



# **Field report: Marine biodiversity surveys at West Mabou Beach (June 2023)**

**Canadian Parks and Wilderness Society – Nova Scotia Chapter**

## **Land Acknowledgement**

West Mabou Beach Provincial Park is located within Mi'kma'ki, the traditional and unceded territory of the Mi'kmaw people.

A very special thanks to the West Mabou Beach Committee, and to the residents of the Mabou area, for their work to protect the lands and waters of West Mabou Beach Provincial Park.

CPAWS-NS would also like to acknowledge the work done by the Mabou Harbour Coastal Management Planning Committee over many years to document the species in the intertidal zone of this park.

**Cover Photo:** West Mabou Beach Provincial Park

**Report prepared by:** Madison Stewart, Hunter Stevens, Angelica Whiteway, Chris Miller

**Additional surveyors:** Teigan Labor, Reanne Harvey

Canadian Parks and Wilderness Society - Nova Scotia Chapter

P.O. Box 51086 Rockingham Ridge

Halifax, NS

B3M 4R8

## Executive Summary

The Nova Scotia Chapter of the Canadian Parks and Wilderness Society (CPAWS-NS) carried out underwater surveys in the marine environment adjacent to West Mabou Beach Provincial Park in June 2023. The purpose of this study was to observe and document ecosystems and species, as well as address data deficiencies in understanding marine biodiversity in the region. Previous ecological surveys undertaken at West Mabou Beach Provincial Park identified important biodiversity in the terrestrial environments of the provincial park, but the adjacent marine environment remains under-studied.

In total, eight marine surveys were undertaken by scientists from CPAWS-NS at six different locations. A total of 50 species were identified, including Atlantic eelgrass (*Zostera marina*), 11 species of algae, 27 species of invertebrates, and 12 species of fish. Rare species observed include Atlantic poacher, eight-strand jelly, and windowpane flounder, as well as the American eel. Predominant ecosystems include sandy-bottom high energy and low energy environments. Extensive eelgrass meadows and oyster beds were observed, predominately in the more sheltered waters within Mabou Harbour near the provincial park. Several locations have hard substrate, including cobbles and the breakwater. A nursery area was identified for Northern moon snail (*Euspira heros*) at one site, where many adult individuals and moon snail egg collars were observed. Return dives at 2 of the 6 sites resulted in new species being identified that were not observed on the initial dives, suggesting that a single survey is insufficient to capture the full spectrum of biodiversity at that location.

Future scientific work should involve returning to these 6 sites for additional surveys, particularly at different times of the year. Targeted surveys at the channel entrance to Mabou Harbour for fish passage, is recommended, as well as night-time surveys throughout the study area. The use of Baited Remote Underwater Video (BRUV) would likely result in new species identifications in deeper water environments than what was surveyed on this expedition. Outstanding conservation values observed in the nearshore environment at West Mabou Beach Provincial Park include high species diversity, extensive eelgrass meadows, oyster beds that are transitioning to oyster reefs, several rare and listed species-at-risk, and continuity of marine environments with an undeveloped terrestrial coastal landscape.

## Table of Contents

Introduction .....	5
Methods .....	6
Results .....	8
<i>Site A: Front of Mabou Beach</i> .....	10
<i>Site B: Outer Mabou Harbour Breakwater</i> .....	12
<i>Site C: Inner Mabou Harbour Breakwater</i> .....	16
<i>Site D: Mabou Sand Dune</i> .....	20
<i>Site E: Mabou Mudflats</i> .....	22
<i>Site F: The Spit</i> .....	24
Discussion.....	29
<i>Species Richness and Diversity</i> .....	29
<i>Rare and At-Risk Species</i> .....	30
<i>Nursery Area</i> .....	30
<i>Oyster Beds</i> .....	31
<i>Eelgrass Beds</i> .....	32
<i>Additional Observations</i> .....	33
Further Research.....	34
Conclusions .....	35
References .....	36
Appendix A: Species Abundance per Survey .....	38



## Introduction

West Mabou Beach Provincial Park is located on the west coast of Unama'ki (Cape Breton Island), at the mouth of Mabou Harbour (Figure 1). The area contains a diversity of ecosystem types, including beaches, dunes, dune forests, sinkholes, wetlands, cliffs, open fields, and coniferous forests. The provincial park is approximately 275 hectares in size and was officially designated under the *Provincial Parks Act* in 2001 (Nova Scotia Environment, 2013; Nova Scotia, 2008). West Mabou Beach Provincial Park is a popular location for outdoor recreation and contains a well-used system of trails and walking paths.

In 2018, the Nova Scotia Chapter of the Canadian Parks and Wilderness Society (CPAWS-NS) initiated a terrestrial field study at West Mabou Beach Provincial Park. This work identified 17 rare species, including four that are listed under the *Nova Scotia Endangered Species Act*. It also resulted in the discovery of a new species of plant in the Maritime provinces: the Upswept Moonwort (*Botrychium ascendens*) (Belliveau, 2018). Fieldwork at West Mabou Beach Provincial Park was undertaken by Alain Belliveau from Acadia University.

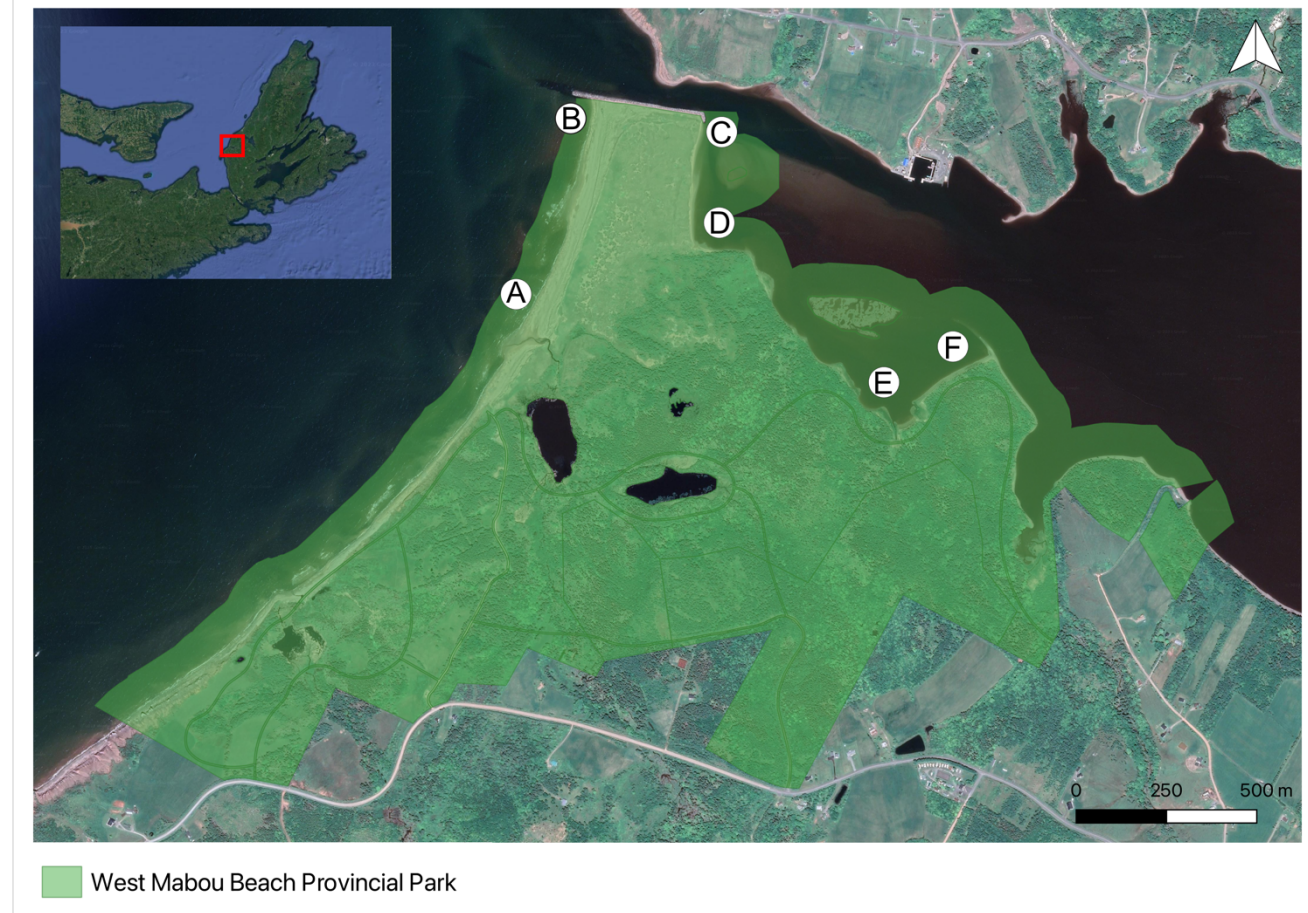
Despite the extensive coastline of West Mabou Beach Provincial Park, it appears that very little scientific research has occurred in the adjacent marine environment. For this reason, CPAWS-NS undertook extensive marine surveys near the park in June 2023 (Figure 1). The purpose of this study is to observe and document the marine ecosystems and species in the nearshore marine environment adjacent to West Mabou Beach Provincial Park. This field report summarizes our findings.



**Figure 1.** The CPAWS-NS team scoping out survey sites at West Mabou Beach.

## Methods

Marine snorkel surveys took place over five days in June 2023 at six different sites in the coastal waters at West Mabou Beach Provincial Park (Figure 2). Two sites were surveyed multiple times for a total of six surveys (Table 1). Sites were selected based on public access from the shore, daily weather and tidal conditions, proximity to points of interest, and diversity of shoreline types.



**Figure 2.** Map of survey sites. (A – Front of Mabou Beach; B – Outer Mabou Harbour Breakwater; C – Inner Mabou Harbour Breakwater; D – Mabou Sand Dune; E – Mabou Mudflats; F – The Spit).

**Table 1.** List of survey locations and dates.

SITE ID	SURVEY LOCATION	DATE(S)
A	Front of Mabou Beach	23-06-2023
B	Outer Mabou Harbour Breakwater	21-06-2023
C	Inner Mabou Harbour Breakwater	20-06-2023, 24-06-2023
D	Mabou Sand Dune	21-06-2023
E	Mabou Mudflats	20-06-2023
F	The Spit	22-06-2023, 24-06-2023

The freedivers who undertook this fieldwork are Hunter Stevens, Reanne Harvey, Madison Stewart, Angelica Whiteway, and Teigan Labor. For each survey, divers entered the water and used the Roving Diver Technique (REEF, n.d., Schmitt, et al., 2022), where divers swam freely and recorded on underwater slates all species and their abundance using the following categories: Single (S) – 1; Few (F) – 1 to 10; Many (M) – 11 to 99; Abundant (A) – 100<. Divers identified organisms to the species level when possible and took photographs of any unknown organisms to be identified later (Figure 3). The cameras used were Olympus TG-6s with a PT-059 underwater housing, GoPro Hero 8, and Sony a6600 with a Sony E 4/10-18 mm OSS lens and Ikelite 200DL underwater housing. At all times that divers were in the water, at least one team member remained on land to provide shore support. Survey duration ranged from 30 to 75 minutes, and the tidal height varied for each survey, but the maximum depth of the surveys did not exceed 5m.



**Figure 3.** A diver photographing a lion’s mane jellyfish using an Olympus TG-6 (no housing). An underwater wrist slate for recording species abundance is also visible.



## Results

The list of species recorded in West Mabou Beach Provincial Park across eight surveys at six sites is summarized in Table 2. In total, 50 unique species were recorded. The greatest number of recorded species was from sites F and C, which were surveyed twice compared to the other sites. This suggests that a single survey at any one site is insufficient to capture the full range of biodiversity that occurs there. Return dives are needed to document the full list of species, so our results may represent an underestimate of the species that occurs here. The site with the fewest number of recorded species was site A. See Appendix A for the full lists of species abundance from each survey.

**Table 2.** List of all species recorded during snorkel surveys, including presence-absence data for each site (black boxes indicate the presence of a species at a given site). \*Data for sites C and F are combined from 2 surveys each, whereas all other sites use data from one survey.

SPECIES		SITE						# SITES OBSERVED
Scientific name	Common name	A	B	C*	D	E	F*	
<b>FISH</b>								
<i>Anguilla rostrata</i>	American eel						■	1
<i>Gasterosteus aculeatus</i>	Threespine stickleback						■	1
<i>Leptagonus decagonus</i>	Atlantic poacher					■		1
<i>Menidia menidia</i>	Atlantic silverside						■	1
<i>Morone saxatilis</i>	Striped bass		■					1
<i>Myoxocephalus scorpius</i>	Shorthorn sculpin		■				■	1
<i>Osmerus mordax</i>	Rainbow smelt				■		■	2
<i>Pseudopleuronectes americanus</i>	Winter flounder	■	■	■	■	■	■	6
<i>Scophthalmus aquosus</i>	Windowpane flounder						■	1
<i>Syngnathus fuscus</i>	Northern pipefish				■			2
<i>Tautoglabrus adspersus</i>	Cunner			■			■	2
<b>INVERTEBRATES</b>								
<i>Argopecten irradians</i>	Bay scallop			■	■	■	■	4
<i>Aurelia aurita</i>	Moon jelly			■			■	1
<i>Cancer borealis</i>	Jonah crab			■				1
<i>Cancer irroratus</i>	Atlantic rock crab	■	■	■	■		■	5
<i>Carcinus maenas</i>	European green crab	■		■				4
<i>Crangon septemspinosa</i>	Sand shrimp	■	■	■	■	■	■	6
<i>Crassostrea virginica</i>	Eastern oyster			■				4
<i>Crepidula fornicata</i>	Common Atlantic slipper snail			■		■		3
<i>Cyanea sp.</i>	Lion's mane jellyfish	■	■	■	■		■	5
<i>Electra pilosa</i>	Thorny sea mat			■				1
<i>Ensis leei</i>	Atlantic jackknife clam			■	■		■	3

<i>Euspira heros</i>	Northern moon snail							4
<i>Homarus americanus</i>	American lobster							2
<i>Ilyanassa obsoleta</i>	Eastern mudsnail							3
<i>Littorina littorea</i>	Common periwinkle							3
<i>Littorina saxatilis</i>	Rough periwinkle							5
<i>Melicertum octocostatum</i>	Eight strand jelly							1
<i>Metridium senile</i>	Clonal plumose anemone							1
<i>Mya arenaria</i>	Soft-shell clam							3
<i>Mytilus edulis</i>	Blue mussel							4
<i>Obelia geniculata</i>	Sea fur							1
<i>Pagurus acadianus</i>	Acadian hermit crab							4
<i>Pagurus longicarpus</i>	Long-armed hermit crab							2
<i>Palaemon adspersus</i>	Baltic Prawn							4
<i>Pleurobrachia pileus</i>	Sea gooseberry							2
<i>Semibalanus balanoides</i>	Common rock barnacle							3
<i>Testudinalia testudinalis</i>	Common tortoise limpet							1
<b>ALGAE</b>								
<i>Ascophyllum nodosum</i>	Knotted wrack							3
<i>Chondrus crispus</i>	Irish moss							5
<i>Chorda filum</i>	Sea lace/Dead man's rope							5
<i>Fucus distichus</i>	Rockweed							1
<i>Fucus serratus</i>	Toothed wrack							5
<i>Fucus spiralis</i>	Spiral wrack							1
<i>Fucus vesiculosus</i>	Bladder wrack							3
<i>Furcellaria lumbricalis</i>	Clawed fork weed							2
<i>Saccharina latissima</i>	Sugar kelp							1
<i>Ulva intestinalis</i>	Gut weed							3
<i>Ulva lactuca</i>	Sea lettuce							4
<b>OTHER</b>								
<i>Zostera marina</i>	Atlantic eelgrass							3
<b>TOTAL # OF SPECIES PER SITE</b>		<b>9</b>	<b>21</b>	<b>30</b>	<b>21</b>	<b>14</b>	<b>39</b>	

*Site A: Front of Mabou Beach*

As this site was directly off the main Mabou Beach (Figure 4), it was characterized by a mostly high-energy sandy bottom. Due to the exposure of this site, the dive team waited for conditions with little wave action to be able to survey properly and safely. The most common organisms found were lion's mane jellyfish (*Cyanea* sp., Figure 5) and winter flounder (*Pseudopleuronectes americanus*; Figure 6). Some American lobster (*Homarus americanus*; Figure 7) and Acadian hermit crab (*Pagurus acadianus*) were also recorded at this site. No species were found in abundance at this site during our survey.



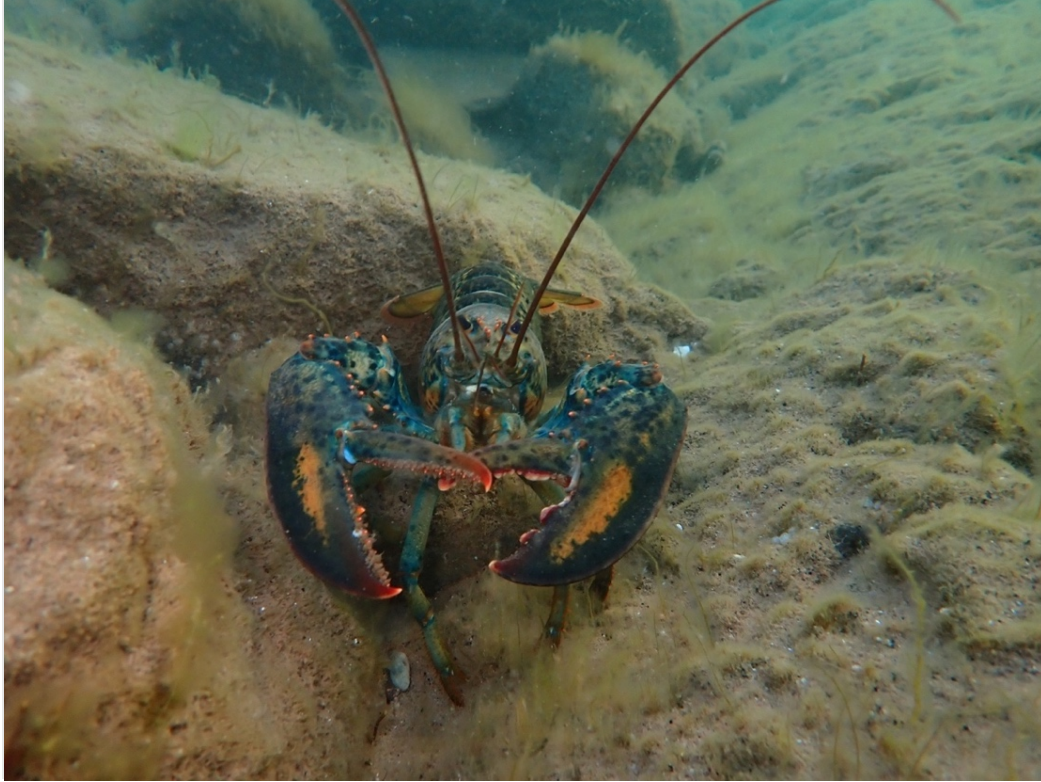
**Figure 4.** Aerial view of Mabou's front beach.



**Figure 5.** Freedivers photographing lion's mane jellyfish (*Cyanea* sp.).



**Figure 6.** Winter flounder (*Pseudopleuronectes americanus*).



**Figure 7.** American lobster (*Homarus americanus*).

*Site B: Outer Mabou Harbour Breakwater*

This site features a sandy bottom along the beach and large boulders forming the breakwater at the entrance of the harbour (Figure 8). Due to its exposure and the timing of the survey in relation to the tides, this site was subject to higher wave action as well as a strong current pulling towards the channel of the harbour. On the boulders of the breakwater, sessile invertebrates, including blue mussel (*Mytilus edulis*) and acorn barnacle (*Semibalanus balanoides*), were found encrusting here in abundance (Figure 9). Sea lettuce (*Ulva lactuca*; Figure 10) and gut weed (*Ulva intestinalis*; Figure 11) were found in large amounts at this site, specifically on and around the boulders of the breakwater. Various other macroalgae species occurred at this site, including toothed wrack (*Fucus serratus*; Figure 12), bladder wrack (*Fucus vesiculosus*), Irish moss (*Chondrus crispus*), clawed fork weed (*Furcellaria lumbricalis*), and sea lace (*Chorda filum*). Freedivers found small caverns between and under the large breakwater boulders, and recorded species such as winter flounder (*Pseudopleuronectes americanus*), American lobster (*Homarus americanus*), and a small colony of plumose anemones (*Metridium senile*; Figure 13). A school of approximately 15-20 striped bass (*Morone saxatilis*) was observed at the edge of the harbour entrance. At this site, freedivers observed an uncommon hydrozoan medusa identified as *Melicertum octocostatum* (Figure 14).



**Figure 8.** Aerial view of the Outer Mabou Harbour Breakwater.



**Figure 9.** Barnacles (*Semibalanus balanoides*) completely covering a boulder.



**Figure 10.** Sea lettuce (*Ulva lactuca*).



**Figure 11.** Gut weed (*Ulva intestinalis*).



**Figure 12.** Toothed wrack (*Fucus serratus*).



**Figure 13.** Clonal plumose anemone (*Metridium senile*) with tentacles withdrawn. Another smaller anemone with its tentacles open is also present.





**Figure 14.** Eight strand jelly (*Melicertum octocostatum*).

*Site C: Inner Mabou Harbour Breakwater*

This site was located on the back side of the beach barrier near the breakwater, in the Inner Mabou Harbour (Figure 15) and is characterized by a sandy bottom that drops off quickly towards the entrance of the harbour (Figure 16). Freedivers observed a variety of mollusk species including bivalves such as the American oyster (*Crassostrea virginica*), blue mussel (*Mytilus edulis*), and gastropods such as moon snail (*Euspira heros*), common periwinkle (*Littorina littorea*; Figure 17), and Atlantic slipper snail (*Crepidula fornicata*). Freedivers also observed several crustacean species including sand shrimp (*Crangon septemspinosus*), rock crab (*Cancer irroratus*; Figure 18) and Acadian hermit crab (*Pagurus acadianus*). Other invertebrates included several lion's mane jellyfish (*Cyanea* sp.) and sea gooseberries (*Pleurobrachia pileus*; Figure 19). The primary fish species observed at this site were winter flounder (*Pseudopleuronectes americanus*) and cunner (*Tautoglabrus adspersus*). Winter flounder were very abundant at this site and different age classes were observed. Algal species observed included *Ulva lactuca*, Irish moss (*Chondrus crispus*), and various fucoids (*Fucus* spp.). A large eelgrass bed (*Zostera marina*) runs parallel to the barrier beach approximately 30 meters from shore. Green crabs were observed at this location eating a deceased winter flounder (Figure 20).



**Figure 15.** Aerial view of the Inner Mabou Harbour, with the deep channel and eelgrass bed visible.



**Figure 16.** Freedivers surveying along the breakwater of the inner harbour.



**Figure 17.** Common periwinkle snail (*Littorina littorea*), including a very small individual on the tip of the larger snail's shell.



**Figure 18.** Atlantic rock crab (*Cancer irroratus*).



**Figure 19.** Sea gooseberry, a type of comb jelly (*Pleurobrachia pileus*).



**Figure 20.** Green crab (*Carcinus maenas*) feeding on a deceased flounder.

*Site D: Mabou Sand Dune*

This site is in the back cove behind the sand dunes of Mabou Beach and is characterized by a low energy, sandy and silty bottom (Figure 21). Across the site, Eastern oyster (*Crassostrea virginica*) was observed in abundance, forming dense beds. Freedivers observed other mollusks, such as common Atlantic slipper snail (*Crepidula fornicata*), soft-shell clam (*Mya arenaria*), rough periwinkle (*Littorina saxatilis*), and Eastern mudsnail (*Ilyanassa obsoleta*). Other common invertebrates at this site include sand shrimp (*Crangon septemspinosa*) and European green crab (*Carcinus maenas*). Winter flounder (*Pseudopleuronectes americanus*) was the most common fish species recorded at this site. One individual of Northern pipefish (*Syngnathus fuscus*; Figure 22) and rainbow smelt (*Osmerus mordax*) were observed as well. The site also had patches of macroalgae, predominately Irish moss (*Chondrus crispus*) and knotted wrack (*Ascophyllum nodosum*). Notably, there was a dense bed of eelgrass (*Zostera marina*) in the deeper areas of the site (Figure 23).



**Figure 21.** Aerial view of the back cove behind the Mabou Beach sand dune, with an eelgrass bed visible.



**Figure 22.** Northern pipefish (*Syngnathus fuscus*).



**Figure 23.** Eelgrass bed (*Zostera marina*).

### *Site E: Mabou Mudflats*

This site is located inside Mabou Harbour on the shore opposite Mabou Lighthouse, and is characterized by shallow, muddy bottom (Figure 24). The land around this site is mostly tidal salt marsh ecosystems and includes an intertidal island offshore that is exposed during low tide. No differences in habitat or species composition were observed between the island and the rest of the site. The most abundant animal at this site was Eastern mudsnail (*Ilyanassa obsoleta*), which fed on detached blades of eelgrass and decaying macroalgae deposited by tidal action. Freedivers observed Eastern oyster (*Crassostrea virginica*) in abundance, along with other bivalves including Atlantic bay scallop (*Argopectens irradians*; Figure 25) and razor clam (*Ensis leei*). Many moon snails (*Euspira heros*; Figure 26) and their egg collars were observed at this site. Winter flounder (*Pseudopleuronectes americanus*) of different age classes were seen frequently. Notably, a small Atlantic poacher (*Leptagonus decagonus*) was observed swimming (Figure 27), which is suspected to be a juvenile individual.



**Figure 24.** Aerial view of the survey area Mabou Mudflats, including the intertidal island.



**Figure 25.** Bay scallop (*Argopecten irradians*) with eyes clearly visible.



**Figure 26.** Northern moon snail (*Euspira heros*).





**Figure 27.** Atlantic poacher (*Leptagonus decagonus*).

#### *Site F: The Spit*

Two surveys were conducted at this site, which is furthest away from the mouth of Mabou Harbour and contains a shallow spit of land that is exposed during low tide (Figure 28). Nearer to shore and west of the spit, the site is characterized by shallow and muddy bottom with small patches of macroalgae (*Fucus* spp., *Ascophyllum nodosum*, *Chondrus crispus*, and *Chorda filum*). Most of this site was covered in dense oyster beds (*Crassostrea virginica*), which appear to be in the process of forming an early-stage oyster reef, as individuals were beginning to grow upon older oysters (Figure 29). Further from land and on the east side of the spit, there were dense eelgrass beds (*Zostera marina*) and sea lace (*Chorda filum*) (Figure 30). Moon jellyfish (*Aurelia* sp.; Figure 31) and lion's mane jellyfish (*Cyanea* sp.) were seen moving on tidal currents in and out of the harbour. The expansive bed of eelgrass provided habitat for some uncommon fish species, including American eel (*Anguilla rostrata*; Figure 32), windowpane flounder (*Scophthalmus aquosus*; Figure 33), Northern pipefish (*Syngnathus fuscus*), smelt (*Osmerus mordax*), and Atlantic silverside (*Menidia menidia*; Figure 34). A small shorthorn sculpin (*Myoxocephalus scorpius*; Figure 35) was also observed.



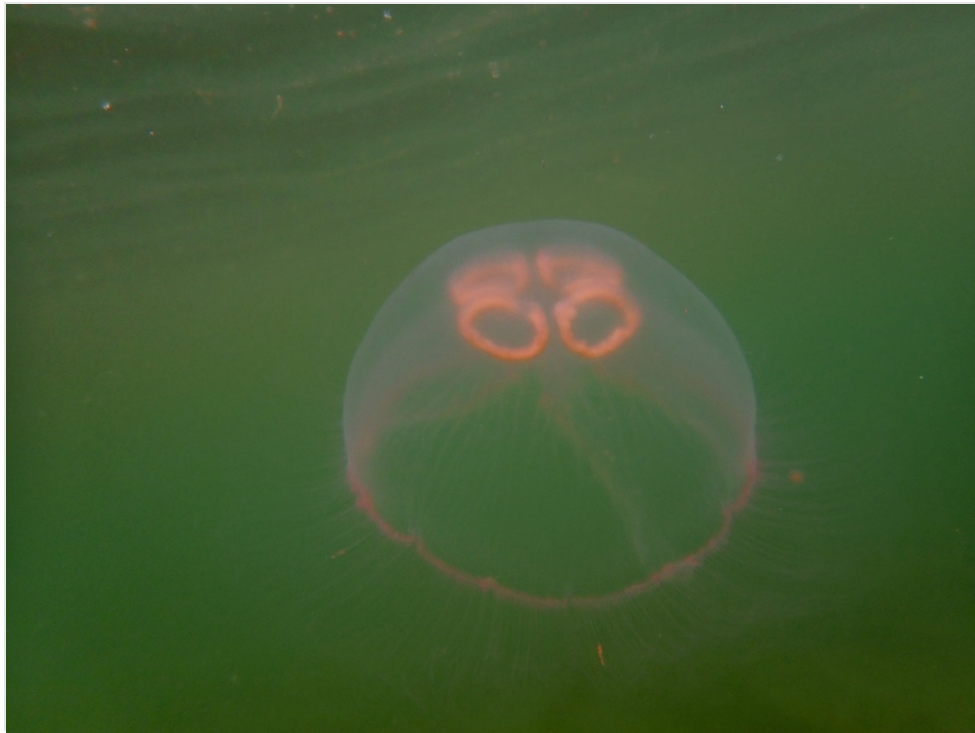
**Figure 28.** Aerial view of the survey area near the Spit.



**Figure 29.** a) Oyster beds with common periwinkles; b) Large oyster (*Crassostrea virginica*).



**Figure 30.** Extensive eelgrass bed (*Zostera marina*) and sea lace (*Chorda filum*).



**Figure 31.** Moon jellyfish (*Aurelia aurita*).



**Figure 32.** American eel (*Anguilla rostrata*) poking its head out in an eelgrass bed.



**Figure 33.** Windowpane flounder (*Scophthalmus aquosus*).



**Figure 34.** Atlantic silverside (*Menidia menidia*).



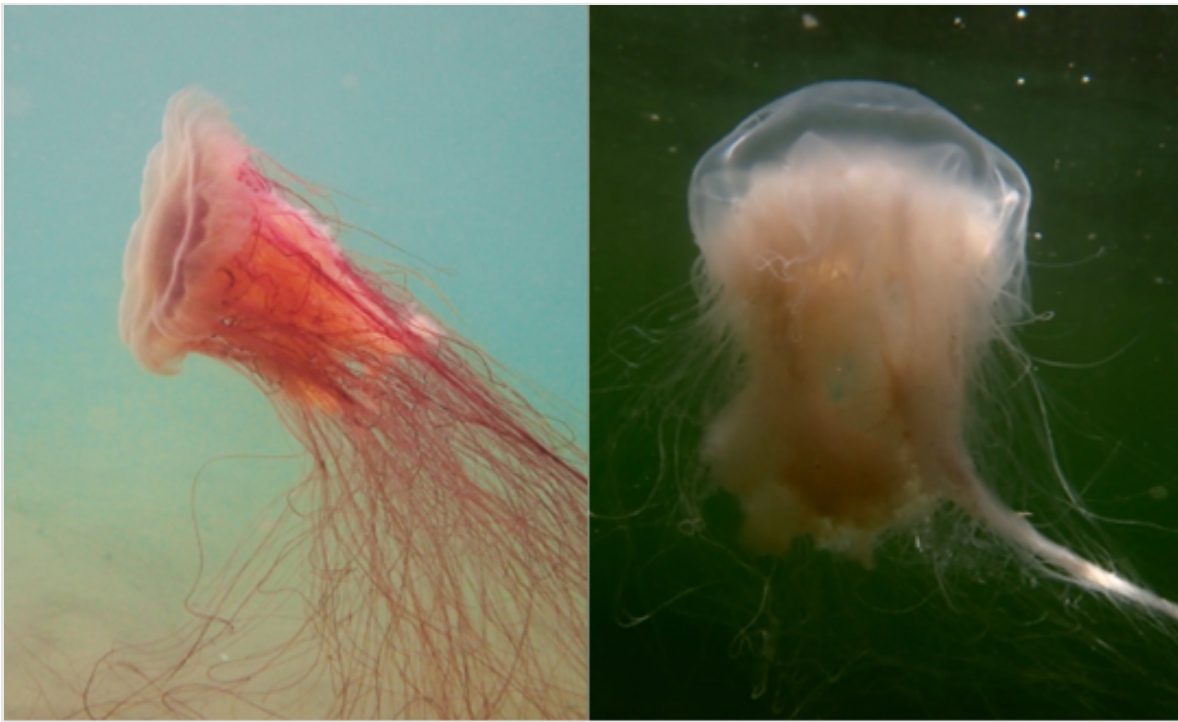
**Figure 35.** Shorthorn sculpin (*Myoxocephalus scorpius*).

## Discussion

### *Species Richness and Diversity*

The snorkel surveys conducted near West Mabou Beach Provincial Park documented the rich biodiversity of marine species and habitat types that occur here. Sandy substrates were found in more exposed sites, such as sites A and B on the front side of the beach, while sites C and D in the less exposed back cove area of the Mabou sand dunes contained sands and silts. Further into Mabou Harbour, sites E and F had muddy substrates and were more of estuarine habitats. Additional variation in sites included large underwater boulders found at sites B and C, eelgrass beds found at sites C, D, and F, and oyster beds found at sites D, E, and F.

Of the 50 species observed in the park, the most common species that were found at all six survey sites were sand shrimp (*Crangon septemspinosa*) and winter flounder (*Pseudopleuronectes americanus*) (Table 2). The next most common species, which were found at five survey sites, were Atlantic rock crab (*Cancer irroratus*), Irish moss (*Chondrus crispus*), sea lace (*Chorda filum*), lion's mane jellyfish (*Cyanea* sp.), toothed wrack (*Fucus serratus*), and rough periwinkle (*Littorina saxatilis*). Our surveys also noted variation between individuals of the same species, as divers recorded two lion's mane jellyfish (*Cyanea* sp.) with different colour morphologies (Figure 36).



**Figure 36.** Lion's mane jellyfish exhibiting different colour morphologies.

Previous intertidal work using seine nets, as part of the Community Aquatic Monitoring Program (CAMP) through the Department of Fisheries and Oceans Canada (DFO), was conducted in Mabou Harbour by the community group, Mabou Beach Coastal Management Planning Committee. The results of this work indicated that Mabou Harbour contained the highest species richness of all 15 program sites across Nova

Scotia, New Brunswick, and Prince Edward Island (Weldon et al., 2005). By comparing these results to those from our snorkel surveys, of which there is almost 20 years between them, we see a continued trend of high biodiversity in this park. Long-term monitoring of this area would help to provide evidence of species richness and trends over many more decades and solidify the importance of protection for this special park.

### *Rare and At-Risk Species*

Freedivers observed a total of 50 species across six sites, which included single observations of rarely seen species, including Atlantic poacher, eight-strand jelly, and windowpane flounder, as well as the American eel, an S3 listed species and a Threatened species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2012). The presence of these rare or at-risk species demonstrates the importance of this survey location for organisms for which there is limited scientific knowledge and/or a need for conservation measures. Some species are data deficient and assessments of their status in Canada are not possible at this time. For example, the Atlantic poacher is almost exclusively acknowledged in taxonomic surveys and infrequently observed in the wild, so many aspects of its behaviour and abundance in Canada are unknown. This demonstrates the importance of our *in-situ* surveys, which allow us to observe a diversity of species in their natural environments rather than from catch data used in other research methods.

Another at-risk species with a known presence at West Mabou Beach, although not observed in our surveys, is the Atlantic salmon (*Salmo salar*). The salmon in this area are part of the Gaspé-Southern Gulf of St. Lawrence population, which is an S1 listed population and listed by COSEWIC as Special Concern (COSEWIC, 2010). These anadromous fish migrate through the Mabou River, which runs westward from the inner island of Cape Breton and out to the Gulf of St. Lawrence through the Mabou Harbour. Salmon in this area move past the park in the fall starting in September (Claytor, 1996), thus our surveys would need to be appropriately timed to capture this migration. As discussed in the Further Research section below, conducting our snorkel surveys in different seasons of the year may help to further document the species that use this park.

### *Nursery Area*

Various life stages were observed in the shallow coastal areas, suggesting that West Mabou Beach Provincial Park provides important nursery grounds for organisms and can support them across their life cycles. This was primarily observed for the Northern moon snail (*Euspira heros*), where adult snails and egg cases were found in high numbers, especially at the muddy and sheltered spit of site F (Figure 37). Moon snails are major predators in the intertidal and coastal zone (Beal, 2006; Weissberger and Grassle, 2003), and are found to predate on a wide breadth of prey organisms, including species found in our surveys, such as soft-shell clam, blue mussel, Eastern mudsnail, Atlantic slippersnail, and common periwinkle (Clements et al., 2013). As moon snails play an important ecological role by influencing the populations and distribution of their prey species (Beal, 2006; Commito, 1982; Weissberger and Grassle, 2003), it is an important finding that the estuarine zone of West Mabou Beach Provincial Park is used as a nursery ground for these mollusks and other organisms.



**Figure 37.** Moon snail egg collar.

### *Oyster Beds*

The team observed dense oyster beds (Figure 29a), especially at the sites inside Mabou Harbour. The oyster beds in the study area exhibit traits that suggest they are transitioning to oyster reefs, with species of invertebrates, mollusks, and fish living on and around the oysters. This primarily included periwinkle snails, slippersnails, sand and baltic shrimp, and barnacles.

Oyster beds play an important role in coastal habitats and are known as “ecosystem engineers” due to their ability to form three-dimensional reefs that provide refuge for other organisms (Lenihan and Peterson, 1998; Posey et al., 1999). The role that oysters play in providing habitat, food, and nursery grounds for other organisms has been found to be beneficial to commercially important species, such as herring, anchovy, and hake (Coen et al., 1999). Oyster beds and reefs have also been shown to stabilize sediment and buffer wave action, thereby protecting the shore from erosion (Meyer et al., 1997; Salvador de Paiva et al., 2018). In West Mabou Beach, the wave-buffering capacity of oysters may play a crucial role in protecting the sensitive salt marsh and sand dune habitats found in the park.

The water filtration capacity of oysters can influence the levels of phytoplankton, nutrients, and sediment in the water column, thus playing an important role in the water quality of the ecosystem (Grabowski and Peterson, 2007). Previous studies have used oysters and other filter-feeding bivalves as bioindicators for water quality and potential contaminants (Fertig et al., 2009). It is important to note that commercial oyster harvesting takes place in Mabou Harbour (Inverness-Victoria Federation of Agriculture, 2018), and the presence of oysters found in our surveys could be a direct or indirect result of this operation.



### *Eelgrass Beds*

Eelgrass (*Zostera marina*) was found at multiple sites during our surveys, with the most abundant eelgrass being found at the Spit (site F; Figure 38). Eelgrass beds play an important role in ecosystem processes, including providing habitat and nursery grounds for a variety of organisms, sequestering carbon, stabilizing the substrate, and dissipating wave action to protect shorelines from erosion (NOAA, 2014). Eelgrass beds are sensitive to anthropogenic disturbance, and studies have shown that the loss or fragmentation of eelgrass beds can influence the species composition and biodiversity of the area (Reed and Hovel, 2006). The abundance and health of eelgrass across the surveyed areas of West Mabou Beach Provincial Park attests to the importance of protection at this site for supporting a range of marine life.



**Figure 38.** A diver surveying over a bed of eelgrass at the Spit (site F).

In Nova Scotia, eelgrass faced a mass die-off in the early 1900's due to wasting disease caused by a slime mold, *Labyrinthula zosterae*, which nearly wiped-out eelgrass populations across the Eastern Seaboard (Muehlstein, 1989). Although eelgrass has managed a slight recovery, the species is still at risk of wasting disease today. Other factors that impact the recovery and growth of eelgrass are pollution, climate change, and coastal development (Lefcheck et al., 2017). In addition, eelgrass beds are facing threats from the invasive European green crab (*Carcinus maenas*), whose high population abundance and voracity for eating eelgrass has also contributed to reduced abundance of this marine plant species.

In recent years, research on eelgrass conservation, monitoring, and restoration has increased, with the goal of preventing further loss of this ecologically important habitat. Collaborative efforts, such as that of the Community Eelgrass Restoration Initiative (CERI) out of Dalhousie University and the Conservancy of Mainland Mi'kmaq, aim to research the resiliency of certain eelgrass populations to climate change. Results

from our study at West Mabou Beach may guide the efforts of this eelgrass initiative and help identify potential sites for use in their study.

### *Additional Observations*

Another important habitat noted during our time in West Mabou was extensive salt marshes (Figure 39), although we did not survey them in detail. The salt marshes were primarily present in the intertidal area of the inner harbour, and especially at the Mabou Mudflats (site E) and the Spit (site F). The presence of salt marshes in close proximity to eelgrass beds and oyster beds, two other important habitat types, provides a trifecta of potential nursery grounds and food sources for species found in this area, including land animals and birds.



**Figure 39.** Salt marsh along the shore of West Mabou Provincial Park.

One of West Mabou Beach's most unique features is the large sand dune that separates the long sand beach on the Gulf of St Lawrence side from the inner Mabou Harbour. West Mabou Beach is designated as critical habitat for endangered bird species, such as piping plover, who depend on the sand dunes for nesting (Birds Canada, 2022). Although not part of our underwater surveys, the sand dune and the species inhabiting it are part of the larger ecosystem and contribute to, as well as rely on, the other surrounding habitats found in the park.

During our surveys, the team witnessed two accounts of scavenging behaviour, namely, green crabs feeding on a deceased winter flounder (Figure 20) and sand shrimp feeding on a deceased lion's mane jellyfish (Figure 40). This further highlights the advantages of our survey methods, as it allows observation of species interactions that would not otherwise be possible with many other survey methods.



**Figure 40.** Sand shrimp (*Crangon septemspinosa*) feeding on a deceased lion's mane jellyfish (*Cyanea* sp.).

## Further Research

Continued monitoring of the area through snorkeling surveys would provide additional biodiversity data and fill knowledge gaps. It would be especially useful to return to the same survey sites multiple times per year to document seasonal changes in the species composition and environment. Surveys conducted at new sites further into the Mabou Harbour (i.e. more estuarine or freshwater) could provide details about the range of species that could frequent the area over varying tidal levels and seasons. Conducting surveys and collecting footage of important species that move past the park, such as Atlantic salmon, could provide additional evidence about the use of this ecosystem and its importance to these sensitive species. In the case of the Atlantic salmon, surveys would need to be timed for their seasonal migration up the Mabou River in the fall. Establishing long-term monitoring of this area could help understand trends in species composition and ecosystem health, as well as provide important insights into potential drivers of these trends, such as through periods of increased coastal development or from severe storm impacts.

Future field expeditions could also incorporate night surveys to capture a greater range of species activities, such as nocturnal predation. The use of drop cameras could provide additional data of species and their distributions by removing disturbance from divers, as well as the potential to use the camera in deeper waters where snorkeling is not feasible. In particular, drop cameras could be utilized to document species

passage through the deep channel connecting Mabou Harbour to the Gulf (between sites B and C). This channel has a lot of boat traffic in and out of the harbour, thus snorkel surveys would not be safe to conduct here. The addition of Baited Remote Underwater Video (BRUVs) could provide an opportunity to draw out and observe more cryptic species that would otherwise not be observed in our snorkel surveys.

## **Conclusions**

- The waters adjacent to West Mabou Beach Provincial Park contain rich biological communities, including oyster beds that are transitioning to oyster reefs, as well as extensive eelgrass beds.
- Overall species richness and diversity at West Mabou Beach is high. A total of 50 species were observed during the surveys.
- Rare species identified include Atlantic poacher, windowpane flounder, eight strand jelly, and American eel.
- The most common species observed were winter flounder, sand shrimp, Atlantic rock crab, toothed wrack, lion's mane jellyfish, Irish moss, sea lace, and rough periwinkle.
- The continuity of ecosystems between the marine and terrestrial landscapes is significant. Many rare ecosystems occur within, and in close proximity to, West Mabou Beach Provincial Park.

## References

- Beal, B.F. (2006). Biotic and abiotic factors influencing growth and survival of wild and cultured individuals of the softshell clam (*Mya arenaria* L.) in eastern Maine *Journal of Shellfish Research*, 25(2), 461–474.
- Belliveau, A. (2018). Biological inventory of the West Mabou Beach Provincial Park; pp 20.
- Birds Canada. (2022, December 15). ‘*Golf course at West Mabou Beach Provincial Park in Nova Scotia would harm endangered piping plovers.*’ <https://www.birdscanada.org/wmb>
- Claytor, R.R. (1996). Weekly fish counts from in-river traps, counting fences, barrier pools, and fishways in southern Gulf of St. Lawrence rivers, from 1952 -1993. *Canadian Data Report of Fisheries and Aquatic Science*, 982.
- Clements, J.C., Ellsworth-Power, M., and Rawlings, T. (2013). Diet breadth of the Northern moon snail (*Lunatia heros*) on the Northwestern Atlantic coast (Naticidae). *American Malacological Bulletin*, 31(2), 331-336.
- Coen, L.D., Luckenbach, M.W., and Breitburg, D.L. (1999). The role of oyster reefs as essential fish habitat: A review of current knowledge and some new perspectives. *American Fisheries Society Symposium*, 22, 438–454.
- Commito, J.A. (1982). Effects of *Lunatia heros* predation on the population dynamics of *Mya arenaria* and *Macoma baithica* in Maine, USA. *Marine Biology*, 69, 187-193.
- COSEWIC. (2012). COSEWIC assessment and status report on the American eel *Anguilla rostrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 109 pp.
- COSEWIC. (2010). COSEWIC assessment and status report on the Atlantic Salmon *Salmo salar* (Nunavik population, [...] Gaspé-Southern Gulf of St. Lawrence population, Eastern Cape Breton population, Nova Scotia Southern Upland population, Inner Bay of Fundy population, Outer Bay of Fundy population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xlvii + 136 pp.
- Fertig, B., Carruthers, T.J.B., Dennison, W.C., Jones, A.B., Pantus, F., and Longstaff, B. (2009). Oyster and macroalgae bioindicators detect elevated  $\delta^{15}\text{N}$  in Maryland’s coastal bays. *Estuaries and Coasts*, 32, 773–786.
- Inverness-Victoria Federation of Agriculture (2018). Water Resources Program Report: Mabou Harbour Watershed. Retrieved from [https://nsfa-fane.ca/wp-content/uploads/2018/03/004\\_Water-Resources-Final-Report-Mabou-Harbour-Watershed.pdf](https://nsfa-fane.ca/wp-content/uploads/2018/03/004_Water-Resources-Final-Report-Mabou-Harbour-Watershed.pdf)
- Grabowski, J.H. and Peterson, C.H. (2007). ‘Restoring oyster reefs to recover ecosystem services’ in *Ecosystem Engineers: Plants to Protists*. Oxford, UK: Elsevier, pp 281-298.
- Lefcheck, J.S., Wilcox, D.J., Murphy, R.R., Marion, S.R., Orth, R.J. (2017). Multiple stressors threaten the imperiled coastal foundation species eelgrass (*Zostera marina*) in Chesapeake Bay, USA. *Global Change Biology*, 23(9), 3474-3483.

- Lenihan, H.S. and Peterson, C.H. (1998). How habitat degradation through fishery disturbance enhances impacts of hypoxia on oyster reefs. *Ecological Applications*, 8(1), 128-140.
- Meyer D.L., Townsend E.C., Thayer G.W. (1997). Stabilization and erosion control value of oyster cultch for intertidal marsh. *Restoration Ecology*, 5(1), 93–99.
- Muehlstein, L.K. (1989). Perspectives on the wasting disease of eelgrass *Zostera marina*. *Diseases of Aquatic Ecosystems*, 7, 211-221.
- National Oceanic and Atmospheric Administration, NOAA (2014). The Importance of Eelgrass. Retrieved from <https://www.fisheries.noaa.gov/feature-story/importance-eelgrass>
- Nova Scotia Environment (2013). Our Parks and Protected Areas: A Plan for Nova Scotia. Retrieved from <https://novascotia.ca/parksandprotectedareas/pdf/Parks-Protected-Plan.pdf>
- Nova Scotia (2008). West Mabou Beach Provincial Park Designation. N.S. Reg. 276/2008. Retrieved from <https://novascotia.ca/just/regulations/regs/ppkwestmabou.htm>.
- Posey, M.H., Alphin, T.D., Powell, C.M., and Townsend, E. (1999). 'Use of Oyster Reefs as Habitat for Epibenthic Fish and Decapods' in *Oyster Reef Habitat Restoration: a synopsis and synthesis of approaches; Proceedings from the symposium, Williamsburg, Virginia, April 1995*. Gloucester Point, USA: Virginia Institute of Marine Science, pp 229-237.
- Reed, B.J. and Hovel, K.A. (2006). Seagrass habitat disturbance: how loss and fragmentation of eelgrass *Zostera marina* influences epifaunal abundance and diversity. *Marine Ecology Progress Series*, 326, 133-143.
- Reef Environmental Education Foundation, REEF (n.d.). Volunteer Fish Survey Project. Retrieved from <https://www.reef.org/programs/volunteerfish-survey-project>.
- Salvador de Paiva, J.N., Walles, B., Ysebaert, T., and Bouma, T.J. (2018). Understanding the conditionality of ecosystem services: The effect of tidal flat morphology and oyster reef characteristics on sediment stabilization by oyster reefs. *Ecological Engineering*, 112, 89-95. <https://doi.org/10.1016/j.ecoleng.2017.12.020>.
- Schmitt, E.F., Sluka, R.D, and Sullivan-Sealey, K.M. (2002). Evaluating the use of roving diver and transect surveys to assess the coral reef fish assemblage off southeastern Hispaniola. *Coral Reefs*, 21, 216-223.
- Weissberger, E.J. and Grassle, J.P. (2003). Settlement, first-year growth, and mortality of surf clams, *Spisula solidissima*. *Estuarine, Coastal and Shelf Science*, 56(3), 669-684.
- Weldon, J., Garbary, D., Courtenay, S., Ritchie, W., Godin, C., Thériault, M-H., Boudreau, M. and Lapenna, A. (2005). The Community Aquatic Monitoring Project (CAMP) for measuring marine environmental health in coastal waters of the Southern Gulf of St. Lawrence: 2004 Overview.

## Appendix A: Species Abundance per Survey

**Table A1.** Site A - Front of Mabou Beach (June 23, 2023; 46.082879, -61.479229)

SPECIES NAME	COMMON NAME	ABUNDANCE
<i>Cancer irroratus</i>	Atlantic rock crab	Few
<i>Chondrus crispus</i>	Irish moss	Few
<i>Crangon septemspinosa</i>	Sand shrimp	Few
<i>Cyanea</i> sp.	Lion's mane jellyfish	Many
<i>Fucus serratus</i>	Toothed wrack	Few
<i>Fucus vesiculosus</i>	Bladder wrack	Few
<i>Homarus americanus</i>	American lobster	Few
<i>Pagurus acadianus</i>	Acadian hermit crab	Few
<i>Pseudopleuronectes americanus</i>	Winter flounder	Many

**Table A2.** Site B - Outer Mabou Harbour Breakwater (June 21, 2023; 46.087637, -61.477173)

SPECIES NAME	COMMON NAME	ABUNDANCE
<i>Cancer irroratus</i>	Atlantic rock crab	Many
<i>Carcinus maenas</i>	European green crab	Few
<i>Chondrus crispus</i>	Irish moss	Many
<i>Chorda filum</i>	Sea lace/Dead man's rope	Abundant
<i>Crangon septemspinosa</i>	Sand shrimp	Few
<i>Cyanea</i> sp.	Lion's mane jellyfish	Single
<i>Fucus serratus</i>	Toothed wrack	Many
<i>Fucus vesiculosus</i>	Bladder wrack	Abundant
<i>Furcellaria lumbricalis</i>	Clawed fork weed	Few
<i>Homarus americanus</i>	American lobster	Single
<i>Littorina littorea</i>	Common periwinkle	Many
<i>Littorina saxatilis</i>	Rough periwinkle	Abundant
<i>Melicertum octocostatum</i>	Eight strand jelly	Single
<i>Metridium senile</i>	Clonal plumose anemone	Few
<i>Morone saxatilis</i>	Striped bass	Many
<i>Mytilus edulis</i>	Blue mussel	Abundant
<i>Pagurus acadianus</i>	Acadian hermit crab	Few
<i>Pseudopleuronectes americanus</i>	Winter flounder	Few
<i>Semibalanus balanoides</i>	Common rock barnacle	Abundant
<i>Ulva intestinalis</i>	Gut weed	Many
<i>Ulva lactuca</i>	Sea lettuce	Abundant

**Table A3.** Site C - Inner Mabou Harbour Breakwater (June 20, 2023; 46.087030, -61.472221)

<b>SPECIES NAME</b>	<b>COMMON NAME</b>	<b>ABUNDANCE</b>
<i>Argopecten irradians</i>	Bay scallop	Single
<i>Cancer borealis</i>	Jonah crab	Few
<i>Cancer irroratus</i>	Atlantic rock crab	Few
<i>Carcinus maenas</i>	European green crab	Many
<i>Chondrus crispus</i>	Irish moss	Few
<i>Chorda filum</i>	Sea lace/Dead man's rope	Few
<i>Crangon septemspinosa</i>	Sand shrimp	Abundant
<i>Crassostrea virginica</i>	Eastern oyster	Many
<i>Crepidula fornicata</i>	Common Atlantic slippersnail	Few
<i>Cyanea</i> sp.	Lion's mane jellyfish	Single
<i>Ensis leei</i>	Atlantic jackknife clam	Few
<i>Euspira heros</i>	Northern moon snail	Few
<i>Fucus distichus</i>	Rockweed	Few
<i>Fucus serratus</i>	Toothed wrack	Few
<i>Littorina littorea</i>	Common periwinkle	Many
<i>Littorina saxatilis</i>	Rough periwinkle	Abundant
<i>Mya arenaria</i>	Soft-shell clam	Few
<i>Mytilus edulis</i>	Blue mussel	Many
<i>Pagurus acadianus</i>	Acadian hermit crab	Few
<i>Palaemon adspersus</i>	Baltic shrimp	Single
<i>Pleurobrachia pileus</i>	Sea gooseberry	Single
<i>Pseudopleuronectes americanus</i>	Winter flounder	Many
<i>Semibalanus balanoides</i>	Common rock barnacle	Abundant
<i>Tautogolabrus adspersus</i>	Cunner	Many
<i>Ulva intestinalis</i>	Gut weed	Many
<i>Ulva lactuca</i>	Sea lettuce	Few
<i>Zostera marina</i>	Atlantic eelgrass	Abundant



**Table A4.** Site C - Inner Mabou Harbour Breakwater (June 24, 2023; 46.087030, -61.472221)

<b>SPECIES NAME</b>	<b>COMMON NAME</b>	<b>ABUNDANCE</b>
<i>Ascophyllum nodosum</i>	Knotted wrack	Few
<i>Cancer irroratus</i>	Atlantic rock crab	Few
<i>Carcinus maenas</i>	European green crab	Many
<i>Chondrus crispus</i>	Irish moss	Few
<i>Chorda filum</i>	Sea lace/Dead man's rope	Few
<i>Crangon septemspinosa</i>	Sand shrimp	Abundant
<i>Crassostrea virginica</i>	Eastern oyster	Many
<i>Crepidula fornicata</i>	Common Atlantic slippersnail	Few
<i>Cyanea</i> sp.	Lion's mane jellyfish	Single
<i>Ensis leei</i>	Atlantic jackknife clam	Few
<i>Euspira heros</i>	Northern moon snail	Many
<i>Fucus serratus</i>	Toothed wrack	Few
<i>Fucus vesiculosus</i>	Bladder wrack	Few
<i>Furcellaria lumbricalis</i>	Clawed fork weed	Few
<i>Littorina littorea</i>	Common periwinkle	Many
<i>Littorina saxatilis</i>	Rough periwinkle	Abundant
<i>Mya arenaria</i>	Soft-shell clam	Few
<i>Mytilus edulis</i>	Blue mussel	Few
<i>Pagurus acadianus</i>	Acadian hermit crab	Few
<i>Palaemon adspersus</i>	Baltic shrimp	Few
<i>Pseudopleuronectes americanus</i>	Winter flounder	Many
<i>Semibalanus balanoides</i>	Common rock barnacle	Abundant
<i>Tautoglabrus adspersus</i>	Cunner	Few
<i>Ulva intestinalis</i>	Gut weed	Few
<i>Ulva lactuca</i>	Sea lettuce	Few
<i>Zostera marina</i>	Atlantic eelgrass	Many

**Table A5.** Site D - Mabou Sand Dune (June 21, 2023; 46.084536, -61.472374)

<b>SPECIES NAME</b>	<b>COMMON NAME</b>	<b>ABUNDANCE</b>
<i>Argopecten irradians</i>	Bay scallop	Few
<i>Ascophyllum nodosum</i>	Knotted wrack	Few
<i>Cancer irroratus</i>	Atlantic rock crab	Few
<i>Carcinus maenas</i>	European green crab	Many
<i>Chondrus crispus</i>	Irish moss	Many
<i>Chorda filum</i>	Sea lace/Dead man's rope	Few
<i>Crangon septemspinosa</i>	Sand shrimp	Abundant
<i>Crassostrea virginica</i>	Eastern oyster	Abundant
<i>Crepidula fornicata</i>	Common Atlantic slippersnail	Many
<i>Cyanea</i> sp.	Lion's mane jellyfish	Single
<i>Ensis leei</i>	Atlantic jackknife clam	Few
<i>Euspira heros</i>	Northern moon snail	Few
<i>Ilyanassa obsoleta</i>	Eastern mudsnail	Abundant
<i>Littorina saxatilis</i>	Rough periwinkle	Abundant
<i>Mya arenaria</i>	Soft-shell clam	Many
<i>Osmerus mordax</i>	Rainbow smelt	Single
<i>Palaemon adspersus</i>	Baltic shrimp	Few
<i>Pseudopleuronectes americanus</i>	Winter flounder	Many
<i>Saccharina latissima</i>	Sugar kelp	Single
<i>Syngnathus fuscus</i>	Northern pipefish	Single
<i>Zostera marina</i>	Atlantic eelgrass	Abundant

**Table A6.** Site E - Mabou Mudflats (June 20, 2023; 46.080633, -61.466195)

<b>SPECIES NAME</b>	<b>COMMON NAME</b>	<b>ABUNDANCE</b>
<i>Argopecten irradians</i>	Bay scallop	Few
<i>Chorda filum</i>	Sea lace/Dead man's rope	Many
<i>Crangon septemspinosa</i>	Sand shrimp	Abundant
<i>Crassostrea virginica</i>	Eastern oyster	Many
<i>Euspira heros</i>	Northern moon snail	Many
<i>Fucus serratus</i>	Toothed wrack	Few
<i>Ilyanassa obsoleta</i>	Eastern mudsnail	Abundant - Thousands
<i>Leptagonus decagonus</i>	Atlantic poacher	Single
<i>Littorina saxatilis</i>	Rough periwinkle	Abundant
<i>Mytilus edulis</i>	Blue mussel	Many
<i>Pagurus longicarpus</i>	Long-armed hermit crab	Few
<i>Palaemon adspersus</i>	Baltic shrimp	Many
<i>Pseudopleuronectes americanus</i>	Winter flounder	Many
<i>Ulva lactuca</i>	Sea lettuce	Single

**Table A7.** Site F - The Spit (June 22, 2023; 46.081585, -61.463497)

<b>SPECIES NAME</b>	<b>COMMON NAME</b>	<b>ABUNDANCE</b>
<i>Anguilla rostrata</i>	American eel	Single
<i>Argopecten irradians</i>	Bay scallop	Few
<i>Ascophyllum nodosum</i>	Knotted wrack	Few
<i>Aurelia aurita</i>	Moon jelly	Few
<i>Cancer irroratus</i>	Atlantic rock crab	Few
<i>Carcinus maenas</i>	European green crab	Many
<i>Chondrus crispus</i>	Irish moss	Few
<i>Chorda filum</i>	Sea lace/Dead man's rope	Abundant
<i>Crangon septemspinosa</i>	Sand shrimp	Abundant
<i>Crassostrea virginica</i>	Eastern oyster	Abundant
<i>Crepidula fornicata</i>	Common Atlantic slippersnail	Many
<i>Cyanea</i> sp.	Lion's mane jellyfish	Single
<i>Ensis leei</i>	Atlantic jackknife clam	Few
<i>Euspira heros</i>	Northern moon snail	Few
<i>Fucus serratus</i>	Toothed wrack	Many
<i>Fucus spiralis</i>	Spiral wrack	Few
<i>Gasterosteus aculeatus</i>	Threespine stickleback	Few
<i>Littorina littorea</i>	Common periwinkle	Abundant
<i>Littorina saxatilis</i>	Rough periwinkle	Abundant
<i>Mya arenaria</i>	Soft-shell clam	Many
<i>Mytilus edulis</i>	Blue mussel	Many
<i>Obelia geniculata</i>	Sea fur	Abundant
<i>Osmerus mordax</i>	Rainbow smelt	Few
<i>Pagurus acadianus</i>	Acadian hermit crab	Few
<i>Palaemon adspersus</i>	Baltic shrimp	Many
<i>Pleurobrachia pileus</i>	Sea gooseberry	Few
<i>Pseudopleuronectes americanus</i>	Winter flounder	Many
<i>Scophthalmus aquosus</i>	Windowpane flounder	Single
<i>Semibalanus balanoides</i>	Common rock barnacle	Abundant
<i>Syngnathus fuscus</i>	Northern pipefish	Single
<i>Tautoglabrus adspersus</i>	Cunner	Few
<i>Testudinalia testudinalis</i>	Common tortoiseshell limpet	Few
<i>Zostera marina</i>	Atlantic eelgrass	Abundant

**Table A8:** Site F - The Spit (June 24, 2023; 46.081585, -61.463497)

<b>SPECIES NAME</b>	<b>COMMON NAME</b>	<b>ABUNDANCE</b>
<i>Argopecten irradians</i>	Bay scallop	Few
<i>Ascophyllum nodosum</i>	Knotted wrack	Few
<i>Aurelia aurita</i>	Moon jelly	Few
<i>Cancer irroratus</i>	Atlantic rock crab	Few
<i>Carcinus maenas</i>	European green crab	Many
<i>Chondrus crispus</i>	Irish moss	Few
<i>Chorda filum</i>	Sea lace/Dead man's rope	Abundant
<i>Crangon septemspinosa</i>	Sand shrimp	Abundant
<i>Crassostrea virginica</i>	Eastern oyster	Abundant
<i>Cyanea</i> sp.	Lion's mane jellyfish	Many
<i>Electra pilosa</i>	Thorny sea mat	Few
<i>Ensis leei</i>	Atlantic jackknife clam	Few
<i>Euspira heros</i>	Northern moon snail	Many
<i>Fucus serratus</i>	Toothed wrack	Many
<i>Ilyanassa obsoleta</i>	Eastern mudsnail	Abundant
<i>Littorina littorea</i>	Common periwinkle	Abundant
<i>Littorina saxatilis</i>	Rough periwinkle	Abundant
<i>Menidia menidia</i>	Atlantic silverside	Many
<i>Mya arenaria</i>	Soft-shell clam	Many
<i>Mytilus edulis</i>	Blue mussel	Many
<i>Myoxocephalus scorpius</i>	Shorthorn sculpin	Single
<i>Obelia geniculata</i>	Sea fur	Abundant
<i>Pagurus longicarpus</i>	Long-armed hermit crab	Many
<i>Pseudopleuronectes americanus</i>	Winter flounder	Many
<i>Semibalanus balanoides</i>	Common rock barnacle	Abundant
<i>Ulva intestinalis</i>	Gut weed	Few
<i>Ulva lactuca</i>	Sea lettuce	Few
<i>Zostera marina</i>	Atlantic eelgrass	Abundant