Restoration and Stewardship of Coastal Ecosystems in the Shediac Bay

The Shediac Bay Watershed Association Inc.

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1 Introduction

The Shediac Bay Watershed Association (SBWA) was founded in 1999 as a result of growing concerns from local community residents over the ecological health of Shediac Bay. In order to establish a long-term water quality-monitoring program, a community-based association was formed. To address growing concerns on water quality in the Shediac Bay, the program "Evaluating the Health of the Shediac Bay" was initiated in 2016. The program aims to assess water contamination sources in small urbanized and agricultural streams, assess the quality of coastal habitats, evaluate eelgrass habitats, and launch restoration initiatives and education campaigns.

The Association has been monitoring freshwater quality in the Shediac River and Scoudouc River watersheds since 1999. In 2015, funding became available to collect water quality data, such as *E. coli*, in the saltwater ecosystems of the Shediac Bay. It began with 7 saltwater sampling sites along the coastline, and expanded to 10 sites in 2016. In the fall of 2016, a study was done using Environmental DNA (e-DNA) testing to assess the source of the E. coli bacteria at 5 of the 10-saltwater sampling sites. Since *E. coli* is present in the lower intestines of humans and warm-blooded animals, the source of fecal contamination can be traced back to the species of which it came from by analyzing the DNA of the bacteria. The results are available online in the archives of the SBWA. This information was used to help prioritize sites for restoration and actions to help reduce bacterial contamination.

In 2019, the investigative water quality sampling program began as a tool to assess a wider range of tributaries and drainages that flow into the Shediac Bay, primarily urbanized and agricultural streams. These sites are meant to move from stream to stream over time, and move upstream systematically when high levels of bacteria and nutrients are detected. These sites are sampled for *E. coli* and nutrients (total phosphorous and nitrogen). These tributaries are further evaluated by characterizing the surrounding land uses, collecting habitat observations and assessing the health of the riparian zones.

A partnership was formed with the Southern Gulf of Saint Lawrence Coalition on Sustainability in 2016, to begin the assessment of the eelgrass habitats in the Shediac Bay. The study has established 4 eelgrass monitoring transects from 2016-2019; in the Scoudouc River Estuary (2016), the Shediac River Estuary (2017), the South Cove Estuary near Pointe-du-Chêne (2018), and near the Grande-Digue dunes (2019). These transect are monitored once per year using the SeagrassNet protocol, to measure changes in density of the eelgrass beds due to the threat of the invasive green crab. Monitoring of the European Green Crab also continued for the ninth year.

Public education and outreach activities are an integral part of all SBWA projects. A partnership with the Shediac Bay Yacht club has produced a boater awareness campaign, aiming to promote best environmental practices for boaters and the promotion of pumping station locations in Southeast NB. The Shediac Bay Yacht Club and Parlee Beach Provincial Park both received a Blue Flag certification in 2019. As a partner in this program, the SBWA helps deliver educational materials and resources.

In 2020 a new program was initiated to restore coastal land using living shoreline techniques. Thanks to partnerships with matching fund sources, work was able to continue at the OceanSurf Campground coastal restoration site.

The SBWA continues to develop public educational materials such as signage, interpretation panels, videos, handouts and social media postings. The Association has expanded its digital outreach on several social media platforms. Normally, a variety of presentations and activities are done with both schools and the general public. Several programs were either modified or cancelled due to the COVID-19 pandemic. The present report highlights the monitoring results and actions that have been undertaken in 2021.

1.1 Overview of the Shediac Bay Watershed

The Shediac Bay Watershed covers 420 km2 of land area and stretches along 36 km of coastline, from Cap Bimet to Cap de Cocagne (Figure. 1). The Shediac Bay Watershed is composed of two major river systems emptying into Shediac Bay: the Shediac River and the Scoudouc River. The Shediac and the Scoudouc Rivers are characterized by small tributaries covering watersheds of 201.8 Km2 and 143.3 km2, respectively. The Shediac River is composed of two major water arms. The northern water arm is created by the convergence of the McQuade Brook, the Weisner and the Calhoun Brook. The southern water arm of the Shediac River is the continuation of the Batemans Brook.

Figure 1: Map of Shediac Bay watershed boundaries

2 METHODOLOGY

2.1 Water Quality Sampling Protocol

Under the scope of the "Investigative Water Quality Sampling Program", monitoring was conducted once a month from July to October 2021, at 8 sampling stations in small streams and tributaries of the Shediac Bay. Water quality sampling was performed using the protocol developed by the New Brunswick Department of Environment.

Regular water samples are to be collected during a period of dry weather, without the influence of non-point source pollution discharged in stormwater runoff. Ambient water quality data is used to determine the general health and water quality trends of a waterbody. A storm event sampling is the collection of water samples during or following a significant rainfall event. The result of a storm event sampling is an estimate of the pollution load leaving an area of land. It helps to better characterize concentrations of diffused contaminants entering a watercourse under a range of flow conditions.

Basic water quality parameters (DO, temperature, pH, conductivity and salinity) were measured using a new YSI- *Professional Plus* multi-parameter metre. Water samples were sent to *RPC Laboratory* for analysis of *E. coli* and inorganic elements.

The equipment needed to conduct the sampling and collect habitat data includes; laboratory issued sample bottles, labels, latex or nitrile gloves, clipboard, waterproof paper for field sheets, pencils, waders or rubber boots, orange reflective vest for safety, GPS, a digital camera, YSI (water conditioning metre), metre stick, survey measuring tape, and a cooler with ice for the water samples.

2.2 Site Information – Investigative Water Sampling

A total of 12 investigative sampling sites were monitored over a two-year period. Sites were selected based on surrounding land uses, such as agriculture and urban development. Based on available funding through NBETF and the SGSL-Coalition, eight (8) of those sites were sampled in 2021.

The sites selected for this project were suspected to have high levels of bacteria and nutrients such as nitrogen and total phosphorus, which normally comes with the land being used for agricultural purposes. Some of the streams also have smaller buffer zones, if any, which allows stormwater runoff to enter streams with minimal filtration. High nitrate levels are also known to be caused by heavy soil erosion as nitrate can be stored in soil.

Table 1: Investigative Water Quality Monitoring Site Coordinates

Site Code	Latitude	Longitude
AG 1	46° 11' 7.9512"	- 64° 33' 29.3796"
AG 1A	46° 11' 27.2184"	- 64° 33' 9.1296"
AG 2	46° 12' 9.2448"	- 64° 33' 11.4228"
AG 5	46° 12' 32.7312"	- 64° 33' 34.4808"
AG 5A	46° 12' 15.3396"	- 64° 33' 38.9016"
FW 2A	46° 12' 51.7716"	- 64° 34' 4.0008"
WQ 11D	46° 18' 2.7"	- 64° 33' 9.2016"
WQ 11E	46° 18' 1.3716"	- 64° 33' 19.4004"

Figure 2: Investigative Water Monitoring Site Locations

2.3 Water Quality Parameters

The water quality monitoring program analyses many chemical and physical parameters to assess the overall water quality for the protection of aquatic life. Although all results are presented in the report, only a few key parameters will be discussed in the report, as some of these were above the recommended guidelines or they are of greater significance to the assessment of the overall water quality.

2.3.1 Water Temperature

Water temperature can fluctuate depending on the period of the day and during seasonal changes. Values are influenced by numerous factors such as the tree canopy providing shade, water velocity and depths, presence of cold springs, etc. It is considered that water above 25 or 29 degrees Celsius ($^{\circ}$C) tends to be of poor quality because less oxygen can be dissolved. Therefore, water temperature directly influences the dissolved oxygen levels. Water temperatures above 22 $^{\circ}$C is said to cause thermal stress to salmonid populations, causing them to stop feeding and search for thermal refugia.

2.3.2 Potential Hydrogen (pH)

The potential hydrogen (pH) level indicates if the water is acidity or basic. It affects how much other substances, such as metals, dissolve in the water. In facts, the pH affects the solubility and toxicity of chemicals and heavy metals in water. Many aquatic organisms are sensitive to changes in pH and may be adversely affected by the pH that is either too high or too low. The pH varies naturally depending on bedrock, climate and vegetation cover, but may also be affected by industrial or other effluents, the exposure of some type of rock (for example during road construction) or drainage from mining operations. According to the CCME's Canadian water quality guidelines, pH should be between 6.5 and 9, as pH levels move away from this range it can stress animal systems and reduce hatching and survival rates in the stream.

2.3.3 Dissolved Oxygen

Dissolved oxygen (DO) represents the concentration of oxygen in gaseous form in the dissolved in the water column. Most of the oxygen in the water comes from the surface atmosphere and is mixed in the water by turbulence and current. The measurement of the concentration of dissolved oxygen in surface waters is essential for measuring changes in water condition and evaluating water quality. It has a direct effect on aquatic life and can be influenced by stream habitat alteration. DO is essential for the survival of fish and many other forms of aquatic life. The temperature limits the amount of oxygen that can dissolve in water, dissolved oxygen varies with temperature and tends to be lower when the water temperature is high. However, temperature is not the only cause of low-oxygen, too many bacteria and an excess amount of biological oxygen demand from the oxygen consumption used by the microorganisms (aerobic bacteria) in the

oxidation of organic matter also affects the dissolved oxygen concentrations. According to the Canadian Council of Ministers of the Environment (CCME) Canadian water quality guidelines, the lowest acceptable DO concentration for aquatic life in cold water is 9.5 mg/l for early life stages and 6.5 mg/l for other life stages.

2.3.4 Conductivity

Conductivity is the measurement of the ability of water to pass an electrical current. It is affected by the amount of inorganic dissolved solids (nitrate, chloride, sulfate, sodium, etc.) found in the water. The conductivity level may be influenced by rainwater, agricultural or urban runoff and the geology of the area. There are no set criteria for conductivity levels for water quality, but the US Environmental Protection Agency states that stream conductivity levels ranging between 0.15 and 0.5 mS/cm usually seem to support a good mixed fishery. Consequently, a higher conductivity level may indicate a higher amount of dissolved material in the water and the presence of contaminants.

2.3.5 Nitrate-Nitrogen

Nitrogen is essential for plant growth, but the presence of excessive amounts in water presents a major pollution problem. Nitrogen compounds may enter water as nitrates or be converted to nitrates from agricultural fertilizers, sewage, industrial and packing house wastes, drainage from livestock feeding areas, farm manures and legumes. The acceptable amount of nitrate-nitrogen for the protection of aquatic life in freshwater is set at 2.9 mg/l (NO3).

2.3.6 Phosphates

Phosphates exist in different forms: orthophosphate, metaphosphate and organically compound contains phosphorus. These forms of phosphate occur in living and decomposing plants and animals, as free ions, chemically bonded in aqueous systems or mineralized compounds in sediments, soils and rocks. Large amount of phosphate coming from cleaning products (detergents), run off from agricultural and residential fertilizer components can lead to eutrophication. Soil erosion is a major contributor of phosphorus to stream. It is recommended by Environment Canada to apply the Canadian Framework for phosphorus. Trigger ranges are based on the range of phosphorus concentrations in water that define the reference trophic status for a site. Measured phosphorus concentrations should not exceed predefined trigger ranges and should not increase more than 50% over baseline (reference) levels. Total phosphorus levels should be under 0.025 mg/L to maintain its unaffected trophic state.

2.3.7 Escherichia coli

Escherichia coli (*E. coli*) is one of many species of bacteria living in the lower intestines of mammals. The presence of *E. coli* in water is a common indicator of fecal contamination. The acceptable count of *E. coli* in water is set at 400 MPN/100 ml.

2.4 Health Canada - Guidelines for Canadian Recreational Water Quality

Table 2: Guidelines for Health Canada Recreational Water Quality Summary Table

Guidelines for Health Canada Recreational Water Quality		
Parameter	Considerations	Guideline
Escherichia coli (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples)	≤ 200 *E. coli* /100 mL
	Single sample maximum concentration	≤ 400 *E. coli* /100 mL
Enterococci (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples)	≤ 35 Enterococci /100 mL
	Single sample maximum concentration	≤ 70 Enterococci /100 mL
*Advice regarding waters intended for secondary-contact recreational activities is provided in Section 4.2. of the *Guidelines for Canadian Recreational Water Quality: Third Edition*		
https://www.canada.ca/content/dam/canada/health-canada/migration/healthy-canadians/publications/healthy-living-vie-saine/water-recreational-recreative-eau/alt/pdf/water-recreational-recreative-eau-eng.pdf		

2.5 CCME - Canadian Environmental Quality Guidelines (CEQGs) for the Protection of Aquatic Life (Freshwater)

Table 3: Summary of the CCME Canadian Environmental Quality Guidelines

CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY						
Parameter	Condition	Value (mg/L)	Condition	Value (mg/L)	Equation Between Conditions	Notes
Ag	—	—	Long-Term	0.00025	—	The following parameters did not have CCME recommended guidelines for the protection of aquatic life and were therefore omitted from the table: ALK_T, Ba, Be, HCO3, Bi, Br, Ca, CO3, Co, COND, Cr, F, HARD, K, Lang_Ind (20°C), Li, Mg, Mn, Na, NOX, Rb, pH (Sat), Sb, Sn, SO4, Sr, TDS, Te, TKN, TOC, TP-L, TURB, V
Al	pH<6.5	0.005	pH≥6.5	0.1	—	
As	—	—	Upper	0.005	—	
B	Short-Term	29	Long-Term	1.5	—	
Cd (Short-Term)	HARD<5.3	0.00011	HARD>360	0.0077	10^(1.016*LOG(HARD)-1.71)	
Cd (Long-Term)	HARD<17	0.00004	HARD>280	0.00037	10^(0.83*LOG(HARD)-2.46)	
Cl	Short-Term	640	Long-Term	120	—	
CLRA	Narrative; refer to CCME website for more information.				—	
Cu	HARD<82	0.002	HARD>180	0.004	0.2*EXP(0.8545*LN(HARD)-1.465)	
DO (warm) †	Early	6	Other	5.5	—	
DO (cold)	Early	9.5	Other	6.5	—	
E-coli ‡	—	—	Upper	400 MPN/100mL	—	
Fe	—	—	Upper	0.3	—	
Mo	—	—	Upper	0.073	—	
NH3_T	Table; refer to CCME website for more information.				—	† The guideline for dissolved oxygen is separated into warm water biota, early life stages; warm water biota, other life stages; cold water biota, early life stages; and cold water biota, other life stages.
NH3_Un	—	—	Long-Term	0.019	—	
Ni	HARD≤60	0.025	HARD>180	0.15	EXP(0.76*LN(HARD)+1.06)	
NO2	—	—	Upper	0.197	—	
NO3	Short-Term	124	Long-Term	2.9	—	
Pb	HARD≤60	0.001	HARD>180	0.007	EXP(1.273*LN(HARD)-4.705)	
pH	Lower L-T	6.5	Upper L-T	9	—	‡ There is no limit for the protection of aquatic wildlife. The limit of 400 MPN/100mL for the protection of environmental and human health is used instead.
Se	—	—	Upper	0.001	—	
Tl	—	—	Upper	0.008	—	
U	Short-Term	0.033	Long-Term	0.015	—	
Zn	—	—	Upper	0.03	—	

Table 4: CCME Recommendation Guidelines for the Protection of Aquatic Life (Freshwater)

CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY OF OTHER PARAMETERS					
Parameter	Description	Value	Units	Notes	
Dissolved O_{2} †	Early life stages, cold water biota†	9.5	mg/L	†	The guidelines for the lowest acceptable dissolved oxygen concentrations are divided into four different categories to accommodate the wide range of tolerances exhibited by freshwater species at various life stages, and with warmer or colder temperature preferences.
	Other life stages, cold water biota	6.5	mg/L		
	Early life stages, warm water biota	6	mg/L		
	Other life stages, warm water biota	5.5	mg/L		
pH	Lower long-term limit	6.5	—	‡	There is no limit for the protection of aquatic wildlife for E. coli. The limit of 400 MPN/100 mL for the protection of environmental and human health is used instead.
	Upper long-term limit	9	—		
E. coli ‡	Upper limit	400	MPN/100 mL		

Table 5: CCME Guidance framework for Phosphorus

CCME Guidance Framework for Total Phosphorus (TP-L)					
Parameter	Description	Value	Units	Notes	
TP-L*	Hyper-eutrophic	> 0.100	mg/L	†	The CCME recommended guidelines for the protection of aquatic wildlife (freshwater) indicates the concentrations of total phosphorus at which each condition may occur. This does not suggest that a stream with hyper-eutrophic levels of total phosphorus will necessarily exhibit hyper-eutrophic properties, for example.
	Eutrophic	0.035 - 0.100	mg/L		
	Meso-eutrophic	0.020 - 0.035	mg/L		
	Mesotrophic	0.010 - 0.020	mg/L		
	Oligotrophic	0.004 - 0.010	mg/L		
	Ultra-oligotrophic	< 0.004	mg/L	*	Total phosphorus level

Table 6: CCME Canadian Environmental Quality Guidelines for Nitrates

CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY						
Parameter	Condition	Value (mg/L)	Condition	Value (mg/L)	Equation Between Conditions	Notes
NO3	Short-Term	124	Long-Term	2.9	—	

2.5.1 Terms and Definitions

All data collected during the sampling season has been organized in three distinct tables: water chemistry data and *E. coli* results, nutrient results, and inorganic results. The following provides the terms and definitions of the acronyms used in the data tables.

Table 7: Terms and definitions for water chemistry and bacterial data tables

TERMS AND DEFINITIONS FOR FIELD DATA COLLECTED BY YSI AND LABORATORY SAMPLES		
Parameter	Unit	Definition
Temp	°C	Air and water temperature measured in degrees Celsius
SAL	ppt	Salinity measured in parts per thousand
Dissolved O_2	mg/L, %	Dissolved oxygen measured in milligrams per litre and percentage
E. coli	MPN/100mL	Escherichia coli concentration measured in most probable number per 100 millilitres
ALK_T	mg/L	Total alkalinity measured in milligrams per litre
CLRA	TCU	Water colour measured in true colour units
COND	µS/cm	Conductivity measured in microsiemens per centimetre in the field and laboratory
HARD	mg/L	Hardness measured in milligrams per litre
Lang_Ind (20°C)	—	Langlier index at 20 degrees Celsius
pH	—	Potential of hydrogen measured in the field and laboratory, and the saturation pH at 20 degrees Celsius
Sat (20°C)	—	The pH at which water at 20 degrees Celsius is saturated with calcium carbonate
TDS	mg/L	Total dissolved solids measured in milligrams per litre
TURB	NTU	Water turbidity measured in nephelometric turbidity units

Table 8: Terms and definitions for nutrients data tables

TERMS AND DEFINITIONS FOR NUTRIENT DATA					
Parameter	Unit	Definition	Parameter	Unit	Definition
HCO_3	mg/L	Bicarbonate measured in milligrams per litre	NH_3_Un	µg/L	Ammonia unionized at 20°C measured in micrograms per litre
Br	µg/L	Bromine measured in micrograms per litre	NO_2	µg/L	Nitrite measured in micrograms per litre
Ca	mg/L	Calcium measured in milligrams per litre	NO_3	µg/L	Nitrate measured in micrograms per litre
CO_3	µg/L	Carbonate measured in micrograms per litre	NO_X	µg/L	Nitrite + Nitrate measured in micrograms per litre
Cl	mg/L	Chloride measured in milligrams per litre	SO_4	mg/L	Sulphate measured in milligrams per litre
F	µg/L	Fluoride measured in micrograms per litre	TKN	mg/L	Total Kjedhal nitrogen measured in milligrams per litre
K	mg/L	Potassium measured in milligrams per litre	TN	mg/L	Total nitrogen calculated in milligrams per litre
Mg	mg/L	Magnesium measured in milligrams per litre	TOC	mg/L	Total organic carbon measured in milligrams per litre
Na	mg/L	Sodium measured in milligrams per litre	TP-L	µg/L	Total phosphorus measured in micrograms per litre
NH_3T	µg/L	Total ammonia measured in micrograms per litre	—	—	—

3 Investigative Water Sampling in the Shediac Bay

In 2021, the SBWA has expanded the water quality sampling program to evaluate the smaller tributaries of the Shediac Bay than have been impacted by land use, such as urban development and agriculture. This investigative sampling established new sites to fill knowledge gaps on water quality in the watershed. Certain streams where high values of *E. Coli* and nutrients were sampled at various points along the watercourse to help determine the influences of activities upstream. All samples are analysed by RPC Laboratory and results are sent to the *Department of Environment and Local Government*.

The purpose of the samples taken by the SBWA is to determine priority areas where restoration programs can be implemented to improve water quality, such as planting trees to restore the buffer along riparian zones. The data is not used to determine the safety of the recreational uses of the bay, such as swimming advisories.

There are many different guideline criteria for determining water quality. For example, Health Canada recommended microbiological guideline values for recreational water quality. The values are based on the presence of fecal indicator bacteria, namely *Enterococci* for marine water and *Escherichia coli* for freshwater.

In marine water, the guideline value is set at a geometric mean of 35 enterococci/100 mL when a minimum of 5 samples are collected (average bacterial concentrations of the 5 bottles must be below 35 MPN/100 mL), and the value of a single sample must be below 70 enterococci/100 mL.

In freshwater, the guideline value is set at a geometric mean of 200 *E. coli* /100 mL when a minimum of 5 samples are collected (average bacterial concentrations of the 5 bottles must be below 200 MPN/100 mL), and the value of a single sample must be below 400 *E. coli* /100 mL.

For this project, all samples collected are single samples and are analyzed for *E. coli*, since the small tributaries are freshwater. Even though certain sites may be impacted by rising tides, *E. coli* sampling can still be used to asses brackish water. All bacterial data in this report is flagged when levels exceed 400 MPN/100 mL.

3.1 Sampling Results

The following section will describe the water quality data collected at the 8 small streams sampling sites for the 2021 field season. The surrounding land uses, as visible from aerial imagery from several years of images on *Google Earth*, are also described for each site. The information is meant to complement the data and provide information on potential causes for contamination.

The purpose of the investigative monitoring program is to identify potential pollution sources and encourage partnerships with landowners for future runoff mitigation projects. The investigative sampling also provides information that helps to fill knowledge gaps on sources of bacteria and nutrients that flow into the Shediac Bay.

3.2 AG1

This water quality sampling site is a tributary to the Scoudouc River. Located in a rural area, this site is surrounded by farm land. The AG1 is on Route NB-132, about four kilometers outside of Shediac. It is located about a kilometer down the Red Bridge Road and is the first stream that the road crosses (Figure 3).

The water sampling results for the site AG1, for 2021, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold-water organisms in September (6.22 mg/L) (Table 9).

Bacterial levels exceeded the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) in July (3,282 MPN/100 mL) (Table 9).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance Framework for Phosphorus were: in the oligotrophic range (0.004 – 0.010 mg/L) July; in the meso-eutrophic (0.020-0.035 mg/L) in August; and in the eutrophic range (0.035-0.100 mg/L) in September and October (Table 10).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Table 9: Water chemistry data and *E. coli* results for AG1, 2021

SITE AG1: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES 2021								
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	COND (mS/cm)	pH (pH)	TDS (mg/L)
	Air	Water						
21-07-15	DND	16.2	0.07	6.64	**3,282**	127.800	7.02	110.00
21-08-18	DND	12.3	0.14	6.9	216	0.213	7.54	183.30
21-09-28	DND	12.4	0.11	**6.22**	189	0.181	7.73	154.70
21-10-22	DND	10.5	0.17	**6.5**	41	0.261	8.16	234.00

Table 10: Nutrient results for AG1, 2021

SITE AG1: NUTRIENT DATA 2021				
Date (yy-mm-dd)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	TP-L (mg/L)
21-07-15	<0.05	1.73	1.73	**0.008**
21-08-18	<0.05	1.44	1.44	**0.024**
21-09-28	<0.05	1.00	1.00	**0.043**
21-10-22	<0.05	0.98	0.98	**0.047**

Figure 3: AG1 site location and surrounding land uses

3.3 AG1-A

This water quality sampling site is downstream from AG1. The AG1-A site is located off the Red Bridge Road on the old train track that is now used by 4 wheelers. From the trail, it is about 100 m through the woods (Figure 4). Given that this site is located in a wooded area, the sampled stream has vegetated buffers on both sides.

The water sampling results for the site AG1-A, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL), for the samples taken in July (1,782 MPN/100 mL) and September (473 MPN/100 mL) (Table 11).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance framework for Phosphorus were: in the meso-eutrophic range (0.020 – 0.035 mg/L) in July; in the eutrophic range (0.035 – 0.100 mg/L) in July and September; and in the hyper-eutrophic range (>0.100 mg/L) in October (Table 12).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Table 11: Water chemistry data and *E. coli* results for AG1-A, 2021

SITE AG1-A: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES 2021								
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	COND (mS/cm)	pH (pH)	TDS (mg/L)
	Air	Water						
21-07-15	DND	15.3	0.09	9.15	**1,782**	155.100	7.36	123.50
21-08-18	DND	15.8	0.12	9.4	63	0.200	7.93	157.95
21-09-28	DND	13.4	0.11	8.68	**473**	0.186	7.68	155.35
21-10-22	DND	10.4	0.13	7.82	72	0.189	7.81	170.30

Table 12: Nutrient results for AG1-A, 2021

SITE AG1-A: NUTRIENT DATA 2021				
Date (yy-mm-dd)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	TP-L (mg/L)
21-07-15	<0.05	0.41	0.41	**0.045**
21-08-18	<0.05	2.20	2.20	**0.025**
21-09-28	<0.05	1.37	1.37	**0.084**
21-10-22	<0.05	1.04	1.04	**0.109**

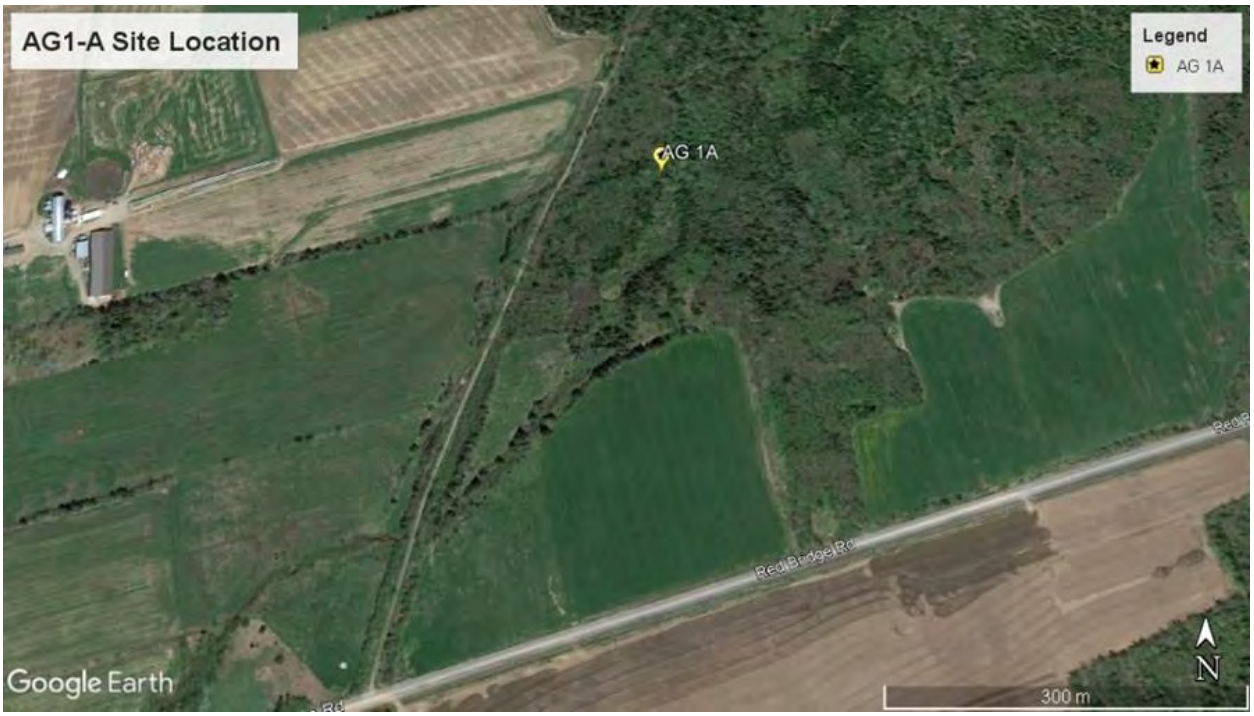


Figure 4: AG1-A site location and surrounding land use

3.4 AG2

This water quality sampling site is a tributary to the Scoudouc River. Located in the middle of a cattle pasture, this stream has minimal buffer zones on either side (Figure 5). The site is located East of Route NB-132. There is now a restoration project underway to replant a buffer zone on along the stream banks.

The water sampling results for the site AG2, for 2021, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold-water organisms in August (5.89 mg/L) and September (6.23 mg/L) (Table 13).

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL), for all samples taken in 2021: July (3,076 MPN/100 mL), August (2,098 MPN/100 mL), September (3,448 MPN/100 mL) and October (2,723 MPN/100 mL) (Table 14).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance framework for Phosphorus were: in the eutrophic range (0.035 – 0.100 mg/L) in August, September, and October; and in the hyper-eutrophic range (>100 mg/L) in July (Table 14).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Table 13: Water chemistry data and *E. coli* results for AG2, 2021

SITE AG2: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES 2021								
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	COND (mS/cm)	pH (pH)	TDS (mg/L)
	Air	Water						
21-07-15	DND	17.6	0.16	6.9	**3,076**	291.000	7.25	220.35
21-08-18	28	19.5	0.15	**5.89**	**2,098**	0.274	7.59	198.90
21-09-28	DND	13.9	0.12	**6.23**	**3,448**	0.203	7.49	167.05
21-10-22	14	10.6	0.11	9.45	**2,723**	0.169	7.77	152.10

Table 14: Nutrient results for AG2, 2021

SITE AG2: NUTRIENT DATA 2021				
Date (yy-mm-dd)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	TP-L (mg/L)
21-07-15	<0.05	0.47	0.47	**0.105**
21-08-18	<0.05	0.45	0.45	**0.058**
21-09-28	<0.05	0.33	0.33	**0.066**
21-10-22	<0.05	0.41	0.41	**0.051**

Figure 5: AG2 site location and surrounding land uses

3.5 AG5

This water quality sampling site is a tributary to the Scoudouc River. The AG5 is off highway NB-15, near the on-ramp from Route NB-132 towards Cap-Pelé. The sample is collected upstream from the culverts. The stream flows down into a pond prior to draining towards the highway. The stream bank is vegetated (Figure 6).

The water sampling results for the site AG5, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) for the sample taken in July (583 MPN/100 mL) (Table 15).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance Framework for Phosphorus were all eutrophic range (>100 mg/L) in October (Table 16).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Table 15: Water chemistry data and *E. coli* results for AG5, 2021

SITE AG5: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES 2021								
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	COND (mS/cm)	pH (pH)	TDS (mg/L)
	Air	Water						
21-07-15	DND	21.2	0.21	7.76	**583**	405.400	7.56	285.35
21-08-18	28	22.0	0.17	7.6	84	0.340	7.89	234.65
21-09-28	DND	16.4	0.19	8.13	309	0.329	7.69	256.45
21-10-22	DND	11.7	0.20	8.84	52	0.314	7.67	273.65

Table 16: Nutrient results forAG5, 2021

SITE AG5: NUTRIENT DATA 2021				
Date (yy-mm-dd)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	TP-L (mg/L)
21-07-15	<0.05	<0.05	<0.05	**0.068**
21-08-18	<0.05	0.10	0.10	**0.044**
21-09-28	<0.05	0.24	0.24	**0.044**
21-10-22	<0.05	0.33	0.33	**0.068**

Figure 6: AG5 site location and surrounding land uses

3.6 AG5-A

This water quality sampling site is also located upstream of the AG5 site. The site is down a gravel driveway off Route NB-132, approximately 500 m from the highway NB-15 (Figure 7). Two branches of the stream go through farm properties and one stream flows from an irrigation pond. AG5-A is mostly surrounded by farm land.

The water sampling results for the site AG5-A, for 2021, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold-water organisms in July (3.64 mg/L), August (4.91 mg/L), and September (5.63 mg/L) (Table 17).

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in the samples taken in July (1,658 mg/L), September (1,334 mg/L), and (563 mg/L) (Table 17).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance Framework for Phosphorus were all hyper-eutrophic range (>100 mg/L) in October (Table 18).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Table 17: Water chemistry data and *E. coli* results for AG5-A, 2021

SITE AG5-A: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES 2021								
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	COND (mS/cm)	pH (pH)	TDS (mg/L)
	Air	Water						
21-07-15	DND	16.4	0.18	**3.64**	**1,658**	316.500	7.20	245.35
21-08-18	28	15.8	0.16	**4.91**	332	0.281	7.35	221.65
21-09-28	DND	13.7	0.18	**5.63**	**1,334**	0.288	7.34	239.20
21-10-22	14	10.3	0.19	6.55	**563**	0.278	7.51	250.90

Table 18: Nutrient results for AG5-A, 2021

SITE AG5-A: NUTRIENT DATA 2021				
Date (yy-mm-dd)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	TP-L (mg/L)
21-07-15	<0.05	<0.05	<0.05	**0.130**
21-08-18	<0.05	<0.05	<0.05	**0.160**
21-09-28	<0.05	<0.05	<0.05	**0.262**
21-10-22	<0.05	0.11	0.11	**1.700**

Figure 7: AG5-A site location and surrounding land uses

3.7 FW2-A

This water quality sampling site is located in the Cornwall Brook, at the crossing with Route NB-132 near the Shediac roundabout (Figure 8). This area is not affected by tide. Small trout and some larger fish have been seen near this site. The SBWA began replanting trees along the banks at this site in 2020, to help mitigate the damages caused by the construction of the new highway interchange between NB-15, NB-11 and NB-132.

The water sampling results for the site FW2-A for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

Bacterial levels exceeded the maximum concentration of E. coli from Health Canada recreational guideline (≥ 400 MPN/100 mL), for the sample taken in July (5,794 MPN/100 mL) and September (609 MPN/100 mL) (Table 19).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance framework for Phosphorus were: in the meso-eutrophic range (0.020 – 0.035 mg/L) in October; and in the eutrophic range (0.035 – 0.100 mg/L) from July to September (Table 20).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Table 19: Water chemistry data and *E. coli* results for FW2-A, 2021

SITE FW2-A: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES 2021								
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	COND (mS/cm)	pH (pH)	TDS (mg/L)
	Air	Water						
21-07-15	DND	17.9	0.24	8	**5,794**	425.700	7.58	326.30
21-08-18	28	18.1	0.18	6.89	75	0.324	7.24	243.10
21-09-28	DND	13.9	40.23	7.37	**609**	0.375	7.24	309.40
21-10-22	14	10.7	0.21	8.13	31	0.313	7.73	279.90

Table 20: Nutrient results for FW2-A, 2021

SITE FW2-A: NUTRIENT DATA 2021				
Date (yy-mm-dd)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	TP-L (mg/L)
21-07-15	<0.05	0.26	0.26	**0.060**
21-08-18	<0.05	0.31	0.31	**0.065**
21-09-28	<0.05	0.19	0.19	**0.042**
21-10-22	<0.05	0.11	0.11	**0.020**

Figure 8: FW2-A site location and surrounding land uses

3.8 WQ-11D

This water quality sampling site is located on Route NB-530 in Grande-Digue, and is accessed through a private property with the landowner's permission (Figure 9). This site has a thick riparian vegetation along most of its length. Hayfields dominate the levels on the edge and above the stream.

The water sampling results for the site WQ-11D, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) on one occasion in July (1,050 MPN/100 mL) (Table 21).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance Framework for Phosphorus were all eutrophic range (>100 mg/L) in October (Table 22).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Table 21: Water chemistry data and *E. coli* results for WQ-11D, 2021

SITE WQ-11D: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES 2021								
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	COND (mS/cm)	pH (pH)	TDS (mg/L)
	Air	Water						
21-07-15	DND	17.8	0.06	8.74	**1,050**	101.500	7.36	76.70
21-08-18	28	19.1	0.07	7.08	41	0.025	7.58	91.00
21-09-28	DND	14.5	0.06	8.12	231	0.107	7.56	87.10
21-10-22	DND	11.4	0.05	9.76	31	0.085	7.89	74.10

Table 22: Nutrient results for WQ-11D, 2021

SITE WQ-11D: NUTRIENT DATA 2021				
Date (yy-mm-dd)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	TP-L (mg/L)
21-07-15	<0.05	1.05	0.36	**0.075**
21-08-18	<0.05	<0.05	<0.05	**0.038**
21-09-28	<0.05	<0.05	<0.05	**0.066**
21-10-22	<0.05	<0.05	<0.05	**0.041**

Figure 9: WQ-11D site location and surrounding land uses

3.9 WQ-11E

This water quality sampling site is also located on Route NB-530 in Grande-Digue, and was accessed through a private property with the landowner's permission (Table 10). This site is above the tidal zone and upstream of the regular SBWA monitoring site WQ-11. The surrounding land use includes agriculture and a pasture for horses near this site.

The water sampling results for the site WQ-11E, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in June (7,701 MPN/100 mL), July (405 MPN/100 mL), August (3,873 MPN/100 mL), and October (5,794 MPN/100 mL) (Table 23).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance Framework for Phosphorus were: in the oligotrophic range (0.004 – 0.010 mg/L) October; in the mesotrophic (0.010 - 0.020 mg/L) in August and September; and in the eutrophic range (0.035-0.100 mg/L) in July (Table 24).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Table 23: Water chemistry data and *E. coli* results for WQ-11E, 2021

SITE WQ-11E: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES 2021								
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	COND (mS/cm)	pH (pH)	TDS (mg/L)
	Air	Water						
21-07-15	DND	17.1	0.08	8.11	41	144.500	7.34	110.50
21-08-18	28	20.0	0.09	8.91	<10	0.170	6.68	122.20
21-09-28	DND	13.6	0.09	7.77	85	8.152	7.44	126.75
21-10-22	DND	11.4	0.09	8.79	10	0.145	7.63	126.10

Table 24: Nutrient results for WQ-11E, 2021

SITE WQ-11E: NUTRIENT DATA 2021				
Date (yy-mm-dd)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	TP-L (mg/L)
21-07-15	<0.05	0.07	0.07	0.060
21-08-18	<0.05	<0.05	<0.05	0.019
21-09-28	<0.05	0.14	0.14	0.012
21-10-22	<0.05	0.23	0.23	0.007

Figure 10: WQ-11E site location and surrounding land uses

3.10 Sampling Summary

The bacterial levels measured in 2021 in the investigative sites of the Shediac Bay are similar in comparison to last years. For all the investigative sites except WQ-11E, the July sample exceeded the Canadian Recreational Water Quality Guideline (400 MPN/100 mL). The WQ-11E did not exceed the water quality guideline for bacteria during the sampling period. The AG2 site was the worst in term of bacterial concentration, exceeding the water quality guidelines on every sample. The FW2-A had the highest recorded concentration of *E. coli* with its July sample (5,794 MPN/100 mL) (Figure 11).

The average total phosphorous for the investigative sampling sites fell into three different categories; Meso-eutrophic (0.020 – 0.035 mg/L), Eutrophic (0.035 - 0.100 mg/L), and Hyper-eutrophic (>0.100 mg/L). These categories are derived from the CCME Guidance Framework for Phosphorus (freshwater) (Table 25).

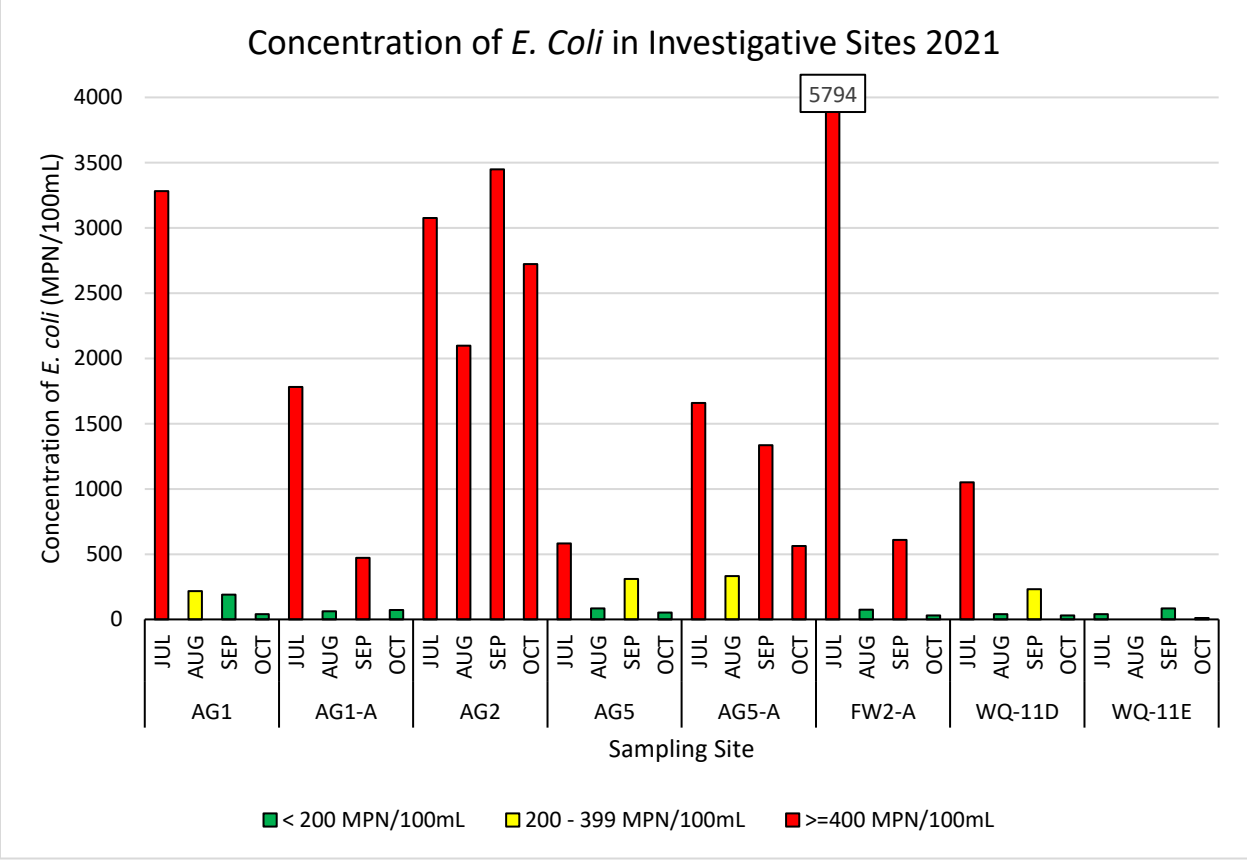


Figure 11: Summary of water quality results for *E. coli*, investigative sampling 2021

Table 25: Average total phosphorous for investigative sampling sites in 2021

Investigative Sampling Site	Average TP-L (mg/L)
AG1	0.031
AG1-A	0.066
AG2	0.07
AG5-A	0.563
AG5	0.056
FW2-A	0.047
WQ-11D	0.055
WQ-11E	0.025

4 Eelgrass Monitoring

The *SeagrassNet* program is a global seagrass monitoring network that monitors the status of seagrass and the threats to these ecosystems. The program started in 2001, and now includes more than 126 sites in 33 countries.

The Southern Gulf of Saint Lawrence Coalition on Sustainability (Coalition-SGSL) has implemented the SeagrassNet program in Atlantic Canada since 2015. They have provided equipment and training to the SBWA for the monitoring program to begin in the Shediac Bay. The first monitoring site was established in the estuary of the Scoudouc River in 2016, and a second site was established in the Shediac River estuary in 2017. In 2018, a third monitoring site was added in the Shediac Bay, near the mouth of the South Cove Estuary (in Pointe-du-Chêne). The final site was established in 2019 on the north shore of the bay in Grande-Digue.

The data collected from these annual surveys will serve to measure changes in eelgrass density in these sensitive habitats. Since the first appearance of the invasive green crab in the Shediac Bay in 2010, Green crab population varies between years. The green crab is an invader is capable of devastating eelgrass habitats. The SeagrassNet program provides a protocol to measure the impacts of the green crab in the Shediac Bay. The protocol for the sampling can be found at www.seagrassnet.org.

4.1 Shediac River Site

The Shediac River Estuary site is located at Shediac Bridge just east of the Route 134 bridge (Table 26 & Figure 12).

This site was established in August 2017. Access is possible from Route 134 across the riprap. The A-line anchors and one C-line anchor and were replaced in 2019 and again in 2020. The team used GPS to set one anchor at the established point and later a compass and tape measure to set the other two points.

Table 26. Shediac River eelgrass monitoring site coordinates

Shediac River						
Transect	**Left**		**Center**		**Right**	
	Latitude	**Longitude**	**Latitude**	**Longitude**	**Latitude**	**Longitude**
A	N 46°16'15.63"	W 64°34'24.52"	N 46°16'15.78"	W 64°34'23.38"	N 46°16'15.92"	W 64°34'22.23"
B	N 46°16'16.49"	W 64°34'24.37"	N 46°16'16.57"	W 64°34'23.21"	N 46°16'16.69"	W 64°34'22.10"
C	N 46°16'17.25"	W 64°34'24.41"	N 46°16'17.29"	W 64°34'23.20"	N 46°16'17.30"	W 64°34'22.08"

Figure 12. Shediac River eelgrass monitoring sites

4.1.1 Results

The 2021 sampling took place on August 6th. This site was heavily impacted by Hurricane Dorian in the fall of 2019. The eelgrass bed was torn from the roots from the strength of the winds and waves. During the sampling in 2020 and 2021, there is barely any presence of eelgrass left in the study areas. Continued monitoring will be useful to measure the recovery rate of this eelgrass bed.

4.1.1.1 Average height of eelgrass

Average plant height is taken at each quadrant by measuring several plants and estimating an average height. Eelgrass height is relative to water depth.

Plant height at the Shediac River site has had no significant change since 2020. The average height of eelgrass had been increasing between 2017 and 2019 in all transects, however, Hurricane Dorian eliminated the Shediac River eelgrass bed almost entirely. No measure of height could be taken due to the absence of eelgrass (Figure 13).

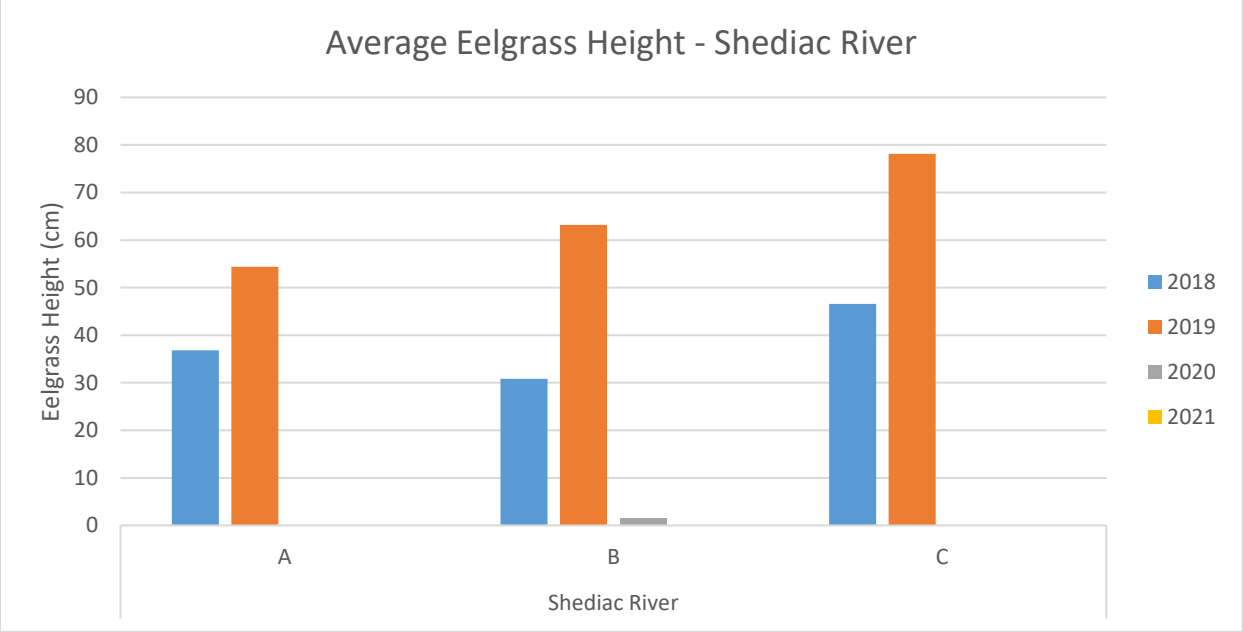


Figure 13: Average Shediac River eelgrass height in centimeter per transect throughout 2018-2021

4.1.1.2 Average Percentage of Cover

The average percent cover also has had no significant change since 2020. Similar to the average height, the average percent cover of eelgrass had been increasing yearly from 2017 to 2019. The Shediac River transects showed no eelgrass presence (*Appendix A – Shediac River Site*), therefore no average percent cover could be measured for 2021 (Figure 14).

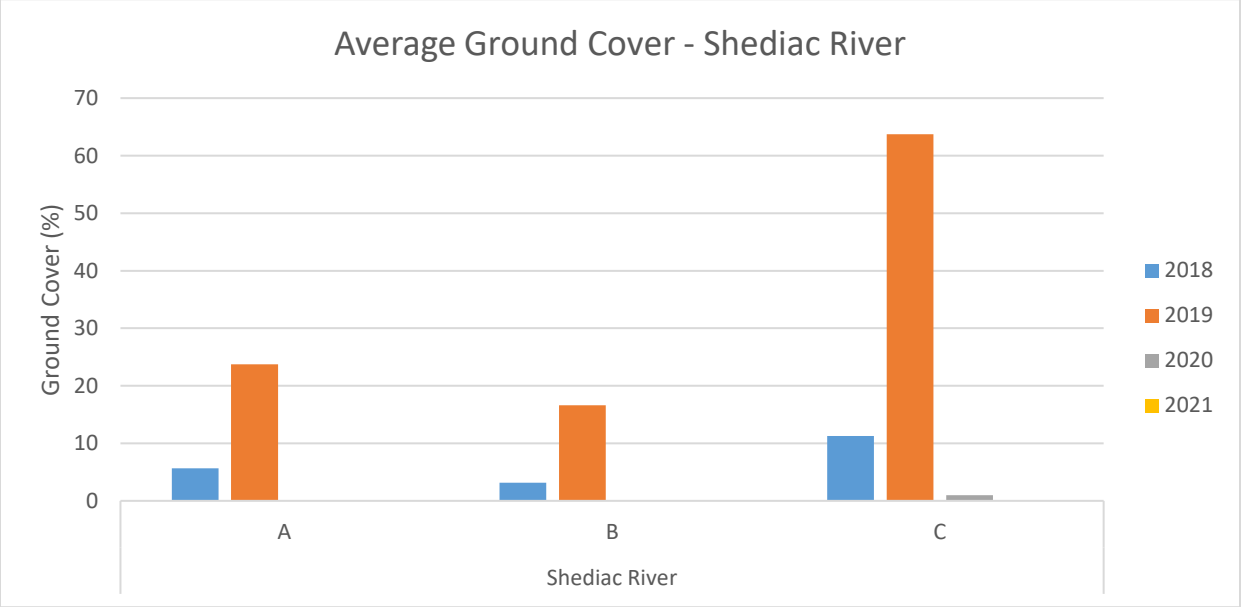


Figure 14: Average Shediac River eelgrass ground cover in percentage per transect throughout 2018-2021

4.2 Scoudouc River Site

Another eelgrass monitoring site is located in the Scoudouc River estuary. Access is from the private Heron Lane. The SBWA has received permission from the property owners to use the road and permission from the Greater Shediac Sewage Commission to park at their lift station for easy access to the beach (Figure 15). This site was established in 2016. However, in 2018, the site anchors could not be found. In 2019, the site was re-established in an area slightly further north (Table 27). The A-line of the original site being too shallow for a proper assessment.

Table 27. Scoudouc river eelgrass monitoring site coordinates

Scoudouc River						
Transect	Left		Center		Right	
	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
A	N 46°13'37.37"	W 64°33'31.60"	N 46°13'36.54"	W 64°33'31.42"	N 46°13'35.84"	W 64°33'31.16"
B	N 46°13'37.64"	W 64°33'30.09"	N 46°13'36.84"	W 64°33'29.89"	N 46°13'36.00"	W 64°33'29.74"
C	N 46°13'37.89"	W 64°33'28.66"	N 46°13'37.12"	W 64°33'28.47"	N46°13'36.32"	W 64°33'28.25"

Figure 15. Scoudouc River eelgrass monitoring sites

4.2.1 Results

Sampling took place on August 3rd, 2020. The Scoudouc River sites were not completely eliminated by Hurricane Dorian but were still affected.

4.2.1.1 Average height of eelgrass

For both nearshore (A) and middle (B) sites, the average plant height has decreased in 2021 with a decrease of 10cm and 7cm respectively. Ever since Hurricane Dorian in 2019, the average plant height has been decreasing in all sites except the offshore site (C). The offshore site has showed signs of recovery from the hurricane with an increase of 15cm in average plant height (Figure 16).

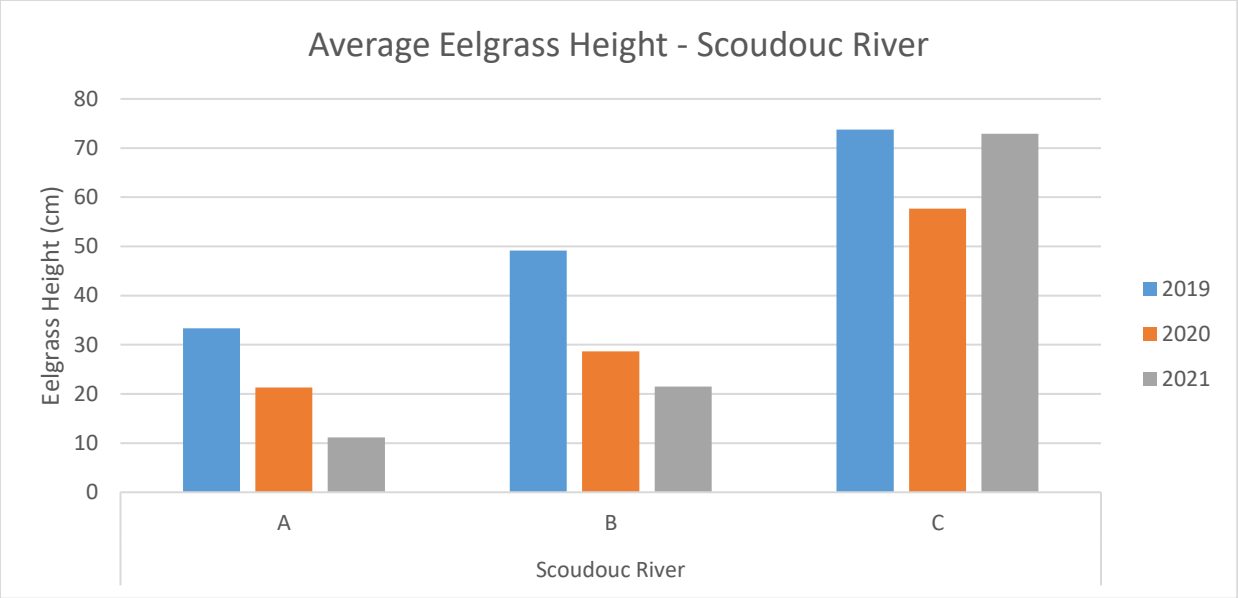


Figure 16: Average Scoudouc River eelgrass height in centimeter per transect throughout 2019-2021

4.2.1.2 Average Percentage of Cover

The average percent cover of eelgrass showed the same trends as the average height. In both nearshore and middle sites there has been a decrease of 41% and 11% respectively from 2020 to 2021. The offshore site, however, has had an increase of 5% (Figure 17).

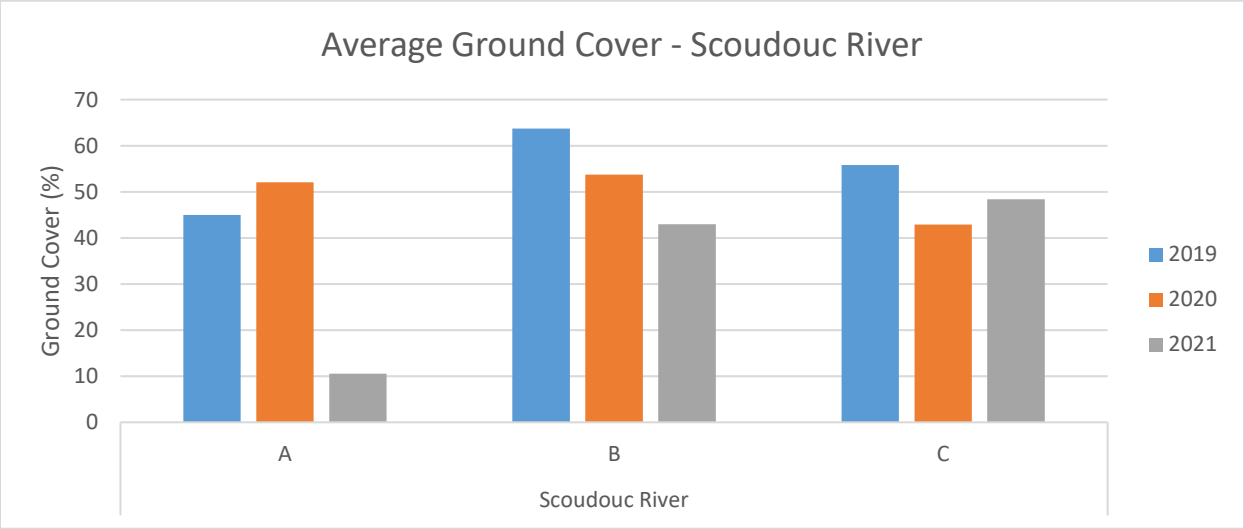


Figure 17: Average Scoudouc River eelgrass ground cover in percentage per transect throughout 2019-2021

4.3 Pointe-du-Chêne Site

The Pointe-du-Chêne assessment site is located at the end of Stead Road (Table 28 & Figure 18).

Table 28. Pointe-du-Chêne river eelgrass monitoring site coordinates

Pointe-du-Chêne						
Transect	Left		Center		Right	
	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
A	N 46°13'51.21"	W 64°31'26.21"	N 46°13'51.68"	W 64°31'25.25"	N 46°13'52.13"	W 64°31'24.30"
B	N 46°13'53.39"	W 64°31'28.39"	N 46°13'53.90"	W 64°31'27.40"	N 46°13'54.34"	W 64°31'26.42"
C	N 46°13'55.32"	W 64°31'30.15"	N 46°13'55.71"	W 64°31'29.15"	N 46°13'56.18"	W 64°31'28.25"

Figure 18: Point-du-Chêne eelgrass monitoring sites

4.3.1 Results

This site was sampled on July 23, 2021. There are now four years of monitoring for this site. This site was also affected by Hurricane Dorian.

4.3.1.1 Average height of eelgrass

Since Hurricane Dorian in 2019, the average height of eelgrass in all sites has decrease yearly. Average plant height in 2021 is much shorter than in 2018 and 2019. Comparing to 2020, nearshore sites average plant height has decreased 5 cm, middle and offshore sites have both decreased 7 cm (Figure 19).

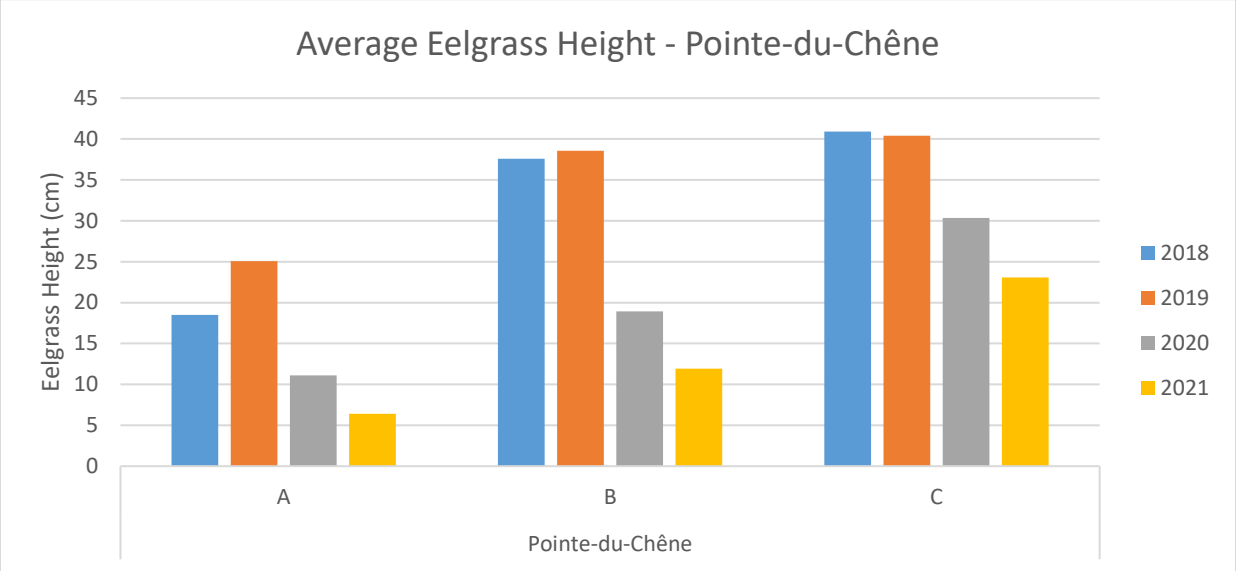


Figure 19: Average Pointe-du-Chêne eelgrass height in centimeter per transect throughout 2018-2021

4.3.1.2 Average Percentage of Cover

The average percent cover has mostly decreased yearly since 2019. All sites except nearshore sites have had a decrease in their plant cover since 2020. Middle sites had a decrease of 12% and offshore sites decreased 15%. The nearshore sites had a slight increase of 2%, showing slight signs of recovery from the hurricane Dorian (Figure 20).

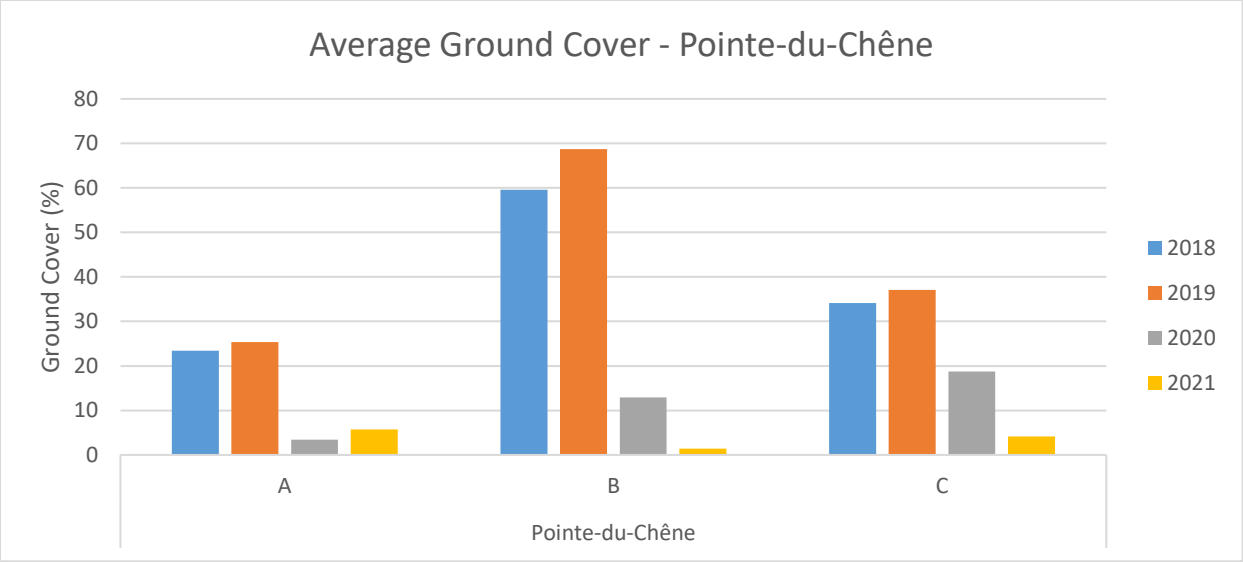


Figure 20: Average Pointe-du-Chêne eelgrass ground cover in percentage per transect throughout 2018-2021

4.4 Grande-Digue Site

The Grande-Digue site was established near the Grande-Digue dune at the end of Allée des Faisans Road (Table 29 & Figure 21) Permission was obtained from the owner of the land for parking and access to the shore for the team and the equipment.

Table 29. Grande-Digue eelgrass monitoring site coordinates

Grande-Digue						
Transect	**Left**		**Center**		**Right**	
	Latitude	**Longitude**	**Latitude**	**Longitude**	**Latitude**	**Longitude**
A	N 46°18'35.36"	W 64°31'10.69"	N 46°18'34.71"	W 64°31'11.39"	N 46°18'34.04"	W 64°31'11.99"
B	N 46°18'34.31"	W 64°31'8.39"	N 46°18'33.67"	W 64°31'8.99"	N 46°18'32.94"	W 64°31'9.58"
C	N 46°18'33.32"	W 64°31'6.09"	N 46°18'32.66"	W 64°31'6.71"	N 46°18'31.95"	W 64°31'7.40"

Figure 21: Grande-Digue eelgrass monitoring sites

4.4.1 Results

The Grande-Digue site is in its third year of monitoring. The sampling took place on July 31.

4.4.1.1 Average height of eelgrass

The eelgrass in Grand-Digue has shown sign of excellent recovery and was the least affected by Hurricane Dorian. Some sights have seen their highest average canopy height recorded. Average canopy height has increased in all sites except offshore. Nearshore and middle sites have had a 10 cm and 2 cm increase respectively. The offshore site had a 7 cm decrease in its average plant height (Figure 22).

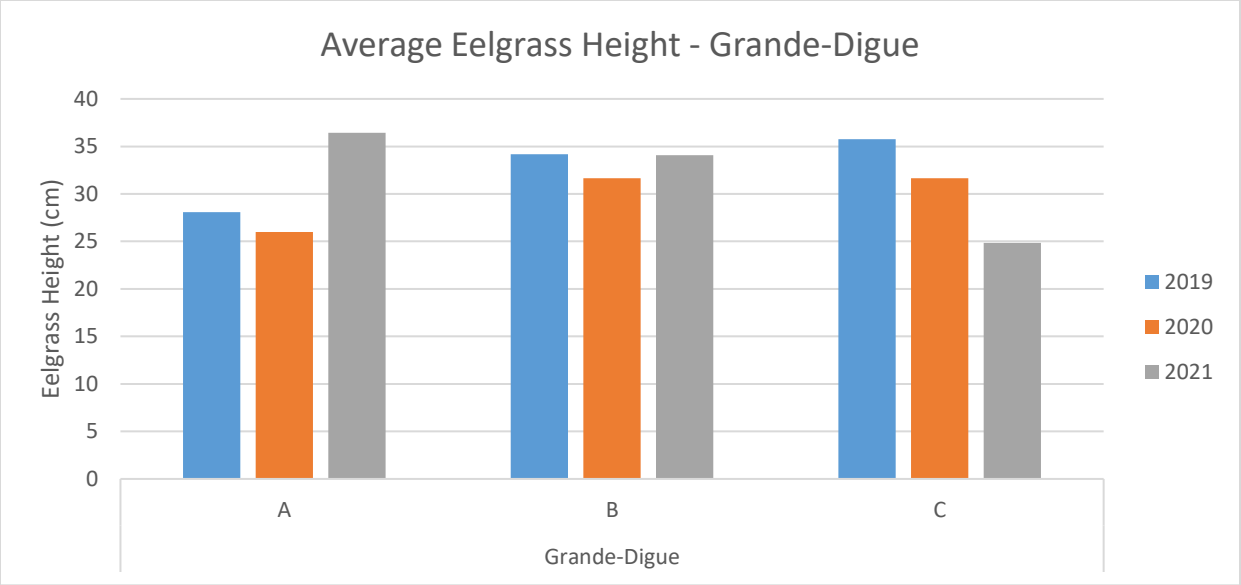


Figure 22: Average Grande-Digue eelgrass height in centimeter per transect throughout 2019-2021

4.4.1.2 Average percentage of cover

The same trends were seen in the average percentage cover. The nearshore and middle sites had an increase of 36% and 7% respectively since 2020. The offshore site, however, decreased 32% in average cover (Figure 23).

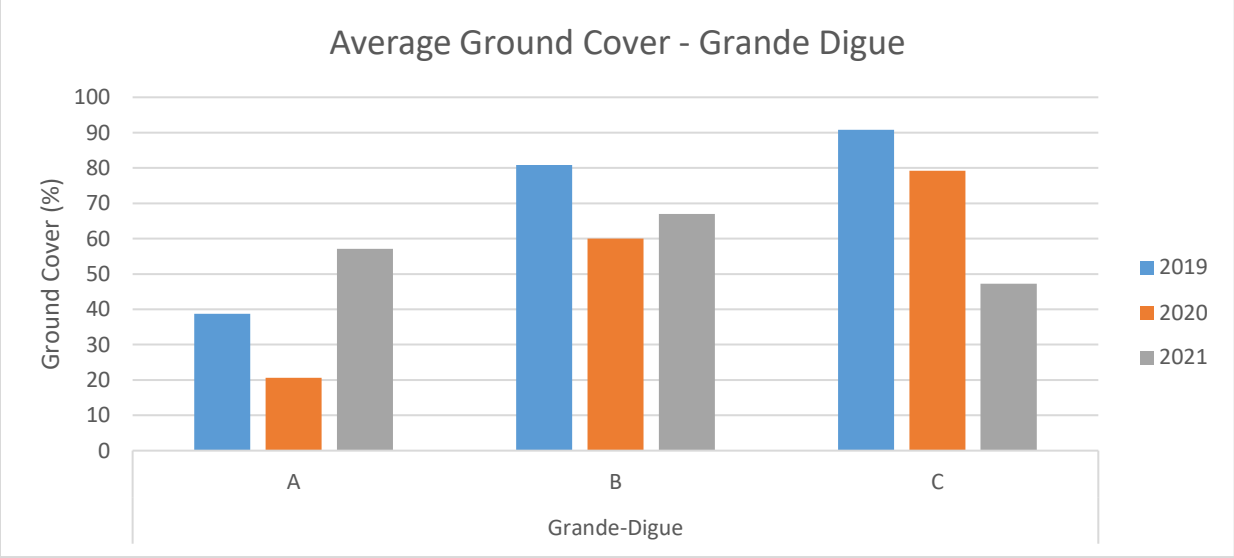


Figure 23: Average Grande-Digue eelgrass ground cover in percentage per transect throughout 2019-2021

4.5 Evaluation of Sites Results

The different parameters evaluated in 2019, 2020 and 2021 are percent cover, average number of plants, total plant height. These parameters where compared across all eelgrass monitoring sites.

4.5.1 Average percent cover

The Grande-Digue site shows the greatest percentage cover and recovery from Hurricane Dorian. The Scoudouc River had second greatest percent cover, however, there has been a slight decrease in both nearshore and middle sites since 2020. The Pointe-du-Chêne site was heavily affected by Dorian and is still having yearly decreases in ground cover, however, the nearshore site has shown slight signs of recovery. Unlike the other sites, the Shediac River has not shown signs of recovery from Hurricane Dorian. This hurricane caused a lot of damage to the coast and appears to have stripped the eelgrass almost entirely this site (Figure 24).

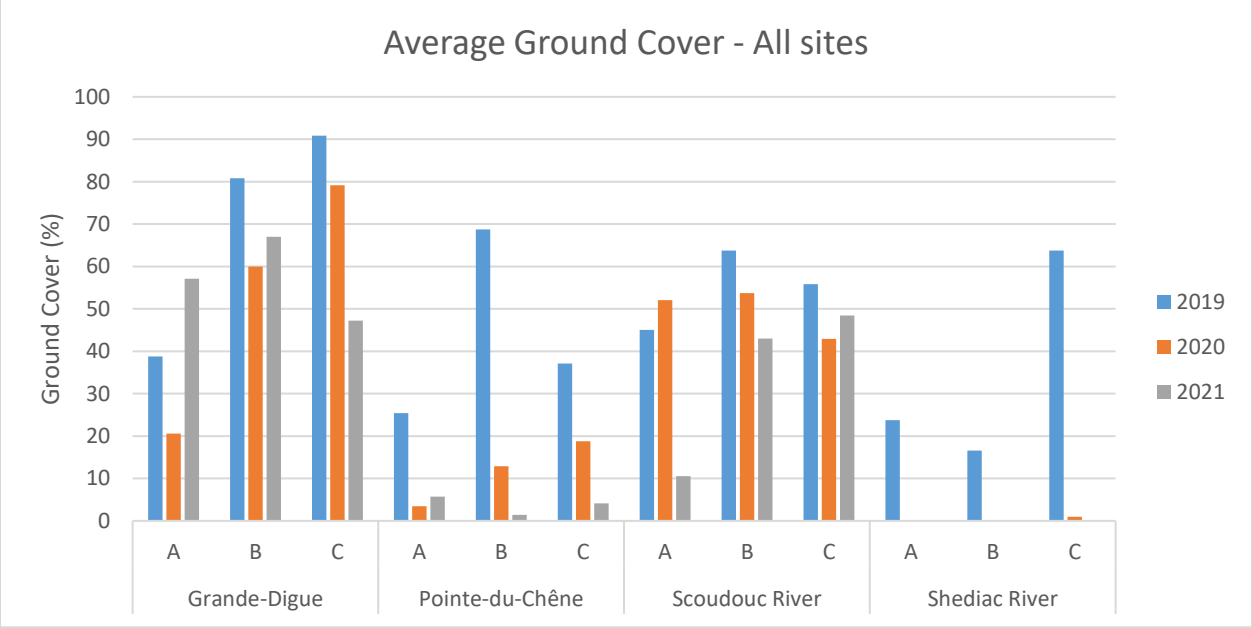


Figure 24: Average monitoring site eelgrass ground cover in percentage per transect throughout 2019-2021

4.5.2 Average height of eelgrass

Looking at the maximum average plant height in each site, we see that the tallest plants in 2021 are found in the offshore Scoudouc river site (Figure 25). The plants at the Grande-Digue site are the least affected by Hurricane Dorian and in some sites, plants have grown taller than pre-Dorian measurements (2019). Scoudouc River has also seen signs of recovery in its offshore sites. The Point-du-Chêne site has had yearly decrease in its plant height since 2019. The Shediac river site is still suffering from the effect of Hurricane Dorian, no plants where available to record height from (Figure 15).

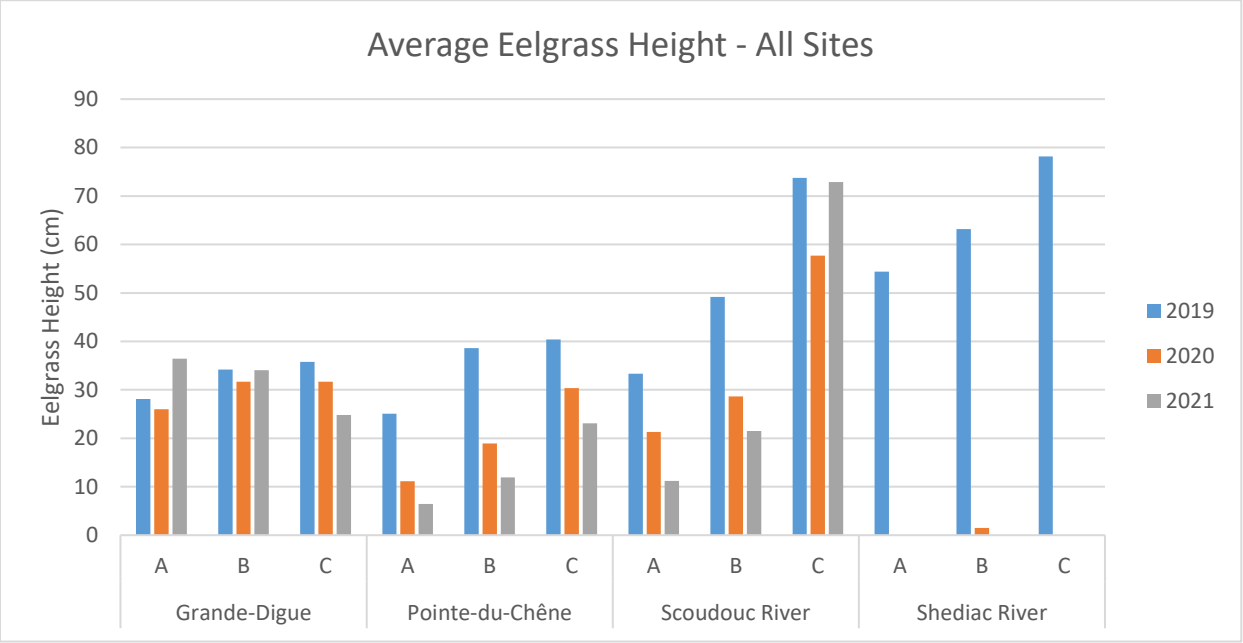


Figure 25: Average monitoring site eelgrass height in centimeter per transect throughout 2019-2021

4.5.2.1 Average shoot density

The Grande-Digue site had the highest plant density in 2021 followed by Scoudouc River. Similar to the other parameters, the only site that recovered from Hurricane Dorian is the Grande-Digue site. The average number of plants has decreased for nearly all transects in 2021 (Figure 26).

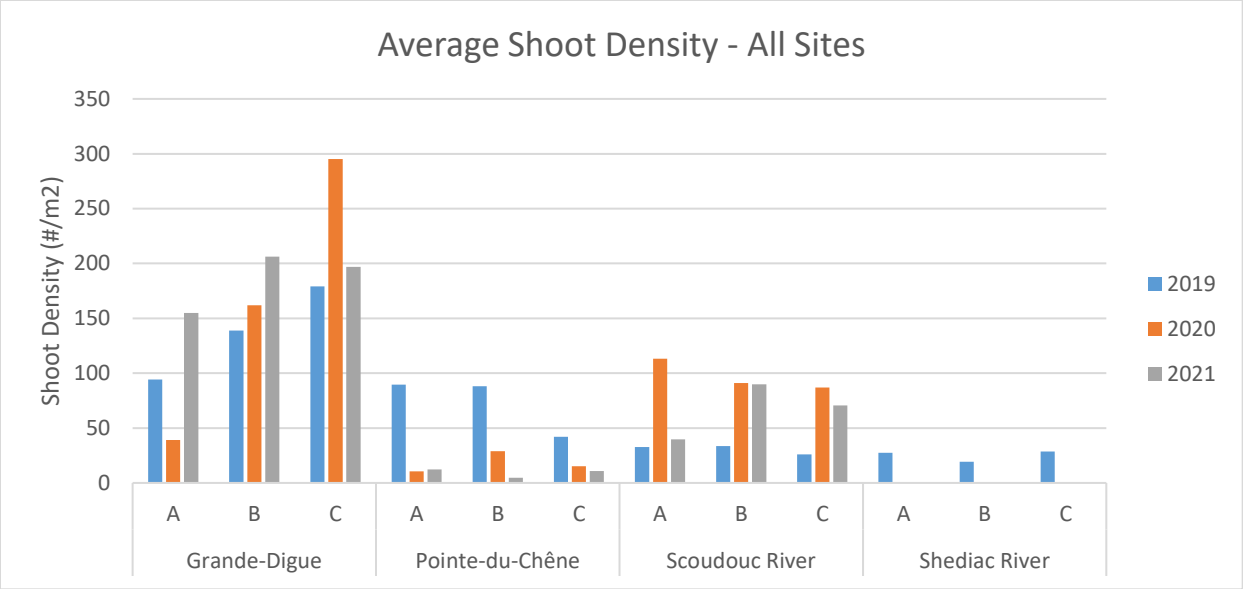


Figure 26: Average monitoring site eelgrass shoot density per square meter from 2019 to2021

4.6 Eelgrass Scientific Consortium

The eelgrass scientific consortium is a group that is coordinated by the Southern Gulf of Saint-Lawrence Coalition, who meets to discuss the state of eelgrass habitats in the maritime provinces. The SGSL-Coalition also went through a transition in 2021; the departure of the executive director and the lack of a replacement has caused the dissolution of the Coalition.

Thankfully, the remaining assets and legacy projects have been transferred to the Ecology Action Centre (EAC) in Halifax. The EAC will be taking over the eelgrass monitoring coordination and scientific consortium.

Although no official meeting was held in 2021, the group met discuss funding and collaboration needs for the future. A funding proposal has been submitted to DFO by the EAC to continue the coordination of monitoring, mapping and restoration of eelgrass beds in the maritime provinces for the next 3 years.

5 Green Crab Monitoring

Since the discovery of the invasive green crab (*Carcinus maenas*) in the Shediac Bay in 2010, the SBWA has been conducting a population monitoring program since 2013. After monitoring for 9 consecutive years, both by sampling using Fukui traps and with the CAMP sampling program (since 2004), valuable information has been gathered on their population trends and distribution in the Shediac Bay.

The amount of green crab caught have been steadily increasing in the Shediac Bay since 2019. The total amount of green crab caught has more than doubled from 2020 to 2021, however, compared to previous sampling years, the 2021 total catch is in the mid-range with 393 green crab caught (Figure 27).

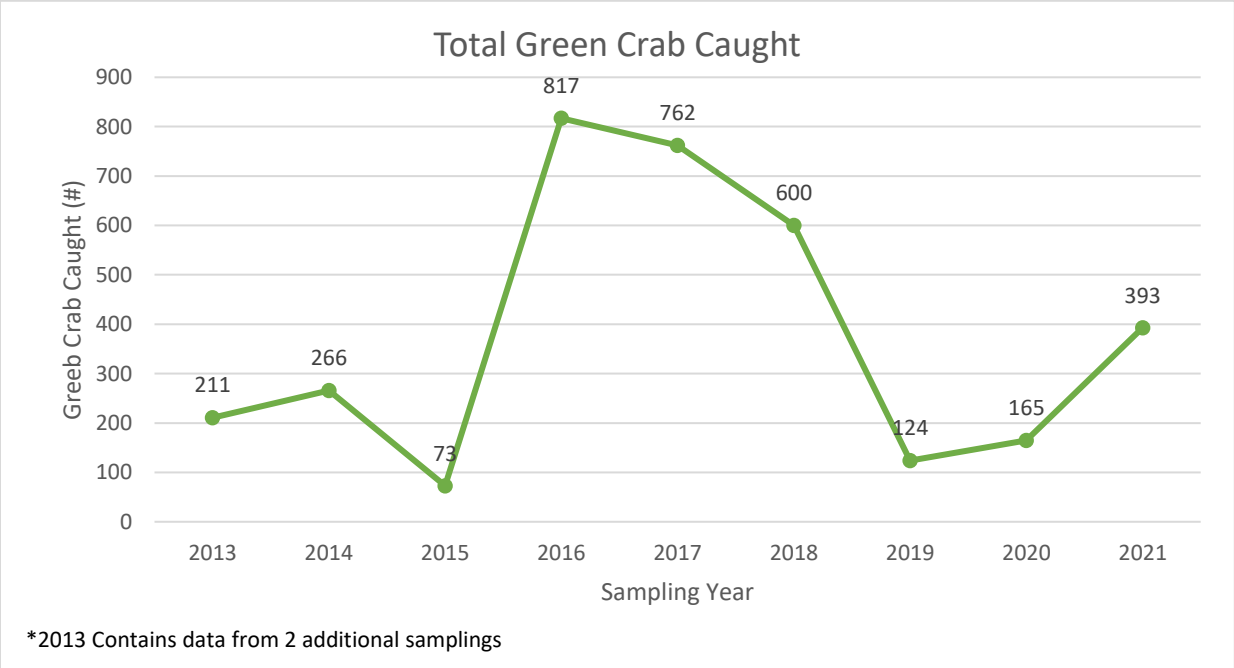


Figure 27: Total amount of green crab caught per year

The 2021 sampling for green crab was carried out from June to October. Male crabs were the most abundant sex across all monitoring months. The month of October had the highest count of female to male ratio (Table 30). The highest counts of green crab were recorded in June, September and October (Figure 28). Sampling sites experienced fluctuations of green crab populations throughout the sampling period. High numbers of green crabs were caught at sites G, H and B. These 3 sites were located in both the Shediac and Scoudouc River estuaries. The sites with the lowest amount of caught crabs through the 2021 monitoring period were sites F and J (Figure 28).

Table 30. Ratio of male to female caught per month for the 2021 sampling period

	June	July	August	September	October
Ratio (M/F)	2	6	5	5	12

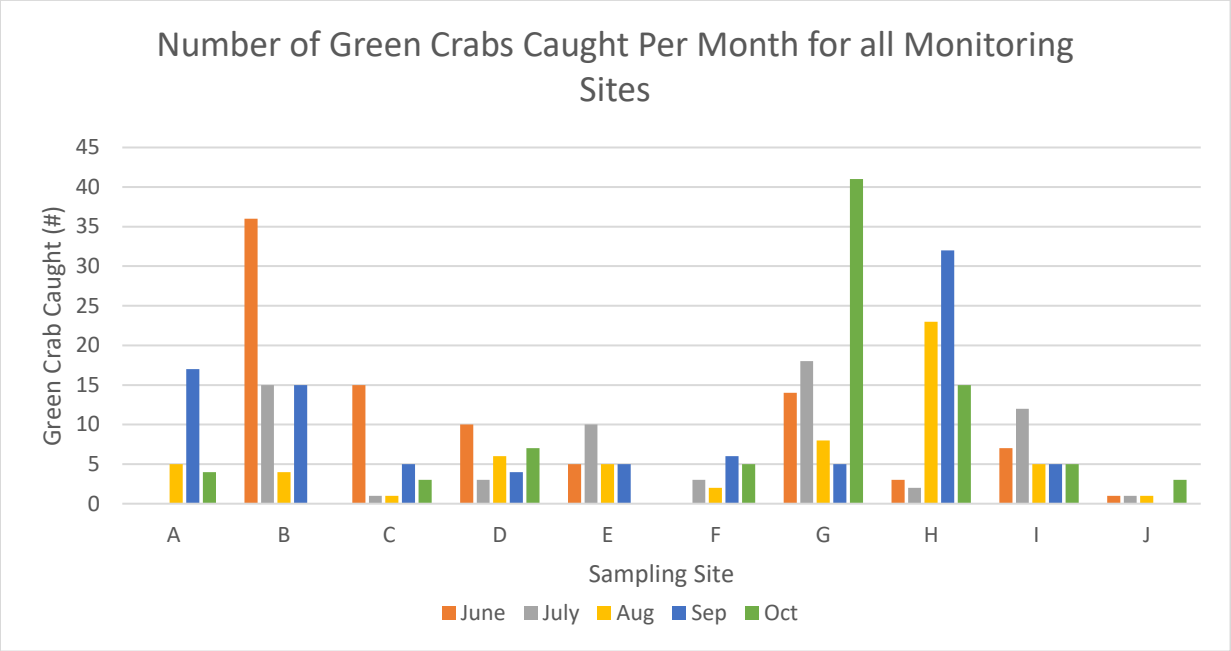


Figure 28: Number of green crabs caught per month for all monitoring site 2021

6 Discussion

6.1 Investigative Water Sampling in the Shediac Bay

The first disclaimer is that SBWA does not by any means proclaim to be water quality experts. The purpose of this project is to collect samples, organize the data, look at surrounding land uses and buffer zones, then pass on the information to experts. We can point out trends from our limited sampling results, but changes occur so quickly that general patterns are not always evident. Our sampling is simply a snapshot of the results on that collection day. It would be very expensive to monitor water quality changes on a daily or even weekly basis. As a non-profit environmental organization, we do not have the resources or capacity for this. Our goal is to look for gross abnormalities in general patterns and hope to identify possible causes.

Many of the flagged parameters above can have a wide range of negative impacts on various aquatic species when concentrations exceed their threshold of tolerance. This threshold varies depending on species, life stage, and sometimes concentrations of other parameters. All water quality data recorded by SBWA is uploaded to an open access platform called *Atlantic DataStream.* This platform allows the sharing of water quality datasets.

The bacterial levels measured in 2021 in the investigative sites of the Shediac Bay are similar in comparison to last years. The high concentration of *E. coli* recorded across most investigative sites in July were caused by the heavy rain event (~25 mm) that occurred 24 hours prior to sampling. Environmental accumulation of bacteria would have been washed out into the streams by rain runoff, especially in sites like AG2 that are surrounded by pastures.

6.2 Eelgrass Monitoring

The decrease in eelgrass cover in 2020 caused by the impact of Hurricane Dorian is still apparent in 2021. The Grande-Digue and Scoudouc River site have shown signs of recovery from the hurricane, however, the two other sites have generally had a decrease in all parameters in 2021. Eelgrass have still yet to come back to the heavily affected Shediac River site. An interesting observation is that offshore monitoring sites usually tend to have better eelgrass cover and taller plants compared to the nearshore sites.

6.3 Green Crab Monitoring

The green crab population seems to be increasing since 2019 based on the total catch amount (Figure 17). Crab population also seems to have remained somewhat stable throughout the

monitoring period in 2021 with only a few instances of fluctuating catch size (Figure 18). If the Shediac Bay green crab population keeps following the trend seen in the last 3 years, the green crab population could require concern.

7 Environmental Restoration

7.1 OceanSurf Campground

The coastline in Southeastern New Brunswick is impacted by rising sea levels and a rise in storm occurrences caused by climate change. In 2019 Hurricane Dorian caused extensive damage to water front properties along the Shediac Bay.

A partnership was formed in 2019 between the Shediac Bay Watershed Association, Vision H2O, the *Groupe de developpement durable du Pays de Cocagne* (GDDPC) and the Acadian Peninsula Regional Service Commission, would collaborate on education and restoration of the coastal zones. Funding was received to hire the company Helping Nature Heal (HNH) from Bridgewater Nova Scotia, for their expertise in living shoreline restoration and protection.

Following an assessment of the site, HNH produced a sketch of the work (Figure 29) and the restoration started at Ocean Surf Campground in 2020 where a workshop was held. Over 50 participants from various backgrounds such as property owners, campground staff, city councilors, university professors, and watershed groups staff attended the workshop and aided in the hands-on implementation of the living shoreline structures.

The construction included a buffer zone to the south-east section of the campground. In the northern section of the project a staged planted berm was planted as well as there was an interpretive panel added. A vegetated rock wall was planted to add extra structural integrity to the bank as well as buffer zones using chevron patterned techniques. There was also a section using a terracing technique which is used to keep soil from being washed away. The crew also constructed a vegetative rock wall by planting in between the rocks to add structure to the natural bank.

In 2021, the SBWA received additional funding from Nature NB and financial support from the from Nature NB and the Acadian Regional Service Commission to re-hire Helping Nature Heal to continue working on the OceanSurf site. . One section of the bank was extended from previous work done in 2020, where several techniques were used, including; waddle fencing, brush mats, and planting well adapted vegetation. All exposed soil was then covered with hay. Vegetation that was planted had mycorrhizal inoculant applied to the roots to which give the plants nutrients on demand and was then watered. Some of the same techniques were then applied at a different location where there was a noticeable amount of bank erosion and also included terracing. These methods are a less expensive, natural alternative to common techniques such as rip rap or rock walls.

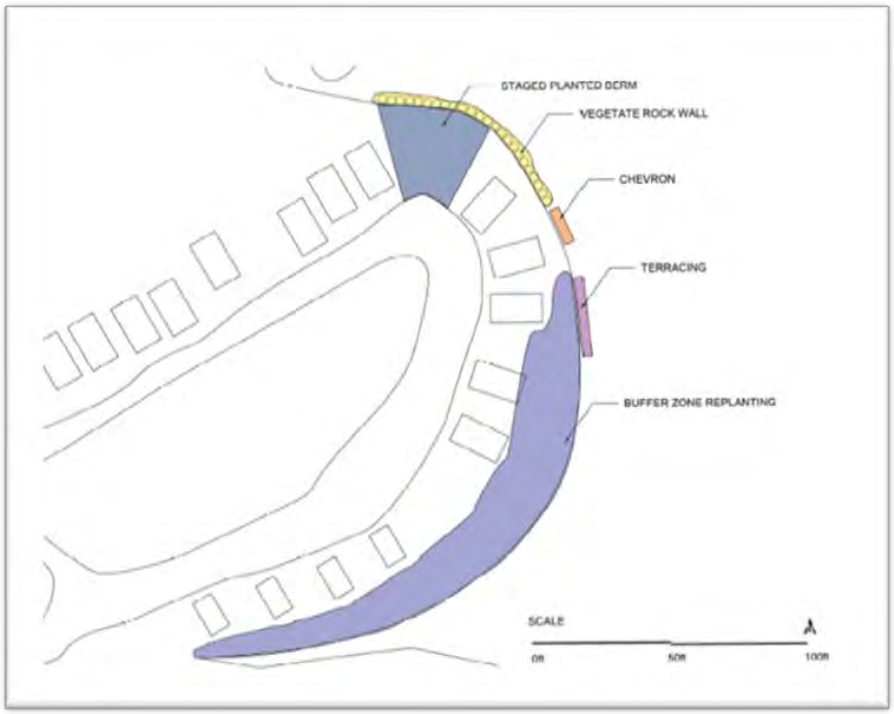


Figure 29: Sketch of 2020 plan for Ocean Surf Campground project

Figure 30: Map of restoration work done at Ocean Surf Campground 2021

The plants were selected by Helping Nature Heal from their nursery and are well adapted to grow coastal regions. Many of the plants and grasses have deep roots which are good for erosion protection and stabilizing the banks. The plants are as listed:

- 12 large potted Spartina Grass
- 7 seedling Sumac
- 2 Blue bead lily
- 3 sheep laurel
- 5 Birch
- 4 Pearly Everlasting
- 7 Aster
- 3 Raspberry
- 3 Carex Grass
- 2 Combo pots of sheep laurel & Grass
- 2 large multi pots of Evening Primrose
- 90 Sea Grass
- 3 Golden Rod
- 10lbs mixed seed grains and grasses with HNH pollinator seed mix
- 24 red Osier Dogwood

Figure 31: Applying the living shoreline techniques in 2021

Figure 32: The living shoreline along with an interpretive sign 2021

Figure 33: Before photos of the dock area of the restoration site in 2019

Figure 34: After photos of the dock area of the restoration site in 2021

7.2 Dune Restoration and Protection

The SBWA was contacted by a citizen during the winter of 2021, with concerns about the degradation of the dune at Belliveau Beach in Pointe-du-Chêne. As protecting and restoration of shorelines was an activity that was submitted with this ETF project, a new activity was initiated.

The first step was to identify landowners and partners for the project. The parcel of land (PID 70506035) that is comprised of sand dunes and salt marsh is owned by the Belliveau family. The parcel is adjacent to Parlee Beach Provincial Park. The landowners were in agreement to implement some education and protection measures for the dunes.

The manager at Parlee Beach Provincial Park was contacted to inform him of the project and identify possible collaborations. The provincial park was able to offer 5 sections of wooden snow fencing for the project. The wooden fencing is preferable as it's more aesthetic than plastic snow fencing for this important tourist area. The SBWA provided the metal T-posts and ties.

The project plan was drafted and submitted to the landowners for their approval. The aim of the project is not to restore the dune completely but rather educate on this fragile ecosystem and promote best practices.

The project concentrated on the two main public entrances that are used by residents of Pointe-du-Chêne. The main entrance is located off Fernwood Avenue. The second entrance is at the corner of King George Street and Fernwood Ave.

These public entrances cause breaches in the dune ecosystem because of excessive trampling of the marram grass. With time these breaches become larger and make the dune more vulnerable to storm waves.

Snow fencing was installed at both entrances to prevent further damages to the dune. Also, the majority of visitors stay close to the entrances when they walk to the beach. The fences keep visitors from getting too close to the dune crest and preventing the establishment of the beach grass.

Marram grass was then transplanted behind the fencing to accelerate the natural restoration of the dune front. The transplants were taken from the back of the dune in dense areas by collecting one in ten plants. Care was also taken not to trample the same areas more than once as this can damage the beach grass. This technique was taken from a project done in Cote Sainte-Anne by the Kent Watershed Coalition in 2013.

An educational signage was installed to educate on the sensitive habitat. An interpretive panel was installed at the Fernwood entrance. The panel explains the role of marram grass in preserving the dune and reducing erosion

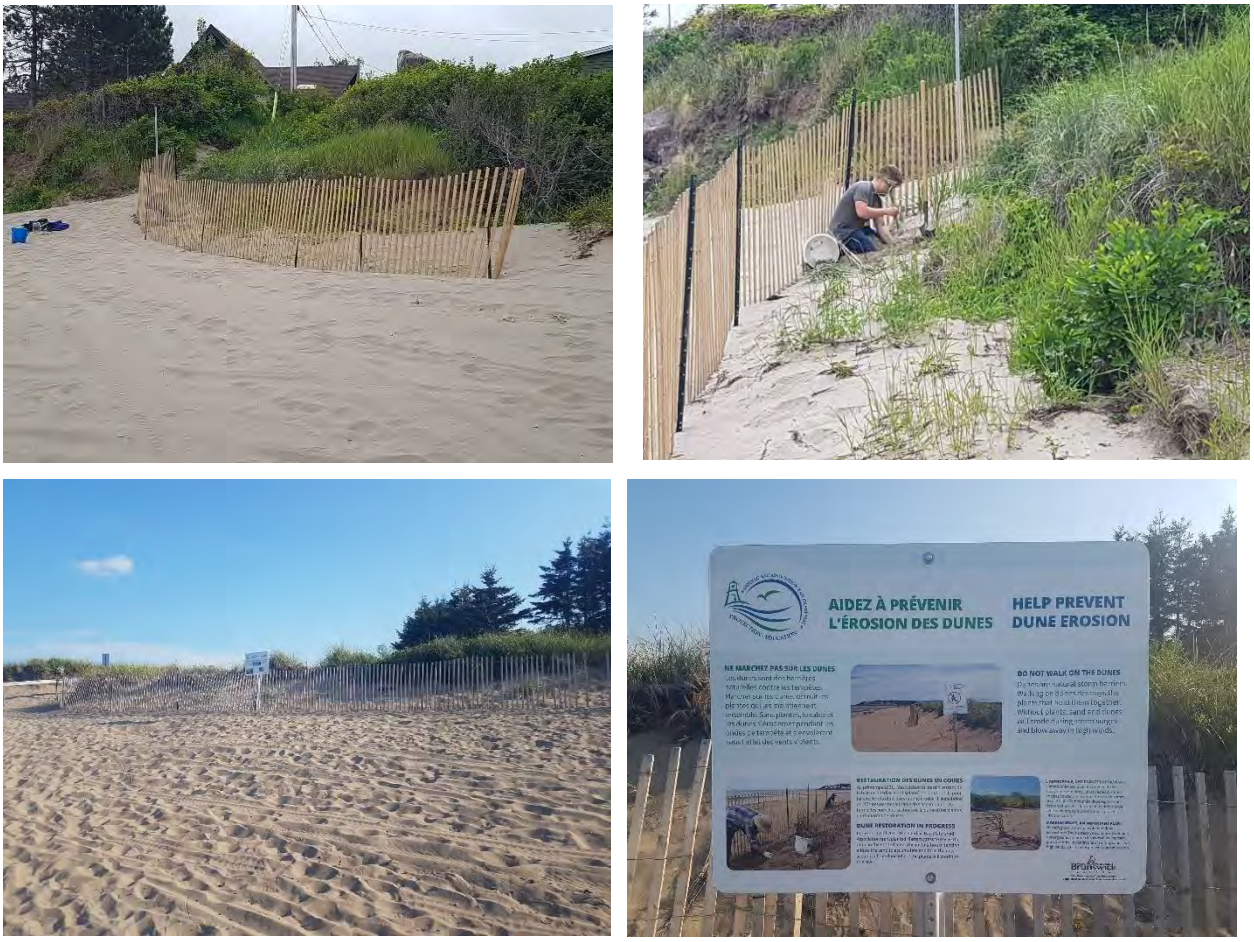


Figure 35: Snow fencing installed at Belliveau beach and marram grass transplanting by SBWA employee

The message is then repeated on medium sized signs that are placed along the fencing and plantations to inform visitors that may have accessed the beach from other areas.
Additionally, smaller signs are installed further along the dune to remind people not to walk on the beach grass.

The aim of the program in 2021 was mostly to educate visitors on the sensitive nature of the dune. The program could be expanded in future years to restore greater surfaces of the dune with snow fences and marram grass plantings. Healthy dunes offer ecosystem services to the community of Pointe-du-Chêne by providing natural erosion control and buffering storm surges. These services would be very expensive to replace with engineered infrastructure.

Figure 36: Dune Restoration Map

8 ENVIRONMENTAL CLEANUP

8.1 Trash Site Cleanup

The SBWA was contacted by the Town of Shediac, who received a report from new homeowners of an old dump site along the edge of their property, on the shoulder of a small stream.

The dump site underwent a first phase cleanup, where the SBWA's staff and volunteers collected over 14 heavy-duty garbage bags and various debris. The Town of Shediac disposed of two truckloads of trash from this cleanup. The next phase of this cleanup will require heavy equipment to retrieve the larger items and is scheduled for the spring of 2022.

In addition, a patch of invasive Japanese Knotweed was discovered in the backyard. A plan is in place target this patch for eradication in 2022.

Figure 37: Trash site cleanup and photo of invasive Japanese Knotweed

Figure 38: Town of Shediac truck filled with trash & SBWA employees and volunteers

8.2 Stream Cleanup

An unnamed stream crossing the Town of Shediac was identified to contain large amount of trash by the SBWA. These observations were made during water sampling at the WQ-3 site and during other stream assessment activities. Following concern from both local residents and the Shediac municipality, the SBWA took on the responsibility of cleaning the unnamed stream.

In partnership with the Town of Shediac, the Shediac Bay Watershed Association conducted an environmental cleanup in 2021. Several sections of the stream were cleaned, resulting in the collection of 18 garbage bags along approximately 500 m of the watercourse.

Due to the length and accessibility of the stream, the cleanup efforts were divided between three access points. The SBWA employees cleaned the trash until the stream became inaccessible. The first access point is located at the Pascal Poirier Park. The second access point is located further upstream next to a bakery. This site had two separate cleaning efforts. Finally, the third site is located even further upstream at the Ourson Park.

The Pascal Poirier Park access point yielded 10 garbage bags of trash. The bakery site yielded four bags plus a tire on the first cleaning effort and two bags on the second effort. Ourson Park access point yielded two trash bags.

Table 31: Amount of garbage bags filled with trash for the different access points

Access Point	Number of Trash Bag
Pascal Poirier Park	10
Bakery (1st effort)	4
Bakery (2nd effort)	2
Ourson Park	2

Figure 39: Distance traveled during the trash cleanup at Pascal Poirier Park

Figure 40: Distance traveled during the trash cleanup at the bakery

Figure 41: Distance traveled during the trash cleanup at Ourson Park

8.3 Beach Sweep

In celebration of World's Oceans Day, a public beach sweep event is organized every year by the SBWA, in partnership with the Town of Shediac. This activity aims to combat marine litter, to raise awareness, and contribute to the protection and conservation of our marine environment in the Shediac Bay.

This year, the event was help on June 12 at the Shediac Bay Marina. A secondary location was co-organized with the citizens group in Pointe-du-Chêne. Trash bags, gloves, hand sanitizer were provided to the volunteers. Door prizes provided by Gestion H2O in the Baie de Caraquet were handed out as well as some donated gift cards from local businesses. We would like to thank the 29 volunteers who came to help clean our shoreline this year.

Figure 42 : SBWA Beach Sweep 2021

9 Education

9.1 Boater Awareness Program

The Shediac Bay Marina (Shediac Bay Yacht Club) received Blue Flag certification in 2019. The Blue Flag certification requires that marina's display information relating to local ecosystems and environmental elements. Environmental education and engagement activities are also encouraged.

The SBWA a privileged partner with the marina and helps coordinate environmental awareness activities. In 2019, an eelgrass interpretation panel was installed at the marina.

Boater education was expanded in 2020 through a partnership with the New Brunswick Invasive Species Council. This program aims to reduce the spread of undesirable aquatic species. Boat owners are informed to clean, empty and dry all boats, trailers, motors and equipment before changing water bodies. This practice helps prevent the introduction of invasive species such as green crab or invasive tunicates into New Brunswick bays. Two signs provided by the New Brunswick Invasive Species Council were installed at the Shediac Bay Yacht Club in the summer of 2020.

In 2021, this partnership was maintained by hosting the annual Beach Sweep event at the Shediac Bay Marina. This activity helps the marina reach their environmental and educational deliverables under the Blue Flag program.

Figure 43: Boater awareness signs installed at the Shediac Bay Yacht Club

9.2 Salt Marsh Educational Park in Pointe-du-Chêne

A partnership has been initiated between the Anglican Parish of Shediac, the Shediac Bay Watershed Association and Ducks Unlimited Canada to develop an educational park on a parcel of land in Pointe-du-Chêne. We envision coordinating a Wetland Center of Excellence (WCE) program at this site (https://www.ducks.ca/initiatives/wetland-centres-of-excellence/). The site is eligible and first steps are being undertaken to implement this program. Permission was granted by the Anglican Parish of Shediac to bring school groups to the wetland for educational presentations.

However, because of the COVID-19 pandemic, WCE program has been put on hold by the DUC. This project continued to be on hold in 2021, but we are hopeful to resume talks in the next year as conditions hopefully improve.

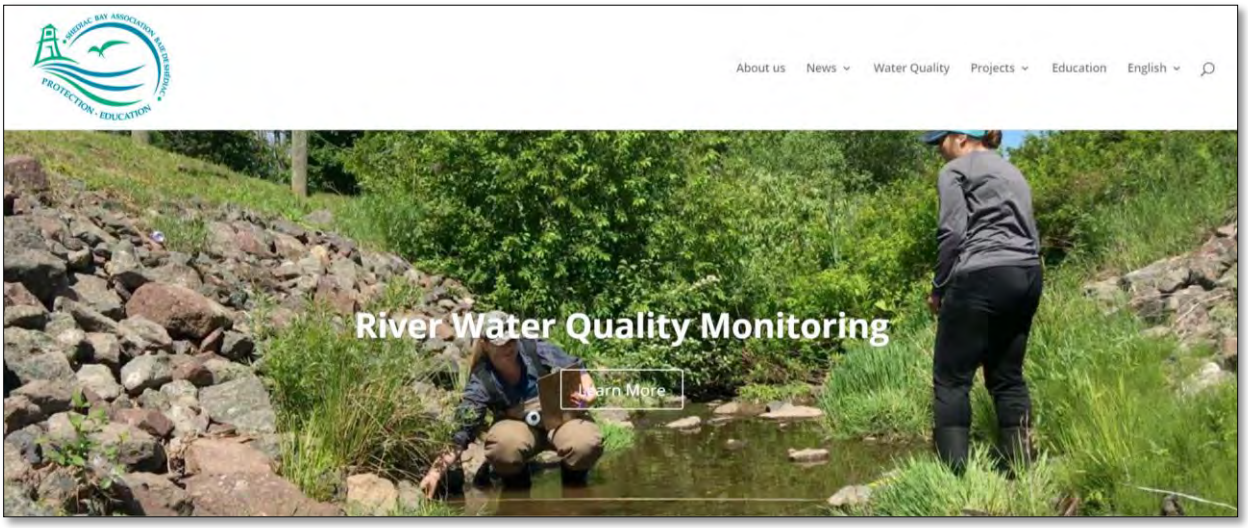
10 Media Outreach

10.1 Newsletter

During the 2021-2022 fiscal year, 3 bilingual newsletters were produced. Two have been released and the third will be published in early March. The newsletters display information and photos on the various projects that the SBWA has been doing in the year. The newsletter is now distributed electronically by email list and is available on our website and Facebook page.

10.2 Socials Medias and Website

The SBWA is working to keep its website and social media up to date, posting photos and short description of activities and projects. The SBWA now has a dedicated employee who focuses on outreach and communications, and the design and production of educational materials.



www.shediacbayassociation.org

www.facebook.com/#!/shediacbaywatershedassociation

https://www.instagram.com/bvshediacwatershed/?hl=en

https://www.youtube.com/channel/UCT1bsN08OyOeIzqqwn9ZhlQ

11 Closing Comments

The evaluation and stewardship of Shediac Bay program has terminated its sixth year. The aim of the program is to identify areas and ecosystems that can benefit from restoration activities and gather data on the health of the Shediac Bay.

The water quality monitoring this year has shown several instances of high bacterial counts and high nutrient loading in small agricultural streams. Land usage around these areas will continue to be evaluated for possible restoration or remediation projects. Landowners will be invited to participate in restoration efforts and stewardship programs to reforest the buffer zones of urbanized and agricultural streams.

When dealing with non-point source pollution in a watershed, one cannot be expected to solve the issues of human activities overnight. Problems related with stormwater runoff and faults in both private and municipal infrastructure can take several years and even decades to be detected and resolved. Collaborations between environmental groups, businesses, private citizens, homeowners and government are crucial in the development and implementation of an action plan. For example, the Shediac Bay Watershed Association has put in place a storm water management program to reduce runoff within the municipality of Shediac.

The eelgrass monitoring program was continued and will be used to assess the evolution of eelgrass beds in Shediac Bay. Sites that have been sampled over several years are already showing changes. However, several more years of sampling are required to see trends. Participation in the Southern Gulf of St. Lawrence Coalition/Ecology Action Centre's eelgrass working group will enable comparisons between different bays in New Brunswick, Nova Scotia and Prince Edward Island.

Green crab catches increased in numbers in the summer of 2021. Total catches were 393, up from165 in 2020. The maximum of 928 crabs caught was reached in 2016. The monitoring of eelgrass and green crabs will make it possible to establish the impact of the arrival of this invasive species in Shediac Bay. More details on the monitoring of green crabs are described in the report available on our website.

In the coming years, there will be sufficient data to establish conservation and restoration priorities. Meetings with the EAC eelgrass consortium and the Department of Fisheries and Oceans will determine if restoration activities are feasible and desirable. The SBWA wants the ecological integrity of Shediac Bay to be maintained in the face of invasive species and climate change.

A coastal restoration and protection committee was started with neighbouring environmental groups to help coordinate efforts along the coast of South Eastern New Brunswick. This group is involved in planning priorities for conservation of the coastal zone. More demonstration sites and education projects are proposed for 2022.

Unfortunately, the Wetland Center of Excellence program was postponed again due to the pandemic. We hope to engage the local community and schools in this program soon.

The Shediac Bay Watershed Association will continue the various educational campaigns around the health of the Shediac Bay. Stewardship activities with the public such as shoreline clean-ups and tree planting activities will resume as soon as public health regulations permit.

The partnerships with the local marinas will continue to promote best practices for boaters of Shediac Bay. Other partnerships such as the Beach Sweep with the Town of Shediac and Shediac Bay Marina will help increase awareness around the importance of a healthy environment. Educational materials will continue to be produced by the SBWA for all its projects.

The Shediac Bay Health Evaluation project has gathered a wide range of information since 2016. The project will continue to expand in the coming years with increasing partnerships. There is still more that can be done to advance our knowledge. As the project evolves, the Association will concentrate on more stewardship projects to help improve the environment around Shediac Bay.

Figure 44: Salt marsh in Grande-Digue

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Appendix A – WATER CHEMISTRY METHODOLOGY

Table 32: RPC Laboratory Analytical Methods

RPC LABORATORY ANALYTICAL METHODS				
Analyte	Parameter	RPC SOP Number	Method Reference	Method Principle
Ammonia	NH_3T	4.M47	APHA 4500-NH3 G	Phenate Colourimetry
pH	pH	4.M03	APHA 4500-H+ B	pH Electrode - Electrometric
Alkalinity (as CaCO3)	ALK_T	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	Cl	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	F	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	SO_4	4.M45	APHA 4500-SO4 E	Turbidimetry
Nitrate + Nitrite (as N)	NO_X	4.M48	APHA 4500-NO3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	NO_3	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Phosphorus - Total	TP-L	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Dissolved Organic	TOC	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	TURB	4.M06	APHA 2130 B	Nephelometry
Colour	CLRA	4.M55	APHA 2020 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	COND	4.M04	APHA 2510 B	Conductivity Meter, Pt Electrode
Trace Metals	—	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Table 33: RPC Laboratory Analytical Methods for *E. coli*

RPC LAB ANALYTICAL METHODS FOR *E. COLI*		
Method	ID	Max Detection Limit
Membrane Filtration	FSA-01	10000 MPN/100 mL
Colilert	FSA-10	2419.6 MPN/100 mL