An aerial photograph of a rocky coastline. The water is a deep green color, and white waves are crashing against the dark, mossy rocks. Several seals are visible resting on the rocks and in the shallow water. The seals have dark bodies and lighter-colored heads. The overall scene is a natural, coastal environment.

# Characterizing Harbour seals (*Phoca vitulina*) in the Saint John Harbour

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# Summary

The population abundance of harbour seals in Atlantic Canada is currently listed as unknown and little is known about their behaviour, food habitats, and distribution in the area. The goal of this project was to provide a baseline of harbour seal populations to fulfil the mandate of the Coastal Environmental Baseline Project (CEBP). The objective of this study was to identify the population number of harbour seals in the Saint John Harbour and to examine the seasonal trends and distribution in seal numbers in the area. Observations were made during the afternoon low tides where seals hauled out on the rocks were counted and recorded. It was found that the population of harbour seals has increased since the 1990s. The CEBP has provided an update to research completed 30 years ago, and continuing this work is essential for understanding changes in the ecosystem over time.

## Introduction

The City of Saint John is located within the estuary where the Wolastoq [St. John River] meets the Bay of Fundy. Within the Saint John Harbour, the Port of Saint John operates as one of Canada's key international seaports averaging approximately 28 million metric tonnes of cargo annually. The harbour does not freeze during the winter allowing for a wide range of traffic, including liquid and dry bulks, break bulk, containers, general cargo, and thousands of cruise ship passengers (Saint John Port Authority, 2009).

The Port plays a significant role regionally, providing close to 3,000 jobs and is considered essential to the province's petroleum, potash, forestry, tourism industries and to its import and export trade (Saint John Port Authority, 2009). The harbour also has an important role environmentally, where freshwater from the Wolastoq interchanges with the tides creating a unique ecosystem for aquatic wildlife. Through the Canadian Department of Fisheries and Oceans Coastal Environmental Baseline Program (CEBP), the Port of Saint John was chosen as a pilot site to collect comprehensive baseline data on various biological and physical components throughout the area.

For the past three years, ACAP Saint John has been conducting baseline research by collecting data on marine mammals, specifically harbour seals (*Phoca vitulina*) that have not been frequently monitored in the Saint John Harbour. ACAP Saint John is a non-profit organization with thirty years of experience completing monitoring programs and providing accurate scientific information to the community. The goal of this project was to provide a baseline of harbour seal populations to fulfil the mandate of the CEBP. The population abundance of harbour seals in Atlantic Canada is currently listed as unknown and little is known about their behaviour, food habitats, and distribution in the area. The most recent population surveys were completed in 1991, and that research forms the basis of the work completed through this project (Colbourne & Terhune, 1991). Harbour seals have been observed hauling out onto off-shore ledges, sandbars, and isolated

beaches, where the seals will come completely out of the water and lie quietly for a few hours (Pauli & Terhune, 1987a). Additionally, Pauli & Terhune (1987a) found that in the Bay of Fundy specifically, harbour seals haul out in the greatest numbers when low tide is in the afternoon. The numbers of seals appearing on a daily basis is dependent on the weather conditions, human interactions (i.e., harbour traffic), reproduction, migration for food, time of day or the state of the tide (i.e., low tide vs high tide) (Pauli & Terhune, 1987a). Possible advantages of hauling out include rest (Krieber & Barrette, 1984), thermoregulation and predator avoidance (Terhune & Brillant, 1996).

Previous research has indicated that counting the number of seals on land/haul out sites can provide an estimate of the minimum seal population in a given area (Pauli & Terhune, 1987b). This methodology utilized by Colburne and Terhune in 1991 was replicated by ACAP Saint John for this project. Their research, completed over 30 years ago, was the most recent harbour seal population study conducted and determined that local seal populations increased in the summer and decreased in the autumn. ACAP Saint John utilized a similar methodology to complete this research providing an updated analysis of the harbour seal population within the Saint John Harbour.

The objective of this study was to (1) identify the population number of harbour seals in the Saint John Harbour and compare results to previous studies conducted in the project area; (2) examine any seasonal trends in seal numbers along the New Brunswick coast and in the Wolastoq; (3) investigate the distribution of harbour seals in the Saint John Harbour and its estuarine environments, including monitoring any long-distance movements of seals that may take place; and (4) collect data that will help contribute to addressing the gaps in the minimal existing baseline harbour seal population data in the Saint John Harbour.

## Methods

### Location

The Saint John Harbour is located on the north shore of the Bay of Fundy where the Woalstoq empties into the harbour (Wiber & Recchia, 2010). The project location is part of the Bay of Fundy and Southern Uplands Priority Area established by Fisheries and Oceans Canada to combat the impacts of human activities and climate change that threaten species at risk and critical habitat (Fisheries and Oceans Canada, 2020). The Port of Saint John operates directly in the Saint John Harbour and is within proximity of important birding areas and protected natural areas including the Musquash Marine Protected Area (Figure 1).

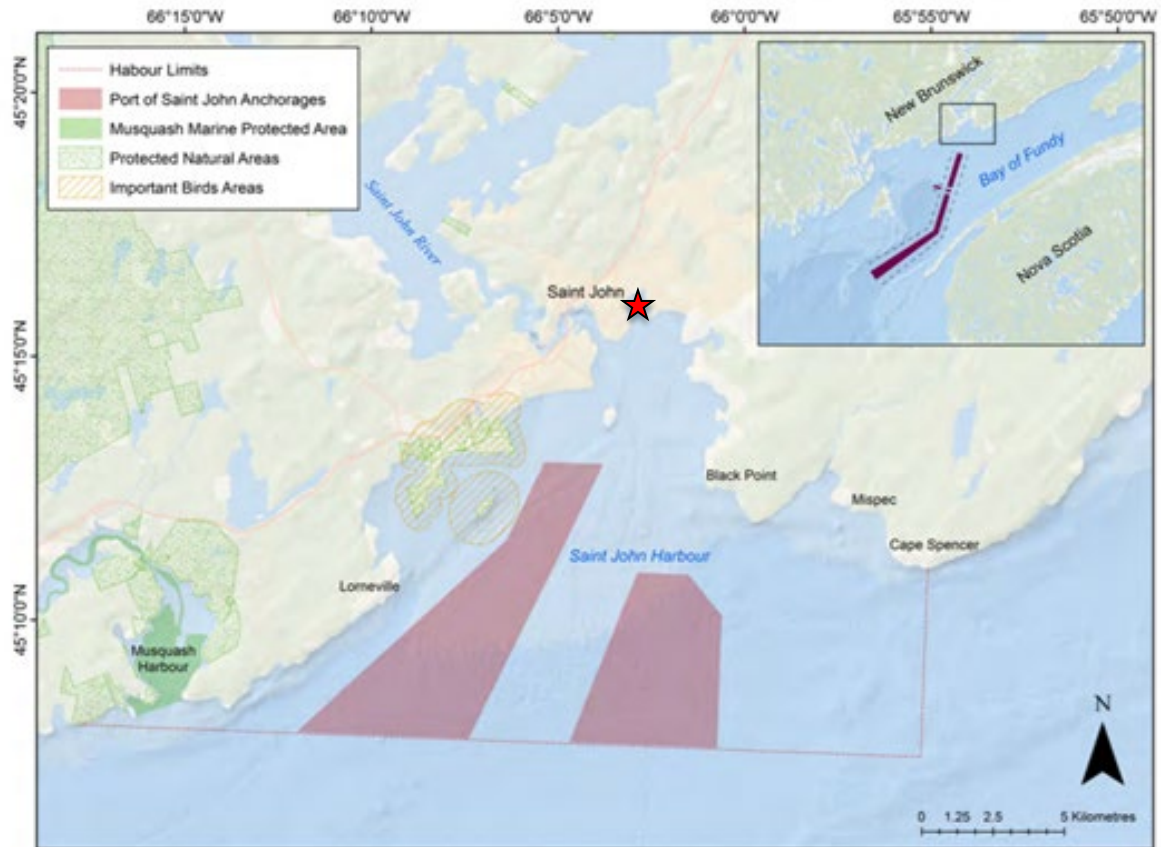


Figure 1. Map of project boundaries. Star indicating the Saint John Harbour.

The harbour seal population surveys were conducted at six different sites throughout the project area (Figure 2). These haul out sites were determined using previous literature and include five marine sites and one upstream site (Colbourne & Terhune, 1991).

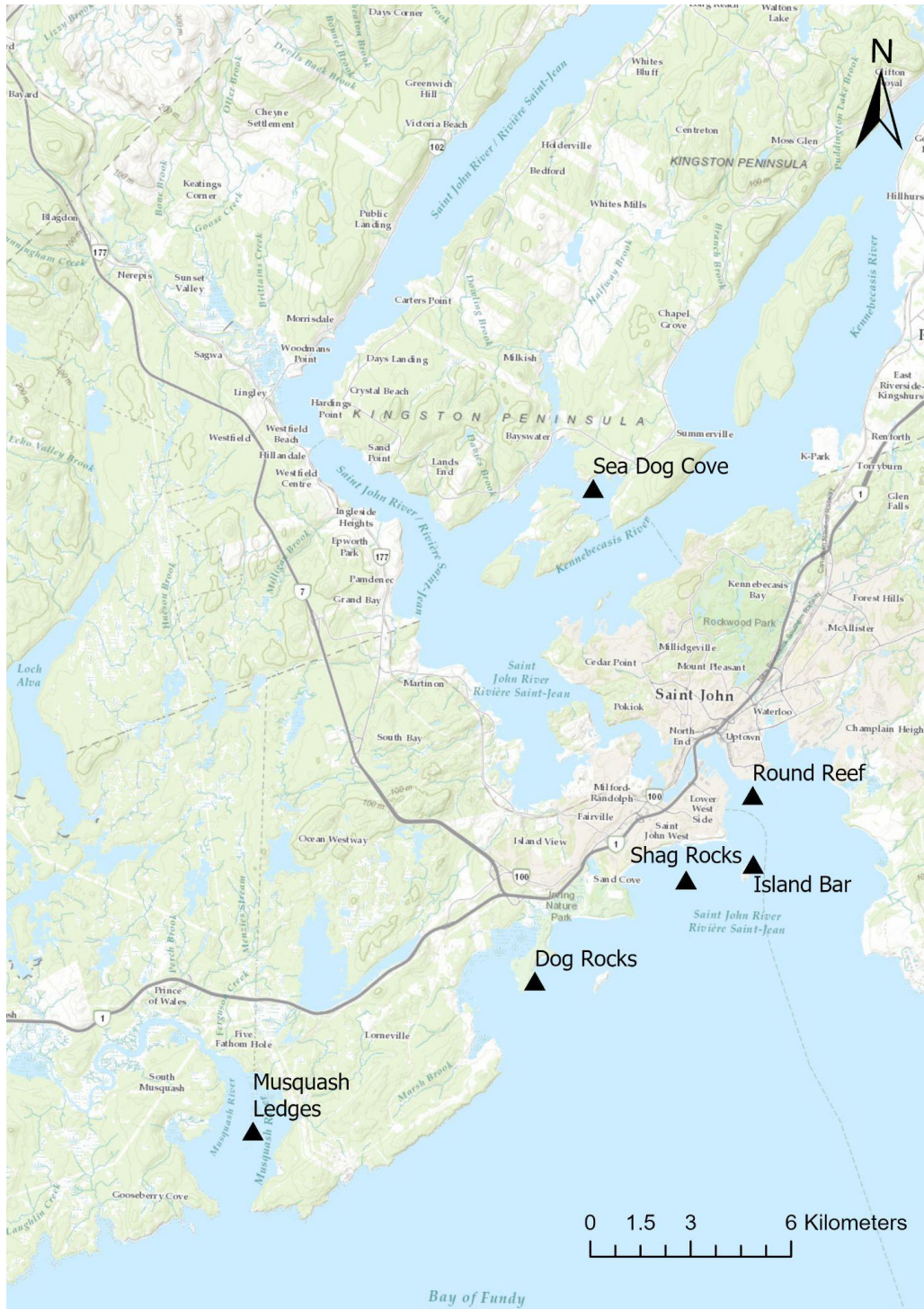


Figure 2. Map of haul out sites.

## Shore/Aerial Surveys

The data collected through this project was gathered primarily through visual surveys both onshore and using aerial methods. Between December 2018 through to December 2021, bi-

weekly surveys were conducted at all haul out sites. ACAP Saint John staff used long range spotting scopes (Bushnell Trophy 65x, Bushnell Legend Ultra-HD 60x, and Bushnell Imageview 45x) and binoculars (10x42 Bushnell Sportsman) directly from shore to observe the number of seals (Figure 3).



*Figure 3. View from shore where seals can be seen hauled out on the rocks at low tide using a spotting scope.*

Aerial drone footage was taken on occasion using a DJI Matrice 210 V2 (fitted with an Olympus PEN E-PM2 camera and a DJI Zenmuse XT2 thermal camera) to gather a more accurate seal count, as well as to identify the species of seals (Figure 4). The drone was only flown during optimal conditions (i.e., <15 kts winds, above 5°C, and no fog, precipitation, or storms in the area). The sites where drone footage was collected included Dog Rocks, Shag Rocks, and Musquash Ledges. The drone was operated by Gina Lonati, a PhD student with the University of New Brunswick Saint John.





*Figure 4. Aerial photograph of seals hauled out on rocks at low tide.*

All surveys took place when the low tide occurred in the mid-afternoon and during favourable weather conditions (i.e., no rain/snow and when temperatures were above  $-10^{\circ}\text{C}$ ). Observations were recorded during each survey including the date, time of day, location, weather conditions, how many seals were counted hauled out on the rocks (including any seals observed swimming around near the site), as well as general observations such as marine traffic.

## Citizen Science

In addition to the surveys completed by ACAP Saint John staff, the project incorporated citizen science to help gather a wider range of data. Between June 2019 through to March 2021, ACAP Saint John encouraged citizens to report their seal sightings through an online community engagement mapping service called *Maptionnaire*. The online map allowed participants to add the location of their sighting, how many seals they saw, and any other observations they had (Figure 5).

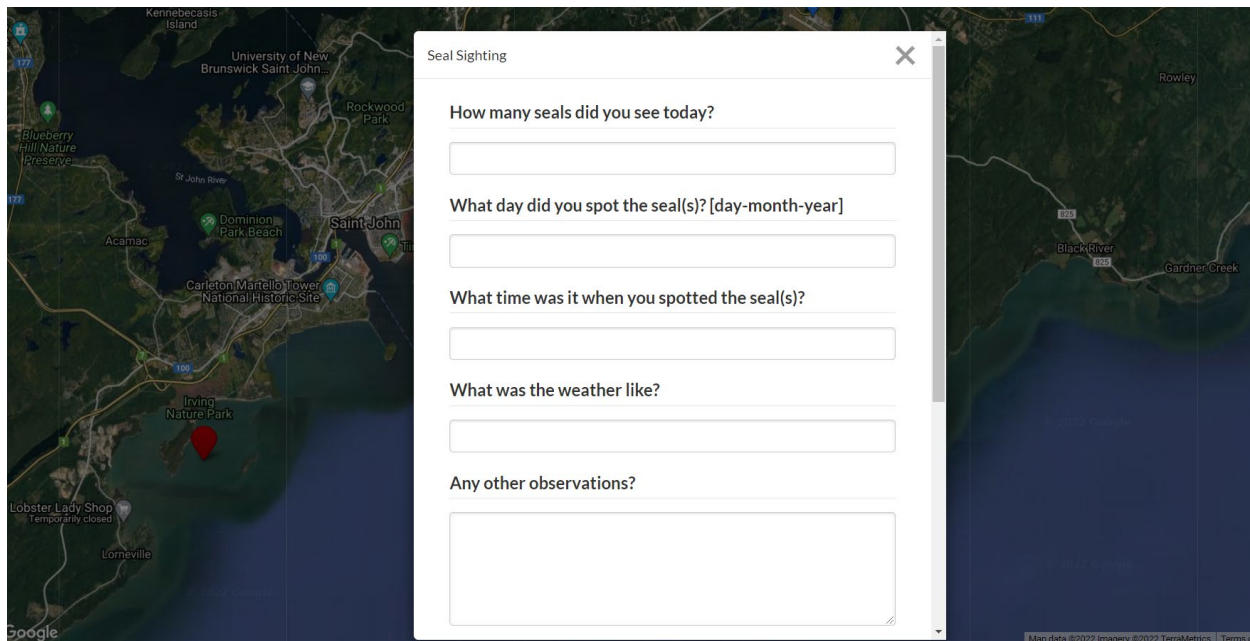


Figure 5. Example of questions asked when citizens reported seal sightings through Maptionnaire.

ACAP Saint John used social media and their extensive volunteer network to spread the word of this citizen science opportunity. The public were encouraged to report any seals they saw swimming or hauled out along the Saint John Harbour limits. Flyers were also distributed to local boating and yacht clubs requesting citizens to report any seals they saw along their travels.

## Satellite Tagging

To collect data regarding the movement of harbour seals in the project area, ACAP Saint John planned to deploy satellite tags onto the marine mammals. In September 2019, three GPS/Iridium 2-way tags (SeaTrkr-4375-4) were purchased from Telonics Inc. with the intention of deployment in spring 2020. The global pandemic and COVID-19 restrictions put a halt on this activity however, with the help from experienced personnel from DFO Bedford Institute of Oceanography and DFO Maurice Lamontagne Institute, deployment of the tags was attempted during the week of September 7-11, 2021.

## Capturing and Tagging Procedure

Using standard captioning techniques by Jefferies et al. (1993) and Sharples et al. (2012), tangle nets were used and hung in the water close to where the seals were hauled out at low tide. Unless the seals had already entered the water, a powerboat slowly approached the haul out site and encouraged the seals to leave (Figure 6). A second powerboat remained relatively close to the tangle net to alert others when a seal was caught in the net.

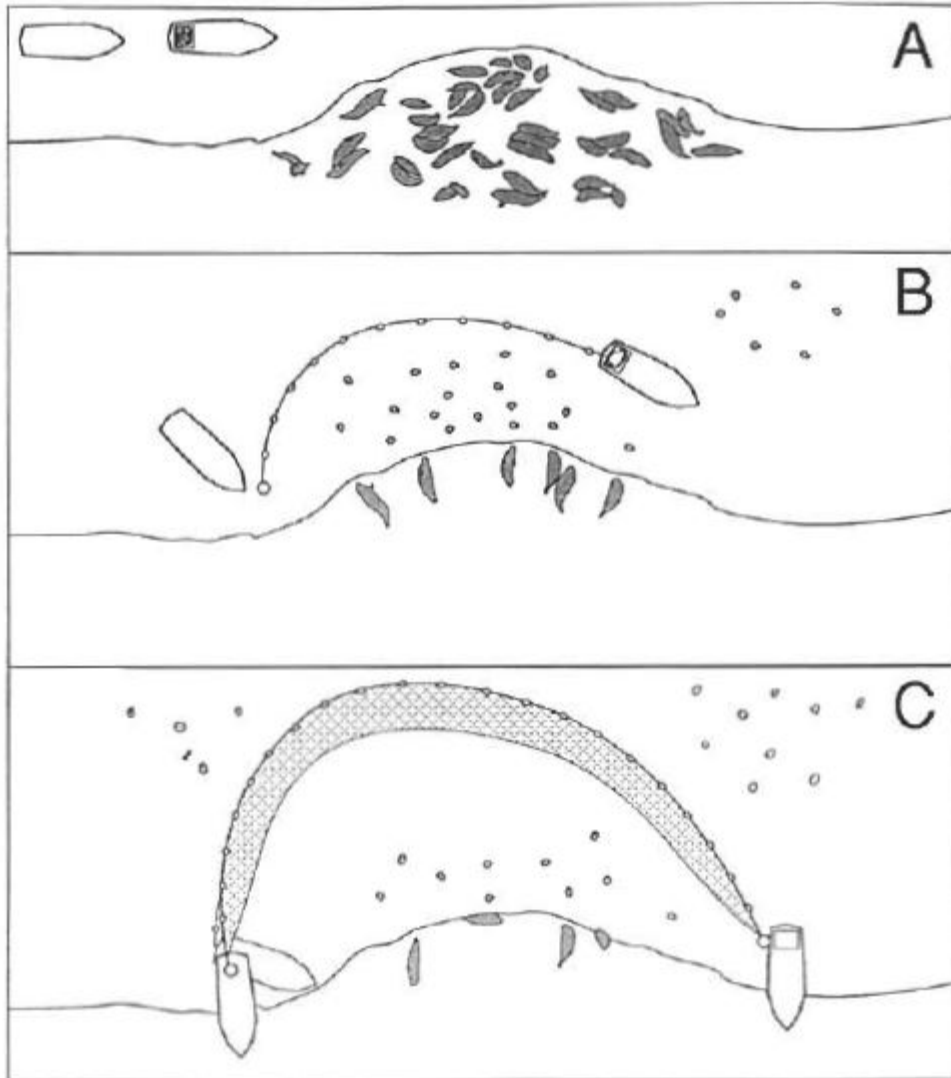


Figure 6. Method of tangle net placement. (A) Two vessels are used to approach harbour seal haul out sites. (B) The net is deployed rapidly from one boat, while the second boat retrieves a buoy at the other end of the net. (C) As seals return to the water the net creates a barrier allowing them to be captured.

The tangle nets used had large netting to allow for fish to swim through with no risk of being caught. The crew identified the only non-target species at risk of being tangled in the net was a grey seal (*Halichoerus grypus*). If this event occurred, the seal would be removed from the tangle net and the net would be redeployed.

If a harbour seal was caught, the crew would haul the seal and the tangle net towards the boat and transfer the animal to a hoop net, which could then be placed onto the vessel. To minimize stress during the capture procedure, a cloth would be placed over the eyes of the seal. The seal would then be immobilized using the chemical anaesthetic Telazol. The satellite tag would then be attached to the fur on the top of the seal's head using a five-minute epoxy where it would remain until their next molt. Once the anaesthetic wears off, the seal would be released safely back into the water slowly.

# Results

## Shore/Aerial Surveys

Over the course of the project, 380 observations were conducted across the six haul out sites. Shag Rocks and Round Reef observations began in December 2018, with Island Bar added just a few weeks later. Access to the Musquash Ledges site was limited in the winter months due to the road conditions, requiring observations to begin in March 2019. Dog Rock was not originally part of the project plan and was added to our observations in May 2019 as research indicated seals haul out at this location. Due to the freezing condition of the river, observations began in Sea Dog Cove when the river thawed. Observations were consistently completed on a biweekly basis, however in some cases the conditions upon arrival at the sites (i.e., access roads too icy, fog rolled in) prevented observations from occurring.

## Sea Dog Cove

Located in the Kennebecasis River, Sea Dog Cove is home to a small population of harbour seals during the spring, summer and fall. The Cove is a popular destination for boaters and during the peak of summer, many motorized boats frequent the area. Although primarily freshwater, the Cove is influenced by the Bay of Fundy tides, leaving the water mildly brackish at times (Haigh & Clarke, n.d.). Observations at this site were conducted by a landowner in Summerville, New Brunswick, who's property overlooks the Cove (45.3386, -66.1078).

During the first few observations, it was noted that the number of seals hauled out were not influenced by the tidal variation but rather, were observed at sunrise and sunset. Following this observation, surveys were then made on a biweekly basis at those times. The Cove was observed to freeze over during the winter months, forcing the seals out of the area. Observations were not gathered during these months (late December to early March) with the initial observations beginning in July 2019.

During the spring, summer and fall, the numbers of seals observed in Sea Dog Cove fluctuated slightly depending on the season, with a spike in numbers near the end of August/early September (Figure 7).

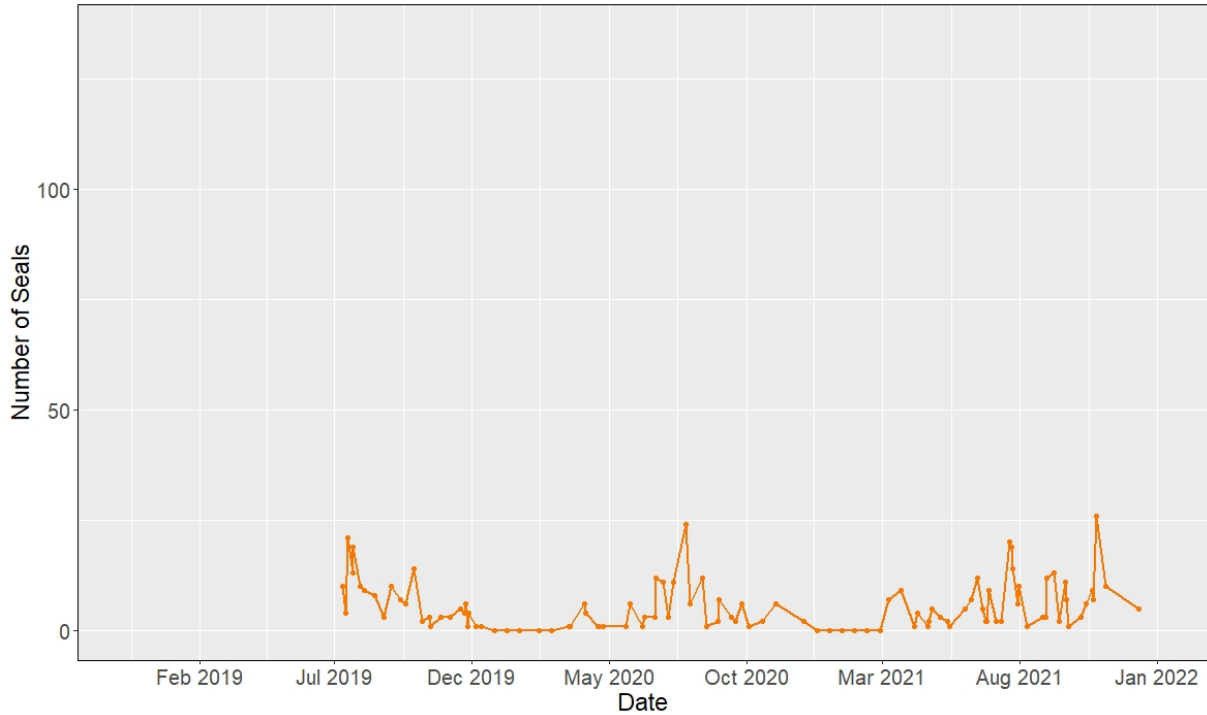


Figure 7. Number of seals observed in Sea Dog Cove between July 2019 - December 2021.

## Round Reef

This small rock shoal is located roughly 0.5 km away from Tin Can Beach in the South End of the city. Observations at this site took place directly on Tin Can Beach (45.2631, -66.0542) using a spotting scope and tripod. During the planning stages of this project, it was thought that seals hauled out here, however during the three years of observations, not a single seal was ever spotted.

## Island Bar

Located on the periphery of Partridge Island, Island Bar can be seen from shore using a 60x HD spotting scope. The observations for this site took place directly on Tin Can Beach (45.2631, -66.0542) beginning in January 2019. Visibility was recognized as a challenge due to the distance from shore (~2.5 km), the glare from the sun, and the mist/smoke coming from the surface of the water.

This site was observed to have seals hauled out consistently throughout the year, with a small increase in the spring (Figure 8).

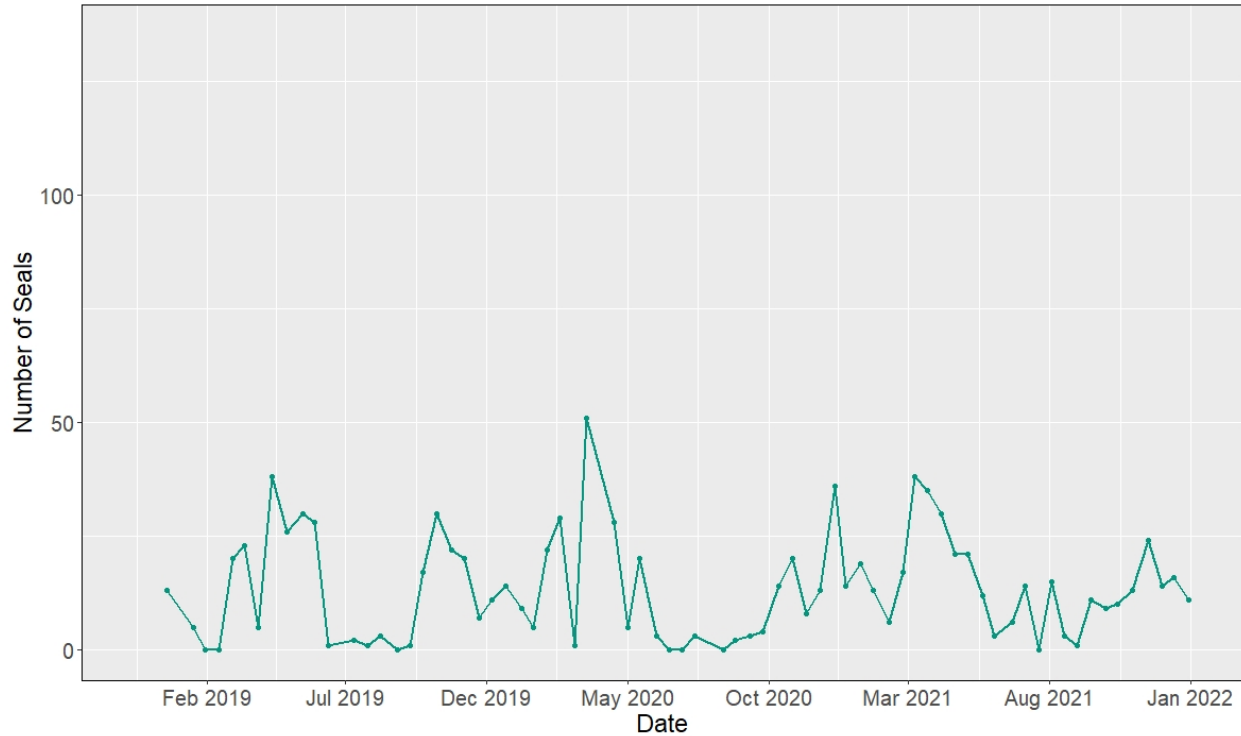


Figure 8. Number of seals observed on Island Bar between January 2019 - December 2021.

## Shag Rocks

The Shag Rocks are a cluster of rocks located roughly 1 km away from Bayshore Beach in West Saint John. Observations took place at the coastal lookout (45.2453, -66.0824) accessed at the end of Sea Street. Scopes were the primary equipment used to complete the surveys however drone footage was sometimes captured at this site providing a different perspective of the rock cluster and hauled out seals.

Seals counts have been observed to increase substantially during the spring and decrease in the late summer to early fall (Figure 9). During the spring, over 100 seals were observed to be hauled out at one time.

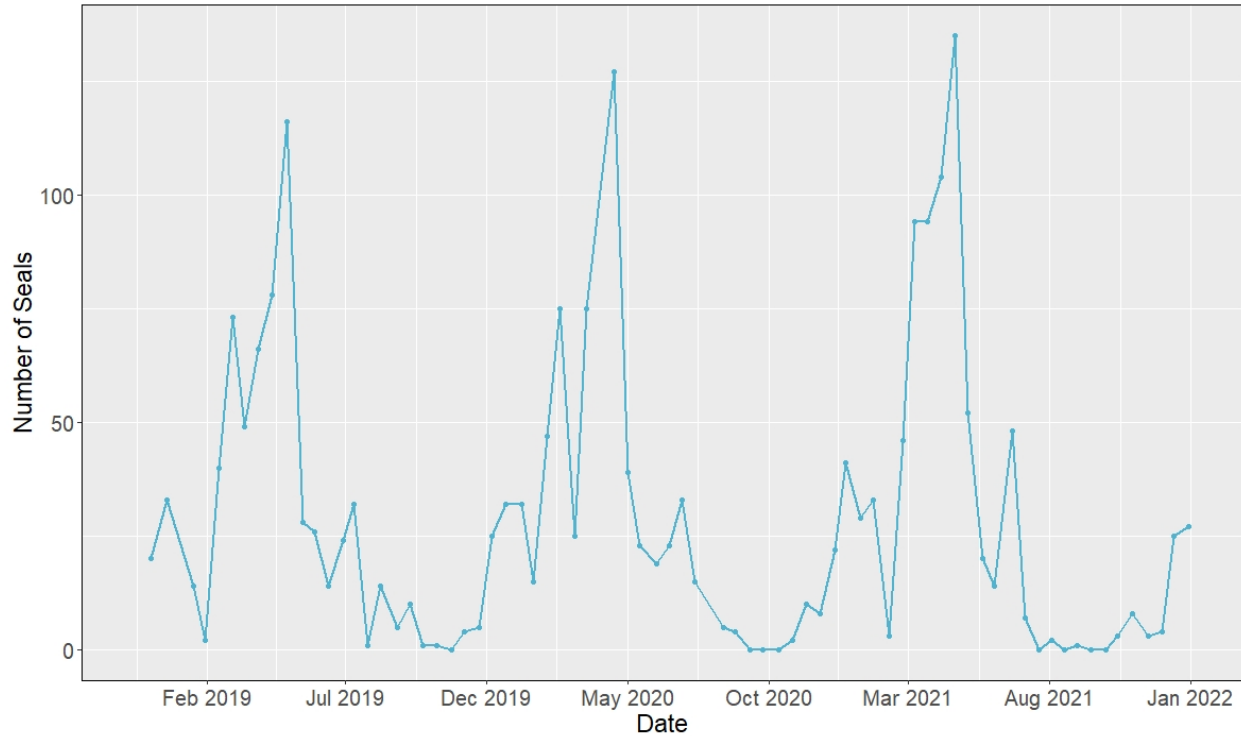


Figure 9. Number of seals observed on the Shag Rocks between December 2018 - December 2021. Peak observations in spring 2021 with over 125 seals counted.

## Dog Rocks

The Dog Rocks are located off the east side of the Irving Nature Park. The park is a primary recreational spot in the city and receives roughly 289,000 visitors over the course of a year (Woods, Personal Communications, 2022). This site was not originally part of the project plan and was added to our observations in May 2019 as research indicated seals haul out at this location. The rock shole is approximately 300 metres away from the shore and can be seen best from the park’s Seal Observation Deck (45.2106, -66.1343). This deck, and lookouts along the Seal Trail are where the observations were made using binoculars. When conditions allowed, drone footage was captured at this site.

The observations indicate that the number of seals increase at this site during the winter months and decrease drastically (down to zero) by the summer months (Figure 10).

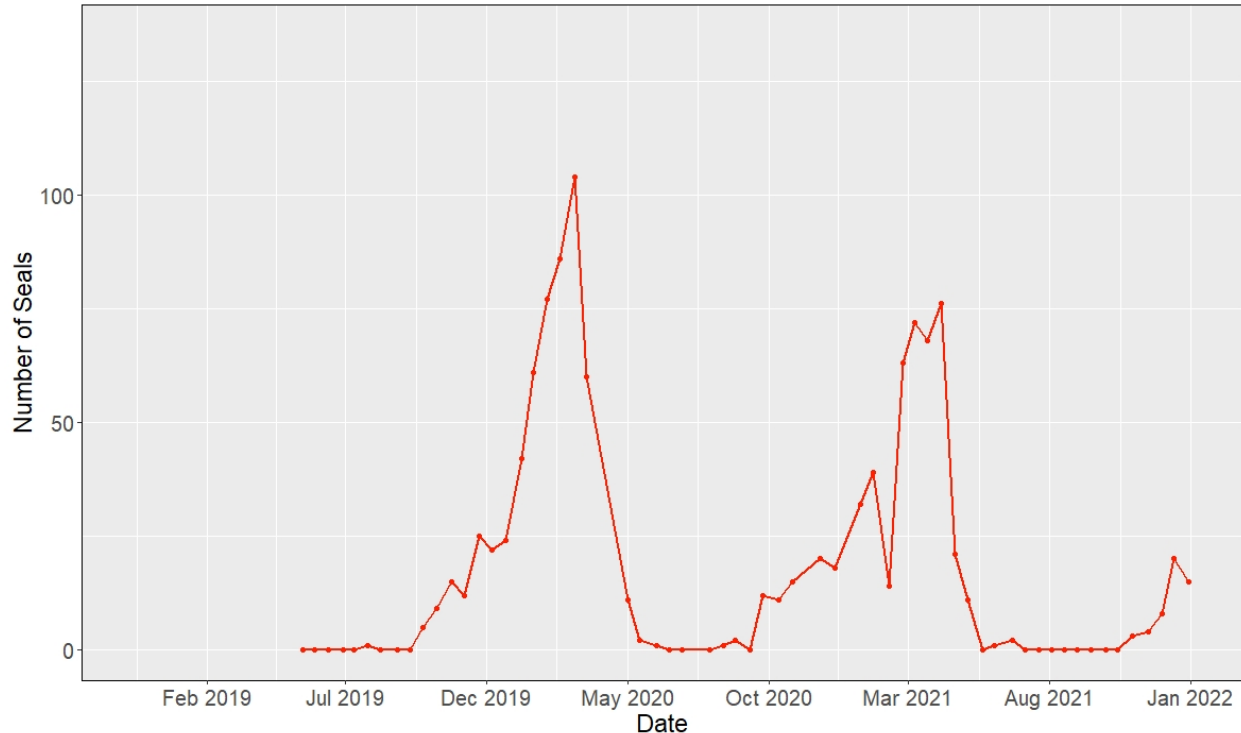


Figure 10. Number of seals observed on the Dog Rocks between May 2019 - December 2021.

## Musquash Ledges

The Musquash Ledges are located roughly 1 km offshore from Black Beach, Lorneville. The site is situated in the Musquash Harbour, part of New Brunswick’s only Marine Protected Area. To observe the haul out site, staff would follow the Black Beach Trail to the first lookout (45.1592, -66.2306) and use a scope to count the number of hauled out seals. When possible, the drone was flown over the Musquash Ledges capturing footage on the southwest facing side of the exposed rock ledges.

The biggest issue with this site was the accessibility to the beach and trail during the winter months, when the build-up of ice and snow on the roads made access difficult and unsafe at times. In favourable conditions snowshoeing to complete the observations was an option however this was not always available.

The observations indicate that the number of seals were the highest during the spring months and decreased throughout the rest of the year (Figure 11).



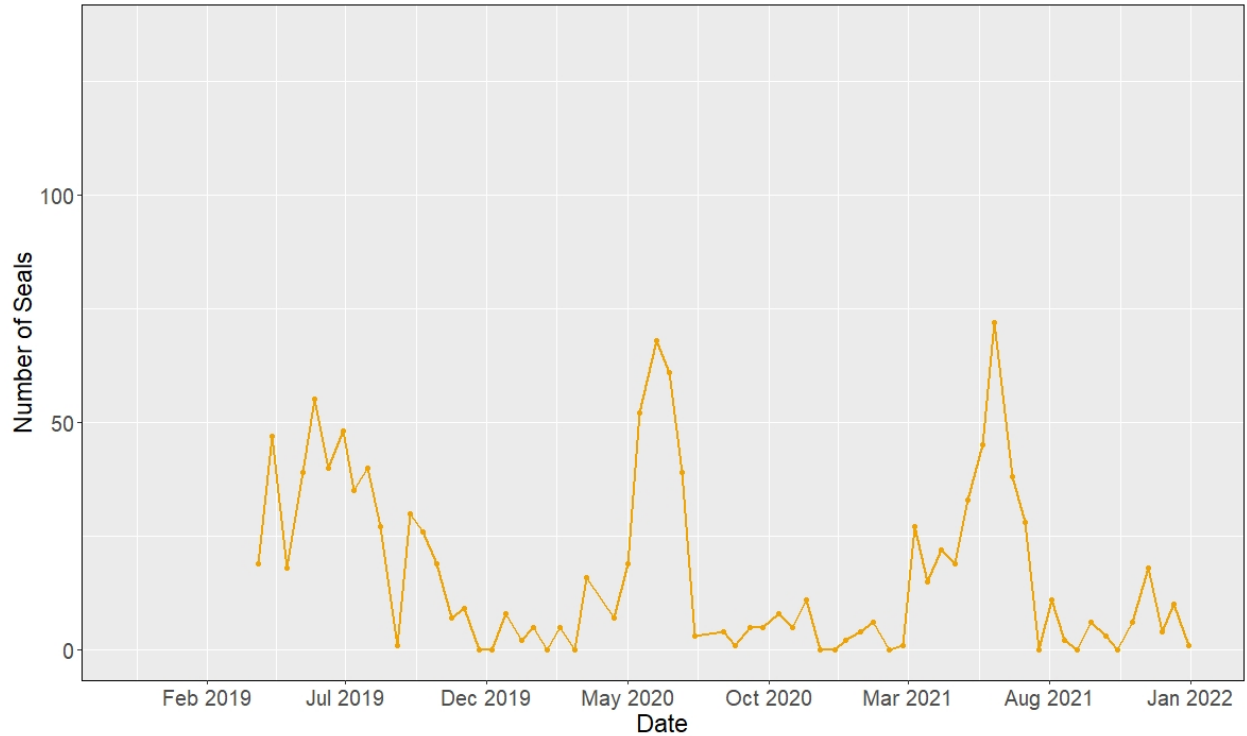


Figure 11. Number of seals observed on the Musquash Ledges between March 2019 - December 2021.

## Citizen Science

Between June 2019 to March 2021 ACAP Saint John received a total of 111 seal sighting submissions through the online platform *Maptionnaire* (Figure 12). Many of the sightings were found near the inner and outer Saint John Harbour, with a few sightings in the upper reaches of the Wolastoq and Kennebecasis River. Observation notes include citizens seeing more than one seal at a time, seals swimming in the water, seals playing in the waves, and seals resting on the rocks. This citizen science data is useful to engage the community in the monitoring of marine mammals and provide a dataset that would otherwise not be gathered.

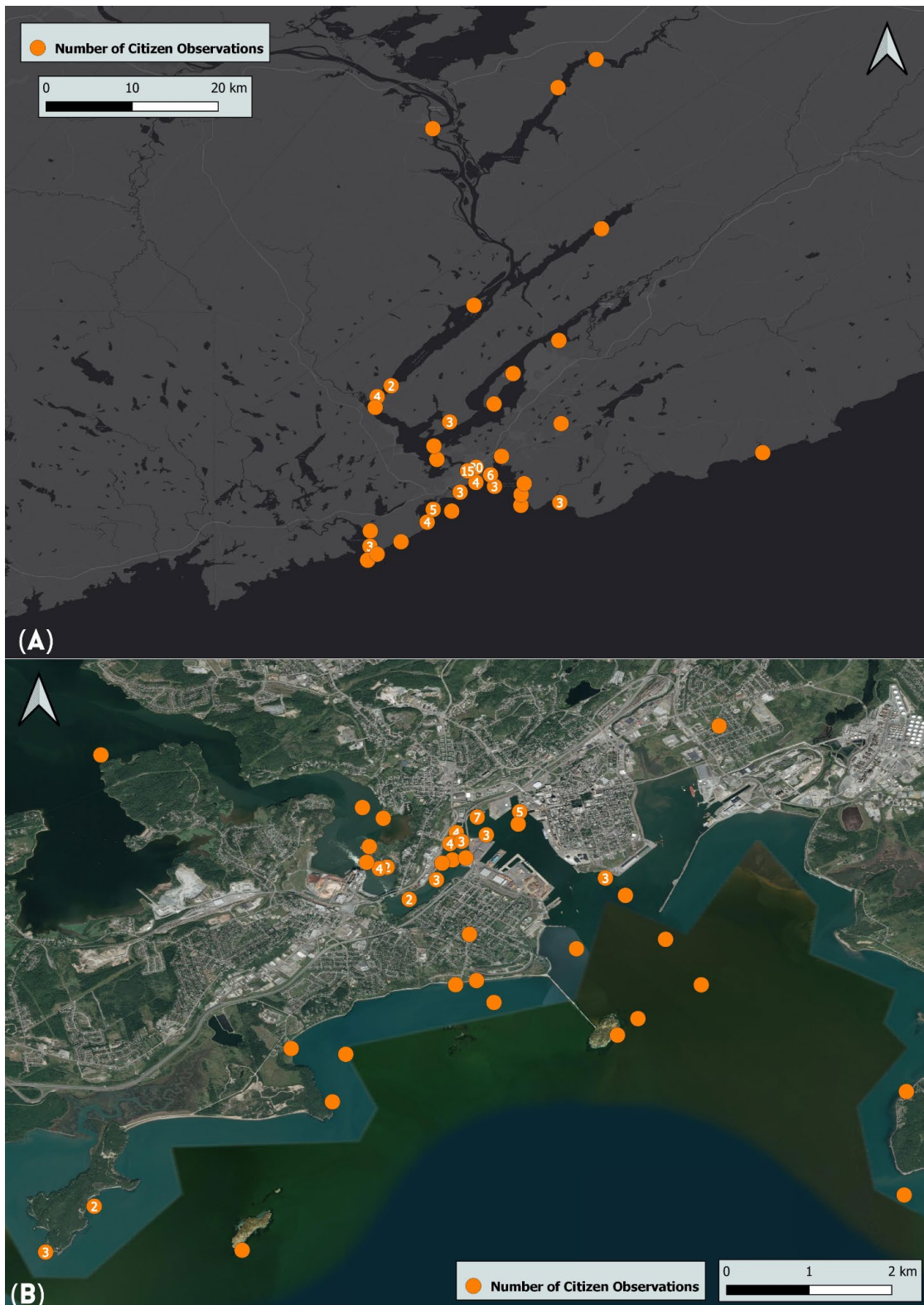


Figure 12. Locations of seals reported through the citizen science initiative available from June 2019 to March 2021 on ACAP Saint John's website. (A) Dots representing locations where citizens spotted seals swimming/hailed out with most sightings throughout the Saint John Harbour and Reversing Falls, and

*several sightings up the Wolastoq. (B) Map focusing on the seals spotted in the Saint John Harbour region with a cluster of them in the Reversing Falls.*

The citizen science data confirmed seal observations within the sites surveyed through this monitoring program including Sea Dog Cove and the Musquash Ledges. Submissions around the Saint John Harbour may not be directly pinpointed to the project sites but can still indicate the distribution of seals throughout the area. It is also important to note how far up the Wolastoq that the seals have been observed. Although this section is out of the project scope, it's relevant to point out that harbour seals can be found in the lower reaches of the Wolastoq watershed.

## Satellite Tagging

During the week of September 7-11, 2021, a team including the CEBP coordinator from ACAP Saint John and experienced personnel from DFO Bedford Institute of Oceanography and DFO Maurice Lamontagne Institute embarked into the Saint John Harbour with hope to fit satellite tags to three seals.

The crew launched on multiple days from DMK Marine Ltd (45.26409, -66.07471) and travelled to multiple known haul out sites depending on the tide schedule. During this time of year, seals have been observed to haul out in larger numbers at Island Bar, thus our efforts focused on this haul out site during this week. At low tide, the boats travelled to Partridge Island and situated around the haul out site. Once the crews were in position the standard capture techniques by Jefferies et al. (1993) and Sharples et al. (2012) using tangle nets was attempted. Each time this activity was attempted, no seals were captured.

Despite the multiple trips into the harbour, the capturing and tagging of harbour seals was unsuccessful. Although this was less than ideal, the lessons learned from this experience may help to guide future research that seeks to tag this species and track their movements in the region.

## Discussion

Prior to ACAP Saint John's work, the study of harbour seal populations in the Saint John region has been relatively limited considering the popularity of this species in the Port City. This three-year project has built on the research completed in 1991 and provides further observation regarding the distribution and movement of this species. Studying mammals in this unique environment, where the Bay of Fundy interchanges with the Wolastoq, can inform future studies in the area and contributes to the baseline monitoring program overseen by Fisheries and Oceans Canada.

Overall, when comparing the results to the work by Colburne and Terhune (1991), the population of harbour seals was observed to have increased. At each haul out site, the highest seal counts were observed during the spring months except at Sea Dog Cove where most seals were spotted during summer. This can be related to ice cover upriver which would limit access until the melt

season is complete. The observations indicate that seals are less abundant at haul out sites during the summer and early fall. This distribution could be related to seals travelling upstream during the summer and fall months while the river is free of ice.

The previous conclusions found that seals were not observed between the months of December to May within the CEMP project area, with the expectation of some sightings of seals laying out on river ice close to the Reserving Falls (Terhune & Almon, 1983). Suggested explanations for the distribution of the population during the winter months included the movement of seals in correlation with food availability (i.e., less food in the area during winter) (Colburne & Terhune, 1991). It is thought that seasonal movement of harbour seal populations may explain the distribution of seals at sites during the 2019-2021 observations.

Colburne & Terhune (1991) identify potential causes of the seasonal movement observed including the likelihood of harbour seals to travel away from the Saint John Harbour to take advantage of food sources such as the gaspereau (*Alosa spp.*) run. The research describes a population of seals travelling as a group as far south as the Passamaquoddy Bay during the fall. Observations from Campobello Island, where groups of seals were spotted by flights in December, support these conclusions (Colburne & Terhune, 1991). The results from the 2019-2021 surveys contrast the findings from 1991, where seals have been observed at haul out sites during the months of October to April. In particular, at Island Bar, Shag Rocks, and Dog Rocks, seal numbers are observed to be high relative to the year-round observations at the sites. These observations suggest that harbour seals are not travelling south during the fall and are able to stay in and around the Saint John Harbour. If the driving force behind the seasonal movement of harbour seals has been previously related to the availability of food, it can be suggested that food sources in the project area are more abundant compared to 30 years ago. Seals no longer need to travel for food and can stay during winter months. Additionally, growing seal populations in Maine may be increasing the competition for resources in the south, putting pressure on harbour seals to stay in the Saint John region (NOAA Fisheries, 2021). Continued monitoring of seals and fish populations in the harbour area can provide critical data for understanding the availability of food in the region and the movement of seals.

Another trend observed in the 2019-2021 surveys is a decline in seals around August with low counts continuing until late fall. At Sea Dog Cove, the opposite trend is observed where the number of seals are highest during summer and early fall. The seasonality of the observations may be related to access up the river and the timing of predation. With a maximum of 25 seals observed at once in the Cove, the observations suggest that a rather small portion of the harbour seal population is travelling upstream during the summer months. Monitoring at sites along the mainstem of the Wolastoq may provide insight into the abundance of seals in the river. However, research finds that it is unlikely that the number of seals in the Wolastoq has changed over the years (Terhune, personal communication). It is more likely that the same group of seals are being observed at Sea Dog Cove, and that the decline at sites in the harbour are related to movement elsewhere.

At all sites, the limitation of the aerial perspective can be identified as a gap in the monitoring program. The movement of harbour seals during the observation reduces the accuracy of the seal count. As the tide changes, seals may be hauling out or jumping back into the water, meaning that the timing of the observations are a factor in the number of seals counted. It is likely that the number of seals is higher when observations are completed after low tide before seals return to the water. The collection of tracking data would provide a deeper understanding of seal movements during the haul out period and between sites. It is also important to note that during shoreline observations the number of seals can be counted, however, it is not always possible to conclude that all seals hauled out are harbour seals. When aerial photography was used, the seals could be identified by species, and on occasion the grey seal was observed among the group of harbour seals.

## Public Outreach

During this project, ACAP Saint John had the opportunity to attend many outreach events including guided nature walks, presentations to classrooms, and public markets (Figure 13). This project allowed us to inform the community about harbour seals in the region and what ongoing research is being conducted.



Figure 13. Examples of educational outreach conducted throughout the duration of the project.

Incorporating the citizen science component into the project was a great way to encourage individuals to get outdoors, interact with nature, and help collect data on our shared marine ecosystem. Community initiatives can be beneficial to long-term monitoring programs as citizens are eager to help and local knowledge can identify trends that may otherwise be overlooked. There is also evidence that citizen science projects help citizens gain knowledge on science processes, increase public awareness, and provide a deeper meaning to participant hobbies. (Bonney et al., 2016).

## Conclusion

Overall, the 2019-2021 observations highlight changes in the abundance and distribution of harbour seals since 1991. Seals are no longer disappearing for the winter but rather remaining in the area. The major movement of the population is now occurring in summer and fall (August-November) where less seals are observed at project sites. The CEBP has provided an update to research completed 30 years ago and is essential for understanding changes in the ecosystem over time. When coupled with broader environmental monitoring, this data may help researchers to preserve and protect marine life in the Saint John Harbour and surrounding region.

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