Fisheries and Oceans Canada | Pêches et Océans Canada
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Maritimes Region

Canadian Science Advisory Secretariat
Science Advisory Report 2025/055

REVIEW AND UPDATE OF THE STATE OF KNOWLEDGE AND CONSERVATION PRIORITIES FOR THE EASTERN SHORE ISLANDS AREA OF INTEREST (AOI)

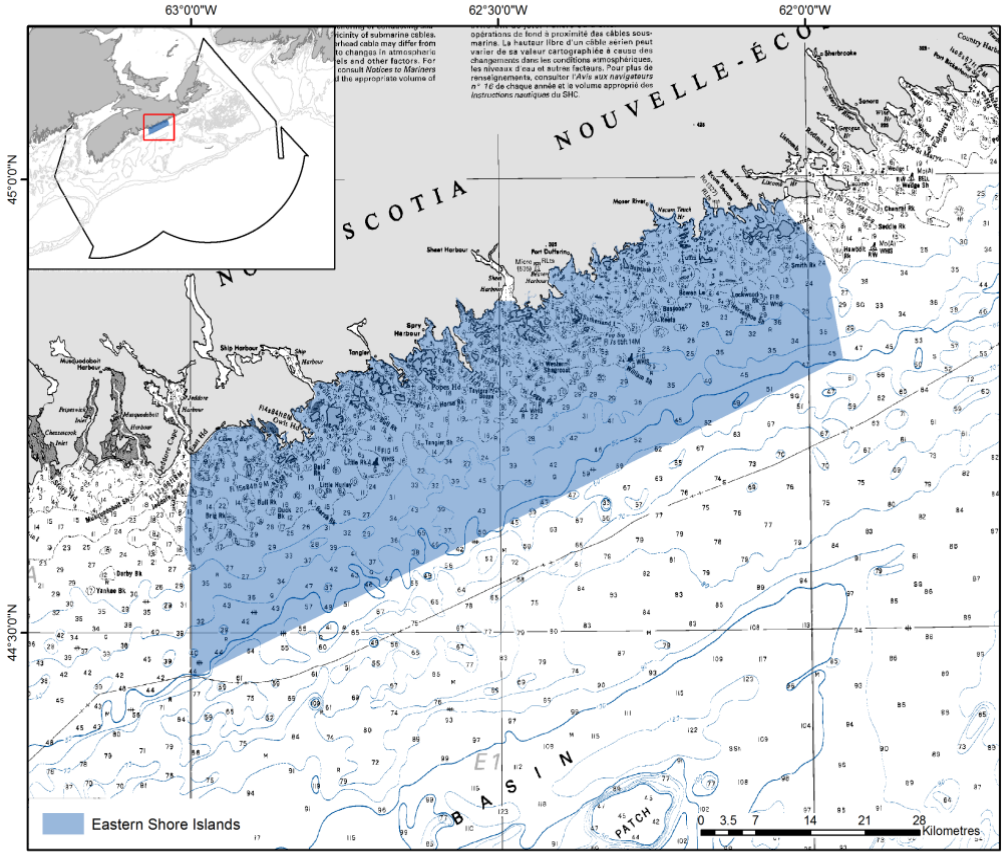

Figure 1. Eastern Shore Islands Area of Interest (AOI; shaded blue) within the Maritimes Region (inset). The AOI boundary is not final, is subject to change, and does not necessarily reflect a proposed Marine Protected Area (MPA) boundary. Basemap: Canadian Hydrographic Service nautical chart 4013 (not to be used for navigation).

CONTEXT

Fisheries and Oceans Canada (DFO) is responsible for the establishment of *Oceans Act* Marine Protected Areas (MPAs) and other effective area-based conservation measures (OECMs) to contribute to Canada's commitment to protect 30% of its oceans by 2030. The Eastern Shore Islands was identified as an Area of Interest (AOI) for *Oceans Act* MPA designation in 2018. That same year, a Biophysical and Ecological Overview for the AOI (DFO 2019; Jeffery et al. 2020) was developed through a Canadian Science Advisory Secretariat (CSAS) peer-review process to support identification of conservation priorities. Although consultation and

engagement on the AOI remains on hold as it has been since 2019, scientific research in the area has continued, leading to significant advancements in data collection and understanding of the oceanography and ecology of the AOI. This process reviewed and updated available baseline ecological data and information collected within the AOI and surrounding area.

The advice arising from this CSAS Regional Peer Review will include a review and update of key biophysical and ecological attributes of the broader study area, potential refinement of the conservation priorities identified in the original Biophysical and Ecological Overview of the AOI (DFO 2019; Jeffery et al. 2020), and the identification of information gaps requiring further research. As a next step, conservation priorities identified through this process will be considered in conjunction with Mi'kmaq knowledge and priorities through the application of an Etuaptmumk (Two-Eyed Seeing) process to refine the list of conservation priorities and inform conservation objectives for the potential MPA. This information will assist in refining the draft MPA vision and goals and will inform subsequent steps of the AOI process.

This Science Advisory Report is from the regional peer review March 4–5, 2025, Review and Update of the State of Knowledge for the Eastern Shore Islands Area of Interest and Surrounding Area. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- The Eastern Shore Islands was identified as an Area of Interest (AOI) for *Oceans Act* MPA designation in 2018, and a Biophysical and Ecological Overview for the area was developed through a Canadian Science Advisory Secretariat (CSAS) peer-review process to support identification of conservation priorities.
- Scientific research in the AOI has continued, including development of oceanographic models, acoustic telemetry, eDNA, juvenile fish seining, SCUBA-based habitat and benthic diversity surveys, mapping of kelp and Eelgrass distribution, and deep-water imagery.
- The Eastern Shore Islands is an area of cultural and ecological significance for the Mi’kmaq people, an area of traditional land and resource use including fishing, hunting, and gathering. Glacial history for the region and geological features are also noted to be important for understanding early Mi’kmaq habitation. Information is provided, where available, on species that were identified in a Mi'kmaq Ecological Knowledge Study for the Eastern Shore Islands area as being important to the Mi’kmaq diet, traditional fishing activities, and culture.[1]

Physical Features of the Eastern Shore Islands

- Bathymetric surveys have now covered approximately 93% of the AOI at a resolution of 10 m or finer, with nearshore areas mapped using bathy-LiDAR and deeper areas with multibeam sonar. This new bathymetry documents depths of up to 150 m in the AOI.
- A new oceanographic model of the AOI shows that the islands influence high particle retention within the archipelago, up to the 60 m isobath, limiting offshore dispersal. Predominantly southwest current flow, periodic wind-driven reversals, and interactions with

[1] Where possible, names of places and species of social, cultural, or economic significance for the Mi’kmaq are provided in **Mi’kmaq** in blue text, *English* in italics, and (*Latin*) in italics and parentheses for species at first mention.

the complex coastline and bathymetry promote upwelling/downwelling processes, and potentially local productivity.

- Summertime chemical oceanographic conditions in the AOI were similar to those observed in the shelf survey (Atlantic Zone Monitoring Program) for carbonate chemistry, dissolved oxygen, and nutrients, with nitrogen limitation in surface waters. Offshore bottom waters showed signs of ocean acidification that can be potentially harmful to calcareous (shell-forming) organisms.

Ecological Features of the Eastern Shore Islands

- Modelling and field surveys indicated the widespread but heterogeneous distribution of macrophyte habitats (**We'taqna'sik** *kelp*, **Qata'skul** *Eelgrass*) across the AOI, including some areas with higher abundance than elsewhere along Atlantic Nova Scotia.
- The use of coastal Eelgrass beds by various species of juvenile fish in the AOI has been confirmed through beach seining and eDNA, including abundant species like **Agumegw** *Atlantic Herring*, **Pitowumpk** *sand lances*, sticklebacks, and **Blamuch** *Atlantic Tomcod*, as well as less common species like Atlantic Lumpsucker, Mackerel Scad, and Northern Pufferfish.
- Acoustic telemetry data contributed to resolving the use of the AOI by migratory species, such as **Sikɨlati** *sharks*, Bluefin Tuna, **Mikjikj** *Leatherback Turtle*, **Komudămoo** *Atlantic Sturgeon*, **Plamu** *Atlantic Salmon*, and **Msanuk** *Atlantic Halibut*. **Webetumekew'** *White Shark* showed high site fidelity and a mixture of migration and summer residency. Several species exhibited connectivity with other conservation areas in the Maritimes.
- Atlantic Salmon (smolts) were tagged and tracked downstream in spring, followed by several weeks of staging in the estuary on the border of the AOI before actively migrating offshore through the AOI coastal zone from mid-May to early-June. Atlantic Salmon from other watersheds were also detected during migration through the coastal zone. In contrast, tagged **Dùladi** *Brook (sea) Trout* are resident to the estuary and coastal zone throughout summer and return to rivers in late summer and early fall.
- SCUBA diving surveys revealed a variety of sponge and other invertebrate species (84 taxa) and high habitat heterogeneity. Sponge abundance and diversity (27 taxa) was comparable to that found in similar depths in other parts of the region, but sponge species new to science and new to the region were documented.
- A drop camera survey along transects running from approximately 40 to 140 m documented nearly 300 benthic taxa, including stalked tunicates, sea pens, and soft corals but none were significant aggregations.
- The AOI overlaps with habitat for various life stages of **Jakej** *American Lobster*, which provide an important commercial fishery for the Eastern Shore (Lobster Fishing Areas 31b and 32) and show continued signs of high biomass through recruitment and landings data.
- eDNA metabarcoding identified spatial and temporal patterns for 64 species of fishes, over 20 species of macroalgae, and more than 100 species of invertebrates among ecological communities across the AOI, including several species not captured in visual or net-based surveys.
- At least nine species of marine mammals have been identified within the AOI based on opportunistic sightings and limited passive acoustic monitoring (PAM) effort.

- Additional observations since 2018 confirm the AOI as an important area for nesting, foraging, and migratory marine birds. Boat-based seabird surveys between 2006 and 2024 recorded 29 marine bird species within the AOI, confirming the AOI as an important area for nesting, foraging, and migratory marine birds.

Known Sensitivities, Resilience, and Recoverability

- Projected warming in the AOI could result in temperatures rising by up to 5°C by the end of the century, with greater increases expected under high-emission scenarios. This continued warming is expected to drive shifts in species distributions and ecosystem dynamics in the area.

Conservation Priorities

- Comprehensive scientific data collection and research conducted in the AOI substantiate all previously proposed conservation priorities.
- New information and analysis would support consideration of additional conservation priorities as described below.
- The high frequency of acoustic telemetry detections of sharks, tuna, **Elqane'j** *groundfish*, and Leatherback Turtle near the archipelago suggests that this area could be a distinctive migratory and foraging habitat, warranting consideration as a conservation priority.
- Given that approximately 70% of the AOI by area lies in waters deeper than 35 m and considering new benthic diversity information from offshore drop camera surveys, it would be useful to ensure deeper-water ecological communities are fully considered within the conservation priorities.
- Acoustic telemetry data from tagged juvenile Atlantic Salmon from West River indicates an estuarine residence of approximately two weeks prior to transitioning to the marine environment and initiating migration. Encompassing this more transitional habitat would better support a conservation priority associated with 'an area of importance for Atlantic Salmon', in addition to other diadromous species.
- Acoustic telemetry provided information on anadromous Brook Trout, showing significant use of the AOI and the estuary by this species throughout the summer.

Knowledge Gaps

- Despite advances in high-resolution mapping and modeling, knowledge gaps remain for fine-scale oceanographic processes, sediment transport, and climate-driven changes. The role of retention zones in species connectivity and ecosystem resilience is not fully understood, nor is the contribution of macrophytes to regional carbon and nutrient cycling.
- A knowledge gap exists regarding invertebrate communities in the deeper waters of the AOI, particularly >35 m. While recent surveys identified species not previously observed and potential vulnerable marine ecosystem indicators, further research could enhance understanding of their distribution and ecological role, especially in relation to the bathymetric features and benthic habitats of the AOI.
- The limited sightings of marine mammals and sea turtles in the AOI may reflect a lack of reporting or observation, rather than the absence of these species, which restricts the ability to monitor potential changes in distribution and biodiversity. PAM data of marine mammal vocalizations and ambient noise collected by DFO has yet to be fully analyzed. PAM results

are considered as the minimum estimate of species occurrence, as animals may have been present but not vocalizing or vocalizations may have been masked by noise or missed by the detector.

- PAM data collected by DFO from within the AOI have not yet been analyzed for the purposes of informing a scientific baseline of anthropogenic underwater noise for the AOI.

INTRODUCTION

Fisheries and Oceans Canada (DFO) has a role in advancing Canada's commitment to protecting 30% of its oceans by 2030 through the establishment of Marine Protected Areas (MPAs) and other effective area-based conservation measures (OECMs). The Eastern Shore Islands were identified as an Ecologically and Biologically Significant Area (EBSA) and incorporated into a regional conservation network strategy (King et al. 2019), as a regionally unique coastal archipelago with rich beds of **We'taqna'sik** *kelp* (e.g., *Laminaria* spp. and *Saccharina* spp.), **Qata'skul** *Eelgrass* (*Zostera marina*), Rockweed (*Ascophyllum nodosum*), and salt marsh (*Spartina* spp.) that support a range of ecologically, culturally, and commercially important species. The Eastern Shore Islands was identified as an AOI for *Oceans Act* MPA designation in 2018, and a Biophysical and Ecological Overview for the area (DFO 2019; Jeffery et al. 2020) was developed through a CSAS peer-review process to support identification of conservation priorities. Scientific research in the area has continued, including oceanographic modelling, acoustic telemetry, eDNA, beach seine surveys, SCUBA-based habitat and benthic diversity surveys, mapping of kelp and Eelgrass distribution, and deep-water image-based surveys.

This document and the associated CSAS peer-review process serves as an addendum to the first Biophysical and Ecological Overview (DFO 2019; Jeffery et al. 2020) of the AOI, reviewing new scientific research and monitoring data collected by Indigenous organizations, non-governmental organizations, academic institutions, and other governmental agencies since the initial review. Where new data were available, key biophysical and ecological attributes were confirmed and refined, particularly in relation to proposed conservation objectives and the broader goals for the Scotian Shelf and Bay of Fundy Bioregion. This updated information will inform subsequent advice on monitoring strategies, identification of research gaps, and the development of management plans for the area, supporting the regulatory process for potential MPA designation under the *Oceans Act*.

Overall, the objectives for this ecological and physical overview are to:

- Evaluate, describe, and map, where possible, any newly identified key biological, physical, and ecological features of the study area, including but not limited to:
    - predominant and/or unique physical and biological oceanographic characteristics;
    - predominant, unique, and/or sensitive habitat features; and
    - ecologically, socially, culturally, and/or commercially significant species and areas; depleted species; and marine mammals and seabirds.
- Identify new, and update where relevant, known sensitivities, resilience, and recoverability of interest within the study area. Include sensitivity of species of known conservation concern, if available.
- Where appropriate, based on the best available science, including information gained since 2018, make recommendations on the addition of conservation priorities that would benefit from spatial conservation in the area, or removal of conservation priorities that are no longer supported by research conducted in the area.

- Identify any new or remaining key uncertainties and knowledge gaps as they pertain to an updated understanding of the existing environment and species of interest within the study area. Where possible, recommend and prioritize measures to address these gaps.

The Government of Canada recognizes existing Aboriginal and treaty rights in sections 25 and 35 of the Constitution Act. The United Nations Declaration on the Rights of Indigenous Peoples, which was endorsed by the Government of Canada in 2016 and implemented in legislation in 2021, provides a road map to advance lasting reconciliation with Indigenous peoples. Canada aims to advance reconciliation with Indigenous peoples by recognizing the relationships and ongoing management of their ancestral lands and waters. DFO works with First Nations and Indigenous organizations in the planning, design, and management of MPAs to ensure that Indigenous rights, use, and knowledge are recognized and reflected. During the Eastern Shore Islands AOI process, DFO has worked with the Mi'kmaq of Nova Scotia including supporting the gathering and documentation of Mi'kmaq knowledge through a Mi'kmaq Ecological Knowledge Study (MEKS). Membertou Geomatics Solutions (2023) completed this MEKS in 2019.

The Eastern Shore Islands is an area of cultural and ecological significance for the Mi’kmaq people, an area of traditional land and resource use including fishing, hunting, and gathering. Glacial history for the region and geological features are also noted to be important for understanding early Mi’kmaq habitation. Information is provided, where available, on species that were identified in a Mi'kmaq Ecological Knowledge Study as being important to the Mi’kmaq diet, traditional fishing activities, and culture.

Where possible, places and species of social, cultural, or economic significance for the Mi’kmaq are provided in **Mi’kmaq** in bold, blue text; *English* in italics; and (*Latin*) in italics and parentheses for species at first mention. The lack of a Mi’kmaq equivalent should not be interpreted as the word does not exist and this document should not be used as a language reference.

ASSESSMENT

A review and update of science conducted in the Eastern Shore Islands study area was presented and reviewed based on information contained within the working paper (Heaslip et al. in prep.[2]), which includes contributions from partners and collaborators at Kwilmu’kw Maw-klusuaqn, Fishermen and Scientists Research Society, Huntsman Marine Science Centre, Canadian Parks and Wilderness Society, Dalhousie University, Environment and Climate Change Canada, and DFO.

Geographic Scope

The Eastern Shore Islands AOI extends from **E'se'katik** *Clam Bay* near **Winipukwejk** *Jeddore Harbour* to Barren Island near **Me'katewik** *Liscomb Point* (Figure 1), from the low tide line to the 100 m isobath, approximately 25 km from the mainland in the Scotian Shelf bioregion. The AOI is in the ancestral, unceded, territory of the Mi’kmaq Nation (CIRNAC 2019), and continues to be a place of ecological, social, cultural, and economic importance to the Mi’kmaq today (Membertou Geomatics Solutions 2023). The AOI is within the Traditional Mi’kmaq Territory of

[2] Heaslip, S.G., Jeffery, N.W., Pettitt-Wade, H., and Stanley, R.R.E. In prep. Review and Update of the State of Knowledge for the Eastern Shore Islands Area of Interest (AOI) and Surrounding Area. DFO Can. Sci. Advis. Sec. Res. Doc.

Eskikewa'kik[3] and includes the nearshore waters surrounding hundreds of islands on the eastern shore of Nova Scotia, many of which are protected through provincial and private conservation efforts. The Eastern Shore Islands Wilderness Area, managed by the Department of Environment and Climate Change, was designated under Nova Scotia's Wilderness Areas Protection Act in 2015, with a 96 ha parcel on Gerard Island added in 2022. Over 400 islands along 75 km of the Eastern Shore, from **E'se'katik** *Clam Harbour* to **Kloqweju'k** *Marie Joseph*, are protected as part of this Provincial Wilderness Area. The Eastern Shore Wildlife Management Area, managed by the Department of Natural Resources and Renewables, includes many provincially owned islands in the eastern archipelago. Privately owned islands have received increased protections through the Nova Scotia Nature Trust and their 100 Wild Islands Legacy Campaign, which has acquired and protected privately owned islands within the archipelago.

The Eastern Shore is recognized for productive fisheries, which are integral to the economy and culture of the local communities. The AOI is geographically aligned with Lobster Fishing Areas 31B and 32, and a major spawning area for **Agumegw** *Atlantic Herring* (*Clupea harengus*) in the western portion. The co-occurrence of commercial fishing and the highly natural area illustrates an intricate interplay, where the rich ecosystem supports the fishery, and the sustainable practices and stewardship by industry members help maintain ecosystem health.

Areas adjacent to the AOI were included to capture the necessary breadth and scope of the various components of the ecosystem. Given the geographic scale at which scientific information has been collected and reported, the study area deemed appropriate is for this assessment includes the nearshore coastal waters (less than approximately 100 m depth) along the east coast of Nova Scotia between West **Sesetkuk** *Chezzetcook* and Goldboro.

Mi'kmaq Ecological Knowledge Study

The MEKS conducted for the AOI presents a historical review of the natural history of the area, a Mi'kmaq Significance Species Analysis, and a Mi'kmaq Traditional Land and Resource Use analysis. Information from the MEKS identified species and areas that are ecologically, socially, culturally, and/or commercially significant to the Mi'kmaq. As a next step, conservation priorities identified through this CSAS process will be considered in conjunction with Mi'kmaq knowledge and priorities through the application of an **Etuaptmumk** *Two-Eyed Seeing* process to refine the list of conservation priorities and inform conservation objectives for the potential MPA.

[3]"**Eskikewa'kik** (meaning uncertain) includes all lands and waters draining into the Atlantic from St. Margarets Bay including Big Indian Lake, Chebucto (Halifax), Eastern Shore, Strait of Canso to Cape Blue on St. Georges Bay. The district includes the entire Musquodoboit River watershed, a portion of the Shubenacadie River to and including the Stewiacke River watershed draining into Cobequid Bay.In addition, **Eskikewa'kik** includes the West St. Marys River watershed, East St. Marys River watershed, Country Harbour River watershed as well as the Salmon River and Milford Haven River watersheds draining into Chedabucto Bay" Membertou Geomatics Solutions (2003).

Aquatic species identified in the MEKS (Membertou Geomatics Solutions 2023) as having social, cultural, or economic significance for the Mi'kmaq include:

- **Kataq** *Eel*;
- **Peju** *Cod*;
- **Plamu** *Atlantic Salmon*;
- **Atoqwa'su** *Trout*;
- **Jìgàkw** *Bass*;
- **Glatpetaw** Catfish;
- **Anakwe'j** *Flounder*;
- **Kaspelaw** *Gaspereau*;
- **Elqane'j** *Groundfish*;
- **Putomaqanej** *Haddock*;
- **Agumegw** Herring;
- **Nmjinikej** *Jonah Crab*;
- **Jakej** *Lobster;*
- **Amlmaw** *Mackerel*;
- **Nkata'law** *Mussel*;
- **Wisnaw** *Perch*;
- **Ne'kipu'ete'w** *Pollock*;
- **An'taliej** *Redfish*;
- **Siglati** *Shark*;
- **Nagabetulow** *Silver Hake*;
- **Seta'su** *Squid*;
- **Km'sqnej** *Swordfish*;
- **Nme'j** *Tuna;* and
- **Gagwesu** *Urchin*.

These species are important in food, social, and ceremonial contexts, reflecting the Mi'kmaq's strong connection to the marine environment. This list of species should not be considered exhaustive. The glacial history and geological features of the region are significant for understanding past landscapes and early Mi'kmaq use of the area. Given the region's natural history and its utilization as part of early human habitation following the last ice age, there is high potential for marine archeological sites in the AOI. Updates on archeology within the AOI could reveal dietary evidence of persistence/occurrence of species, including migratory birds. Although archeological findings to date are limited, the AOI has high potential for further exploration, with a need for sites of potential archeological significance to be protected from bottom-disturbing activities.

Physical Features of the Eastern Shore Islands

Jeffery et al. (2020) presented a summary of the known physical and ecological features of the Eastern Shore Islands AOI. Characterized by a dense archipelago of over 200 nearshore islands, this AOI forms a complex and ecologically unique coastal region on the Scotian Shelf. This high level of naturalness is due to minimal human impact, a diverse range of interconnected marine habitats, and strong physical oceanographic influences. The region has the highest density of coastal islands in Nova Scotia, averaging 1.4 islands per kilometer of coastline—three times greater than any other stretch along the Scotian Shelf. This creates a network of sheltered bays, narrow channels, and dynamic coastal environments that support a wide range of marine life. The presence of these numerous islands results in a heterogeneous ecosystem with a variety of microhabitats contributing to high biodiversity. Bathymetric surveys have now covered approximately 93% of the AOI at a resolution of 10 m or finer, with nearshore areas mapped using bathy-LiDAR and deeper areas with multibeam sonar. This new bathymetry documents depths of up to 150 m in the AOI.

The AOI encompasses a unique interplay of coastline, bathymetric features, and oceanographic processes, another distinguishing feature of the AOI. The complex circulation patterns within the nearshore zone, captured by a high-resolution model, are intrinsically linked to the intricate coastline and bathymetric features, creating a highly retentive environment. This environment, characterized by Lagrangian Coherent Structures and localized gyres near islands, tends to retain advecting materials (including pelagic spores, eggs, and larvae), particularly in areas between islands. The distinctive oceanography, including periodic flow reversals and coastal upwelling, forms a key aspect of this ecosystem (Ma et al. 2024). The division between inshore and offshore zones, marked by the 60 m isobath, delineates two circulation regimes: the

southwestward-flowing Nova Scotia Current offshore, and complex cross-shore transport and localized gyres inshore (Feng et al. 2022). These patterns significantly impact ecological dynamics, with nearshore organisms experiencing higher retention compared to other areas along the Nova Scotia coast without such island networks. A new oceanographic model for the AOI shows that the islands influence high particle retention within the archipelago, up to the 60 m isobath, limiting offshore dispersal. Predominantly southwest current flow, periodic wind-driven reversals, and interactions with the complex coastline and bathymetry promote upwelling/downwelling processes, and potentially local productivity. High-resolution modeling efforts using the Finite Volume Community Ocean Model (FVCOM) approach have enhanced understanding of these dynamics, underscoring how coastal complexity, particularly the presence of islands, affects both horizontal and vertical advection, influencing primary productivity and ecosystem connectivity. Summertime chemical oceanographic conditions in the AOI were similar to those observed in the shelf survey (Atlantic Zone Monitoring Program) for carbonate chemistry, dissolved oxygen, and nutrients, with nitrogen limitation in surface waters. Offshore bottom waters showed signs of ocean acidification that can be potentially harmful to calcareous (shell-forming) organisms.

Biological and Ecological Features of the Eastern Shore Islands

Lower Trophic Levels

The AOI supports extensive biogenic habitats, including Eelgrass meadows, intertidal zones dominated by Rockweed (*Ascophyllum nodosum*, *Fucus* spp.), and kelp forests, which play a vital role in supporting biodiversity and ecosystem function. Modelling and field surveys indicated the widespread but heterogeneous distribution of macrophyte habitats (kelp, Eelgrass) across the AOI, including some areas with higher abundance than elsewhere in Atlantic Nova Scotia. The spatial extent of these habitats was mapped using predictive models and in situ observations for the AOI. Predicted habitat for Eelgrass covers approximately 1,880 ha, primarily in sheltered embayments, providing important nursery and foraging habitat for a range of fish species. Rockweed beds, which extend over 805 ha, form dense intertidal canopies that contribute to habitat complexity. **We'taqna'sik** *kelp* forests, dominated by *Laminaria* and *Saccharina* species, span approximately 31,500 ha and 30,500 ha respectively in the AOI, primarily in high-energy subtidal environments.

SCUBA diving surveys revealed a variety of sponge and other invertebrate species (84 taxa) and high habitat heterogeneity. Sponge abundance and diversity (27 taxa) were comparable to that found at similar depths in other parts of the region, but sponge species new to science and new to the region were documented in the AOI. A drop camera survey along transects running from approximately 40 to 140 m depth documented nearly 300 benthic taxa, including stalked tunicates, sea pens, and soft corals but none were significant aggregations.

Fishes

The use of coastal Eelgrass beds by various species of juvenile fish in the AOI has been confirmed through beach seine and eDNA surveys, including abundant species like **Agumegw** *Atlantic Herring*, **Pitowumpk** *sand lances* (*Ammodytes* spp.), sticklebacks (*Gasterosteus* spp.), and **Blamuch** *Atlantic Tomcod* (*Microgadus tomcod*); and less common species like Atlantic Lumpsucker (*Cyclopterus lumpus*), Mackerel Scad (*Decapterus macarellus*), and Northern Pufferfish (*Sphoeroides maculatus*).

Acoustic telemetry data contributed to resolving use of the AOI by pelagic migratory species, such as **Sikɨlati** *sharks*, Bluefin Tuna (*Thunnus thynnus*), **Mikjikj** Leatherback Turtle (*Dermochelys coriacea*), **Komudămoo** *Atlantic Sturgeon* (*Acipenser oxyrinchus*), **Plamu** *Atlantic Salmon* (*Salmo salar*), and **Msanuk** *Atlantic Halibut (Hippoglossus hippoglossus)*.

Webetumekew' *White Shark* (*Carcharodon carcharias*) showed high site fidelity and a mixture of migration and summer residency. Several species exhibited connectivity with other conservation areas in the Maritimes. Juvenile Atlantic Salmon (smolts) were tagged and tracked downstream in spring, followed by several weeks staging in the estuary on the border of the AOI before migrating offshore through the coastal zone from mid-May to early-June. Juvenile Atlantic Salmon (post-smolts) from other watersheds throughout the Atlantic were also detected during migration through the coastal zone. In contrast, tagged anadromous **Dùladi** *Brook Trout* (*Salvelinus fontinalis*) are resident to the estuary and coastal zone throughout summer, and return upriver during winter.

eDNA metabarcoding identified spatial and temporal patterns for 64 species of fishes, over 20 species of macroalgae, and more than 100 species of invertebrates among ecological communities across in the AOI, including several species not captured in visual or net-based surveys. Such species include Basking Shark (*Cetorhinus maximus*), Atlantic Spiny Dogfish (*Squalus acanthias*), Common Thresher Shark (*Alopias vulpinus*), Grey Triggerfish (*Balistes capriscus*), and Spotfin Butterflyfish (*Chaetodon ocellatus*).

The western portion of the AOI overlaps with a major spawning area for Atlantic Herring, a critical component of the coastal ecosystem. The sheltered bays and Eelgrass meadows serve as nursery grounds for juvenile **Peju** *Atlantic Cod* (*Gadus morhua*), **Putomaqanej** *Haddock* (*Melanogrammus aeglefinus*), and *White Hake* (*Urophycis tenuis*), supporting regional fish populations. The AOI overlaps with habitat for various life stages of **Jakej** *American Lobster* (*Homarus americanus*), which provide an important commercial fishery for the Eastern Shore (Lobster Fishing Areas 31b and 32) and show continued signs of high biomass through recruitment and landings data.

Marine Mammals and Sea Turtles

Large cetaceans and Leatherback Turtle are expected to use the AOI transiently, moving along the Scotian Shelf and occasionally visiting shallower inshore areas. At least nine species of marine mammals have been identified within the AOI based on opportunistic sightings and limited passive acoustic monitoring (PAM) effort. Data from the DFO Maritimes Region Whale Sightings Database (MacDonald et al. 2017) includes 27 sightings of cetaceans and 41 sightings of seals within the AOI during 2007–2024. This database includes sightings of Atlantic White-sided Dolphin (*Lagenorhynchus acutus*); **Mujpe'j** *Harbour Porpoise* (*Phocoena phocoena*; listed under SARA and assessed by the Committee on the Status of Endangered Wildlife in Canada [COSEWIC] as Special Concern; Humpback (*Megaptera novaeangliae*); Fin (*Balaenoptera physalus*; listed under SARA and assessed as Special Concern by COSEWIC); Minke (*B. acutorostrata*); Sperm (*Physeter macrocephalus*); and North Atlantic Right (*Eubalaena glacialis*; listed under SARA and assessed as Endangered by COSEWIC) whales; Grey (*Halichoerus grypus*) and **Waspu** Harbour (*Phoca vitulina concolor*) seals; and a number of cetacean and pinniped species of unknown identification. As part of the Coastal Acoustic Monitoring (CAM) Project, DFO and a local community member partnered to deploy PAM moorings off Sheet Harbour for approximately three years, from August 2019 to October 2022. As of the writing of this report, only data from August 2019 to April 2020 have been analyzed. During this period, vocalizations of Blue Whale (*Balaenoptera musculus*; listed under SARA and assessed as Endangered by COSEWIC) were recorded in January; Fin Whale were recorded in November; Humpback Whale were recorded in December, January, and February; and Grey Seal vocalizations occurred throughout the winter months.

Harbour and Grey seals are present in the AOI with two breeding colonies of Grey Seal located on Bowen's Ledge and White Island, both situated off **Mekwe'saqnuk** *Ecum Secum*. Grey seal

surveys occur every 3 to 10 years with pupping observed in the most recent survey in 2021. Grey Seal were one of the few species detected on the coastal acoustic telemetry arrays in both summer and winter. Timing and duration of pupping for Harbour Seal in Atlantic Canada is not well known, but seals are known to haul out more during the pupping season, increasing their detectability. Understanding haul out behavior and pupping seasons are important because haul out correction factors significantly impact abundance estimates. However, these correction factors are currently informed by limited data.

Birds

The AOI is also a key habitat for breeding and non-breeding migratory birds, supporting globally significant concentrations of breeding and overwintering species. It is particularly important for Roseate Tern **Niktulnej** (*Sterna dougalli*) and Piping Plover (*Charadrius melodus*), both listed as Endangered under Canada's *Species at Risk Act* (SARA). The remote islands offer safe nesting grounds with reduced predation and disturbance, making them essential for the survival of these species. In addition, the region provides breeding habitat for Common Eider (*Somateria mollissima*; 56 islands support nesting) and Black Guillemot (*Cepphus grylle*) as well as overwintering habitats for Harlequin Duck (*Histrionicus histrionicus*), Purple Sandpiper (*Calidris maritima*) and a variety of migratory shorebirds. Boat-based seabird surveys between 2006 and 2024 recorded 29 marine bird species within the AOI, confirming the AOI as an important area for nesting, foraging, and migratory marine birds.

The diversity of functional groups of marine birds found in the AOI is likely linked to the abundant and varied food base supported by the distinctive habitats and circulation features in the region. Key habitats, including Rockweed, Eelgrass, and sand flats provide foraging habitat for shorebirds and benthic feeders (e.g., Common Eider). Such habitats are also rich in small crustaceans, worms, juvenile **Elqane'j** *groundfish*, and forage fish like Atlantic Herring and **Pitowumpk** *sand lance* (*Ammodytes* spp.), important prey species for a wide variety of surface feeding and pursuit-diving marine birds.

Anthropogenic Stressors

Unlike other coastal regions of Nova Scotia, the AOI remains largely undeveloped, with few point sources of pollution, contaminants, and invasive species. The remoteness of the archipelago has helped preserve this pristine coastal ecosystem, making it one of the least disturbed marine environments in the Scotian Shelf Bioregion. This combination of high island density, diverse habitats, intact ecosystems, and key biodiversity hotspots makes the Eastern Shore Islands a region of unique ecological context. The interplay between geomorphology, oceanographic processes, and biological communities creates a highly dynamic system that supports rich biodiversity, commercially valuable fisheries, and critical conservation areas.

Projected warming in the AOI could result in temperatures rising by up to 5°C by the end of the century, with greater increases expected under high-emission scenarios. This continued warming will drive shifts in species distributions and ecosystem dynamics in the area. Declines in population size or shifts in distribution are expected with changing environmental conditions, particularly for species that feed primarily on one prey item. For example, Common Eiders feed on marine invertebrates, primarily **Nkata'law** *Blue Mussel* (*Mytilus edulis*), which are impacted by temperature extremes from storms, climate change, and other emerging stressors. Under high-emission scenarios (RCP 8.5), several species, including **Paqtɨsmuey** *Atlantic Wolffish* (*Anarhichas lupus*), may experience substantial habitat loss. The AOI is located adjacent to a thermal transition zone in ocean conditions, where surface and bottom temperatures shift between warmer and colder waters. In this offshore, this transition corresponds with genetic population structure breaks for key species like European Green Crab (*Carcinus maenas*),

Northern Shrimp (*Pandalus borealis*), Atlantic Cod, and American Lobster (Stanley et al. 2018). Given this ecological and potential genetic distinctiveness (interface of environmentally mediated structure), the AOI may function as a buffer against climate-driven range shifts, at least temporarily. Cooler waters in the AOI compared to other parts of Nova Scotia may delay some of the changes associated with ocean warming, but long-term temperature increases are expected to impact the ecosystem, particularly by expanding the suitable habitat for aquatic invasive species (AIS). European Green Crab, for example, have already demonstrated northward range expansion, and warmer conditions may facilitate further AIS introductions via natural dispersal and human activities such as vessel traffic and aquaculture.

The AOI contains significant kelp forest habitat, particularly on cooler, wave-exposed shores, and models predict the area will be important for kelp through 2075. However, spatial and temporal variability in kelp abundance and predicted declines from warming highlight the need for continued monitoring to understand these changes and underlying causes. Despite the relatively undisturbed nature of the AOI, coastal macrophyte beds (Eelgrass, kelp, and Rockweed) experienced declines across Atlantic Canada due to warming, sea-level rise, and human activity. While Eelgrass in Nova Scotia has been shown to be more resilient than in other regions, the full extent of Eelgrass beds in the AOI remains unknown, and long-term monitoring is needed to assess how climate-driven changes and AIS (e.g., invasive tunicates, bryozoans) will affect these critical habitats.

Another uncertainty is the role of ocean acidification in shaping species distributions. Atlantic Salmon from the Nova Scotia Southern Upland Designatable Unit are already vulnerable to the acidification of rivers in the Southern Uplands, which reduces survival and available spawning habitat. These populations migrate through the AOI, making it a key transitional habitat and corridor that maintains connectivity between freshwater and marine habitats that are further along the Nova Scotia coast or offshore. While acidification impacts are well-documented in freshwater systems, the extent to which marine acidification will impact Atlantic Salmon behavior, prey availability, and overall ecosystem structure in the AOI have not been assessed. Furthermore, much of coastal Nova Scotia, including the AOI, lacks baseline data on spatial-temporal patterns in marine pH, limiting our ability to assess future changes in pH and, therefore, risks to ecosystems.

Although broad-scale climate trends suggest increased warming, declining oxygen levels, and shifting species distributions, significant uncertainties remain about how these processes will interact with the unique geomorphology and oceanography of the AOI. The spatial distribution and long-term stability of macrophyte beds (i.e., Eelgrass, Rockweed, and kelp) in the AOI, are also unknown, limiting the ability to assess their capacity to buffer against climate-driven changes. Furthermore, while species like Atlantic Cod and American Lobster have well-documented population trends, others such as migratory sharks, cetaceans, and large pelagic fishes are poorly studied in this region, making it challenging to predict how changing environmental conditions will alter predator-prey dynamics.

Review of Conservation Priorities

Conservation priorities recommended for the Eastern Shore Islands AOI (DFO 2019) include:

- the relatively high naturalness;
- the unique and complex geomorphology in terms of the dense archipelago and diverse mosaic of substrates and marine biogenic habitat, from shallow to deep water;
- an area of importance for **Plamu** *Atlantic Salmon*;
- an **Agumegw** *Atlantic Herring* spawning area;

- an important habitat for juvenile groundfish including **Peju** *Atlantic Cod*, White Hake, and **Ne'kipu'ete'w** *Pollock* (*Pollachius virens*), provided by estuaries, subtidal Rockweed, Eelgrass, kelp, and rocky substrates; and
- an important area for nesting, foraging, and migratory seabirds.

Comprehensive scientific data collection and research conducted in the AOI substantiate all previously proposed conservation priorities. Research and monitoring conducted since the 2018 assessment of the Eastern Shore Islands AOI are provided as support for the conservation priorities based on the reasoning in the following sections for each conservation priority.

Relatively High Naturalness

The proposed conservation priority of "relatively high naturalness" in the AOI is supported by multiple studies documenting both low cumulative human impacts and indicators of ecosystem health. Studies of key habitat-forming species reinforce the ecological integrity of the region. Extensive Eelgrass beds have been documented throughout the AOI, providing essential habitat and indicating a thriving coastal ecosystem. Surveys have identified widespread suitable habitat and large, contiguous Eelgrass beds (O'Brien et al. 2022), which are consistently associated with high biodiversity. Notably, He et al. (2022) recorded the highest vertebrate species richness among coastal Eelgrass beds in Nova Scotia using eDNA sampling. Similarly, studies on kelp (Murphy et al. 2019; Murphy et al. 2024; Murphy et al. 2022) beds found that kelp populations in the AOI seem to be thriving, particularly in contrast to areas farther south (Attridge et al. 2022). A combination of cooler water temperatures and morphological plasticity associated with greater wave exposure in more exposed areas of the AOI is thought to contribute to this trend (Savard-Drouin et al. 2024).

Cumulative impact assessments across Atlantic Canada (Murphy et al. 2019; Murphy et al. 2024; Murphy et al. 2022) further support the ecological integrity of the region, documenting relatively low anthropogenic stressors, minimal coastal development, intact macrophyte beds, fewer invasive species, and lower contaminant levels compared to other regions. However, a few areas of concern highlight the need for continued monitoring. Microplastics have been detected in shellfish (Saunders 2023), and plastic debris has been documented on Clam Harbour Beach (N. Kelly, unpublished data[4]). Additionally, results are still pending for recent analyses of trace metals and polycyclic aromatic hydrocarbons (PAHs) in sediments and Blue Mussel sampled by DFO within the AOI. Ongoing baseline monitoring is essential to assess the status of potential cumulative effects (e.g., climate change, oil spills, wind farms, aquaculture), to better understand their potential impact not only on the naturalness and ecosystems of the area, but also on species, and to track changes over time.

Unique and Complex Geomorphology

The AOI is a unique ecosystem shaped by its intricate landforms, rugged coastline, and complex bathymetry. Above the water, the dense archipelago, steep headlands, and numerous inlets create a highly structured and varied landscape. Below the surface, this same complexity is mirrored in the seafloor topography, with diverse bottom types, glacially carved channels, and a mosaic of benthic habitats. This physical heterogeneity supports a rich biological community, fostering diverse and productive ecosystems across the AOI from shallow to deep water. The diversity of habitat types in the AOI is one of its defining features, encompassing a dense archipelago, varied substrate types, and distinct geomorphological formations. Healthy kelp forests and genetically distinct Eelgrass beds (Jeffery et al. 2024) further highlight the ecological distinctiveness of the region. Notably, kelp and Eelgrass beds in the AOI seem to be dense,

[4] N.E. Kelly, DFO, Maritimes Region, Dartmouth, NS.

thriving, and may be more resilient to invasive species compared to similar habitats on the south shore of Nova Scotia. Eelgrass beds in this region are also associated with high diversity of fish and invertebrates relative to other areas (He et al. 2022), likely due to the health and expanse of these biogenic habitats, further underscoring their ecological importance. Alongside Eelgrass and kelps, sessile invertebrates such as sponges, tunicates, cnidarians, and Horse Mussel (*Modiolus modiolus*, Goodwin et al. 2025; Paulin et al. 2025) form additional biogenic structures that enhance habitat complexity. Collectively, these biogenic features are shaped and linked to the unique physical environment of the AOI, where the interaction of complex bathymetry, dynamic circulation, and varied substrates support a rich and diverse ecosystem.

Numerical simulations of ocean circulation paint a similar picture, illustrating how the physical features of the archipelago shape unique circulation patterns that define the region's ecological character (Feng et al. 2022). The complex landforms and bathymetric features create localized retention zones that enhance self-recruitment and limit offshore dispersal of pelagic organisms (Ma et al. 2024). These circulation dynamics contribute to a highly productive coastal environment, with features such as upwelling events that are promoted by interactions between currents and the rugged topography. The result is a dynamic and interconnected ecosystem where physical and biological processes are linked, reinforcing the characterization of the AOI as an ecologically rich and distinct system within Nova Scotia's coastal waters.

Area of Importance for Plamu *Atlantic Salmon*

Tagging efforts, supported by deployments of acoustic receivers, have confirmed that the marine habitats of the AOI provide important transitional habitat for Atlantic Salmon from the Nova Scotia Southern Upland Designatable Unit (Endangered - COSEWIC). As a key transition zone between freshwater and marine environments, the AOI and its associated diversity of habitats support Atlantic Salmon before their migration to the Labrador Sea and western Greenland.

Acoustic telemetry data from tagged juvenile Atlantic Salmon from West River, Sheet Harbour indicates an estuarine residence of approximately two weeks prior to transitioning to the marine environment and initiating migration. Encompassing this more transitional habitat would better support a conservation priority associated with 'an area of importance for Atlantic Salmon', in addition to other diadromous species. Acoustic telemetry data show that after migrating downstream in spring, juvenile Atlantic Salmon (post-smolts) spend several weeks in estuaries before actively moving through the AOI coastal zone in late May to early June. The estuarine habitat may be of particular importance for Atlantic Salmon in this system given the longer occupancy of this habitat after leaving the river system, in comparison to the marine habitats. The short duration of detections at coastal receivers suggests that juveniles (post-smolts) do not linger in nearshore waters but instead transition quickly offshore. Juvenile salmon tagged in West River, Sheet Harbour were detected far beyond the AOI, including in St. Anns Bank MPA, the Grand Banks of Newfoundland, and the Strait of Belle Isle. The AOI also serves as a migration corridor for Atlantic Salmon from other river systems, with coastal receivers in the AOI detecting fish tagged in the Penobscot River (Maine), Bay of Fundy, St. Lawrence River, and Tobique River (New Brunswick).

While this conservation priority focuses on Atlantic Salmon, acoustic telemetry information from anadromous Brook Trout shows significant use of the estuary and AOI throughout the summer. Access to estuaries is important for both species for their period of summer residency in the AOI. Unlike juvenile Atlantic Salmon, which migrate offshore after spending time in the estuary, Brook Trout remain resident to the area and return to the river in the fall.

Collectively, these findings reinforce the AOI's importance as a transition zone for migrating juvenile Atlantic Salmon and highlight the importance of estuaries for summer residency with

timing of residency varying among species and individuals. Ongoing monitoring could provide further insights into marine habitat use by juvenile and returning adult Atlantic Salmon depending on active tagging projects.

Agumegw *Atlantic Herring* Spawning Area

The Eastern Shore Atlantic Herring spawning area overlaps with the western portion of the AOI. The spawning stock biomass of Atlantic Herring in the Eastern Shore increased to 28,057 t in 2023, up from 20,313 t in 2022, but less than the five-year average of 46,823 t. Atlantic Herring are the most abundant (in terms of sequence reads) fish detected in the AOI with eDNA metabarcoding, particularly in surface water samples. While this increase is encouraging, it is important to highlight that Atlantic Herring populations across Atlantic Canada have experienced declines from historic levels. In 2022, a moratorium on commercial and bait fishing for southern Gulf of St. Lawrence spring Atlantic Herring, reflecting concerns over decreased abundance. These factors highlight the importance of maintaining the productivity of this species and protecting key life history functions to support its recovery in Atlantic Canada.

Important Habitat for Juvenile Elqane'j *Groundfish*

The diverse habitats of the AOI, including boulders, cliffs, overhangs, and macrophyte beds (such as kelp and Eelgrass), provide essential environments for juvenile groundfish within the AOI. These habitats support a rich assemblage of species. Beach seining in the Eelgrass beds regularly captures White Hake, Pollock, Atlantic Tomcod, and Anagwaach *Winter Flounder* (*Pseudopleuronectes americanus*). While juvenile Atlantic Cod have not been captured in beach seines, eDNA metabarcoding frequently detects their presence in coastal and offshore benthic water samples, suggesting they are relatively common. Schools of Pollock are also commonly observed in open waters during camera and SCUBA diving surveys conducted within the AOI (Goodwin et al. 2025).

Beach seine and eDNA surveys conducted in spring, summer, and fall reveal a diverse range of juvenile fish species, with Blamuch *Atlantic Tomcod*, Pitowumpk *sand lances*, sculpins, Threespine Stickleback (*Gasterosteus aculeatus*), and Cunner (*Tautogolabrus adspersus*) among the most prevalent. Atlantic Herring and Pitowumpk *sand lances* are particularly abundant, numbering in the thousands at some sites. Additionally, rare species, including juvenile American Butterfish, Northern Pufferfish, and Northern Sennet (also known as the Northern Barracuda) have been recorded. The AOI also supports the juvenile phase of several diadromous fish species, such as Atlantic Salmon, Brook Trout, and Kataq *American Eel* (*Anguilla rostrata*), which occur in high abundance and spend weeks in the coastal estuaries prior to brief occurrence on the marine coast beyond the estuary during their summer migration.

The complexity and health of biogenic habitats, along with the diverse physical features and productivity of the AOI, contribute to the ecological richness and distinctiveness of this area. The expanse and health of biogenic habitats provides essential coastal environments for a variety of fish species. Efforts to characterize the distribution of these habitats (i.e., kelp, Rockweed, and Eelgrass), assess the diversity of associated species using methods like eDNA and beach seine surveys, and measure the functional diversity of associated species using stable isotope analysis has provided evidence that these habitats are used by a variety of species, including juvenile fishes. Use of these methods in complementary studies has documented the abundance of species present and the critical role of these biogenic habitats for helping to sustain juvenile fish populations. The combination of healthy, diverse habitats and high productivity in the AOI underscores their importance as a conservation priority feature for the area, confirming the role they play in supporting the various taxa that depend on them.

Important area for Nesting, Foraging, and Migratory Marine Birds

The AOI represents an important area for nesting, foraging, and migratory marine birds. The area provides crucial foraging grounds for endangered species such as Roseate Tern and Piping Plover and overwintering habitats for Purple Sandpipers and Harlequin Ducks. The diversity of functional groups of marine birds in the AOI is likely linked to the abundant and varied food base supported by the distinctive habitats and circulation features in the region. Key habitats, including Rockweed, Eelgrass, and sand flats, not only support fishes and invertebrates but also provide foraging opportunities for marine birds. These habitats are rich in small crustaceans, worms, and forage fishes like Atlantic Herring, sand lances, enhancing the ecological value of the AOI for various marine bird species throughout their nesting, breeding, and foraging activities.

Additional Considerations

Considerable progress has been made in understanding the invertebrate communities in the AOI through a combination of SCUBA diving, eDNA metabarcoding, and deeper water camera surveys (84 species from SCUBA diving surveys and 300 from the drop camera survey aboard the Canadian Coast Guard Ship [CCGS] *Hudson* in 2018). However, while diverse these communities are typical of coastal Nova Scotia and no unique species or aggregations of invertebrates have been surveyed. In the 2021–2022 sponge surveys (Goodwin et al. 2025), 27 species of sponges were identified which was considered not to be especially diverse or abundant for the coastal zone. Despite these findings, new observations were made with three new species records for Canada (*Hymedesmia jecusculum*, *H. stellifera*, and *Plocamiancora arndti*), a range extension for a recently described species (*Crellomima mehqisinpekonuta*) from the Bay of Fundy, and four species which may be new to science (*Halichondria* sp., *Hymedesmia* sp., *Protosuberites* sp., and *Sphaerotylus* sp.). In the deeper water, some species that are considered indicators of vulnerable marine ecosystems (VMEs) were detected, including sponges, feather stars, soft corals, and sea pens. To be considered a VME, aggregations of these species must be considered unique or rare, slow-growing and slow to recover from disturbance, fragile, provide function as a habitat or food resource for other species, and provide or contribute to structural habitat complexity (Morato et al. 2018). The invertebrate species detected in the AOI's deeper waters (>50 m) contribute towards habitat complexity and are likely fragile, but they probably do not meet the criteria for uniqueness and rarity. Nevertheless, these species serve a distinctive ecological role for the AOI and presence records for each species could be used to develop new species distribution models extending into the coastal zone, where trawl surveys do not operate and data are generally lacking (e.g., Kenchington et al. 2016).

Considerable progress has been made in understanding the migratory and periodic residency behavior of species in the AOI. The diverse and productive habitats of the area provide essential foraging and nesting grounds for migratory birds and support dispersal pathways for various marine species, including fish and mammals. Acoustic telemetry contributed to our understanding of the timing of Bluefin Tuna, **Webetumekew'** *White Shark*, and **Komudămoo** *Atlantic Sturgeon* presence in the area, taking advantage of the abundant food base and favorable conditions offered by the unique habitats and circulation features of the AOI. The south shore of Nova Scotia is considered a summer hotspot for White Shark and there is increasing evidence to suggest the species is occurring more frequently in Canadian waters, highlighting the importance of coastal monitoring that includes the AOI and potential shifts in seasonal residency further along the coast with climate change (Bastien et al. 2020). Acoustic telemetry data indicated that some tagged White Shark remain in the vicinity of the AOI throughout summer and return annually with sequential detections every few days lasting up to

a month for some individuals, while others are detected for brief periods during migration. Additionally, detections of other taxa, including **Msanuk** *Atlantic Halibut* that exhibit the rare example of a species only present during winter months, Grey Seal showing evidence of summer and winter presence, and more Leatherback Turtle individuals (3) detected than other conservation areas in the Maritimes Region with an acoustic telemetry array. The prevalence of species detections closer to shore throughout summer suggests that migration to the AOI capitalizes on the highly productive waters and associated prey availability within and among the islands.

New information and analyses support the consideration of additional conservation priorities:

- **Coastal migratory corridor**: New information from the Eastern Shore Islands AOI array of acoustic telemetry receivers suggests that the AOI is a migratory and potential foraging area for various species. The high frequency of acoustic telemetry detections of sharks, tuna, groundfish, and sea turtles near the archipelago suggests that this area could be a distinctive migratory and foraging habitat, warranting consideration as a conservation priority.
- **Offshore invertebrate diversity/habitat:** New information on invertebrate diversity from image-based benthic diversity surveys highlights key features of the AOI, including diverse invertebrate communities and habitats, particularly in deeper waters. Given that approximately 70% of the AOI lies in waters deeper than 35 m and considering new benthic diversity information from offshore drop camera surveys, it would be useful to ensure deeper-water ecological communities are fully considered within the conservation priorities.

Sources of Uncertainty and Knowledge Gaps

Despite advances in high-resolution mapping and modeling, knowledge gaps remain for fine-scale oceanographic processes, sediment transport, and long-term climate-driven changes. The role of retention zones in species connectivity and ecosystem resilience is not fully understood, nor is the contribution of macrophytes to regional carbon and nutrient cycling. A knowledge gap exists regarding invertebrate communities in the deeper waters of the AOI, particularly >35 m. While recent surveys identified new species and potential vulnerable marine ecosystem indicators, further research could enhance understanding of their distribution and ecological role, especially in relation to the complex features and benthic habitats of the AOI. Key areas of uncertainty in the AOI include species movements, habitat conditions, climate-driven changes, and environmental stressors. Additional research on commercially important species, such as American Lobster, would improve understanding of inshore-offshore seasonal movements, particularly through integration with acoustic telemetry monitoring.

The limited sightings of marine mammals and sea turtles in the AOI may reflect a lack of reporting or observation, rather than the absence of these species, which restricts the ability to monitor potential changes in distribution and biodiversity. PAM data of marine mammal vocalizations and ambient noise collected by DFO have yet to be fully analyzed. PAM results are considered as the minimum estimate of species occurrence as animals may have been present but not vocalizing or vocalizations may have been masked by noise or missed by the detector. PAM data collected by DFO from within the AOI have not yet been analyzed for the purposes of informing a scientific baseline of anthropogenic underwater noise for the AOI. The extent and abundance of benthic invertebrates in deeper waters (>35 m) remain poorly documented, with existing data limited to four transects in 2018. Climate change projections indicate potential habitat loss, particularly for adult life stages of various taxa, but further research is required to assess impacts for habitats of juvenile fishes and evaluate the resilience of fish communities to shifting environmental conditions and the arrival of new species. While

the AOI remains relatively pristine, localized pollution concerns exist, including elevated levels of plastic debris in Clam Harbour and elevated microplastic concentrations in Blue Mussel, underscoring the need for continued environmental monitoring. The region also contains significant kelp forest habitat, particularly on cooler, wave-exposed shores, and remains a key area for kelp through 2075. However, spatial and temporal variability in kelp abundance and predicted declines due to warming highlight the need for ongoing monitoring to understand these changes and their underlying causes. Long-term time series of data are needed to assess the sensitivity, resilience and recoverability of habitats and species of interest within the study area; however, modelling has provided some information on vulnerabilities of the conservation priorities to environmental changes that are currently happening.

CONCLUSIONS AND ADVICE

Advancing Cost-effective Tools for Monitoring

As the Eastern Shore Islands is a coastal AOI, which begins at the low-tide line on shore, research and monitoring this area does not rely solely on large research vessels or deepwater sampling methods. Much of the work discussed here was achieved by working from shore, small DFO vessels (<30 feet in length), and chartered fishing vessels. Deeper, offshore work has used the CCGS *M. Perley* for deploying thermistor chains, Acoustic Doppler Current Profilers, and acoustic receivers, and collecting eDNA samples, and the HUD2018 survey used the CCGS *Hudson*, which has since been decommissioned. A replacement CCG oceanographic research vessel could be tasked for conducting research in the deeper, offshore waters, including continued eDNA sampling, and camera/video surveys.

We recommend continued monitoring in the AOI that focuses on methods such as eDNA sampling, SCUBA diving/snorkeling, beach seining, beach litter and microplastics monitoring, and deployment of oceanographic instruments including acoustic receivers, PAM recorders, and temperature loggers on an annual basis. Such monitoring has led to significant advancements in the understanding of the region's oceanography and ecology and continued collaboration among research and monitoring programs would help to optimize efficiency of data collection and analysis. Most of these methods require minimal financial investment once equipment has been purchased and can occur with adequate personnel and allocation of vessel time. eDNA requires funding for processing in the laboratory and qualified staff, but provides a high return on the information gained from standardized water sampling with results that can be compared with other conservation areas. When possible, research and monitoring programs should work together to collect and share samples and research platforms (e.g., coordinate cruise planning for water, eDNA, and biological sampling; coordinate research cruises with seabird or marine mammal observers on board; share eDNA extracts and species lists; coordinate instrument/mooring deployments with sampling/surveys; and utilize collaborative infrastructure, logistics, and data management resources both internally, e.g., DFO Oceanographic Missions, and externally, e.g., Ocean Tracking Network). Such collaborations allow research to be conducted that would not otherwise occur and optimizes resource use.

Community-Based Fisheries Research

Community-based fisheries research, with a focus on species vital to Indigenous and coastal communities, and collaboration with local communities and fishermen, could help to leverage local knowledge to support sustainable management of fisheries and habitats. Research projects focusing on fisheries species are critical to Indigenous and coastal communities. Collaborating with local communities and fishermen can be instrumental in identifying pertinent questions and leveraging local knowledge. The sustainability of the fisheries within the AOI,

particularly species important to Mi'kmaq and commercially important species like American Lobster and Atlantic Herring, should be a key focus of monitoring and conservation efforts. Research on American Lobster in the AOI could include additional tagging or population genetics studies, to understand seasonal movements and source/sink dynamics across the Scotian Shelf. These data are vital to support the sustainable management of this species. Similarly, research on Atlantic Herring specific to the Eastern Shore, beyond reporting the data from the industry-led acoustic surveys, has not been conducted by DFO Science since the Eastern Shore Islands was identified as an AOI. Tagging studies could be designed to better understand turnover rates and seasonal migration patterns of Atlantic Herring, to complement acoustic surveys and to help avoid double-counting in spawning stock biomass assessments. In addition to American Lobster and Atlantic Herring, we recommend maintaining an array of acoustic receivers in the AOI to detect tagged migratory species that exhibit periods of residency in the AOI, and examine movement corridors in conjunction with other acoustic receiver arrays in the bioregion (e.g., Ocean Tracking Network's Halifax Line and receivers in the Gully and St. Anns Bank MPAs). These efforts will ensure that we have the necessary data to support the sustainable management of these fisheries.

Monitoring of Marine Mammals and Sea Turtles

Relatively little dedicated marine mammal research has occurred in the AOI, and opportunistic sightings of marine mammals and sea turtles are often not reported. Additional work on the inshore habitat use of cetaceans, further collection and analyses of PAM data, and information on the timing of Harbour Seal pupping would help to address this knowledge gap. Collection of opportunistic sightings from researchers, citizen scientists, and others could provide further information on these species. However, given that marine mammals and sea turtles remain poorly studied compared to other ecosystem components, targeted research efforts (e.g., through PAM for cetaceans and/or dedicated visual surveys for sea turtles, cetaceans, and pinnipeds) are needed to understand how species utilize the habitat within the AOI at a level of resolution useful for management purposes.

Ecosystem Based Management Approach for Monitoring

The Maritimes Ecosystem-Based Management (EBM) Framework (Bundy et al. 2021; EBM Working Group 2024) is an interdisciplinary approach that considers ecological, economic, social and governance objectives to achieve sustainable resource use at appropriate temporal and spatial scales. EBM recognizes the interconnected nature of social-ecological systems and considers human activities and environmental stewardship in a multiple use context. The ecological pillar supports the conservation of ecosystem structure and function, species diversity, ecosystem resilience, and the protection or restoration of critical habitats. Conservation outcomes could be tracked by assessing habitat distribution, species composition, and ecosystem productivity as part of a monitoring program informed by the EBM Framework. A monitoring program designed with such long-term monitoring goals, clear benchmarks, and adaptive management responses would help to ensure that conservation objectives are met. Monitoring efforts should be tailored to local conditions but standardized where possible to allow comparability among conservation areas and inform effective management decisions across the bioregional conservation network. Research should focus on identifying suitable indicators for the AOI and associated thresholds to support this EBM approach and the ongoing management of the AOI. A monitoring program structured around the EBM ecological pillars (habitat, biodiversity, and productivity) could help in the identification of appropriate indicators and thresholds to ensure a comprehensive approach to monitoring (aligning with broader EBM goals), which captures changes in ecological state and informs adaptive management.

Conclusion

The Eastern Shore Islands represent a regionally significant and unique coastal ecosystem within the Scotian Shelf Bioregion, characterized by relatively high naturalness, intricate geomorphology, and rich biogenic habitats. The AOI serves as an ecological refuge for diverse species, including juvenile groundfish, migrating Atlantic Salmon, spawning Atlantic Herring, and breeding and non-breeding migratory birds. Scientific monitoring and research – led by numerous groups within DFO Science and partners in Indigenous organizations, non-government organizations, academic institutions, and other government agencies – since the announcement of the AOI in 2018, strongly supports the conservation priorities identified for this site: high ecological integrity, key fish spawning and nursery areas, and important and critical habitats for at-risk species (DFO 2019; Jeffery et al. 2020). Extensive Eelgrass and kelp beds, high biodiversity, and studies confirming minimal cumulative human impacts underscore the health and resilience of this area. Emerging threats, such as climate change, aquatic invasive species, and habitat degradation, necessitate continued monitoring, and the overall naturalness and diversity that characterize the AOI reinforces its significance as a component of the Marine Conservation Network Plan for the Scotian Shelf-Bay of Fundy Bioregion. Beyond its ecological value, the area encompassed by the AOI is a testament to the long-standing stewardship of peoples who have enjoyed and relied on the area for generations, and whose sustainable practices have contributed to the preservation of a highly natural and intact coastal environment. The health of this ecosystem is directly tied to the well-being of Mi'kmaq and coastal communities, which have historically relied on its rich marine resources for food, culture, and livelihoods. Maintaining the health of this ecosystem is not only a commitment to biodiversity conservation but also an investment in sustaining the productivity of this area, securing future fisheries, and maintaining the ecological integrity that supports both human and marine life.

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