin, DAFA, pers. comm., December 2005).

An oceanographic study on New Brunswick's east coast suggested that bottom culture should be practiced for oysters and quahogs due to the recreational importance of the Bay (SEnPAq Consultants and Université de Moncton 1990).

**Table 20. Aquaculture leases in Shediac Bay**

| Surface area (Ha) | Type | Species |
|---|---|---|
| 2.02 | Bottom culture | American oyster |
| 1.14 | Bottom culture | American oyster |
| 3.32 | Bottom culture | American oyster, quahog |
| 21.2 | Bottom culture | American oyster, bar clam, quahog |
| 10.12 | Bottom culture | Blue mussel, quahog |
| 13.1 | Bottom culture | American oyster, bar clam, blue mussel, quahog |
| 11.5 | Bottom culture | American oyster, bar clam, blue mussel, quahog |
| 13.6 | Bottom culture | American oyster, blue mussel, quahog |
| 4.86 | Bottom culture | American oyster |
| 7.73 | Bottom/off-bottom culture | American oyster, blue mussel, quahog |
| 8.02 | Bottom culture | American oyster |
| 24.6 | Bottom culture | American oyster, bar clam, blue mussel, quahog |

Source: C. Godin, DAFA, pers. comm. (December 2005)

#### 6.4.3.4. Fish processing plants

Three fish processing plants are found in the Shediac Bay watershed (Figure 30). Together, the companies produce a total of nine different products which are exported to other regions in Canada, the Caribbean, Japan and the United-States. Table 21 provides details on product type and marketing country for each plant.

**Table 21. Fish processing plants, their products and export countries**

| | Chitin and chitosan | Snow Crab | Smoked Herring | Lobster | Mackerel | Cod | Sole | Hors d'oeuvres | Entrées | Destination |
|---|---|---|---|---|---|---|---|---|---|---|
| Eastern Sea Products Ltd. (Brand: Seapro) | | | X | | X | | | | | Canada, Caribbean, United-States |
| Ocean Pier Inc. (Brand : Ocean Pier & Pasta Factory) | | | | | | X | X | X | X | Canada, United-States |
| Shediac Lobster Shop Ltd. (Brand: Shediac Bay) | X | X | | X | | | | | | Canada, Japan, United-States |

Business New Brunswick (2003)

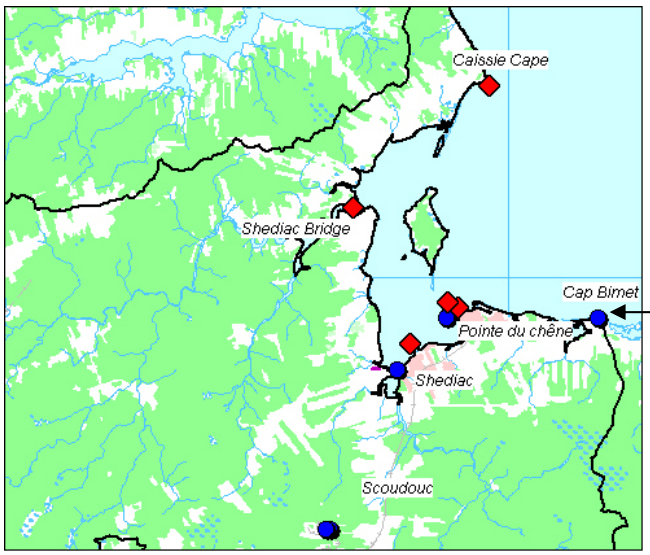



**Figure 30: Ports, marinas and fish processing plants**

Source: DFO

6.4.3.5. Ports and harbours

Historically, the region was known for its major shipping port at Pointe-du-Chêne. Built in 1840, the wharf was a port for cargo ships and a terminal for the ferry to Prince Edward Island until 1911. The port would receive ships from Europe and North America that would transport timber, potatoes and other cargo (Brun 1994).

Presently, the Shediac Bay harbors three wharves for fishing vessels and two marinas for recreational boaters (Figure 30). Table 22 provides details of the wharf facilities and available services.

**Table 22. Wharfs and marinas in the Shediac Bay watershed**

| Name | Details |
|---|---|
| Cassie-Cape wharf | Managed by the Cassie Cape Harbor Authority, Class C wharf, 24 boats; channel is dredged every 2 years, wharf's basin is dredged every 20 years |
| Pointe-du-Chêne wharf | Managed by Pointe-du-Chêne Harbor Authority, has fuel dispenser (diesel and gasoline) |
| Pointe-du-Chêne Yacht Club | 125 berths, services include electricity, water and pump-out station, marina's basin was dredged in May 2005 |
| Shediac Bay Yacht Club and Marina (Figure 31) | The marina is managed by the Town of Shediac. Approximately 200 berths, services include electricity, water and sewage pump-out station. The Yacht Club supports a sailing school. |
| Shediac Bridge wharf | Small wharf used by local fishermen, data n/a |

C. Gaudet, Small Craft Harbors, DFO, pers. comm., (August 30th, 2005)
D. Thibodeau, Small Craft Harbors, DFO, pers.comm., (September 19th 2005)
Shediac Bay Yacht Club (2005)

**Figure 31: Shediac Bay marina**

### 6.4.4. Other industries or services

#### 6.4.4.1. Manufacturing

Enterprise South East (responsible for communities between and including Cap Pelé, Dorchester, Memramcook, Port Elgin, Sackville and Shediac) compiled data on other major industries in their territory based on the 2001 census. Table 23 lists these industry categories.

**Table 23. Five major industries in the Enterprise South East territory**

| Five major industries | % of total industries |
|---|---|
| Manufacturing | 20.3% |
| Healthcare and social assistance | 8.7% |
| Retail trade | 8.6% |
| Construction | 7.5% |
| Educational services | 7.2% |
| All Others | 46.9% |

Serge Doucet, Enterprise South East, pers. comm. (December 19th, 2005)

Table 24 lists the major manufacturing companies within the Shediac Bay Watershed.

**Table 24. Major manufacturing companies in the Shediac Bay Watershed**

| Company | Location |
|---|---|
| Consumers Glass | Scoudouc |
| Caradon Lock-Wood | Scoudouc |
| Glenwood Kitchen | Shediac |
| Cabinets & Speciality Products | Shediac |
| Shediac Lobster Shop | Shediac |
| Atlantic Refreshments | Scoudouc |
| Springwall Sleep Products | Scoudouc |
| C & U Belliveau Concrete Products | Shediac |

The Canadian Institute for Research on Regional Development (1996), Town of Shediac (2005c)

#### 6.4.4.2. Golf courses

Shediac features one golf course located on South Cove Road (off Main Street). Wikiwak Golf Club offers a nine-hole golf course and also an executive course which features 4 holes and a view of Shediac Bay.

## 6.5. TOWARDS A HEALTHY ENVIRONMENT AND DEVELOPING SUSTAINABLY

The following organizations have contributed to the well being of the watershed by their activities:

The **Shediac Bay Watershed Association (SBWA)** is a community-based association that was founded in 1999. Its vision includes “communities working together to foster a healthy ecosystem that will sustain the quality and quantity of water for future generations” (Morrissey et *al*., 2003, p.4). The association has undertaken various projects including the Water Classification Program, stream restoration projects, public awareness programs, shoreline sanitary surveys, flora and fauna surveys, created a community wetland atlas, shellfish restoration project, septic system remediations and beach sweeps (Shediac Bay Watershed Association 2005). The SBWA has developed a water remediation plan for the watershed and has produced a status of the bay report in 2006 (D. Audet, pers. comm., December 2006). The association has also collaborated on the Community Aquatic Monitoring Program on an annual basis since 2003. The Shediac Bay Watershed Association plans to continue the septic systems remediation project, increase public awareness with the green boating outreach program and continue various projects related to their remediation plan in the years to come.

The **Southeastern Anglers Association** (SAA) is a non-profit organization established since 1993. The SAA is an umbrella organization for four groups: Club de chasse et pêche de Grande-Digue, Kent Salmon and Trout Anglers Association, Richibouctou River Association and Kouchibouguacsis River Association (Melanson et *al*. 1998). This Association promotes stream restoration to restore populations of brook trout and Atlantic salmon in rivers and streams. The SAA developed a feasible sport fishery strategy, carried out habitat enhancement projects, studies and surveys. It was the recipient of the 2000 Canada’s National Recreational Fisheries Award (Fisheries and Oceans Canada 2005c).

The club **Les amis de la nature du Sud-Est Inc**. was founded in 1989 by Frère Léo Martin. Today, the club has approximately 55 members. The club covers the region of Shediac, Dieppe, Moncton and surrounding areas. Monthly meetings are held on the first Monday of each month. Monthly excursions are also organized every third Saturday or

Sunday. A newsletter "*La Plume Verte*" is published four times a year. Members of the club participate in a number of activities such as the Christmas bird count, bird watching, flora identification, geology, astrology and other subjects related to our natural heritage (N. Belliveau, pers. comm., December 19, 2005).

# 7. ECOLOGICAL OVERVIEW

## 7.1. NATURAL ATTRIBUTES

### *7.1.1. Species of particular interest*

#### 7.1.1.1. Mammals

The Harbour porpoise has been recommended for a listing of “threatened” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Its designation is pending the outcome of public consultation. The Harbour porpoise is a small whale that inhabits the continental shelf and is well adapted to cold waters. They feed frequently and follow concentrations of prey and take advantage of physical landscape features that may concentrate prey. Their diet consists of a variety of small fishes, including cod, herring, hake, capelin, sand lance and squid. The biggest threat to this species is entanglement in ground fishing gear, a threat that has been reduced since the closure of the cod fishery and decline in other groundfish stocks (Environment Canada 2005).

#### 7.1.1.2. Insects

The Monarch butterfly (*Danaus plexippus)* is designated as a species of “special concern” under the *Species at Risk Act* and COSEWIC since November 2001. Monarchs are found where milkweed (Asclepius) and wildflowers occur (Environment Canada 2005) and are at the edge of their range in New Brunswick. In eastern New Brunswick where milkweed is naturally scarce, their occurrence is not common, with only the occasional individual observed.

#### 7.1.1.3. Birds

The Piping Plover (*Charadrius melodus melodus*) is designated as an “endangered” species under the federal *Species at Risk Act* and the provincial *Endangered Species Act*. This small shorebird nests on sandy beaches, sand spits and barrier beaches. Its dry sand color renders it inconspicous in its environment. Piping Plovers arrive on New Brunswick’s beaches from late April to May. A shallow nest is scraped in the sand or gravel in which the female lays a clutch of usually 4 eggs. Plover forage for food on the shoreline and in mudflats. The major threat to the species is loss of habitat and human disturbances during breeding season. Storm surges and elevated water levels associated with climate change

also threaten the species' habitat (Amirault et *al*. 2004; Environment Canada 2005). In 1991, only one pair of Piping Plover nested on the boundaries of the watershed, on the Petit Barachois beach (D. Amirault, pers. comm., January 6, 2006)

A Red-shouldered hawk (*Buteo lineatus*) has, on occasion, wintered in the area (NB Nature List serve Archives https://listserv.unb.ca/archives/naturenb.html). This species is considered of "special concern" by COSEWIC due to threats to its mature forest habitat (Environment Canada 2006).

#### 7.1.1.4. Fish

Striped bass (*Morone saxatilis*) was once common in bays and estuaries within the Northumberland Strait. The southern Gulf of St Lawrence striped bass population is on the COSEWIC's list of "threatenend" species since November 2004. It has no status under the Species at Risk Act at present, pending public consultations (Canadian Wildlife Service 2004). Habitat changes and over fishing by commercial and recreational fishers likely resulted in the decline of the population to such a degree that the commercial fishery was closed in 1996. Recreational and First Nations fisheries closed in 2000. Some population recovery has been observed since the closure of the fisheries (COSEWIC 2004).

#### 7.1.1.5. Reptiles

Leatherback turtles (*Dermochelys coriacea*) are designated as "endangered" by COSEWIC and the provincial government. This species is not common in the Northumberland Strait but some individuals do move into the strait during their annual migration north into the Gulf of St. Lawrence to feed on jellyfish (M. James, pers. comm., January 30 2006). Entanglement in fishing gear and disturbance on their nesting beaches in Central and South America are the principal threats to this species (Environment Canada 2006).

#### 7.1.1.6. Other

Table 25 lists species at risk in the Shediac Bay Watershed based on information gathered from the Federal Species at Risk Act (SARA), Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2004), and the NB Endangered Species Act.

**Table 25. Species at risk in the Shediac Bay Watershed**

| Species | Species Occurrence in Area | Taxonomic Group | Federal designations SARA & COSEWIC | NB Endangered Species Act |
|---|---|---|---|---|
| Monarch *Danaus plexippus* | Occurs rarely in eastern NB as accidental migrant | Arthropod | SARA – Special concern, Schedule 1 COSEWIC - Special concern (since November 2001) | Not listed |
| Piping Plover *Charadrius melodus melodus* | Occasional breeder and migrant on area beaches | Bird | SARA – Endangered, Schedule 1 COSEWIC - Endangered (May 2001) | Endangered |
| Barrow's Goldeneye *Bucephala islandica* | | Bird | SARA – Special concern, Schedule 1 COSEWIC - Special concern (November 2000) | Not listed |
| Yellow Rail *Coturnicops noveboracensis* | | Bird | SARA – Special concern, Schedule 1 COSEWIC - Special Concern (November 2001) | Not listed |
| Peregrine Falcon *Peregrinus anatum* | | Bird | SARA – Threatened, Schedule 1 COSEWIC - Threatened (since May 2000) | Endangered |
| Red-shouldered hawk *Buteo lineatus* | Rare winter resident in area | Bird | SARA – Special concern, Schedule 3 COSEWIC – Special concern | Not listed |
| Striped Bass *Morone saxatilis* | Formerly abundant, currently undetermined | Fish | SARA – Not listed COSEWIC - Threatened (November 2004) | Not listed |
| Wood Turtle *Glyptemys insculpta* | | Reptile | SARA – Special concern, Schedule 3 COSEWIC - Special Concern (since April 1996) | Not listed |
| Leatherback Turtle *Dermochelys coriacea* | Occasional migrant in Northumberland Strait | Reptile | SARA – Endangered, Schedule 1 COSEWIC – Endangered | Endangered |

Sources: SARA, COSEWIC, and the NB Endangered Species Act

Schedule 1: Official list of Wildlife Species at Risk

Schedule 2 and 3: list of species that must be reassessed by COSEWIC before they are considered for Schedule 1.

### 7.1.2. Other significant regions

The following descriptions are federal and/or provincial significant areas that do not have a specific status.

#### 7.1.2.1. Essential Habitats

An overview of essential habitats for certain marine species was completed for the Southern Gulf of St. Lawrence (Therrien et *al*. 2000). Numerous sites are considered essential for various stages in the life cycle of a particular aquatic species. Shediac Bay is considered as potentially essential habitat for the quahog (Figure 32) and Atlantic herring (Figure 33). The quahog is found in shallow depths, between the intertidal and sublittoral coast limits. The area also constitutes a spring spawning ground for Atlantic herring.

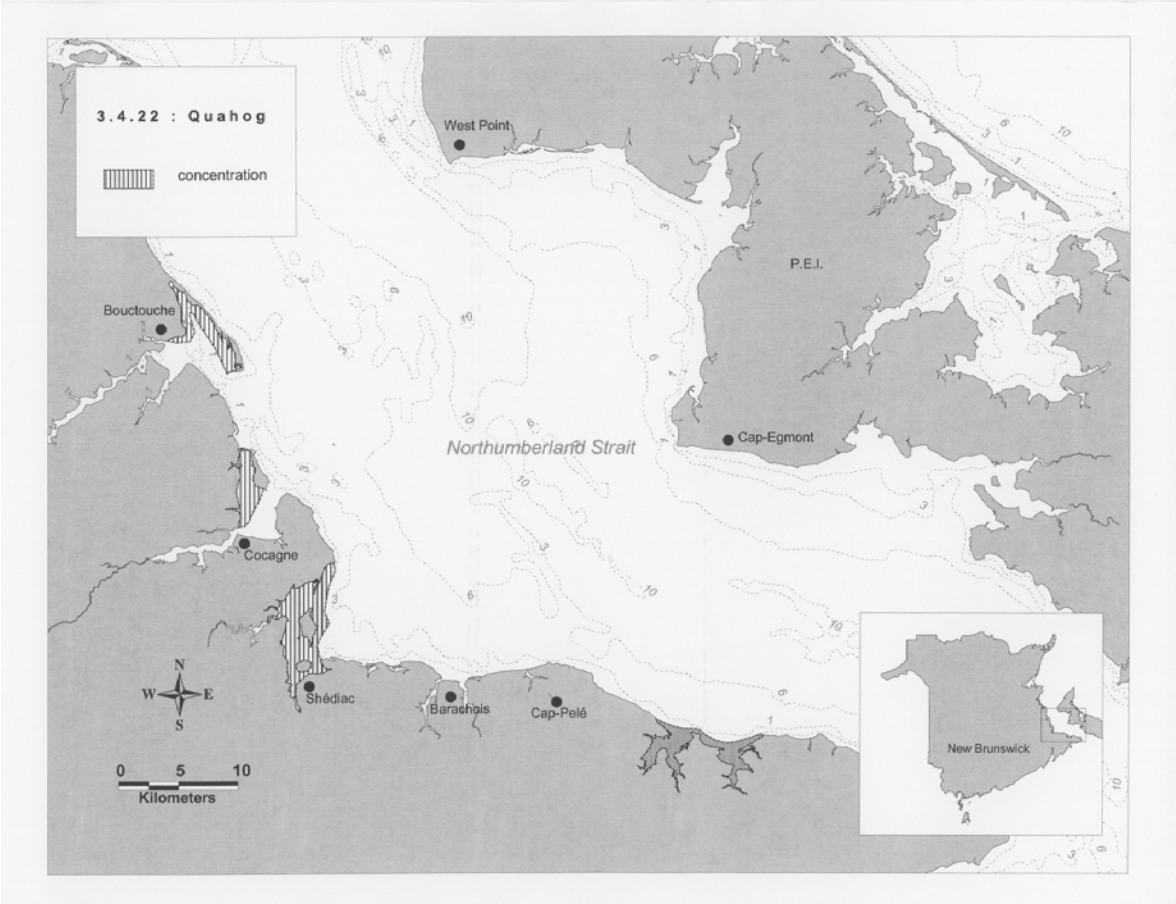



**Figure 32: Potential essential habitat for quahog**

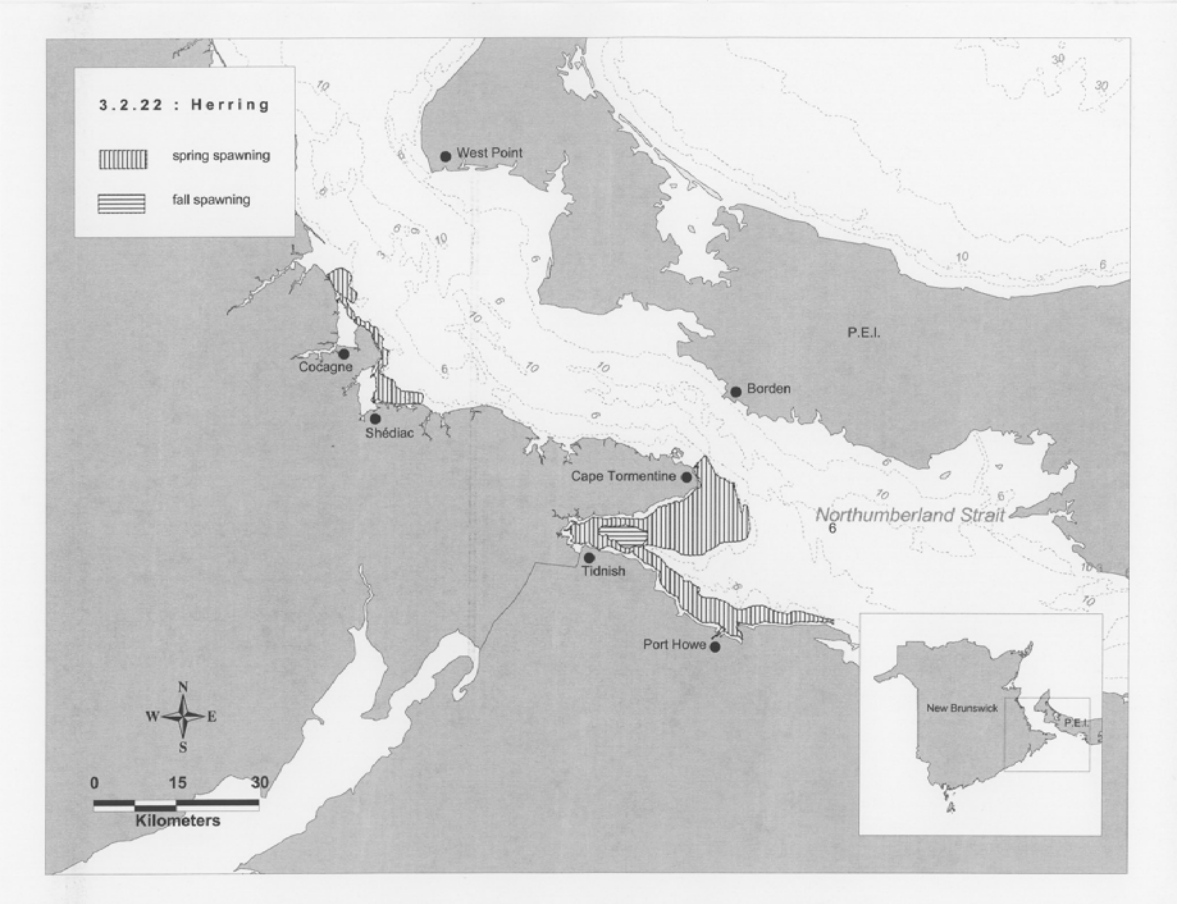



**Figure 33: Potential essential habitat for herring**

Both figures 32 and 33 were drawn from Therrien et *al*. (2000)

#### 7.1.2.2. Ecologically Significant Areas

Between 1993 and 1995, the Nature Trust of New Brunswick in cooperation with the Government of New Brunswick created a database of sites with a rich diversity of species or with special features. More than 900 ecologically significant areas were identified within the province of New Brunswick (The Nature Trust of New Brunswick 2005). Two ESA points are found within the Shediac Bay watershed boundaries (Figure 34). One is located at Petit Barachois (# 545), south of the town of Shediac near Cap Bîmet. This barrier beach supported a nesting pair of Piping Plovers in 1991. The other (# 497) is Shediac Island, noted as being important habitat for migratory birds (*ibid*).

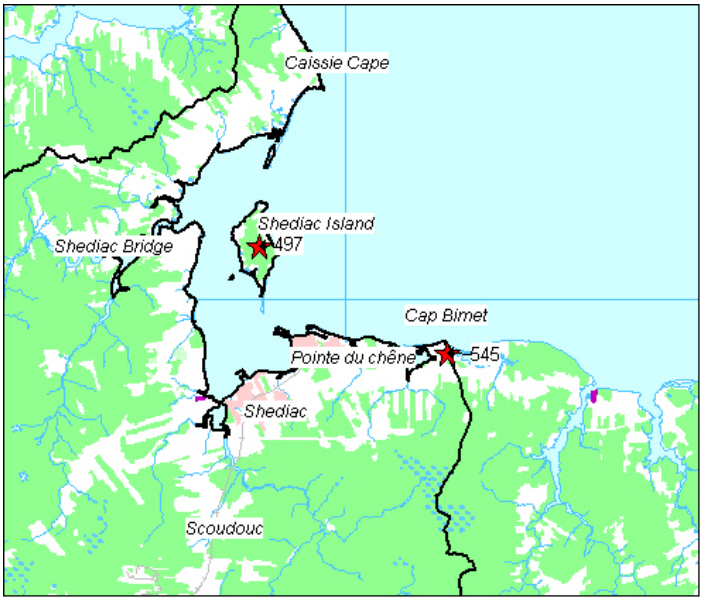



**Figure 34: Environmentally significant areas**

Nature Trust of New Brunswick (1995) - The ESA points are identified by a star

#### 7.1.2.3. Shediac Island

Shediac Island is also designated as a nature park (Figure 35). It is a site of archaeological interest as aboriginal artifacts dated from the 14th century were discovered on the Island. It offers visitors 3 kilometres of walking trails in which they can enjoy various ecosystems. Peat bogs, fields, salt marshes, forests and sandy beaches make up the various ecosystems on the island. A Great blue heron colony is also present (Town of Shediac 2005b).

**Figure 35: Nature trail on Shediac Island**

#### 7.1.2.4. Bird Colonies

Great Blue Herons nest in colonies on treetops. These sites, known as rookeries, are sensitive to human disturbances. Colonies of this majestic bird have been observed on the north and south end of Shediac Island. Numbers have varied yearly (Table 26). Common Terns also settle in colonies on islands and sand spits. They are often seen in bays and estuaries diving head first after small fish (Burrows 2002).

**Table 26. Bird colonies within the Shediac Bay watershed**

| Location | Species | Year censused | Colony size |
|---|---|---|---|
| Shediac Island South | Great Blue Heron | 1974 | 15 pair |
| Shediac Island South | Great Blue Heron | 1979 | 61 pair |
| Shediac Island South | Great Blue Heron | 1981 | 103 pair |
| Shediac Island South | Great Blue Heron | 1984 | 105 pair |
| Shediac Island South | Great Blue Heron | 1989 | 15 pair |
| Shediac Island South | Great Blue Heron | 1998 | 0 pair |
| Shediac Island North | Great Blue Heron | 1979 | 25 pair |
| Shediac Island North | Great Blue Heron | 1981 | 37 pair |
| Shediac Island North | Great Blue Heron | 1998 | 192 pair |
| Shediac Marina | Common Tern | 1994 | 1 pair |
| Shediac Marina | Common Tern | 2000 | 2 pair |
| Marsh West of Cap Brûlé | Common Tern | 2000 | 0 |
| Cap Brûlé | Common Tern | 2000 | 70 individuals |

J. Steward, Canadian Wildlife Survey, pers. comm., (January 9th 2006)

#### 7.1.2.5. Rare coastal plants

A rare coastal plant species survey was carried out along the Northumberland coast in 2004 and 2005. The goal was to determine the status and distribution of rare vascular plant species in various coastal habitats such as sand spits, barrier dunes, coastal lagoons, saline and brackish marshes, headlands, tidal flats and transitional zones. Thirteen species were discovered within the studied coastal areas (Table 27). Many of these coastal plant species were found to be threatened by ATV traffic, residential development, trail construction, road construction and land reclamation (Mazerolle 2004; Mazerolle 2005).

**Table 27. Rare coastal plant species discovered during a survey in 2004-2005**

| Plant species | Year censused | Location | Threat |
|---|---|---|---|
| Saltgrass *Distichlis spicata* | 2004 | Grande-Digue, Shediac Island, Shediac, Pointe-du-Chêne, South Cove, Cap Brule, Lac-des-Boudreau, Cap-Bîmet, Barachois | ATV traffic in Grande-Digue; Residential development, land reclamation, trail construction |
| Horned seablite *Suaeda claceoliformis* | 2004 | Grande-Digue, Shediac Island Cap Brule, Lac-des-Boudreau, Cap-Bîmet, Barachois | ATV traffic in Grande-Digue |
| Germander *Teucrium canadense* | 2004 | Grande-Digue | ATV traffic in Grande-Digue |
| Dwarf hairgrass *Eleocharis parvula* | 2004 | Shediac, Pointe-du-Chêne, South Cove | Residential development, land reclamation, trail construction |
| Bastard toadflax *Comandra umbellate* | 2005 | Shediac Island | |
| Dodder *Cuscuta cephalanti* | 2005 | Shediac Island | |
| Dwarf hairgrass *Eleocharis parvula* | 2005 | Shediac Island | |
| Golden dock *Rumex maritimus* | 2005 | Shediac Island | |
| Fleshy starwort *Stellaria crassifolia* | 2005 | Shediac Island | |
| Germander *Teucrium canadense* | 2005 | Shediac Island | |
| Welsh mudwort *Limosella australis* | 2005 | Shediac River | Road construction and maintenance |
| Brookweed *Samolus valerandi sub. Parviflora* | 2005 | Shediac River | |
| Horned pondweed *Zannichellia palustre* | 2005 | Shediac River | |

Mazerolle (2004, 2005)

## 7.2. STRESSORS AND IMPACTS FROM HUMAN ACTIVITIES

Tables 28a and 28b below present a summary of the stressors and impacts from human activities that were identified in the various documents consulted in the course of the preparation of this report. It is essential to bear in mind that some subjects have been more extensively researched than others, providing more information to determine the environmental impact of the activities concerned. The stressors and impacts of other human activities identified in these tables may be less detailed, or altogether lacking, either because of inadequate information or because the activities in question are infrequent or not practiced in the area under study. The items identified in the tables are discussed in greater detail in the following pages.

**Table 28a. Stressors and impacts imposed on the environment by human activities**

| *Stressors and impacts* | WATER QUALITY STRESSORS | | | | | | BIOTA STRESSORS | | | | | | PHYSICAL CHANGES TO THE HABIAT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Introduction of sediment | Introduction of nutrients | Introduction of pathogens | Chemical contamination or changes | Heavy metal contamination | Air point and non-point source pollution | Introduction of exotic or invasive species | Introduction of disease or parasites | Threat to ecosystem biodiversity | Threat to ecosystem productivity | Threat to aquatic fauna | Threat to aquatic flora | Obstruction to fish passage | Changes in the bottom composition | Contributing factor to anoxic condition | Disturbance to aesthetic appearance | Shoreline changes |
| ***Human activities*** | | | | | | | | | | | | | | | | | |
| Commercial fishing, fixed gear | | | | | | | | | | P | | | | | | P | |
| Commercial fishing, mobile gear | | | | | | | | | | P | | | | P | | P | |
| Fresh water recreational fishing | | | | | | | | | | | | | | | | | |
| Salt water recreational fishing | | | | | | | | | | | | | | | | P | |
| In suspension molluscs aquaculture | | | | | | | | | | | | | | | | P | |
| Bottom molluscs aquaculture | | | | | | | | | | | | | | | | | |
| Cage or pond rearing salmonid aquaculture | | | | | | | | | | | | | | | | | |
| Forestry activities | X | | | | | | | | P | | P | P | P | P | | | |
| Silviculture | | | | | | | | | | | | | | | | | |
| Agriculture of vegetables and small fruits | X | P | | | | | | | | | | | | P | P | | |
| Agriculture, orchards | | | | | | | | | | | | | | | | | |
| Livestock rearing | X | X | X | | | P | | | P | P | P | P | P | P | P | | |
| Fish processing plants | | X | P | | | P | | | P | P | P | P | | | P | | |
| Fruit and vegetable processing plants | | | | | | | | | | | | | | | | | |
| Pulp and paper mill | | | | | | | | | | | | | | | | | |
| Other industrial plants | | | | | | | | | | | | | | | | | |
| Peat mining | | | | | | | | | | | | | | | | | |
| Recreational and tourist activities | X | | | | | | | | | | P | P | | P | | P | |
| Hunting | | | | | | | | | | | | | | | | | |
| Ecotourism activities | | | | | | | | | | | | | | | | | |

X= Stressors and impacts supported by existing data for the watershed.
P= Activities that may potentially exert stress or an impact on the ecosystem, but are not supported by data pertinent to this specific ecosystem.

**Table 28b:Stressors and impacts imposed on the environment by human activities**

| *Stressors and impacts* | | WATER QUALITY STRESSORS | | | | | | BIOTA STRESSORS | | | | | | PHYSICAL CHANGES TO THE HABITAT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Introduction of sediment | Introduction of nutrients | Introduction of pathogens | Chemical contamination or changes | Heavy metal contamination | Air point and non-point source pollution | Introduction of exotic or invasive species | Introduction of disease or parasites | Threat to ecosystem biodiversity | Threat to ecosystem productivity | Threat to aquatic fauna | Threat to aquatic flora | Obstruction to fish passage | Changes in the bottom composition | Contributing factor to anoxic condition | Disturbance to aesthetic appearance | Shoreline changes |
| ***Human activities*** | | | | | | | | | | | | | | | | | | |
| | Property maintenance | | | | P | | | | | | | | | | | | | |
| | Household activities | | | | | | | | | | | | | | | | | |
| | Domestic waste water treatment | | X | X | | | P | | | P | P | P | P | | | P | | |
| | Mineral | | | | | | | | | | | | | | | | | |
| | Oil and gas | X | | | | | | | | | | | | | | | | |
| | Sand and gravel | | | | | | | | | | | | | | X | | | |
| | Water resources | | | | | | | | | | | | | | | | | |
| | Harbour infrastructure activities | | P | X | P | P | | | | P | P | P | P | | | P | | |
| | Channel dredging | X | | | P | X | | | | P | | P | P | | P | | | |
| | Marine transport | | | | | | | P | P | | | | | | | | | |
| | Illegal boat ramp to a watercourse | | | | | | | | | | | | | | | | | |
| | Dams | | | | | | | | | | | | | | | | | |
| | Beach infilling | | | | | | | | | X | | P | P | | P | | | X |
| | Breakwaters | | | | P | | | | | | | | | | | | | X |
| | Hydro electric plant | | | | | | | | | | | | | | | | | |
| | Nuclear energy plant | | | | | | | | | | | | | | | | | |
| | Thermal energy plant | | | | | | | | | | | | | | | | | |
| | Sea level rise | | | | | | | | | | | | | | | | | X |
| | Temperatures | | | | | | | | | | | | | | | | | |
| | Commercial shipping by land | | | | | | | | | | | | | | | | | |
| | Domestic transportation | | | | | | | | | | | | | | | | | |
| | Coastal and urban development | X | | P | P | | | | | X | | P | P | P | | | | X |
| | Roads, bridges and causeways | X | | | | | | | | | | P | P | P | | | | P |
| | Municipal waste water treatment | | X | X | P | | P | | | P | P | P | P | | | P | | |

The information presented in tables 28a and 28b is detailed below. It is categorized for easy reference using the titles and sub-titles from the tables. This section is to allow the reader to reference a particular issue and better understand the impacts and threats to the environment imposed by human activities. For this reason, information is repeated from one issue to another, making this section ponderous for continuous reading.

### 7.2.1. Water quality stressors

#### 7.2.1.1. Introduction of sediment

Many human activities can introduce sediment into a watercourse, especially if poor practices are employed. Forestry practices such as cutting trees and vegetation near watercourses can potentially increase bank erosion and siltation into streams (Jordan 2000). During a shoreline sanitary survey carried out by the Southeastern Anglers Association (LeBlanc et *al*. 2000), sediment loading problems were identified in the Shediac River system. Three farms were also identified as potential sources of sedimentation of the river. Bank erosion was observed near clear cuts, dirt roads, river crossings, ATV trails and culverts *(ibid)*. Eroded ditches near farms and pits also appeared to contribute to the siltation of the watercourse (*ibid)*.

The same survey (LeBlanc et *al.* 2000) identified many possible sources contributing to the sedimentation along the Scoudouc River system. ATV river crossings, the NB natural gas pipe line and the NB powerline also crossing the Scoudouc River system were noted as contributing some degree of sedimentation into this river system.

The Southeastern Anglers Association and the Shediac Bay Watershed Association have worked together to improve water quality within the watershed. In 1999, a cattle fence was erected in the upper Shediac Rver (Irishtown) to restrict livestock access to the stream and reduce sedimentation and **coliform** contamination (LeBlanc et *al*. 2000). Trees were also planted to increase the integrity of the riverbank along the watercourse (Audet 2005).

#### 7.2.1.2. Introduction of nutrients

Phosphorus (P) and Nitrogen (N) are essential nutrients for algal growth. Excess nutrients in aquatic habitats contribute to **anoxic** conditions known as **eutrophication.** It is considered one of the most significant environmental problems in coastal ecosystems (Tchoukanova et *al*. 2003). Human activities, such as fish plant effluent, municipal wastewater, faulty septic systems, agriculture and land run-off (Jordan 2000; Richard &

Robichaud 2002; Morrissey et *al*. 2003), can increase nutrient levels in aquatic ecosystems resulting in excessive algal growth. Excessive amounts of decomposing algae can deplete oxygen levels in the water and produce **anoxic** conditions.

There is a waste water treatment lagoon on the north side of the Scoudouc River. The surrounding vegetation seems to proliferate suggesting a potential risk for eutrophication (V. Mallet, pers. comm., February 12, 2006). Results obtained from the NB Department of Environment and Local Government suggested high concentrations of coliforms and nutrients at the lagoon's outlet (S. Drost, pers. comm., February 10, 2006).

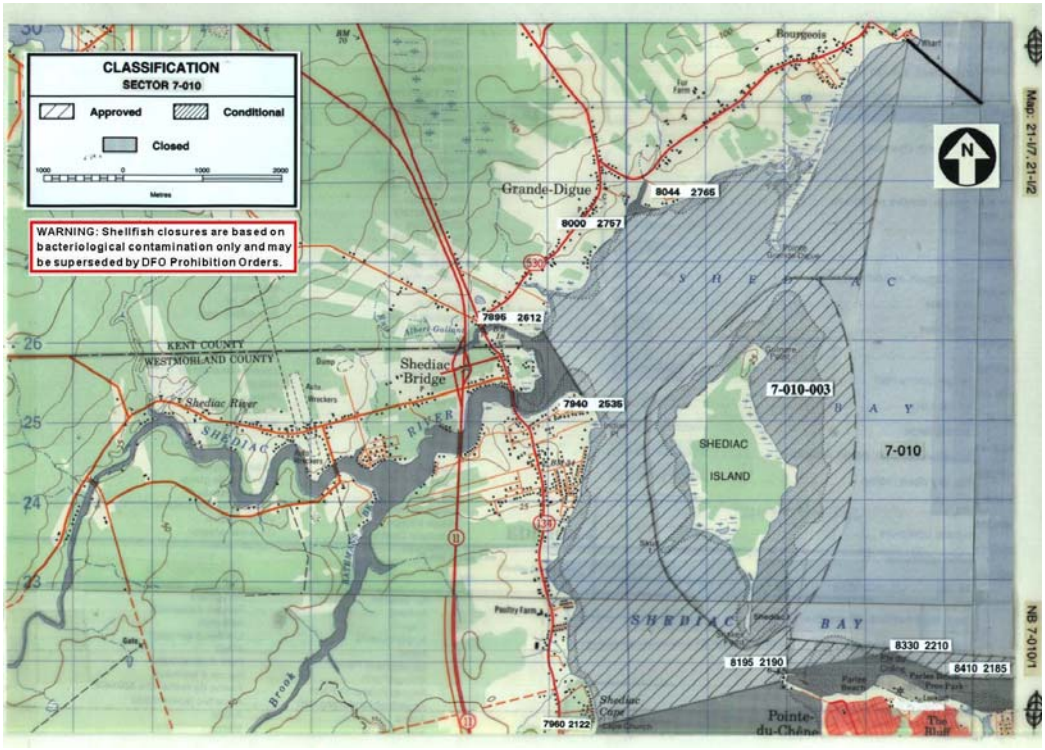
#### 7.2.1.3. Introduction of pathogens

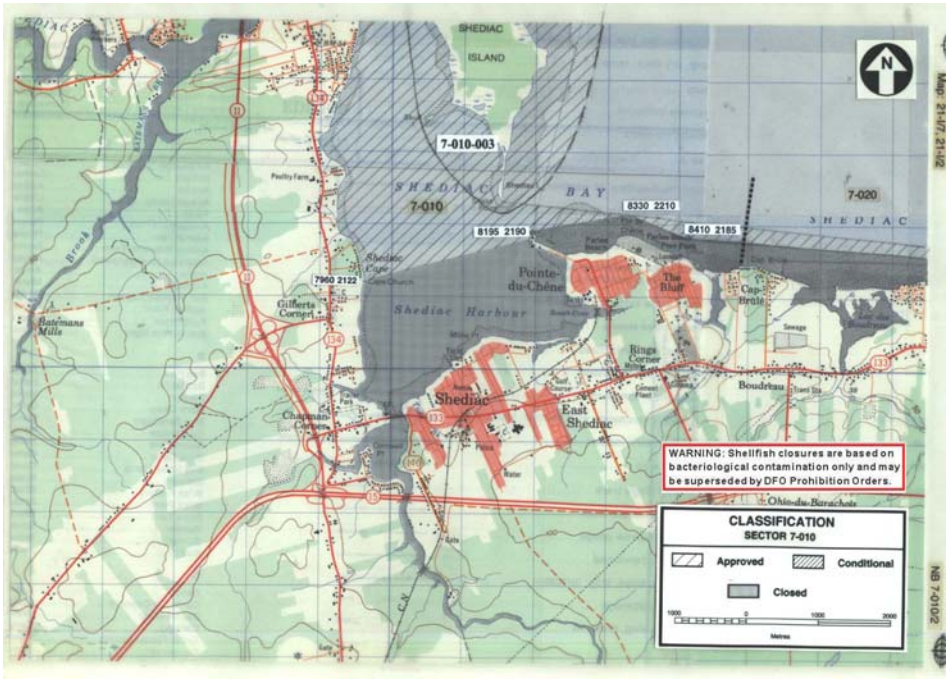
Coliforms are bacteria contained in the faecal matter produced by humans and animals. Faecal matter may also contain other **pathogen**s. Potential sources of faecal coliforms include municipal and domestic wastewater treatment systems, boats with onboard toilets and no holding tanks, and manure piles near streams. All of these can introduce pathogens into water. Land run-off from agricultural and urban areas can also introduce pathogens into the marine environment (NPA 2000).

Year-round shellfish closures are common in coastal areas near towns and villages. Shellfish closures are the result of bacteriological pollution in which shellfish are deemed unfit for human consumption due to health risks. Shellfish closures are mandatory near coastal infrastructures and activities where contamination potential is high, such as near wharfs and sewage lift stations (Environment Canada 2001). The present shellfish classification (Figures 36) includes closures at Shediac River, Gallants Brook, Batemans Brook and an unnamed inlet in Grande-Digue (Richard & Robichaud 2002). Shediac Harbour, from Shediac Bridge to Pointe-du-Chêne, is also closed to shellfish harvesting. This section includes all waters of the Scoudouc River *(ibid)*. Current closures extend from Pointe-du-Chêne wharf to Cap Bîmet, including Parlee Beach and Lac Boudreau *(ibid).*

The first sanitary survey in Shediac Bay, conducted in 1933, found limited contamination. In 1940, Shediac Bay was considered severely contaminated due to sewage coming from cottages, camp grounds and the Town of Shediac. In 1947, the first shellfish harvesting area was closed (Waller et *al*. 1976 – as cited in Auffrey 2003). Today, many sources are identified as point and non-point sources during sanitary and bacteriolocal surveys. These sources are fish plants, faulty septic tanks, agricultural run-off, industrial

effluent, marinas, municipal wastewater facilities, etc. Pollution conditions are usually aggravated by rainfall and spring thaw (Environment Canada 2001).




**Figures 36: Shellfish growing classification maps for Shediac Bay watershed**

Environment Canada, (February 22, 2008) Shediac Harbour NB-07-010-002, Shediac River NB-7-010-001: **http://www.atl.ec.gc.ca/epb/sfish/maps/nb/area7.html**

Approximately 14 kilometres of shoreline including the Town of Shediac is serviced by a municipal wastewater facility which treats raw sewage with a secondary treatment plant, located at Cap Bîmet (Crandall Engineering Ltd. 2000; Richard & Robichaud 2002). Eighteen lift stations are part of the collection system. Several lift stations have a potential to by-pass untreated wastewater by direct discharge or by surface overflow into coastal waters (Richard & Robichaud 2002). Most lift stations are in close proximity to a watercourse and are a threat to water quality within the watershed *(ibid*). The collection system has suffered in the past from severe infiltration problems during heavy rainfall and spring thaw events. Upgrades have been done to rectify the problem. However, during the spring thaw period in 2001, untreated wastewater was bypassed on two occasions at lift station 4 (*ibid)*.

Several septic systems from homes and cottages were also identified as systems of unknown efficiency where leachage is probable (Richard & Robichaud 2002). Since 2003, the Shediac Bay Watershed Association, through funding from the New Brunswick Environmental Trust Fund, has provided subsidies to residences in need of an upgrade of their failing septic systems (Audet 2005). A total of 52 households received new septic systems (D. Audet, pers. comm., April 25$^{th}$, 2008).

Wharves and marinas also constitute a potential threat to water quality in the Shediac Bay. Some boating activities can have negative impacts on our environment. For example, sewage discharge and use of chemical products may pollute our waters. During a waste strategy survey among boaters, 42% of the 370 vessels using the Shediac Bay waters were equipped with an on-board holding tank. Both marinas are serviced by sewage pump-out stations that are discharged into the municipal sewage system (Richard & Robichaud 2002). Transport Canada now has a pollution prevention regulation requiring, among other things, that all boats that have a toilet and navigate on Canadian waters, have either a holding tank or a marine sanitation device capable of treating black waters to an acceptable level of coliform contamination (< 250ppm). No wastewater discharge will be allowed where pumpout stations are available or within 3 nautical miles of a shellfish bed (Transport Canada 2008). The Shediac Bay Watershed Association has also carried out a Green Boating Program that aims at promoting green practices by raising awareness to boat owners.

Effluents from local fish plants are also a potential source of pathogens. A now defunct fish processing plant located at Cap Bîmet had several pipes that discharged large volumes of effluent into local coastal waters. The facility employed up to 400 employees during peak production and was open year round. The plant was however, serviced by an aerated package treatment plant (Richard & Robichaud 2002). Another important fish processing facility is located near the mouth of the Scoudouc River. This facility has a submerged pipe that discharges its effluent into the neighbouring bay (Richard & Robichaud 2002).

Other potential sources of pathogens are effluents from drainage ditches, pipes and agricultural run-off. Many of these sources are scattered throughout the watershed (Richard & Robichaud 2002).

#### 7.2.1.4. Chemical contamination or changes

Chemical substances can enter the marine environment from various sources. For example, chlorine products are used as a common disinfectant for treatment of municipal wastewater. Over-chlorination can occur during this procedure thus discharging a chlorinated solution into the receiving waters (NPA 2000). Also, municipal wastewater can contain up to 200 different chemical substances, including oils, grease, paint thinner, antifreeze and other industrial waste (Milewski et *al*. 2001).

Urban run-off is directed towards ditches or storm sewers and channeled to the receiving aquatic and marine environment. The amount of run-off can be significant after a major rainfall or during spring thaw. This run-off may contain toxic substances, in some cases hydrocarbons, heavy metals and chlorinated organics as well as suspended solids (Eaton et *al*. 1994).

Treated timbers used in the construction of wharves and breakwaters can also have an impact on the environment and be toxic to aquatic species (Eaton et *al*. 1994; Jordan 2000).

Pesticides used on properties, lawns and gardens to control weeds and insects can impact the environment and human health. These chemical solutions can run-off into local streams during rainfalls and potentially leach into ground water and contaminate potable water supplies (Black & Jordan 2000). As of January 1$^{st}$ 2003, the Town of Shediac has

introduced a municipal by-law to control and regulate the use of pesticides within the city limits (Town of Shediac 2005c). For a copy of the by-law, visit www.shediac.org.

#### 7.2.1.5. Heavy metal contamination

Heavy metals can enter the marine environment through different human activities such as mining and excavation operations or they can originate from more distant sources such as smokestacks from power plants.

Harbour dredging is a common practice to ensure safe navigational routes. Heavy machinery is needed to extract the sediment that is then deposited on either the sea bottom or on land. Dredging can disturb and resuspend contaminated sediments in the water column (NPA 2000). Before a proposed dredging activity proceeds, the sediment is assessed for contaminants. This helps determine the deposition site for the excavated materials. Environment Canada records from 1987 indicated high levels of PCB's in harbour sediments of the Pointe-du-Chêne wharf (Milewski et *al*. 2001).

#### 7.2.1.6. Air pollution (point and non-point sources)

Shediac Bay, like many other coastal areas, shows signs of increased nutrient levels (D. Audet, SBWA, pers. comm., January 12 2006). Increases in nutrient levels can bring about algal blooms. Large amounts of organic material (e.g. algae) in decomposition can deplete oxygen levels in the water column resulting in **anaerobic conditions**. Under anaerobic conditions, hydrogen sulfide ($H_2S$) production is likely. This gas produces a foul odor, is toxic and can result in the loss of aquatic species (Lotze et *al*. 2003). In Shediac Bay, mats of green algae lying in the **intertidal zone** are visible at low tide. The SBWA has received numerous complaints of nauseating smells originating from Pointe-du-Chêne during summer months (D. Audet, pers. comm., January 3rd 2006).

### 7.2.2. Biota stressors

#### 7.2.2.1. Introduction of exotic species, diseases and parasites

Exotic and invasive species, diseases and parasites can be introduced into aquatic ecosystems through the transfer of fish from one ecosystem to another or through the discharge of **ballast** waters of vessels from maritime transport. Approximately 10 to 12 billion tonnes of ballast waters travel in ships on an annual basis (Rosenthal et *al*. 2001). Ships discharge ballast water off the coast of PEI in the Gulf of St. Lawrence.

The only known aquatic invasive species in the Shediac Bay is codium (*Codium fragile tomentosoides*), a green algae introduced from Japan. It is also known as the “oyster thief”. It was first noticed in Nova Scotia in 1996. Codium smothers shellfish such as mussels and oysters, preventing them to feed. Once weakened, they become vulnerable to predators. Because codium has gas bubbles which enables it to float, infested oysters can detach and float away. The algae can be a pest to the aquaculture industry and increase harvesting costs. It can also displace native kelp, an important habitat for sea urchin and lobster (Fisheries and Oceans Canada 2005a). Very little information is available on the possible presence of other invasive species in the watershed or the possibility of introduced diseases or parasites through maritime transport.

#### 7.2.2.2. Threat to ecosystem biodiversity

Excessive nutrients in an aquatic system (eutrophication) can change the composition of aquatic species present in the ecosystem. Changes in species composition from a herbivore to a detritivore food chain are possible (Lotze et *al*. 2003). Eutrophic conditions also stimulate annual growth of green algae such as *Ulva*. Anoxic conditions, a result of decomposing organic matter, can eliminate the presence of invertebrates and fish within the water column and sediment (Environment Canada 2001).

Oyster reefs are important structures in estuarine ecosystems. They increase biodiversity of an area by providing substrate, shelter for both predators and prey, and a viable food source. Bacterial pollution and increased sedimentation from land erosion can be an important factor in oyster reef degradation (Milewski et *al.* 2001). Dredging and dumping of dredged materials can also adversely affect oyster reefs *(ibid)*. The Shediac Bay Watershed Association has undertaken a shellfish restoration project to enhance oyster habitat in the bay (Audet 2005).

Wetland alteration can reduce the amount of available habitat for various terrestrial and aquatic species dependant on these ecosystems (NPA 2000). Wetlands help maintain and improve water quality by filtering contaminants and excessive nutrients and help reduce erosion. The rush for waterfront lots has created an increased stress on coastal habitats especially in the in the Pointe-du-Chêne area (the bluff) and at Cap Bîmet, where development has reached its maximum capacity. The result has been a loss of important salt marshes and coastal habitats within the watershed (Jordan 2000; Milewski et *al*. 2001).

#### 7.2.2.3. Threat to ecosystem productivity

Eelgrass beds are important nursery grounds and essential habitats to aquatic species, playing a major role in coastal ecosystems. According to studies conducted by DFO scientists in 13 estuaries along the Gulf of St. Lawrence (Fisheries and Oceans Canada 2005a), there is a widespread decline of eelgrass biomass in all studied estuaries. The loss of eelgrass beds may be the result of nutrient pollution, invasive species and/or environmental changes within the ecosystem *(ibid*). A study on nutrient pollution (Lotze et *al*. 2003) suggested that eelgrass beds showed a lower density of eelgrass cover in highly impacted bays and harbours due to nutrient loading. Moreover, eutrophic conditions also have negative impacts on eelgrass beds due to reduced oxygen levels in the water column and in the sediment.

The New Brunswick coastline has seen an increase in areas closed to shellfish harvesting (see section- introduction to pathogens). In addition, water quality is one of the most significant concerns in terms of shellfish closures and beach closures for the fishing and tourism industry (Environment Canada 2001). Shellfish fisheries have seen a loss of income due to elevated fecal coliform bacteria (Fisheries and Oceans Canada 2005a). Consumption of contaminated shellfish poses a threat to human health (Environment Canada 2001).

Over-fishing, decline in water quality, destruction of bottom habitat, and loss of spawning and juvenile habitat are potential sources in the decline of estuarine and coastal fisheries (Eaton et *al*. 1994)

#### 7.2.2.4. Threat to aquatic fauna and flora

Habitat destruction and alteration, especially in coastal ecosystems, can have a significant impact on aquatic life. The increase of value of coastal property has lead to the infilling of saltmarshes and wetlands for housing and cottage development along Shediac Bay (Lotze et *al*. 2003, NPA 2000).

Sedimentation of watercourses can occur through various human activities (see section 7.2.1.1 introduction of sediment). Large quantities of suspended sediment in the water can impair fish gills, reduce visibility, increase temperature and impact fish habitat in the watercourse (NPA 2000). Restoration and habitat enhancement projects near agriculture and farm lands have improved fish habitat within the watershed (Goguen &

LeBlanc-Poirier 1999). The introduction of sediments into the marine environment can also smother benthic organisms and decrease biodiversity (Milewski et *al*. 2001)

### 7.2.3. Physical changes in the habitat

#### 7.2.3.1. Obstruction of fish passage

A major highway divides the Scoudouc River and many smaller secondary roads truncate the landscape and create many additional crossings that could impede fish movement (Fisheries and Oceans Canada 2006). Because most of the tributaries must pass through culverts underneath highway and roads, there is potential for the disruption of fish migrations. During a pilot project survey conducted in 2007 (Godin 2007), 36 % of the 78 culverts assessed were classified as good, while 32 % were recorded as having a drop likely impeding the passage of certain fish species.

#### 7.2.3.2. Changes in bottom composition

The introduction of sediments into the marine environment can smother benthic organisms and decrease biodiversity (Milewski et *al.* 2001). There is substantial anecdotal evidence of increased fine sediment being deposited on the bottom of the Northumberland Strait. This is corroborated by the observed increase in suspended solids in the water column (S. Jones pers. comm., March 9 2006; S Fields pers. comm., March 13 2006; Ollerhead 2005).

Annually, the Parlee Beach authority performs sand beach replenishing. Sand from a submerged sand bar off shore near the Pointe-du-Chene wharf is collected and relocated on Parlee Beach.

The use of dredges and trawls can also alter the structure of the bottom by “grading” the surface as the gear is dragged along (MacLean & Murphy 2005)

#### 7.2.3.3. Contributing factors to anoxic conditions

The introduction of excessive nutrients into the marine environment due to human activities (see section 7.2.1.2 -introduction of nutrients) can create optimum conditions for algal blooms. The decay of the overabundant plant material depletes dissolved oxygen levels in the water column creating anoxia and potential fish kills. Although not investigated, sea lettuce (*Ulva* sp.) decay is likely related to multiple complaints of nauseous odors received by the SBWA, specifically in the Pointe-du Chêne wharf area (D. Audet, pers.

comm., January 6 2006). The decomposition process produces anaerobic conditions which exude foul smelling gases such as hydrogen sulphide ($H_2S$) and ammonia ($NH_4$) (NPA 2000).

#### 7.2.3.4. Contributing factors to aesthetic disturbances

The tourism industry depends on a pristine coastline to attract visitors. Litter and marine debris can have a negative impact on the appearance of seaside destinations. Litter and garbage can reach the coast through fishing and recreational vessels, coastal activities, illegal dumping, rivers and wind (PARTENARIAT 2004). Illegal dump sites are found along the Shediac river systems, and contain old household appliances (fridge, stove), car parts, metal scrap and plastic (LeBlanc et *al*. 2000). Junk yards with old cars were also observed during a shoreline sanitary survey along the Shediac River system *(ibid)*. The debris poses a threat to wildlife as animals can get entangled, or ingest and suffocate on debris (NPA 2000).

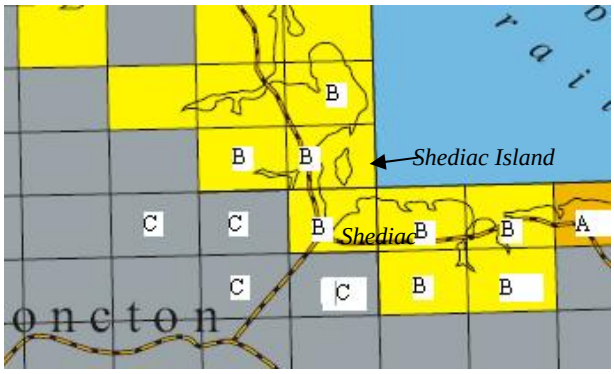
Feacal bacteria pollution can also have an impact on the tourism industry as local beaches are subject to closure when contaminant levels exceed guidelines. The current federal guideline for bacterial levels in recreational waters is 200 MPN/100 ml. Sea bathing in waters in excess of this guideline can potentially cause gastrointestinal illness, minor skin, eye, ear, nose and throat infections (Environment Canada 2001).

#### 7.2.3.5. Shoreline changes

Erosion is a natural process in coastal ecosystems but it can also be provoked by human activity. As land is lost to the ocean, coastal erosion becomes a significant economic and social problem for coastal communities. Shediac Island, for example, erodes at a rate of 30 cm/yr. This poses a risk to the archaeological sites that are on the island. The desire for waterfront property and intense development in proximity to the coast has affected the integrity of the ecosystem. Development has occurred in unsuitable areas such as wetlands and saltmarshes thus rendering the coastline sensitive to coastal erosion (Black & Jordan 2000). An assessment of coastal erosion in the Shediac Bay watershed, undertaken in 2000, suggests that erosion rates are weak in the study area (Ollerhead & Rush 2000). However, a large portion of the shore was modified by building breakwaters, mostly in highly inhabited areas.To reduce the impact of erosion on properties, land owners erect protective structures made of different materials such as wood, rocks and concrete (LeBlanc et *al*. 2000).

Storms and corresponding surges are a reality for coastal communities. Coastal infrastructures (i.e. wharves) and residences become at risk during storm surges and coastal flooding. Sea ice is also a concern during storm events as wind and waves push the ice inland. The first settlers of this coastal community experienced storm devastation as early as the 19th century. In 1868, one of the greatest storms of New Brunswick struck the region and destroyed parts of the Pointe-du-Chêne wharf and railway. Again in 1924, huge waves destroyed the wharf and the Paturel processing plant. More recently in January and October of 2000, a combination of extremely high tides and winds caused a storm surge that resulted in extensive flooding and property damage all along the New Brunswick coastline. The coastal communities of Shediac and Pointe-du-Chêne were severely affected. A total of 181 cottages and 81 residences were damaged by the storm in the Beaubassin District amounting to $1.6 million in claims (Gauvin 2004).

A study on sensitivity of the coasts of New Brunswick to storm waves found that the Shediac Bay watershed is considered moderately sensitive to storm waves (O'Carroll & Bérubé 1997) (Figure 37).




Sensitivity Index :
A : High
B : Moderate
C: Low

Drawn from:
O'Carroll & Bérubé (1997)

**Figure 37: Sensitivity of coast to storm waves**

Some areas near the mouths of rivers are however, much more susceptible to flooding. A map of potential storm surge inundation zones identified areas of greater risk of flooding during storm events (Ollerhead & Rush 2000).

Sea level rise is a serious threat to coastal habitats and infrastructures. The New Brunswick Sea Level Rise project (Daigle & Project Research Team 2006) is examining sustainable management and adaptation strategies in the Pointe-du-Chene area. During storm surge events, this highly populated area becomes isolated from the mainland due to

flood waters (Figures 38 and 39). From a general perspective, it is estimated that natural sea-level rise is being more than tripled by human induced global warming with an estimated rise of 70 cm over the next 100 years (Forbes et *al*. 2001). Increased sea levels combined with increased frequency and severity of storms that are also predicted to occur as a result of global warming are likely to substantially increase shoreline erosion and negatively impact the habitat of coastal species (USGS 2005). For example, where salt marshes border roads or other human developments along Route 15, the ability of the saltmarsh to migrate shoreward will be compromised and the total area of saltmarsh will be reduced. If global warming results in a greater ice-free period, this could combine with increased winter storms to further amplify the effects of shoreline erosion.

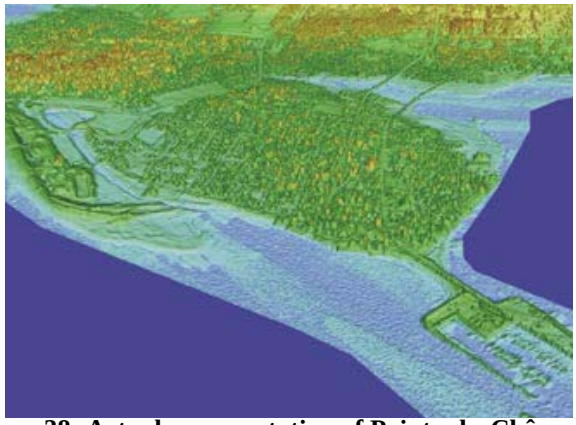


**Figure 38: Actual representation of Pointe-du-Chêne area**

**Figure 39: Flood risk model of the Pointe-du-Chêne area**

Both figures produced by LiDAR digital elevation models and flood-risk mapping

Drawn from : Webster, T.L. et *al.* (2006)

The bar and dune systems that help to enclose the bays are the result of very dynamic long-shore sediment transport patterns. As sea level rises there is likely to be increased interest in protecting shoreline properties and infrastructure by hardening of the shoreline with armour stone, riprap and retaining walls. These measures, along with the construction of wharves and piers, have the potential to alter the sediment movement patterns that provide sediment to the bars and dune systems (Nicholls et *al.* 2000; D. Berube pers. comm). Therefore, sustainable shoreline development and management needs to account for the dynamics of coastal systems in order to prevent additional, long term problems (Viles & Spencer 1995).

## 7.3. SUMMARY OF MAIN ISSUES OF CONCERN

Table 29 presents a summary of the main issues of concern that could be taken into consideration in the preparation of an integrated management plan for this coastal community area. Activities identified as giving cause for concern could be addressed in a plan of action managed at the local or regional level.

**Table 29: Summary of main issues of concern**

| Threats and impacts | Activity of concern | Details | Major consequences |
|---|---|---|---|
| ***water quality stressors*** | | | |
| Introduction of sediment | Agriculture and farm run-off<br>ATV trails<br>Dirt roads and ditches | Access of livestock to watercourse<br>Trails in proximity to streams and rivers | Habitat change<br>Disturbance to aquatic life |
| Introduction of nutrients | Municipal and domestic wastewater treatment<br>Fish processing plant effluent | Sewage waste improperly or not treated<br>Plant effluents improperly processed | Closing of shellfish beds<br>Eutrophication of water body |
| Introduction of pathogens | Municipal and domestic wastewater treatment<br>Fish processing plant effluent<br>Farm run-off | Sewage waste and effluents improperly or not treated<br>Access of livestock to watercourse | Closing of shellfish beds<br>Health risks |
| Non-point source pollution | Introduction of organic waste causing algal blooms | Eutrophication of water body<br>Mats of decaying organic matter in intertidal zones | Foul smelling gases produced by anoxic conditions |
| ***Biota stressors*** | | | |
| Threat to ecosystem biodiversity | Nutrient pollution, infilling of saltmarshes sedimentation threathen coastal habitats | Loss of coastal habitats such as eelgrass, oyster reefs and wetlands | Loss of important and essential habitats for wildlife |
| ***Physical changes to the habitat*** | | | |
| Factors contributing to anoxic conditions | Activties that introduce exces nutrients | Proliferation of algae;<br>Excess of decaying organic matter in intertidal zones | Eutrophication<br>Depleted oxygen in water column |
| Factors contributing to shoreline changes | Sea-level rise, storm surges and coastal development | Coastal erosion and coastal flooding | Extensive damage to coastal infrastructure and residences<br>Economic and social concern |

# 8. CONCLUSION

DFO promotes the application of integrated management to achieve sustainable development of the aquatic natural resources of coastal and marine ecosystems. All human activities, whether pursued inland or in the coastal region itself, may have direct or indirect consequences for the natural environment. The use of integrated management is a means of managing our activities in such a way as to achieve a preventive (rather than a curative) approach, not only for environmental issues as such but also for conflicts among users.

Awareness and stewardship programs will be developed in an integrated management framework. These programs will serve to inform and educate people, thereby motivating them to adopt environmentally sound practices. The result should be a growing feeling of responsibility in communities that become involved with the management of their watershed, and consequently a reduced level of activities that threaten or adversely impact upon the natural environment.

The preparation of an environmental overview for a particular bay is a first step toward the integrated management of that bay. It is a management tool that will be useful, not only at the outset, as a means of informing the main stakeholders, but throughout the entire process, as a means of enabling them to reach sound decisions. Regular updates will be necessary to ensure that outdated information is replaced, and research projects should be undertaken in order to fill in any information gaps, thereby ensuring that the tool will retain its utility and effectiveness.

## 8.1. LIST OF INFORMATION GAPS

The compilation of this document has helped identify important parameters affecting the water quality of the watershed and knowledge gaps pertaining to the area. This valuable information can help guide the stakeholders in planning the next steps towards achieving the integrated management of the Shediac Bay watershed. Outlined below are a number of subjects for which information is outdated or unavailable.

- Information on marine and freshwater fauna and flora in the bay;
- Recent data on chemical and physical properties of the bay;

- Information on state of coastal habitats (dunes, beaches, salt marshes, etc.);
- Impacts of tourism activities on coastal habitats, fauna and flora;
- Decaying algae and air quality along the shoreline (eutrophication status);
- Data on impacts of bridges and roads on fish habitat – Fish passage status (culvert inventory) which could limit the migration of various fish species;
- Data on fish species in watercourses – Electrofishing survey;
- Interpretation of data for freshwater macro-invertebrates taken in 2002;
- Information about benthic macro-invertebrate fauna (freshwater & marine habitats);
- Data on terrestrial and aquatic invasive species in watershed;
- Information on the sources of sediments accumulating in local watercourses;
- Data on the distribution and quality of eel grass beds;
- Data on the sources of bacterial contamination

## 8.2. MOVING TOWARD RISK MANAGEMENT

The objective of integrated management is to practise an approach featuring preventive measures instead of taking corrective action. The list below presents some suggested initiatives aimed at bringing about a shift from corrective measures taken after the fact to potential risk management.

- Identify the various fish species that inhabit the watershed and the factors that are essential to their survival;
- Identify all fish habitats in the watershed and their condition;
- Ensure sustainable development of rivers and riparian lands by means of buffer zone maintenance and the adoption of sound environmental practices;
- Identify in order of priority, obstacles to fish passage;
- Take corrective measures to remove obstacles to fish passage;
- Identify sources of sedimentation in streams;
- Take corrective measures to eliminate sources of sedimentation;
- Identify stretches of rivers and streams with sediment buildup;

- Install structures designed to capture sediment already in rivers and streams;
- Encourage sound environmental practices through public awareness and education

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# 10. APPENDICES

## 10.1. APPENDIX 1: GLOSSARY

***Anaerobic condition:*** a condition in which dissolved oxygen, nitrate and nitrite are absent. [Definition standardized by ISO.] (Source: Termium / Water quality: vocabulary. International Organization for Standardization. [Geneva] : ISO, 1980. 1st ed. = 1ère éd.)

***Anoxic:*** [Said of a] condition in which the concentration of dissolved oxygen is so low that certain groups of micro-organisms prefer oxidized forms of nitrogen, sulfur, or carbon as an electron acceptor. [Definition standardized by ISO.] (Source: Termium / Water quality: vocabulary. Part 5 International Organization for Standardization. Geneva : ISO, 1986.) 1st ed. = 1ère éd. )

***Ballast:*** Unnecessary stock used for stabilizing an ocean carrier operating below its stowage capacity (Source: Termium / Dictionary of international trade / Jerry M. Rosenberg, Jerry Martin. New York : J. Wiley, ©1994.)

***Barrier beach:*** A strip of cobbles or sand joining two headlands (Source: “By the sea” glossary)

***Bathymetry:*** The study of the ocean depth. (Source: “By the Sea” glossary)

***Chlorophyll***: Generic name for the green, fat-soluble pigments of plants. They have a complex structure (similar to hemoglobin's) and are essential photoreceptors for the synthesis of glucides (i.e. photosynthesis). (Source: Termium / Dept. of the Secretary of State of Canada, Translation Bureau, Terminology)

***Coastal ecosystems:*** Communities of living things found near the sea, the physical factors that affect them (sunlight, temperature, salt, currents, etc.), and the flow of energy from one organism to the next. (Source: “By the Sea” glossary)

***Coliform:*** A group of aerobic and facultatively anaerobic Gram-negative, non-spore-forming, lactose-fermenting bacteria which typically inhabit the large intestine of man and animals. Generally, apart form *E. coli*, many of them are able to survive and multiply in the natural environment (Source: Termium / water quality : vocabulary. Part 7. International Organization for Standardization. Geneva : ISO, 1990. 1st ed. = 1ère éd.)

***Community*:** An association of lifeforms living within a specific environment, linked through a food chain and other interactions. A salt marsh is composed of a community of living beings. (Source: “By the Sea” glossary)

***Dendritic patterns***: Branching tree-like patterns

***Diadromous:*** [Said of] Truly migratory fishes which migrate between the sea and freshwater. (Source: Termium / Fish migration / F. R. Harden Jones; illustrated by H. E. Jenner. Harden Jones, F. R. London : Edward Arnold, 1968)

***Ecosystem:*** Comprises all living things in a community together with physical factors of sunlight, temperature, salt, currents, etc., as well as the flow of energy from one organism to the next. (Source: “By the Sea” glossary)

***Estuary***: A partially enclosed body of water in the lower reaches of a river, which is freely connected with the sea and which receives fresh water supplies from upland drainage areas. (Source: Termium / Definition standardized by ISO.)

***Eutrophication***: The enrichment of water, both fresh and saline, by nutrients, especially compounds of nitrogen and phosphorus, that will accelerate the growth of algae and higher forms of plant life. (Source: Termium / Definition standardized by ISO.)

***Glaciofluvial deposits*** : Deposits resulting of meltwater transportation and deposition. They tend to be stratified and consist of rounded or sub-rounded particles. (Source: Termium / Université Laurentienne - École des traducteurs, Laurentian University – Translation)

***Halophytic plant :*** (Halophyte) A halophyte is a plant that naturally grows where it is affected by salinity in the root area or by salt spray, such as in saline semi-deserts, mangrove swamps, marshes and sloughs, and seashores. (Source: Termium / Internet. [http://www.wikipedia.org/wiki/Halophytes]. (20030213)

***Integrated management:*** is a continuous planning process in which interested parties, stakeholders and regulators reach general agreement on the best mix of conservation, sustainable resource use and economic development for coastal and marine areas. (Source: Termium / Internet. [http://www.oceansconservation.com/iczm/imhome.htm]. Fisheries and Oceans Canada. \"Integrated Management Web Site\)

***Intertidal zone***: The area covered by water at high tide and exposed to the air at low tide (Source: “By the Sea “ glossary)

***Isostatic rebound:*** The isostatic readjustment upward of a land mass depressed by glacial loading. (Source: Termium / McGraw-Hill dictionary of scientific and technical terms / Daniel N. Lapedes, editor in chief. New York : McGraw-Hill, [1974] xiv, 1634, 26 p.)

***Morainal till***: Unstratified drift, deposited directly by a glacier without reworking by meltwater, and consisting of a mixture of clay, silt, sand, gravel, and boulders ranging widely in size and shape. (Source: Termium / Dictionary of geological terms / Robert L. Bates and Julia A. Jackson, editors ; prepared under the direction of the American Geological Institute.Garden City, N.Y. : Anchor Press, 1984., 3rd ed)

***Pathogen:*** An agent (virus, micro-organism or other substance) capable of producing disease in a susceptible plant or animal, including man (Source: Termium / Lainé, Claude, TB - Scientific and Technical Division – Montréal)

***Pit***: A pit contains unconsolidated material such as sand, gravel, soil, etc. (M. O’Donnell, pers. comm., January 13th 2006)

***Productivity*****:** The amount of organic matter formed in an ecosystem and its rate of formation. In other words, a measure of how rich or fertile an ecosystem is. (Source: “By the Sea” glossary)

***Quarry:*** A quarry contains consolidated material such as stone, rock, material that may need to be excavated by drilling and blasting or a machine with a ripper. (M. O’Donnell, pers. comm., January 13th 2006)

***Stratification:*** The layering of different temperature levels within a given material (Source: Termium / Dictionnaire contextuel anglais-français de l'énergie solaire / par Robert Serré. Ottawa, 1979.)

## 10.2. APPENDIX 2: LIST OF SPECIES

### Aquatic fauna and flora / Faune et flore aquatique

#### Crustaceans / Crustacés

| English | Français | Latin |
|---|---|---|
| American Lobster | Homard | *Homarus americanus* |
| Mud Crab | Crabe de boue | *Neopanopeus sayi* |
| Rock Crab | Crabe commun | *Cancer irroratus* |
| Sand Shrimp | Crevette de sable | *Crangon septemspinosa* |
| Grass shrimp | Crevette d'herbe | *Palaemonetes vulgaris* |

#### Echinoderms / Échinodermes

| English | Français | Latin |
|---|---|---|
| Asterias sea star | Astéries, étoiles de mer | *Asterias sp.* |
| Green Sea Urchin | Oursin vert | *Strongylocentrotus droebachiensis* |

#### Fish / Poissons

| English | Français | Latin |
|---|---|---|
| American Eel | Anguille | *Anguilla rostrata* |
| Arctic Rockling | Mustèle argentée | *Gaidropsarus argentatus* |
| Atlantic Herring | Hareng | *Clupea harengus harengus* |
| Atlantic Mackerel | Maquereau | *Scomber scombrus* |
| Atlantic Salmon | Saumon de l'Atlantique | *Salmo salar* |
| Atlantic Silverside | Capucette d'Atlantique | *Menidia menidia* |
| Atlantic Tomcod | Poulamon | *Microgadus tomcod* |
| Banded Killifish | Fondule barrée | *Fundulus diaphanus* |
| Blackspotted stickleback | Épinoche tachetée | *Gasterosteus wheatlandi* |
| Brook Trout | Truite mouchetée | *Salvelinus fontinalis* |
| Capelin | Capelan | *Mallotus villosus* |
| Cunner | Tanche-tautogue | *Tautogolabrus adspersus* |
| Fourspine Stickeback | Épinoche à quatre épingles | *Apeltes quadracus* |
| Gaspereau/Alewife | Gaspareau | *Pomolobus pseudoharengus* |
| Mummichog | Choquemort | *Fundulus heteroclitus* |
| Ninespine Stickleback | Épinoche à neuf épines | *Pungitius pungitius* |
| Northern pipefish | Syngnathe brune | *Syngnathus fuscus* |
| Rainbow Smelt | Éperlan | *Osmerus mordax* |
| Sand lance | Lançon d'amérique | *Ammodytes americanus* |
| Smooth Flounder | Plie lisse | *Liopsetta putnami* |
| Striped Bass | Bar rayé | *Morone saxatilis* |

| | | |
|---|---|---|
| Threespine Stickleback | Épinoche à trios épines | *Gasterosteus aculeatus* |
| Winter Flounder | Plie rouge | *Pseudopleuronectes americanus* |

**Marine mammals / Mammifères marins**

| English | Français | Latin |
|---|---|---|
| Harbour seal | Phoque commun | *Phoca vitulina* |

**Marine Reptiles / Reptiles marins**

| English | Français | Latin |
|---|---|---|
| Leatherback turtle | Tortue luth | *Dermochelys coriacea* |

**Molluscs / Mollusques**

| English | Français | Latin |
|---|---|---|
| American Oyster | Huître américaine | *Crassostrea virginica* |
| Brook Floater | Anodonte | *Pyganodon sp.* |
| Creeper | | *Strophitus undulatus* |
| Eastern Elliptio | Elliptio maigre de l'est | *Elliptio complanata* |
| Eastern Pearlshell | Moule perlière d'eau douce | *Margaritifera margaritifera* |
| Quahaug | palourde | *Mercenaria mercenaria* |
| Blue Mussel | Moule bleue | *Mytilus edulis* |
| Common Northern Moon Shell/Moon Snail | Lunatie sp. | *Lunatia heros* |
| Razor Clam | Couteau | *Ensis directus* |
| Soft-shell Clam | Mye | *Mya arenaria* |
| Surf Clam | Mactre d'Amérique | *Spisula solidissima* |

**Plants / Plantes**

| English | Français | Latin |
|---|---|---|
| Cattail | Quenouille | *Typha sp.* |
| Eelgrass | Zostère | *Zostera marina* |
| Horned pond weed | Zannichellie des marais | *Zannichellia palustris* |
| Pond Lily | Nénuphar | *Nuphar variegatum* |
| Rockweeds | Fucus | *Fucus sp.* |
| Rush | Jonc | *Juncus sp.* |
| Salt-water Cord-grass | Spartine alterniflore | *Spartina alterniflora* |
| Sea Lettuce | Laitue de mer | *Ulva lactuca* |
| Sedges | Carex sp. | *Carex paleacea + others* |

## Terrestrial fauna and flora / Faune et flore terrestre

### Mammals / Mammifères

| English | Français | Latin |
|---|---|---|
| American Mink | Vison d'Amérique | *Mustela vision* |
| Beaver | Castor | *Castor canadensis* |
| Black Bear | Ours noir | *Ursus americanus* |
| Bobcat | Lynx roux | *Lynx rufus* |
| Common Raccoon | Raton laveur | *Procyon lotor* |
| Eastern Coyote | Coyote | *Canis latrans* |
| House Mouse | Souris commune | *Mus musculus* |
| Little Brown Bat | Petite chauve-souris brune | *Myotis lucifugus* |
| Long Tailed Weasel | Belette à longue queue | *Mustela frenata* |
| Moose | Orignal | *Alces alces* |
| Muskrat | Rat musqué | *Ondatra zibethicus* |
| Porcupine | Porc-épic d'Amérique | *Erethizon dorsatum* |
| Red Fox | Renard roux | *Vulpes vulpes* |
| Red Squirrel | Écureuil roux | *Tamiasciurus hudsonicus* |
| River Otter | Loutre de rivière | *Lutra canadensis* |
| Short-tailed Weasel; Ermine | Hermine | *Mustela erminea* |
| Snowshoe Hare | Lièvre d'Amérique | *Lepus americanus* |
| Striped Skunk | Mouffette rayée | *Mephitis mephitis* |
| White-tailed Deer | Cerf de Virginie | *Odocoileus virginianus* |
| Woodchuck | Marmotte commune | *Marmota monax* |

### Reptiles / Reptiles

| English | Français | Latin |
|---|---|---|
| Common Snapping Turtle | Chélydre serpentine | *Chelydra serpentina* |
| Maritime Garter Snake | Couleuvre rayée | *Thamnophis sirtalis pallidula* |
| Redbelly Snake | Couleuvre à ventre rouge | *Storeria occipitomaculata* |
| Smooth Green Snake | Couleuvre verte | *Opheodrys vernalis* |
| Wood Turtle | Tortue des bois | *Clemmys insculpta* |

### Amphibians / Amphibiens

| English | Français | Latin |
|---|---|---|
| American Toad | Crapaud d'Amérique | *Bufo americanus* |
| Bullfrog | Ouaouaron | *Rana catesbeiana* |
| Eastern Newt; Red-spotted Newt | Triton vert | *Notophthalmus viridescens* |
| Green Frog | Grenouille verte | *Rana clamitans* |

| | | |
|---|---|---|
| Mink Frog | Grenouille du nord | *Rana septentrionalis* |
| Northern Leopard Frog | Grenouille léopard | *Rana pipiens* |
| Northern Two-lined Salamander | Salamandre à deux lignes | *Eurycea bislineata* |
| Pickerel Frog | Grenouille des marais | *Rana palustris* |
| Redback Salamander | Salamandre rayée | *Plethodon cinereus* |
| Spring Peeper | Rainette crucifière | *Pseudacris crucifer* |
| Wood Frog | Grenouille des bois | *Rana sylvatica* |
| Yellow-spotted Salamander | Salamandre maculée | *Ambystoma maculatum* |

**Birds / Oiseaux**

| **English** | **Français** | **latin** |
|---|---|---|
| American Crow | Corneille d'Amérique | *Corvus brachyrhynchos* |
| American Goldfinch | Chardonneret jaune | *Carduelis tristis* |
| America Kestrel | Crécerelle d'Amérique | *Falco sparverius* |
| American Robin | Merle d'Amérique | *Turdus migratorius* |
| Barrow's Goldeneye | Garrot d'islande | *Bucephala islandica* |
| Belted Kingfisher | Martin-pêcheur d'Amérique | *Ceryle alcyon* |
| Black-capped Chickadee | Mésange à tête noire | *Parus atricapillus* |
| Black Duck | Canard noir | *Anas rubripes* |
| Blue Jay | Geai bleu | *Cyanocitta cristata* |
| Blue-winged Teal | Sarcelle à ailes bleues | *Anas discors* |
| Canada Goose | Bernache du Canada | *Branta canadensis* |
| Common Eider | Eider à duvet | *Somateria mollissima* |
| Common Golden Eye | Garrot à oeil d'or | *Bucephala clangula* |
| Common Tern | Sterne pierregarin | *Sterna hirundo* |
| Great Blue Heron | Grand héron | *Ardea herodias* |
| Great horned Owl | Grand-duc d'Amérique | *Bubo virginianus* |
| Green-winged Teal | Sarcelle à ailes vertes | *Anas crecca* |
| Harlequin Duck | Canard arlequin | *Histrionicus histrionicus* |
| Hudsonian Godwit | Barge hudsonienne | *Limosa haemastica* |
| Mallard | Canard colvert | *Anas platyrhynchos* |
| Merlin | Faucon émerillon | *Falco columbarius* |
| Mourning Dove | Tourterelle triste | *Zenaida macroura* |
| Nelson's Sharp-tailed Sparrow | Bruant de Nelson | *Ammodramus nelsoni* |
| Northern Harrier | Busard Saint Martin | *Circus cyaneus* |
| Osprey | Balbusard | *Pandion haliaetus* |
| Peregrine Falcon | Faucon pèlerin | *Falco peregrinus* |
| Piping Plover | Pluvier siffleur | *Charadrius melodus* |
| Red-tailed Hawk | Buse à queue rousse | *Buteo jamaicensis* |

| | | |
|---|---|---|
| Red-winged Blackbird | Carouge à épaulettes | *Aeglaius phoeniceus* |
| Ruddy Turnstone | Tournepierre à collier | *Arenaria interpres* |
| Ruffed grouse | Gélinotte huppée | *Bonasa umbellus* |
| Semipalmated Plover | Pluvier semi-palmé | *Charadrius semiplamatus* |
| Semipalmated Sandpiper | Bécasseau semi-palmé | *Calidris pusilla* |
| Short-billed Dowitcher | Bécasseau roux | *Limnodromus griseus* |
| Tree Swallow | Hirondelle bicolore | *Tachycineta bicolor* |
| Willet | Chevalier semipalmé | *Catoptrophorus semipalmatus* |
| Yellow Rail | Râle jaune | *Coturnicops noveboracensis* |
| Yellow Warbler | Paruline jaune | *Dendroica petechia* |

**Plants / Plantes**

| **English** | **Français** | **Latin** |
|---|---|---|
| Alder | Aulne | *Alnus sp.* |
| American Dune Grass | Seigle de mer | *Elymus mollis* |
| Asters | Asters | *Aster sp.* |
| Balsam Fir | Sapin baumier | *Abies balsamea* |
| Bastard Toadflax | Comandre a ombelle | *Comandra umbellate* |
| Beachgrass | Ammophile à ligule courte | *Ammophilia breviligulata* |
| Beach Pea | Pois de mer | *Lathyrus japonicus* |
| Black Spruce | Épinette noire | *Picea mariana* |
| Blueberry | Bleuet | *Vaccinium sp.* |
| Bog Laurel | Kalmia a feuille d’andromède | *Kalmia polifolia* |
| Brookweed | Mouron d’eau | *Samolus valerandi sub. Parviflora* |
| Canada Fleabane | Érigéron du Canada | *Erigeron canadensis* |
| Cottongrass | Linaigrette de Virginie | *Eriophorum virginicum* |
| Dodder | Cuscute | *Cuscuta cephalanti* |
| Dwarf Hairgrass | Herbe | *Eleocharis parvula* |
| Fleshy Starwort | Stellaire | *Stellaria crassifolia* |
| Germander | Germandrée du Canada | *Teucrium canadense* |
| Glasswort | Salicorne d’europe | *Salicornia europaea* |
| Golden Dock | Renouée a feuilles de Patience | *Rumex maritimus* |
| Golden Rod | Verges d’or | *Solidago sp.* |
| Grey Birch | Bouleau gris | *Betula populifolia* |
| Grove sandworth | Sabline latériflore | *Arenaria lateriflora* |
| Labrador Tea | Thé du Labrador | *Ledum groenlandicum* |
| Larch | Mélèze | *Larix laricina* |
| Leatherleaf | Cassandre caliculé | *Chamaedaphne calyculata* |
| Myrica sp. | Myrique sp. | *Myrica sp.* |

| | | |
|---|---|---|
| Orchid Family | Ochidacées | *Orchidaceae sp.* |
| Pitcher Plant | Sarracénie pourpre | *Sarracenia purpurea* |
| Red maple | Érable rouge | *Acer rubrum* |
| Red Spruce | Épinette rouge | *Picea rubens* |
| Round-leafed sundew | Droséra | *Drosera rotundifolia* |
| Russian Thistle | Soude brulée | *Salsola kali* |
| Saltgrass | Limoselle | *Distichlis spicata* |
| Sea Blite | Soude | *Sueda claceoliformis* |
| Sea Lavender | Limonie de Caroline | *Limonium carolinianum* |
| Sea Milkwort | Glaux maritime | *Glaux maritima* |
| Sea Rocket | Caquillier édentulé | *Cakile edentula* |
| Seaside Arrowgrass | Troscart maritime | *Triglochin maritime* |
| Seaside Plantain | Plantain maritime | *Plantago maritime* |
| Sphagnum | Sphaigne | *Sphagnum sp.* |
| Sheep Laurel | Kalmia à feuilles étroites | *Kalmia angustifolia* |
| Speckled Alder | Aulne rugueux | *Alnus rugosa* |
| Strawberries | Fraise | *Fragaria ananassa* |
| Trembling Aspen | Peuplier faux-tremble | *Populus tremuloides* |
| Welsh Mudworth | Aster laurentienne | *Limosella australis* |
| White Birch | Bouleau blanc | *Betula papyrifera* |
| Wild Rose | Rosier sauvage | *Rosa canina* |

**Arthropods / Arthropodes**

| **English** | **Français** | **Latin** |
|---|---|---|
| Monarch Butterfly | Papillon monarque | *Danaus plexippus* |

### 10.3. LIST OF ABBREVIATIONS

**BP** – Before present

**CAMP** – Community Aquatic Monitoring Program

**COSEWIC**- Committee on the Status of Endangered Wildlife in Canada

**CWQGPAL** – Canadian Water Quality Guidelines for the Protection of Aquatic Life

**DELG** – New Brunswick Department of Environment and Local Government

**DFO** – Department of Fisheries and Oceans

**DNR** – New Brunswick Department of Natural Resources

**Ha** – Hectare

**Hwy** – Highway

**Km** - Kilometer

**LSDs** – Local Service Districts

**LOMAs** – Large Ocean Management Areas

**MPN** – Most Probable Number

**N** – Nitrogen

**N/A** – Not applicable

**NB** – New Brunswick

**NTU** – Nephelometric Turbidity Unit

**P** – Phosphorus

**pH** – Potential of Hydrogen

**SARA** – Species at Risk Act

**SBW** – Shediac Bay Watershed

**SBWA** – Shediac Bay Watershed Association

**SSA** – Southeastern Anglers Association

**TCH** – Trans-Canada Highway

## 10.4. APPENDIX 4: RESULTS FROM THE PROVISIONAL WATER CLASSIFICATION PROGRAM

| Stream (sample point) | Location | Class | Water quality issues | Parameters not met by CWQG[2] | Land-use |
|---|---|---|---|---|---|
| ShdA | Shediac River near Irishtown, above route 115 | C | Very high *E. coli* values (700 MPN/100 ml) | Aluminum | Agricultural, farming, future residential development |
| ShdB | McQuade Brook at Scotch Settlement | B | Elevated *E. coli* values (78 MPN/100 ml) | | Majority forested area, few residential areas |
| ShdC | Shediac River at Cape Breton | B | Elevated *E. coli* values (104 MPN/100 ml) | | Few agricultural and residential area; surrounded by forested land |
| ShdD | Shediac River downstream from Evangeline | B | Elevated *E. coli* values (83 MPN/100 ml) | Aluminum and Cadmium | Limited forestry in area; few residences in vacinity |
| ShdE | Shediac River at covered bridge location | A | | Aluminum (background level) | Forestry, Agricultural area upstream |
| ShdF | Clahoun Brook near Saint-Philippe | B | Elevated *E. coli* values (68 MPN/100 ml) | Aluminum and Iron | Proximity to Caledonia industrial park; mini-home development upstream, majority forested land, history of agriculture, few residences |
| ShdH | Weisner Brook at bridge near St-Philippe | A | Elevated *E. coli* values (74 MPN/100 ml) | | History of agriculture, majority forested land |
| ScdA | Bateman's Brook at Bateman's Mills | A | | Aluminum and Iron (background levels) | Active farming near and upstream; forested land upstream |
| ScdB | Scoudouc River near Big Meadow | B | Elevated *E. coli* values (163 MPN/100 ml) | Aluminum and Iron | Majority forested land; beaver dam |
| ScdC | Scoudouc River south of Ohio-au-Barachois | A | | Aluminum, pH and Iron (background levels) | Majority forested land, wetland area (bog), poorly maintained dirt roads; beaver dam |

[2] CWQG- Canadian Water Quality Guidelines for the protection of aquatic life

| | | | | | |
|---|---|---|---|---|---|
| ScdD | Scoudouc River at powerline | B | Elevated *E. coli* values (49 MPN/100 ml) | Aluminum, Cadmium and Iron; a few samples showed high values of chloride, copper and fluoride | Majority forested land |
| ScdE | Scoudouc River near pipeline crossing | A | | Aluminum and Iron (background levels) | Majority forested land |
| ScdF | Scoudouc River at Francis's camp | B | | Aluminum and Iron | Majority forested land; active farming in vicinity and upstream |
| ScdG | Scoudouc River at TCH | B | | Aluminum, Iron and Zinc | Majority forested land; boggy area downstream; sample site downstream from Moncton Airport |
| X | Unnamed tributary emptying into Cornwall Point | C | Not performed | | Flows near Scoudouc industrial park; agricultural region; forested and boggy areas |

## 10.5. APPENDIX 5: SUMMARY OF THE COMMUNITY WETLANDS ATLAS

| Site # | Location | Type | Length (m) | Comments | Land-use |
|---|---|---|---|---|---|
| 61 | Grande-Digue, located near barrier dune/beach | Coastal marsh | 1904 | marram grass, russian tissle, sea rocket, salt tolerant braken | Summer activities, faulty septic systems, farming and fish plant waste |
| 57 | Near Grande-Digue, on either side of Hwy 11 | Bog | 442 | black spruce, larch sphagnum moss, white birch and pitcher plants | wooded area near residental and farmland |
| 58 | Near Grande-Digue, on either side of Hwy 12 | Bog | 602 | | |
| 59 | Near Grande-Digue, on either side of Hwy 13 | Bog | 1006 | black spruce, larch, sphagnum moss, red maple and pitcher plants, moose tracks | wooded area near residental and farmland |
| 15 | Within streams that empty into Shediac River | Emergent wetland | 323 | alder, grasses, red maple, trembling aspen, cattails, beaver dam | wooded area |
| 18 | Within streams that empty into Shediac River | Emergent wetland | 155 | grasses, pond lilies, alders, red maple and trembling aspen | wooded area |
| 19 | Within streams that empty into Shediac River | Emergent wetland | 484 | grasses and cattails | wooded area |
| 16 | Tributaries of the Shediac River | Emergent wetland | 436 | grasses, sphagnum moss, cattails, alders, pond lilies | forrested area with some logging |
| 20 | Tributaries of the Shediac River | Emergent wetland | 747 | red maple, white birch, alders, grasses | forrested area with some logging |
| 12 | Mid-way along Shediac River | Emergent wetland | 561 | grasses, alders, red maple moose tracks | nearby residential, agricultural and logging activities |
| 13 | Mid-way along Shediac River | Emergent wetland | 285 | alders, grasses, red maple | nearby residential, agricultural and logging activities |
| 4 | Along Shediac River | Emergent wetland | 216 | red maple, grasses, alders and cotton grass | near residential and farming area |
| 5 | Along Shediac River | Emergent wetland | 1295 | | logging area, forestry run-off |
| 2 | Near headwaters of Shediac River | Emergent wetland | 1888.9 | grasses and alders | agricultural land (threatened by expansion of farm, agricultural sprays and fertilizers) |
| 3 | Near headwaters of Shediac River | Emergent wetland | 2751.2 | grasses and alders | agricultural land (threatened by expansion of farm, agricultural sprays and fertilizers) |

| | | | | | |
|---|---|---|---|---|---|
| 1 | Near headwaters of Shediac River - Lutes Mountain | Emergent wetland | 754 | | gravel pit (run-off and siltation), farmland, residential |
| 10 | Shediac River sub-watershed | Emergent wetland | 1248 | larch, black spruce, grasses, white birch, trembling aspen | forested area, threathened by logging . Headwaters tributary of Shediac River |
| 29 | Between Shediac and Scoudouc rivers | Bog | 722 | pitcher plant, grasses, black spruce, sphagnum moss, cotton grass, larch | agricultural land and residential activities |
| 25 | Border headwaters of both Shediac and Scoudouc rivers | Emergent wetland | 484 | grasses, ccattails, white birch, alders | wooded area, surrounded by cut areas near Hwy 15, residential potential |
| 26 | Border headwaters of both Shediac and Scoudouc rivers | Emergent wetland | 670 | | Streams runs through, wooded area, surrounded by cut areas near Hwy 15, residential potential |
| 27 | Border headwaters of both Shediac and Scoudouc rivers | Emergent wetland | 208 | alders, trembling aspen, grasses, red maple, gray birch, pond lilies | wooded area, surrounded by cut areas near Hwy 15, residential potential |
| 28 | Border headwaters of both Shediac and Scoudouc rivers | Emergent wetland | 325 | grasses, pond lilies, cattails, white birch | Streams run through, wooded area, surrounded by cut areas near Hwy 15, residential potential |
| 34 | Near headwaters of Scoudouc River | Emergent wetland | 1133 | grasses, sphaghum mosses, cattail, alders, pond lilies | forested land between TCH, Road run-off (salt, oils, ) |
| 35 | Near headwaters of Scoudouc River | Emergent wetland | 295 | grasses cattails, sphagnum moss, larch | forested land between TCH, Road run-off (salt, oils, ) |
| 38 | Scoudouc River subwatershed | Emergent wetland | 648 | alders, grasses, red maple, grey birch | forested with some cutting |
| 39 | Scoudouc River subwatershed | Emergent wetland | 1163 | grasses, alders, pond lilies, white birch, black spruce, moose tracks | stream runs through, forested with some cutting |
| 41 | West of Scoudouc road, Scoudouc River subwatershed | Bog | 876 | black spruce, larch, pitcher plant, bog laurel, sphagnum moss, labrador tea shrubs, moose tracks | semi-wooded, semi-cut area |
| 43 | Scoudouc River subwatershed, east of route 132 | Bog | 2452 | black spruce, larch, sphagnum moss, picher plants, leatherleaf, labrador tea shrubs, moose tracks | Wooded area, cut areas, agricultural acitiviies nearby |
| 44 | Scoudouc River subwatershed, east of route 133 | shrub wetland | 510 | alders, red maple, blueberries, wet ground, deer tracks | Wooded area, cut areas, agricultural activites nearby |
| 51 | South easterly portion of watershed Scoudouc River | Bog | 3579 | black spruce, larch, leatherleaf, sphagnum moss | forrested area, threathened by logging |

| | | | | | |
|---|---|---|---|---|---|
| 52 | South easterly portion of watershed Scoudouc River | Emergent wetland | 953 | stream containing alders, red maple, grasses gray birch | forrested area, threathened by logging |
| 53 | South easterly portion of watershed Scoudouc River | Emergent wetland | 1171 | stream grasses, alders, red maple, moose tracks | forrested area, threathened by logging |
| 54 | South easterly portion of watershed, Scoudouc River | shrub wetland | 656 | stream containing alders, red maple and grasses | forrested area, threathened by logging |
| 49 | Eastern portion, Scoudouc River | Bog | 18400 | black spruce, larch, leatherleaf, sphagnum moss, pitcher plant | forrested land, cut and new growth areas, Main roadway separates wetland 49 and 50 |
| 50 | Eastern portion, Scoudouc River | Bog | 4159 | black spruce, larch, leatherleaf, sheep laurel, pitcher plant, beaver dam | forersted land, cut and new growth areas, Main roadway separates wetland 49 and 50 |
| 47 | Eastern portion, Scoudouc River | Bog | 5798 | black spruce, larch, leatherleaf, sphagnum moss, pitcher plant | forrested, cut and new growth trees, dirt road poor condition |
| 48 | Eastern portion, Scoudouc River | Bog | 3397 | black spruce, larch, leatherleaf, sheep laurel, pitcher plant, beaver dam | Forrested, cut and new growth trees, dirt road poor condition |
| 45 | East side of watershed, near Town of Shediac | Emergent wetland | 3543.6 | stream, cattails, grasses, red maple, larch | Wooded and clear cut areas, residential area 0.5 to 1 km distance, threathened by urban encroachement |
| 46 | East side of watershed, near Town of Shediac | Bog | 20375 | black spruce, larch, pitcher plant, bog laurel, sphagnum moss, labrador tea shrubs, moose tracks | Wooded and clear cut areas, residential area 0.5 to 1 km distance, threathened by urban encroachement |