Workshop Report on Recent and Short-Term Research and Monitoring Efforts in the St. Anns Bank Marine Protected Area

Camille Mancion, Nicholas W. Jeffery

Fisheries and Oceans Canada
Bedford Institute of Oceanography
1 Challenger Drive
Dartmouth, NS B2Y 4A2

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WORKSHOP REPORT ON RECENT AND SHORT-TERM RESEARCH AND MONITORING EFFORTS IN THE ST. ANNS BANK MARINE PROTECTED AREA

Camille Mancion, Nicholas W. Jeffery

Fisheries and Oceans Canada
Bedford Institute of Oceanography
1 Challenger Drive
Dartmouth, NS B2Y 4A2

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Table of Contents

List of Figures

Glossary

BRUV	Baited Remote Underwater Video
CBFHA	Cape Breton Fish Harvesters Association
CBU	Cape Breton University
CSAS	Canadian Science Advisory Secretariat
CTD	Conductivity Temperature and Depth
DFO	Department of Fisheries and Oceans Canada
eDNA	Environmental Deoxyribonucleic Acid
MPA	Marine Protected Area
NMDS	Non-metric Multidimensional Scaling
OTN	Ocean Tracking Network
SAB	St. Anns Bank
SBERS	Scatarie Bank Experiential Research Site
Unama'ki	Cape Breton Island

Abstract

Mancion, C., and Jeffery, N.W. 2025. Workshop Report on Recent and Short-Term Research and Monitoring Efforts in the St. Anns Bank Marine Protected Area. Can. Manuscr. Rep. Fish. Aquat. Sci. 3291: ix + 34 p. https://doi.org/10.60825/3vq9-c105

A workshop on recent scientific research projects in the St. Anns Bank Marine Protected Area (SAB MPA) was held on March 7, 2024, following the Canadian Science Advisory Secretariat (CSAS) monitoring review for St. Anns Bank on March 5-6. This hybrid workshop focused on research initiatives led by external organizations and by the Department of Fisheries and Oceans Canada (DFO) in the MPA since its designation in 2017. Recently developed monitoring programs, short-term projects and information streams were showcased during the workshop. These projects were not subject to peer-review in the CSAS meeting and were presented in the workshop to communicate current scientific efforts occurring in the MPA and promote collaboration. Projects were presented by DFO scientists from the Bedford Institute of Oceanography and St. Andrews Biological Station, as well as external partners including the Geological Survey of Canada, Cape Breton University, the Ocean Tracking Network, and Cape Breton Fish Harvesters Association. The workshop showcased a diversity of new and ongoing research, with topics including acoustic telemetry, benthic imagery, net-based sampling, trawl surveys and environmental DNA (eDNA) sampling. Discussions during the workshop highlighted a need for external partners to help monitor the SAB MPA, and to further develop collaborations. The need for Indigenous knowledge and involvement of the Mi'kmaq in monitoring the MPA was also discussed as a key component while a co-governance arrangement develops between DFO and the Mi'kmaq for the SAB MPA. Regular workshops were suggested on an annual or biannual schedule to keep partners and stakeholders informed on ongoing research in the MPA. This can help strengthen collaboration and partnerships, and ensure adequate scientific monitoring is occurring.

Résumé

Mancion, C., and Jeffery, N.W. 2025. Workshop Report on Recent and Short-Term Research and Monitoring Efforts in the St. Anns Bank Marine Protected Area. Can. Manuscr. Rep. Fish. Aquat. Sci. 3291: ix + 34 p. https://doi.org/10.60825/3vq9-c105

Un atelier sur les récents projets de recherche scientifique dans la zone de protection marine (ZPM) du banc de Sainte-Anne a eu lieu le 7 mars 2024, à la suite de l'examen du Secrétariat canadien des avis scientifiques (SCAS) pour le suivi scientifique au banc de Sainte-Anne, qui s'est déroulé les 5 et 6 mars. Cet atelier hybride s'est concentré sur les initiatives de recherche menée par des organisations externes et par le ministère de Pêches et Océans Canada (MPO) dans la ZPM depuis sa désignation en 2017. Des programmes de suivi, des projets à court terme et des flux d'information récemment élaborés ont été présentés au cours de l'atelier. Ces projets n'ont pas fait l'objet d'un examen par les pairs lors de la réunion du SCAS et ont été présentés lors de l'atelier afin de communiquer les efforts scientifiques en cours dans la ZPM et de promouvoir la collaboration. Les projets ont été présentés par des scientifiques du MPO de l'Institut océanographique de Bedford et de la Station biologique de St. Andrews, ainsi que par des partenaires externes, notamment la Commission géologique du Canada, l'Université du Cap-Breton, l'Ocean Tracking Network et l'Association des pêcheurs du Cap-Breton. L'atelier a permis de présenter une diversité de nouvelles recherches en cours, avec des sujets tels que la télémétrie acoustique, l'imagerie benthique, l'échantillonnage au filet, les relevés au chalut et l'échantillonnage de l'ADN environnemental (ADNe). Les discussions qui ont eu lieu au cours de l'atelier ont mis en évidence la nécessité de faire appel à des partenaires externes pour aider au suivi de la ZPM du banc de Sainte-Anne, ainsi que pour développer davantage des collaborations. Le besoin de connaissances autochtones et la participation des Mi'kmaq au suivi de la ZPM ont également été discutés comme un élément clé alors qu'un accord de cogestion se développe entre le MPO et les Mi'kmaq pour la ZPM du banc de Sainte-Anne. Il a été suggéré d'organiser des ateliers réguliers (annuel ou semestriel) afin de tenir les partenaires et les intervenants au courant des recherches en cours dans la ZPM. Cela peut aider à renforcer la collaboration et les partenariats, et à assurer un suivi scientifique adéquat.

Introduction

The St. Anns Bank Marine Protected Area (SAB MPA) is located off the east coast of Unama'ki (Cape Breton). Nova Scotia and is known for a wide diversity of habitats that support different species. The MPA covers 4,364 km^2 and extends from the inner continental shelf to the outer slope of the Laurentian Channel (Figure 1). The SAB MPA was designated to conserve and protect biodiversity, ecosystem function and natural features. This designation provides comprehensive long-term protection in a part of coastal Unama'ki where the sea has provided for the Mi'kmaq, local communities, and supported marine commerce for centuries. For generations, the Mi'kmaq have harvested from the coast in all seasons, targeting a variety of fish, invertebrates and mammals. The importance of St. Anns Bank to the Mi'kmaq also lies in its connection to other ecosystems, such as the Bras d'Or Lake or the Gulf of St. Lawrence, forming the migration routes for culturally important species.

Fisheries and Oceans Canada (DFO) and the Mi'kmaq of Nova Scotia are working together to establish a partnership for future governance and management of the MPA. Current management is led by DFO with input from the Mi'kmaq, the St. Anns Bank MPA Advisory Committee, federal and provincial government departments, Indigenous organizations, marine industries, environmental non-governmental organizations, academic institutions, and local communities. The MPA has four management zones (Figure 1). The Core Protection Zone (Zone 1) covers 3,308 km^2 and is an area where most human activities are restricted, including commercial fish harvesting. Zones 2, 3, and 4 are Adaptive Management Zones, where certain types of activities compatible with conservation objectives are permitted (e.g., bottom longline fishing and trap fishing) (Fisheries and Oceans Canada 2023). Rights based fishing, such as food, social, and ceremonial fishing, continues throughout the site as a legally protected right affirmed in Canada's *Constitution Act* and federal commitments in subsequent legislation.

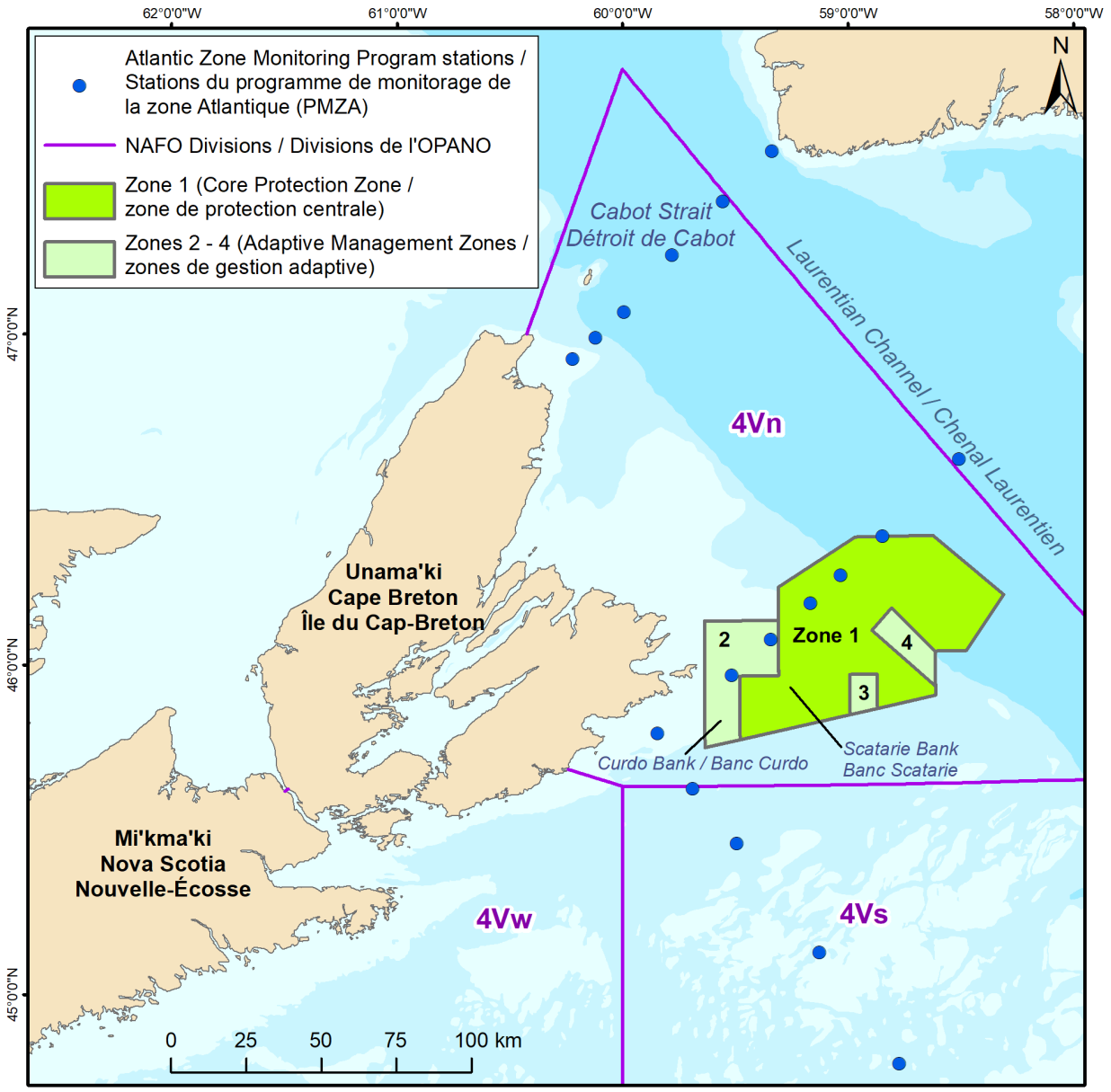

Figure 1. Map illustrating St. Anns Bank MPA, including Curdo Bank, Scatarie Bank, and the four management zones. Atlantic Zone Monitoring Program stations are also identified.

Designated under Canada's *Oceans Act* in 2017, the SAB MPA is relatively new and lacks a synoptic monitoring program, though two monitoring frameworks have been proposed (Kenchington 2014, Choi et al. 2018). Regular, ongoing research programs which began prior to the MPA's establishment are currently used for monitoring, including the Atlantic Zone Monitoring Program (AZMP), regional snow crab survey, the Maritimes summer ecosystem trawl survey, an array of acoustic receivers to track fish and other animal movements, and passive acoustic monitoring for cetaceans. These programs and data sources were reviewed separately in a peer-review CSAS process (March 5-6, 2024), with

the exception of the summer ecosystem survey which has several data gaps in the MPA in recent years due to vessel issues. In addition to the snow crab survey and ecosystem trawl survey, several DFO-led fisheries surveys have occurred in the MPA recurringly including the halibut longline survey (joint DFO-Industry), the Laurentian Channel bottom trawl scientific winter survey, the 4Vn sentinel survey (until 2022), and the Unit 2 redfish survey (joint DFO-Industry).

Beyond these relatively regular data streams within and around the SAB MPA, shorter-term research programs have begun in the MPA, led by DFO, Natural Resources Canada, industry (Cape Breton Fish Harvesters Association), and academic partners (primarily Cape Breton University with some earlier work led by Dr. Craig Brown, Dalhousie University, see Lacharité et al. 2018, Lacharité and Brown 2019). Since 2021, DFO has been conducting environmental DNA (eDNA) metabarcoding surveys in the SAB MPA, with limited success in 2021 and 2022 due to weather constraints, and great success in 2023 with all target stations sampled. These eDNA surveys will contribute to records of species detected in and around the MPA, including plankton and algae species that aren't regularly recorded in net-based surveys. Animal tracking has been taking place in SAB since 2015 through a three-way partnership between the Ocean Tracking Network, fishing industry, and DFO. In early project stages, an acoustic receiver array was deployed on Scatarie Bank (Zone 1 of the MPA) to collect information on tagged animals in the area. Imagery surveys led by Dr. Bruce Hatcher (Cape Breton University) using SCUBA on Scatarie Bank, and by Dr. Peter Lawton and Kirk Phelan (DFO Science) using a towed fibre-optic camera system in 2023 have revisited previous imagery surveys and re-confirmed benthoscape classifications developed by Drs. Craig Brown and Myriam Lacharité. Industry partners at Cape Breton Fish Harvesters Association (CBFHA) have also begun conducting eDNA surveys and baited remote underwater video (BRUVs) for biodiversity monitoring in the SAB MPA.

As DFO and the Mi'kmaq strengthen the Nation-to-Nation relationship regarding the SAB MPA, there will be collaborative work done together on research and monitoring initiatives whilst incorporating the principle of Etuaptmumk, or a Two-Eyed Seeing approach.

Workshop Overview

The workshop on recent and short-term research and monitoring efforts in the SAB MPA was held on March 7, 2024, at the Bedford Institute of Oceanography (Dartmouth, NS) with both in-person and virtual attendance on MS Teams (agenda in Appendix A). This workshop followed a two-day regional CSAS meeting (held on March 5-6, 2024) that reviewed data from four research programs to understand long-term trends in oceanography and biology in the MPA. The purpose of the workshop was to showcase knowledge, information and ongoing data streams, including preliminary results where possible, from within and outside of DFO.

The objectives of the workshop included:

- Provide a summary of the two-day Regional Peer Review Process on the Review of St. Anns Bank Monitoring: Selected Research Activities, Indicators, and Guidance on Next Steps
- Identify data gaps and opportunities for cross-functional collaboration
- Provide suggestions and recommendations to presenters on data collection methods and future analyses
- Inform the best way to communicate monitoring efforts in the St. Anns Bank MPA to the public

The workshop was chaired by Nick Jeffery (DFO Science) and Camille Mancion (DFO Marine Planning and Conservation) and had over 43 participants. Camille Mancion presented an overview of the establishment, cultural significance and management of the SAB MPA. Ryan Stanley (DFO Science) provided a brief overview of the recent CSAS data review and current science programs operating in the MPA. Nine presentations on various research programs occurring in the MPA were then given by various organizations, including DFO, Natural Resources Canada, Cape Breton University, the Ocean Tracking Network (OTN), and the Cape Breton Fish Harvesters Association. A brief question period was held after each presentation, followed by longer discussions at the end of each theme to discuss potential information gaps, suggestions for monitoring, and the development of potential collaborations among workshop attendees.

In the afternoon, Remi Daigle (DFO Science) presented an app developed in R *shiny* co-developed with Jaimie Harbin (DFO Science) which focused on data exploration and visualization for the SAB MPA. The app includes a map and shapefile of the MPA boundaries, as well as datasets from DFO Science, including acoustic telemetry, environmental DNA, snow crab trawl survey, and the summer ecosystem survey. The app allows users to select and map datasets, and explore basic statistics from these data,

such as species accumulation curves and species compositions at various sample sites. It provides a simple interface to explore data and trends over time in the SAB MPA, and eventually, other conservation areas as well. However, it is still in development and is currently only available to DFO staff.

Throughout the workshop, the interactive tool Mentimeter was used to engage virtual and in-person participants, beginning with a Word Cloud activity on the importance of St. Anns Bank to participants (Figure 2). The term 'connectivity' emerged as the most common answer, indicating the importance of the MPA as a migration area for different species between the Scotian Shelf, Newfoundland and Labrador, and the Gulf of St. Lawrence.

Figure 2. A word cloud generated in Mentimeter using responses from workshop attendees when asked why St. Anns Bank is important to them.

Information Presented

In this section, the title and abstracts for every oral presentation are included as written by the presenting author(s). Presenter names and affiliations are provided for each presentation. The presentations were organized under three themes, including 1) Geology, 2) Monitoring Marine Mammals and Ambient Noise, and 3) Ecosystem and Fish/Invertebrate Species Monitoring Trends.

Theme: Geology

The Diversity of St. Anns Bank Geology: From Lava Flows and Coal Measures, Glacial Imprint & Iceberg Scour, to Recent Current-scoured Mud

Edward (Ned) King, Natural Resources Canada, Geological Survey of Canada-Atlantic

St. Anns Bank, off eastern Cape Breton, has diverse seascapes reflecting influences from bedrock type, glacial sculpting and deposition and both past and present-day oceanographic elements. Its diversity includes most of the elements that characterize large areas of the mid and inner Scotian Shelf. Topography is strongly controlled by bedrock. The main elevated feature is a questa-form, comprising a flat-surfaced but gently south-dipping face comprising erosion-resistant lava flows with a basalt affinity and a steeper north scarp that drops to a flatter terrain comprising gently folded Carboniferous sedimentary strata of sandstones and mudstones. The basalt is a local intrusion into the strata that occurred in the early Cretaceous, very young in the regional context, and the only known outcropping example. A land-based analogue is the (older) North Mountain basalt along the south shore of Minas Basin. With very little sediment cover, meso-morphologic expression is stepped and tabular. It was exposed a short time during the glacial low-stand of sea-level when a series of ridges near the top apparently formed from coastal (beach) redistribution of sand and gravel. The Carboniferous bedrock strata also express a meso-morphology of multiple low-relief ridges and troughs following individual harder and softer strata. Land-based analogues are the coal-bearing measures of the Sydney area. The glacial imprint is dominated by thick tills in the east but thin cover in the central and west with a variety of scales and orientations of fluting, moraines and drumlinized forms. Stacked sequences of tills flanking the Laurentian Channel are topped with a network of relict iceberg scours which express near-randomly oriented troughs and berms formed both in till and overlying glacimarine mud. They were formed during deglacial calving of the ice stream and remain much as when they first formed but with variable trough infill of sandier material. A dominant SSE glacier flow under full glaciation is inferred from mid and small sized terminal moraines and drumlins and fluted terrain which evolved to variations on southwesterly flow under deglaciation. Several depositional phases appear to be superimposed. Deglaciation and subsequent sea-level low-stand at about 65 m below present contributed to muddy infill in several sub-basins under a variable influence of wave and current processes. Current-parallel elongation of pockmarks in post-glacial mud magnifies to winnowing, sand dunes and various forms of current-parallel furrowing. This produced a variety of seabed textural facies dominated by gravel and cobbles in shallow water transitioning to sandier and then muddier in the

basins. Past and present seabed currents flowed south and southwest and attest to the influence of the proto and present Nova Scotia Current (King 2014).

Theme: Monitoring Marine Mammals and Ambient Noise

Vessel activity and low frequency underwater sound in the St Anns Bank MPA from 2015 to 2023

Jinshan Xu, Fisheries and Oceans Canada, Bedford Institute of Oceanography

St. Anns Bank Marine Protected Area (MPA) serves as an important corridor for various marine species, including fish and marine mammals. Since 2015, a network of sub-surface moorings outfitted with autonomous underwater acoustic systems has been deployed within the MPA to monitor the vocalizations of baleen whales. In this investigation, underwater acoustic data collected from these moorings within St. Anns Bank MPA from 2015 to 2023, along with Automatic Identification System (AIS) data, has been analyzed to examine both ocean ambient noise and anthropogenic noise (Figure 3). The vessel traffic within the St. Anns Bank MPA encompasses several categories. Among these, cargo ships, tankers, fishing vessels, and passenger ships constitute the majority of maritime activity. The noise budget contribution from vessel traffic, wind, and other contributors have been estimated quantitatively based on vessel detection based on single hydrophone data (Breeze et al, 2021, Miller et al 2008) and High-Resolution Deterministic Prediction System (HRDPS) wind data. In the low frequency band (1/3 octave band centered at 100hz), vessel noise is dominant in most of these observation sites, especially for the shallow ocean locations (Figure 4). Vessel noise also varies in different seasons which could be due to either shipping traffic pattern shifts or varying sound propagation conditions.

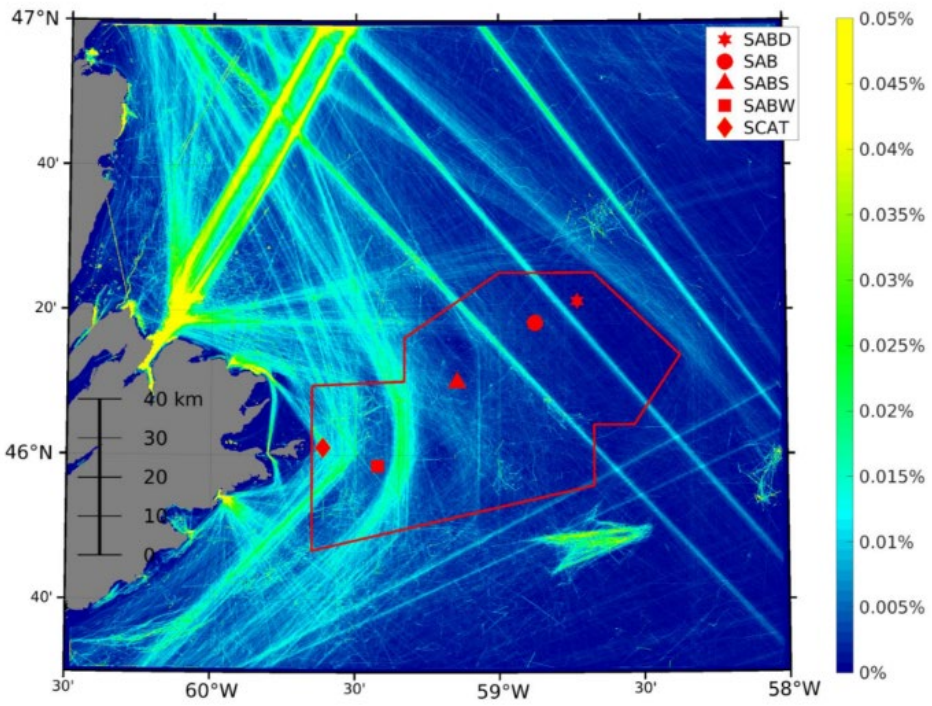

Figure 3. Vessel traffic density from 2017 to 2023 in and around the SAB MPA. The red symbols represent passive acoustic moorings (PAMs), including SAB Deep (SABD), SAB Shallow (SABS), SAB West (SABW), and Scatarie Island (SCAT).

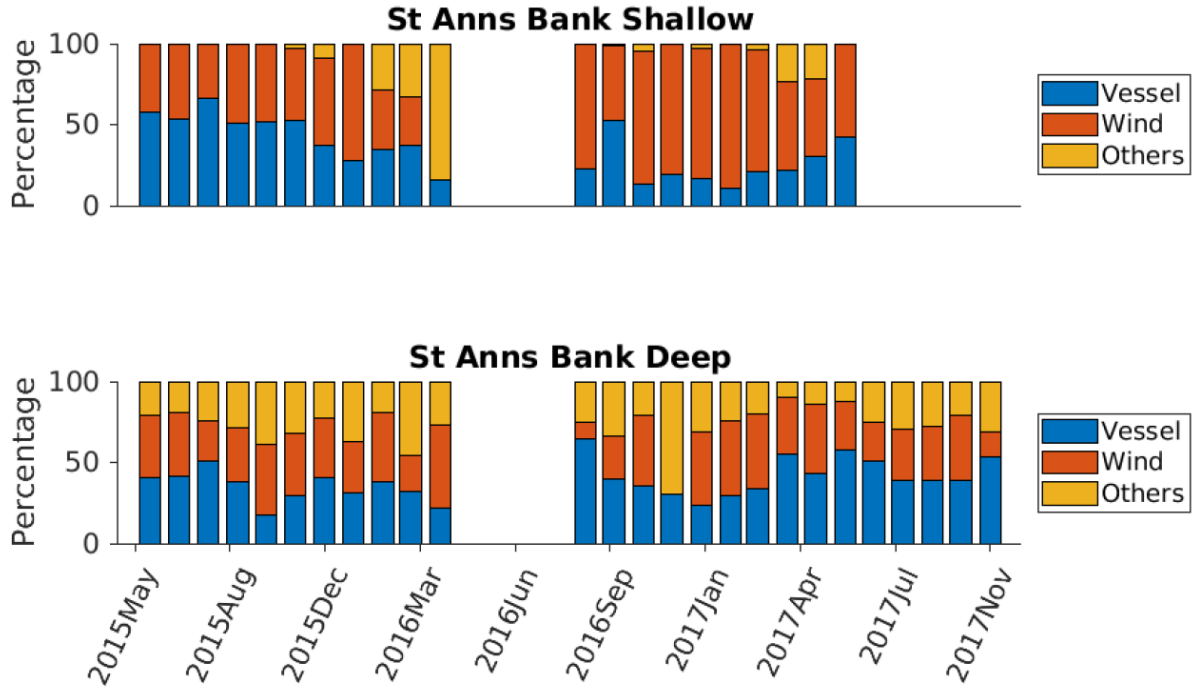

Figure 4. 100Hz noise energy budget between 2015-2017 in two acoustic mooring sites: St. Anns Bank Shallow (SABS) and St. Anns Bank Deep (SABD).

Abundance and Distribution of Grey and Harbour Seals

Christine Abraham and Nell den Heyer, Fisheries and Oceans Canada, Bedford Institute of Oceanography

Our knowledge of the summer abundance and distribution of harbour seals in eastern Canada is limited due to lack of surveys. Between 2019 and 2021, land and aerial surveys were conducted to determine the size and distribution of harbour seal haulouts along the Atlantic coast of Nova Scotia (NS) and Bay of Fundy and in the Bras D'Or Lake, NS. The minimum count of adult and pup harbour seals was 2,161 and 165, respectively. Harbour seals were mostly observed close to shore, in small groups and concentrated in the Bay of Fundy and Southwest NS (SWNS). Only four adult and two pup harbour seals were counted on Sable Island. This was the first comprehensive seal survey for the Atlantic coast of NS and the Bay of Fundy and establishes a new time series for future population studies.

Grey seals form a single population that is divided into two herds in Canada for management purposes based on the location of breeding sites: Scotian Shelf (Sable Island and Coastal Nova Scotia) and Gulf of St. Lawrence (Gulf) (Figure 5). As done previously, pup production was assessed through aerial surveys in 2021 and estimated at 98,200 (95% CI= 86,800–109,700), with 81,300 (95% CI= 74,500–88,100) born on the Scotian Shelf, and 16,900 (95% CI= 12,300–21,500) born in the Gulf. Sable Island was the largest colony with 76,600 (95%= 70,800–82,300) pups (78% of the total). The 2021 survey marks the first time in 60 years that the estimate of pup production has decreased on Sable Island. A new integrated population model (IPM) was used to convert pup production estimates to total population size in 2021 at 366,400 (95% CI= 317,800–409,400, rounded to the nearest 100). For the Scotian Shelf, the total abundance estimate was 310,700 (95% CI= 263,200–351,500); the Gulf was 56,000 (95% CI= 48,600–64,600). The rate of growth of the population has continued to slow. Total abundance increased at a rate of 1.5% per year between 2016 and 2021. Juvenile mortality is an important driver in our estimates of abundance and provision of harvest advice. However, the level of juvenile mortality and how it changes over time is poorly understood.

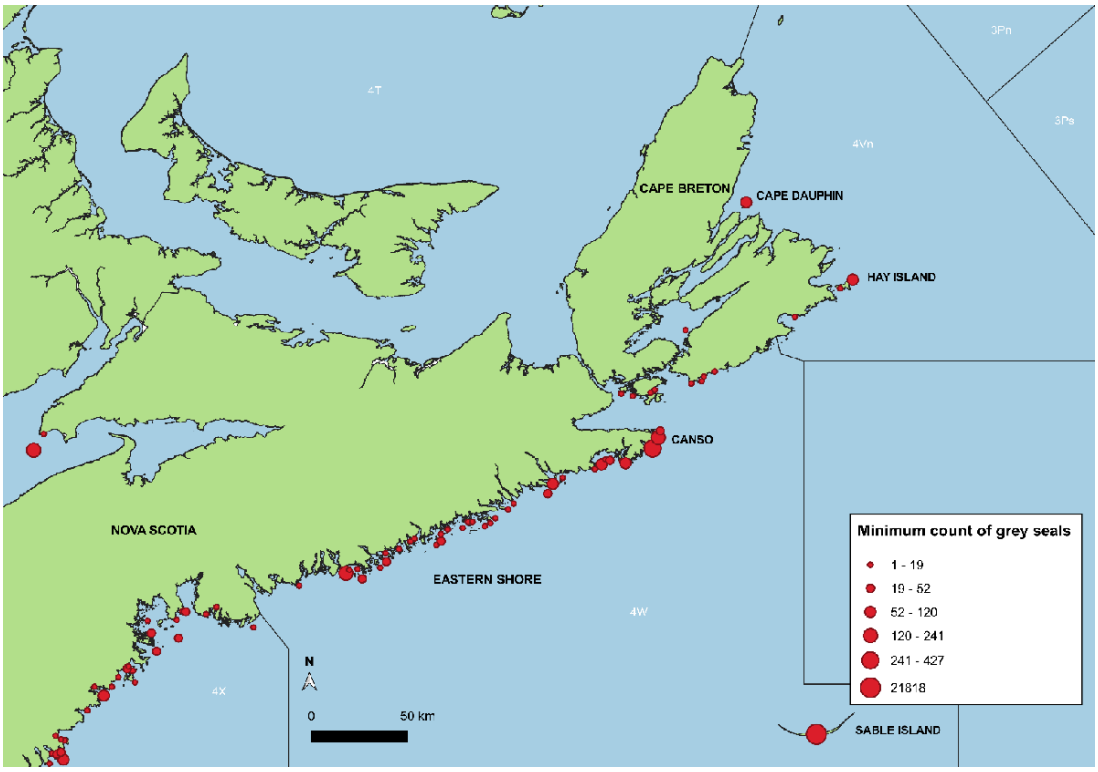

Figure 5. Minimum counts of grey seals across Atlantic Nova Scotia between June 14-17 2020, including Hay Island which is the closest haul out area to the SAB MPA.

Theme: Ecosystem and Fish/Invertebrate Species Monitoring Trends

DFO Maritimes Region Ecosystem Survey

Ryan Martin[1] and Nick Jeffery[2]

[1] Fisheries and Oceans Canada, St. Andrews Biological Station, [2]Bedford Institute of Oceanography

The Maritimes region ecosystem trawl survey has occurred each summer since the 1970s and was a key data source for the designation of St. Anns Bank MPA. This survey implements a random stratified design across the Scotian Shelf and Bay of Fundy, which provides information on fish biomass and abundance for stock assessment purposes, as well as fish and invertebrate diversity, oceanographic data, and marine bird and cetacean sightings data. Since the designation of SAB as an MPA, the ecosystem survey has collected data on benthic fish and invertebrates in 2017, 2019, and 2023 for a total of 13 sets (Figure 6). Over 160 species of fish and invertebrates were captured in the MPA in those three years, and the 13 trawl sets sampled a combined area of approximately 0.26km^2. The species sampled by this survey show clear separation of community structure in areas shallower than 100m and deeper than 150m, largely corresponding with the dominant substrate types at those depths (i.e., gravel and till at shallower depths, mud at deeper depths) (Figure 7). To help mitigate potential bottom impacts of the trawl, the survey is transitioning to new trawl gear with lighter and smaller doors (550 vs 1000 kg), rockhopper ground gear, and shortening both the tow duration (30 to 20 min) and distance (1.75 to 1 nautical miles). Overall, the summer ecosystem survey collects valuable data and samples on species diversity and biomass and is a valuable tool to help monitor Maritimes region MPAs.

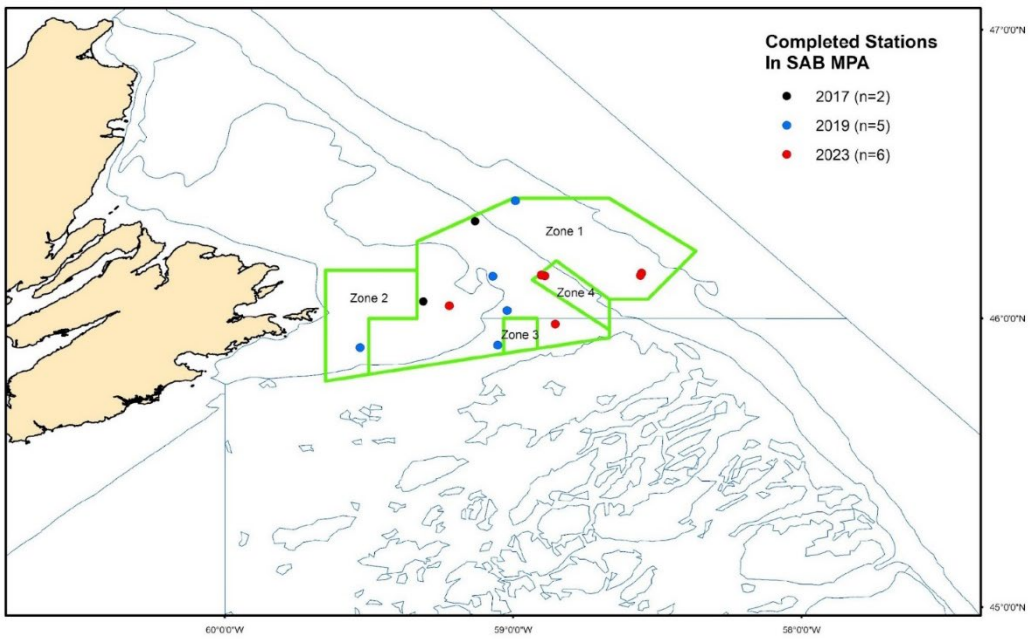

Figure 6. A map of research trawl sets conducted by the DFO Maritimes ecosystem survey in 2017 (black), 2019 (blue), and 2023 (red), in the St. Anns Bank MPA (green polygon). A total of 13 sets occurred over these three years.

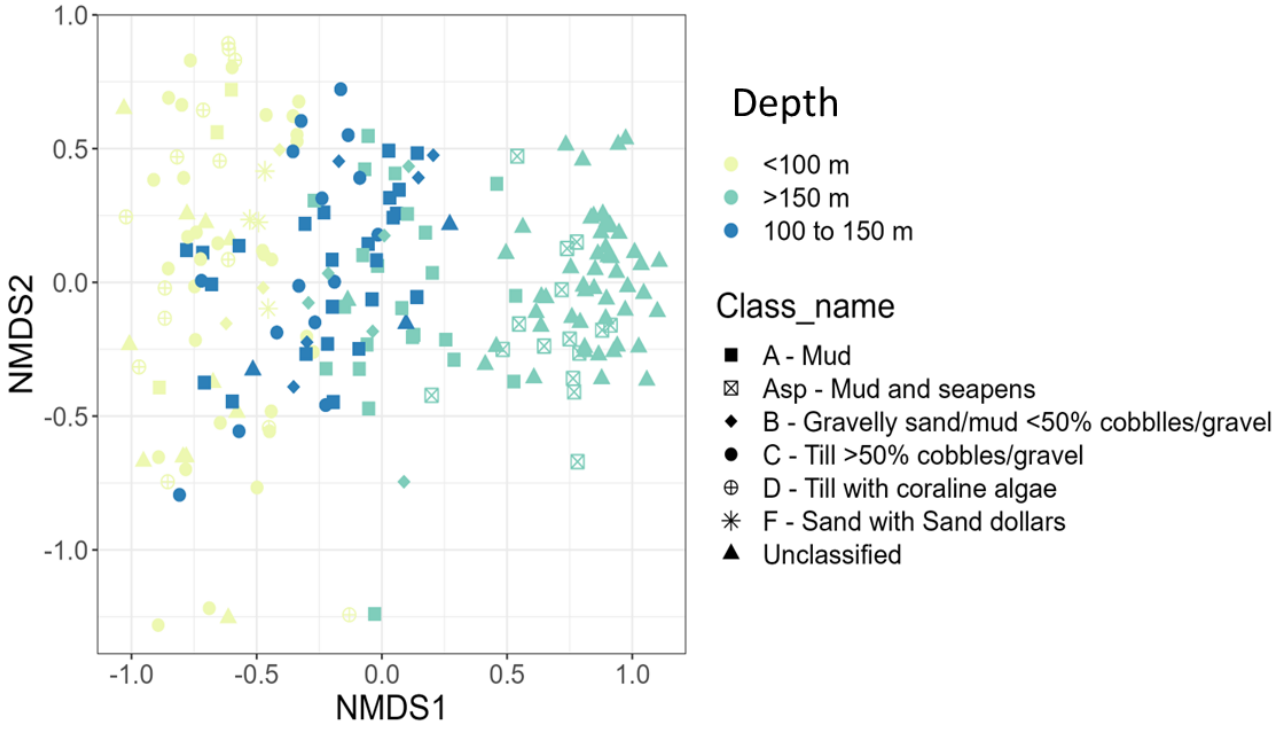

Figure 7. A non-metric multidimensional scaling plot of benthic fish and invertebrate communities collected in the SAB MPA by the DFO summer ecosystem survey. Clear

separation of benthic communities is seen corresponding to depth and benthoscape classification.

A renewed focus on benthic habitats and faunal assemblages in the St. Anns Bank MPA using near-seafloor optical imaging tools

Peter Lawton[1], Laura L. Teed[1], Javier Murillo Perez[2], Ryan Stanley[2], Nick Jeffery[2], and Kirk Phelan[2]

[1] Fisheries and Oceans Canada, St. Andrews Biological Station, [2] Bedford Institute of Oceanography

In August 2023 we conducted the first near-seafloor optical imagery survey in the St. Anns Bank Marine Protected Area (MPA) since 2015. Using high-resolution multibeam bathymetry data (5-35 m resolution) acquired from the Canadian Hydrographic Service, target sites were selected based on unique bathymetric features (e.g. Scatarie Bank and Curdo Bank) and to overlay new geo-referenced imagery coverage against prior surveys conducted in the MPA. Prior surveys include DFO optical imagery surveys (2009 and 2015), DFO ecosystem trawl surveys where benthic invertebrate by-catch was enumerated (2017-2022), and a series of optical imagery ground-truthing locations used to develop a benthoscape classification within the MPA (2013-2014; Lacharité et al., 2017; Marine Geophysical Research 39: 307-322). The 2023 survey also represented the first full field implementation of the new DFO Maritimes Region fibre-optic based imaging system (FOBIS) instrument package, developed primarily for use in bioregional marine conservation network ecological monitoring. The FOBIS instrument package provided two primary imagery sources: a SubC 1Cam Alpha 6 video camera provided continuous downward-facing digital video of the seafloor, and a Nikon D850 camera (oriented downward and under operator control from the surface) provided digital still images at periodic intervals (with a target of 30-s intervals) during each transect. A separate forward-facing video camera was used for monitoring the seafloor ahead of the instrument package (to avoid obstacles) and yielded supplementary imagery for generalized assessment of benthic habitat features. Altitude above the seafloor as well as other instrument diagnostics, and CTD measurements from an onboard sensor, were recorded in real time at the surface using custom software. The FOBIS package, capable of deployment to 200 m depths, was used in a drift survey mode keeping approximately 1 m above the seafloor, and was tracked using an acoustic positioning system. Sixteen near-seafloor optical imagery transects were conducted over five survey days (Figure 8), simultaneously collecting over eight hours of both forward- and downward-facing video and ~1800 high-resolution still images (with average seafloor area ~2 m^2). Transects ranged from 0.9 to 2.9 km in length, for a total distance surveyed of over 20 km, and covered depths from 19 to

144 m. Ten transects of primary interest were selected for preliminary identification of benthic species presence (to the lowest taxonomic level possible using imagery alone). High-quality digital still images were selected approximately 50 m apart along each transect, resulting in 210 images analyzed using the image annotation software BIIGLE (https://biigle.de/) (Figure 9). Preliminary results found extensive patches of an ecologically and biologically significant crinoid species, as well as a high species diversity on the shallow banks. Species identifications (currently over 350 benthic organism "labels" within a BIIGLE species identification tree) will be confirmed with taxonomist input before undertaking comparisons of benthic assemblage composition between the new and historical benthic surveys within the MPA. We expect to survey the St. Anns Bank MPA again in 2024 to expand overall spatial coverage, and to further standardize ecological monitoring approaches using these new near-seafloor optical imaging tools and image annotation approaches.

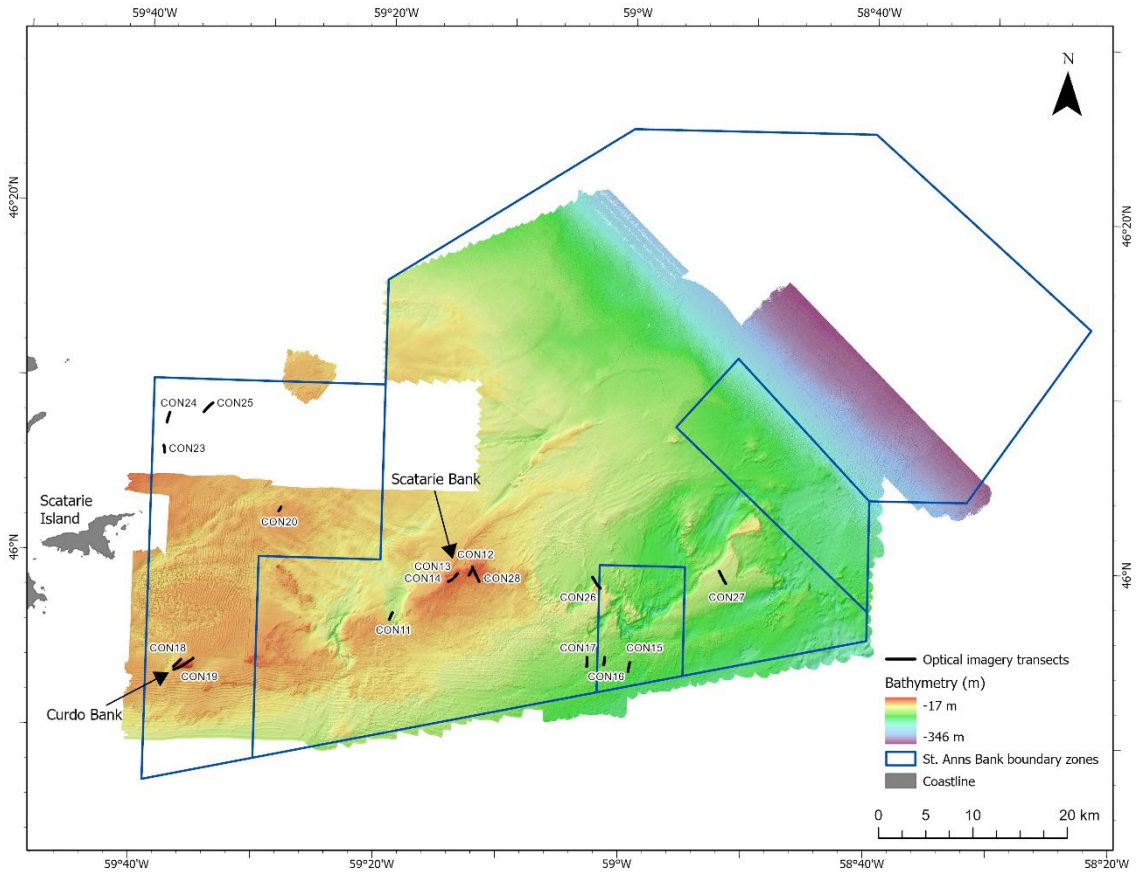

Figure 8. Camera transects conducted within the SAB MPA in August 2023. The transects focused on banks within the MPA (Curdo Bank – CON18, 19, and Scatarie Bank – CON12, 13, 14, 25), management zone comparisons, and areas of unique benthoscapes.

Figure 9. An example image from BIIGLE annotating various benthic organisms from a camera transect in the MPA. Large feather stars (Crinoidea) are prominently shown, while other smaller species are identified and coloured according to their phylum.

The Scatarie Bank Experiential Research Site

Bruce Hatcher[1], John Lindley[2], and Tim Rawlings[1]

[1] Department of Biology, Cape Breton University, [2] Department of Biology, Dalhousie University

Scatarie bank is a unique ecological community within the SAB-MPA that is worthy of detailed research as an indicator ecosystem at an oceanographic crossroads. An outcrop of early cretaceous basaltic flows that has intruded into carboniferous, sedimentary rock, the bank is a small feature in the western part of the MPA that rises from deep water to 25m depth. The Scatarie Bank Experiential Research Site (SBERS) occupies the shallowest part of Scatarie Bank (25-28m) where a permanent mooring with oceanographic instruments and Autonomous Reef Monitoring Structures (ARMS) was deployed in December 2023 (Figure 10). At SBERS, divers can enjoy the underwater beauty of the bedrock benthoscape of the SAB MPA, potentially increasing the publicity of the MPA and creating local pride in marine conservation. SBERS is dominated by high rugosity substrates, and a diversity of macroalgae, though kelps at SBERS show signs of abrasion from the extreme hydrodynamic conditions. Sessile invertebrates, especially sponges and

bryozoans are abundant and can be large, but mobile invertebrates are rare. Benthic fishes at SBERS are also rare, but schooling fish can be abundant, likely drawn to the area by the shallow and productive waters on Scatarie Bank. While Scatarie Bank is difficult to reach and work at, primarily due to distance from shore, weather, and high currents, the area is worth additional research from SCUBA divers and benthic imagery. A virtual reality game based on video from SBERS has been developed and is undergoing improvements to make this offshore bank more accessible to the public.

Figure 10. A permanent mooring located at the Scatarie Bank Experiential Research Site within St. Anns Bank MPA. The platform hosts several Autonomous Reef Monitoring Structures (ARMS), and instruments to record temperature and salinity over time.

The Ocean Tracking Network: supporting acoustic telemetry in St. Anns Bank

Caitlin Bate, The Ocean Tracking Network

The Ocean Tracking Network (OTN) is a global aquatic research, data management, and partnership platform headquartered at Dalhousie University in Halifax, Nova Scotia, Canada. OTN's mission is to inform the stewardship and sustainable management of aquatic animals by providing knowledge on their movements, habitats, and survival in the face of changing global environments. Since 2015 we have partnered with the Department of Fisheries and Oceans Canada and snow crab fishers to deploy and maintain an acoustic

receiver array in the St. Anns Bank Marine Protected Area (Figure 11). This array listens for the presence of acoustically tagged marine animals inside the MPA. Knowledge generated through OTN collaborations is used provincially, federally, and internationally to help guide the management of valued aquatic species and the sustainable use of ocean and freshwater resources. This partnership is fostering international-scale collaboration and transforming aquatic species research into knowledge that benefits everyone.

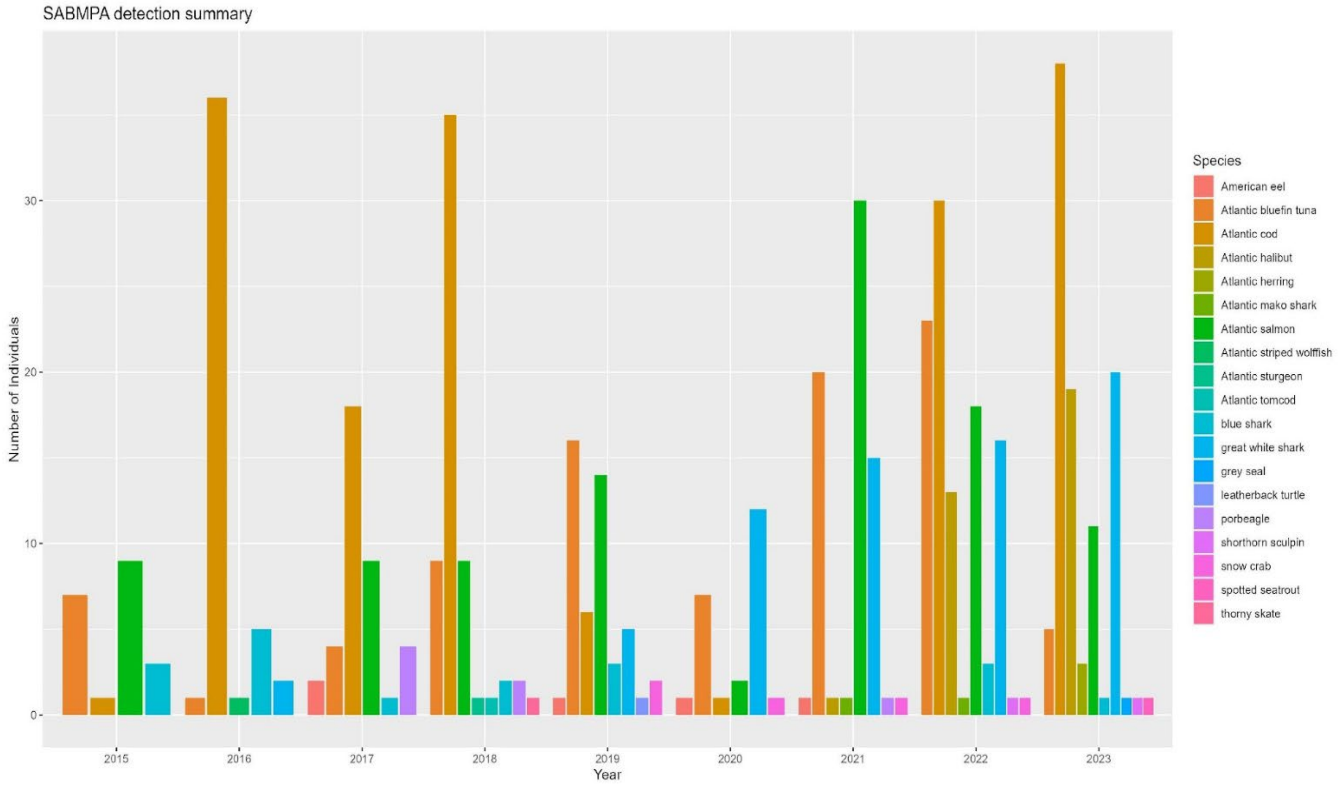

Figure 11. Summary of animal detections from acoustic receivers in the St. Anns Bank MPA from 2015 to 2023.

Assessing fish and invertebrate diversity in the St. Anns Bank MPA using Environmental DNA metabarcoding

Nick Jeffery, Ryan Stanley, Heidi Gavel, and Harri Pettitt-Wade, Fisheries and Oceans Canada, Bedford Institute of Oceanography

Since 2021, DFO Science (Maritimes Region) has conducted water sampling and CTD (conductivity, temperature, depth) casts at various stations across the SAB MPA to collect environmental DNA samples for biodiversity monitoring (Figure 12). Using a six-bottle (4L each) CTD rosette (Seabird), triplicate surface and bottom water samples are collected where possible across the MPA, which are then filtered over a 0.22µm filter to capture eDNA from fish and invertebrates. Samples are sequenced on an Illumina MiSeq platform

at two markers (typically COI for general eukaryotic diversity and 12S or 16S for fish diversity) and taxonomy is assigned using public reference databases. In 2022, metabarcoding of eDNA samples revealed 14 fish (Figure 13) and nearly 100 invertebrate species which were primarily planktonic species. eDNA detected the most common fish species that are also captured in the regional snow crab trawl survey, as well as common benthic invertebrates (e.g., Snow Crab, sea cucumbers, and sand dollars). Metabarcoding the COI marker also detected numerous zooplankton and phytoplankton species, such as copepods and diatoms that are not captured in net-based surveys. While preliminary, our results suggest that eDNA is a useful tool to sample parts of the MPA where direct sampling does not take place. eDNA can also detect a broader range of species than net-based surveys which complements other sampling methods to provide a synoptic understanding of biodiversity in the MPA.

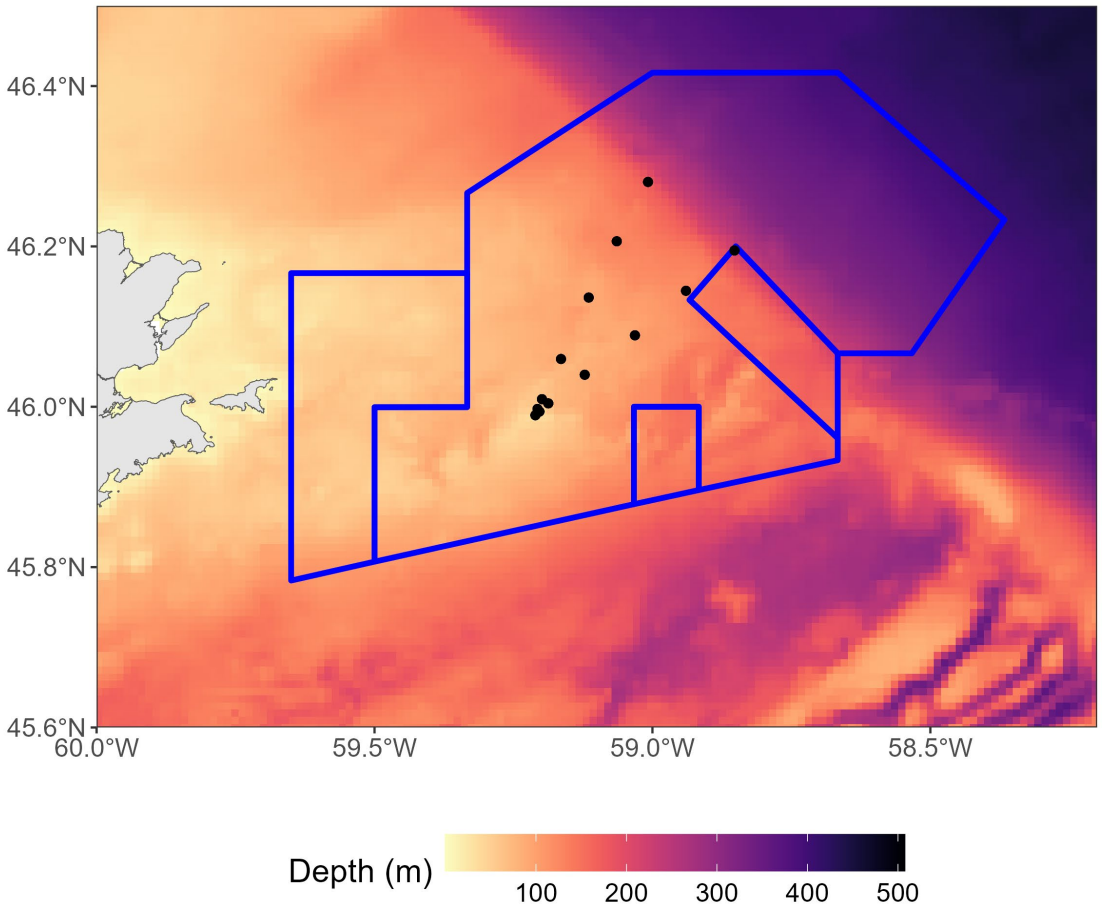

Figure 12. A map of St. Anns Bank MPA showing eDNA stations sampled in August 2022 (black circles). The survey design radiates towards deeper water (darker shading) from Scatarie Bank (lighter shading).

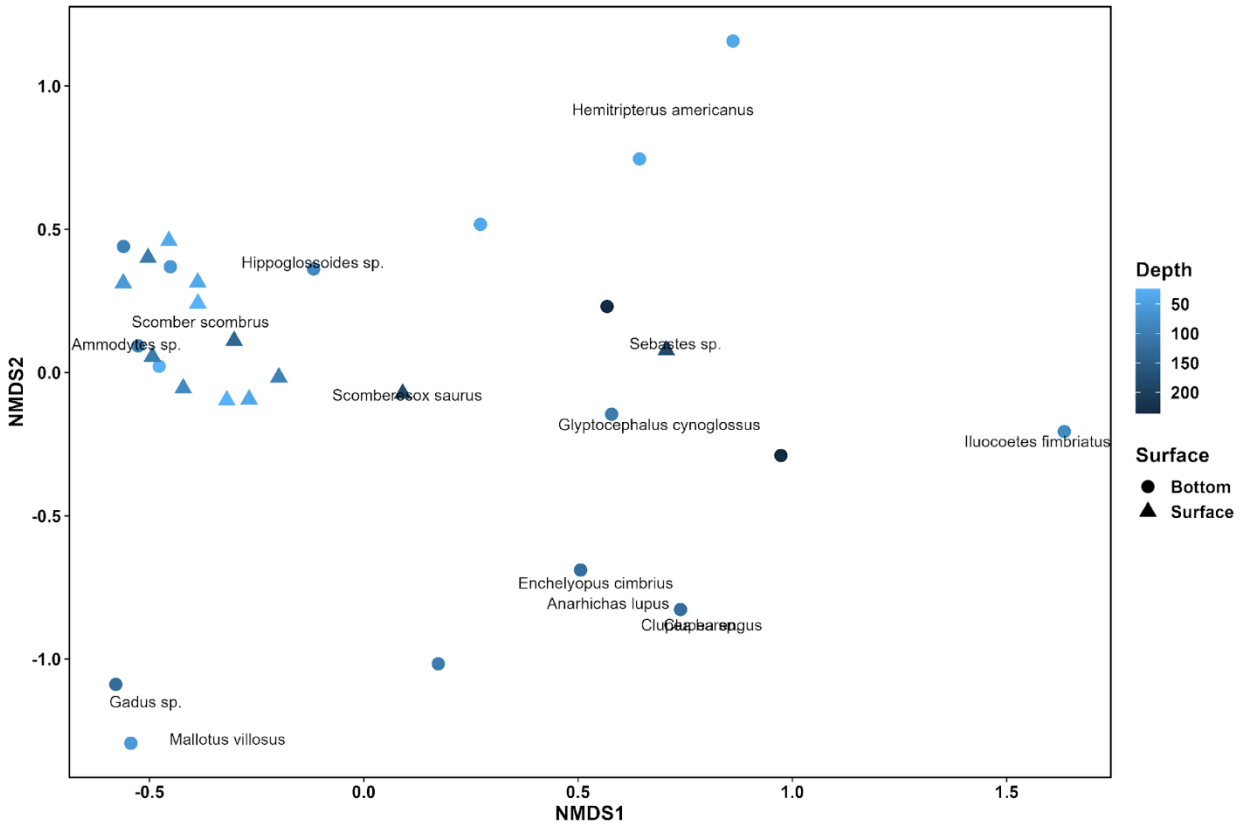

Figure 13. Non-metric multidimensional scaling (NMDS) plot of fish diversity using the 16S Teleo fish markers for eDNA samples collected in summer 2022 from the SAB MPA. A clear separation of benthic and pelagic samples can be seen.

CBFHA Ecosystem Monitoring within the St. Anns Bank Marine Protected Area

Fiona Peets, Cape Breton Fish Harvesters Association

The Cape Breton Fish Harvesters Association (CBFHA) developed a project that aimed to provide a greater understanding of the biological diversity within the St. Anns Bank Marine Protected Area through various ecosystem monitoring techniques. With careful calculation and provisions in order to minimize environmental impact while sampling in the MPA, monitoring techniques included using baited remote underwater video (BRUV) cameras in Zone 2 capture to sea-floor images over a span of 24 hours and using a remote operated underwater vehicle (ROV) to move freely through the water column in order to capture video footage of the MPA. A water sampler rosette containing a CTD was also used to collect water samples in the different zones of the MPA which were then filtered over specialized filters and analyzed for environmental DNA (eDNA) (Figure 14). This essentially provides a list of all species present within the area of where the water sample was taken. Despite challenges faced, some sampling was still possible during the project timeline. An

additional plan to do more eDNA sampling along Cape Breton's shoreline was also developed in order to maximize the project's funding.

Figure 14. Deployment (left) of a water sampler rosette by the CBFHA used for eDNA sampling. The rosette (right) contains Niskin bottles to collect water samples at specified depths, and a CTD to record temperature and conductivity profiles of the water column.

Mentimeter results

The workshop highlighted numerous research projects led by various organizations working in the SAB MPA. During discussion periods, several questions were posed to the group using Mentimeter (results in Appendix C). Mentimeter questions and responses are summarized below.

Theme: Monitoring Marine Mammals and Ambient Noise

1. **Do you perceive any information gaps related to the conservation objectives? If yes, what are the gaps? How can those gaps be filled?**

   Incorporation of Mi'kmaq knowledge and traditional use information was identified as a gap under this theme, particularly in providing a different type of baseline information. Another gap highlighted was the lack of information on biodiversity and areas of high biodiversity in certain parts of the MPA, particularly the pelagic zones and areas extending from the shelf break to deep portions of the Laurentian Channel. This is because there are no fisheries-independent surveys for pelagic fish that occur in the MPA, and deep portions of the MPA are beyond the operational limits of net-based surveys, such as the summer ecosystem survey. Most surveys in the MPA, including the DFO-industry Halibut longline survey, the Maritimes Snow Crab survey, and the summer ecosystem survey sample benthic and demersal fishes and invertebrates.

   For marine mammals, several information gaps were identified including the impacts of current fishing activity on marine mammals, and the lack of research on marine mammal presence and vessel traffic. There was discussion on the types of marine mammal data collected and analyzed to date (presence and species diversity), including whether additional information such as spatial and temporal use patterns should be explored. The following question was raised: can various programs based on acoustic signal detections be integrated to enhance overall data availability?

   It was also noted that additional multibeam coverage should be conducted to complete benthoscape mapping in St. Anns Bank. As of 2024, 63% of the SAB MPA was mapped using multibeam, and additional multibeam mapping is planned in the near future. Finally, climate change was also identified as a knowledge gap under this theme.

Theme: Ecosystem and Fish/Invertebrate Species Monitoring

2. **Do you perceive any information gaps related to the conservation objectives? If yes, what are the gaps? How can those gaps be filled?**

Similar to the previous theme, research and information gaps were noted in the deep water portions of the MPA towards the Laurentian Channel. Increased collaboration across different projects could help address this gap, which could be accomplished through more frequent workshops or meetings to discuss projects and monitoring in SAB MPA. Moreover, developing an activity map to illustrate research efforts inside the MPA and the data available was suggested to enhance internal and external coordination. Creating an overview of different projects that link to indicators and MPA conservation objectives was also suggested as a way to enhance understanding of information gaps.

To study benthic assemblage distributions and develop integrated approaches, small working group meetings could be established with researchers using different types of technology. In addition, sediment baseline research was suggested as an important component of further understanding benthic habitats.

There was discussion on establishing sentinel sites inside the MPA that could be compared with sites outside the MPA boundary to assess management effectiveness. It was suggested that sentinel sites inside the MPA could be used to develop monitoring plans and evaluate trends. Next, it was noted that fishing activity inside Zones 2-3 of the MPA could be evaluated and compared with fishing activity outside the MPA.

Seasonal gaps in oceanographic measures and properties, and long time-series data were identified as information gaps. Studying both primary productivity and net productivity were recommended, noting that bio-geophysical modelling is required for this type of research.

Furthermore, increasing research on sea turtle migration and foraging behaviour in the MPA was highlighted given that Leatherback turtles are identified as a conservation priority for the St. Anns Bank MPA. Additionally, DNA barcode libraries, used for eDNA sampling, were noted as an information gap under this theme. Finally, it was recommended to conduct additional work to fill human use and cultural connection knowledge gaps within the MPA.

Additional questions

3. What additional opportunities do you see for collaboration on research & monitoring in St. Anns Bank?

Mi'kmaq-led initiatives and incorporating Mi'kmaq knowledge in research and monitoring were identified as opportunities for the SAB MPA. The MPA could also benefit from engaging local Unama'ki/Cape Breton communities to increase interest in

the MPA and collaboration on emerging monitoring or research topics. One potential avenue to better engage with local communities could be through participation in local outreach events in Cape Breton. Additional opportunities for outreach were discussed including upgrading the Scatarie Bank Experiential Research Site (SBERS) virtual reality dive that was developed several years ago. The SBERS virtual reality dive, hosted at the Marine Science and Heritage Centre in Louisbourg, allows visitors to explore marine life in the St. Anns Bank MPA through a virtual dive in a submarine.

Identifying opportunities for collaboration on shared missions with partner organizations and neighboring DFO regions (Quebec and Newfoundland) was highlighted an opportunity for information sharing, complementary surveys, and to address regional vessel issues as vessel time has been limited in the Maritimes Region following the decommission of CCGS *Hudson* in 2022. Furthermore, supporting capacity building for external organizations that conduct surveys or use technologies that DFO has experience using was also noted as an opportunity for collaboration.

In December 2023, Cape Breton University deployed permanent mooring structures with oceanographic instruments and Autonomous Reef Monitoring Structures (ARMS) in Scatarie Bank (Zone 1 of the MPA). It was suggested that additional logging and monitoring instruments could be moored to the seabed in Scatarie Bank and used by various research groups and organizations. Careful consideration is required for planning and deployment of these structures in the area as oceanographic (strong currents at different depths) and weather conditions (high winds) in Scatarie Bank can be unpredictable.

Several ideas were proposed on SCUBA diving in St. Anns Bank including community and scientific dive charters to Scatarie Bank and Curdo Bank, which are both within recreational dive limits (<40 metres). Collaborating with the dive community was also suggested to increase vessel opportunities and citizen science in the SAB MPA.

Furthermore, enhancing international researchers' interest can increase opportunities for collaboration with MPAs across the border including "sister sites" such as Stellwagen Bank National Marine Sanctuary in the United States. Similarly, academic partnerships and opportunities for students (undergraduate and graduate) should be leveraged for resources, expertise and research projects that can contribute to MPA monitoring, using SAB data. One suggestion was to host a hackathon to engage graduate students in solving a complex problem, using data from the SAB MPA. Additionally, increasing open data and conducting research on the SAB MPA in the context of global MPA networks was also recommended.

Finally, annual workshops and coordination meetings were suggested to enhance communication and collaboration across research teams and organizations conducting research and monitoring efforts in the St. Anns Bank.

4. **What are the best ways to communicate monitoring efforts & interesting findings?**

To answer this question, participants were asked to rank several options that were presented to the group. Newsletters and annual reports received the top number of votes, followed by the website, then webinar series, in-person workshops/meetings, infographics, social media and finally, videos.

Recommendations and Future Workshops

Following the workshop, an anonymous feedback survey was circulated to workshop participants. In total, 11 responses were received. Survey respondents voiced that the workshop was indeed useful to showcase scientific projects occurring in the MPA and to seed potential collaborations among researchers and organizations. The feedback suggested that participants enjoyed using Mentimeter as an engagement tool during the discussion period. It was noted that there was insufficient time during the day to allow for proper discussion of the projects themselves, or potential collaboration opportunities and relationship-building. Participants recommended holding regular workshops (e.g., bi-annually) to keep researchers, collaborators, and partner organizations up to date on monitoring and research projects taking place in the MPA. An online space for collaboration amongst all participants was suggested as a way to share future planned work and resources available for partner organizations.

In future workshops, the goal is to have further discussions on opportunities for Mi'kmaq-led initiatives and collaboration with Mi'kmaq partners for monitoring the SAB MPA. Workshop respondents highlighted additional topics that could be explored in future workshops including social sciences, science communication, collaboration for monitoring, increasing public knowledge on St. Anns Bank including reporting on multidisciplinary research, and plans for future surveys – including lessons from past surveys.

Acknowledgements

We would like to thank workshop participants for attending and sharing their knowledge, experiences, and perspectives on monitoring and research in the St. Anns Bank MPA.

Special thank you to the presenters for their presentations as well as abstracts, figures, and references prepared for this report. Thanks to Kaleb Zelman for taking notes during the workshop. Finally, we would like to extend our sincere thanks to Catherine Schram and Halle Martin for their feedback and review of this report.

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Appendix A: Workshop Agenda

Time	Presentation	Speaker(s)
9:00-9:15	Welcome and introductions	Chair & facilitator
9:15-9:30	*St. Anns Bank Marine Protected Area*	Camille Mancion (DFO)
9:30-9:45	*Summary of Regional Peer Review Process (March 5-6)*	Ryan Stanley (DFO)
Geology		
9:45-10:10	*The Diversity of St. Anns Bank Geology: From Lava Flows and Coal Measures, Glacial Imprint & Iceberg Scour, to Recent Current-scoured Mud*	Edward King (Natural Resources Canada)
10:10-10:25	**BREAK**	
Monitoring marine mammals and ambient noise		
10:25-10:40	*Vessel Activity and low-frequency underwater sound in St Anns Bank from 2015 to 2023*	Jinshan Xu (DFO)
10:40-10:55	*Abundance and Distribution of Grey and Harbour Seals*	Christine Abraham & Nell den Heyer (DFO)
10:55-11:35	**DISCUSSION**	All participants
Ecosystem and fish\invertebrate species monitoring trends		
11:35-11:50	*DFO Maritimes Region Ecosystem Survey*	Nick Jeffery (DFO)
11:50-12:50	**LUNCH**	
12:50-13:05	*A renewed focus on benthic habitats and faunal assemblages in the St. Anns Bank MPA using near-seafloor optical imaging tools*	Laura Teed & Peter Lawton (DFO)
13:05-13:20	*The Scatarie Bank Experiential Research Site*	Bruce Hatcher (Cape Breton University)
13:20-13:55	**DISCUSSION**	All participants
13:55-14:10	*The Ocean Tracking Network: supporting acoustic telemetry in St. Anns Bank*	Caitlin Bate (Ocean Tracking Network)
14:10-14:25	**BREAK**	
14:25-14:40	*Assessing fish and invertebrate diversity in St. Anns Bank MPA using Environmental DNA metabarcoding*	Nick Jeffery (DFO)

Time	Presentation	Speaker(s)
14:40-14:55	*Environmental DNA monitoring and longline survey*	Fiona Peets (Cape Breton Fish Harvesters Association)
14:55-15:50	**Discussion and workshop recap using Mentimeter**	All participants
15:50-16:00	Wrap up	Chair

Appendix B: Workshop Attendance

Name	Affiliation	Branch/ Sector
Christine Abraham	DFO Maritimes	Science
Donald Andrews	DFO Maritimes	Eastern Nova Scotia Area Office
Caitlin Bate	Ocean Tracking Network	-
Lindsay Beazley	DFO Maritimes	Science
Bec Borchert	Kwilmu'kw Maw-Klusuaqn (KMK)	-
Stephanie Clay	DFO Maritimes	Science
Andrew Cooper	DFO Maritimes	Science
Remi Daigle	DFO Maritimes	Science
Nell den Heyer	DFO Maritimes	Science
Emmanuel Devred	DFO Maritimes	Science
Pamela Emery	DFO Maritimes	Species at Risk
Genevieve Faille	DFO Quebec	Science
Derek Fenton	DFO Maritimes	Marine Planning and Conservation
Bruce Hatcher	Cape Breton University	-
David Hebert	DFO Maritimes	Science
Nick Jeffery	DFO Maritimes	Science
Owen Jones	DFO Maritimes	Science
Edward King	Natural Resources Canada	-
Peter Lawton	DFO Maritimes	Science
Chantelle Layton	DFO Maritimes	Science
Megan Lynch	DFO Newfoundland	Marine Planning and Conservation
Gabrielle Macklin	DFO Maritimes	Science
Paul Macnab	DFO Maritimes	Marine Planning and Conservation
Camille Mancion	DFO Maritimes	Marine Planning and Conservation
Hilary Moors-Murphy	DFO Maritimes	Science
Alison Penney	DFO Maritimes	Eastern Nova Scotia Area Office
Tanya Pelrine	DFO Maritimes	Marine Planning and Conservation
Fiona Peets	Cape Breton Fish Harvesters Association	-
Harri Pettitt Wade	DFO Maritimes	Science
Joseph Pratt	Ocean Tracking Network	-
Tim Rawlings	Cape Breton University	-
Catherine Schram	DFO Maritimes	Marine Planning and Conservation
Hui Shen	DFO Maritimes	Science
Rabindra Singh	DFO Maritimes	Science
Ryan Stanley	DFO Maritimes	Science
Laura Teed	DFO Maritimes	Science

Name	Affiliation	Branch/ Sector
Nadine Templeman	DFO Newfoundland	Marine Planning and Conservation
Sara Vanderkaden	Oceans North	-
Priyanka Varkey	DFO Maritimes	Science
Margaret Warren	DFO Newfoundland	Science
Kelsey White	Confederacy of Mainland Mi'kmaq (CMM)	-
Tana Worcester	DFO Maritimes	Science
Jinshan Xu	DFO Maritimes	Science
Kaleb Zelman	DFO Maritimes	Marine Planning and Conservation

Appendix C: Mentimeter Results

Theme: Monitoring marine mammals and ambient noise	
Question 1: Do you perceive any information gaps related to the conservation objectives? If yes, what are the gaps? How can those gaps be filled?	
Responses	
Mi'kmaq traditional use and generational knowledge to give a different "baseline" (10 votes)	Pelagic systems are not well studied in this area relative to benthic systems. Surface and midwater-based capture techniques or other methods could fill gaps (7 votes)
Do we know which areas are "marine areas of high biodiversity" within the MPA? (7 votes)	Do we know which areas are "marine areas of high biodiversity" within the MPA? (7 votes)
Biodiversity data from the shelf break and Laurentian Channel (6 votes)	Climate change (5 votes)
Deep water is not really being sampled by anything really. 1/3 of the MPA (Laurentian Channel below 200m) needs more attention (5 votes)	Marine mammals – is general presence and diversity sufficient or do we require more detail on within MPA spatial and temporal use patterns (4 votes)
Effects of current fishing activities (bycatch) (2 votes)	Can we integrate among the different programs that are based on acoustic signal detections to provide increased data availability overall (2 votes)
Would be interesting to have the link between whale presence and traffic. For example, calculate/model collision risk. But maybe harder to have model distribution map of whales to do that (2 votes)	Northwest benthic habitat (1 vote)
Need additional multibeam coverage to complete benthoscape mapping (1 vote)	

Theme: Ecosystem and fish/invertebrate species monitoring
Question 2: Do you perceive any information gaps related to the conservation objectives? If yes, what are the gaps? How can those gaps be filled?

Responses	
The deep sections of the MPA and northern sections in general appear to have a general data gap. Increased collaboration across projects could help meet the challenges of these areas (8 votes)	Not an information gap per se, but I feel internal/external coordination would be greatly enhanced through the creation of an 'activity' map for the data we are collecting in the MPA, and data links (7 votes)
Would agreement on several "sentinel" sites be useful for developing monitoring plans related to evaluating trends within the MPA and co-locating different sensors and survey approaches at those sites (7 votes)	Within the MPA versus reference sites outside the MPA to assess management objectives (6 votes)
Seasonal gaps in oceanographic measures – filled with moored instrumentation packages (5 votes)	To best understand gaps would be nice to have a crosswalk overview of projects to indicators and conservation objectives (4 votes)
Fishing activity levels inside (Zones 2-3) and outside the MPA so that comparisons between inside/outside stations can be better articulated. Access to standardized effort rasters where available (4 votes)	Develop more integrated approaches for documenting benthic assemblage distributions in the MPA, perhaps via smaller workgroup meetings of regional researchers using different technology approaches (4 votes)
Human use and cultural connection (3 votes)	Link to climate change, identify key vulnerable species or indicator species (3 votes)
DNA barcode libraries (2 votes)	Long time-series data (1 vote)
Sea-turtle use in the MPA could use additional work – it was identified early as a priority species (1 vote)	Seasonal in situ measurements of oceanographic properties
Productivity: not just primary productivity, but net (i.e. export) productivity. Some of this is being done, but it requires a bio-geo-physical model (1 vote)	Poaching/unregulated species harvest
Infauna, sediments grain etc.? For benthic habitats, we focus on epifauna but it might be important to do baseline also in the sediment	We did not talk much about sedimentary habitats and infaunal assemblages e.g. In deeper portions of the MPA towards the Laurentian Channel

Question 3: What additional opportunities do you see for collaboration on research & monitoring in St. Anns Bank?	
Responses	
Shared science missions (charter a boat, do a 'bioblitz' of activities)	Engagement with the coastal communities of Cape-Breton – creating interest and investment in the MPA – and fostering new and emerging monitoring/research themes. Lots of positive spin-off benefits.
Mi'kmaw-led projects	Provide capacity building for outside collaborators who may be adopting survey technologies for which DFO has a long history of using (in terms of guidance on best practices etc.)
Collaborate with Quebec region Banc-des-Americains MPA monitoring, exchange on protocol, see opportunity for complementary surveys (e.g. acoustic), and other MPAs in this region	Pose a challenge to graduate students, given them data, create a nominal prize – hackathon to answer a question
Move diving to Curdo Bank or do along with Scatarie	Is there any way to use the shipping traffic as vessels of opportunity? Are CPR lines totally out of date?
Joint dives on the Curdo and Scatarie Banks	Academic partnerships to leverage resources, expertise
Get international researchers interested to connect with sister sites, e.g. Stellwagen Bank in U.S	Host logging instruments on the SBERS mooring
Sentinel stations with instruments supporting many groups	Dive charter to Scatarie Bank
Funding of an upgraded version of the SBRES virtual reality dive	Outreach booths at local Cape Breton events
Research that examines SAB MPA in the context of global MPA networks	More open data!
Dive-in theatre	Look at opportunities to collaborate with DFO NL and joint missions to SAB and Laurentian Channel (was the hope in 2017 & 2018 CHONe missions)

Annual coordination meetings for planned work	It has been a 'death by a thousand meetings' for everyone but I really think a workshop like this one held annually would be a way to enhance communication and collaboration on St. Anns Bank
Vessel-sharing/shared missions	Mi'kmaq knowledge and input
Work with dive community to get more citizen science and vessel opportunities	Engaging more undergraduate and graduate programs. Tons of interesting data that could be incorporated into upper level undergrad classes and graduate programs – these would feed back into the MPA

Question 4: What are the best ways to communicate monitoring efforts & interesting findings?

Responses: