The Southwest New Brunswick Marine Resources Planning Area: A Short Overview

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Short Version 1.1

Prepared for:
Southwest New Brunswick Marine Resources Planning Steering Committee
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Southwest New Brunswick
MARINE RESOURCES PLANNING

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1 Introduction

This document has been developed as a resource to facilitate future efforts in the development of a marine resources plan for Southwest New Brunswick. It is the companion document to the more detailed, *The Southwest New Brunswick Marine Resources Planning Area: A Background Document.* It has been written with the intent of providing the reader with a very basic background of the current planning process as well as the social, economic, and ecological character of the planning area.

Both *The Southwest New Brunswick Marine Resources Planning Area: A Short Overview,* and the more detailed *The Southwest New Brunswick Marine Resources Planning Area: A Background Document* will be available for download from the Southwest New Brunswick Marine Resources Planning Process website at www.bofmrp.ca.

1.1 The Planning Process

Integrated marine resources planning in Southwest New Brunswick has been carried out in part by local community groups such as the St. Croix Estuary Project (SCEP) and Eastern Charlotte Waterways (ECW), as well as through international collaborations such as the St. Croix International Waterway Commission (1993). More recently, the Federal and Provincial governments have met with communities to discuss marine resources planning (MRP) for the area of Southwest New Brunswick (SWNB) between the USA – CANADA border and the Musquash watershed near Dipper Harbour (MRPP Committee 2005). The SWNB MRP differs from the existing processes in that it focuses almost exclusively on the marine area. Thereby, it compliments other processes that focus on the terrestrial watersheds and coastal communities.

In 2004, the Federal Department of Fisheries and Oceans and the New Brunswick Department of Agriculture, Fisheries and Aquaculture began discussions to improve resources planning and management of the Southwest portion of the Bay of Fundy. As a result, Phase I and the Southwest New Brunswick Marine Resources Planning Process Committee were established and began to meet, guided by the following Mission Statement:

> ***SWNB MRP Mission Statement:***
> *Develop a Marine Resources Plan that will guide the decisions on the use of marine space and activities and will be implemented by all regulatory agencies with marine jurisdiction for the Southwest Bay of Fundy in New Brunswick. The plan will ensure that competing demands for marine resources are addressed while acknowledging legitimate community needs and access to resources, and recognizing the principles of social, economic and environmental sustainability.*

During Phase I of the SWNB MRP Process it was the responsibility of the MRP Committee to provide a Phase I Report that would include recommendations for a marine planning process in Southwest New Brunswick Bay of Fundy. A list of participants of the MRP Committee, and a copy of the Phase I Report can be viewed on the SWNB MRP website, www.bofmrp.ca.

Also as part of Phase 1 the SWNB MRP Committee conducted a public survey in 2006 to identify and rank the most valued assets of the Bay of Fundy, and identify both personal connections to the Bay of Fundy and the most important aspects residents wished to preserve and protect. Some 1050 people responded to the survey (Corporate Research Associates 2006).

The responses of the survey and the priorities shown in Table 1 address one needed component of the planning process. Another necessary component to move forward is an awareness of the information resources available on the most important aspects identified in the survey, as well as the general social, economic, and ecological character of the project area. The establishment of a technical working committee to prepare such a background document for public consultation was a recommendation of Phase I (Corporate Research Associates 2006), and the development of this document became a component of Phase II, the plan development.

Table 1: Planning Area Priorities: Determined as the result of the Phase I Public Consultation which occurred in April and May 2006 (Corporate Research Associates. 2006).

Important	*Value*
Conserve Marine Life	Natural Environment
Protect the Ecosystem	Marine Life
Fish Stocks	Way of life
Access to beaches for recreation	Healthy resource/fishery
Protect Spawning areas	Public Access
Access to Wharves	Leisure/recreational activities
Access to Aquaculture	Fishery
	Business/Industry/Tourism
	Work/Employment

In September 2006 Phase II of the Southwest New Brunswick Marine Resources Plan Development commenced with the appointment of a Steering Committee and a Chair to guide and lead the development of a marine resources plan, and compile a background document for public consultation. Social, economic, and ecological information resources have been compiled and presented in the document *The Southwest New Brunswick Marine Resources Planning Area: A Background Document.* The Background Document serves to identify many of the literary resources currently available to those participating in the SWNB MRP process, and along with the community priorities identified in Phase I and presented in Table 1 will allow movement toward the next Phase of the planning process.

2 State of the Area

The current proposed geographic area for the SWNB marine resources planning is depicted in Figure 1. It covers the marine area between the Hague Line (Canada / US marine border) and the Musquash Watershed, near Dipper Harbour extending from the high water mark on the shoreline out to the approximate mid-bay line between New Brunswick and Nova Scotia. The southern and mid Bay boundaries follow Provincial boundaries, and the eastern boundary provides inclusion of most of the aquaculture production areas of the Bay of Fundy (MRPP Committee 2005). The area does not directly include the land base and freshwater rivers and lakes.

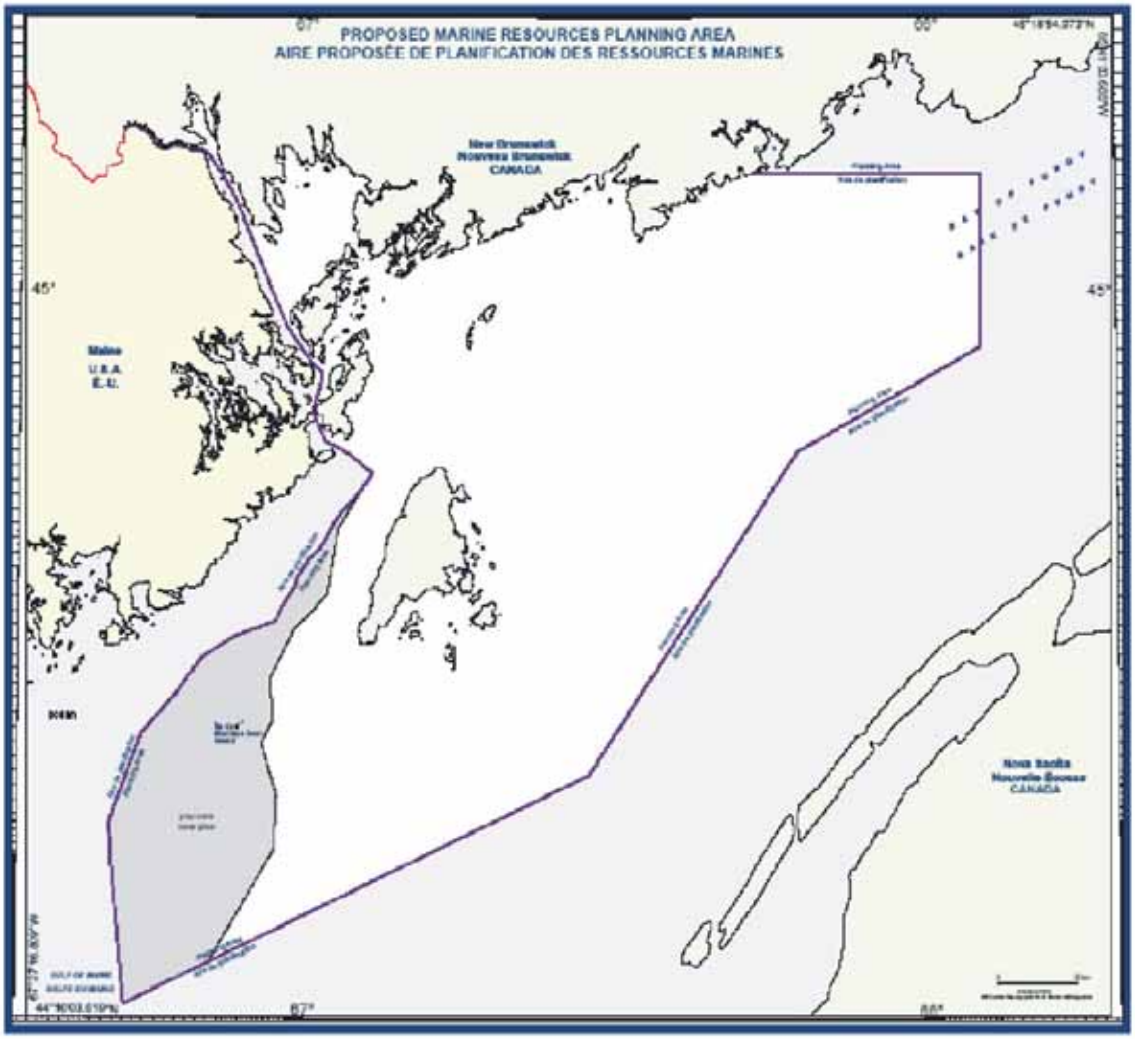


Figure 1: The proposed marine planning area for SWNB includes the marine area east of the Hague Line (Canada / US marine border, north of the approximate center line of the Bay of Fundy, and south of the New Brunswick coastline between the Canada / US border and the Musquash Watershed near Dipper Harbour.

2.1 Social, Cultural and Economic Overview

First Nations people, including the Mik'maq, Maliseet, and Passamaquoddy (Hunter and Associates 19??) have long inhabited the SWNB Bay of Fundy coastline. Subsequently Samuel de Champlain settled on St. Croix Island, in the river estuary at the western extent of the project area, in 1604. Consequently, since shortly after the last ice age covered the land, people have lived near and had a working relationship / dependence on the marine resources of SWNB.

To describe the current human relationships and demographics for the MRP area we draw on our knowledge of Charlotte County, as the county lines approximately join the land base to the MRP boundary. The county is one of the smallest by area, and one of the least populated in New Brunswick. It contains 4.8% of the Provincial land area and approximately 3.8% of the population (~27,300 people in 2001) (Enterprise Charlotte 2007). Only 2.5% of

the county's population speaks French, compared to approximately 33.5% for the Province (Statistics Canada 2002*)*.

The long history of reliance on marine resources has undoubtedly shaped the fishing community culture that exists in SWNB and influences the social aspects of the community. It has been noted in a study of Deer Island weir fishermen that standardized methods of data collection are inadequate in studies of the socio-economic change in the that fishery sector because the traditional fishing way of life is non-standardized and non-routine (Mitchell 1987). The organization and operation of a traditional commercial fishery is not only shaped by ecological conditions, government policy, and market forces, but also by how the fishermen and their communities respond to those structural forces (Mitchell 1987). Therefore, we might expect that the weir fishery in SWNB, and other fisheries for that matter, to be shaped by reciprocal exchange between structure and culture.

The fishing industry is a major driver in the local economy, and a significant number of fishermen in the area are due to retire in SWNB over the next 10 years (Anonymous 2007). The mean age of lobster fishermen is 54, and salmon farmers 49, for a randomly selected group of license holders on Grand Manan and Deer Island (Walters 2007). The local population aging is also a reflection of the movement of young people away from rural areas toward growing economies in other regions. For instance, the exodus of working-age youth from New Brunswick to areas like Alberta has contributed to an increased population age in the Province. The median age of the population in Charlotte County is nearly 39 years (Statistics Canada 2002*)*.

Out of 18 industries assessed on the 1996 Census data for Charlotte County, the fishing and processing sectors have been identified as areas in which the community has a "competitive advantage". In 2006, traditional fisheries in just the Marine Resources Planning area of SWNB for groundfish, pelagic fish, mollusks and crustaceans had a landed value of approximately $38.6 million. District 50 around Grand Manan Island had a landed lobster value of nearly $16 million in 2006, while District 53 between Blacks Harbour and Maces Bay had a herring fishery worth $4.8 million (DFO 2006). Both of these were the largest within the Marine Resources Planning area for these respective fisheries, dominating other locations in the planning area by a significant amount.

The salmon aquaculture industry in SWNB has become a vital component of the economy of Charlotte County, employing an estimated one in five workers. The spin-off industries from aquaculture are estimated to provide some 2,900 indirect jobs in addition to the approximate 1,600 direct jobs in the industry itself (Enterprise Charlotte 2007). In 2005, there were 1250 jobs in the New Brunswick aquaculture industry accounting for 32% of the total Canadian employment in that industry sector.

As of 2005, the total product value of the aquaculture industry in the Province exceeded $230 million, and the traditional fisheries of the Province exceeded $204 million (DFO 2008). In Charlotte County, the traditional fishing and aquaculture industries together likely account for 25 % or more of the economy (Rouse, M. Pers. comm. 2007). As shown in Figure 2, this has contributed to local employment growth, while a declining trend has been observed in nearby Saint John over the same 1987-2003 time frame.

Given the local employment growth it is not surprising that only 8 % of Charlotte County residents commute out of the county for work. However, one economic concern is that a significant portion of Charlotte County's earned dollars are spent in Saint John & Fredericton, and still more goes cross border to the US (Matthew Fischer & Associates 2004).

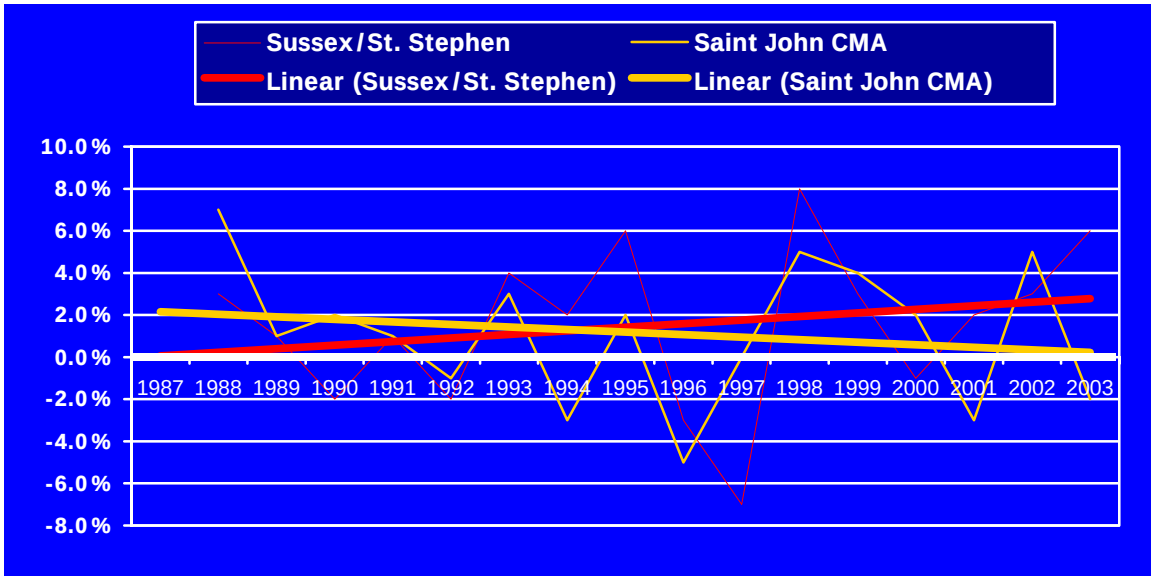


Figure 2: Percent (%) Change in Employment 1987-2003. Note the trend line for Sussex/St. Stephen has risen from 0% to 3% while the trend line for Saint John has declined from 2% to 0% (Source: Matthew Fischer & Associates 2004).

Charlotte County stands out in New Brunswick for its' consistently positive, albeit slow in-migration (average 88 persons/year) (Matthew Fischer & Associates 2004). Yet, during a recent study of Charlotte County businesses in manufacturing, aquaculture, fisheries, tourism and that portion of the service sector employing skilled trades and non-traditional workers, a skill shortage in the trades was identified. This shortage is being exacerbated by the out migration of skilled trades people to employment opportunities in Western Canada as well as the lack of graduating apprentices from within the province. **T**he available labour force was the number one issue identified by more than 53% of surveyed businesses interviewed in the traditional fishery, aquaculture, and manufacturing sectors (Rouse, M. Pers. comm. 2007). A second major shortage of general labour was also identified, especially among employers in the seasonal industries (McCarthy and Power 2006). Although a labour shortage has been identified within the county, there are still unemployed people living in SWNB, and recent efforts have been made to identify the barriers to employment (Power 2007) and put a community growth strategy in place to address these issues (Enterprise Charlotte 2007). In a concurrent study, the skilled trades employers in Charlotte County noted their challenges were offering competitive wages (with western Canada) and in some cases the seasonality of their employment needs (McCarthy and Power 2006).

During recent community meetings in Charlotte County a number of social issues were identified that present challenges to the growth employment in communities of SWNB. These issues included a lack of adequate, affordable housing, particularly for those who work only seasonally; substance abuse with youth and the need to ensure they obtain a secondary school education; the lack of 24 hour services at hospitals, convenience stores, restaurants etc.; the change in the traditional family related to teen pregnancies, divorce rates and couples waiting longer to have children. All of these issues were felt to increase the cost of social services and to affect the education system. The current social challenges are compounded by the lack of incentive for low skilled workers to stay employed given the low wages that are available, the cost of transportation (no public transit system), and the shortage of day care facilities (Enterprise Charlotte 2007).

Since 2002 the Fundy Community Foundation has hosted several community dialogues in Charlotte county on the following community priorities: 1) Seniors and the challenges faced by elderly people living in the rural communities of Charlotte County; 2) Transportation and the challenges of moving people within the County as well as to and from nearby urban centers; 3) Youth and the challenges faced by young people living and growing up in our rural communities; and 4) Poverty in Charlotte County (Fundy Community Foundation 2006). All of these session identified barriers, needs and opportunities that exist within the communities to addressing these social issues.

Rural public transportation has been identified by a number of communities, particularly seniors, as a priority. Transportation has been identified as one of the major barriers for seniors in accessing other available services and resources (Fundy Community Foundation 2003). The demand for low-cost transportation services comes from (a) youth (primarily rural) in need of getting from A to B for work, job interviews, and recreational opportunities; (b) seniors who don't drive or don't like to drive (e.g. in the evenings, on winter roads etc.); (c) anyone else who simply needs greater mobility to get around than what existing transportation services provide (Fundy Community Foundation 2002). Recently, the transportation issue has in part been addressed through the establishment of the Charlotte County Alternative Transportation Association, and a "Dial A Ride", products that are a direct result of community dialogue on transportation (Fundy Community Foundation 2006).

Poverty exists as a social issue in Charlotte County as evidenced by the need for four food banks. A few of the barriers to people living in poverty in Charlotte County that have been identified through community forums include (Fundy Community Foundation 2006):

- Attitudes-community, individual (education so people recognize poverty), judgmental attitudes
- Geography (remote, rural area)
- Government policy
    a. rates of assistance are too low
    b. minimum wage too low
    c. restrictions on sharing resources
- Education and training opportunities often restrict adults over 30 years

Youth have been a priority group identified when discussing social issues in Charlotte County. During a community forum on youth in 2003, there was an overwhelming feedback from youth to the community that "you have to listen to what we have to say". There was a strong sense from the youth participants that there is a need for a youth-driven dialogue in Charlotte County (Fundy Community Foundation 2003b). In partial response to this need, the Healthy Community Healthy Youth Charlotte County initiative to develop asset-based approaches to addressing root causes of youth issues was formed (Fundy Community Foundation 2006).

A loss of Charlotte County heritage is another community concern. Community members have identified one of the chief concerns with respect to heritage as being a large segment of the population that is unaware of its community heritage and that this heritage is not being passed on and is therefore being lost. There is a belief that new settlement is happening haphazardly in rural areas, resulting in a loss of suitable agriculture and recreation lands to housing development. As a result young families that want to get into farming have problems finding land that is both suitable and affordable. Further, a movement toward more seasonal residences is creating a "dark community" syndrome in some areas, where communities are only full for two or three months in the summer leaving large sections of the community "in the dark" for the remainder of the year. Community residents feel these factors represent a

real challenge to developing and/or preserving community identity and a rich community life throughout the entire year (Fundy Community Foundation 2002).

2.2 Environment

The environment consists of the physical and chemical habitat of an area, which influences what plant and animals will exist in a given location. Understanding our environment is a critical step in understanding why the living things we see exist in the locations we see them. People in Charlotte County have spoken very passionately about environmental issues and the importance of ensuring the environment does not get over looked for the sake of economic development (Hunter and Associates 19??).

Physical and Chemical Environment
The following are a few examples of some of the physical and chemical information that is available on the marine environment in Southwest New Brunswick and the MRP area.

The Bay of Fundy has the highest tides in the world. Although the highest range exists outside of SWNB, tides of 8.5 meters do occur locally. Very high and increasing tides occur on regular intervals of one month, seven months, 4.5 years, and 18 years[1]. With the approach of the Saros Tides [~18 year tidal cycle] in 2012-13, the risks of storm surge and coastal flooding will increase. Due to what is called the Coriolis force, tides in the Bay of Fundy move in a counter clockwise direction, with the strongest currents during the rising tide occurring on the Nova Scotia side of the Bay, and the strongest outgoing tidal currents moving along the New Brunswick, including the SWNB MRP area. This stronger “ebb” tidal current velocity is generally about 0.7 m/sec along the New Brunswick side of the Bay of Fundy, but local water velocity extremes in Head Harbour Passage between Campobello Island and Deer Island have been recorded at 2-3 m/sec (Hunter and Associates 19??). The counter clockwise tidal circulation pattern of the Bay of Fundy ends with a counterclockwise “gyre” east of Grand Manan (Chang et. al. 2005). This gyre is thought to be a major factor in bringing deep water nutrients to the surface where they grow plankton populations that will in turn feed all kinds of fish, birds, and whales.

One phenomenon that accounts for the amplification of tides in the Bay of Fundy is the effect of “shoaling and funneling”. The ocean waters shallow as they move into the Bay of Fundy, and the cross-sectional area of the Bay is greatly reduced. The first cross sectional reduction occurs in the SWNB MRP area between Grand Manan Channel and Saint John (see Figure 3), which is about ¼ of the cross section of the Gulf of Maine (Hagerman et. al. 2006).

On a more local scale, Western Passage and Letete Passage are the two main connections between the Bay of Fundy and Passamaquoddy Bay. Western Passage is much wider and carries most of the tidal flow in to and out of Passamaquoddy Bay. It is known for its strong currents and eddies, including the “Old Sow” whirlpool. The turbulence generated by the collision of two currents is enhanced by the plunging bottom profile south of Deer Point, which deepens from 40 to nearly 100 meters at a slope of more than 45°(Hagerman et. al. 2006). The Old Sow whirlpool is most active during flood current, 2 to 3 hours before high water, when the vortex can attain a diameter of up to 76 m and a depth of up to 12 m, making it the largest tidal whirlpool in the Western hemisphere. The Old Sow vies for title of the world's most powerful whirlpool, having vortex current speeds up to 15 knots (28km/hr) (Hagerman et. al. 2006).

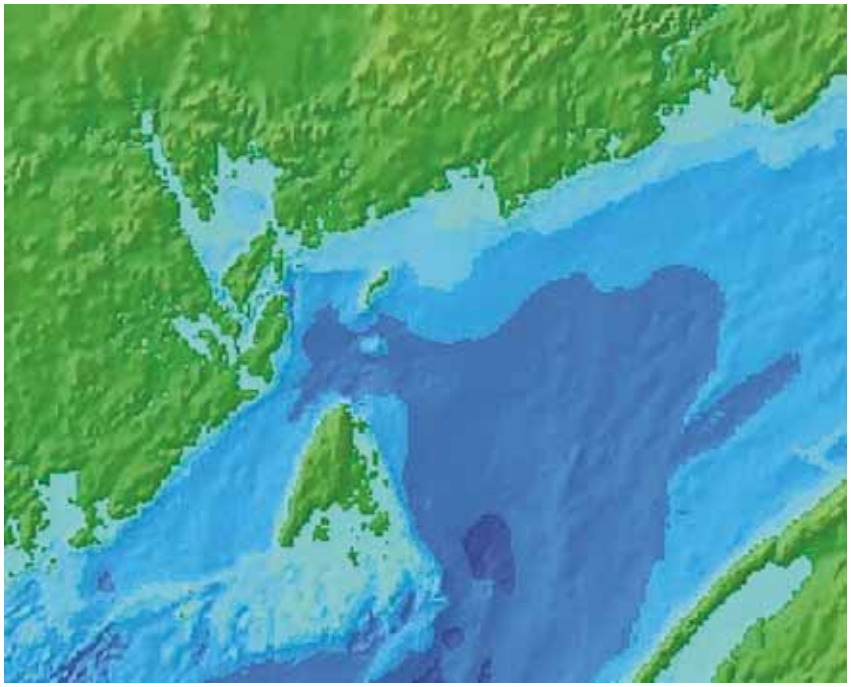


Figure 3: Digital bathymetry map of the SWNB MRP area shows how the outer Bay of Fundy quickly becomes shallower in the SWNB marine area. Darker blue areas are deeper. The large island is Grand Manan. (Source: Image modified from Gulf of Maine Council on the Marine Environment http://pubs.usgs.gov/of/1998/of98-801/bathy/. Original image by Ed Roworth and Rich Signell of the U.S. Geological Survey (USGS).)

Ecosystem Characteristics

Understanding an ecosystem means we don't just understand the physical and chemical environment, but that we also understand the living things that are there and how they interact with their environment and each other. When examining these "ecosystem linkages" within an area, most if not all relationships can be fit into one of two general categories;

- physical – biological linkages, or,
- biological interactions.

A local example of a physical – biological linkage is how the large volume of marine water pushes through the many small passages that surround Deer, Campobello, and the other islands in the western portion of the planning area and into Passamaquoddy Bay. The tides first push water into Passamaquoddy before rushing back through these constrictions on the falling tide. The physical constrictions create high tidal current velocities and promote significant turbulence and mixing of the local waters. This mixing is one of the keys to the "benthic pump", a process by which nutrients, plankton, and decaying materials are brought high into the water column where fish and bird communities thrive on the abundance of food "pumped" toward the surface (Hunter and Associates 19??). In this way the physical shape of the SWNB coastline, and the velocity of the water moving through the passages, helps feed the diverse biological communities that exist there through a key physical-biological ecosystem linkage.

The second, and equally important category of ecosystem linkages is the category of "biological interactions". This category describes how one living thing depends on another, and where its place is within a food chain. This may be the relationship of eel grasses as a

fish nursery area, or the importance of the Spiney dogfish (a relatively new commercial species in the Bay of Fundy) within the food web of the Bay. Loss or reduction in eel grass beds might be expected to have a negative effect on herring that spawn and rear in the grasses. Similarly, removal of a voracious predator like the dogfish through fishing, may result in other fish populations growing.

As management of our marine resources becomes more involved, so must our understanding of terms such as “ecosystem”, “keystone” species, and “critical” habitat.

2.2.1 Current Indicators and Keystone Species

A keystone species is one that plays a crucial role in its community, or a pivotal role in the food web structure of an ecosystem (Bredin et. al. 2001). That is to say that either as a predator or prey, a large number of the other species in the community rely on the keystone, and changes in the keystone population are likely to have significant impacts (positive and/or negative) on other species in the community. A list of keystone marine fishes have been identified for the Bay of Fundy that includes the Spiny dogfish, American Shad, Atlantic Herring, Rainbow Smelt, Atlantic Cod, Haddock, Pollock and Winter Flounder (Dadswell et. al. 1984). Between 1976 and 1983 when the assessment was done, the SWNB MRP area had one of the highest distributions of fish from this list within the Bay of Fundy.

Even at the single species scale of management, indicators for the current “state” of a species can be numerous. A recent report on the lobster fishery in SWNB and the Bay of Fundy suggests that a suite of indicators are necessary to monitor future health of the lobster stocks. These include fishery dependent indicators of abundance, fishery-independent indicators of abundance, fishing pressure indicators, production indicators, and ecosystem indicators to estimate fishery impacts on the ecosystem (Robichaud and Pezzack 2007). Although the average citizen does not need to understand what all of these indicators are or what they measure, it is important to realize that we need to measure or monitor a number of indicators to understand just one species.

Indicators do not need to be living things. A number of indicators have been identified and are currently monitored in the SWNB marine area in order to assess the environmental effects of marine finfish aquaculture on the ocean habitat. These indicators include the following: analyzing living things within the marine community that are large enough to be seen by the naked eye, measuring total free sulphides and zinc/copper (Zn/Cu) concentrations in surface sediments, documenting habitat appearance with underwater video and photography, and measuring dissolved oxygen concentration (DFO 2005). Provincially, the primary indicator of environmental quality at marine finfish aquaculture sites is the sediment sulfide concentration measurement, which is an indicator of the oxygen conditions within the sediment (NBDENV 2006). Performance based standards of sulfide content in sediments are used to regulate aquaculture operations once they are up and running (Boldon, M. Pers. comm. 2007) to make sure the operations are not depleting oxygen and thereby making the sea floor uninhabitable for other bottom dwelling organisms.

2.2.2 Sensitive and Critical Areas

During the planning process it is necessary to consider the terms “sensitive” and “critical” carefully. We often tend to use the terms as a relative measure, sometimes within valuable modeling that is directly applicable to marine planning. For example, modeling has shown that the SWNB MRP area is moderately sensitive to future sea level rise (Percy 2007) (See

Figure 4). However, these terms now are more often used with legal meaning. For example, critical habitat is a legal term defined under the Species at Risk Act as:

"….the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species."

Grand Manan Basin matches the characteristics of Critical Habitat as defined by SARA for the Right whale by supporting the highest concentrations of copepods in the Bay of Fundy. The topography and movement of water masses in Grand Manan Basin concentrate the resident copepod population. However, Fisheries and Oceans also notes that there is no evidence to suggest the amount of available Critical Habitat is limiting Right whales from reaching their recovery targets (DFO 2007).

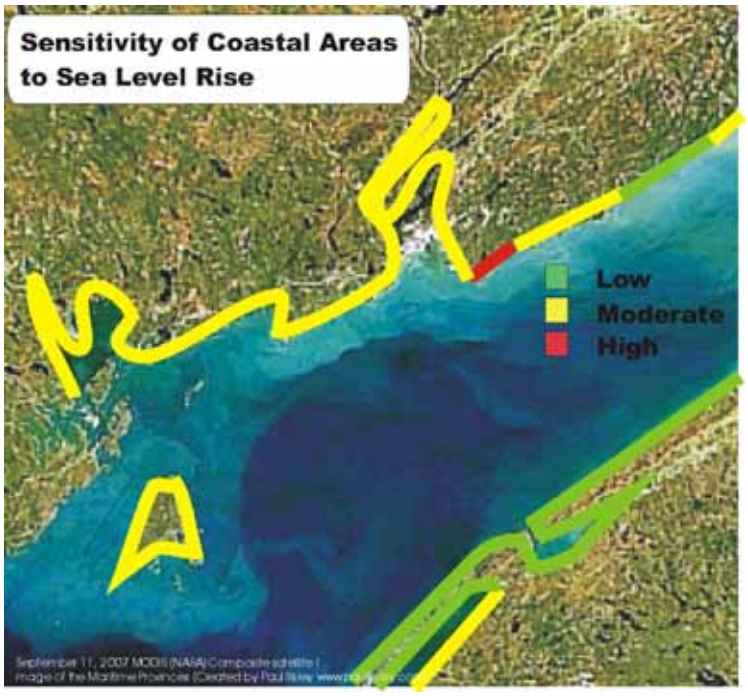


Figure 4: Sensitive habitats can have a legal interpretation, while other predictive models use the term to indicate such things as sensitivity of the SWNB coastline to sea level rise, as shown above (Source: Modified from Percy 2007).

Critical marine habitats have been identified within the SWNB MRP area for a number of species including herring in the whole Quoddy Region, Bonaparte's gull, Great Black back gull, and Red-necked phalaropes in outer Passamaquoddy Bay, and multi-species seabird colonies on the Grand Manan Archipelago (Messieh 1992). These sites are not "critical habitats" in the legal sense applied through the Species At Risk Act (SARA), but those that biologist believe are key to a particular species survival. Other habitats have also been identified for critical species of the Quoddy Region in a non-legal sense. The Humpback whale and Right whale were identified through the Huntsman Marine Centre as the highest priority of fourteen species to identify their regionally significant habitats, whereas the periwinkle and shrimp were the highest ranking species considered to be of local importance (Burt 1997).

The waters and islands around Head Harbour passage, north east of Campobello Island, are of national significance for breeding, staging and wintering populations of shorebirds, ducks, cormorants, gulls and geese (Hunter and Associates. 19??). This area is further important to

nursery area for female Harbour porpoise and their calves (MacKay 2005). Similarly, the Atlantic wolffish of SWNB, which has been listed by COSEWIC as a species of Special Concern, is part of a population of large, solitary, slow-growing, late-maturing, nest-building benthic fish that has declined an estimated 87% since the 1970s. Apparent threats are related to bottom fishing and habitat alteration, perhaps compounded by environmental change. Although the Atlantic wolffish has met criteria for an Endangered Species listing, because they are reasonably widespread with moderate numbers and it is not considered to be facing imminent extinction, they have not received the Endangered Species listing. The recent known locations for Atlantic wolffish within the planning area are shown in Figure 5, and these could arguably be considered sensitive or critical for that species.

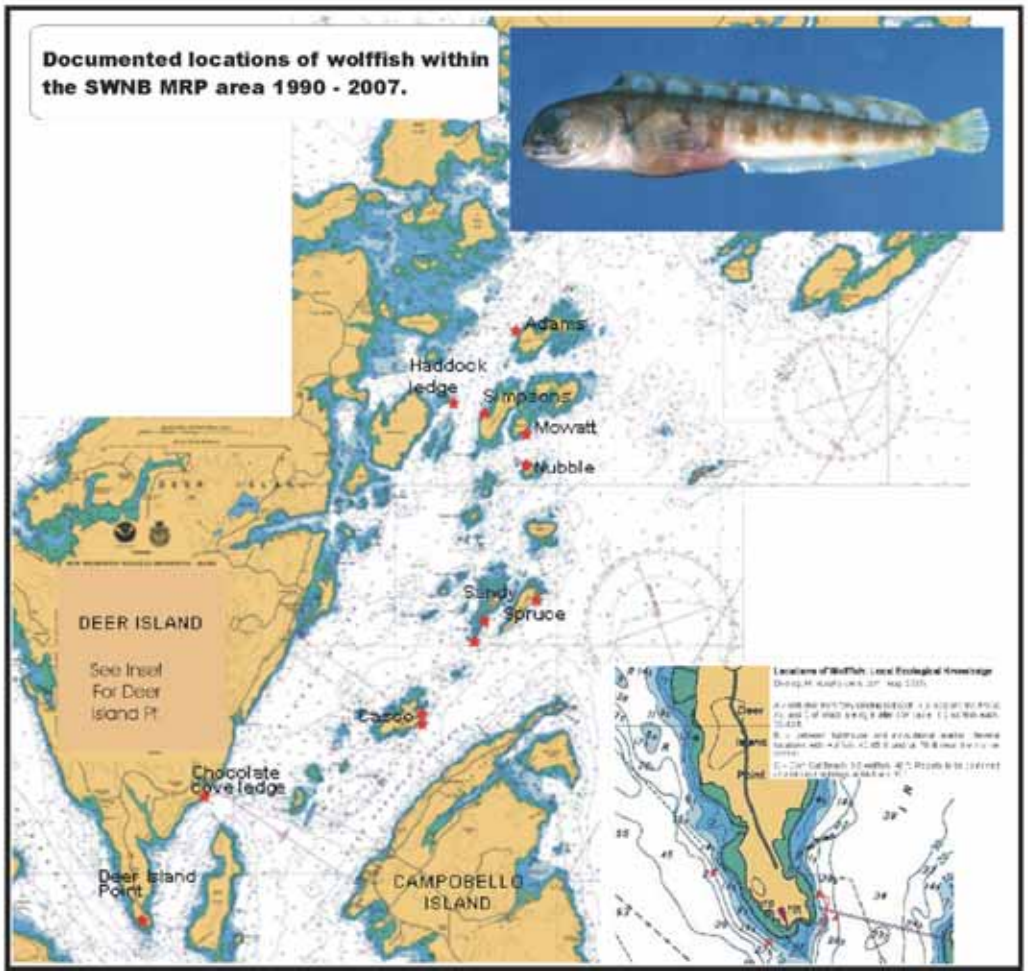


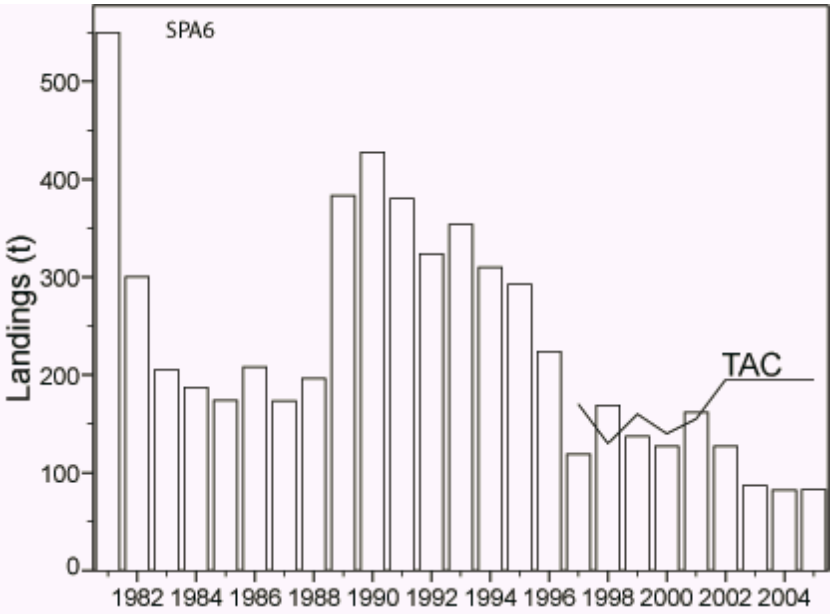
Figure 5: Documented locations within the SWNB MRP area where Atlantic Wolffish, a COSEWIC listed species of Special Concern, have been found between 1990 - 2007. Habitat of the Wolffish appears to be highly sensitive to bottom disturbance.

2.2.3 Marine Populations

The number of species of living organisms within the SWNB MRP area is very large, with more than 100 species of fish and 40 species of algae (Senes Consultants Ltd. 2006), and numerous other marine mammals and birds. Each is part of a population, and to describe them all would be a monumental task. However, years of research have been carried out in the SWNB area, and it does allow us to describe many of these species. A few examples of the kinds of information available are provided here.

The Federal Scallop Production Area 6 is a boundary that approximates that of the SWNB MRP area, and is therefore a good fit for determining the status of the population in the marine planning area. The Stock Status Report for 2004 noted that landings to November 2004 were 81 t against a Total Allowable Catch (TAC) of 195 t. Commercial catch rates for the fleet that fishes this area had remained steady the previous 4 years, but effort was down significantly. The scallop population appears to be stable with removals in the range of 80 to 160 t per year (DFO 2004). Effort has decreased by 57% over the period 1998-2005 and is below the long term median level. Landings to November 2006 were 91 t against a TAC of 100 t. The mid-Bay of Fundy catch rate may be a better reflection of population trends as it is based on somewhat higher levels of effort but there still does not appear to be any large changes in the last 10 years. The abundance of commercial size scallops appeared to remain unchanged from 2005 to 2006 in sub areas along the SWNB coastline and the areas east and south of Grand Manan. However, longer term abundance has possibly declined as much as 44-46% in waters immediately around Grand Manan (DFO 2007). Most of the stock indicators show no signs of good recruitment, and suggest that the stock is being fished down (DFO 2006) (See Figure 6).

Figure 6: The declining trend of Scallop landings (meats, t) between 1981-2005 in Scallop Production Area 6, an area that approximates the SWNB MRP area (Source DFO 2006).



Unlike the scallop production area, the boundaries of the DFO Lobster Fishing Areas (LFA) upon which stock status is reported do not closely match the SWNB MRP area. Much of LFA 38 and approximately half of LFA 36 occur in the planning area. Therefore, it is more difficult to obtain a description of the lobster population(s) within the planning area. However, generalizations, and specific sampling location results allow for insight into the local lobster population. Lobster landings in the Bay of Fundy, including SWNB continue to be above long-term means, and during the last five years have stabilized at an historical high plateau (See Figure 7). During the 2005-06 season landings peaked at an historical high. Assessment of fishing pressure indicators suggest that the stock is still fished at moderate levels with estimates for exploitation on the order of 52 to 58% (Robichaud and Pezzack 2007). In 2006, 2173 tonnes of lobster were reported landed for the SWNB MRP area, and 62% of that volume was landed in District 50 Grand Manan (DFO 2006). Lobster settlement

index (since 1991) surveys off Beaver Harbour (in the middle of the SWNB MRP area), showed a historical high settlement in 2005 and 2006.

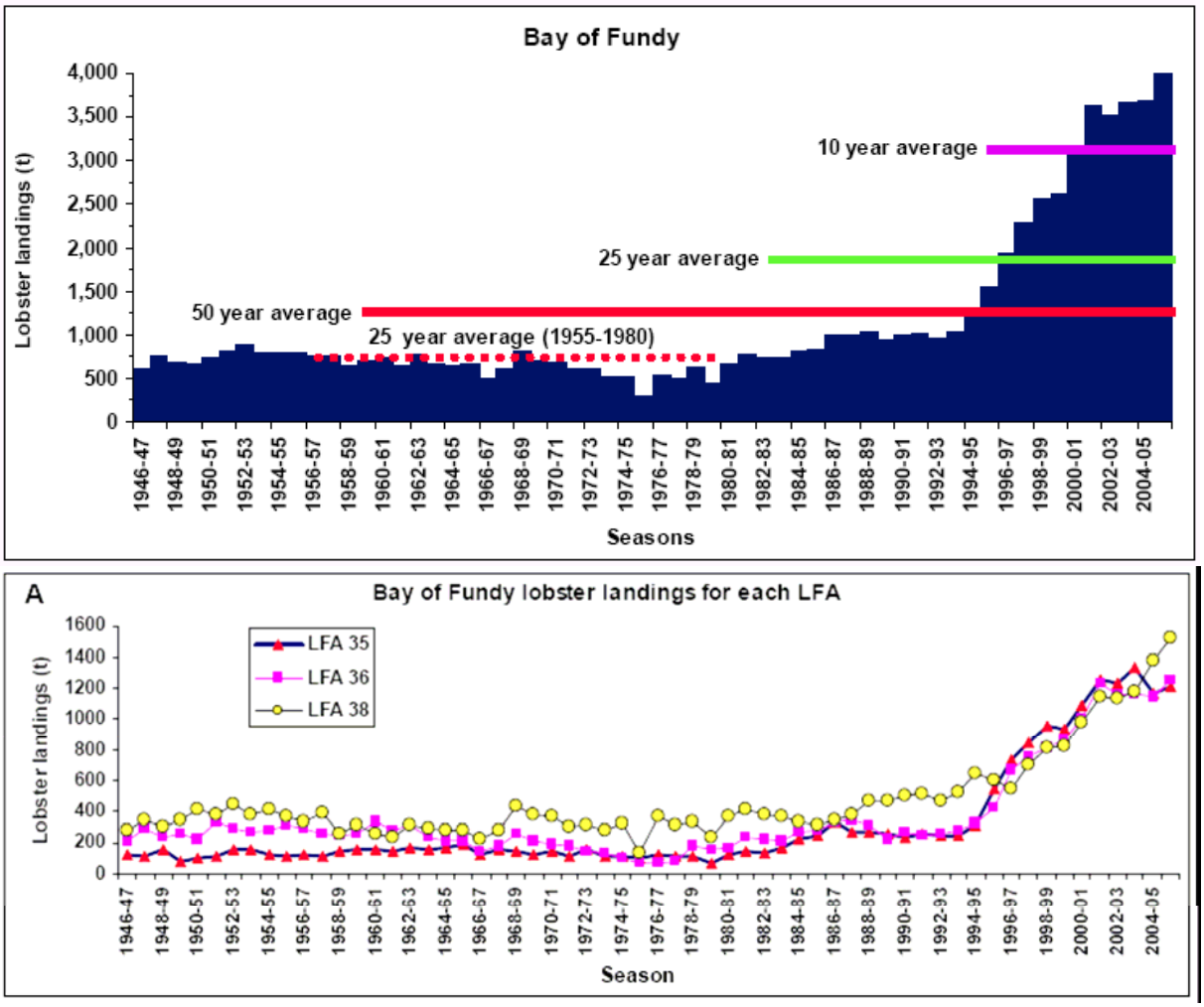


Figure 7: Much of Lobster Fishing Area (LFA) 38 and part of LFA 36 fall within the SWNB MRP area. In these areas lobster catches have peaked at historical highs (Source: Robichaud and Pezzack 2007).

Although the Stock Status Reports by Fisheries and Oceans are one of the best resources for evaluating marine populations in Southwest New Brunswick, one can no underestimate the value of information held by local fishermen and based on years and generations of fishing. This information is often referred to as TEK, or Traditional Ecological Knowledge. In Southwest New Brunswick fishermen have identified lost haddock, cod and Pollock spawning in Passamaqoddy Bay, and along the New Brunswick shore from Maces Bay to Musquash on the eastern end of the SWNB MRP area. At one time, cod, haddock, and pollock all spawned in the waters south of The Wolves islands (Graham et. al. 2002). These locations are mapped, providing visual impact of the change in range. Recent observations by fishermen of spawning stocks note that the area southeast of Grand Manan Island, known as the Grand Manan Plate, is the key area for cod and haddock. This spawning location on the Plate is sometimes referred to as “the Gravelly”, an area of complex tides and currents and undersea ridges (Graham et. al. 2002). No recent significant pollock spawning has been noted in the SWNB area by the fishermen. Little current detail on the former spawning areas exists because poor catches in those locations mean few people fish the former productive waters.

3 Current Uses and Activities

The number of human uses of the marine resources in Southwest New Brunswick is numerous and includes such things as tourism (eco-tourism, whale watching/boat tours, sea kayaking, etc.), shipping, and recreation. However, the traditional fishery and aquaculture production are two of the most significant in terms of economics, use of space. Each exports a major volume of their product to the USA and employs a significant portion of the local population.

Paturel International, a company located on Deer Island, is the world's largest shipper of lobster (MacKay 2005), and lobster is the most widely and intensively fished species in SWNB (Walters 2007). During 2006, some 1350 metric tonnes of lobster were landed in District 50 Grand Manan alone (DFO 2006). Unlike many areas of the Bay of Fundy and the Gulf of Maine coastline, where lobstermen commonly fish trawls of 10-15 pots, lobstermen in the Passages and around much of SWNB area fish 'doubles' and 'triples'. (i.e. only two or three traps per set of buoys). This smaller number is the maximum that can be effectively handled in the short time window typically available to work traps during slack water. Lobstermen may put up to 45 kgs of weight in a trap to keep it from being moved around by the unusually strong currents (Hagerman et. al. 2006). With the more recent move toward deeper open water fishing later in the season, longer "trawls" are sometimes used in those lower current waters.

In 2006, the five additional highest value traditional fisheries in the MRP area (after lobster) were for herring, groundfish (with halibut, pollock, hake, flounder and cod most abundant), scallops, sea urchins, and soft shell clams (DFO 2006).

Since the 1980's, aquaculture in SWNB has been growing, focusing primarily on producing Atlantic salmon. Currently it is one of the most significant economic drivers in Charlotte County. In 2005, 75% of the 35 000 tonnes of New Brunswick's farmed salmon was exported to the United States (New Brunswick Salmon Growers Association 2008), the majority of which was produced in SWNB. With approximately 93 currently active aquaculture sites in the MRP area, there are limited opportunities for additional sites along the coastline. Study of local water circulation further indicates that increasing the number of coastal sites in some of the MRP area would increase the connectivity between sites (Page et. al. 2005), a risk factor in the management of the industry. Therefore, the industry is examining the potential of open water sites much further off the coastline as a safe way to continue to grow the sector.

Not all activities in SWNB are based on resource extraction. Activities such as tourism are often based on use of space and observation, such as for sea kayaking and whale watching One of the greatest uses of the area is boat traffic. Several ferries operate between the mainland and the islands of the planning area, and account for the greatest number of reported trips (see Table 2). On the eastern boundary of the SWNB MRP area in the open waters of the Bay of Fundy, about 800 large sea-going vessels move along the designated shipping lanes. A portion of these ships then move further into the MRP area to designated anchorages that exist north of the Wolves Islands, and to the ports of Eastport and Bayside (Chang et al. 2005). Oceangoing vessel navigation occurs through Western passage to Bayside, NB, and Head Harbour Passage to Eastport, ME and Bayside, NB (Hagerman et. al. 2006). The only navigation entrance to Passamaquoddy Bay for oceangoing vessels is around the northern end of Campobello Island through the deep waters of Head Harbour Passage and up Western Passage (Hagerman et. al. 2006).

3.1 Governance, Management, and Enforcement Responsibilities

Provincially, the NB Department of Natural Resources has one of the larger responsibilities regarding coastal and ocean related activities. The department is mandated to manage all Provincial Crown lands, including approximately 2.1 million hectares of tidally-influenced submerged land and overlying waters. These submerged lands are located adjacent to approximately 5,501 kilometers of coastal shoreline distributed around the Province including the Bay of Fundy and the SWNB MRP area. The department has shared responsibility for managing and protecting wetlands with the provincial Department of the Environment.

General

Vessel Type	2002	2003	2004	2005	Total
Ferry	1	3027	3679	2583	9290
Fishing		1901	2165	2617	6683
Barge		19	438	164	621
General Cargo	54	134	140	119	447
Bulk	65	122	123	112	422
Tug		76	174	165	415
Special Purpose		64	138	100	302
Ro-Ro			229	5	234
Coast Guard	2	57	92	27	178
Dredge		28	69	43	140
Yacht		19	20	8	47
Military		8	12	5	25
Passenger	4	5	5	3	17
Tanker	3	2	8	4	17
Factory Ship	2			4	6
Container	1	2		2	5
Total	132	5 464	7 292	5 961	18 849

Source: Maritime Innovation from CCG data.

Table 2: Shipping traffic in SWNB. Large ships > 500 mt, or those carrying dangerous goods must report passage Canadian Coast Guard's Marine Communications & Traffic Services. Smaller boats do not. Therefore, the number of trips for smaller vessels, like fishing boats and yachts, are under-represented in this table (Source: as presented in Senes Consultants Ltd. 2006).

The Department of Natural Resources manages 30 *Protected Natural Areas*, including islands, coastal areas and gorges. Other roles of the Provincial Department of Natural Resources include administration of the *Oil and Natural Gas Act* and issuance of licenses to search off-shore, providing authorization for coastal structures and works on submerged Crown land, and issuing approvals for erosion control structures and permanent works below the Ordinary High Water. The DNR require formal approval for seasonal and temporary works below the Ordinary High Water Mark, including commercial or extensive structures such as marinas and multi-boat floating docks. Finally, the Geological Surveys branch maintains a coastal studies program to map and monitor coastal erosion. Coastal erosion is significant in New Brunswick due to factors such as sea level rise, storm surges, and sediment deficits. The branch provides profiles of seismic surveys completed between 1948 and the present; including 12,996 kilometers of profiles offshore.

Along with various legislative responsibilities, several provincial policy documents exist to help improve management of the coastal resources of SWNB. The most significant of these are arguably those of the Department of Environment (NBDEVN 2006a-b) and the

Department of Agriculture and Aquaculture (NBDAA 2007, 2000a, 2000b) that influence management of the aquaculture industry in SWNB.

Federally, the Department of Fisheries and Oceans (DFO) is the lead department with respect to oceans policies and programs, yet in total there are twenty-three Federal Departments and Agencies that have ocean related activities, and thirteen that have relevant legislation (DFO 1997). However, the Department of Fisheries and Oceans is the only one with resource management responsibilities with a primary focus on water and the resources it contains. Along with a lead role in fisheries management, the DFO maintains responsibilities for Federal fishing and recreational harbours, and for the provision of hydrographic and fish inspection services.

3.2 Current Use Interactions

There are several instances where current uses and activities overlap. The significance of these use interactions is often not fully understood, relating to our lack of understanding of the two primary categories of ecosystem interaction; physical – biological linkages, and biological interactions (as discussed in Section 2.2 Environment). Some efforts are currently initiated to better understand these relationships, such as the evaluation of linkages between aquaculture sites and the distribution, abundance, and movements of lobster (Lawton et. al. 2002, Lawton et. al. 2001), and the operating and biological influences of aquaculture and other traditional commercial fisheries such as the herring weir fishery, the scallop fishery, and the sea urchin fishery (Chang et al. 2007). For example, through study it is now known that herring purse seining and the groundfish fishery areas in SWNB only overlap with finfish aquaculture Bay Management Areas (BMA's) an estimated 3-10%, whereas scallop catches, herring weirs, and the sea urchin fishery have a more significant overlap with the BMA's at 50-85 % (Chang et al. 2007). Through science and MRP the importance of these interactions will need to be assessed, and a direction for future progress charted. An example of MRP exists in a Rockweed Management Plan for SWNB that outlines that no harvesting should occur within 200 m of a herring weir after a particular time in order to avoid any disturbance of the herring near the weirs (Eastern Charlotte Waterways Inc. 2005).

Along with the challenges of integrating a long existing traditional fishing industry and a relatively new aquaculture industry in the project area, several benefits exist regarding the expanded use of the marine resources in SWNB. These include infrastructure revival with the new financial infusion from aquaculture (Hill, B. Pers. Comm. 2007), and the general observation by lobster fishermen that fishing success is better near salmon aquaculture sites (Walters 2007). Use interactions can be both negative and positive, and MRP assists in balancing these two types of interactions.

3.3 Current Protection and Restrictions

The New Brunswick Government has adopted a coastal management approach based on sensitivity to impact. In order to accomplish this, the coastal area of the Province has been divided into three sensitivity zones, an approach used by the United Nations for the UNESCO (United Nations Educational, Scientific and Cultural Organization) Biosphere Reserves (NBELG 200x). Development activities are restricted within these zones as defined in the Coastal Areas Protection Policy for New Brunswick (NBELG 200x), in order to protect sensitive habitats.

Beyond the broadly applicable Provincial Coastal Areas Protection Policy, there are three Federal marine protection programs that offer legislative protection to designated areas. There are no DFO regulated Marine Protected Areas (MPA), such as the recently designated Musquash MPA, and none of Parks Canada's National Marine Conservation Areas within the

SWNB MRP area. However, the third program is one delivered by Environment Canada, the Protected Marine Areas Program (PMAP). A legislated PMAP site can be implemented as one of three types: Migratory Bird Sanctuary, National Wildlife Area, or a Marine Wildlife Area (BoFEP 2000). There are two Migratory Bird Sanctuaries in the SWNB MRP area, one on Grand Manan Island and the other on Machias Seal Island (Environment Canada 2007), but no Marine Conservation Areas or National Wildlife Areas.

Protection of habitats and species can also be offered through landowner agreements. The New Brunswick Nature Trust has entered into agreements with several landowners to create 8 nature preserves and one easement on the islands and coastal lands of the MRP area (see Figure 8) (NB Nature Trust. 2008).

Figure 8: Eight Nature Preserves have been established through New Brunswick Nature Trust in the SWNB MRP area (Source: Nature Trust website 2008).

So, although several forms of protection exist within SWNB for the marine and estuarine areas, with the exception of Migratory Bird Areas, none are legislated protection. The following are additional of protected areas that are generally not legally enforceable, but are instead protected by suggested operational guidelines that must be voluntarily implemented by the user.

A Scallop Conservation Area exists on the east side of Grand Manan, known as the Duck Island Sound box. Within this designated area scallop fishing is limited (Chang et al. 2005) in order to allow seed production as a nursery area. A Right Whale Sanctuary has been designated off Grand Manan island (Brown and Kraus. 1997). Rockweed harvest exclusion areas and Rockweed Management Areas have been established that allow for seasonal harvest were developed to protect seabird areas and dulse areas in SWNB (Eastern Charlotte Waterways Inc. 2005). Five Important Bird Areas (IBA's) have been designated (Chang et al. 2005); the Grand Manan site has several overlapping protections as Bird Observatory, Bird Sanctuary (provincial or private), Migratory Bird Sanctuary (federal), and Provincial Park (Anonymous 2007). Several of these IBA sites are not noted just for species

at risk being present, nor just for national or continental significance, but also for global significance of congregatory species, waterfowl concentrations, and colonial waterbirds/seabird concentrations.

In 2005, there were 32 listed marine and coastal species at risk in the Quoddy Region (MacKay 2005), a boundary that approximates the SWNB MRP project area. These species are shown in Table 3. These species are afforded legislated protection under Canada's Species at Risk Act (SARA). Under SARA, Fisheries and Oceans Canada must produce recovery strategies and action plans for aquatic species listed as endangered or threatened, and these documents can be obtained through the SARA Public Registry (Government of Canada 2007).

Table 3: Federally listed coastal and marine species in the Quoddy Region of Southwest New Brunswick as of 2005 (Source: modified from MacKay 2005).

ENDANGERED Atlantic Salmon (Maine) Butternut (Canada-vasc. plant) Eskimo Curlew (bird) Peregrine Falcon (bird) Porbeagle shark (fishes) North Atlantic Right Whale (marine mammal) Jacob's Ladder (vasc. plant)	**SPECIAL CONCERN** Atlantic Cod (Maritime pop. – fishers) Atlantic Wolfish (fishes) Redbreast sunfish (fishes) Shortnose sturgeon (fishes) Barrow's Goldeneye (birds) Bicknell's thrush (birds) Harlequin Duck (Eastern pop. – birds) Red shouldered hawk (bird) Short-eared owl (bird) Yellow rail (bird) Canada lynx (mammal) Eastern cougar (mammal) Fin whale (Atlantic pop. – mammal) Gray wolf (mammal) Harbour porpoise (mammal) Sowerby's beaked whale (mammal) Monarch butterfly (arthropod) Wood turtle (reptile)
THREATENED Bald Eagle (bird) Least Bittern (bird) Striped Bass (fishes) Winter Skate (fishes) Cusk (fishes) Yellow Lampmussel (mollusk) Tomah Mayfly (arthropod)	

3.4 First Nations

The SWNB region was first occupied nearly 11 000 years ago by post ice-age peoples and has served a succession of native cultures since, including the present day Passamaquoddies (St. Croix International Waterway Commission 1993). Although there are not any First Nations communities in the area today, about 1 % (310 persons) of the Charlotte county population is First Nations (Statistics Canada 2002). Among their current interests in SWNB, First Nations have a traditional camp in St. Andrews, conduct a food fishery for lobster, and use the coastal areas for collection of ceremonial sweet grass (Paul, T. Pers. Comm. 2007). Whales have been part of the life in the Quoddy Region since people set foot in the area, and First Nation traditions include the Whale Ceremony, in which tribal members feed and make offerings to the whales. They normally do this from Split Rock, near Eastport Maine (Senes Consultants Ltd. 2006). Although this site is technically outside of the MRP area boundary, historic First Nations use of the land would have had no reason to follow modern day political boundaries, and this ceremony is representative of the resource use by the peoples of the day. One early description of the Passamaquoddy

people's habitats are those lands beginning at the Lepreau river and Mace's Bay on Bay of Fundy, striking northwest some fifty miles to Magaguadavic Lake, then bearing northward to near Pokiok river, keeping about fifteen miles south of Saint John river until it reaches the present border of Maine on the sources of the Mattawamkeag river (Caldbick1997). This is similar too much of the land base that drains to the marine waters of the SWNB MRP area.

In the mid 1990s the Passamaquoddy Nation re-established the St. Croix-Schoodic band of passamaquoddies with a new Tribal Chief and Council headquartered at Qonasqamkuk (Indian Point, St. Andrews) (Passamaquoddy Nation 2008). Qonasqamkuk was the Traditional Capital of the Passamaquoddy Indians, a site of General Council meetings for area first nations people and the site of a large shell midden. It is also the ancient place of worship for the Passamaquoddy and other first nations people, a sacred burial ground for Passamaquoddy Chiefs, and a traditional place where the Passamaquoddy quested for ancestral strength, wisdom and spiritual guidance (Passamaquoddy Nation 2008).

In February 2007 the Mi'kmaq and Maliseet First Nations, to whom the Passamaquoddy are closely associated and who also periodically would have come to the area, signed a Bilateral Agreement with the Province of New Brunswick to further relationship building and cooperation. The objective of the agreement is that:

> *The Parties shall work together in good faith, and on a government to government basis, in order to resolve bilateral issues identified and discussed by the Parties through the mechanism of this Agreement.*

The scope of this agreement is broad in nature, and establishes Technical Negotiating Committees for such interests as Land and Resources; Governance and Jurisdiction; Economy Development and Sustainability; Health; Education; Social Development (Government of New Brunswick 2007). As such, the agreement has relevance to marine resources planning in Southwest New Brunswick, as it does throughout the province.

4 Potential Resource Uses

As we seek new economic opportunities, and as we learn more about the ecology of SWNB, new resource uses arise. This section of the report deals with resource uses that are relatively new, proposed, or being evaluated within the marine area of Southwest New Brunswick.

4.1 Traditional Fisheries

The commercial fishery sector in Charlotte County has recently explored the commercial harvest of several relatively new species such as sea urchins, dogfish, sea cucumber (DFO 2006), rockweed, rock crab, marine worms, eels, etc. Rockweed has been a particularly productive growth sector, and has become reasonably established within SWNB, with about 11,000 tonnes being landed in 2005 (Sutherland 2005). It is suggested that the main opportunities for the traditional fishery sector are in under utilized fish species (eel, giant whelk, dog fish, marine worms, etc.) and in possible new value added products (smoked products, brine products, unique presentation of products, etc.) (Enterprise Charlotte 2007).

The Orange Footed Sea cucumber fishery in SWNB occurs in inshore areas as shown in Figure 9. Fisheries and oceans has been evaluating this new fishery annually to collect scientific data on the population and determine if a cucumber fishery should continue and at what levels of catch. They have determined that given the uncertainties within the sector, the

ecological risk of increasing or decreasing the TAC in 2007 can not be quantified (DFO 2006).

With most new fisheries, a Stage I (experimental) license is often issued for a period of time. It is then determined through monitoring the experimental fishery and through collection of scientific data whether a Stage II license is warranted. The objective of Stage II (Exploratory) is to determine whether a species/stock can sustain a commercially viable operation and to collect the biological data to build a preliminary database on stock abundance and distribution (DFO 2006).

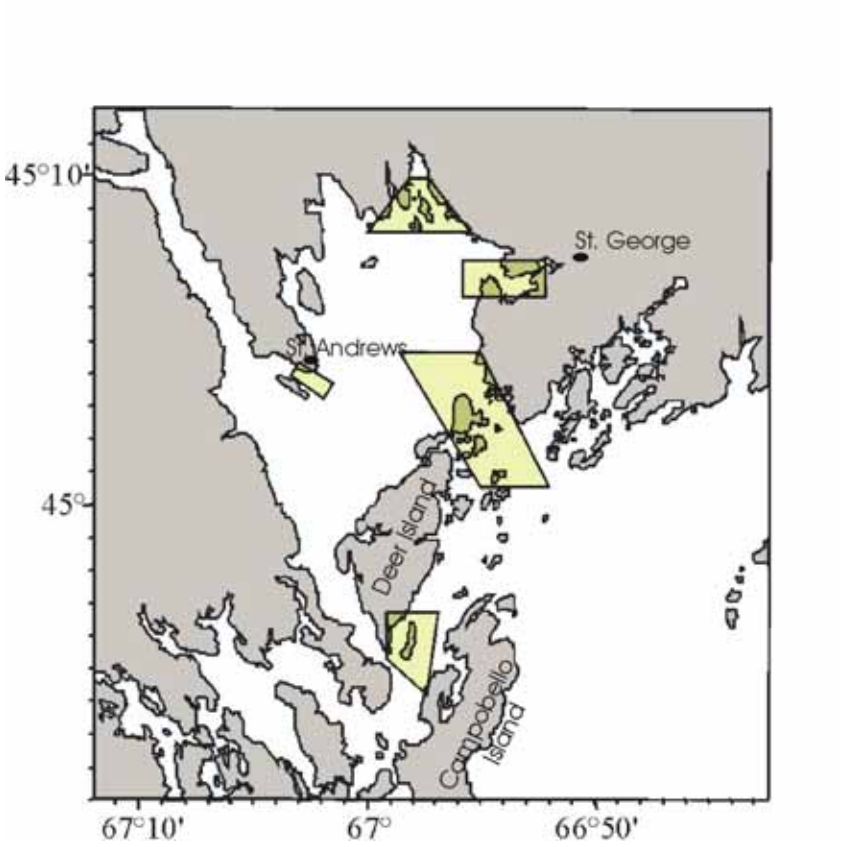


Figure 9: Location of the inshore sea cucumber harvest zones implemented in 2006 in SWNB (Source: modified from DFO 2006)

4.2 Aquaculture

Approximately 95% of the active marine finfish operations are raising Atlantic salmon with the other 5% rearing newer aquaculture species of cod and Atlantic halibut. Research and development efforts to date have focused on the potential for production of cod, Atlantic halibut, and haddock. The New Brunswick Department of Agriculture and Aquaculture supports pre-commercial development of alternative species through licensing of species on existing marine finfish farms. In the near future, mussels are likely to be raised on a couple of sites as part of a new Integrated Multi-Trophic Aquaculture (IMTA) approach. This approach would grow three trophic levels of organisms on one site (kelps, mussels, salmon). It is anticipated that by having three levels of organisms on a site, waste products from higher-level organisms will be taken up by lower level organisms, further reducing nutrient loading (Hill, B., Pers. comm. 2007). It has also been suggested that the aquaculture industry must continue to seek new and innovative ways to add value, perhaps by drawing on its existing expertise to increase exports of eggs and smolts (Enterprise Charlotte 2007).

The limited potential for additional near shore sites in conjunction with recent advances in technology, has created an environment where businesses are looking toward open ocean sites, where new cage and feeding technologies could be employed. Currently marine finfish farms in SWNB are located within approximately 1 km of the shoreline, and generally with some shelter from the currents and waves of the open ocean. The NB Department of Agriculture and Aquaculture is working to establish criteria to outline eligibility to apply for an offshore site in the Bay of Fundy Region. It is believed that development of open ocean aquaculture could provide one of the more significant boosts to the local economy in the near future (Rouse, M. Pers. comm. 2007).

4.3 Energy

Three forms of energy development have been raised in recent years within the SWNB MRP area. Two of those forms, tidal and wind energy, are renewable. A third would see an industrial terminal built on the US side of Passamaquoddy Bay to off-load liquefied natural gas. Although this latter development would occur outside of the MRP area, a significant increase in ship traffic servicing the facility would pass through the planning area.

Liquefied Natural Gas (LNG) is an important component of North America's non-renewable energy. Currently, there are two LNG Terminal facilities being proposed for the US side of Passamaquoddy Bay, and as such they fall outside of the Canadian environmental assessment and regulatory process. The US Environmental Protection Agency has recommended that the Federal Energy Regulatory Commission, which oversees Environmental Impact Statements, treat the Downeast LNG, and Quoddy Bay LNG projects as alternatives to each other and assess the advantages and disadvantages of these alternatives, including providing rationale for preferring one option to another (Senes Consultants Ltd. 2006). For vessel traffic impacts on aquatic resources, it was noted that significant adverse impacts could not be determined given the current information resources (Senes Consultants Ltd. 2006).

Currently it is estimated that 800 ships use the shipping lanes in SWNB (Chang, Page and Hill 2005), and that approximately 150 of those enter into the St. Croix estuary area (Downeast LNG. 2007). Along with the proposed LNG facility in Robbinston, Maine would come an increase in ship traffic to service that facility. The company, Downeast LNG, expects approximately 48 ships to come to the facility annually with a higher frequency during the winter months (Downeast LNG 2007). This would be a large ship increase of approximately 1/3rd into the Passamaquoddy area over current levels. A second company is proposing an LNG plant more seaward, at the community of Pleasant Point Reservation in Maine. Quoddy Bay LNG anticipates 180 ships would come to the facility each year, with a higher frequency during their startup phase (Quoddy Bay LNG 2007).

Within a recently released Community Growth Strategy for Charlotte County and SWNB, tidal power development was identified as an "External Opportunity" for future growth in the county by surveyed stakeholders (Enterprise Charlotte. 2007).

Trial tidal power projects have recently been approved within the Minas Basin on the Nova Scotia side of the Bay of Fundy. However, during one project to examine potential tidal power sites around the Bay of Fundy, any site that had both flood and ebb peak tidal velocities averaging at least 3 knots (1.5 m/sec) was assessed (Hagerman et al. 2006). Four of the eight sites that met the criteria were in the SWNB MRP area as shown in Table 4. They include Lubec Narrows, Western Passage, Head Harbour Passage, and L'Etete Passage. Head Harbour Passage appears most favourable from an energy production standpoint.

Site Name	Tidal In- stream Power Density Averages			Channel Cross Sectional Flow Area (=B)	Total Annual In-Stream Energy (=A x B x 8766 hrs/yr)	Total TISEC Project Rated Capacity at 15% Energy Withdrawal
	Peak Flood Flows Only	Peak Ebb Flows Only	Entire Flow Distribution (=A)			
Lubec Narrows	8 kW/m^2	16 kW/m^2	5.5 kW/m^2	750 m^2	36 000 MWh	1.2 MW
Western Passage	5.1 kW/m^2	4.6 kW/m^2	2.2 kW/m^2	16 300 m^2	314 000 MWh	10.8 MW
Head Harbour Passage	4.5 kW/m^2	4.5 kW/m^2	1.9 kW/m^2	24 600 m^2	410 000 MWh	14.0 MW
L'Etete Passage	8.7 kW/m^2	8.7 kW/m^2	3.7 kW/m^2	3 760 m^2	122 000 MWh	4.2 MW

Table 4: Potential tidal power production from select locations investigated along the New Brunswick shoreline, Bay of Fundy (Source: modified from Hagerman et al. 2006).

Three factors warranted the selection of the Head Harbour Passage site for system level design evaluation:

- Good tidal energy source
- Ease of interconnection and accessibility to a sizeable market
- Proximity to a major port with infrastructure that could facilitate implementation of the project.

It has been estimated that the Head Harbour Passage site embodies and average of 56 MW of power in the tidal stream, of which 8.5 MW could be extracted without any harm to the environment. At peak, a plant could extract 20 MW (Previsic and Bedard 2006). In order to extract a meaningful amount of energy, the plant would need to be placed directly within the existing shipping lane. Such placement would require that the type of structure be a fully submerged technology. Modeling of the possible reduction in water energy and associated long-term biological effects from the placement of tidal instream energy systems on animals, ecosystem productivity, and biological diversity has not yet been done.

Wind energy is part of NB Power's overall plan to provide an additional 10 per cent of its supply from renewable energy sources to help address the growing demand for electricity and meet emission stabilization and reduction targets. NB Power currently has a 20-year power purchase agreement for a 20 MW wind farm at Dark Harbour on the western coast of Grand Manan Island. This site would be 5 % of the Provinces 2016 target of 400 MW from the private sector (NB Power 2005). The proposed wind farm will consist of approximately 10 wind turbines with a total maximum output of 20 megawatts. The proposed wind farm on Grand Manan would generate enough electricity to power 6000 homes, which is more than what exists on Grand Manan. Excess energy could be exported to the mainland via existing submarine cable (Gustafson 2004).

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