Fisheries and Oceans Canada | Pêches et Océans Canada

80 East White Hills Road
St. John's, NL A1C 5X1

November 22nd, 2023

Committee for the Regional Assessment of Offshore Wind Development in Newfoundland and Labrador

Subject: Response to the Request for Advice submitted by the Committee for the Regional Assessment of Offshore Wind Development in Newfoundland and Labrador

Dear Committee:

Please see attached Fisheries and Oceans Canada (DFO) response to the "Request for Advice" received from the Committee for the Regional Assessment of Offshore Wind Development in Newfoundland and Labrador on August 4th, 2023.

Please note some information shared is sensitive in nature and should not be posted to the public registry without first consulting DFO. This includes the following information:

- information on Food, Social, Ceremonial fisheries; and
- information on communal-commercial fishing licences.

If you have any questions, please contact Kimberley Keats at Kimberley.Keats@dfo-mpo.gc.ca.

Yours sincerely,

Kelly, Jason Digitally signed by Kelly, Jason Date: 2023.11.22 14:48:02 -03'30'

Jason Kelly
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Attachments:

1. Suitable_Habitat_Polygons.zip
2. CSAS IA – Tier 1 – Corals & Sponges (NL Offshore Wind RA)
3. CSAS IA – Tier 1 – AIS (NL Offshore Wind RA)
4. CSAS IA – Tier 1 – EBSA, SBA & Coastal Areas (NL Offshore Wind RA)
5. CSAS IA – Tier 1 – Fish Stocks (NL Offshore Wind RA)
6. CSAS IA – Tier 1 – Oceanography (NL Offshore Wind RA)
7. CSAS IA – Tier 1 – Other Important Species (NL Offshore Wind RA)
8. CSAS IA – Tier 1 – Mammals, Turtle & Sharks (NL Offshore Wind RA)
9. Commercial Fishing Information for the RA Committee_DFO-NL
10. Resource Management Input for the RA Committee_DFO-NL

11. Attachment 1_Fisheries Seasons in 4R3Psn_Resource Management Input_DFO-NL
12. Attachment 2_Fisheries Closures in 4R3Psn_Resource Management Input_DFO-NL
13. Attachment 3_Communal Commercial Licences_Resource Management Input_DFO-NL
14. Notes on Use of Clipped Dataset and CCRI
15. Clipped_Data.gdb.zip

CORALS & SPONGES

Background / Context: The Impact Assessment Agency of Canada (IAAC) is seeking general marine and coastal data, and published information, in support of a regional assessment for offshore wind in Newfoundland. The IAAC is looking for existing science information that generally characterizes the marine ecosystem and species in the 'focus area' outlined in the figure below, including current and recent trends, data limitations, knowledge gaps, impacts of climate change, available geo-spatial data, cumulative impacts, and important citations/publications that should be consulted for the regional assessment. Please note that any information Fisheries and Oceans Canada (DFO) provides to IAAC may be posted to a public registry. The following constitutes DFO Science sector's response to this request.

Figure. Focus area highlighted in green for the Newfoundland offshore wind regional assessment.

Question/request: Known information, data/null data, data gaps, vulnerabilities, impacts of climate change, cumulative impacts, and citations and important references regarding corals, sponges, sea pens, and associated species distribution modeling results in the Newfoundland & Labrador offshore wind focus area.

Response:

1. Overview / summary of current knowledge

There are over 160 species of corals and sponges known to occur in Newfoundland waters. These species have been observed across the continental shelf, in troughs, valleys, and canyons, as well as along the shelf edge (Wareham and Edinger, 2007; Murillo et al., 2011; Baker et al., 2012; Murillo et al., 2012; Wareham Hayes et al., 2019). They exist in a variety of shapes and sizes, with some known to be found in high densities, while others are more sparsely distributed. Throughout their range, these species represent complex, three-dimensional structures that can provide large- and small-scale habitats in the deep sea. Evidence suggests that coral and sponge areas represent diversity hotspots with areas of high coral species richness being positively correlated with areas of high fish species richness (Gullage et al, 2022).

For more information on the structure, function, and biology of corals and sponges found in Newfoundland waters refer to Avoidance and Mitigation of Coral and Sponge Species During Exploratory Drilling Activities Offshore Newfoundland and Labrador (dfo-mpo.gc.ca) (Gullage et al. 2022). Distribution maps for each functional group of corals and sponges, as well as their definitions can also be found in the above-noted document (see: Figures 2-9 in document). An example figure from the document is provided below (Figure 1). Several of these functional groups can be found within the focus area of the Regional Assessment. Species distribution Modelling (SDM) can also be used to predict areas containing coral and sponge species and habitats of biological or ecological importance based on their relationship with the environment in sampled areas (Guijarro et al., 2016). Figures identifying Species Distribution Models for the Newfoundland and Labrador Region, including the focus area, can be found in Guijarro et al. (2016).

2. Gaps in data collection

There is a lack of coral and sponge survey data in coastal and deep water areas (>1500 m). DFO's multispecies survey data are only collected in areas that have "trawlable" habitat, meaning deep muddy habitats, rocky outcrops, and other potential coral and sponge habitats are generally excluded from this dataset. Therefore, it is likely that other important coral and sponge areas occur in the region but have not yet been identified. Underwater cameras and remotely operated vehicles have been used over the past decade to fill some of these gaps, but given the size of the bioregion these methods are only collecting data in relatively small areas. As such, Species Distribution Models are used to infer indirectly areas where corals and sponges may be found.

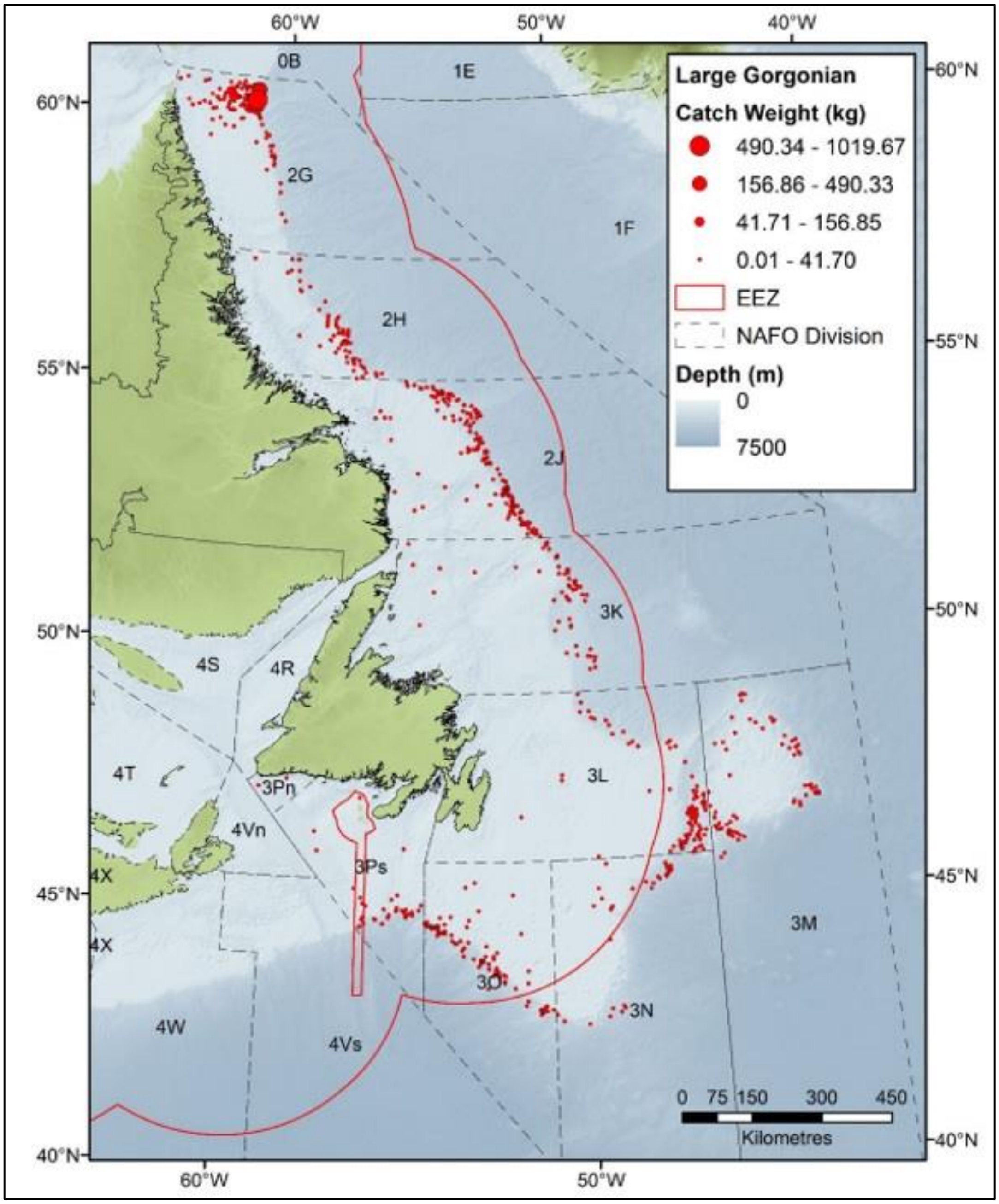

Figure 1. Distribution and catch weights of large gorgonian corals with Newfoundland and Labrador waters.

3. Known vulnerabilities / impacts of climate change

There are few studies on the potential impacts of climate change on corals and sponges in the Northwest Atlantic (e.g, Morato et al., 2019). However, there are at least a few potential ways that corals and sponges could be impacted. For instance, changes in the strength and directionality of currents can significantly affect physical and biological environments, the composition of water masses, and the ability of the currents to potentially disperse material in the region. Given that corals and sponges depend on currents to feed and disperse gametes, localized changes to currents can impact their ability to feed and reproduce. There is also potential for impacts on corals and sponges due to the progression of ocean acidification. Most corals have calcium carbonate skeletons, which makes them particularly vulnerable to impacts of decreased water pH. Research has shown that the changes in coral structure resulting from increased levels of carbon dioxide (CO_2) reduces overall strength, making them more susceptible to mechanical damage (Hennige et al., 2015; Roberts et al., 2006). Furthermore, in environments where food is limited, or where organisms have pre-existing injuries (e.g., from trawling), regeneration may be even less successful (Henry and Hart, 2005). Climate change related increased ocean temperatures and hypoxia are also expected to impact cold-water corals and other benthic organisms such as sponges (Ramirez-Llodra et al., 2011).

Potential impacts to coral and sponges specifically due to Offshore Wind Development would include physical damage from installations on coral/sponge habitats when they are anchored to the floor.

4. List any accompanying geo-spatial data / maps

See Table 1 below. The coral and sponge point data presented in Figures 2-9 of Gullage et al. (2022) is not available on *OpenData*, but can be made available upon request.

5. Cumulative effects

There has been very little work completed on cumulative impacts on cold-water corals or sponges and measuring these impacts can be extremely challenging, as little is known on the impacts from individual stressors and even less on their interactions (e.g., Ragnarsson et al. 2017). DFO has published some work regarding mitigation of impacts on corals and sponges from offshore petroleum drilling (DFO 2021). Submarine cables can also have an impact on benthic organisms including corals and sponges, during installation, repair, removal, and operational phases, through disturbances of the seafloor that have a direct impact on benthic habitats (e.g., Dunham et al. 2015) or through increased turbidity, and/or release of contaminants (Ragnarsson et al. 2017). The impact from activities such as bottom fishing, deep-sea mining, and oil and gas on cold-water coral physiology, for example, can be exacerbated by climate change (Smith et al. 2008).

6. List important / references

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Table 1. Geospatial datasets related to corals and sponges.

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Corals, Sponges & Sea Pens	Delineating Coral and Sponge Concentrations in the Biogeographic Regions of the East Coast of Canada Using Spatial Analyses	Yes	DFO	https://open.canada.ca/data/en/dataset/89082830-6830-4f73-b4ca-d5a32ea6fd0d		
Large Gorgonian Coral	Large Gorgonian Coral Fields in the Newfoundland-Labrador Shelves (Campelen Trawl Sample)	Yes	DFO	https://open.canada.ca/data/en/dataset/1cc185a4-e256-4f55-bfc0-5bbea7d39c20		Data request required - contact Camille.Lirette@dfo-mpo.gc.ca
Small Gorgonian Coral	Small Gorgonian Coral Fields in the Newfoundland-Labrador Shelves (Campelen Trawl Sample)	Yes	DFO	https://open.canada.ca/data/en/dataset/681b9130-3746-461c-ace9-ad2e945df838		
SiBA	Delineation of Coral and Sponge Significant Benthic Areas in Eastern Canada (2016)	Yes	DFO	https://open.canada.ca/data/en/dataset/6af357a3-3be1-47d5-9d1f-e4f809c4c903	http://publications.gc.ca/collections/collection_2016/mpo-dfo/Fs70-5-2016-093-eng.pdf	
Corals & Sponges	Coral and Sponge Concentrations in the Gulf Region of Canada	Yes	DFO	https://open.canada.ca/data/en/dataset/7b71b73b-0d05-4c61-958d-4beccd1bd3b1		Data request required - contact Camille.Lirette@dfo-mpo.gc.ca
Sponges	Sponge Fields in the Newfoundland-Labrador Shelves (Campelen Trawl Sample)	Yes	DFO	https://open.canada.ca/data/en/dataset/bf700895-f24c-42c1-b672-27f57abdea2f		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Sponges	Sponge Fields in the Gulf (Western IIA Trawl Sample) - Open Government Portal (canada.ca)	Yes	DFO	https://open.canada.ca/data/en/dataset/a45aa280-d8ca-4751-b8ac-655c90650eb1		
Sponges	Sponge significant concentration areas in the Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/93d845fa-8f16-4a46-9084-2e368fc0e493		
Sea Pens	Sea Pen Fields in the Newfoundland-Labrador Shelves (Campelen Trawl Sample)	Yes	DFO	https://open.canada.ca/data/en/dataset/a9962271-d880-4b7f-a0ca-edcdea021494		
Sea Pens	Sea pens significant concentration areas in the Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/87ae08e8-5fc2-476a-b3f5-c8f0ea4be9ef	http://waves-vagues.dfo-mpo.gc.ca/Library/40577806.pdf	
Sea Pens	Sea Pen Fields in the Gulf (Campelen Trawl Sample) - Open Government Portal (canada.ca)	Yes	DFO	https://open.canada.ca/data/en/dataset/5cba47a9-8d3c-4dae-b3a7-16b193286719		
Coral & Sponge Habitats	Habitat Suitability Modelling for Corals and Sponges and Coral and Sponge Location Point Data	No	DFO		https://www.int-res.com/abstracts/meps/v582/p57-77/	Shapefiles illustrating suitable habitat as described by models published in Gullage et al. (2017; 2022) have been provided.
Coral & Sponge Species Distribution Models	Species Distribution Modelling of Corals and Sponges from Research Vessel Survey Data in the Newfoundland and Labrador Region for Use in the	Yes	Mendeley	https://data.mendeley.com/datasets/zwvv3xx3rc/1	https://publications.gc.ca/collections/collection_2016/mpo-dfo/Fs97-6-3171-eng.pdf	Available through Mendeley

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
	Identification of Significant Benthic Areas					
Coral & Sponge Kernel Density Analysis	Kernel Density Analyses of Coral and Sponge Catches from Research Vessel Survey Data (2016)	Yes	DFO	https://open.canada.ca/data/en/dataset/fb1d1c3d-ba6e-4d0d-b629-f4f497edc10f	http://publications.gc.ca/collections/collection_2016/mpo-dfo/Fs97-6-3167-eng.pdf	
Coral and Sponge Distribution – Point Data	Distribution and Catch Weights of Corals and Sponges from DFO RV surveys Within the NL Region	No	DFO		https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/4098834x.pdf	Available upon Request – Associated with Gullage et al. 2022 - Figures 2-9.

ECOLOGICALY AND BIOLOGICALLY SIGNFICANT AREAS (EBSA) & SIGNIFICANT BENTHIC AREAS (SiBA), AND/OR OTHER IMPORTANT MARINE AND COASTAL AREAS

Background / Context: The Impact Assessment Agency of Canada (IAAC) is seeking general marine and coastal data, and published information, in support of a regional assessment for offshore wind in Newfoundland. The IAAC is looking for existing science information that generally characterizes the marine ecosystem and species in the 'focus area' outlined in the figure below, including current and recent trends, data limitations, knowledge gaps, impacts of climate change, available geo-spatial data, cumulative impacts, and important citations/publications that should be consulted for the regional assessment. Please note that any information Fisheries and Oceans Canada (DFO) provides to IAAC may be posted to a public registry. The following constitutes DFO Science sector's response to this request.

Figure. Focus area highlighted in green for the Newfoundland offshore wind regional assessment.

Question/request: Known information, data/null data, data gaps, vulnerabilities, impacts of climate change, cumulative impacts, citations and important references regarding Ecologically and Biologically Significant Areas (EBSA), Significant Benthic Areas (SiBA), and/or other important marine and coastal areas in the Newfoundland & Labrador offshore wind focus area.

Response:

1. Overview / summary of current knowledge

Ecologically and Biologically Significant Areas (EBSA) were identified in the Newfoundland and Labrador bioregion during two separate peer-review processes (DFO 2013; DFO 2019). The 2017 process (see: DFO 2019; Wells et al. 2019) is the one relevant to the focus area, as it includes information that overlaps with that portion of the focus area in NAFO Division 3P. Data layers considered in the EBSA analysis included: eelgrass; capelin spawning areas; Atlantic salmon; waterfowl; Common Eider; seabirds; Important Bird Areas; Community Coastal Resource Inventory; corals and sponges; fish and shellfish (e.g. DFO Research Vessel multispecies survey data); and marine mammals.

The fish and shellfish data were broken down into core fish species, including: fish functional groups; at-risk species; juvenile fish and fish spawning areas; aggregate layers were also generated using these data to represent diversity, evenness, and richness. Marine mammals' data included harp, hooded, and grey seal telemetry data, harbour seal distribution and abundance data, cetaceans survey and sightings data, as well as blue whale and leatherback turtle important habitat polygons. Seabird data sources included pelagic seabird surveys, seabird colony surveys, and murre telemetry data. Significant benthic areas (corals and sponges) were also considered.

In total, 14 EBSAs were identified during a peer review process based on these data sources and subject matter expert knowledge. Of these areas, four EBSAs overlap with the focus area (see: Figure1 below). No EBSAs were identified along the coast of western Newfoundland during this process as the west coast was outside of the study area and EBSAs were identified in the Gulf of St. Lawrence under different processes led by Quebec and Gulf regions. Detailed descriptions of the four EBSAs are also provided below, as adopted from DFO (2017). Any reference to citations, appendices, etc., in the following summaries are in reference to those found in the associated DFO (2017) publications. The four EBSA that overlap with focus area in NAFO Division 3P are: 1) South Coast EBSA; 2) Laurentian Channel EBSA ; 3) Placentia Bay EBSA; and 4) Southwest Slope EBSA.

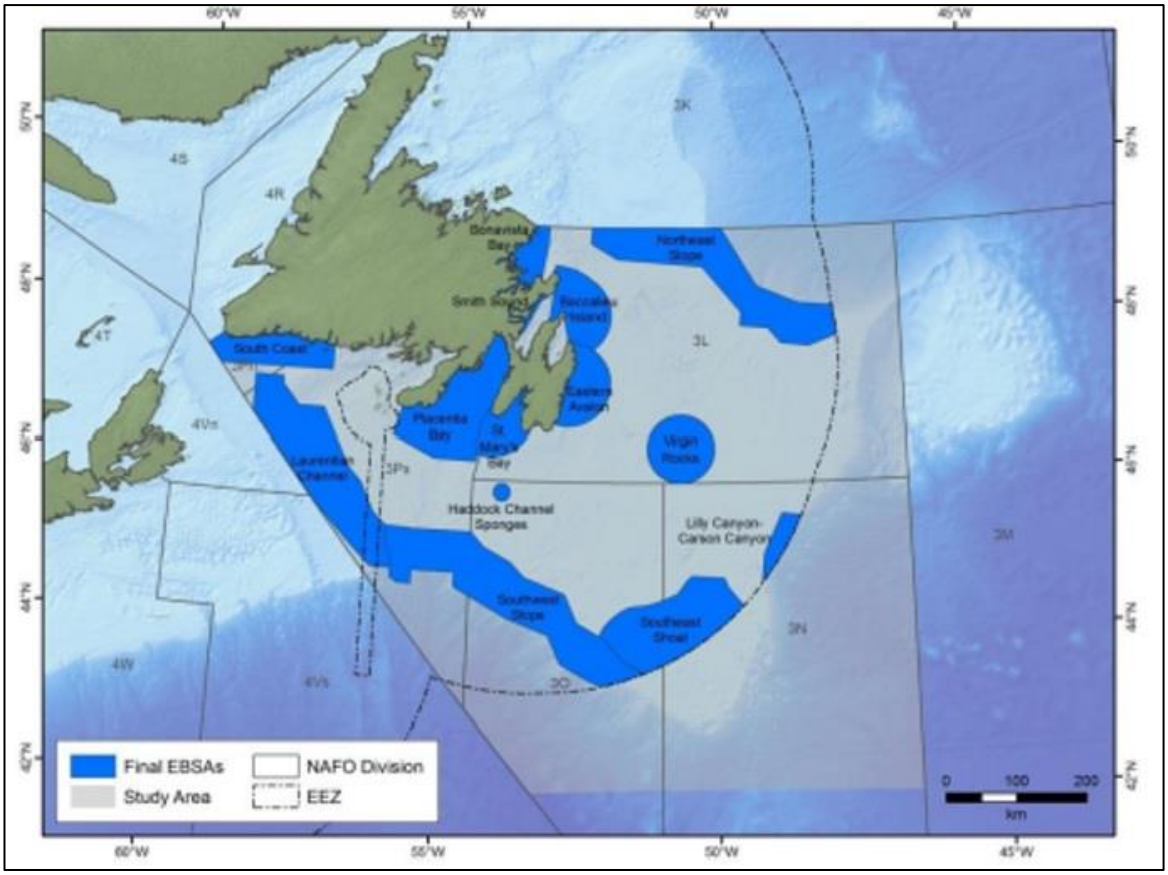

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Figure 1. Ecologically and Biologically Significant Areas in Placentia Bay/Grand Banks study area (DFO 2019).

1) <u>South Coast EBSA</u>: The South Coast EBSA (Figures 7 and 16; Wells et al., 2019)) is located along the South coast of Newfoundland from Cape Ray to just east of the island of Ramea. The western boundary matches the boundary between NAFO Divisions 4R and 3Pn while the southern boundary extends seaward by roughly 35-40 km to include the northwest portion of the Laurentian Channel and Rose Blanche Bank. During initial review of the composite layer (spring RV survey data only, Figure 3; Wells et al. 2019) and the Marine Mammals group layer, this EBSA was originally identified as two separate areas. After considering unpublished data and expert opinion (J. Lawson, pers. comm.), the two areas were joined based on the fact that this area is known to be important habitat for the endangered Blue Whale and other marine mammals (Figure 16; Wells et al. 2019). Other key features noted in this area include three fish functional groups (planktivores, piscivores and plankpiscivores), two seabird functional groups (surface shallow-diving coastal piscivores and surface shallow-diving piscivores), and two seal species (Hooded Seals and Grey Seals). Atlantic Cod, Redfish and Shrimp Important Areas (IAs) are also found in this EBSA. Cod and Redfish are found toward the west (Rose Blanch Bank area) while Shrimp are found toward the east. Sea pen and sponge SiBAs are found in this EBSA. The largest sea pen SiBA is found at the northern end of the Laurentian Channel just southwest of Rose Blanche Bank while the only sponge SiBA is relatively small and found just below the 200 m contour roughly 7 km southwest of Grand Bay-West (Kenchington et al. 2016b). A review of coastal data revealed that several eelgrass beds are found along the coast with the largest beds located between Cape Ray and Channel-Port aux Basques. The two most important Common Eider colonies occur in this EBSA, however they are relatively small (<30 individuals each) in comparison to the larger colonies (up to hundreds of individuals) found in other parts of Atlantic Canada. There are two IBAs in this area. The Grand Bay West to Cheeseman Provincial Park IBA was identified because it provides coastal dune nesting habitat and intertidal foraging habitat for the globally vulnerable and nationally endangered Piping Plover. The Big Barasway IBA also supports a significant population of Piping Plover. The large Black Dogfish area identified by Kulka (2006) extends into the western portion of this EBSA. The Smooth Skate area identified by Kulka et al. (2006) almost covers the entire EBSA.

2) Laurentian Channel EBSA: The Placentia Bay EBSA (Figures 7 and 15) boundary extends across the mouth of the Bay from St. Lawrence on the west side to the St. Mary's Bay EBSA boundary on the east side. It primarily was identified based on coastal data, but the seaward boundary was extended south to capture IAs for corals and sponges as well as Leatherback Turtle important habitat. This EBSA has important salmon rivers, Capelin spawning beaches, eelgrass habitat and seabird colonies (Figure 15) in the nearshore, and many other key features just outside the bay (Table 7, Appendix H). Piper's Hole River and Cape Rodger River, which drain into this bay, have been found to contain part of a genetically distinct population of salmon that inhabits rivers along the Avalon and Burin Peninsulas (Bradbury et al. 2015, Moore et al. 2014). Capelin spawning beaches are heavily concentrated on the east side of the bay but a few are also found on the west side on Sound Island and Woody Island and in Butts Hole and the beach just to the south of it. Spawning beaches also exist in Little Lawn Harbour, Herring Cove and Blue Beach Cove on the southern tip of the Burin Peninsula. Eelgrass habitat is found in many coves and harbours throughout the bay, however the invasive Green Crab is having an impact on the health of this important habitat in this area (Matheson et al. 2016). Leatherback Turtles are known to frequent the entire bay, with 18% of all sightings from the 2016 NAISS survey found within the boundaries of this EBSA (J. Lawson, unpublished data). Furthermore, Placentia Bay was identified as the only area in the study area that contains important habitat for Leatherback Turtles (DFO 2012). Another large area of important habitat is identified in the DFO (2012) report which extends slightly into the study area and is captured by the South Coast EBSA (see below) but the size of that area is insignificant compared to the area found within Placentia Bay. This EBSA also captures part of a larger area denoted as important for Blue Whales (DFO 2018). While no Blue Whales were sighted in the bay during the

2016 NAISS survey, one IA was identified on the southern tip of the Burin Peninsula based on sightings and survey data. Mysticetes and Hooded Seal IAs are also found throughout the bay out to the headlands. Large gorgonian coral, soft coral and sponge IAs are found near the seaward boundary of the Placentia Bay EBSA. They are mostly found in parts of Halibut Channel, St. Pierre Channel and in the Placentia Bay nearshore region (see Figure 9). This EBSA contains the Placentia Bay IBA which was identified based partly on the large numbers of shearwaters that are lured into Placentia Bay to feed on spawning capelin. More than 100,000 individuals of Greater Shearwater have been recorded, which is a globally significant concentration. Note that Great Shearwater and Sooty Shearwater do not breed anywhere in the Northern Hemisphere. As such, large numbers of individuals of these species travel to this specific area primarily to access abundant and predictable prey resources during their non-breeding season. Almost 40% of the tern species colonies identified in the upper tenth percentile are found in Placentia Bay. Terns, Common Murre and Black-legged Kittiwake forage throughout the bay. Some 1000 to 2000 Common Eiders often winter around the Virgin Rocks, Placentia Bay (Rao et al. 2009). Two areas noted for high concentrations of ichthyoplankton in the Bay, which were identified during the 2016 EBSA refinement exercise (DFO 2016 taken from Bradbury et al. 2003), were also used as overlays to ensure they were captured by the candidate EBSA boundary. One area extends along the western side of Placentia Bay from the coast to the center of the Bay, and from Southeast Bight to Burin. The second area occurs at the head of the Bay (Swift Current/Come By Chance area) and extends all the way out and across the Bay as far south as Fox Harbour. Furthermore, Lawson and Rose 2000 found that there are several important spawning areas for Atlantic Cod within the boundaries of this EBSA. One spawning aggregation was found near Bar Haven Island near the head of the bay, another at Oderin Bank in the center of the bay and another just off Cape St. Mary's.

3) Placentia Bay EBSA: The Laurentian Channel EBSA (Figures 7 and 24) extends through the Laurentian Channel south of Newfoundland. The northwest boundary extends slightly across the boundary between NAFO Subdivisions 3Ps and 3Pn whereas the southern boundary ends just north of the Laurentian Fan. This EBSA is split by the EEZ maritime boundary between Canada and the French territory of St. Pierre and Miquelon. The EBSA boundary was delineated based on the composite layer (spring RV survey data only, Figure 17) meaning it contains IAs for a diverse set of species (see Appendix H). While it may appear that this EBSA is an extension of the SW Slope EBSA, the key features for each EBSA differed enough to recognize the areas separately (see Table 8). Also, the physical features of both of these areas differ substantially. The SW Slope EBSA extends along the edge of Grand Bank and down a steep slope to depths of almost 2000 m. The Laurentian Channel EBSA extends from the edge of St. Pierre Bank and Burgeo Bank and includes the relatively flat Channel itself which is up to 400 m deep. The Laurentian Channel area is comprised primarily of mud, clay, sand and gravel (DFO 2010), which is partially why the area supports high concentrations of sea pens. Habitat types of the SW Slope are more varied and support a high number and diversity of many types of corals and sponges (Edinger et al. 2011). Most key features of the Laurentian Channel EBSA were identified based on the aggregation criterion, including Greenland Halibut, Witch Flounder, all six fish functional groups, sea pens, small gorgonian corals and Blue Whale (Appendix H). IAs for several at-risk species are also found here including Smooth Skate, Thorny Skate, White Hake, Winter Skate and Blue Whale. Some species or functional groups were found throughout the entire Laurentian Channel EBSA including Witch Flounder, Smooth Skate and the following fish functional groups: planktivores, plankpiscivores and piscivores. IAs for some species or groups were found in the southern two-thirds of the EBSA above the 400 m bathymetric contour (Thorny Skate and large benthivores). An IA for medium benthivores showed a similar distribution but extended up onto St. Pierre Bank. Small benthivore IAs were found in the north half of the EBSA only. For White Hake, a couple of small IAs were found in the center of the EBSA above the 400 m bathy contour while another IA extended into the French territorial zone and the SW Slope EBSA. A sea pen IA was found in the channel below the 200 m depth contour. There is also one large sea pen SiBA centered in the EBSA and a smaller sea pen SiBA in the north end that extends beyond the northern boundary. A small gorgonian IA was found in the southern end of the EBSA and a small SiBA for this group was found in the same area. Blue Whale important habitat was identified both at the northern and southern ends of this EBSA, however most of this area has been identified as highly suitable habitat for Blue Whale (Gomez et al. 2017). The Laurentian Channel has a high occurrence of Black Dogfish, and some studies have inferred that it may be a place where pupping occurs (Kulka 2006). The southeastern boundary of the polygon created during a 2008 review (DFO 2016) based on RV survey data from 1971-2005 ends at the French EEZ. Recent survey point data show a similar pattern but extend beyond this area into SW Slope and Hermitage Channel. A KD analysis was not done for this species and IAs were not extracted based on the upper tenth percentile so there is uncertainty regarding the uniqueness of IAs for this species, especially given that additional data have been collected since the original polygon was created in 2008. Smooth Skates also use the Laurentian Channel as an important juvenile/nursery area (Kulka et al. 2006). The polygon created for Spiny Dogfish during a 2008 review (DFO 2016) extends beyond the southern boundary of this EBSA into the SW Slope. The point data for this species show a similar pattern but are also found in areas outside the polygon. Again, given that no further analysis was done for this species, we cannot comment on the uniqueness of this area for this species. The Laurentian Channel was one of two IAs identified for Greenland Halibut on the Campelen spring layer, meaning it is somewhat of a unique feature for the study area. However, the NE Slope EBSA seems to be consistently more important for this species. The only IAs identified for Winter Skate are located in the southern end of this EBSA but extend through French territorial waters and onto St. Pierre Bank, as well as into the northern end of the SW Slope EBSA (Appendix K). While there was no data layer for Porbeagle Shark, it is known that they are found in this area in spring and migrate to areas further south during late fall (Campana et al. 2012). A portion of one of their known mating grounds occurs in the southern part of the Laurentian Channel (Campana et al. 2012, Simpson and Miri 2013).

4) Southwest Slope EBSA: The Southwest Slope EBSA (Figure 7 and 22) extends along the southwest slope of Grand Bank from the southern end of the Laurentian Channel to the boundary of the EEZ. It ranges in depth from 200m to just over 2000m. This EBSA was delineated based on the 60% composite layer (spring RV survey data only, Figure 17), meaning it contains important areas for a number of species and taxonomic groups. The boundary was extended to the south to capture IAs for corals and species at risk. This EBSA had a high number of key features, similar to the NE Slope EBSA. While the NE Slope EBSA had more unique and aggregating features, the SW Slope had more features based on fitness consequences. In the SW Slope EBSA, at-risk fish species, corals and fish functional groups were the main groups driving the patterns appearing in the composite layer (Appendix H). Witch Flounder IAs are found here along with IAs for 11 at-risk species: American Plaice, Atlantic Cod, Northern Wolffish, Redfish, Roundnose Grenadier, Smooth Skate, Thorny Skate, White Hake, Winter Skate and Blue Whale. IAs for 5 fish functional groups are found here, including small and large benthivores, planktivores, plankpiscivores and piscivores. Coral IAs include those for black corals, small and large gorgonian corals, stony cup corals and sea pens. Finally, surface shallow-diving piscivorous seabird IAs are found here. Many of the IAs for individual species are found throughout the entire length of the SW Slope EBSA (Witch Flounder, Redfish, Thorny Skate, White Hake, Blue Whale). The same can be said for several of the fish functional groups (small and large benthivores, plankpiscivores, piscivores). However, the IAs for some species were mainly concentrated in the northwest end of the EBSA (Atlantic Cod, Winter Skate) while others like Northern Wolffish were concentrated in the southeast end of the EBSA. American Plaice IAs were found at both ends. Other IAs were found all along the SW Slope but not beyond the edge of Halibut Channel (Smooth Skate, planktivores fish functional group). Surface, shallow-diving piscivore seabird IAs were found from the center of the EBSA and extending toward the southeast, with the largest IA directly south of Whale Deep. Most of the coral IAs were generally found beyond the 200 m depth contour. A small black coral IA was found near the southeast end. Large gorgonian coral IAs were mostly found in the northwest end of the EBSA but one large IA was found in same area as the IAs for black coral and surface shallow-diving piscivorous seabirds. Stony cup corals were found all along the slope as far as Halibut Channel. Another small IA is found at the north end extending into French territorial zone/Laurentian Channel. Sea pen IAs are found in patches all throughout the length of the EBSA. In 2007, a research team completed a deep-sea cruise at three stations that all fall within the boundaries of the SW Slope EBSA: Haddock Channel, Halibut Channel and Debarres Canyon. The objective of this cruise was to collect *in situ* observations of deep-sea corals in the area.

Over 160,000 coral colonies were enumerated and 28 species were found over 7 ROPOS dives (Baker et al. 2012). This study confirmed the presence of many of the coral species and groups that were found here during DFO RV surveys. In terms of uniqueness, all known small gorgonian IAs in the study area were located in this EBSA. However, a small SiBA for small gorgonian corals also occurs in 3L (see Kenchington et al. 2016b, Figure 54), and is not included within the boundary of any EBSA. The majority of IAs for Roundnose Grenadier were found throughout the entire EBSA (see Appendix H). Finally, a Haddock feeding and spawning area, as well as a Redfish spawning area (Ollerhead et al. 2004) that was digitized during the 2016 EBSA refinement process (DFO 2016) was included as an overlay in this area and is captured almost entirely by the candidate EBSA boundary. The American Plaice spawning area digitized from the 2016 EBSA refinement process (DFO 2016) is mainly concentrated in the SE Slope EBSA, however a small portion of it extends into the SW Slope EBSA. The Atlantic Halibut areas acquired during the 2016 EBSA refinement process also fall within the boundaries of this EBSA. A review of RV survey point data for this species revealed that they are found in many other areas throughout the study area. These areas include the SE Shoal, the Laurentian Channel, and areas outside the EEZ boundary.

Significant Benthic Areas (SiBA) are regional habitats that contain sponges (Porifera), large and small gorgonian corals (Alcyonacea, formerly classed as Gorgonacea), and/or sea pens (Pennatulacea) as a dominant and defining feature (DFO, 2017). There are several SiBAs. that overlap with the focus area, particularly in the Gulf of St. Lawrence on the west coast of Newfoundland as seen in Figures 2 and 3 below outlined in DFO (2017). A Sensitive Benthic Area is a benthic area of significant that is vulnerable to a proposed or ongoing fishing activity. See DFO (2017) for additional information as well as references.

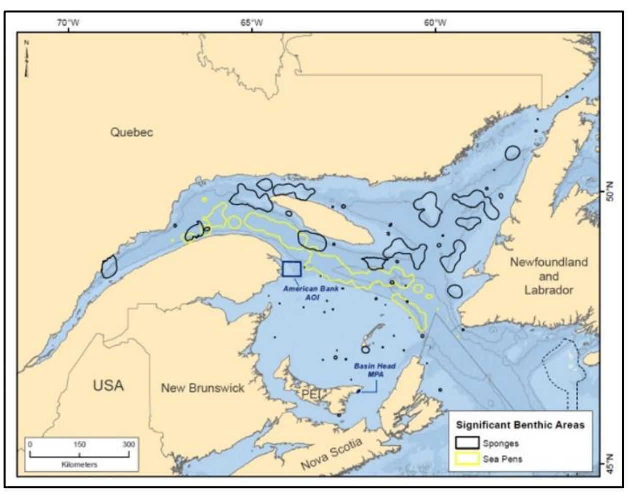

Figure 2. Significant Benthic Areas for sponges (black polygons) and sea pens (yellow polygons) for the Gulf of St. Lawrence. Details can be found in Kenchington et al. (2016).

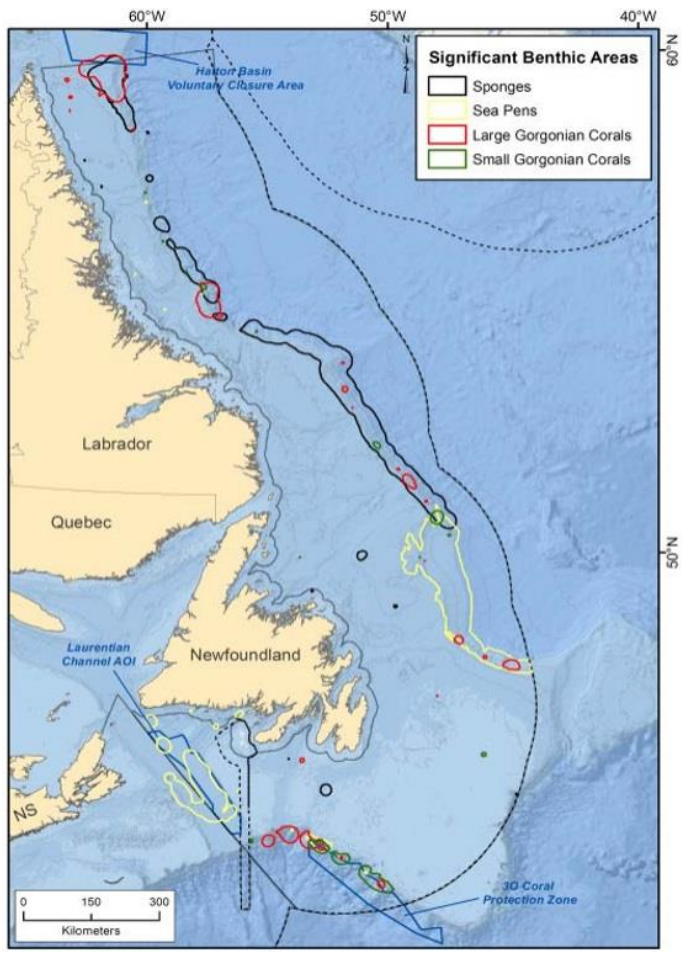

Figure 3. Significant Benthic Areas for sponges sea pens, large and small gorgonian corals for the Newfoundland and Labrador Region. Details can be found in Kenchington et al. (2016).

2. Gaps in data collection: Brief summary of data and knowledge gaps related to data collection (e.g., areas that are data-sparse or poorly understood).

Data for many species, particularly fish, were limited in some areas (e.g. depths greater than 1500 m; see: Brodie, 2005). Data in coastal areas were limited in scope and availability, with the exception of some data that identified areas of aggregation and feeding for seabirds and waterfowl. Shorebird species were excluded from analyses because data for these species is limited. However, Piping Plover data are relatively comprehensive and critical habitat has been identified for this species; therefore, Piping Plover habitat contained within EBSAs is described. Because of the above-mentioned data limitations, the level of confidence in the boundaries delineated for coastal EBSAs may be lower than for those in more data-rich areas. No EBSAs were identified in waters deeper than approximately 2000 m due to lack of biological data.

3. **Known vulnerabilities / impacts of climate change: Brief summary of known vulnerabilities or potential impacts to known areas of Ecologically and Biologically Significant Areas (EBSA), Significant Benthic Areas (SiBA), and/or other important marine and coastal areas associated with climate change.**

   No specific study or review has been done regarding the impact of climate change on EBSAs, SiBAs, or other important areas in the Newfoundland region. However, as EBSAs are identified based on specific ecological and biological features, these individual features are vulnerable to climate change and a summary of these impacts can be found online (see: Impacts on ecosystems and fisheries (dfo-mpo.gc.ca)).

4. **List any accompanying geo-spatial data / maps: Provide hyperlinks or include as separate attachments, mapping data on spatial or temporal trends, or predictive modelling that would indicate a higher potential for interaction of Ecologically and Biologically Significant Areas (EBSA), Significant Benthic Areas (SiBA), and/or other important marine and coastal areas with any planned offshore wind development.**

   See Table 1 below. Some of the associated publications listed below are for the 2013 process that identified EBSAs in the northern part of the NL bioregion (Wells et al. 2017, DFO 2013). The correct references that would be relevant to the Regional Assessment focus area are: DFO (2019) and Wells et al. (2019). Additional references have been provided for more context (see: DFO, 2013; Templeman, 2007).

5. **Cumulative effects: Brief summary of known cumulative effects or potential impacts to Ecologically and Biologically Significant Areas (EBSA), Significant Benthic Areas (SBA), and/or other important marine and coastal areas with any planned offshore wind development.**

   There have not been any studies or reviews conducted regarding cumulative impacts on EBSAs, SiBAs, or other important areas in the Newfoundland region.

6. **List important / references: List references and provide hyperlinks, where possible, to references cited in the responses above and/or other important references the IAAC should be aware of.**

Brodie, W. 2005. A description of the autumn multispecies surveys in SA2+ Divisions 3KLMNO from 1995-2004. NAFO SCR Doc. 05/8. Available at: https://archive.nafo.int/open/sc/2005/scr05-008.pdf.

DFO. 2013. Identification of Additional Ecologically and Biologically Significant Areas (EBSAs) in the Newfoundland and Labrador Shelves Bioregion. Can. Sci. Advis. Sec. Sci.

Advis. Rep. 2013/048. Available at: https://publications.gc.ca/collections/collection_2013/mpo-dfo/Fs70-6-2013-048-eng.pdf.

DFO. 2016. Refinement of information relating to Ecologically and Biologically Significant Areas (EBSAs) identified in the Newfoundland and Labrador (NL) Bioregion. Can. Sci. Advis. Sec. Sci. Resp. 2016/032. Available at: https://publications.gc.ca/collections/collection_2016/mpo-dfo/Fs70-7-2016-032-eng.pdf.

DFO. 2017. Delineation of Significant Areas of Coldwater Corals and Sponge-Dominated Communities in Canada's Atlantic and Eastern Arctic Marine Waters and their Overlap with Fishing Activity. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2017/007. Available at https://publications.gc.ca/collections/collection_2017/mpo-dfo/Fs70-6-2017-007-eng.pdf.

DFO. 2019. Re-evaluation of the Placentia Bay-Grand Banks Area to Identify Ecologically and Biologically Significant Areas. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2019/040. Available at: https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40818949.pdf.

Templeman, N.D. 2007. Placentia Bay-Grand Banks Large Ocean Management Area Ecologically and Biologically Significant Areas. Can. Sci. Advis. Sec. Res. Doc. 2007/052: iii + 15 p. Available at: https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/331779.pdf.

Kenchington, E., L. Beazley, C. Lirette, F.J. Murillo, J. Guijarro, V. Wareham, K. Gilkinson, M. Koen Alonso, H. Benoît, H. Bourdages, B. Sainte-Marie, M. Treble, and T. Siferd. 2016. Delineation of Coral and Sponge Significant Benthic Areas in Eastern Canada Using Kernel Density Analyses and Species Distribution Models. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/093. vi + 178 p. Available at: https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40577806.pdf.

Wells, N.J., Tucker, K., Allard, K., Warren, M., Olson, S., Gullage, L., Pretty, C., Sutton-Pande, V.,and K. Clarke. 2019. Re-evaluation of the Placentia Bay-Grand Banks Area of the Newfoundland and Labrador Shelves Bioregion to Identify and Describe Ecologically and Biologically Significant Areas. Can. Sci. Advis. Sec. Res. Doc. 2019/049. Available at: https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40855247.pdf.

Table 1. Geospatial datasets related to EBSA, SiBA, and Important Coastal Areas.

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Marine Bioregions	Federal Marine Bioregions	Yes	DFO	https://open.canada.ca/data/en/dataset/23eb8b56-dac8-4efc-be7c-b8fa11ba62e9		
EBSA	Ecologically and Biologically Significant Areas	Yes	DFO	https://open.canada.ca/data/en/dataset/d2d6057f-d7c4-45d9-9fd9-0a58370577e0		Includes Nova Scotia and Newfoundland and Labrador data.
EBSA	Ecologically and Biologically Significant Marine Areas (EBSAs), Newfoundland and Labrador Shelves	Yes	DFO	https://open.canada.ca/data/en/dataset/b7ede61e-9859-46d3-bba7-d5cb346638e8	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40818949.pdf https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40855247.pdf http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2017/2017_013-eng.html http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2013/2013_048-eng.html	The correct references that would be relevant to the regional assessment focus area are: https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40818949.pdf https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40855247.pdf
EBSA	Ecological and biological significant areas in the Estuary and Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/1a11d2c1-bcad-47c7-87d1-f16f38aee4d9		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
EBSA	Fishing effort (commercial) within Significant Benthic Areas in Canada's Atlantic and Eastern Arctic marine waters	Yes	DFO	https://open.canada.ca/data/en/dataset/273df20a-47ae-42c0-bc58-01e451d4897a		The dataset is for commercial fishing effort based on VMS + logbook data. The data currently on Open Data needs to be updated - this is in progress.
VME	NAFO Vulnerable Marine Ecosystem (VME) Habitats	Yes	NAFO			Data available, but needs to be requested from NAFO. Will be outside the EEZ and may not be the most relevant for the new focus area. Best contact within DFO may be Mariano Koen-Alonso? Ellen Kenchington's lab has also been heavily involved in this work. There are also VME and seamount closures (i.e. areas closed to bottom fishing) also outside the EEZ. It is also important to distinguish between VME habitats (areas delineated by science as being vulnerable marine ecosystems, based on specified criteria) and VME closures (areas that are closed to fishing but are not always the entire VME habitat area). For more information, please

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
						refer to annual NAFO WG-ESA summary reports (i.e. NAFO SCS Docs)
Coastal/Offshore Conservation Area	Coastal/Offshore Conservation Area	Yes	CPCAD	https://www.canada.ca/en/environment-climate-change/services/national-wildlife-areas/protected-conserved-areas-database.html		
Marine Refuges & OECMs	Marine Refuges & OECMs	Yes	DFO	https://open.canada.ca/data/en/dataset/44769543-7a23-4991-a53f-c2cf7c7a946f		
Marine Protected Areas (MPA)	Marine Protected Areas	Yes	DFO	https://open.canada.ca/data/en/dataset/a1e18963-25dd-4219-a33f-1a38c4971250		
Ocean Act MPA Areas of Interest	Ocean act Areas of Interest	Yes	DFO	https://open.canada.ca/data/en/dataset/32bf34ea-d51f-46c9-9945-563989dfcc7b		
Ecological Production Units	Ecological Production Units	Yes	DFO	https://open.canada.ca/data/en/dataset/9a515ef8-0e2a-479e-9b25-55658eae30be	nafo.int/Portals/0/PDFs/sc/2015/scs15-19.pdf https://www.nafo.int/Portals/0/PDFs/sc/2014/scr14-069.pdf	Should be "Ecosystem Production Units"
Marine Spatial Planning Areas	Eastern Canada Marine Spatial Planning Areas	Yes	DFO	https://open.canada.ca/data/en/dataset/f089a3f3-45e9-47de-b1c4-170e9950d8e7		Atlantic Canada MSP Atlas: https://gisp.dfo-mpo.gc.ca/apps/Atlantic-Atlas/?locale=en

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Megahabitats	Megahabitats of the St. Lawrence Estuary and Gulf - Personnal Geodatabase	Yes	DFO	https://open.canada.ca/data/en/dataset/3e89da6c-fd76-4e53-af62-dfec141ffda5		
Epipelgagic Habitat	Coastal and epipelagic habitats of the St. Lawrence Estuary and Gulf - Database	Yes	DFO	https://open.canada.ca/data/en/dataset/5edf2b99-1058-438a-a450-155e888a5390		
Habitat Bank	Habitat Bank	No	DFO	https://gisd.dfo-mpo.gc.ca/arcgis/rest/services/Maritimes_EM/FishHabitat_Restoration_Maritimes/MapServer/1		Request required.

FISH STOCKS

Background / Context: The Impact Assessment Agency of Canada (IAAC) is seeking general marine and coastal data, and published information, in support of a regional assessment for offshore wind in Newfoundland. The IAAC is looking for existing science information that generally characterizes the marine ecosystem and species in the 'focus area' outlined in the figure below, including current and recent trends, data limitations, knowledge gaps, impacts of climate change, available geo-spatial data, cumulative impacts, and important citations/publications that should be consulted for the regional assessment. Please note that any information Fisheries and Oceans Canada (DFO) provides to IAAC may be posted to a public registry. The following constitutes DFO Science sector's response to this request.

Figure. Focus area highlighted in green for the Newfoundland offshore wind regional assessment.

Question/request: Known information, data/null data, data gaps, vulnerabilities, impacts of climate change, cumulative impacts, and citations and important references regarding important primary, secondary, and emerging fish stocks in the Newfoundland & Labrador offshore wind focus area. If possible, please note importance of focus area to overall fish stock productivity (e.g., spawning areas, aggregation areas, migration routes, hotspots, etc.). Include information on groundfish, shellfish, large pelagics, small pelagics, and any other important secondary/emerging species.

Response:

1. Overview / summary of current knowledge

The Newfoundland offshore wind focus area for regional assessment overlaps with Northwest Atlantic Fisheries Organization (NAFO) management units 3P (further subdivided as 3Ps and 3Pn) and 4R. Management unit 3P is located west of the Grand Banks in the offshore off the south coast of Newfoundland (see: Figure 1). In contrast, management unit 4R is located in the eastern Gulf of St. Lawrence in the offshore off the west coast of Newfoundland. Information on important primary, secondary, and emerging fish stocks in 3P and 4R, that overlap with the focus area, is provided in Table 1 below. Table 2 below provides links to available geospatial data related to fish stock in this area. DFO does not assess secondary or emerging fish stocks in NAFO 4R.

Figure 1. Focus Area outlined in green for the Newfoundland offshore wind regional assessment overlaid with NAFO management units 3P and 4R.

The status of the fish community in 3Ps is integrated into stock assessments in the region and relies on results from the Newfoundland and Labrador Research Vessel multispecies survey. These ecosystem level summaries look at trends in indices of biomass, abundance, and fish size at the functional group level. These summaries also compute the estimated consumption of the fish community as a whole, as well as key fish predators using data on diet collected through the survey. The overall biomass of the fish community declined in the late-1980s and early-1990s, and involved changes in the structure of the fish community. This was a period of wide-spread and large-scale changes across the entire bioregion and is widely considered a regime shift and has not returned to a similar biomass or structure.

In the last decade the fish community showed a rebuilding of biomass until 2014 when declines were observed again, before the most recent improvements in 2019-2021. With these fluctuations in biomass there have been changes in the community structure with increased dominance of warm-water species such as Silver Hake amongst the piscivorous fish. These changes have been observed alongside the changes in ocean temperature in the region. As the area continuous to change, it is not unexpected that we will see further changes in species composition including an increase in warm water species. The focus area is considered to be in a low productivity state based on similar trends in the biomass indices within the region and neighboring Grand Bank, and patterns in key predators stomach weights which support the notion that bottom-up processes are limiting the recovery of the entire fish community.

Oceanographic conditions in Subdivision 3Ps are influenced by several factors, including local atmospheric climate conditions, advection by the Labrador Current from the east, the warmer and saltier Gulf Stream waters from the south, and the complex bottom topography in the region. Near bottom temperatures, while showing significant variability from one year to the next, have experienced a general warming trend since 1980. Bottom temperatures continue to remain above normal in the area in recent years. Standing stocks of phytoplankton and nitrate inventories that provide the primary energy inputs to the base of the food web in 3Ps were not available in 2019.

Observations from the Grand Bank, upstream of 3Ps, indicate near normal deep nitrate inventories and enhanced phytoplankton biomass in 2019 compared to lower levels observed during the 2011-2016 period. Satellite remote sensing data indicate continued lower magnitude of the spring phytoplankton bloom in 3Ps, consistent with observations on the Grand Bank in 2019. The duration of the spring bloom was longer than normal on the Grand Bank in 2019 but has remained near normal in 3Ps over the past decade. Delayed timing of the spring bloom observed during 2014-2017 has now returned to near normal in 3Ps in 2018-2019. No spring zooplankton data is available in 3Ps for abundance and biomass indices during 2019. Observations on the Grand Bank during 2019 indicate near-normal abundance of keystone copepod taxa but a reduction in biomass.

The Gulf of St. Lawrence marine ecosystem, including in 4R, is undergoing major changes. Since 2009, the deep waters of the Gulf of St. Lawrence (GSL) have been warming with inward advection from Cabot Strait (Galbraith et al. 2023). The deep water layer (>150 m) originates from the entrance of the Laurentian Channel, where the waters of two currents, the Labrador Current (cold, less saline, highly oxygenated) and the Gulf Stream (warm, more saline, low oxygen) mix resulting in water for which the temperature, salinity, and dissolved oxygen vary according to the relative contribution of each current; the deep waters are warming and becoming depleted of oxygen. Water temperatures above 7°C have been recorded since 2012 in the GSL near the Cabot Strait and have occupied a significant proportion of deep waters in recent years, including those where some fish species (including groundfish such as cod). At 150 m depth, the average water temperature in the GSL reached one of the highest values of the series in 2022.

During DFO's 2022 annual multidisciplinary survey in the Estuary and northern Gulf of St. Lawrence – the survey covers the waters of the Laurentian Channel and the area north of it, from the Lower Estuary in the west to the Strait of Belle Isle and the Cabot Strait in the east, namely, the Northwest Atlantic Fisheries Organization (NAFO) divisions 4R, 4S, and the northern part of 4T – a preliminary analysis of water temperature data collected in 2022 demonstrated that conditions have warmed at depths greater than 150 m, establishing new records since 1915 at 150 m, 200 m and 300 m. The August cold intermediate layer minimum temperature was only slightly cooler in 2022 than in 2021 when it attained the highest recorded values observed in contemporary Conductivity, Temperature, and Depth (CTD) era. Surface water temperatures were above normal in July-August. For more information see Bourdages et al. (2023).

2. Gaps in data collection

See Table 1 for fish stock-specific data gaps.

3. Known vulnerabilities / impacts of climate change

Climate change is expected to have wide-ranging impacts on fish abundance and distribution in the North Atlantic Ocean. Key impacts of climate change in the ocean are warming temperatures, acidification, decreased oxygen, and changes to primary production that will change the growth, metabolism, condition, survival, and abundance of fish. Warming is expected to influence commercial species expansion or contraction across the ocean landscape, as populations seek waters that suit their temperature preferences. Climate change may also reduce biomass of commercial and non-commercial species and impact ecosystem structure in the focus area. Further, there will be changes to the geographic distribution in response to environmental shifts and shifts in species composition (Boyce, Schleit, and Fuller 2020). Business-as-usual (no climate mitigation) will mean more stocks will be affected, whereas low emissions means fewer marine species to be impacted with less impacts to fisheries. It is difficult to predict and account for all impacts of climate change on the ecosystem as it is a large and complex area with many species interactions and different habitats.

Changes in physio-chemical-biological conditions in 3P and 4R are observed to be associated with changes in structure of the marine community in these areas. In some instance, changes could negatively affect the productivity of many fish stocks (e.g., cod and Greenland halibut), but also be favourable to other stocks area (e.g., high abundance of redfish and low abundance of prey). For instance, during the summer, cod live closer to the cold intermediate layer (CIL), a layer of water formed by the surface layer of the previous winter. In recent years, there has been a decrease in volume and an increase in temperature of the CIL. The long-term prospects for many fish stocks in the GSL are uncertain due to observed ecosystem changes.

4. List any accompanying geo-spatial data / maps

See Table 2 below. Data layers illustrating commercial fishing effort, based on logbook records and Vessel Monitoring System (VMS) records are available on *OpenData* under the following title: *Fishing effort within Significant Benthic Areas in Canada's Atlantic and Eastern Arctic marine waters* (see details in Table 2). Although the dataset title suggests the analysis has a focus on sensitive benthic areas, the maps included do detail effort across the entire Atlantic (including the DFO Newfoundland and Labrador, DFO Maritimes, DFO Gulf, and DFO Quebec regions) and Eastern Arctic region. Ongoing updates are conducted for this work, with layers for 2005-2021 currently pending upload to *OpenData*.

It is advised that the above-mentioned dataset in *OpenData* be checked often to ensure that the most recent data is being used for the Regional Assessment. If an update is not made available before analysis for the Regional Assessment is initiated, it is important to note that the 2005-2019 layers contain known positional errors in the Gulf of St. Lawrence region due to logbook recording discrepancies. The datafile that is pending upload to *OpenData* has corrected these issues, and it is suggested that if this data is to be included in the Regional Assessment that the newest data be used when it is made publicly-available. Last, commercial fishing effort layers have been developed based on the methodology outlined within Koen-Alonso et al. (2018).

5. Cumulative effects: Brief summary of known cumulative effects or potential impacts of species with planned offshore wind development.

This impacts of offshore wind development on regional fish stocks are not known. Cumulative impacts associated with fish stocks, particularly those in the cautious, critical, or unknown zones, are often associated with historical over-fishing, habitat degradation, and a changing marine climate that impacts water column structure, nutrients, primary productivity, and changing predator-prey relationships. Impacts associated with offshore wind development, such as habitat alteration, disruption, destruction, noise associated with installation or servicing, and/or vessels that may be vectors for Aquatic Invasive Species may impact the status of some fish stock; particularly benthic and/or vulnerable fish stocks.

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Table 1. Overview of fish stocks that overlap with Focus Area.

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
NAFO 3Ps Stocks					
Atlantic Cod	3Ps	Critical	The Subdivision 3Ps Atlantic Cod stock off southern Newfoundland extends from Cape St. Mary's to just west of Burgeo Bank and over St. Pierre Bank and most of Green Bank. It is managed jointly by Canada and France and the last stock assessment took place in November of 2021. Spawning stock biomass (SSB) has been in the critical zone since the early-2000s. In 2022, the 3Ps cod stock remained well within the critical zone (48% of the limit reference point, LRP) of Canada's Precautionary Approach Framework. Consistency with the Framework would require that removals from all sources must be kept at the lowest possible level while the stock is in the critical zone. It is highly likely the stock will remain in the critical zone through at least the beginning of 2024. Increased natural mortality and low recruitment are limiting the growth of this stock. Poor fish condition is of the major factors impacting increased natural mortality levels. Fishing mortality is currently low. The 2011 cohort has been supporting the fish stock and fishery over the last few years. However, subsequent recruitment reached historically low levels, with very few fish entering the population in any year since then. While projections indicate there is a moderate-to-high likelihood that the stock will show modest growth in the short term, it is unlikely the stock will grow significantly in the near future. Model projections of the stock predict that the stock will remain below the LRP up to early 2024. Ongoing warming water trends, together with more recent increased dominance of	Stock Assessment of NAFO Subdivision 3Ps Cod (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			warm water fishes, indicate that this ecosystem continues to experience structural changes. In this context, bottom-up effects are contributing to poor fish condition and high natural mortality of cod.		
Atlantic halibut	3NOPs4VWX5Zc	Healthy	Atlantic Halibut (*Hippoglossus hippoglossus*) is the largest of the flatfishes and ranges widely over Canada's East Coast. The management unit definition, Northwest Atlantic Fisheries Organization (NAFO) Divisions 3NOPs4VWX5Zc, is based largely on tagging results that indicate that Atlantic Halibut move extensively throughout the Canadian North Atlantic with smaller fish moving further than larger fish. Atlantic Halibut are most abundant at depths of 200-500 m in the deep-water channels running between the banks and along the edge of the continental shelf, with larger individuals moving into deeper water in winter. The geographic range of Atlantic Halibut in the Northwest Atlantic extends from the coast of Virginia, United States of America (USA), in the south to the waters off northern Greenland. Female Atlantic Halibut grow faster than the males and attain a much larger maximum size. The 3NOPs4VWX5Zc Atlantic Halibut stock has a history of overfishing that predates the time series used in the stock assessment model (i.e., prior to 1970). The stock has increased from the depleted state observed in the early 1990s. The 2022 three-year mean biomass based on the Stratified Random Halibut Survey higher than the upper stock reference (USR), placing the stock in the Healthy Zone.	Assessment of Atlantic Halibut on the Scotian Shelf and Southern Grand Banks (NAFO Divisions 3NOPs4VWX5Zc) (dfo-mpo.gc.ca)	Stock Status Update of Atlantic Halibut (Hippoglossus hippoglossus) on the Scotian Shelf and Southern Grand Banks in NAFO Divisions 3NOPs4VWX5ZcO for 2022 (dfo-mpo.gc.ca)

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
American plaice	3Ps	Critical	American plaice is a flatfish that is broadly distributed in the waters surrounding Newfoundland and Labrador. This stock is assessed using a Bayesian surplus production model and was last assessed in November of 2019. The 3Ps American plaice stock has shown little or no growth since 2008. Projections of stock size to the beginning of 2023 demonstrated a high probability that the stock would remain below the limit reference point. Consistency with Canada's Precautionary Approach Framework would require that removals from all sources must be kept at the lowest possible level while the stock is in the critical zone. Bottom temperatures in 3Ps remain above normal which may contribute to low productivity in American plaice. The spring bloom continues to be reduced in magnitude. Zooplankton biomass in 3Ps was near normal in 2017 and 2018 after four years of low production, with an increased proportion of smaller species. Oceanographic data were unavailable from 2019. Ongoing warming trends, together with an increased dominance of warm water fishes, indicate that this ecosystem continues to experience structural changes.	Stock assessment of NAFO Subdivision 3Ps American Plaice in 2019 (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.
Capelin	3Ps	Unknown	NAFO Division 3Ps (St. Pierre Bank) capelin stock is data poor and stock status is unknown. There are no data on recent trends in stock status. There is no capelin-directed fishery-independent survey in Div. 3Ps. Capelin are sampled on the annual spring multi-species (MS) bottom trawl survey, so there are biological and distribution data available as well as predator (fish) diet data. These spring MS survey data cannot be used to develop a capelin	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/4105880x.pdf	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41108279.pdf

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			abundance/biomass index due to timing of the survey and gear type. The Div. 3Ps stock is part of the Citizen Science Capelin Beach Spawning Diary Network. The median first day of beach spawning in Div. 3Ps is June 23 (years: 1991-2021), which is ~10 days earlier than the 2+3KL capelin stock (Murphy 2022). The Div. 3Ps stock spawns at both beach and deep-water (< 40 m; demersal) sites (Bliss et al. 2023). The science advice for the 2+3KL capelin stock is used to manage the Div. 3Ps stock. The 2+3KL capelin stock is in the critical zone. The TAC associated with the Div. 3Ps stock is often transferred to the 2+3KL capelin fishery. The impacts of climate change on this stock is unknown. The Science Advisory Report is from the regional peer review meeting of the 2+3KL Capelin stock assessment (March 9-12, 2021), and the Science Response is from the 2+3KL Stock Status Update (March 14-15 2022). Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Haddock	3Ps	Critical	Haddock range from the Strait of Belle Isle south to Cape Hatteras. Spawning occurs on the St. Pierre Bank in spring. The 3Ps Haddock stock was last assessed in 2018. Haddock abundance, biomass and spawning stock biomass have been at or below the survey time series average (1996-2018) for the last four years and remains in the critical zone. Consistency with Canada's Precautionary Approach Framework would require that removals from all sources must be kept at the lowest possible level while the stock is in the critical zone. The stock is characterized by sporadic	Stock Assessment of Haddock (Melanogrammus aeglefinus) in NAFO Subdivision 3Ps (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			large recruitment events, which have not been observed since 2007. The ecosystem in Subdivision 3Ps remains under reduced productivity conditions. Spring bloom magnitude and zooplankton biomass have shown very low levels since 2014, with late spring blooms from 2013-17. These conditions could negatively impact transfer of energy to higher trophic levels.		
Herring	3Ps	Unknown	This stock was last fully assessed in 2019 (DFO 2019) which included stock status updates for Fortune Bay to 2017, and St. Mary's Bay-Placentia Bay to 2018. Atlantic Herring on the south coast of Newfoundland (3Ps) are divided into two stock complexes: St. Mary's Bay-Placentia Bay and Fortune Bay. These stock complexes are comprised of a mixture of spring spawners and fall spawners. During the early 2000s all areas with the exception of Fortune Bay saw a shift from spring spawners to fall spawners dominance; the proportion of spring spawners has remained low in Fortune Bay in comparison to complexes on the northeast coast in recent years. Herring recruitment dynamics are highly variable and thought to be largely driven by environmental conditions; fall spawner success has been linked to warmer water temperatures whereas spring spawner recruitment may be driven by prey (plankton) dynamics. Spawning components within these stock complexes never discretely separate. In SMBPB landings have increased in recent years, with 89% of the 2,100 t quota taken in 2019 and 32% in 2020. In FB the quota and landings have decreased over the past decade; 56% of the 789 t quota was landed in 2019 and 34% in 2020. With the lack of an established	Science Advisory Report (2019/049)	Science Response (2022/035)

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			limit reference point (LRP), stock status is calculated using three metrics from the spring research gillnet program: overall catch rates as a percentage of the reference period mean, catch rates of ages 7-10 as a percentage of the reference period mean, and the number of mature year classes above the reference period mean. In Fortune Bay, stock status increased slightly in 2017 due to the incoming strong 2012 year class, there was no change in 2018. The stock status remains low as a single year class is comprising the majority of the catch. Future prospects for Fortune Bay and the overall evaluation of stock status were negative. Combined catch rates in the Placentia Bay gillnet research program in 2018 were above the reference period mean and higher than the catch rate derived from the 2016 Placentia Bay acoustic survey; however, the catch was dominated by a single year class and recruitment was at or below average, giving an overall stock status of uncertain.		
Icelandic scallop	3Ps Core zone - Canada-France Transboundary area	Unknown (no Precautionary Approach Framework)	Populations of Iceland Scallop (Chlamys islandica) off Newfoundland and Labrador are typically found in waters from 50 to 200 m, usually on hard bottom with variable substrate composition, consisting largely of sand, gravel, shell fragments, and stones. The directed fishery for Iceland Scallop started on St. Pierre Bank in 1989 and peaked at 6,000 t in 1992. Prior to 1996 the entire catch was taken by Canada. A decision by an International Court of Arbitration in 1992 resulted in jurisdictional changes over the disputed waters south of Newfoundland and St. Pierre and Miquelon. Following that decision, an annual total allowable catch (TAC) level has been established for an area	The Status of Iceland Scallop (Chlamys Islandica) in the Canada-France Transboundary Zone (Core area) of St. Pierre Bank in 2017 (dfo-mpo.gc.ca) Reseach Document from last Stock assessment in February 2018	Assessment cited to left is most recent science advice on this stock.

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			called the "Transboundary Zone" or simply the "CORE". Joint TACs have been in place for the CORE since 1995. France and Canada are allocated a fixed percentage of the TAC: 70% and 30%, respectively. A Canadian research survey in September 2017 resulted in a minimum dredgeable biomass estimate of 1,200 t which is among the lowest in the survey time series, and a decrease of approximately 60% since 2009. The mean shell height was found to be consistently higher in Canadian waters than in French waters and an average meat count of 85 scallop/500 g from the 2017 survey was the highest in the survey time series. Predatory sea stars were observed at the lowest level in the survey time series and the annual natural mortality estimate was also the lowest in the survey time series.		
Northern shortfin and Longfin squid	Northern Stock component: 3Ps, 3Pn	Northern shortfin: Unknown – "Low productivity state" Longfin squid: Unknown in Canada	Northern Shortfin and Longfin Squid are transboundary stocks and are fully assessed every three years (with updates in all other years). Northern Shortfin Squid is assessed and managed by the Northwest Atlantic Fisheries Organization (NAFO), whereas Longfin Squid is only assessed and managed within US waters by the Mid-Atlantic Fishery Management Council (MAFMC). Both species are thought to spawn off the United States. The 3Ps focus area is a known hotspot for Northern Shortfin Squid and Longfin Squid recreational fisheries (particularly in recent years) during the summer and fall months. Both species are commercially and recreationally fished in Eastern Canada (although Northern Shortfin Squid is usually the target species). In general, the population dynamics, connectivity, ecology, and abundance of	Scientific Council Report, September 2022 (nafo.int) Assessment of Northern Shortfin Squid (Illex illecebrosus) in Subareas 3+4 for 2019 (nafo.int) 3_Longfin+squid_data_update_report_for_2019_MAFMC_SSC_ABC_me	

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			squid are poorly understood throughout their range, particularly off Canada. DFO multispecies trawl surveys provide an indication of stock status, but migration patterns, diurnal movements, large annual fluctuations in abundance, and opportunistic fisheries make understanding squid, their ecology, and their fisheries difficult and survey results alone are unreliable for identifying annual distribution patterns. Northern Shortfin Squid and Longfin Squid population dynamics are highly reactive to changes in climatic conditions. However, the overall impacts of climate change for Northern Shortfin and Longfin Squid in the focus areas remain unknown. In general, climate change is expected to influence distribution, movement patterns, growth, phenology, and abundance of squid species. There are currently no known maps available that adequately depict the patterns of Northern Shortfin Squid and Longfin Squid abundance and distribution in the 3Ps focus area, although research is ongoing. Offshore wind structure pile driving during offshore wind farm construction could impact squid short-term feeding success and behaviours (Jones et al., 2021; Cones et al., 2022). Low-frequency underwater noise that occurs during regular offshore wind operations has been documented causing severe acoustic trauma in cephalopods species (Solé et al., 2017, 2018, 2019).	eting.pdf (squarespace.com)	
Northern shrimp	3Ps	Unknown	There is a Northern Shrimp fishery in the 3Ps portion of Shrimp Fishing Area (SFA) 7 (based on the *Atlantic Fisheries Regulations* map), which only opens at the request of the industry through a Notice to Fish Harvesters (it was last open in 2021). The shrimp	NAFO 2023. Report of the Scientific Council and STACFIS Shrimp Assessment Meeting 13	Assessment cited to left is most recent science advice related to this stock (see text).

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			fishing effort in this area is primarily concentrated in the deeper part of the Fortune Bay Channel, stretching from off Grand Bank up to close to Bay L'Argent. Some data from the Canadian multi-species randomized trawl survey and fisheries logbooks are available in this area, but no assessment has been made for the 3Ps shrimp stock due to its limited Total Allowance Catch. However, the stock in 3Ps is considered to reflect the trend in the adjacent 3LNO portion of SFA 7 stock (regulated by NAFO), which is currently in the critical zone (below B_{lim}) according to the latest assessment report (NAFO 2023), with no indication of recovery in recent years and no exploitation since 2015. Larval connectivity modeling studies suggested that the 3Ps area's contribution to overall shrimp stock productivity through larval dispersal is expected to be minimal due to the downstream location of this area in relation to the more productive northern areas on the Newfoundland and Labrador shelves (Le Corre et al., 2020). There is no available information on a potential relationship between shrimp in 3Ps and the Gulf of St. Lawrence and Scotian Shelf shrimp stocks.	to 15 September 2023 Vigo, Spain. scs23-20.pdf (nafo.int)	
Pollock	3Ps	Under moratorium	Pollock are a semi-pelagic species and occur from southern Labrador, around Newfoundland into the Gulf of St. Lawrence and south to Cape Hatteras. Mature pollock are often found along the slopes of the St. Pierre Bank. They were last assessed in December of 2018 and do not generally occur in Newfoundland and Labrador waters in sufficient numbers to support a commercial fishery. Pollock have been under moratorium since 1993 and	Stock Assessment of NAFO Subdivision 3Ps Pollock (Pollachius virens) (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.

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			bycatch levels had remained low. Research survey catches may not give a reliable biomass or abundance index for this species. Subsequently, stock status could not be determined. The ecosystem in 3Ps remains under reduced productivity conditions. Spring bloom magnitude and zooplankton biomass have shown very low levels since 2014, with late spring blooms from 2013-2017. These conditions could negatively impact transfer of energy to higher trophic levels.		
Sea cucumber	3Ps	Unknown	Populations of sea cucumber (*Cucumaria frondosa*) off Newfoundland and Labrador are normally found in waters down to 100 m, usually on hard bottom with a cobble-shell-boulder substrate composition. There are two main Sea Cucumber concentrations on the Canadian portion of the St. Pierre Bank, one northwest and one southeast of the French Economic Zone. In 2010, the southeastern area was closed to fishing as a conservation measure to preserve the resource in this area until the effects of fishing could be evaluated, but this area was opened to fishing in 2017. There was a sea cucumber assessment in 2023, however, this data is not yet available on the CSAS website. Sustainable exploitation rates are unknown. Given the uncertainties with this species on the St. Pierre Bank, there is no scientific basis for assessing the risk of any increase in harvest level.	Science Advisory Report 2017/029 (dfo-mpo.gc.ca)	Science Response 2018/010 (dfo-mpo.gc.ca)

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Sea scallop	3Ps-St. Pierre Bank, NL	Unknown (no Precautionary Approach Framework)	Populations of Sea scallop (Placopecten magellanicus) on St. Pierre Bank are mainly found in three beds (North, Middle, and South beds) at depths of 40-100 m. They are usually found on hard bottom with variable substrate composition, consisting largely of sand, gravel, shell fragments, and stones. The Sea and Iceland Scallop distributions overlap to varying degrees with complete overlap in the Middle bed, and a high degree of overlap in the North bed. A large area in the southern portion of the South bed, with a sandy substrate, is inhabited by only Sea Scallop. A Fisheries and Oceans Canada (DFO) survey in September 2019 resulted in a minimum dredgeable biomass (MDB) estimate of 12,725 tonne, round weight. This point estimate is associated with high variability and a subsequent high level of uncertainty. The stock in the North bed is currently dominated by a modal group of scallop 75 mm, while in the Middle and South beds the modal group is 120 mm and 130 mm, respectively. The natural mortality index for Sea Scallop has decreased from 0.13 in 2015 to 0.02 in 2019, similar to levels observed from 2003 to 2006. The abundance of small scallop in the North bed indicate favourable prospects for the fishery in the near future.	An Assessment of Sea Scallop on the St. Pierre Bank (Subdivision 3Ps) (dfo-mpo.gc.ca) An Assessment of Sea Scallop (Placopecten magellanicus) on St. Pierre Bank in 2019 (dfo-mpo.gc.ca) Research Document from Assessment in February 2020.	Assessment cited to left is most recent science advice on this stock.
Silver hake	3Ps	Unknown	Silver hake are bottom dwellers found in the warmer waters of the Atlantic, with the northern most part of their range reaching the southern portions of Newfoundland. They live at variable depths, about 50-400 meters, but occasionally as deep as 900 meters. Silver hake tend to migrate inshore during the warmer months and	No recent stock assessment available.	No recent stock assessment available.

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			into deeper waters in winter. They are more abundant further south of the Scotian Shelf and the Georges Bank, but have been increased in dominance in 3Ps in recent years. They started showing significant increases in 2008 and has steadily increased since then. It is now the most dominant piscivorous fish species in the division, a group that previously was dominated by Atlantic cod.		
Snow crab	3Ps	Healthy	Snow crab (Chionoecetes opilio) occupy a broad geographic range in the Northwest Atlantic from Greenland to southern Nova Scotia. Distribution in waters off Newfoundland and southern Labrador is widespread and continuous with the genetic stock spanning throughout the region. The Newfoundland and Labrador (NL) Region assesses Snow crab based on Assessment Divisions (ADs). The focus area covers two ADs; 3Ps and 4R3Pn. AD 4R3Pn results are based primarily on data from 4R. Snow crab undertake an ontogenetic migration from shallow cold areas with hard substrates to warmer deeper areas with soft substrates (Mullowney et al. 2018). Large males are most common on mud or mud/sand in deep areas, while smaller Snow crab are common on harder substrates typically associated with shallow areas. Some Snow crab also undertake a migration in the winter or spring for mating and/or molting. Although the dynamics of winter and spring migrations are not fully understood, they are known to be associated with different mating periods for first-time spawning (primiparous) and multiple-time spawning (multiparous) females and are generally from deep to shallow areas. Maps of the	Assessment of Newfoundland and Labrador (Divisions 2HJ3KLNOP4R) Snow Crab (dfo-mpo.gc.ca) This is the most recent published SAR however the SAR for the 2023 assessment meeting will be published very soon. An Assessment of Newfoundland and Labrador Snow Crab (Chionoecetes opilio) in 2020 (dfo-mpo.gc.ca) This is the most recently published Research Document however the	

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			distribution of various categories of Snow crab from trawl surveys up to 2019 and trap surveys up to 2020 can be found in the most recently published Research Document (see adjacent link). Snow crab is a deep, cold-water species that inhabits a narrow range of temperatures making it susceptible to temperature-related changes. Environmental factors, such as water temperature, can affect Snow crab in a variety of ways, including the timing of molting and reproduction, early survival, and subsequent recruitment to the fishery. Warming water conditions negatively affect Snow crab by limiting their habitat, as well as changing their available diet and predators. Atmospheric forcings and sea ice extent are also important variables in predicting Snow crab abundances at different life stages (Mullowney et al. 2023). Newfoundland and Labrador Snow crab was last assessed in February 2023. The following information is from that assessment. The Science Advisory Report for this meeting is currently in the process of publication. Information up to 2021 can be found in the adjacent linked publication. In AD 3Ps, landings continued to increase from a time-series low of around 1,200 tonne in 2017 to around 7,700 tonne in 2022, while effort increased to nearly 400,000 trap hauls. In the absence of trawl data, the trap survey time series was solely used to infer trends in 2022. The trap-based exploitable biomass index has continued to increase to time-series high levels in 2022. Recruitment has remained around the same level for the last four years. Trap-based exploitation rate index is projected to remain at a low level with status quo removals in	Res Doc for 2021 is in the process of process of publication.	

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			2023. Following the Canada's Precautionary Approach Framework, with status quo removals, the stock status is projected to be in the Healthy zone in 2023.		
Waved whelk	3Ps	Unknown	In the early 2000s the Waved whelk (*Buccinum undatum*) fishery in offshore 3Ps developed and expanded rapidly. The fishery is currently concentrated in three distinct offshore areas in 3Ps, known as the North, West, and South fishing grounds, with a fishing season running from April 1 to September 30 of each year. Total whelk landings in 3Ps were 5,819 tonne in 2011. More than half the landings (61%) were from the South grounds, with the North and West grounds contributing 29% and 10% respectively. This stock has no been assessed since 2013, so current fishery status is not known. This species has seemingly high 'catchability' (attraction to baited traps), low reproductive rates, and limited dispersal, so it is thought to be susceptible to localized over-exploitation and has been extirpated in some areas of its range. Populations are isolated due to the absence of a pelagic larval stage and the limited movement of adults. Comprehensive biological data necessary for the provision of advice to assist in formulating management strategies are not available. Impacts of climate change on this stock is not known. However, they are predicted to exhibit large vulnerability to climate change as they are have limited movement, require specific habitats and are dependent on calcium carbonate shells (Hare et al. 2016, Borsetti et al. 2020).	Science Advisory Report 2013/066 (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.

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White hake	3Ps	Unknown	White Hakes in Subdivision 3Ps and Division 3NO constitute a single biological stock. Distributions of White Hake over 2008-17 were consistent with historic data from DFO-NL spring surveys; indicating that White Hakes in Div. 3P were found mostly in the Laurentian, Hermitage, and Halibut Channels. Large episodic recruitment of Divs. 3NOPs White Hake was observed in 2000. Recruitment remained at much lower levels since 2001. In 2017, the 3NOPs index increased, but was still very small in comparison to the last large recruitment peak. Ecosystem signals observed in Subdiv. 3Ps in recent years indicated that structural changes are occurring, and overall ecosystem productivity may be low. Although the direct impacts of these changes on White Hake life stages (i.e., pelagic eggs and larvae, bottom-dwelling juveniles and adults) are unknown, they imply that at least some aspects of White Hake productivity may be affected. Difficulties in applying the limit reference point (LRP) concepts to White Hake include its episodic recruitment and other data limitations. LRP options were not accepted for this species. Further, age-structured assessment of the 3NOPs stock is currently not feasible; however, population abundance-at-length estimates from the DFO Newfoundland and Labrador spring surveys suggest that no large recruitment has occurred for 3NOPs White Hake over the past sixteen years. A six-year science stock assessment schedule is recommended for 3Ps White Hake.	Assessment of White Hake (Urophycis tenuis) in NAFO Subdivision 3Ps (dfo-mpo.gc.ca) Species last assessed in November 2017.	

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Witch flounder	3Ps	Healthy	Witch Flounder is a long lived deepwater flatfish and is primarily distributed along the slope around St. Pierre Bank and in through Hermitage Channel, and in Hermitage Bay and Fortune Bay on Newfoundland's South Coast. It was last assessed in December of 2017. The stock is currently above the limit reference point and has been in most years of the time series (1983-2017). This stability indicates the stock was able to sustain the range of harvest rates over the time period. Recruitment has been mostly lower than average since 2012; however, the relationship between pre-recruits and future exploitable biomass remains unclear. There is no analyses linking the stock to climate change.	Stock assessment of Witch Flounder (Glyptocephalus cynoglossus) in NAFO Subdivision 3Ps (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.
NAFO 3Pn and 4R Stocks					
Preliminary results from the ecosystemic survey in August 2022 in the Estuary and northern Gulf of St. Lawrence	4R, 4S, northern 4T	Not applicable	This report presents preliminary results from the ecosystemic survey in August 2022 in the Estuary and northern Gulf of St. Lawrence. The ecosystemic survey is a multi-species, fishery-independent survey. Its purpose is to assess the ecosystem with consistent and standardized protocols. This survey examines, among other things, spatial and temporal changes in the distribution and relative abundance of fish and their assemblages. It also aims to gather information on the biological parameters of commercial species. The survey covers waters of the Laurentian Channel and the area north of it, from the Lower Estuary in the west to the Strait of Belle Isle and the Cabot Strait in the east, namely, the Northwest Atlantic Fisheries Organization (NAFO) divisions 4R, 4S, and the northern part of 4T. In total, 78 fish taxa	Preliminary results from the ecosystemic survey in August 2022 in the Estuary and northern Gulf of St. Lawrence (dfo-mpo.gc.ca)	Research document cited to left is most recent science advice on this topic.

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			and 208 invertebrate taxa were identified during the mission. Historical perspectives (catch rates, spatial distribution and length frequency) are presented for 25 taxa. These commercial fishery independent data will be used in several stock assessments including cod (Gadus morhua), redfish (Sebastes spp.), Greenland halibut (Reinhardtius hippoglossoides), Atlantic halibut (Hippoglossus hippoglossus), witch flounder (Glyptocephalus cynoglossus), and northern shrimp (Pandalus borealis). Oceanographic conditions such as temperature, conductivity (salinity), turbidity, dissolved oxygen, luminosity, and fluorescence were also sampled during this survey. A total of 79 vertical profiles of the water column were done at the fishing stations as well as 13 extra stations that fall under the Atlantic Zone Monitoring Program (Atlantic Zonal Monitoring Program - Background and Context). The report summarizes findings of the survey, including observations regarding physical oceanography, biodiversity, and fish.		
Atlantic cod	3Pn4R4S	Critical	NAFO 3PnRS Atlantic cod begin to spawn at the end of March, with spawning activity intensifying in May and continues until June. Since 1990, the Spawning Stock Biomass (SSB) of 3Pn4RS cod has been in the critical zone (for 30 years, SSB has been at low levels). In 2010, the Committee on the Status of Endangered Wildlife in Canada designated as endangered cod from the Laurentian North population (3P4RS), which includes 3Pn4RS cod. A fishery management measure includes closure of areas during	Assessment of the Northern Gulf of St. Lawrence (3Pn, 4RS) Atlantic Cod Stock in 2022 (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			spawning and during winter (3Pn). In 2022, 3Pn4RS cod condition was particularly poor, especially in 4S, and at levels where increased natural mortality has been observed in the past. The SSB estimate for 2022 was in the critical zone and corresponded to 60% of the precautionary approach Lower Reference Point. Estimated fishing mortality in 2021 and 2022 was also low, while natural mortality has been estimated to be high over the past decade. Additional details regarding potential impacts of oceanography and environmental conditions on the stock, fishery, and sources of uncertainty are further described in the 2022 stock assessment. The Science Advisory Report is from the regional peer review of February 23 and 24, 2023 on the assessment of the Northern Gulf of St. Lawrence (3Pn, 4RS) Atlantic cod stock. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Atlantic halibut	4RST	Healthy	Atlantic halibut can be found throughout the lower estuary and Gulf of St. Lawrence (GSL) in NAFO 4RST. Atlantic halibut landings have been increasing since the early 2000s and have reached the highest values since 1960. The science advisory report shows the distribution of catches made during fishery-independent mobile gear surveys which took place between July and September from 1985 to 2020 (see Figure 2). The probability of capture is higher on the channel banks at depths near 200 m and around the 35 m isobath. Atlantic halibut generally seem to avoid the cold intermediate layer, typically located between 50 m and 100 m	Stock assessment of Gulf of St. Lawrence (4RST) Atlantic halibut in 2022 (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			depth. Some Atlantic halibut have been observed to undertake seasonal migrations, moving from shallow areas in the summer (less than 50 m) to deeper channels in the winter. In general, the ecosystem of the GSL has undergone significant changes in recent decades, including warming of deeper waters, where record high temperatures were observed in 2022. The temperatures observed in deeper waters are not expected to negatively impact the survival or development of Atlantic halibut, as they do not exceed the documented preferred temperatures for the species. High total catch rates have been observed in 4R, although they cannot be attributed to specific geo-locations (see: Figure 4). The stock is in the healthy zone Additional details regarding potential impacts of oceanography and environmental conditions on the stock, fishery, and sources of uncertainty are further described in the 2022 stock assessment. This Science Advisory Report is from the March 6–7, 2023 regional peer review meeting on the Assessment of the Gulf of St. Lawrence (4RST) Atlantic Halibut stock. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Atlantic mackerel	Northern contingent	Critical	Northwest Atlantic mackerel (Scomber scombrus L.) can be found in waters from North Carolina to Labrador and are highly migratory. They overwinter in deeper warmer waters at the edge of the continental shelf and migrate inshore during the spring to spawn and then disperse to feed during the summer. There are two spawning contingents in the Northwest Atlantic: northern and	Assessment of the northern contingent of Atlantic mackerel (Scomber scombrus) in 2022 (dfo-mpo.gc.ca)	

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			southern. The northern contingent spawns in Canada, primarily in the Southern Gulf of St. Lawrence during June and July, although a component of the stock migrates into or through 3P and/or 4R August to November each year. Available evidence shows that although there might be some opportunistic spawning around Newfoundland, this is relatively minor. The estimated Spawing Stock Biomass (SSB) has been at its lowest values in 2021 and 2022 and the stock is in the Critical Zone. The stock's decline into the Critical Zone (2005–2011) was associated with high total landings and estimated fishing mortality above the reference level, with no further reduction in stock productivity. The northern contingent of mackerel has been in or near the Critical Zone since 2011. The available evidence indicates the stock rebuilding potential is currently limited by a truncated age structure, low recruitment, and high predation pressure. Canada closed the commercial and bait mackerel fisheries in 2022 and 2023. Habitat loss or degradation is of no known concern to this stock. Additional information on migration patterns of mackerel and its spawning dynamics is broken down by region are described by Van Beveren et al (2023). Additional details regarding potential impacts of oceanography and environmental conditions on the stock, fishery, and sources of uncertainty are further described in the 2022 stock assessment. This Science Advisory Report is from the February 20–22, 2023 regional peer review on the Assessment of the northern contingent of Atlantic Mackerel (*Scomber scombrus*). Additional publications from this meeting will be posted on		

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			the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Capelin	4RST	Healthy	Atlantic capelin can be found throughout the lower estuary and Gulf of St. Lawrence (GSL) in NAFO 4RST. Capelin is a small, schooling, forage fish that plays an important role in the ecosystem. Most capelin catches in 4RST are made on the West coast of Newfoundland. In fact, Capelin landings are dominated by the seine fleet (small and large purse seiners) in NAFO 4R taking 82% of the total landings during the 2010-2021 time series. Capelin have two modes of spawning, beach and demersal, the location of both modes being dependent on the presence of appropriate substrate. In the GSL, the spawning period on beaches generally begins in late April or May in the west of the Estuary and then progresses eastwards throughout the GSL to end in July or August along the Lower North Shore of Quebec and the West coast of Newfoundland. Similar to beach spawners, demersal spawners tend to spawn on sites composed of sandy or fine gravel substrate but are exposed to generally lower and more constant temperatures and higher salinities than on beaches. Additional details regarding potential impacts of oceanography and environmental conditions on the stock, fishery, and sources of uncertainty are further described in the 2015 stock assessment. This Science Advisory Report is from the Regional Peer Review of April 20-21, 2022 on the Assessment of the Estuary and Gulf of St. Lawrence (Divisions 4RST) capelin stock. Additional publications from this meeting will be posted on the Fisheries and	Assessment of the Estuary and Gulf of St. Lawrence (Divisions 4RST) Capelin Stock in 2021 (dfo-mpo.gc.ca)	Update of stock status indicators of the Estuary and Gulf of St. Lawrence (Divisions 4RST) capelin stock in 2022 (dfo-mpo.gc.ca)

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			Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Greenland halibut	4R4ST	Cautious	Greenland halibut (*Reinhardtius hippoglossoides*) can be found throughout the lower estuary and Gulf of St. Lawrence (GSL) in NAFO 4RST. Specifically, the Greenland halibut Stock Management Area in the Gulf of St. Lawrence includes 4R (Esquiman), 4S (North Anticosti) and 4T (Western Gulf of St. Lawrence). . Greenland halibut are mainly found in channels at depths varying from 200 to 400 m. Spawning occurs once a year between January and March in the depths of the Laurentian Channel southwest of Newfoundland. Directed fishing is currently authorized for the inshore fixed gear fleets of Quebec and the west coast of Newfoundland. Catch rates throughout 4RST are relatively low around southwest and western Newfoundland in 4R (see: Figure 3). The fishing allocation is divided between the Quebec (82%) and the Newfoundland (18%) fleets. Based on data available on January 12, 2023, the Quebec and Newfoundland fixed gear fleets landed 49% and 37% of their respective fishing allocation for 2022-2023. These landings data are preliminary, but should not increase significantly with the continuation of fishing by the Quebec fleets during spring 2023. The number of active harvesters in the directed Greenland halibut fishery decreased by more than 50% between the 2014-2016 and 2021-2022 seasons, from an average of 150 to about 75 harvesters. Fishing effort shows a downward trend across the Gulf since 2013 and has reached the lowest level observed of the 1999-2022 period. More	Assessment of the Gulf of St. Lawrence (4RST) Greenland halibut stock in 2022 (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.

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			than 80% of estimated fishing effort was located in the western Gulf in 2022. Juveniles are predominant in the Lower Estuary and north of Anticosti Island and are generally found at shallower depths than adults. In August, an average of 23% of the Greenland halibut abundance is found in the Lower Estuary. Under the precautionary approach, the stock status indicator placed the stock at the top of the cautious zone in 2022. Additional details regarding potential impacts of oceanography and environmental conditions on the stock, fishery, and sources of uncertainty are further described in the 2022 stock assessment. The Science Advisory Report is from the regional peer review meeting of February 13-14, 2023 on the Assessment of the Gulf of St. Lawrence (4RST) Greenland Halibut stock. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Herring	4R	Unknown	Herring populations on the west coast of Newfoundland, NAFO Division 4R, are characterized by the presence of two spawning components or stocks. Spring spawners generally spawn in April and May, and fall spawners in August and September. Spring- and fall-spawning herring are considered separate stocks and, as such, are assessed separately. Herring stocks have a complex structure that remains largely unknown. Each stock consists of several populations that use temporally and spatially distinct spawning areas. Every year, herring undertake long-distance migrations between feeding, spawning and overwintering areas. In 4R, since	Assessment of the west coast of Newfoundland (NAFO Division 4R) herring (Clupea harengus) stocks in 2021 (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.

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			2012 most fishery landings were reported from NAFO unit area 4Rb, except in 2020 and 2021, where most landings were reported from unit areas 4Ra and 4Rc, respectively. In general, the data and knowledge available are insufficient to quantitatively assess the status of the resource. Concerns related to some aspects of the stock's acoustic survey led to a rejection of the assessment model as the basis for the science advice, resulting in the rejection of the reference points and the precautionary approach. However, the main results of last assessment indicate that maintaining the TAC at status quo should not pose any significant risk to the two herring spawning stocks in Division 4R in the short term. Maximum exploitation rates in 2020-2021, estimated as the ratio of the TAC over the highest biomass index estimated in the acoustic survey, were low (< 15%) compared to commonly used biological reference points for species with similar life history characteristics. The abundance of young fish observed in the 2020-2021 acoustic surveys and commercial catches for both spring and fall spawners is an encouraging sign for the future of these. Additional details regarding potential impacts of oceanography and environmental conditions on the stock, fishery, and sources of uncertainty are further described in the 2015 stock assessment. This Science Advisory Report is from regional peer review of March 1-2, 2022 Assessment of the west coast of Newfoundland (NAFO Division 4R) herring (*Clupea harengus*) stocks in 2022. Additional publications from this meeting will be posted on the Fisheries and		

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			Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Lumpfish	3Pn, 4RS	Unknown	Lumpfish, also known as lumpsuckers (Cyclopterus lumpus), fishing takes place in spring for a very short period of time. Females are exclusively fished, for the caviar market. Scientific knowledge on lumpfish in the Gulf of St. Lawrence is limited, as structure of the population is unknown and lumpfish stocks have not been identified. This report provides the last assessment for lumpfish in 3Pn, 4R, and 4S Divisions. This assessment is focused on the areas of interest where directed fishery is carried out for this species. At the time of this assessment, lumpfish was a candidate for assessment by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The DFO annual survey held in August, which was used to inform the assessment, indicated that lumpfish are a rare catch and are not very abundant. Lumpfish is more widely distributed in the northern Gulf of St. Lawrence, with the highest concentrations being observed along the North Shore. The sharp decline in landings and effort suggests a significant decline in resource abundance since 2006. The abundance of lumpfish seems to fluctuate on a cyclical basis and has been low since 2009. Local fishery over-exploitation is also possible given that lumpfish seem to return to the same spawning sites every year. Despite uncertainty as to the causes of this low abundance, the vulnerability of this resource to reproductive potential overfishing argues for a very cautious approach. Additional details regarding potential impacts of oceanography and environmental	Assessment of Lumpfish (Cyclopterus Lumpus) in the Gulf of St. Lawrence (3Pn, 4RS) in 2015 (dfo-mpo.gc.ca)	Assessment cited to left is most recent science advice on this stock.

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			conditions on the stock, fishery, and sources of uncertainty are further described in the 2015 stock assessment. This scientific advisory report stems from the meeting of 18 February 2016 on the Assessment of Gulf of St. Lawrence NAFO Divisions 4RS and Subdivision 3Pn Lumpfish. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Snow Crab	3Pn4R	Healthy	Snow crab (Chionoecetes opilio) occupy a broad geographic range in the Northwest Atlantic from Greenland to southern Nova Scotia. Distribution in waters off Newfoundland and southern Labrador is widespread and continuous with the genetic stock spanning throughout the region. The Newfoundland and Labrador (NL) Region assesses Snow crab based on Assessment Divisions (ADs). The focus area covers two ADs; 3Ps and 4R3Pn. AD 4R3Pn results are based primarily on data from 4R. Snow crab undertake an ontogenetic migration from shallow cold areas with hard substrates to warmer deeper areas with soft substrates (Mullowney et al. 2018). Large males are most common on mud or mud/sand in deep areas, while smaller Snow crab are common on harder substrates typically associated with shallow areas. Some Snow crab also undertake a migration in the winter or spring for mating and/or molting. Although the dynamics of winter and spring migrations are not fully understood, they are known to be associated with different mating periods for first-time spawning (primiparous) and multiple-time spawning (multiparous) females and are generally from deep to shallow areas. Maps of the	Assessment of Newfoundland and Labrador (Divisions 2HJ3KLNOP4R) Snow Crab (dfo-mpo.gc.ca) This is the most recent published SAR however the SAR for the 2023 assessment meeting will be published very soon. An Assessment of Newfoundland and Labrador Snow Crab (Chionoecetes opilio) in 2020 (dfo-mpo.gc.ca) This is the most recently published Research Document however the	Assessment cited to left is most recent science advice on this stock.

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			distribution of various categories of Snow crab from trawl surveys up to 2019 and trap surveys up to 2020 can be found in the most recently published Research Document (see adjacent link). Snow crab is a deep, cold-water species that inhabits a narrow range of temperatures making it susceptible to temperature-related changes. Environmental factors, such as water temperature, can affect Snow crab in a variety of ways, including the timing of molting and reproduction, early survival, and subsequent recruitment to the fishery. Warming water conditions negatively affect Snow crab by limiting their habitat, as well as changing their available diet and predators. Atmospheric forcings and sea ice extent are also important variables in predicting Snow crab abundances at different life stages (Mullowney et al. 2023). Newfoundland and Labrador Snow crab was last assessed in February 2023. The following information is from that assessment. The Science Advisory Report for this meeting is currently in the process of publication. Information up to 2021 can be found in the adjacent linked publication. In AD 3Ps, landings continued to increase from a time-series low of around 1,200 tonne in 2017 to around 7,700 tonne in 2022, while effort increased to nearly 400,000 trap hauls. In the absence of trawl data, the trap survey time series was solely used to infer trends in 2022. The trap-based exploitable biomass index has continued to increase to time-series high levels in 2022. Recruitment has remained around the same level for the last four years. Trap-based exploitation rate index is projected to remain at a low level with status quo removals in	Res Doc for 2021 is in the process of process of publication.	

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			2023. Following the Canada's Precautionary Approach Framework, with status quo removals, the stock status is projected to be in the Healthy zone in 2023.		
Other Applicable Stocks					
American Lobster	LFAs 3-14C	Unknown, but considered healthy based on recent stock assessment results. (no Precautionary Approach Framework)	Adult lobsters prefer rocky substrates where they can find shelter, but also live on sand and even muddy bottoms (Jarvis 1989; Dinning and Rochette 2019). In Newfoundland waters, at the northern range of the species distribution, it takes approximately 8-10 years for a newly hatched lobster to reach the minimum legal size (MLS) of 82.5 mm in carapace length (CL) (Ennis 1978, 1980). Lobsters have a total lifespan of more than 30 years (Lawton and Lavalli 1995). Growth is achieved through molting. Frequency of molting decreases with increasing age, with large lobsters molting once every few years. Growth is also affected by temperature; molting frequency tends to increase with water temperature (Fogarty 1989). Molting and mating occur from July to September and females typically extrude (spawn) eggs roughly one year subsequent to mating. The most recent stock assessment took place in October 2022. The LFAs were assessed based on four regions: Northeast Coast (LFAs 3–6), Avalon (LFAs 7–10), South Coast (LFAs 11–12), and West Coast (LFAs 13–14). The key indicators for the assessment are reported landings, fishery catch per unit effort (CPUE), exploitation rate and total mortality in legal-sized lobster, and biomass indices. Preliminary total reported landings in 2022 were at their highest level in a century (5,780 tonne); this reflects increasing trends in the South	Assessment of American Lobster in Newfoundland (dfo-mpo.gc.ca). Science Advice Report for October 2022 assessment. Assessment of American Lobster in Newfoundland (dfo-mpo.gc.ca) This document is based on Stock assessment October 2019. Research Document for October 2022 assessment is pending publication.	Assessment cited to left is most recent science advice on this stock.

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			coast, West coast, and Northeast coast regions while reported landings in the Avalon region have remained low. Despite showing signs of high exploitation rates in most areas, all key indicators are consistent in showing sustained signs of growth throughout all assessment regions. Short-term recruitment prospects appear steady in the Northeast and Avalon regions and at the highest levels in the time series in the South and West Coast regions. Data gaps include limited data coverage, at sea, and geospatial data not collected in all LFAs. Most data sources are fishery dependent, require more independent data sources to inform lobster stock assessment. * Citations in text above are included in the reference list within the adjacent Research Document that is hyperlinked.		
Northern shrimp	SFA 8 (Esquiman)	Critical (SFA 8) based on the last assessment done on October 26, 2023 (yesterday)	Northern shrimp (*Pandalus borealis*) fishery in the Gulf of St. Lawrence is conducted by trawlers in four shrimp fishing areas (SFA): Estuary (SFA 12), Sept-Iles (SFA 10), Anticosti (SFA 9) and Esquiman (SFA 8); Esquiman (SFA 8) overlaps with NAFO 4R off the west coast of Newfoundland. The species is generally associated with the deep water mass and is found mainly at depths where the substrate consists of fine, consolidated sediments and where the temperature varies between 1-6°C. The Gulf of St. Lawrence is near the southern limit of the species' distribution, and water temperatures there are close to the upper threshold of its thermal preference range. Northern shrimp are therefore	Assessment of Northern Shrimp stocks in the Estuary and Gulf of St. Lawrence in 2021 (dfo-mpo.gc.ca)	Assessment cited left to the left is the most science advice on this stock.

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			vulnerable to warming of both the surface layer and the deeper waters. DFO research survey data indicate that northern shrimp are widespread in the Estuary and in the northern Gulf of St. Lawrence (see: Figure 2). Northern shrimpindices of total biomass and male and female biomass for Esquiman showed upward trends from 1990 to 2003 but have shown downward trends since that time. The estimates for 2020 and 2021 are among the lowest of the historical series. Warming of deep waters, depletion of dissolved oxygen, and increased predation by redfish appear to be important factors contributing to the decline of shrimp. These ecosystemic conditions are not expected to improve in the short to medium term. As of the 2021 assessment, the Esquiman stock is considered to be in the healthy zone. However, the sum of evidence (bias in the main stock status indicator, high exploitation rate, increase in predation and in deep waters temperature, and reduction in shrimp distribution area) shows that DFO is currently operating outside the framework in which the precautionary approach was developed for the stock. This situation has the consequence of increasing the risk for the sustainability of the stocks by using the current decision rules. The precautionary approach should be revised before the next assessment.. Additional details regarding potential impacts of oceanography and environmental conditions on the stock, fishery, and sources of uncertainty are further described in the 2021 stock assessment.		

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			The Science Advisory Report is from the January 27-28, 2022 regional peer review meeting on the Assessment of Estuary and Gulf of St. Lawrence Northern Shrimp Stocks. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Northern Wolffish, Spotted Wolffish, Atlantic Wolffish	NAFO Subareas 0, 2, 3, 4, 5	Northern Wolffish and Spotted Wolffish (SARA Threatened), Atlantic Wolffish (SARA Special Concern)	Northern Wolffish (*Anarhichas denticulatus*), Spotted Wolffish (*A. minor*), and Atlantic Wolffish (*A. lupus*) in Canadian Atlantic and Arctic waters are found from the Davis Strait to the Maritimes Provinces; the distributions of the three species overlap to some extent across their geographic range (DFO 2020b). The three species of wolffish were added to Schedule 1 of Canada's Species at Risk Act (SARA) in 2003, with the status of Atlantic Wolffish being assessed as Special Concern, and those of Northern Wolffish and Spotted Wolffish being assessed as Threatened, due to major declines in abundance (>90%) and reductions in the area of occupancy over 2 to 3 generations. The SARA status of these species were re-assessed and confirmed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2012: there have been some increases in Spotted Wolffish abundance and area of occupancy over most of its Canadian range (COSEWIC 2012a); Northern Wolffish has experienced small increases in abundance and area occupied since about 2002 (COSEWIC 2012b); and, while continued declines in Atlantic Wolffish abundance have occurred in the Southern Gulf of St. Lawrence and Scotian Shelf, there have been overall increases in	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/364041.pdf.	Assessment cited left to the left is the most science advice on this stock.

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			this species' abundance and area of occupancy (COSEWIC 2012c). COSEWIC considers each wolffish species in Canadian waters as a single population or Designatable Unit (DU). The analysis of DFO RV survey catch data indicates that the majority of Northern Wolffish and Spotted Wolffish stocks are centered in Divs. 2J3K, and in both Divs. 2J3K and Divs. 3LNO in the case of Atlantic Wolffish. These ecosystem production units or bioregions include the broadest range of sizes, and the largest proportion of adults and spawner components of the respective stocks for the entire Canadian range, whereas Subdiv. 3Ps, the Gulf of St. Lawrence, and the Scotian Shelf, constitute marginal areas where immature and smaller size components of the stocks predominate. Despite the marked spatial heterogeneity in the distribution of wolffish stocks in Newfoundland and Labrador waters, critical habitats for Northern Wolffish and Spotted Wolffish have been identified in most bioregions, including in Subdiv. 3Ps (DFO 2020b). The three wolffish species have narrow thermal tolerances, and change to thermal habitats is likely one of the most significant threats to these species in Canadian waters, since the shelf waters over most of the Grand Banks are forecasted to continue to warm, as the effects of climate change intensify (Han et al. 2015, Han et al. 2018, Le Corre et al. 2021). Currently, no stock assessment models for wolffish species inhabiting Canadian waters are available due to limited information on life history traits (e.g. growth rate, age at maturity, recruitment, and natural mortality). In addition, wolffish landings and discards by		

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			commercial fisheries are rarely identified to species when reported by domestic and foreign fleets, and although SARA requires mandatory release of Northern Wolffish and Spotted Wolffish caught in Canadian waters as a conservation measure, the percentages of post-release mortality are unknown in different fisheries. The trends in indices of stock size during the last two decades coincided with a period when wolffish species became protected by SARA, along with concurrent shifts in oceanographic conditions and functional groups within the bioregions inhabited by wolffish (Rose 2004, Buren et al. 2014, Pedersen et al. 2017, Koen-Alonso and Cuff 2018, Cyr et al. 2022). Hence, it is unclear if the recent trends in abundance indices of wolffish stocks are driven mainly by a reduction in fishing mortality, changes in environmental conditions and community structure, or the result of cumulative effects. The most recent Science Advisory Report on the status of wolffish stocks in the Atlantic and Arctic regions is from the zonal peer review meeting of February 26-27, 2014 (DFO 2015, Collins et al. 2015). The most recent zonal peer review meeting on the status of wolffish stocks took place in January 17-18, 2023. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Redfish	Units 1 & 2	Healthy (S. Mentella)	The Redfish fisheries in Unit 1 and Unit 2 harvest two Redfish species, the Deepwater Redfish (Sebastes mentella) and Acadian Redfish (Sebastes fasciatus), each considered a single stock. The Unit 1 management unit includes NAFO Divisions 4RST and	Redfish (Sebastes mentella and Sebastes fasciatus) Stocks Assessment in Units 1	Assessment cited to left is most recent science advice on this stock.

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		Unknown (S fasciatus)	Subdivisions 3Pn4Vn from January to May. The Unit 2 management unit includes NAFO Subdivisions 3Ps4Vs, Subdivisions 4Wfgj, and Subdivisions 3Pn4Vn from June to December. Combined annual landings for both stocks dropped from over 100,000 t in the 1970s to less than 12,000 t as of 1995. Management measures have been applied to promote stocks recovery. Since 1995, the Redfish fishery in Unit 1 has been under a moratorium, with a 2,000 t/year index fishery authorized since 1999. An experimental fishery was additionally established in Unit 1 in 2018-19, with an initial quota of 2,500 t which has increased annually to reach 5,463 t in 2021-2022. There has been no moratorium on the commercial fishery in Unit 2, where the total allowable catch has been 8,500 t/year since 2006. Strong cohorts in 2011, 2012 and 2013 have recruited to the stocks and resulted in a significant increase in Redfish biomass in Units 1 and 2 since 2016. In 2021, the spawning stock biomass of S. mentella would be in the Healthy Zone based on the proposed upper stock reference (USR). The magnitude of the increase in spawning stock biomass of S. fasciatus is uncertain, but evidence indicates the stock is at least above the lower reference point (LRP). However, the status of the S. fasciatus stock relative to the precautinoary approach (PA) currently is considered unknown. Short-term prospects for Redfish stocks in Units 1 and 2 are generally positive. High biomass of S. mentella allows for increased harvests, while caution is warranted for S. fasciatus and bycatch species. Fishery management measures include closure periods	and 2 in 2021 (dfo-mpo.gc.ca)	

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			and spatial management measures to reduce incidental bycatch and fishing impacts on the seabed, and protect sensitive species, habitats and Redfish reproduction. Additional details regarding potential impacts of oceanography and environmental conditions on the stock, fishery, and sources of uncertainty are further described in the 2022 stock assessment. The Science Advisory Report is from the February 21-24 and March 16, 2022 zonal advisory meetings on the Assessment of Redfish Stocks (S. mentella and S. fasciatus) in Units 1 and 2 in 2021. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		
Smooth Skate	NAFO Divs. 3LNOP + Subarea 4	Unknown	Smooth Skate in Canadian waters are distributed from Hopedale Channel (Labrador) to Georges Bank. According to the Committee on the Status of Endangered Wildlife Species in Canada (COSEWIC) Smooth Skate form four designatable units (DU), including Subdiv. 3Ps (Larentian-Scotian DU), where the center of abundance distribution in Canadian waters is located (COSEWIC 2012). The DFO spring RV survey biomass index has generally increased from 1998 to 2010, but stabilized thereafter at the level of the historical average until 2015 (last assessment year) (DFO 2017). Most Smooth Skate are found in water temperatures ranging between 2.7 and 10ºC. Feeding studies indicate that Smooth Skate diet consists primarily of small crustaceans throughout most of its life, and fish only at the largest sizes. The		Recovery potential assessment for Smooth Skate (*Malacoraja senta*) Funk Island Deep designatable unit (dfo-mpo.gc.ca)

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			shelf waters over most of the Grand Banks, including Subdiv. 3Ps, are forecasted to continue to warm, as the effects of climate change intensify, concurrent with changes in functional groups of various ecosystem production units. The expansion in suitable/warmer thermal habitat could potentially benefit Smooth Skate stocks over time, but the impact of changes in community structure on the status and trends of Smooth Skate stocks is unknown at present, but will likely be a major driver. The most recent Science Response Report on the status of Smooth Skate stock in the Laurentian-Scotian DU is from the peer review meeting of November 29, 2016 (DFO 2017).		
Thorny Skate	NAFO Divs. 3LNO and Subdiv. 3Ps	Cautious	Thorny Skate in Canadian waters are distributed continuously from Baffin Bay to Georges Bank. Thorny Skate in Subdiv. 3Ps and Divs. 3LNO are considered to form a single stock, which is managed by Canada in Subdiv. 3Ps and by the Northwest Atlantic Fisheries Organization (NAFO) in Div. 3LNO. The DFO spring RV survey biomass index in Subdiv. 3Ps generally increased since the mid-1990s (DFO 2022). Divs. 3LNOPs Thorny Skate stock is currently above the limit reference point (B_{lim}) (Simpson et al. 2015). The probability that its current biomass is above B_{lim} is greater than 95%. Thorny Skate live on the bottom at depths ranging from 18 to 1200 m, and in water temperatures of 0 to 10ºC, but mostly between 0 and 4ºC. They can be found on a	Assessment of NAFO Subdivision 3Ps Thorny Skate (*Amblyraja radiata*) (dfo-mpo.gc.ca)	

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			variety of bottom types including sand, gravel, mud and broken shells. Thorny Skate diet include a wide range of prey, mainly fish and crustaceans, in particular Sand Lance and Snow Crab. The shelf waters over most of the Grand Banks, including Subdiv. 3Ps, are forecasted to continue to warm, as the effects of climate change intensify. There has been an increase in the abundance of forage fish like Sand Lance in Subdiv. 3Ps in recent years, which likely contributed to support the increased productivity of the Thorny Skate stock, but also of warmer water species such as Silver Hake (the dominant groundfish species by weight in recent years). Silver Hake is an opportunistic predator, with a wide-ranging diet including both invertebrates and finfish species. The prevalence of Silver Hake in Subdiv. 3Ps has the potential to increase competition or predatory pressure on Thorny Skate; in addition, considering the narrow thermal tolerance of Thorny Skate, the expansion in warmer thermal habitat could potentially be detrimental to the species over time. The most recent Science Advisory Report is from November 2-6, 2020 (DFO 2022). Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
White Hake	NAFO Divs. 3NO and Subdiv. 3Ps	Unknown	White Hake in Canadian waters are distributed from southern Labrador to Georges Bank. White Hake in Subdiv. 3Ps and Divs. 3NO are considered to form a single stock, which has been assessed by the Northwest Atlantic Fisheries Organization (NAFO) every two years since 2005. Indices of stock size from DFO spring RV surveys indicated that the majority of the stock is centered in Subdiv. 3Ps. The survey biomass index generally increased from the mid-1990's until 2002, but has declined and stabilized around the level of the historical average (1996-2017) thereafter. Limit reference points (LRPs) for White Hake in Subdiv. 3Ps have not been defined. White Hake are mainly found in water temperatures of 4 to 10ºC. Juvenile White Hake diet is comprised mostly of crustaceans such as shrimp and crabs, whereas adults feed mostly on fish (e.g. Atlantic Cod, Haddock, Sand Lance). The extent of bottom areas in Subdiv. 3Ps where water temperatures exceeded 4ºC has been increasing over the past two decades, and warm slope water intrusions have elevated temperatures to near 10ºC in some of the habitats occupied by White Hake in recent years. The expansion in suitable/warmer thermal habitat could potentially benefit White Hake over time, but the recent prevalence of Silver Hake in Subdiv. 3Ps has the potential to increase competition or predatory pressure, implying that at least some aspects of the productivity of the White Hake stock in the area may be affected. The most recent Science Advisory Report is from November 1, 2017 (DFO 2018). Additional publications from this	Assessment of White Hake (Urophycis tenuis) in NAFO Subdivision 3Ps (dfo-mpo.gc.ca)	

Fish Stock / Species Name (include SME name)	List Fishery Management Unit	Stock Status (Healthy, Cautious, Critical, Unknown)	Brief description of stock status, recent trends, importance of focus area to stock health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.		

Table 2. Geospatial datasets related to fish stocks that overlap with the focus area.

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Commercial Fishing	Fishing effort within Significant Benthic Areas in Canada's Atlantic and Eastern Arctic marine waters	Yes	DFO	https://open.canada.ca/data/en/dataset/273df20a-47ae-42c0-bc58-01e451d4897a	https://publications.gc.ca/collections/collection_2018/mpo-dfo/fs70-5/Fs70-5-2018-015-eng.pdf	This commercial fishing effort is product developed and updated annually by Science using commercial logbook and VMS data. Updated layers covering 2005 - 2021 are pending publication and should be used for the RA in place of the 2005 - 2019 layers when they are available.
Commercial Fishing	Eastern Canada Commercial Fishing	Yes	DFO	https://open.canada.ca/data/en/dataset/502da2ef-bffa-4d9b-9e9c-a7425ff3c594		
Fish Density	Average Relative Density of Fish Functional Groups and Species in the Newfoundland and Labrador Shelves Bioregion, 1981-2017	Yes	DFO	https://open.canada.ca/data/en/dataset/da63ecd4-0720-47b3-a447-d0b1a1716b76	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40958838.pdf	
RV Survey	DFO RV Survey Data (3P)	No	DFO			What is the intended use for these data? If it is for species hot-spot mapping the Average Relative Density (ARD) layers listed above may serve that purpose, and save some work.
Survey	Pelagic and Benthic Fish (3P): Lobster, Crab, Scallop, Herring, Tuna, etc.	No	DFO			Not available publicly, but methodology is based on peer reviewed process and available upon request.

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Fish Density	Biodiversity, richness, and evenness of fish species based on RV Survey data	No	DFO			Not available publicly, but methodology is based on peer reviewed process and available upon request.
Cod	Forecasted Changes in Growth Potential, Egg Survival and Thermal Habitat Suitability for Cod Species in the Northwest Atlantic and Eastern Canadian Arctic	Yes	DFO	https://open.canada.ca/data/en/dataset/e05dbae7-ca9c-4d8c-9d12-c60967b5482f		
Commercial Catch	Commercial catches sampling program in the Estuary and Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/e118947b-8c0b-4be2-895c-b99125e4eec1		
Commercial Catch	Commercial catches sampling program in the Estuary and Gulf of St. Lawrence – Atlantic cod (Gadus morhua)	Yes	DFO	https://open.canada.ca/data/en/dataset/a0cb7ca8-2c04-4621-b88a-916425178112		
Pelagic Richness	Pelagic fish group richness in the Estuary and Gulf of St.Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/267e20aa-97e8-43da-8c23-1234376938bc		
Pelagic Biomass	Pelagic fish total biomass in the Estuary and Gulf of St.Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/308b7792-a075-4b43-a68f-37bf35d76a9f		
Pelagic Abundance	Pelagic fish species abundance in the Estuary and Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/f1fc359c-0ed1-4045-a421-adef2497b68d		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Demersal Richness	Demersal fish group richness in the Estuary and Gulf of St.Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/182acf27-3ca0-49bb-9a68-50dbd8657331		
Dermersal Biomass	Demersal fish total biomass in the Estuary and Gulf of St.Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/9b1d5058-81a9-420c-afb9-69791b06e35a		
Demersal Abundance	Demersal fish species abondance in the Estuary and Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/d4ec2d6b-f4bc-4c6c-b866-b26e507a3b76		
Multi-species	Evaluation of groundfish and shrimp annual multidisciplinary survey in the Estuary and northern Gulf of St. Lawrence (CCGS Teleost 2004 - 2021)	Yes	DFO	https://open.canada.ca/data/en/dataset/40381c35-4849-4f17-a8f3-707aa6a53a9d	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2019/2019_037-fra.html	
Groundfish	Evaluation of groundfish annual multidisciplinary winter survey in the northern Gulf of St. Lawrence (MV Gadus Atlantica 1978 - 1994)	Yes	DFO	https://open.canada.ca/data/en/dataset/4bbd03ce-ae48-4aaa-97ac-5594c2a3a6c2		
Groundfish	Evaluation of groundfish annual multidisciplinary survey in the northern Gulf of St. Lawrence (MV Lady Hammond 1984 - 1990)	Yes	DFO	https://open.canada.ca/data/en/dataset/86a9d0b0-fcce-48ed-a124-68061d7b7553		
Mobil Gear Sentinel	Mobile gear sentinel fisheries program - northern Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/929fe07f-ab8e-4b3c-8ee3-1aa7a9ea0b1a		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Fixed Gear Sentinel	Fixed gear sentinel fisheries program - northern Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/d82e5388-f241-4c27-875a-941a49ab70c8		
Stimpson surfclam	Known concentration areas of the Stimpson's surfclam in the Estuary and the Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/8bb29ee0-6cd8-4dd4-abe0-afe8682a69d9		
Atlantic surfclam	Commercial catches sampling program in the Estuary and Gulf of St. Lawrence – Atlantic surfclam (Spisula solidissima)	Yes	DFO	https://open.canada.ca/data/en/dataset/69e347ee-78e1-4e6d-813d-1a34d3261fda		
Greenland halibut	Commercial catches sampling program in the Estuary and Gulf of St. Lawrence – Greenland halibut (Reinhardtius hippoglossoides)	Yes	DFO	https://open.canada.ca/data/en/dataset/071397a0-4945-4497-a505-1e3ba8dd35c1		
Lumpfish	Lumpfish catch rates since 1990 in the Estuary and Gulf of St. Lawrence (NAFO divisions 3PN and 4RST)	Yes	DFO	https://open.canada.ca/data/en/dataset/533d694b-b692-4127-bf22-d1e41c0b5bba		
Smooth Skate	Presence of the Smooth Skate in the Estuary and Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/8a92a7da-19ec-4c37-9df9-bc32c9c1f0e0		
Thorny Skate	Presence of the Thorny Skate in the Estuary and Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/3980fabb-5266-48bf-a6f9-ecb790c2b050		
Winter Skate	Relative occurrence of the Winter Skate in the Estuary and Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/4cddb0a2-ea06-401b-86bf-5cfb003db366		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Redfish	Commercial catches sampling program in the Estuary and Gulf of St. Lawrence – redfish (Sebastes sp.)	Yes	DFO	https://open.canada.ca/data/en/dataset/27b713bc-783a-4fc4-81e5-dcf988fca23e		
Atlantic herring	Commercial catches sampling program in the Estuary and Gulf of St. Lawrence – Atlantic herring (Clupea harengus)	Yes	DFO	https://open.canada.ca/data/en/dataset/48bf4050-ce1e-4b25-90b4-bf4c896d6ec0		
Atlantic halibut	Commercial catches sampling program in the Estuary and Gulf of St. Lawrence – Atlantic halibut (Hippoglossus hippoglossus)	Yes	DFO	https://open.canada.ca/data/en/dataset/a63b923e-3108-439a-8a98-1276e6ec1f73		
Atlantic mackerel	Commercial catches sampling program in the Estuary and Gulf of St. Lawrence – Atlantic mackerel (Scomber scombrus)	Yes	DFO	https://open.canada.ca/data/en/dataset/6f1991aa-cd35-443f-937b-c2e00532f75a		
Capeline	Commercial catches sampling program in the Estuary and Gulf of St. Lawrence – capelin (Mallotus villosus)	Yes	DFO	https://open.canada.ca/data/en/dataset/e7a9ae4d-c320-47d7-98a9-229dd7c500c0		
Atlantic Wolfish	Relative occurrence of Atlantic Wolffish in the Estuary and Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/8babe9f3-4630-436e-957a-c230c2e81256		
Northern Wolfish	Relative occurrence of Northern Wolffish in the Estuary and Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/b490d186-81c6-48b7-8929-05459115df00		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Spotted Wolfish	Relative occurrence of Spotted Wolffish in the Estuary and Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/531d92fb-90fa-446e-b6df-2a56958856dd		
Snow Crab	Collaborative post-season Snow Crab trap survey	No	DFO/FFAW		An Assessment of Newfoundland and Labrador Snow Crab (Chionoecetes opilio) in 2020 (dfo-mpo.gc.ca)	This data is not currently Open Source however a formal data request can be made and would need approval from DFO and FFAW. Maps of the catches from 2013-2020 from this survey can be found in the Associated Publications column. More up to date Research Documents are in draft form and are not currently published.
American Lobster	Fishery Science Colloborative Program- Lobster Monitoring Reseach data- At sea sampling and Index Logbook data	No	DFO/FFAW		Assessment of American Lobster in Newfoundland (dfo-mpo.gc.ca)	Would require approval from DFO and FFAW for this data.

BIOLOGICAL AND PHYSICAL OCEANOGRAPHY

Background / Context: The Impact Assessment Agency of Canada (IAAC) is seeking general marine and coastal data, and published information, in support of a regional assessment for offshore wind in Newfoundland. The IAAC is looking for existing science information that generally characterizes the marine ecosystem and species in the 'focus area' outlined in the figure below, including current and recent trends, data limitations, knowledge gaps, impacts of climate change, available geo-spatial data, cumulative impacts, and important citations/publications that should be consulted for the regional assessment. Please note that any information Fisheries and Oceans Canada (DFO) provides to IAAC may be posted to a public registry. The following constitutes DFO Science sector's response to this request.

Figure. Focus area highlighted in green for the Newfoundland offshore wind regional assessment.

Question/request: Known information, data/null data, data gaps, vulnerabilities, impacts of climate change, cumulative impacts, and citations and important references regarding physical oceanography, such as waves, tides, currents, ice, and sea level rise, in the Newfoundland & Labrador offshore wind focus area. Further, information on productivity parameters, such as salinity, temperature, pH, dissolved oxygen, chlorophyll-a, phytoplankton & zooplankton, in the Newfoundland & Labrador offshore wind focus area. Note: there is a particular interest related to Chlorophyll-a concentrations and the noted trends in timing and location of blooms in the focus area.

Response:

1. Overview / summary of current knowledge:

Recent assessments of the physical oceanographic conditions in the Northwest Atlantic Region are reported annually under the Canadian Science Advisory Secretariat (CSAS) (e.g. DFO, 2023; Cyr et al., 2022) and in Canadian Technical Reports of Hydrography and Ocean Sciences (e.g. Galbraith et al., 2023). These reports discuss large scale trends in the physical oceanography, including sea surface temperatures, bottom temperatures, sea-ice coverage, water masses, temperature and salinity stratification, and modelled currents. Although these reports consider a domain larger than the focus area of the regional assessment (see Figure 1 below), they report on data collected in the Northeast Gulf of St. Lawrence, the 3P NAFO Subdivision, and the Bonne Bay and Southwest St. Pierre Bank transects that all overlap with the focus area.

The general trends indicate warming conditions since the 1980s in most areas of the Atlantic Zone, including the focus area. Historical temperature and salinity profiles in the Atlantic Canada region, including the focus area, are available in a published data product (Coyne et al., 2023). Modelled currents from 2022 in the focus area are reported in Figures 57, 58, and 59 of Galbraith et al. (2023). In the western Newfoundland region of the focus area, depth-averaged currents from 0 to 20-m are typically directed to the northeast and strongest in the winter (January to March). Along the south coast of Newfoundland, depth-averaged currents from 0 to 20-m are typically directed to the west and strongest in the winter and weakest in the summer (July to September). The general circulation in this region is influenced by the Labrador Current, the Gulf Stream, and the estuarine flow of the Gulf of St. Lawrence, in addition to atmospheric forcing and, as such, is subject to interannual variability.

In terms of real-time data in the focus area, several water-level tidal stations are managed by the Canadian Hydrographic Service. Graphs of real-time water levels and/or tidal predictions are available (https://www.tides.gc.ca/en/stations). Additionally, 48-hour wave forecasts in the region are made available by Environment and Climate Change Canada (https://weather.gc.ca/model_forecast/wave_e.html) as well as 48-hour forecasts of the oceanographic conditions (currents, sea surface height, sea ice, temperature and salinity) (https://open.canada.ca/data/en/dataset/bfe44cce-a9c4-467f-9172-c8800b32e4ec).

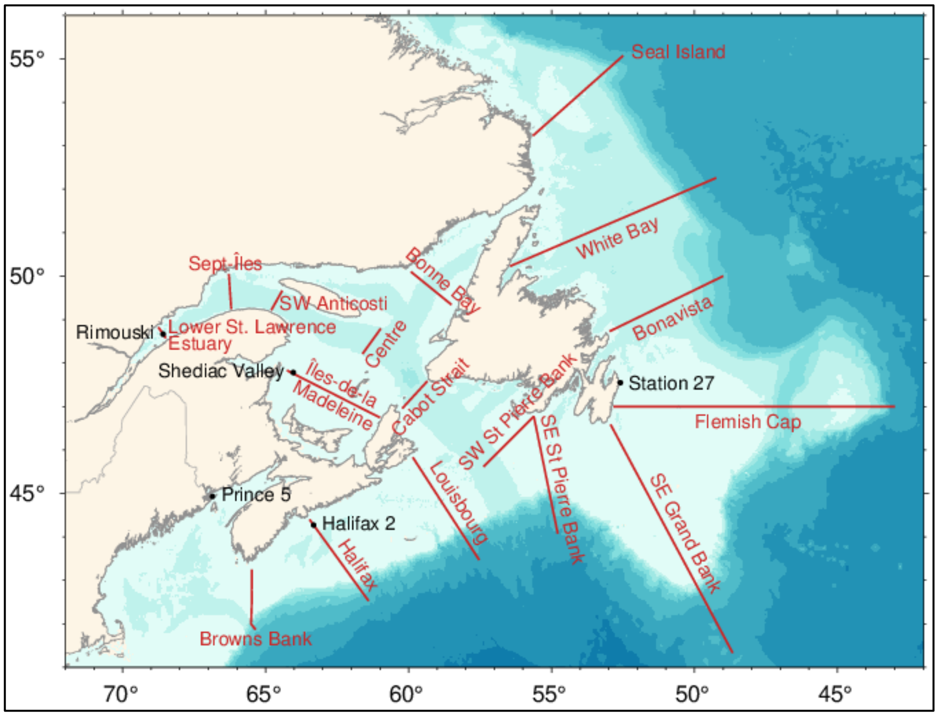

Figure 1. Atlantic Zone Monitoring Program (AZMP) high frequency stations (black) and standard transects (red). Figure adopted from DFO (2023).

Water samples collected by the Atlantic Zone Monitoring Program (AZMP) during seasonal surveys showed an overall increase in chlorophyll-*a* biomass on the Newfoundland and Labrador Shelf, the Scotian Shelf, and in the Gulf of St. Lawrence since 2018 with chlorophyll-*a* biomass being mainly above the long-term (1999-2020) baseline levels. This increase in chlorophyll biomass is associated with a general increase in nutrient (nitrate) concentrations during the same period. Remote sensing of surface chlorophyll-*a* concentrations showed that the timing of the onset, the magnitude and duration of the spring phytoplankton bloom are variable across the Canadian Northwest Atlantic with no clear large-scale temporal trends. Data however show a later-than-normal bloom timing for the St. Pierre Bank from 2014 through 2018 (DFO 2023).

2. Gaps in data collection:

The primary sources of data gaps for physical and biological oceanography in the highlighted zones arise from the different spatial and temporal scales of the expected impacts of offshore wind farms and collected data. The focus of monitoring in these regions has been on detecting inter-annual variations and secular changes through repeated observations at specific sites and seasons. Most anticipated impacts of offshore wind farms are understood to cover spatial scales of 10s of kms. Physical and biogeochemical oceanographic monitoring in the focus area is primarily restricted to the three transects listed above. As such, most of the focus area would be considered data poor. In addition, some of the strongest anticipated impacts include the net effect on stratification, which is a key variable for not only physical processes, but also chemical and biological oceanographic conditions. Stratification exhibits important seasonal changes, the timing of which are specific to a particular locale. Monitoring in these regions is generally restricted to between 2 to 4 times a year. Finally, the availability of data would depend on how close to the coast the wind farm site is chosen to be. Most oceanographic monitoring in these areas is concentrated on the shelf and away from coastal features like fjords and bays.

3. Known vulnerabilities / impacts of climate change:

In the Northwest Atlantic, continuation of general ocean warming trend, along with associated reduction in sea ice extent, is expected to continue over the coming years. In addition, seasonal reduction in extent of the cold intermediate layer across the various shelf areas in the Northwest Atlantic is ongoing. Various sea surface and bottom temperature data products and maps are presented in the physical oceanographic assessments identified above (Cyr et al. 2022; DFO, 2023; Galbraith et al. 2023). Modelled climate projections suggest warmer sea surface temperatures and reduced sea ice extent in the western Newfoundland area of the focus area and warmer sea surface temperatures along the south coast of Newfoundland (Han et al, 2019; Lavoie et al., 2020). Sea level projections suggest substantial increases at Port-aux-Basques, Newfoundland (Han et al., 2016) and in the focus area in general (Zhai et al., 2023).

Various biogeochemical changes in the state of the ocean are occurring with respect to an increasing partial pressure in carbon dioxide (pCO_2) concentrations and decreasing ocean pH (or ocean acidity) along with an associated reduction in the saturation extent of carbonate ions in seawater. Phytoplankton biomass inferred from distribution and abundance of pigments also undergo large seasonal and interannual variability that may be associated with trends in macronutrient concentrations. Various biological and chemical data products and maps are presented in the biological oceanographic assessments identified above. Cyr and Gailbrath (2021) outline a climate index for the Newfoundland and Labrador shelf.

There are a number of recent publications that outline the potential impacts off offshore wind development on the physical-chemical marine environment (e.g., Carpenter et al., 2016; Daewal et al., 2022; Dorel et al., 2022; Han et al, 2019; Schultze et al, 2020). Potential impacts may include disruption of stratification of the water column, with subsequent impacts to the vertical movement of deep nutrients to the surface and associated negative impacts to levels of dissolved oxygen, primary productivity, and general reduction of energy for higher trophic levels and aspects of climate change, including long-term trends in ice coverage.

4. List any accompanying geo-spatial data / maps:

See Table 1 below.

5. Cumulative effects:

Offshore wind farms (OWFs) have the potential to affect physical oceanographic conditions in the focus area through two main mechanisms. First, simulations of the interactions of tidal flows with the monopile structures of the wind turbines demonstrate reduced stratification in the vicinity of the turbines through the creation of additional turbulence (Carpenter et al., 2016; Schulze et al., 2020). Such added turbulence has been observed at a site in the Taiwan Strait as an increase in the turbidity of ocean water downstream of the turbine (Huang, 2022). Second, OWFs have been seen to create wind “wakes” where wind speeds are lower than they would be without the turbines 10s of km downstream of the OWF (Christiansen and Hasager, 2005). Reductions in near-surface wind speeds are modelled to lead to reductions in wind shear with the ocean, potentially affecting the production of waves, the exchange of momentum (and possibly heat) between the atmosphere and ocean, and the production of oceanic surface currents and turbulence within the mixed layer (Christiansen et al., 2022). These effects have the potential to increase stratification and reduce the mixed layer depth (Daewel et al., 2022). In one modelling study of OWFs in the North Sea (Christiansen et al., 2022), the second mechanism was found to overwhelm the first, but whether that result would apply to the focus area would depend on the comparative strengths of local physical processes at the site and the configuration of the OWF.

Changes in the stratification may largely impact the ocean by vertically redistributing temperature, salinity, oxygen, nutrients, etc. Changes in stratification may also impact the timing of the phytoplankton spring bloom with potential impact on the whole ecosystem; for example, a match/mismatch between primary production and other trophic levels (Cyr et al, 2023). Stratification is not the only possible impact of OWFs on biological productivity, however. Increased turbulence within the water column due to the physical disturbance of the wind turbines on tidal currents can lead to the resuspension of detritus throughout the water column, thereby providing additional food sources for zooplankton. This resuspension can also mix nutrients from the sediments back into the water column, potentially extending phytoplankton primary production.

Both results were observed at a site in the Yellow Sea (Wang et al., 2019). However, a greater patchiness to primary production has been simulated for the North Sea, where primary production decreases in some locations and increases in others, possibly due to the spatially variable balance between the two mechanisms listed above or purely due to the anomalous up- and down-wellings triggered by the introduction of lateral wind shear near the wind turbines (Daewel et al., 2022). Precisely how these mechanisms would manifest in the focus area is not clear, but any impacts to primary production can affect the ecosystem, as mentioned above.

6. List important / references:

Carpenter, J.R., L. Merckelbach, U. Callies, S. Clark, L. Gaslikova, and B. Baschek. 2016. Potential Impacts of Offshore Wind Farms on North Sea Stratification. PLOS ONE, 28pp. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0160830.

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Table 1. Geospatial datasets related to physical oceanography.

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Bathymetry	General Bathymetric Chart of the Ocean, GEBCO	Yes	GEBCO	https://www.gebco.net/data_and_products/gridded_bathymetry_data/		Coarser gridded bathymetry than NONNA below, but has complete coverage of the study area.
Bathymetry	Canadian Hydrographic Service Non-Navigational (NONNA) Bathymetric Data	Yes	DFO	https://open.canada.ca/data/en/dataset/d3881c4c-650d-4070-bf9b-1e00aabf0a1d		
Waves	Regional Deterministic Wave Prediction System - National	Yes	ECCC	https://open.canada.ca/data/en/dataset/9a6594f9-ad0e-4421-ba9d-16338e5a9cbe		Follow-up with Environment Canada
Waves	Global Deterministic Wave Prediction System	Yes	ECCC	https://open.canada.ca/data/en/dataset/803a6e2a-41ed-44c2-9eeb-1b5306b4048e		Follow-up with Environment Canada
Waves	Canadian ensemble of CMIP5 ocean wave heights simulations (mean and extremes)	Yes	ECCC	https://open.canada.ca/data/en/dataset/d82b1c57-e766-495a-8a81-3bc1ebba87ae		Follow-up with Environment Canada
Waves	Fetch and relative wave exposure indices for the coastal zones of the Scotian Shelf-Bay of Fundy and Newfoundland-Labrador Shelves bioregions	No	DFO	https://open.canada.ca/data/en/dataset/9f43c64c-4cbc-4e54-8199-7765331445f3		Request required. Contact: DFO.CESDDataRequest-DSECDemandededonnes.MPO@dfo-mpo.gc.ca. Also follow-up with Environment Canada.
Waves	Fetch and relative wave exposure indices for the coastal zone of the Newfoundland and Labrador Shelves bioregion	Yes	DFO	https://open.canada.ca/data/en/dataset/f1da3a6f-3515-447e-9a73-50c8299816ec		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Tides & Waters Levels	Tides and Water Levels	Yes	DFO	https://open.canada.ca/data/en/dataset/87b08750-4180-4d31-9414-a9470eba9b42		Follow-up with Environment Canada
Currents	Monthly Currents Climatology of the Northwest Atlantic Ocean from BNAM model (1990-2015)	Yes	DFO	https://open.canada.ca/data/en/dataset/dd5ef0d6-d588-4f4f-99e5-27c4bdfddf6a	https://waves-vagues.dfo-mpo.gc.ca/Library/40731327.pdf	
Currents	Acoustic Doppler Current Profiler data from the Coast of Bays, Newfoundland	Yes	DFO	Acoustic Doppler Current Profiler data from the Coast of Bays, Newfoundland - Open Government Portal (canada.ca)	Science Advisory Report 2016/039 (dfo-mpo.gc.ca)	
Current, Temperature, Salinity	Fortune Bay (NL, Canada) oceanographic observations May 2015 - May 2017	Yes	DFO	https://www.seanoe.org/data/00511/62314/	https://essd.copernicus.org/articles/12/1877/2020/	
Sea Ice	Coastal Ice-Ocean Prediction System for the East Coast of Canada (CIOPS-East)	Yes	ECCC	https://open.canada.ca/data/en/dataset/bfe44cce-a9c4-467f-9172-c8800b32e4ec		
Sea Ice	Sea ice in Canada	Yes	ECCC	https://open.canada.ca/data/en/dataset/8ca062f1-edef-48d8-91ac-7ff236ffd9e8		
Storm Surge	Global Deterministic Storm Surge Prediction System	No	ECCC	https://open.canada.ca/data/en/dataset/d244c9fa-776f-446f-9ccf-1d575cc21a5c		Follow-up with Environment Canada
Ocean Climate Change	Coastal Environmental Exposure Layer	Yes	DFO	https://open.canada.ca/data/en/dataset/e6405791-c9b9-4246-a5ed-e5cf610075b5		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Sea Level Rise	Canadian Extreme Water Level Adaptation Tool (CAN-EWLAT)	Yes	DFO	https://open.canada.ca/data/en/dataset/a3edf193-5c56-4b38-bcc5-c8708c60ce38	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41093720.pdf	
Shoreline Classification	Atlantic Shoreline Classification	Yes	ECCC	https://open.canada.ca/data/en/dataset/30449352-2556-42df-9ffe-47ea8e696f91		
Currents in Coastal Bays	Acoustic Doppler Current Profiler data from the Coast of Bays, Newfoundland	Yes	DFO	Acoustic Doppler Current Profiler data from the Coast of Bays, Newfoundland - Open Government Portal (canada.ca)	Science Advisory Report 2016/039 (dfo-mpo.gc.ca)	
Current, Temperature, Salinity in Fortune Bay NL	Fortune Bay (NL, Canada) oceanographic observations May 2015 - May 2017	Yes	DFO	https://www.seanoe.org/data/00511/62314/	https://essd.copernicus.org/articles/12/1877/2020/	
Real-time Oceanographic and Meteorological	Real-time Surface Data from VIKING Buoys as Part of the Atlantic Zone Monitoring Program (AZMP)	Yes	CIOOS	https://catalogue.ogsl.ca/en/dataset/ca-cioos_06f7045a-51a5-474b-9c27-7670b737e4f1		
General Oceanographic and Meteorological	General Ocean Data	Yes	CIOOS	https://explore.cioos.ca/?lang=en		
General Oceanographic	Atlantic Zonal Monitoring Program	No	DFO	http://mixing.ent.dfo-mpo.ca/AZMP/		Available upon request from DFO

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
General Oceanographic	Conductivity, temperature, depth (CTD)	No	DFO	http://mixing.ent.dfo-mpo.ca/tsg/indiv/autoscale/index.html		Available upon request from DFO
General Oceanographic	Sea Ice	No	DFO	http://mixing.ent.dfo-mpo.ca/sea-ice/		Available upon request from DFO
General Oceanographic	Sea surface temperature	No	DFO	http://mixing.ent.dfo-mpo.ca/sst/AnnualAnalysis2023.html		Available upon request from DFO
General Oceanographic	AZMP Viking Buoy Multiple Parameters	No	DFO	http://mixing.ent.dfo-mpo.ca/cgi-bin/Buoy2HTML.cgi		Available upon request from DFO
General Oceanographic	AZMP Viking Buoy Multiple Parameters	No	DFO	http://mixing.ent.dfo-mpo.ca/viking/		Available upon request from DFO
General Oceanographic	AZMP Viking Buoy Conductivity, temperature, depth (CTD)	No	DFO	http://mixing.ent.dfo-mpo.ca/viking-ctd/		Available upon request from DFO
Atlantic Zonal Monitoring Program	Atlantic Zone Monitoring Program (AZMP)	Yes	DFO	https://open.canada.ca/data/en/dataset/9ae96713-4330-4ef1-9c1b-aa05759d0dfd		
Salinity & Temperature	Surface temperature and salinity - Shipboard Thermosalinographs	Yes	DFO	https://open.canada.ca/data/en/dataset/8a3dc9e5-f3af-4270-8c09-43fa2c25848b		
Salinity & Temperature	Ocean Data Inventory (ODI): A Database of Ocean Current,	Yes	DFO	https://open.canada.ca/data/en/dataset/7da1f04f-49b0-4208-a49e-d0597b1f55c6	http://www.dfo-mpo.gc.ca/CSAS/Csas/Doc	

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
	Temperature and Salinity Time Series for the Northwest Atlantic				REC/2004/RES2004_097_e.pdf	
Salinity & Temperature	Bottom salinity at the Atlantic Zone Monitoring Program (AZMP)-Quebec's stations	Yes	DFO	https://open.canada.ca/data/en/dataset/9571b5fa-3311-44c8-a565-d5694f34afac		
Salinity & Temperature	Bottom temperature at the Atlantic Zone Monitoring Program (AZMP)-Quebec's stations	Yes	DFO	https://open.canada.ca/data/en/dataset/e9a7a0c0-aa8b-4797-9335-ebccf81db195		
Salinity & Temperature	Monthly Salinity Climatology of the Northwest Atlantic Ocean from BNAM model (1990-2015)	Yes	DFO	https://open.canada.ca/data/en/dataset/c44a8574-9f7d-45b7-afda-27802353a04c	https://waves-vagues.dfo-mpo.gc.ca/Library/40731327.pdf	
Salinity & Temperature	Monthly Temperature Climatology of the Northwest Atlantic Ocean from BNAM model (1990-2015)	Yes	DFO	https://open.canada.ca/data/en/dataset/5577393c-5eb2-4d07-a64e-d2a1b675a242	https://waves-vagues.dfo-mpo.gc.ca/Library/40731327.pdf	
Salinity & Temperature	Bottom water temperature and salinity in the Estuary and Gulf of St.Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/10987662-c496-4ba8-a6b9-21cb5a134da2		
Salinity & Temperature	Coast of Bays seawater vertical and horizontal structure: Hydrographic structure, spatial variability and seasonality, 2009-2013	Yes	DFO	https://open.canada.ca/data/en/dataset/a650f132-7502-402f-a42e-7ba4dea3f829		
pH	Bottom water pH in the Estuary and Gulf of St.Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/15c36c35-bb63-425e-9753-12704d310844		
Dissolved Oxygen	Deep water dissolved oxygen in the Estuary and Gulf of St.Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/fb362c48-fe21-4e4d-abee-cf7ef92b475d		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Dissolved Oxygen	Bottom dissolved oxygen at the Atlantic Zone Monitoring Program (AZMP)-Quebec's stations	Yes	DFO	https://open.canada.ca/data/en/dataset/59bbb435-9516-4c64-a8ea-d5f0b7b1aee8		
Chlorophyll-a	Chlorophyll-a concentration at the Atlantic Zone Monitoring Program (AZMP)-Quebec's stations	Yes	DFO	https://open.canada.ca/data/en/dataset/d155effe-048d-45cf-8683-d827dadc428b		
Nutrients	Nutrient concentration at the Atlantic Zone Monitoring Program (AZMP)-Quebec's stations	Yes	DFO	https://open.canada.ca/data/en/dataset/7f493139-6abd-4e07-8a08-2bb29f8e5623		
Phytoplankton	Phytoplankton counts at the Atlantic Zone Monitoring Program (AZMP)-Quebec's stations	Yes	DFO	https://open.canada.ca/data/en/dataset/795e649f-c595-46b2-bc41-156c05cb7c41		
Primary Productivity	High primary production areas in the Estuary and the Gulf of St. Lawrence	Yes	DFO	https://open.canada.ca/data/en/dataset/47a95c17-f92e-446b-8928-ccf14a39e117		
Zooplankton	Calanus spp. size and lipid content metrics in North Atlantic, 1977-2019	Yes	DFO	https://open.canada.ca/data/en/dataset/72e6d3a1-06e7-4f41-acec-e0f1474b555b		
Zooplankton	Zooplankton biomass at the Atlantic Zone Monitoring Program (AZMP)-Quebec's stations	Yes	DFO	https://open.canada.ca/data/en/dataset/7229e77a-08d5-4d73-acb0-d9722106c730		
Grasses	National Eelgrass Dataset For Canada (NETForce)	Yes	DFO	https://open.canada.ca/data/en/dataset/a733fb88-ddaf-47f8-95bb-e107630e8e62		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Bottom Habitat	Seafloor photographs, offshore Canada	Yes	DFO	https://open.canada.ca/data/en/dataset/44cbbdc0-d33d-abe7-b08a-f5872bc0a48a		
Shoreline	Atlantic Shoreline Classification	Yes	ECCC	https://open.canada.ca/data/en/dataset/30449352-2556-42df-9ffe-47ea8e696f91		
Shellfish Water Quality	Shellfish Water Classification Program – Marine Water Quality Data in Canada	Yes	ECCC	https://open.canada.ca/data/en/dataset/6417332a-7f37-49bd-8be9-ce0402deed2a		
Shellfish Water Quality	Shellfish Water Classification Program – Marine Water Quality Data in Newfoundland and Labrador	Yes	ECCC	https://open.canada.ca/data/en/dataset/ce879b1f-1193-4d28-be18-7ed1bb200051		

OTHER IMPORTANT SPECIES

Background / Context: The Impact Assessment Agency of Canada (IAAC) is seeking general marine and coastal data, and published information, in support of a regional assessment for offshore wind in Newfoundland. The IAAC is looking for existing science information that generally characterizes the marine ecosystem and species in the 'focus area' outlined in the figure below, including current and recent trends, data limitations, knowledge gaps, impacts of climate change, available geo-spatial data, cumulative impacts, and important citations/publications that should be consulted for the regional assessment. Please note that any information Fisheries and Oceans Canada (DFO) provides to IAAC may be posted to a public registry. The following constitutes DFO Science sector's response to this request.

Figure. Focus area highlighted in green for the Newfoundland offshore wind regional assessment.

Question/request: Known information, data/null data, data gaps, vulnerabilities, impacts of climate change, cumulative impacts, and citations and important references regarding other important species (e.g., Salmon, American eel, Striped bass, etc.) in the Newfoundland & Labrador offshore wind focus area. This excludes fish stocks, marine mammals, and sea turtles, which are captured in another thematic template.

Response:

1. Overview / summary of current knowledge

American eel: The plausible native continental range of the American eel includes Newfoundland and Labrador (see: Figure 1 of Cairns, 2020). The American eel (*Anguilla rostrata*) is the West Atlantic representative of the cosmopolitan genus Anguilla, whose members spawn in ocean waters and grow in coastal and fresh waters. American eels spawn in the Sargasso Sea and have a continental growth range from Greenland to northern South America. Mature American eel (referred to as silver eels) may actively migrate through the focus area for the regional assessment on the southward migration to the spawning area in the Sargasso Sea. Juvenile eel larva (referred to as leptocephali) may be transported into the focus area by ocean currents. When they return to coastal waters they metamorphose into glass eels, where they are the target of a valuable commercial fishery. American eel landings records are available for Newfoundland and Labrador Statistical Districts starting in 1952 (Cairns, 2020). In Newfoundland and Labrador, landings prior to the start of statistics-gathering in 1952 are believed to have been low and intermittent, reflecting the lack of eel fishing tradition in that area. Eel fisheries were attempted in Newfoundland prior to 1952, but efforts did not produce ongoing fisheries. Reported Labrador landings are nil in most years. The Atlantic and Fundy coasts of Maritimes Region are the only Canadian locations of elver fisheries, apart from the small and poorly documented elver fishery in Newfoundland. See Cairns (2020) for additional information and associated references.

In April 2012, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) concluded that American Eel (*Anguilla rostrata*) from eastern Canada was one Designatable Unit (DU). The Committee assessed the species status as threatened because of declines in abundance indices of up to 99% in some areas over the last two or more generations (COSEWIC 2012). Trends in indices supported the conclusion from COSEWIC that there has been a decline in American eel abundance over the past 32-years, with declines having been most severe in the St. Lawrence Basin and specifically Lake Ontario. Some indicators showed recent (16-year) upturns in abundance, which have yet to manifest themselves as improvements in standing stock indices. At current abundance levels, it is unlikely that habitat availability presently limits production of eels over broad spatial scales. Over the long term, as the eel population grows and recovers, restoring access to habitats will likely be necessary to achieve longterm abundance objectives (DFO, 2014a). See DFO (2014a) for additional references.

Atlantic Salmon: The Newfoundland and Labrador (NL) region has 15 Salmon Fishing Areas (SFAs) (see: Figure 1 below) that contain approximately 407 known Atlantic salmon rivers (DFO, 2023; Kelly et al., in prep [1]). The focus area for the regional assessment encompasses part of SFA 10 (western Placentia Bay) and extends around the south and southwest coast of Newfoundland (SFAs 11-13) into part of SFA 14A. There are 119 salmon populations in this focus area (17 in SFA 10, 35 in SFA 11, 20 in SFA 12, 40 in SFA 13, and 7 in SFA 14A), 29% of all salmon populations within the NL region (Kelly et al., in prep[1]). Historical Atlantic salmon monitoring data are available for approximately 15 salmon rivers within the focus area, however, annual monitoring activities on most of these rivers has been patchy over time (particularly on the west coast) resulting in only 5 rivers with consistent time series data. Adult abundance data are obtained via the installation of salmon counting fences, snorkel surveys, or a combination of both (DFO, 2023). For some rivers, biological sampling data are available (e.g. salmon length, weight, age and life history). There are no data available for Atlantic salmon populations in SFA 12 (southwest coast), largely due to the remoteness of these rivers and logistical challenges with operating a salmon monitoring project in those areas. Atlantic salmon returns to monitored rivers on the south coast of Newfoundland (SFA 11) suggest significant declines in recent decades, some by over 90% (DFO, 2022; DFO, 2023; DFO, In Press). The three rivers monitored in this region have been consistently designated in the critical zone at DFO Science stock assessments (DFO, 2020; DFO, 2022; DFO, 2023). The majority of monitored rivers in SFA 13 and the Gros Morne National Park region of SFA 14A have also been assessed in the critical zone in recent years (DFO, 2020; DFO, 2022; DFO, 2023).

[1] Kelly, N.I., Burke, C., Lancaster, D., Lehnert, S., Loughlin, K., Van Leeuwen, T., Dempson, J.B., Robertson, M., and Bradbury, I. Updated information on Atlantic Salmon (*Salmo salar*) populations in insular Newfoundland of relevance to the COSEWIC status report. DFO Can. Sci. Advis. Sec. Res. Doc. 20xx/nnn.

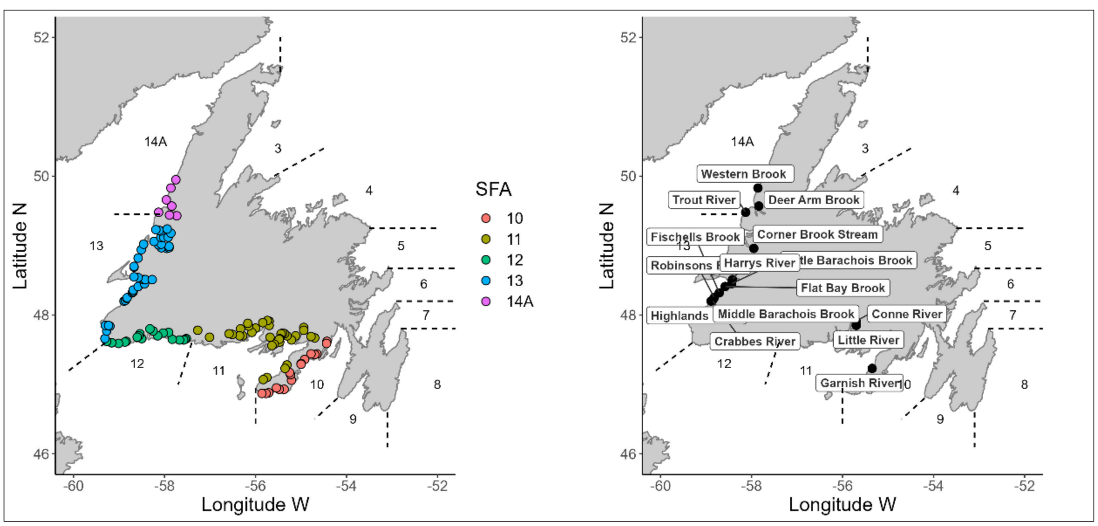

Figure 1. Map of the 119 Atlantic salmon rivers within the focus area (left panel) and rivers with historical Atlantic salmon monitoring data within the past two decades (right panel). Approximate SFA boundaries are marked with dashed lines. Salmon Fishing Areas (SFAs) 3-14A are numbered.

In Newfoundland, juvenile Atlantic salmon typically spend the first three to four years of life in freshwater before migrating to sea as smolts (DFO, 2020). In the marine environment, Atlantic salmon spend most of their time at temperatures ranging from 3-10°C and depths less than 10 meters (Reddin and Shearer 1987; Minke-Martin et al. 2015; Strøm et al. 2017; Strøm et al. 2018), and occasionally make deeper dives associated with foraging behaviour (Reddin et al. 2011; Hedger et al. 2017). Atlantic salmon from populations in the northwest Atlantic Ocean typically migrate to the Labrador Sea either through the Gulf of St Lawrence or around eastern Newfoundland (Reddin 2006). The majority of adult salmon populations in Newfoundland (SFAs 3-12 and 14A) are predominantly comprised of grilse that have spent one year at sea before returning to spawn for the first time. Salmon populations from the Maritimes, Quebec, eastern USA, Labrador and the Bay St. George region of SFA 13 contain higher proportions of fish that spent two or more years on their maiden trip to sea before returning to spawn for the first time (Kelly et al., in prep[1]). These fish typically migrate further north in the Labrador Sea and are potentially intercepted in the West Greenland fishery (ICES 2023). The southern Labrador Sea and northeast and east coasts of Newfoundland are used by migrating salmon as overwintering grounds before returning to their natal rivers to spawn the following spring or summer.

Historical tagging data and commercial catch data indicate that salmon populations from Atlantic Canada and eastern USA use at least part of the focus area during their marine migration (Reddin and Lear, 1990; Reddin 2006; Miller et al. 2012; Bradbury et al. 2016). Reddin and Lear (1990) describe the tag returns from the commercial fishery. Salmon tagged in locations like St. Lawrence (1973), Placentia Bay (1975), and throughout the east coast were recaptured across the south coast (e.g., Burgeo, Port aux Basques) and throughout the Maritimes (Reddin and Lear 1990). Salmon tagged near Port aux Basques (1976) were recaptured along the west coast of Newfoundland and the Maritimes (Reddin and Lear 1990). This is further substantiated by the historical data on commercial and recreational catches in southern Newfoundland (May and Lear, 1971; Lear, 1973; Reddin and Short, 1981; Ash and O'Connell, 1987). The St. Pierre-Miquelon mixed stock commercial salmon fishery harvested 2.9 tonnes of Atlantic salmon on average from 2002-2021. Recent genetic data from the St Pierre-Miquelon mixed stock fishery analysis (Bradbury et al., 2015; ICES 2021; ICES, 2023) suggests that this fishery has been dominated by contributions from Gulf and Gaspe Peninsula regions as well as smaller contributions from southern and western Newfoundland.

Striped Bass: Striped Bass (*Morone saxatilis)* are a large and highly fecund predatory fish species native to the east coast of North America, with confirmed spawning populations from the St. John's River, Florida, USA, to the St. Lawrence River, Quebec, Canada (Andrews et al., 2019). As adults, Striped bass use a range of habitats that include riverine, estuarine, or sometimes offshore environments where they feed on a variety of teleost fishes and invertebrate species including Atlantic salmon smolts (Daniels et al. 2018; Andrews et al. 2019). In recent years striped bass have been reported in coastal regions of southern Labrador (Van Leeuwen et al. 2021), having originally migrated from the Miramichi River population (DFO 2018). Striped bass eat a variety of species (DFO 2016) including Atlantic salmon smolts, however, smolt predation by striped bass on the Miramichi River has been highly variable between years (1.9% - 17.5% Daniels et al. 2019). To date there have been no known detections or catches of striped bass in waters of coastal Newfoundland. It is possible that striped bass may migrate into Newfoundland waters in the future as marine conditions vary with climate but the extent to which this will occur is uncertain.

2. Gaps in data collection

American eel: There are a number of data and knowledge gaps associated with American Eel habitat utilization, life history characteristics, and indices of abundance. Further, population dynamics limit the analyses and conclusions in the recovery potential assessment of the American Eel (DFO, 2014a). Some of these data gaps include:

- There is no complete assessment of the habitat presently available and utilized by American Eel in eastern Canada. Many areas of eastern Canada, particularly the northern zones of the Gulf of St. Lawrence, Newfoundland and Labrador have sparse information on presence of eels and no information on abundance with which to estimate even coarsely the standing stock of eels in these areas.
- There are few longterm indices of abundance of recruiting stages (elvers), of standing stock, and of silver eel escapement.
- The available information on size, age, and growth rates has improved in recent years, however comprehensive and representative data on age, growth rates, size and/or age at maturity and how these vary among habitats utilized by eels and among regions in eastern Canada are still lacking.
- No spawning eels have ever been sampled on the spawning grounds in the Sargasso Sea such that mature female fecundity, egg size, and variations of these characteristics with phenotype (age, body size, energy content) have been inferred from sampling of silver eels in continental waters.
- A species wide assessment model is lacking for American Eel.
- Turbine mortality rates have been estimated for a few hydro-generating facilities but with limited replication. Models have been developed to predict mortalities based on turbine design, size of animals, and operational details, but validation of these models for the American Eel has not been conducted
- The impact on reproductive fitness of some threats is inferred from other species as direct evidence of their impact on eels is lacking.
- The causal certainty of a number of potential threats was assessed as low because the studies that examined the link between the factors and the effects on eel survival, growth, behaviour, reproductive fitness and population dynamics have not been conducted.

Active sites for data collection are shown in Figure 2 below (from Cairns 2020), but there are considerable knowledge gaps on the temporal and spatial dynamics of American eel migration through the focus area. While exact migratory corridors areunknown, it is prudent to assume that the majority of American eels migrating between Sargasso Sea and Atlantic

Canadian waters may travel through the focus area, making the area critical to Canadian eel populations.

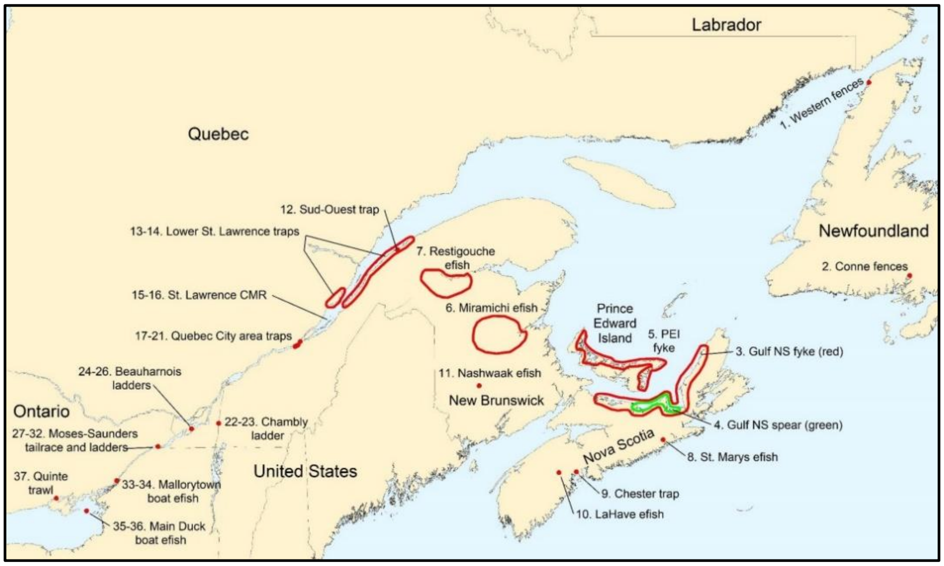

Figure 2. Locations of American eel abundance indices in Canada, including two sites in Newfoundland. See Table 29 in Cairns (2020) for a description of codes. Figure adopted from Cairns (2020).

<u>Atlantic Salmon</u>: In the case of Newfoundland salmon populations within the focus area, there is limited fine scale information on the salmon migration (Dempson et al., 2011; Bøe et al. 2019). DFO Science conducted a 4 year smolt tracking study in northwest Placentia Bay from 2017-2022 and are currently analyzing the data. In addition, DFO Science is currently conducting a two-year study tracking the early phase of the Atlantic salmon smolt migration out of Grandys River near Burgeo to understand residency and migration routes for salmon populations in SFA 12, as well as a two-year study tracking the marine migration of smolts from Conne River through the Bay d’Espoir region of SFA 11.

The effects of offshore wind development on Atlantic salmon are uncertain. However, research suggests that offshore wind farms can have local impacts on the physical (temperature, salinity, nutrient distribution) and biological (primary productivity) characteristics of the marine environment (van Berkel et al., 2020). It is difficult to ascertain the degree to which these changes would impact Atlantic salmon during their marine migration, however, changes within the food web dynamics (prey and predator availability) could have negative impacts on growth and survival of salmon at sea particularly in the first few months when growth is critical (Friedland et al., 2005).

<u>Striped Bass</u>: Limited information available, however, as adults, Striped bass use a range of habitats that include offshore environments. To date there have been no known detections or catches of striped bass in waters of coastal Newfoundland. However, it is possible that striped bass may migrate into Newfoundland waters in the future as marine conditions vary with climate but the extent to which this will occur is uncertain. Thus, the effects of offshore wind development on Striped bass are uncertain.

3. Known vulnerabilities / impacts of climate change

<u>American eel</u>: Climate change has the potential to impact the species by increasing the frequency and intensity of storms, which may impact eels migrating through the *focus area*. Juvenile American eel larva are transported northward by oceanic currents and many end up entering waters within the *focus area*. This larval transport could potentially be affected by changing oceanic temperatures or circulation patterns. Glass eels entering rivers *in Newfoundland* could encounter the influence of climate change through altered thermal and hydrographic regimes in freshwater, which may influence survival and habitat use. In addition to the potential impacts of climate change, the potential effect on migration of electro-magnetic field (EMFs) should be considered, with respect to the transport of energy produced to the electricity grid. Potential effects could be possible in both Atlantic Salmon and American eel but may be of a higher potential for eel.

<u>Atlantic salmon</u>: Climate-related impacts have been thoroughly reviewed in the context of their potential consequences for Atlantic salmon both in freshwater and marine environments (e.g. Jonsson and Jonsson 2009; Todd et al. 2011; Mills et al. 2013). Besides direct effects, climate shifts can influence prey availability, predator abundance, and alter other traits such as sea age at maturity, age at smolification, run timing, disease resistance, and growth (Cote et al. 2015; Olmos et al. 2020; Thorstad et al. 2021). The periodic occurrence and later high abundance of salmon at West Greenland was attributed to variability and subsequent warming of waters in the North Atlantic (Dunbar and Thomson 1979). More recent studies have noted that the distribution, abundance, and size of Atlantic salmon were linked to changes in the climate of the North Atlantic that may have contributed to decreased productivity (Beaugrand and Reid 2012; Rikardsen et al. 2021; Utne et al. 2021).

<u>Striped bass</u>: Striped bass use a range of habitats that include riverine, estuarine, or sometimes offshore environments that will be impacted by climate change. Besides direct effects, climate shifts can influence prey availability and expand the range of fish species northward. For example, striped bass have expanded their range northward into coastal regions of southern Labrador (Van Leeuwen et al. 2021), having originally migrated from the Miramichi River population (DFO 2018).

4. List any accompanying geo-spatial data / maps.

See Table 1 below. Figures 3 and 4 below provide geo-spatial information on salmon and striped bass, respectively.

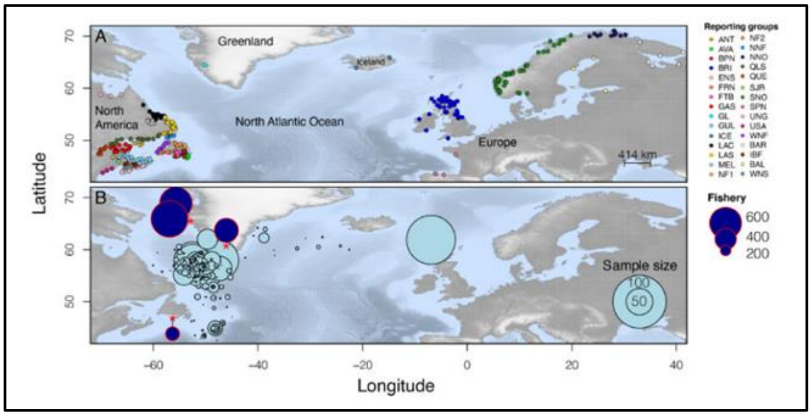

Figure 3. Number and location of Atlantic salmon collected at sea either through fisheries (dark; total n ¼ 2012) or research activities (light; n ¼ 1493, including 86 from Faroes). Figure adopted from Bradbury et al. (2021).

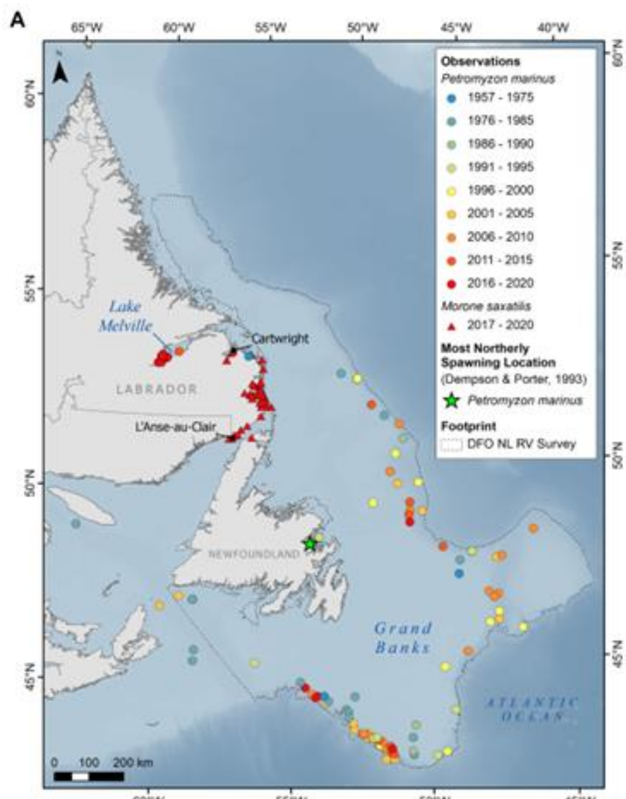

Figure 4. Distribution of sea lamprey Petromyzon marinus (circles) and striped bass Morone saxatilis (triangles) observations from Newfoundland and Labrador (NL) regions across years. Figure adopted from Van Leeuwen et al. (2021).

5. Cumulative effects

American eel: Similar potential concerns as for Atlantic salmon below.

Atlantic salmon: Knowledge on the potential impacts of offshore wind development on fishes, e.g. Atlantic salmon, remains scattered (Svendsen et al. 2022). Potential stressors from offshore wind development include: electromagnetic fields (EMF), underwater noise, particle motion and vibration. Many invertebrate, fish, marine mammal, and sea turtle species can detect and may use electric or magnetic fields to orient, navigate, find prey or mates, or to cue particular life stages. In particular, Atlantic salmon and American eel can be sensitive to EMF (e.g., Gill and Bartlett, 2021). Studies, however, have not attempted to ascertain the exact relationship between electric or magnetic fields and observed behavioural modifications.

In general, the significance of EMF as a stressor on fish populations remains unknown and there has yet to be any evidence that existing underwater cables have caused significant disruptions to survival and reproductive success in any species. But EMFs may cause temporary and significant navigational disruptions (disorientation) to migrating species (DFO, Gill and Bartlett, 2021; DFO, 2014b). In addition, offshore wind development structures may have several ecosystem effects in marine environments, by attracting and enabling various species (including Atlantic salmon and those that prey upon Atlantic salmon) to occur in novel areas due to the addition of habitat in a relatively featureless environment. A similar phenomenon seen for other artificial reef structures or fish aggregation devices (Schneider et al. 2023).

Striped bass: Similar potential concerns as for Atlantic salmon above.

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Table 1. Geospatial datasets related to other marine species.

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
American eel	Landings, abundance series, and biological data for a potential range-wide American eel stock assessment	Yes	DFO	https://open.canada.ca/data/en/dataset/7ce80b52-b555-11ea-bdf6-1860247f53e3		

MARINE MAMMALS, SEA TURTLES, SHARKS & PINNIPEDS

Background / Context: The Impact Assessment Agency of Canada (IAAC) is seeking general marine and coastal data, and published information, in support of a regional assessment for offshore wind in Newfoundland. The IAAC is looking for existing science information that generally characterizes the marine ecosystem and species in the 'focus area' outlined in the figure below, including current and recent trends, data limitations, knowledge gaps, impacts of climate change, available geo-spatial data, cumulative impacts, and important citations/publications that should be consulted for the regional assessment. Please note that any information Fisheries and Oceans Canada (DFO) provides to IAAC may be posted to a public registry. The following constitutes DFO Science sector's response to this request.

Figure. Focus area highlighted in green for the Newfoundland offshore wind regional assessment.

Question/request: Known information, data/null data, data gaps, vulnerabilities, impacts of climate change, cumulative impacts, and citations and important references regarding important marine mammals, sea turtles, and sharks in the Newfoundland & Labrador offshore wind focus area. If possible, please note importance of focus area to overall species productivity (e.g., spawning areas, aggregation areas, migration routes, hotspots, etc.). NOTE: there is particular interest related to North Atlantic right whale and other highly-vulnerable marine mammal and sea turtle species in the focus area.

Response:

1. Overview / summary of current knowledge

The Newfoundland offshore wind 'focus area' overlaps with Northwest Atlantic Fisheries Organization (NAFO) management units 3P (further subdivided as 3Ps and 3Pn) and 4R. Management unit 3P is located west of the Grand Banks of the south coast of Newfoundland (see: Figure 1). Management unit 4R is located in the eastern Gulf of St. Lawrence off the west coast of Newfoundland.

Figure 1. Focus Area outlined in green for the Newfoundland offshore wind regional assessment overlaid with NAFO management units 3P and 4R.

Information on important marine mammal, sea turtle, shark, and pinniped species that overlap with the focus area is provided in Table 1 below. Table 2 below provides links to available geospatial data related to these species.

<u>Marine mammals</u>: More than 16 species of marine mammal may be found in the focus area (see Table 1 below), although some are observed rarely. Based on a 2016 large-scale aerial survey by DFO Science, white-beaked dolphins (*Lagenorhynchus albirostris*) are the most common marine mammal in the focus area off the south coast of Newfoundland (Lawson and Gosselin 2018). Humpback and fin whales are the most common large whales, with harbour and grey seals being detected frequently along coastal areas of southern and southwestern Newfoundland. Some marine mammals will remain in the focus area throughout the year (e.g., blue whale, white-beaked dolphin, harbour seal), while others are seasonal and appear to arrive in the focus areas to feed on seasonally-abundant prey such as zooplankton and spawning fish (fin whales, harbour porpoise, grey seals).

<u>Sea turtles</u>: Four species of sea turtles are found in Atlantic Canada: the leatherback sea turtle (*Dermochelys coriacea*); loggerhead sea turtle (*Caretta caretta*); Kemp's ridley sea turtle (*Lepidochelys kempii*); and green sea turtle (*Chelonia mydas*). Leatherbacks and loggerheads are listed as Endangered under Canada's *Species at Risk Act.* Kemp's ridley and green turtle are not listed under SARA; they are globally listed as Critically Endangered and Endangered, respectively. All four sea turtle species are found in the focus area, but leatherbacks and loggerheads are the most abundant. There are relatively few data representing live sightings of Kemp's ridley and green sea turtles.

Leatherback sea turtles are the largest and most reported of sea turtle species found in Atlantic Canada, as well as in the southern Newfoundland waters of the focus area. Leatherbacks have a broad distribution and are found in both nearshore and offshore waters of Atlantic Canada. The *Species at Risk Act* (SARA) has not yet been formally delineated Critical Habitat for leatherbacks, although ongoing science consultations have derived candidate areas. Important high use (foraging) areas for the leatherback turtle have been identified in Atlantic Canada (DFO 2020; Mosnier et al. 2018). Leatherbacks are seasonally abundant in the summer and fall, but have also been reported from November to May (typically via entanglements in fishing gear). Juvenile loggerhead sea turtles also use Atlantic Canadian waters as foraging habitat. Loggerheads are mostly on the outer banks of the continental shelf, shelf slope, and offshore waters and less commonly in nearshore waters such as the focus area south and southeast of Newfoundland. The other two species are extremely rare in the focus area, and have usually been dead or cold-stunned individuals.

<u>Sharks</u>: There are numerous shark species that either reside in Canadian waters or seasonally migrate to Canadian waters. Primary species include:

- Shortfin mako shark (North Atlantic Population; pelagic; COSWEIC: endangered)
- Porbeagle shark (Northwest Atlantic Population; pelagic; COSWEIC: endangered)
- Blue shark (North Atlantic Population; pelagic; COSWEIC: not at risk)
- White shark (Northwest Atlantic Population; pelagic; COSWEIC: endangered; Listed on Schedule 1 of SARA)
- Greenland shark (North Atlantic and Arctic Population; demersal; COSWEIC: not assessed)
- Basking shark (Northwest Atlantic Population; pelagic; COSWEIC: special concern)
- Spiny dogfish (Northwest Atlantic Population; demersal; COSWEIC: special concern)
- Common thresher shark (Northwest Atlantic Population; pelagic; COSWEIC: not assessed)

Several other semi-tropical sharks are less commonly found in Canadian waters, including (but are not limited to):

- Bigeye thresher shark (North Atlantic Population; pelagic; COSWEIC: not assessed)
- Tiger shark (North Atlantic Population; pelagic; COSWEIC: not assessed)
- Oceanic whitetip (North Atlantic Population; pelagic; COSWEIC: not assessed)
- Atlantic sharpnose (North Atlantic Population; pelagic; COSWEIC: not assessed)
- Dusky shark (North Atlantic Population; pelagic; COSWEIC: not assessed)

Little information exists about the abundance, population structure, distribution, or habitat requirements of demersal and deep-water sharks that would be expected to be found along the edge of the continental shelf and deeper waters of the Northwest Atlantic. Species include (but are not limited to):

- Black dogfish (demersal; COSWEIC: not assessed)
- Deepsea catshark (demersal; COSWEIC: not assessed)

Critical Habitat has not been defined for any shark species in Canadian waters, although it is anticipated by 2025 from an ongoing, multi-region collaborative research project for White shark. Research on other species will commence once listing decisions are made. Because of the widespread distribution of all shark species in Canadian waters, Critical Habitat(s) may occur within the focus are area. Habitat use varies substantially by species. White shark (Bowlby et al. 2022) and Basking shark (Braun et al. 2018) make frequent use of coastal habitats (within the 200m bathymetric contour) during the summer months (primarily June to November) while feeding. Summer seal haul-outs are one feature that White shark tend to aggregate around, where grey and harbour seals are found in groups throughout coastal Nova Scotia and into the Gulf of St. Lawrence, with the largest colony around the Magdalen Islands. Basking sharks are planktonic feeders and would be expected to be found where primary productivity was high. Areas of high primary productivity are not static but would depend on water conditions (currents, temperature, upwelling, etc.) and time of year.

In general, sharks use structure to their advantage while feeding (e.g. Braun et al. 2019). This means that they would be expected to congregate around upwelling characterized by distinct discontinuities in water temperature, as well as in regions with rough bathymetry, characterized by abrupt changes in depth. Pelagic species use habitats throughout the water column (i.e. vertical habitat use; Andrzejaczek et al. 2022). Several species (e.g. porbeagle) tend to be found closer to the surface at night and in deeper water during the day, following vertically-migrating prey (e.g. Wang et al. 2020). Fishery-dependent data suggests that captures of numerous species (e.g. shortfin mako, blue shark, thresher) tend to be highest along the edge of the continental shelf and in deep basins.

The distribution of pelagic sharks is also related to the Gulf Stream current. Both temperate species (e.g. porbeagle) as well as semi-tropical species (e.g. basking shark, blue, tiger, threshers, shortfin mako) seasonally use the warm waters of the Gulf Stream. The majority of satellite tracking data suggests that semi-tropical species may move into the Gulf Stream during the winter months, when leaving Canadian habitats. Atlantic Canada represents a small part of the population-level range of the shark species that can be found in Canada. Shark physiology is very adaptable and individuals can use areas with a wide range of environmental characteristics. Pelagic species move 1000s of kilometers in a year and have the potential to distribute throughout the focus area. Essentially all of the species considered in this document could be expected to be found (at varying density) throughout the focus area during the summer and fall (primarily June to November), with the exception of deep sea species and Greenland shark. Deepsea and demersal species are likely present all year.

The distribution of sharks within the focus area would be primarily related to feeding behaviour. Spawning and pupping areas are less well-known and sharks do not follow defined migration routes when undertaking seasonal movements. Smaller pelagic sharks are piscivorous, primarily eating teleost fish and cephalopod species. Only larger adult shortfin mako and white shark would also feed on marine mammals (seals, porpoises, small whales, etc.). Thus, productive fishing grounds for teleost fishes or hotspots for teleost fishes would also be associated with higher densities of numerous species of sharks. These habitats could be found at varying depths and locations.

Pinnipeds: Information to be provided on Nov. 7, 2023.

2. Gaps in data collection

The broad and oceanic distribution of marine mammals, sea turtles, sharks, and pinnipeds makes it difficult to collect data on these species. In addition, climate change has made marine weather conditions less predictable and increased the number of days with fog and/or strong winds; this poor weather significantly reduced the opportunities for systematic surveys or opportunistic sighting detections. For whales and sharks, absence of targeted fisheries has limited the ability to accurately assess the status of the population through fisheries or hunt statistics. Further, primary threats to certain species (e.g., sea turtles) often are beyond Canada’s control to directly manage (e.g., removal of eggs from southern nesting beaches). Species-specific assessment reports noted in Table 1 speak to gaps in knowledge in greater detail.

Marine mammals: Marine mammals range in size from 24 m-long blue whales to 1.5 m-long harbour porpoises and harbour seals. These size dissimilarities, plus differences in behaviour (i.e., contrast the aerial displays of large humpbacks with the small surface breathing pattern of porpoises) and surface intervals (i.e., contrast the frequent near-surface behaviour of harbour seals with the extended dive durations of sperm and beaked whales), mean that some species are more likely to be visually-detected than others. Apparent gaps in distribution of different marine mammals in the focus area may also be a function of observer effort, with much less time spent searching the waters of offshore areas or any parts of the focus area during winter. Apparent concentrations of certain marine mammals can be ephemeral and driven by local aggregations of their prey, such as spawning capelin.

Due to their cost, DFO Science conducts few aerial- or vessel-based surveys for marine mammals, with most transect replication occurring across years rather than within one season in the focus area. Recent satellite tracking of grey seals, and humpback, fin, sperm, and killer whales in Newfoundland waters (DFO unpubl. data) has confirmed that these marine mammals can move hundreds of kilometres per day when migrating, but also restrict movements to smaller areas when they are feeding. More such satellite tracking needs to be undertaken in the focus area to better understand the habitat use by marine mammals there, and quantify individual and annual variation in movement patterns.

Habitat modelling has been done for a few marine mammal species in Atlantic Canada, let alone at the scale of the focus area (see: Gomez et al., 2017; Moors-Murphy et al., 2019; Gomez et al., 2020). While the results point to potential habitat of greater occupancy for several species, the underlying data are usually proxies for measures such as prey and broader oceanographic integration. Better habitat models can only be created with improved information on marine mammals' prey species (rather than proxies such as chlorophyll) and greater survey coverage across seasons and years.

Sea turtles: Most sea turtles are present in Atlantic Canada from early June through to late October. Many sea turtle sightings derive from citizen science; such sightings made by the public are reported to government and non-government entities. The Canadian Sea Turtle Network (CSTN; www.seaturtle.ca) maintains a database of sea turtle sightings for Atlantic Canada, as does The Marine Mammal Section in DFO Newfoundland and Labrador. Despite the efforts made to solicit reports of sightings, reporting effort is variable on a yearly (or seasonal) basis. Most public sea turtle sightings are limited to periods of increased recreational boat use corresponding to the tourism season (therefore data are biased to the summer months and nearshore waters), and the period of best weather. Sightings data also come from systematic surveys using aerial and vessel platforms.

Leatherback sea turtles are large and distributed widely (see Table 1) and are therefore more likely to be visually detected versus other species. Hard-shelled sea turtles are much smaller than leatherbacks and less common in nearshore waters, making them difficult to visually locate. The lack of sightings in areas outside of areas where turtles are typically reported by the public should not be interpreted as an absence of sea turtles. Similarly, concentrated numbers of sightings do not always reflect a large number of individuals in an area. DFO Science conducts annual vessel-based surveys for leatherback sea turtles in July and August, and with widely-spaced transects in many areas. This highly biases the volume of reports there. There are no population abundance estimates for sea turtles in Atlantic Canada. Their distribution in Atlantic Canada is entirely marine (no nesting). Depth utilization varies by species and ranges from surface waters to several hundred metres.

Sharks: For the majority of species, there is essentially no fishery-independent data on habitat use or distribution. Even the amount of information from fishery-dependent data changes seasonally, with lower effort during the winter from fisheries that would have higher interaction rates with sharks. This means that our understanding of where pelagic sharks tend to be is heavily influenced by where fisheries are taking place and by shark catchability from the gear types being used. Commercial fisheries in Canada are not targeting sharks and would be expected to avoid shark bycatch if possible. This means that areas of high concentration for numerous shark species (and the environmental characteristics associated with them) may be missed from fishery-dependent data.

Habitat modeling has not been done for any shark species at the scale of the focus area. A global analysis for blue shark suggests that high-quality habitat would be found throughout the OSW study region for approximately 6 months of the year (Druon et al. 2022). There is extremely little information on spawning and pupping locations for the majority of the shark species found in Canadian waters. There is also extremely little information on the historical distribution of any shark species in Canadian waters. Prior to 2001, species identification was poor for morphologically similar species that were captured by fisheries (e.g. shortfin mako, porbeagle; Bowlby et al. 2022b). Pelagic shark bycatch was inconsistently recorded in commercial logbooks and detailed shark monitoring was only implemented in 2010 by at-sea observers. Deepwater species are rarely captured and have no potential to be monitored using available electronic tagging technology, given depth limitations of the tags. Much of what is currently known about shark distribution patterns has been determined since the advent of satellite tagging technologies (early 2000s onward).

Pinnipeds: Information to be provided on Nov. 7, 2023.

3. Known vulnerabilities / impacts of climate change

Many marine mammals, sea turtles, sharks, and pinnipeds have a broad distribution throughout Canadian waters, encompassing areas from the Bay of Fundy, into the Gulf of St. Lawrence, out to the Grand Banks towards the Flemish Cap, and along coastal Newfoundland and Labrador. In addition, many of the species are considered at-risk due to historical over-fishing, habitat degradation, and a changing marine climate that impacts water column structure, nutrients, primary productivity, and changing predator-prey relationships. Impacts associated with offshore wind development, such as habitat alteration, disruption, destruction, noise associated with installation or servicing, and/or vessels that may strike a species could have significant impact on the species status; particularly those endangered species such as the North Atlantic right whale, blue whale, and leatherback sea turtle. Alternately, it is known that some marine mammal species aggregate to feed on prey attracted to undersea structures associated with offshore wind developments. Species-specific assessment reports noted in Table 1 speak to known vulnerabilities and/or impacts of climate change in greater detail.

Marine mammals: Marine mammals rely on prey that are variable in abundance in space and time. This makes them vulnerable to biological impacts if the density of prey falls below levels sufficient to meet their energy needs, or forces them to move to areas with higher risk, such as into shipping lanes or closer to shore. Such changes in the prey base could be an indirect product of climate change or a direct result of human activities (e.g., offshore wind energy structures can alter local oceanic currents or nutrient mixing processes; Dorrell et al., 2022). Ice entrapment of cetaceans such as blue whales and dolphins is a unique feature of the SW Newfoundland coastal area near the Port aux Port peninsula (Moors-Murphy et al., 2019). As climate change has increased sea ice movements in the southern Gulf, and stronger spring winds push it less predictably, this sea ice is an increasingly important source of spring mortality for marine mammals in the southwest Newfoundland portion of the focus area.

Sea turtles: Climate change is a recognized threat to sea turtles (DFO, 2020). Predicted impacts of warming ocean temperature for sea turtle populations include shifts in their spatial and temporal distributions in Atlantic Canada; and this can change the nature and magnitude of risks they will encounter. Ocean temperature impacts the distribution of jellyfish, the principal prey of leatherbacks in Atlantic Canadian waters. Planktonic blooms occur earlier with warming temperatures (Hays et al., 2005) which could result in leatherbacks arriving earlier in on their foraging grounds to exploit periods of high jellyfish abundance. Most leatherbacks occur in waters >15°C (James et al., 2006). A northward shift in the 15°C isotherm has been documented (McMahon and Hays, 2006).

Sharks: The general prediction is that ocean warming will cause pelagic sharks to shift northward in their distribution and to arrive earlier in the season (Hammerschlag et al. 2022). Semi-tropical species may enter the focus area earlier in the year and leave later and/or may be found at higher regional densities. It is more difficult to determine how temperate species and deepwater species might react. Porbeagle and Greenland shark may also shift their distribution northward and/or to deeper waters, but this is unlikely to result in their absence from the focus area. Climate change hypotheses are difficult to validate, given the lack of historical distribution data on sharks.

The long evolutionary history of sharks demonstrates their high adaptive capacity to changing conditions, making it very difficult to predict how shark habitats will vary under climate change (Hazen et al. 2013). Other biological components of marine ecosystems would also influence shark habitat use, given that sufficient resources must exist at lower tropic levels to support higher tropic level shark populations. While abiotic conditions may be more conducive to sharks in future years due to climate change, the biological communities that sharks depend on may not be. Last, numerous shark species have been subject to sustained overfishing at a global level and are currently at risk (e.g. oceanic whitetip, white shark). If recent conservation actions are effective, it will be very difficult to distinguish between range expansion as abundance increases versus changes in habitat use under climate change.

Pinnipeds: Information to be provided on Nov. 7, 2023.

4. List any accompanying geo-spatial data / maps

See Table 2 below.

5. Cumulative effects

Cumulative impacts associated with at-risk marine species, particularly those that are endangered or threatened, are often associated with the combination of historical over-fishing and bycatch, habitat degradation, and a changing marine climate that impacts water column structure, nutrients, primary productivity, and changing predator-prey relationships, and food supply. Impacts associated with offshore wind development, such as habitat alteration, disruption, destruction, noise associated with installation or servicing, and/or vessels that may strike at-risk marine species; particularly slow moving and surface feeding animals. But as importantly, these potential impacts may be additive, or worse synergistically, with other ongoing stressors.

Marine mammals: While researchers have used modelling to assess the potential impacts of single stressors, usually underwater anthropogenic sound, on marine mammals (e.g. Donovan et al. 2017; Moore et al. 2012), efforts to cumulate multiple stressors to assess impacts have been far more problematic. This is mainly due to our relatively poor understanding of the impacts of single stressors on individual and population-level biological processes, let alone how multiple stressors might combine to yield an effect. Studies have tried this with limited numbers of stressors (see Pirotta et al., 2019), but real-world assessments are needed to ground-truth these models.

Sea turtles: Sea turtles face common threats from many different sources (e.g., fishing, maritime transport, offshore petroleum, etc.) which may contribute to habitat degradation, vessels strikes, marine debris, and ocean noise.

Sharks: Sharks have the ability to sense electromagnetic signals in the water through specialized cells in their snouts. Numerous species are attracted to or affected by electromagnetic signals. Instances where sharks have been attracted to the electromagnetic field given off by lithium batteries include: (1 attacks on ocean gliders deployed by the Ocean Tracking network in Canadian waters; and (2 preferential interaction with GoPro cameras during fieldwork even in the presence of bait. As such, sharks that may be affected by the offshore wind developments.

Pinnipeds: Information to be provided on Nov. 7, 2023.

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Table 1. Overview of marine mammals, sea turtles, sharks, and pinnipeds (e.g., seals) that overlap with Focus Area.

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
Marine Mammals					
Atlantic White-sided Dolphin	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NL population size is large, but population trend is unknown; they are found throughout NL waters, which serve for migration, socializing, and feeding; Atlantic White-sided dolphins are vulnerable to gear entanglement, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins		https://media.fisheries.noaa.gov/2022-08/Atl%20White-Side%20Dolphin-West%20N%20Atl%20Stock_SAR%202021.pdf https://www.dfo-mpo.gc.ca/csas-sccs/publications/resdocs-docrech/2009/2009_031-eng.htm
Blue Whale	Endangered (COSEWIC and SARA)	CH has been proposed through a CSAS process, but has not yet been formally established by the DFO, but would include the new focus areas for the study	The NW Atlantic population has a small size, and low reproductive rate; NL south and southwest coasts are important habitat for blue whales in the winter and spring for feeding; blue whales are vulnerable to vessel strike, gear entanglements, ice entrapment, and climate change if it reduces the amount or changes the distribution of their zooplankton prey; data gaps exist in our knowledge of (1) annual movements and habitat use relative to prey density	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2022/2022_026-eng.html	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2018/2018_003-eng.html

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			and (2) regional abundance; displacement by underwater anthropogenic sounds may cumulate with other stressors		
Common Dolphin	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NL population size is large, but population trend is unknown; they are found throughout NL waters, which serve for migration, socializing, and feeding; common dolphins are vulnerable to gear entanglement, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins		https://www.dfo-mpo.gc.ca/csas-sccs/publications/resdocs-docrech/2009/2009_031-eng.htm
Fin Whale	Special Concern (COSEWIC and SARA)	CH has not been proposed through a CSAS process	The NW Atlantic population appears to be growing; NL south and southwest coasts are important habitat for fin whales in the spring and fall for migration into the Gulf; fin whales are particularly vulnerable to vessel strike, as well as gear entanglements, and climate change if it reduces the amount or changes the distribution of their fish and zooplankton prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for fish stocks such as capelin and herring	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2022/2022_026-eng.html	https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/sr-RoqualCommunFinWhale-v00-2019-Eng.pdf https://publications.gc.ca/collections/collection_2020/eccc/CW69-14-428-2019-eng.pdf

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
Harbour Porpoise	Special Concern (COSEWIC)	CH has not been proposed through a CSAS process	The NL population size is small, but population trend is unknown; they are found throughout NL waters, which serve for migration, socializing, and feeding, although most commonly seen along the south coast of Newfoundland and in the Gulf of St. Lawrence; porpoise are vulnerable to gear entanglement, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; masking of underwater sounds (a form of habitat degradation by noise disturbance (e.g., industrial developments such as offshore wind, tidal, and wave energy, and oil and gas developments) and displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins	https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/statements/rs_147_1171_2022-11_e.pdf	https://sararegistry.gc.ca/virtual_sara/files/cosewic/sr%20Harbour%20Porpoise%202022%5Fe%2Epdf https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/sr%20Harbour%20Porpoise%202022_e.pdf
Humpback Whale	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population appears to be growing; NL south and southwest coasts are important habitat for humpback whales for migration into the Gulf; fin whales are particularly vulnerable to vessel strike, as well as gear entanglements, and climate change if it reduces the amount or changes the distribution of their fish and zooplankton prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2022/2022_026-eng.html	https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/humpback-whale-2022.html

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			cumulate with other stressors such as competition with humans for fish stocks such as capelin and herring		
Killer Whale	Special Concern (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population size is near 100 whales, although abundance trend is unknown; this species is found throughout NL waters which serve for migration and feeding; killer whales are vulnerable to gear entanglements, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of diet, and annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey fish stocks and bioaccumulation of toxins		https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/sr_killer_whale_0809_e.pdf
Long-finned Pilot Whale	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population size is large, and likely increasing; while found throughout NL waters, deeper shelf break areas serve for migration and feeding; pilot whales are vulnerable to gear entanglements, and climate change if it reduces the amount or changes the distribution of their squid prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey squid stocks and bioaccumulation of toxins		https://media.fisheries.noaa.gov/2022-08/Long-Fin%20Pilot%20Whale-West%20N%20Atl%20Stock_SAR%202021.pdf

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
Minke Whale	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population trend is unknown; between 2017 and 2023 the U.S. has declared an Unusual Mortality Event along the Atlantic Coast; NL coastal and deeper waters are important habitat for minke whale migration and feeding; minke whales are vulnerable to gear entanglements, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for fish stocks such as capelin and herring.		https://media.fisheries.noaa.gov/dam-migration/56_f2016_minkewhale_508.pdf
North Atlantic Right Whale	Endangered (COSEWIC and SARA)	CH has not been proposed through a CSAS process	The NW Atlantic population has a small and declining size; NL south and southwest coasts are important habitat for right whales in the winter and spring for migration to the southern Gulf; right whales are vulnerable to vessel strike, gear entanglements, and climate change if it reduces the amount or changes the distribution of their copepod prey; data gaps exist in our knowledge of (1) annual movements and habitat use relative to prey density and (2) potential impacts of climate change	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2020/2020_037-eng.html	https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/sr_North%20Atlantic%20Right%20Whale_2013_e.pdf
Northern Bottlenose Whale	Endangered (SARA - Scotian Shelf pop); Special	CH has not been proposed through a CSAS process	The Gully population size is small, whereas that of the Davis Strait-Baffin Bay-Labrador Sea is unknown; this species is found in NL waters, where deeper shelf break areas serve for migration and feeding; Northern Bottlenose	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-	https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/fi

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
	Concern (COSEWIC - Davis Strait-Baffin Bay-Labrador Sea pop)		Whale whales may be vulnerable to climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins	AS/2022/2022_032-eng.html	les//cosewic/sr_northern_bottlenose_whale_0911_eng.pdf https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2020/2020_008-eng.html https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2014/2014_041-eng.html
Sei Whale	Endangered (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population size and trend are unknown; NL coastal and shelf break areas are important habitat for sei whales for migration and feeding; sei whales are vulnerable to gear entanglements, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density;		https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/Sr-SeiWhaleRorqualBoreal-v00-2019-Eng.pdf

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for fish stocks such as capelin and herring		
Sowerby's Beaked Whale	Special Concern (COSEWIC and SARA)	CH has not been proposed through a CSAS process	The NW Atlantic population size is unknown, as are populations trends; this species is found occasionally in NL waters, where deeper shelf break areas serve for migration and feeding; Sowerby's beaked whales may be vulnerable to climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins		https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/SrBaleineBecSowerbyBeakedWhale-v00-2019-Eng.pdf
Sperm Whale	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population size and trend are unknown; NL shelf and shelf break areas are important habitat for male sperm whales for migration and feeding; sperm whales are vulnerable to vessel strike, gear entanglements, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for squid stocks		https://media.fisheries.noaa.gov/dam-migration/2019_sars_atlantic_spermwhale.pdf
Risso's Dolphin	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population size is large, and likely increasing; while found occasionally in NL waters, where		https://media.fisheries.noaa.gov/2022-

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			deeper shelf break areas serve for migration and feeding, this species is more common further south; Risso's dolphins may be vulnerable to climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins		08/Riss%20Dolphin-West%20N%20Atl%20Stock_SAR%202021.pdf
White-beaked Dolphin	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NL population size is large, and increasing; they are the most ubiquitous dolphin found throughout NL waters, which serve for migration, socializing, and feeding; white-beaked dolphins are vulnerable to gear entanglement, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins		https://media.fisheries.noaa.gov/dam-migration/2019_sars_atlantic_whitebeaked dolphin.pdf https://www.dfo-mpo.gc.ca/csas-sccs/publications/resdocs-docrech/2009/2009_031-eng.htm
Sea Turtles					
Leatherback Sea Turtle	Endangered (COSEWIC and SARA)	CH has been proposed through a CSAS process, but has not yet been	Occur in Canadian waters around Newfoundland and as far north as southern Labrador, in the Gulf of St. Lawrence, on the Scotian Shelf, and in the Bay of Fundy; the south coast	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-	https://www.canada.ca/en/environment-climate-

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
		formally established by the DFO, but would include the new focus areas for the study	of NL is an important NW Atlantic feeding area in the late summer and fall; leatherbacks are vulnerable to vessel strike, gear entanglements, and climate change if it reduces the amount or changes the distribution of their jellyfish prey.	AS/2022/2022_004-eng.html	change/services/species-risk-public-registry/cosewic-assessments-status-reports/leatherback-sea-turtle-atlantic-2022.html https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/leatherback-turtle-atlantic/chapter-10.html https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/report-

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
					progress-recovery-document/leatherback-sea-turtle-2022.html
Loggerhead Sea Turtle	Endangered (COSEWIC and SARA)	CH has not been defined in Canadian waters by DFO Loggerhead habitat is defined temporally and geographically, in part, by sea surface temperature	Occur (rarely) in offshore Canadian waters on the Scotian Shelf, around Newfoundland, and in the Gulf of St. Lawrence during the summer and fall; There is currently no population estimate for the Northwest Atlantic; threats include bycatch (incidental capture in active fishing gear), entanglement (in ghost gear or other marine debris), underwater noise, marine pollution, vessel strikes, and climate change if it reduces the amount or changes the distribution of their prey. When in Canadian waters during the spring, summer, and fall, Loggerheads are thought to forage mostly in the oceanic zone. Loggerhead Sea Turtles appear to prefer sea surface temperatures >20°C. In Atlantic Canada, waters >20°C are found in the oceanographically dynamic region along the shelf break and further offshore, where the warm waters of the Gulf Stream mix with the cooler waters of the Labrador Current.	https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/loggerhead-sea-turtle-2020-final.html	https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/loggerhead-sea-turtle-2010.html
Sharks					
Porbeagle Shark	Endangered (COSEWIC)	Not defined. Species common seasonal range is within the focus area.	Porbeagle shark are widely distributed in the Northwest Atlantic, occurring in Canadian waters; around Newfoundland and Labrador, on the Scotian Shelf, and in	https://waves-vagues.dfo-mpo.gc.ca/library-	Assessment cited to left is most recent

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			the Bay of Fundy. Details on species available in publication hyperlinked at right.	bibliotheque/365107.pdf	science advice on this species.
Basking shark	Special Concern (COSEWIC)	Not defined. Species common seasonal range is within the focus area.	Basking shark are widely distributed in the Northwest Atlantic, occurring in Canadian waters; around Newfoundland and Labrador, on the Scotian Shelf, and in the Bay of Fundy. Details on species available in publication hyperlinked at right.	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/333307.pdf	Assessment cited to left is most recent science advice on this species.
White Shark	Endangered (SARA)	Not defined. Species common seasonal range is within the focus area.	White shark are widely distributed in the Northwest Atlantic, occurring in Canadian waters; around Newfoundland and Labrador, on the Scotian Shelf, and in the Bay of Fundy. Details on species available in publication hyperlinked at right.	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/327294.pdf	Assessment cited to left is most recent science advice on this species.
Shortfin Mako	Endangered (COSEWIC)	Not defined. Species common seasonal range is within the focus area.	Shortfin mako are widely distributed in the Northwest Atlantic, occurring in Canadian waters; around Newfoundland and Labrador, on the Scotian Shelf, and in the Bay of Fundy. Details on species available in publication hyperlinked at right.	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41056255.pdf	Assessment cited to left is most recent science advice on this species.
Pinnipeds Information to be provided on Nov. 7, 2023.					

Table 2. Geospatial datasets related to marine mammals, sea turtles, sharks, and pinnipeds (e.g., seals).

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Marine Mammals	Science/ Journal Publications	Yes	Jasco Applied Sciences	https://www.jasco.com/publications		Peer-reviewed journal articles by JASCO scientists. Topics include marine mammal and fish behaviour, distribution, and bioacoustics, ambient soundscapes, vessel sound signatures, and the monitoring, modelling, and regulation of anthropogenic sound.
SARA	DFO Aquatic Species at Risk Distribution 2022	No	DFO	https://gisp.dfo-mpo.gc.ca/arcgis/rest/services/FGP/DFO_SARA_Distribution/MapServer/0		Request Required. Specific species distribution of fish and marine mammals (e.g. North Atlantic Right Whale, White Shark)
SARA	Significant parameters for different species with status under the Species at Risk Act (SARA)	No	DFO	https://open.canada.ca/data/en/dataset/4c7880ac-cb01-4e12-8305-2ae8eb675390		
SARA CH	Critical Habitat	Yes	DFO	https://search.open.canada.ca/openmap/db177a8c-5d7d-49eb-8290-31e6a45d786c		Critical habitat for ALL DFO species, not only fish. Includes wolffish critical habitat
SARA CH	DFO SARA Critical Habitat (Proposed/Draft)	No	DFO	https://gisd.dfo-mpo.gc.ca/arcgis/rest/services/Maritimes_EM/CriticalHabitat_ProposedDraft_Maritimes/MapServer		Request Required. Proposed critical habitat for Leatherback Sea Turles and Atlantic Mud-piddock.

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
SARA	Fisheries and Oceans Canada Species at Risk Distribution (Range)	Yes	DFO	https://open.canada.ca/data/en/dataset/e0fabad5-9379-4077-87b9-5705f28c490b		
Whales	Identifying priority areas to enhance monitoring of cetaceans in the Northwest Atlantic Ocean	Yes	DFO	https://open.canada.ca/data/en/dataset/c094782e-0d6f-4cc0-b5a3-58908493a433		
Blue Whale	Feeding and migration important areas for Blue whales in the Estuary and the Gulf of St. Lawrence and in the Atlantic Ocean			https://search.open.canada.ca/openmap/8fafd919-fcbe-43a3-a911-3d9461273441		
Shark	Recreational Shark Fishing Tournament Landings Data and Canadian Dart Tag Database	Yes	DFO	https://open.canada.ca/data/en/dataset/4309f1f7-6779-416d-9660-c02f0f99b482		
Greenland Shark	Habitat Suitability of Greenland Shark (Somniosus microcephalus) in the Newfoundland and Labrador Region	Yes	DFO	https://open.canada.ca/data/en/dataset/cb06a10b-5e4e-4682-91d1-22a22f55a488		
Sharks	White Shark SPOT Geo-location (OCEARCH 2013-2020)	No	DFO	https://gisd.dfo-mpo.gc.ca/portal/home/item.html?id=a1f51c97d3b542b08c14d1126e1b38c5		A compilation of marine species sightings data sources for Atlantic Canada.
Harp Seal	Harp seal distribution in the Gulf of St. Lawrence and Atlantic Ocean			https://open.canada.ca/data/en/dataset/7f0951a6-e2b7-4cc9-a9cd-4e1c80f410cc		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Harp Seal	Important areas for Harp seal pupping and migration in the Gulf of St. Lawrence and Atlantic Ocean			https://open.canada.ca/data/en/dataset/f291a95e-6bb2-4888-a7d6-3fc784d7dccb		

MARINE MAMMALS (CETACEANS & PINNIPEDS), SEA TURTLES & SHARKS

Background / Context: The Impact Assessment Agency of Canada (IAAC) is seeking general marine and coastal data, and published information, in support of a regional assessment for offshore wind in Newfoundland. The IAAC is looking for existing science information that generally characterizes the marine ecosystem and species in the 'focus area' outlined in the figure below, including current and recent trends, data limitations, knowledge gaps, impacts of climate change, available geo-spatial data, cumulative impacts, and important citations/publications that should be consulted for the regional assessment. Please note that any information Fisheries and Oceans Canada (DFO) provides to IAAC may be posted to a public registry. The following constitutes DFO Science sector's response to this request.

Figure. Focus area highlighted in green for the Newfoundland offshore wind regional assessment.

Question/request: Known information, data/null data, data gaps, vulnerabilities, impacts of climate change, cumulative impacts, and citations and important references regarding important marine mammals, sea turtles, and sharks in the Newfoundland & Labrador offshore wind focus area. If possible, please note importance of focus area to overall species productivity (e.g., spawning areas, aggregation areas, migration routes, hotspots, etc.). NOTE: there is particular interest related to North Atlantic right whale and other highly-vulnerable marine mammal and sea turtle species in the focus area.

Response:

1. Overview / summary of current knowledge

The Newfoundland offshore wind 'focus area' overlaps with Northwest Atlantic Fisheries Organization (NAFO) management units 3P (further subdivided as 3Ps and 3Pn) and 4R. Management unit 3P is located west of the Grand Banks of the south coast of Newfoundland (see: Figure 1). Management unit 4R is located in the eastern Gulf of St. Lawrence off the west coast of Newfoundland.

Figure 1. Focus Area outlined in green for the Newfoundland offshore wind regional assessment overlaid with NAFO management units 3P and 4R.

Information on important marine mammal, sea turtle, and shark species that overlap with the focus area is provided in Table 1 below. Table 2 below provides links to available geospatial data related to these species.

Marine mammals – Cetaceans: More than 16 species of cetaceans may be found in the focus area (see Table 1 below), although some are observed rarely. Based on a 2016 large-scale aerial survey by DFO Science, white-beaked dolphins (*Lagenorhynchus albirostris*) are the most common cetacean in the focus area off the south coast of Newfoundland (Lawson and Gosselin 2018) while humpback and fin whales are the most common large whales. Some cetaceans will remain in the focus area throughout the year (e.g., blue whale, white-beaked dolphin), while others are seasonal and appear to arrive in the focus areas to feed on seasonally-abundant prey such as zooplankton and spawning fish (fin whales, harbour porpoise).

Marine mammals – Pinnipeds: Two species of pinnipeds are typically found in the focus area: Atlantic harbour seal (*Phoca vitulina vitulina*) and grey seal (*Halichoerus grypus*). Atlantic harbour seals are year-round residents in the focus area and can be found on both the west and south coasts of Newfoundland (Hamilton et al., 2023; Mosnier et al., 2023). Harbour seals are relatively sedentary, typically remaining within few hundred kilometers of natal sites. As such, the focus area overlaps with habitats used for breeding in this species, with harbour seal pups being born in coastal waters in June-July. In contrast, grey seals are seasonal migrants to the focus area, primarily moving into the region in the summer months to forage before departing again in the fall to return to breeding colonies in the Gulf of St Lawrence or on the Scotian Shelf. They can be found hauled-out on both the west and south coasts of Newfoundland when in the region (Hamilton et al., 2023; Mosnier et al., 2023). In addition to harbour and grey seals, harp seals (*Pagophilus groenlandicus*) and hooded seals (*Cystophora cristata*) are seasonal visitors to the focus area, feeding and transiting through the focus areas during annual migrations to and from breeding locations in the Gulf of St. Lawrence (Stenson and Sjare, 1997; Bazjak et al., 2009; Andersen et al., 2013a; Andersen et al., 2013b; Stenson et al., 2016).

Sea turtles: Four species of sea turtles are found in Atlantic Canada: the leatherback sea turtle (*Dermochelys coriacea*); loggerhead sea turtle (*Caretta caretta*); Kemp's ridley sea turtle (*Lepidochelys kempii*); and green sea turtle (*Chelonia mydas*). Leatherbacks and loggerheads are listed as Endangered under Canada's *Species at Risk Act.* Kemp's ridley and green turtle are not listed under SARA; they are globally listed as Critically Endangered and Endangered, respectively. All four sea turtle species are found in the focus area, but leatherbacks and loggerheads are the most abundant. There are relatively few data representing live sightings of Kemp's ridley and green sea turtles.

Leatherback sea turtles are the largest and most reported of sea turtle species found in Atlantic Canada, as well as in the southern Newfoundland waters of the focus area. Leatherbacks have a broad distribution and are found in both nearshore and offshore waters of Atlantic Canada. The *Species at Risk Act* (SARA) has not yet been formally delineated Critical Habitat for leatherbacks, although ongoing science consultations have derived candidate areas. Important high use (foraging) areas for the leatherback turtle have been identified in Atlantic Canada (DFO 2020; Mosnier et al. 2018). Leatherbacks are seasonally abundant in the summer and fall, but have also been reported from November to May (typically via entanglements in fishing gear). Juvenile loggerhead sea turtles also use Atlantic Canadian waters as foraging habitat. Loggerheads are mostly on the outer banks of the continental shelf, shelf slope, and offshore waters and less commonly in nearshore waters such as the focus area south and southeast of Newfoundland. The other two species are extremely rare in the focus area, and have usually been dead or cold-stunned individuals.

Sharks: There are numerous shark species that either reside in Canadian waters or seasonally migrate to Canadian waters. Primary species include:

- Shortfin mako shark (North Atlantic Population; pelagic; COSWEIC: endangered)
- Porbeagle shark (Northwest Atlantic Population; pelagic; COSWEIC: endangered)
- Blue shark (North Atlantic Population; pelagic; COSWEIC: not at risk)
- White shark (Northwest Atlantic Population; pelagic; COSWEIC: endangered; Listed on Schedule 1 of SARA)
- Greenland shark (North Atlantic and Arctic Population; demersal; COSWEIC: not assessed)
- Basking shark (Northwest Atlantic Population; pelagic; COSWEIC: special concern)
- Spiny dogfish (Northwest Atlantic Population; demersal; COSWEIC: special concern)
- Common thresher shark (Northwest Atlantic Population; pelagic; COSWEIC: not assessed)

Several other semi-tropical sharks are less commonly found in Canadian waters, including (but are not limited to):

- Bigeye thresher shark (North Atlantic Population; pelagic; COSWEIC: not assessed)
- Tiger shark (North Atlantic Population; pelagic; COSWEIC: not assessed)
- Oceanic whitetip (North Atlantic Population; pelagic; COSWEIC: not assessed)
- Atlantic sharpnose (North Atlantic Population; pelagic; COSWEIC: not assessed)
- Dusky shark (North Atlantic Population; pelagic; COSWEIC: not assessed)

Little information exists about the abundance, population structure, distribution, or habitat requirements of demersal and deep-water sharks that would be expected to be found along the edge of the continental shelf and deeper waters of the Northwest Atlantic. Species include (but are not limited to):

- Black dogfish (demersal; COSWEIC: not assessed)
- Deepsea catshark (demersal; COSWEIC: not assessed)

Critical Habitat has not been defined for any shark species in Canadian waters, although it is anticipated by 2025 from an ongoing, multi-region collaborative research project for White shark. Research on other species will commence once listing decisions are made. Because of the widespread distribution of all shark species in Canadian waters, Critical Habitat(s) may occur within the focus are area. Habitat use varies substantially by species. White shark (Bowlby et al. 2022) and Basking shark (Braun et al. 2018) make frequent use of coastal habitats (within the 200m bathymetric contour) during the summer months (primarily June to November) while feeding. Summer seal haul-outs are one feature that White shark tend to aggregate around, where grey and harbour seals are found in groups throughout coastal Nova Scotia and into the Gulf of St. Lawrence, with the largest colony around the Magdalen Islands. Basking sharks are planktonic feeders and would be expected to be found where primary productivity was high. Areas of high primary productivity are not static but would depend on water conditions (currents, temperature, upwelling, etc.) and time of year.

In general, sharks use structure to their advantage while feeding (e.g. Braun et al. 2019). This means that they would be expected to congregate around upwelling characterized by distinct discontinuities in water temperature, as well as in regions with rough bathymetry, characterized by abrupt changes in depth. Pelagic species use habitats throughout the water column (i.e. vertical habitat use; Andrzejaczek et al. 2022). Several species (e.g. porbeagle) tend to be found closer to the surface at night and in deeper water during the day, following vertically-migrating prey (e.g. Wang et al. 2020). Fishery-dependent data suggests that captures of numerous species (e.g. shortfin mako, blue shark, thresher) tend to be highest along the edge of the continental shelf and in deep basins.

The distribution of pelagic sharks is also related to the Gulf Stream current. Both temperate species (e.g. porbeagle) as well as semi-tropical species (e.g. basking shark, blue, tiger, threshers, shortfin mako) seasonally use the warm waters of the Gulf Stream. The majority of satellite tracking data suggests that semi-tropical species may move into the Gulf Stream during the winter months, when leaving Canadian habitats. Atlantic Canada represents a small part of the population-level range of the shark species that can be found in Canada. Shark physiology is very adaptable and individuals can use areas with a wide range of environmental characteristics. Pelagic species move 1000s of kilometers in a year and have the potential to distribute throughout the focus area. Essentially all of the species considered in this document could be expected to be found (at varying density) throughout the focus area during the summer and fall (primarily June to November), with the exception of deep sea species and Greenland shark. Deepsea and demersal species are likely present all year.

The distribution of sharks within the focus area would be primarily related to feeding behaviour. Spawning and pupping areas are less well-known and sharks do not follow defined migration routes when undertaking seasonal movements. Smaller pelagic sharks are piscivorous, primarily eating teleost fish and cephalopod species. Only larger adult shortfin mako and white shark would also feed on marine mammals (seals, porpoises, small whales, etc.). Thus, productive fishing grounds for teleost fishes or hotspots for teleost fishes would also be associated with higher densities of numerous species of sharks. These habitats could be found at varying depths and locations.

2. Gaps in data collection

The broad and oceanic distribution of marine mammals, sea turtles, and sharks makes it difficult to collect data on these species. In addition, climate change has made marine weather conditions less predictable and increased the number of days with fog and/or strong winds; this poor weather significantly reduced the opportunities for systematic surveys or opportunistic sighting detections. For whales and sharks, absence of targeted fisheries has limited the ability to accurately assess the status of the population through fisheries or hunt statistics. Further, primary threats to certain species (e.g., sea turtles) often are beyond Canada's control to directly manage (e.g., removal of eggs from southern nesting beaches). Species-specific assessment reports noted in Table 1 speak to gaps in knowledge in greater detail.

Marine mammals – Cetaceans: Cetaceans range in size from 24 m-long blue whales to 1.5 m-long harbour porpoises. These size dissimilarities, plus differences in behaviour (i.e., contrast the aerial displays of large humpbacks with the small surface breathing pattern of porpoises) and surface intervals (i.e., the extended dive durations of sperm and beaked whales), mean that some species are more likely to be visually-detected than others. Apparent gaps in distribution of different cetaceans in the focus area may also be a function of observer effort, with much less time spent searching the waters of offshore areas or any parts of the focus area during winter. Apparent concentrations of certain cetaceans can be ephemeral and driven by local aggregations of their prey, such as spawning capelin.

Due to their cost, DFO Science conducts few aerial- or vessel-based surveys for cetaceans, with most transect replication occurring across years rather than within one season in the focus area. Recent satellite tracking humpback, fin, sperm, and killer whales in Newfoundland waters (DFO unpubl. data) has confirmed that these marine mammals can move hundreds of kilometres per day when migrating, but also restrict movements to smaller areas when they are feeding. More such satellite tracking needs to be undertaken in the focus area to better understand the habitat use by cetaceans, and quantify individual and annual variation in movement patterns.

Habitat modelling has been done for very few cetaceans in Atlantic Canada, let alone at the scale of the focus area (see: Gomez et al., 2017; Moors-Murphy et al., 2019; Gomez et al., 2020). While the results point to potential habitat of greater occupancy for several species, the underlying data are usually proxies for measures such as prey and broader oceanographic integration. Better habitat models can only be created with improved information on prey species (rather than proxies such as chlorophyll) and greater survey coverage across seasons and years.

Marine mammals – Pinnipeds: Data on seasonal distribution and habitat use within the focus area is limited for both harbour and grey seals. Recent aerial surveys have provided information on haul-out locations and counts for both species during the early summer months in the focus area (Hamilton et al., 2023; Mosnier et al., 2023). However, information on seasonal movements and foraging locations within the focus area is lacking for both species. In addition, data on the timelines for the harbour seal breeding season (phenology of pupping) in the focus area is lacking. The breeding period is a highly sensitive period for harbour seal mother-pup pairs and information on the onset and duration of this period is needed to understand the potential for particular activities to create disturbance with negative impacts on pups including, but not limited to, reduced growth and survival.

Sea turtles: Most sea turtles are present in Atlantic Canada from early June through to late October. Many sea turtle sightings derive from citizen science; such sightings made by the public are reported to government and non-government entities. The Canadian Sea Turtle Network (CSTN; www.seaturtle.ca) maintains a database of sea turtle sightings for Atlantic Canada, as does The Marine Mammal Section in DFO Newfoundland and Labrador. Despite the efforts made to solicit reports of sightings, reporting effort is variable on a yearly (or seasonal) basis. Most public sea turtle sightings are limited to periods of increased recreational boat use corresponding to the tourism season (therefore data are biased to the summer months and nearshore waters), and the period of best weather. Sightings data also come from systematic surveys using aerial and vessel platforms.

Leatherback sea turtles are large and distributed widely (see Table 1) and are therefore more likely to be visually detected versus other species. Hard-shelled sea turtles are much smaller than leatherbacks and less common in nearshore waters, making them difficult to visually locate. The lack of sightings in areas outside of areas where turtles are typically reported by the public should not be interpreted as an absence of sea turtles. Similarly, concentrated numbers of sightings do not always reflect a large number of individuals in an area. DFO Science conducts annual vessel-based surveys for leatherback sea turtles in July and August, and with widely-spaced transects in many areas. This highly biases the volume of reports there. There are no population abundance estimates for sea turtles in Atlantic Canada. Their distribution in Atlantic Canada is entirely marine (no nesting). Depth utilization varies by species and ranges from surface waters to several hundred metres.

Sharks: For the majority of species, there is essentially no fishery-independent data on habitat use or distribution. Even the amount of information from fishery-dependent data changes seasonally, with lower effort during the winter from fisheries that would have higher interaction rates with sharks. This means that our understanding of where pelagic sharks tend to be is heavily influenced by where fisheries are taking place and by shark catchability from the gear types being used. Commercial fisheries in Canada are not targeting sharks and would be expected to avoid shark bycatch if possible. This means that areas of high concentration for numerous shark species (and the environmental characteristics associated with them) may be missed from fishery-dependent data.

Habitat modeling has not been done for any shark species at the scale of the focus area. A global analysis for blue shark suggests that high-quality habitat would be found throughout the OSW study region for approximately 6 months of the year (Druon et al. 2022). There is extremely little information on spawning and pupping locations for the majority of the shark species found in Canadian waters. There is also extremely little information on the historical distribution of any shark species in Canadian waters. Prior to 2001, species identification was poor for morphologically similar species that were captured by fisheries (e.g. shortfin mako, porbeagle; Bowlby et al. 2022b). Pelagic shark bycatch was inconsistently recorded in commercial logbooks and detailed shark monitoring was only implemented in 2010 by at-sea observers. Deepwater species are rarely captured and have no potential to be monitored using available electronic tagging technology, given depth limitations of the tags. Much of what is currently known about shark distribution patterns has been determined since the advent of satellite tagging technologies (early 2000s onward).

3. Known vulnerabilities / impacts of climate change

Many marine mammals, sea turtles, and sharks have a broad distribution throughout Canadian waters, encompassing areas from the Bay of Fundy, into the Gulf of St. Lawrence, out to the Grand Banks towards the Flemish Cap, and along coastal Newfoundland and Labrador. In addition, many of the species are considered at-risk due to historical over-fishing, habitat degradation, and a changing marine climate that impacts water column structure, nutrients, primary productivity, and changing predator-prey relationships. Impacts associated with offshore wind development, such as habitat alteration, disruption, destruction, noise associated with installation or servicing, and/or vessels that may strike a species could have significant impact on the species status; particularly those endangered species such as the North Atlantic right whale, blue whale, and leatherback sea turtle. Alternately, it is known that some marine mammal species aggregate to feed on prey attracted to undersea structures associated with offshore wind developments. Species-specific assessment reports noted in Table 1 speak to known vulnerabilities and/or impacts of climate change in greater detail.

Marine mammals – Cetaceans: Cetaceans rely on prey that are variable in abundance in space and time. This makes them vulnerable to biological impacts if the density of prey falls below levels sufficient to meet their energy needs, or forces them to move to areas with higher risk, such as into shipping lanes or closer to shore. Such changes in the prey base could be an indirect product of climate change or a direct result of human activities (e.g., offshore wind energy structures can alter local oceanic currents or nutrient mixing processes; Dorrell et al., 2022). Ice entrapment of cetaceans such as blue whales and dolphins is a unique feature of the SW Newfoundland coastal area near the Port aux Port peninsula (Moors-Murphy et al., 2019). As climate change has increased sea ice movements in the southern Gulf, and stronger spring winds push it less predictably, this sea ice is an increasingly important source of spring mortality for cetaceans in the southwest Newfoundland portion of the focus area.

Marine mammals – Pinnipeds: For harbour and grey seals in the focus area, the predominant impact of climate change will be through its impacts on the distribution or abundance of their prey. Activities that displace high quality prey may have a significant impact on the ability of both species to acquire sufficient energy to meet their needs. In addition, as noted above, harbour seal breeding occurs in the focus area. Activities that disturb harbour seal mother-pup pairs during the period of offspring dependence may have significant consequences for the growth and survival of pups.

<u>Sea turtles</u>: Climate change is a recognized threat to sea turtles (DFO, 2020). Predicted impacts of warming ocean temperature for sea turtle populations include shifts in their spatial and temporal distributions in Atlantic Canada; and this can change the nature and magnitude of risks they will encounter. Ocean temperature impacts the distribution of jellyfish, the principal prey of leatherbacks in Atlantic Canadian waters. Planktonic blooms occur earlier with warming temperatures (Hays et al., 2005) which could result in leatherbacks arriving earlier in on their foraging grounds to exploit periods of high jellyfish abundance. Most leatherbacks occur in waters >15°C (James et al., 2006). A northward shift in the 15°C isotherm has been documented (McMahon and Hays, 2006).

<u>Sharks</u>: The general prediction is that ocean warming will cause pelagic sharks to shift northward in their distribution and to arrive earlier in the season (Hammerschlag et al. 2022). Semi-tropical species may enter the focus area earlier in the year and leave later and/or may be found at higher regional densities. It is more difficult to determine how temperate species and deepwater species might react. Porbeagle and Greenland shark may also shift their distribution northward and/or to deeper waters, but this is unlikely to result in their absence from the focus area. Climate change hypotheses are difficult to validate, given the lack of historical distribution data on sharks.

The long evolutionary history of sharks demonstrates their high adaptive capacity to changing conditions, making it very difficult to predict how shark habitats will vary under climate change (Hazen et al. 2013). Other biological components of marine ecosystems would also influence shark habitat use, given that sufficient resources must exist at lower tropic levels to support higher tropic level shark populations. While abiotic conditions may be more conducive to sharks in future years due to climate change, the biological communities that sharks depend on may not be. Last, numerous shark species have been subject to sustained overfishing at a global level and are currently at risk (e.g. oceanic whitetip, white shark). If recent conservation actions are effective, it will be very difficult to distinguish between range expansion as abundance increases versus changes in habitat use under climate change.

4. List any accompanying geo-spatial data / maps

See Table 2 below.

5. Cumulative effects

Cumulative impacts associated with at-risk marine species, particularly those that are endangered or threatened, are often associated with the combination of historical over-fishing and bycatch, habitat degradation, and a changing marine climate that impacts water column structure, nutrients, primary productivity, and changing predator-prey relationships, and food supply. Impacts associated with offshore wind development, such as habitat alteration, disruption, destruction, noise associated with installation or servicing, and/or vessels that may strike at-risk marine species; particularly slow moving and surface feeding animals. But as importantly, these potential impacts may be additive, or worse synergistically, with other ongoing stressors.

Marine mammals – Cetaceans: While researchers have used modelling to assess the potential impacts of single stressors, usually underwater anthropogenic sound, on cetaceans (e.g. Donovan et al. 2017; Moore et al. 2012), efforts to cumulate multiple stressors to assess impacts have been far more problematic. This is mainly due to our relatively poor understanding of the impacts of single stressors on individual and population-level biological processes, let alone how multiple stressors might combine to yield an effect. Studies have tried this with limited numbers of stressors (see Pirotta et al., 2019), but real-world assessments are needed to ground-truth these models.

Marine mammals – Pinnipeds: As species that are strongly associated with coastal ecosystems, both harbour and grey seals face common threats from a wide variety of anthropogenic sources including disturbance, pollution from coastal run-off, coastal development, and interactions with fisheries and aquaculture. In addition, climate change is projected to have significant impacts on their environment with significant potential changes in prey distribution and abundance. Little is known about the potential cumulative effects of these multiple stressors on these species.

Sea turtles: Sea turtles face common threats from many different sources (e.g., fishing, maritime transport, offshore petroleum, etc.) which may contribute to habitat degradation, vessels strikes, marine debris, and ocean noise.

Sharks: Sharks have the ability to sense electromagnetic signals in the water through specialized cells in their snouts. Numerous species are attracted to or affected by electromagnetic signals. Instances where sharks have been attracted to the electromagnetic field given off by lithium batteries include: (1 attacks on ocean gliders deployed by the Ocean Tracking network in Canadian waters; and (2 preferential interaction with GoPro cameras during fieldwork even in the presence of bait. As such, sharks that may be affected by the offshore wind developments.

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Table 1. Overview of marine mammals (cetaceans & pinnipeds), sea turtles, and sharks that overlap with Focus Area.

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
Marine Mammals – Cetaceans					
Atlantic White-sided Dolphin	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NL population size is large, but population trend is unknown; they are found throughout NL waters, which serve for migration, socializing, and feeding; Atlantic White-sided dolphins are vulnerable to gear entanglement, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins		https://media.fisheries.noaa.gov/2022-08/Atl%20White-Side%20Dolphin-West%20N%20Atl%20Stock_SAR%202021.pdf https://www.dfo-mpo.gc.ca/csas-sccs/publications/resdocs-docrech/2009/2009_031-eng.htm
Blue Whale	Endangered (COSEWIC and SARA)	CH has been proposed through a CSAS process, but has not yet been formally established by the DFO, but would include the new focus areas for the study	The NW Atlantic population has a small size, and low reproductive rate; NL south and southwest coasts are important habitat for blue whales in the winter and spring for feeding; blue whales are vulnerable to vessel strike, gear entanglements, ice entrapment, and climate change if it reduces the amount or changes the distribution of their zooplankton prey; data gaps exist in our knowledge of (1) annual movements and habitat use relative to prey density	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2022/2022_026-eng.html	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2018/2018_003-eng.html

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			and (2) regional abundance; displacement by underwater anthropogenic sounds may cumulate with other stressors		
Common Dolphin	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NL population size is large, but population trend is unknown; they are found throughout NL waters, which serve for migration, socializing, and feeding; common dolphins are vulnerable to gear entanglement, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins		https://www.dfo-mpo.gc.ca/csas-sccs/publications/resdocs-docrech/2009/2009_031-eng.htm
Fin Whale	Special Concern (COSEWIC and SARA)	CH has not been proposed through a CSAS process	The NW Atlantic population appears to be growing; NL south and southwest coasts are important habitat for fin whales in the spring and fall for migration into the Gulf; fin whales are particularly vulnerable to vessel strike, as well as gear entanglements, and climate change if it reduces the amount or changes the distribution of their fish and zooplankton prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for fish stocks such as capelin and herring	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2022/2022_026-eng.html	https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/sr-RoqualCommunFinWhale-v00-2019-Eng.pdf https://publications.gc.ca/collections/collection_2020/eccc/CW69-14-428-2019-eng.pdf

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
Harbour Porpoise	Special Concern (COSEWIC)	CH has not been proposed through a CSAS process	The NL population size is small, but population trend is unknown; they are found throughout NL waters, which serve for migration, socializing, and feeding, although most commonly seen along the south coast of Newfoundland and in the Gulf of St. Lawrence; porpoise are vulnerable to gear entanglement, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; masking of underwater sounds (a form of habitat degradation by noise disturbance (e.g., industrial developments such as offshore wind, tidal, and wave energy, and oil and gas developments) and displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins	https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/statements/rs_147_1171_2022-11_e.pdf	https://sararegistry.gc.ca/virtual_sara/files/cosewic/sr%20Harbour%20Porpoise%202022%5Fe%2Epdf https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/sr%20Harbour%20Porpoise%202022_e.pdf
Humpback Whale	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population appears to be growing; NL south and southwest coasts are important habitat for humpback whales for migration into the Gulf; fin whales are particularly vulnerable to vessel strike, as well as gear entanglements, and climate change if it reduces the amount or changes the distribution of their fish and zooplankton prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2022/2022_026-eng.html	https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/humpback-whale-2022.html

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			cumulate with other stressors such as competition with humans for fish stocks such as capelin and herring		
Killer Whale	Special Concern (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population size is near 100 whales, although abundance trend is unknown; this species is found throughout NL waters which serve for migration and feeding; killer whales are vulnerable to gear entanglements, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of diet, and annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey fish stocks and bioaccumulation of toxins		https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/sr_killer_whale_0809_e.pdf
Long-finned Pilot Whale	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population size is large, and likely increasing; while found throughout NL waters, deeper shelf break areas serve for migration and feeding; pilot whales are vulnerable to gear entanglements, and climate change if it reduces the amount or changes the distribution of their squid prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey squid stocks and bioaccumulation of toxins		https://media.fisheries.noaa.gov/2022-08/Long-Fin%20Pilot%20Whale-West%20N%20Atl%20Stock_SAR%202021.pdf

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
Minke Whale	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population trend is unknown; between 2017 and 2023 the U.S. has declared an Unusual Mortality Event along the Atlantic Coast; NL coastal and deeper waters are important habitat for minke whale migration and feeding; minke whales are vulnerable to gear entanglements, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for fish stocks such as capelin and herring.		https://media.fisheries.noaa.gov/dam-migration/56_f2016_minkewhale_508.pdf
North Atlantic Right Whale	Endangered (COSEWIC and SARA)	CH has not been proposed through a CSAS process	The NW Atlantic population has a small and declining size; NL south and southwest coasts are important habitat for right whales in the winter and spring for migration to the southern Gulf; right whales are vulnerable to vessel strike, gear entanglements, and climate change if it reduces the amount or changes the distribution of their copepod prey; data gaps exist in our knowledge of (1) annual movements and habitat use relative to prey density and (2) potential impacts of climate change	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2020/2020_037-eng.html	https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/sr_North%20Atlantic%20Right%20Whale_2013_e.pdf
Northern Bottlenose Whale	Endangered (SARA - Scotian Shelf pop); Special	CH has not been proposed through a CSAS process	The Gully population size is small, whereas that of the Davis Strait-Baffin Bay-Labrador Sea is unknown; this species is found in NL waters, where deeper shelf break areas serve for migration and feeding; Northern Bottlenose	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-	https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/fi

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
	Concern (COSEWIC - Davis Strait-Baffin Bay-Labrador Sea pop)		Whale whales may be vulnerable to climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins	AS/2022/2022_032-eng.html	les//cosewic/sr_northern_bottlenose_whale_0911_eng.pdf https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2020/2020_008-eng.html https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2014/2014_041-eng.html
Sei Whale	Endangered (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population size and trend are unknown; NL coastal and shelf break areas are important habitat for sei whales for migration and feeding; sei whales are vulnerable to gear entanglements, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density;		https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/Sr-SeiWhaleRorqualBoreal-v00-2019-Eng.pdf

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for fish stocks such as capelin and herring		
Sowerby's Beaked Whale	Special Concern (COSEWIC and SARA)	CH has not been proposed through a CSAS process	The NW Atlantic population size is unknown, as are populations trends; this species is found occasionally in NL waters, where deeper shelf break areas serve for migration and feeding; Sowerby's beaked whales may be vulnerable to climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins		https://wildlife-species.az.ec.gc.ca/species-risk-registry/virtual_sara/files//cosewic/SrBaleineBecSowerbyBeakedWhale-v00-2019-Eng.pdf
Sperm Whale	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population size and trend are unknown; NL shelf and shelf break areas are important habitat for male sperm whales for migration and feeding; sperm whales are vulnerable to vessel strike, gear entanglements, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for squid stocks		https://media.fisheries.noaa.gov/dam-migration/2019_sars_atlantic_spermwhale.pdf
Risso's Dolphin	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NW Atlantic population size is large, and likely increasing; while found occasionally in NL waters, where		https://media.fisheries.noaa.gov/2022-

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			deeper shelf break areas serve for migration and feeding, this species is more common further south; Risso's dolphins may be vulnerable to climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins		08/Riss%20Dolphin-West%20N%20Atl%20Stock_SAR%202021.pdf
White-beaked Dolphin	Not at Risk (COSEWIC)	CH has not been proposed through a CSAS process	The NL population size is large, and increasing; they are the most ubiquitous dolphin found throughout NL waters, which serve for migration, socializing, and feeding; white-beaked dolphins are vulnerable to gear entanglement, and climate change if it reduces the amount or changes the distribution of their prey; data gaps exist in our knowledge of annual movements and habitat use relative to prey density; displacement by underwater anthropogenic sounds may cumulate with other stressors such as competition with humans for prey stocks and bioaccumulation of toxins		https://media.fisheries.noaa.gov/dam-migration/2019_sars_atlantic_whitebeakeddolphin.pdf https://www.dfo-mpo.gc.ca/csas-sccs/publications/resdocs-docrech/2009/2009_031-eng.htm
Marine Mammals – Pinnipeds					
Atlantic Harbour Seal	Not at Risk (COSEWIC, 2007)	Critical Habitat has not been proposed through a DFO Canadian Science	First Atlantic Canada wide stock assessment completed in October 2023 (CSAS process). Science Advisory Report to be released once approved and translated. Population	Science Advisory Report from October 2023 species	

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
		Advisory Secretariate (CSAS) process.	trend unknown. Year-round resident in the focus area. The largest concentration of harbour seals in Newfoundland waters is found in the focus area (Hamilton et al. 2023). Data on seasonal distribution and habitat use in the focus area remains limited. Harbour seals are relatively sedentary. Although there is a post-weaning dispersal of pups, adults typically stay within a few hundred kilometers of natal sites and, therefore, they may be particularly vulnerable to local disturbance from anthropogenic activities. Harbour seal pupping occurs in the focus area (June-July). Activities that disturb harbour seal mother-pup pairs during the period of offspring dependence may have significant consequences for the growth and survival of pups. More precise data on the timelines for the harbour seal breeding season (phenology of pupping) in the focus area is needed to better understand the specific periods of vulnerability. The predominant impact of climate change will be through impacts on the distribution or abundance of their prey. Any activities that displace high quality prey may have a significant impact on the ability of harbour seals in the focus area to acquire sufficient energy to meet their needs.	assessment is currently in the approval process and can be provided once publicly available.	
Grey Seal	Not at Risk (COSEWIC, 1999)	Critical Habitat has not been proposed through a DFO Canadian Science	Species last assessed in 2021. The Northwest Atlantic population is estimated at 366,400 individuals. The population is continuing to increase but at a slower rate than in the past. Grey seals are seasonal migrants to the	Science Advisory Report 2022/018 (dfo-mpo.gc.ca)	

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
		Advisory Secretariate (CSAS) process.	focus area, primarily moving into the region in the summer months to forage before departing again in the fall to return to breeding colonies in the Gulf of St. Lawrence or on the Scotian Shelf. They can be found hauled-out on both the west and south coasts of Newfoundland when in the region (Hamilton et al., 2023; Mosnier et al 2023). Data on seasonal distribution and habitat use within the focus area remains limited. The predominant impact of climate change will be through impacts on the distribution or abundance of their prey. Any activities that displace high quality prey may have a significant impact on the ability of grey seals in the focus area to acquire sufficient energy to meet their needs.		
Harp Seal	Not assessed	Critical Habitat has not been proposed through a DFO Canadian Science Advisory Secretariate (CSAS) process.	Species last assessed in 2019 with the Northwest Atlantic population estimated to be 7.6 million individuals. A new population model has been reviewed at a CSAS meeting and approved. Results will be posted soon. Seasonal visitors to the focus area, feeding and transiting through the focus areas during annual migrations to and from breeding locations in the Gulf of St. Lawrence	Science Advisory Report 2020/020 (dfo-mpo.gc.ca)	
Hooded Seal	Not at Risk (COSEWIC, 1986)	Critical Habitat has not been proposed through a DFO Canadian Science Advisory Secretariate (CSAS) process.	Species last assessed in 2005. The current population status is unknown and the population trend is also unknown. There are seasonal visitors to the focus area, including feeding and transiting through the focus areas during annual migrations to and from breeding locations in the Gulf of St. Lawrence.	Most recent stock assessment: Research Document - 2006/068 (dfo-mpo.gc.ca)	

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
				There is no associated SAR for this assessment.	
Sea Turtles					
Leatherback Sea Turtle	Endangered (COSEWIC and SARA)	CH has been proposed through a CSAS process, but has not yet been formally established by the DFO, but would include the new focus areas for the study	Occur in Canadian waters around Newfoundland and as far north as southern Labrador, in the Gulf of St. Lawrence, on the Scotian Shelf, and in the Bay of Fundy; the south coast of NL is an important NW Atlantic feeding area in the late summer and fall; leatherbacks are vulnerable to vessel strike, gear entanglements, and climate change if it reduces the amount or changes the distribution of their jellyfish prey.	https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2022/2022_004-eng.html	https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/leatherback-sea-turtle-atlantic-2022.html https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/leatherback-turtle-atlantic/chapter-10.html

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
					https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/report-progress-recovery-document/leatherback-sea-turtle-2022.html
Loggerhead Sea Turtle	Endangered (COSEWIC and SARA)	CH has not been defined in Canadian waters by DFO Loggerhead habitat is defined temporally and geographically, in part, by sea surface temperature	Occur (rarely) in offshore Canadian waters on the Scotian Shelf, around Newfoundland, and in the Gulf of St. Lawrence during the summer and fall; There is currently no population estimate for the Northwest Atlantic; threats include bycatch (incidental capture in active fishing gear), entanglement (in ghost gear or other marine debris), underwater noise, marine pollution, vessel strikes, and climate change if it reduces the amount or changes the distribution of their prey. When in Canadian waters during the spring, summer, and fall, Loggerheads are thought to forage mostly in the oceanic zone. Loggerhead Sea Turtles appear to prefer sea surface temperatures >20°C. In Atlantic Canada, waters >20°C are found in the	https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/loggerhead-sea-turtle-2020-final.html	https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/loggerhead-sea-turtle-2010.html

Species Name (include SME name)	SARA / COSEWIC Status	Critical Habitat / Recommended Set-backs	Brief description of species status, recent trends, importance of focus area to species population health, potential vulnerability of stock to climate change, data gaps, and cumulative effects	Hyperlink to Most Recent Stock Science Advisory Report (SAR)	Hyperlink to Most Recent Stock Status Update Report (SSRP), if more recent than SAR
			oceanographically dynamic region along the shelf break and further offshore, where the warm waters of the Gulf Stream mix with the cooler waters of the Labrador Current.		
Sharks					
Porbeagle Shark	Endangered (COSEWIC)	Not defined. Species common seasonal range is within the focus area.	Porbeagle shark are widely distributed in the Northwest Atlantic, occurring in Canadian waters; around Newfoundland and Labrador, on the Scotian Shelf, and in the Bay of Fundy. Details on species available in publication hyperlinked at right.	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/365107.pdf	Assessment cited to left is most recent science advice on this species.
Basking shark	Special Concern (COSEWIC)	Not defined. Species common seasonal range is within the focus area.	Basking shark are widely distributed in the Northwest Atlantic, occurring in Canadian waters; around Newfoundland and Labrador, on the Scotian Shelf, and in the Bay of Fundy. Details on species available in publication hyperlinked at right.	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/333307.pdf	Assessment cited to left is most recent science advice on this species.
White Shark	Endangered (SARA)	Not defined. Species common seasonal range is within the focus area.	White shark are widely distributed in the Northwest Atlantic, occurring in Canadian waters; around Newfoundland and Labrador, on the Scotian Shelf, and in the Bay of Fundy. Details on species available in publication hyperlinked at right.	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/327294.pdf	Assessment cited to left is most recent science advice on this species.
Shortfin Mako	Endangered (COSEWIC)	Not defined. Species common seasonal range is within the focus area.	Shortfin mako are widely distributed in the Northwest Atlantic, occurring in Canadian waters; around Newfoundland and Labrador, on the Scotian Shelf, and in the Bay of Fundy. Details on species available in publication hyperlinked at right.	https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41056255.pdf	Assessment cited to left is most recent science advice on this species.

Table 2. Geospatial datasets related to marine mammals (cetaceans & pinnipeds), sea turtles, and sharks.

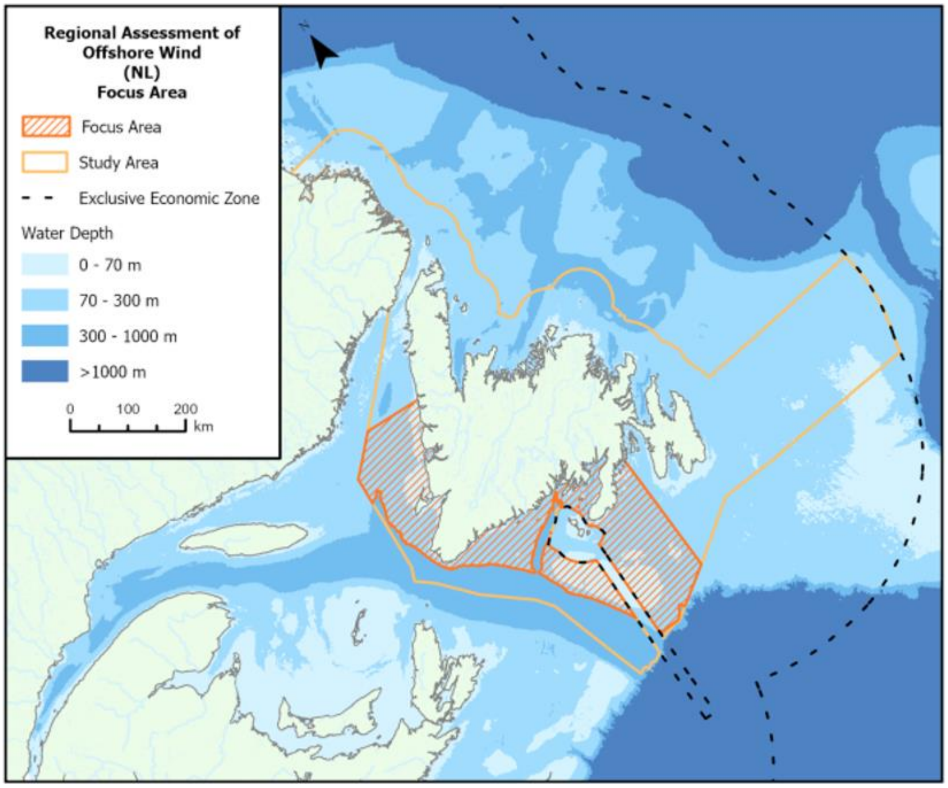
Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Marine Mammals	Science/ Journal Publications	Yes	Jasco Applied Sciences	https://www.jasco.com/publications		Peer-reviewed journal articles by JASCO scientists. Topics include marine mammal and fish behaviour, distribution, and bioacoustics, ambient soundscapes, vessel sound signatures, and the monitoring, modelling, and regulation of anthropogenic sound.
SARA	DFO Aquatic Species at Risk Distribution 2022	No	DFO	https://gisp.dfo-mpo.gc.ca/arcgis/rest/services/FGP/DFO_SARA_Distribution/MapServer/0		Request Required. Specific species distribution of fish and marine mammals (e.g. North Atlantic Right Whale, White Shark)
SARA	Significant parameters for different species with status under the Species at Risk Act (SARA)	No	DFO	https://open.canada.ca/data/en/dataset/4c7880ac-cb01-4e12-8305-2ae8eb675390		
SARA CH	Critical Habitat	Yes	DFO	https://search.open.canada.ca/openmap/db177a8c-5d7d-49eb-8290-31e6a45d786c		Critical habitat for ALL DFO species, not only fish. Includes wolffish critical habitat
SARA CH	DFO SARA Critical Habitat (Proposed/Draft)	No	DFO	https://gisd.dfo-mpo.gc.ca/arcgis/rest/services/Maritimes_EM/CriticalHabitat_ProposedDraft_Maritimes/MapServer		Request Required. Proposed critical habitat for Leatherback Sea Turles and Atlantic Mud-piddock.

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
SARA	Fisheries and Oceans Canada Species at Risk Distribution (Range)	Yes	DFO	https://open.canada.ca/data/en/dataset/e0fabad5-9379-4077-87b9-5705f28c490b		
Whales	Identifying priority areas to enhance monitoring of cetaceans in the Northwest Atlantic Ocean	Yes	DFO	https://open.canada.ca/data/en/dataset/c094782e-0d6f-4cc0-b5a3-58908493a433		
Blue Whale	Feeding and migration important areas for Blue whales in the Estuary and the Gulf of St. Lawrence and in the Atlantic Ocean			https://search.open.canada.ca/openmap/8fafd919-fcbe-43a3-a911-3d9461273441		
Shark	Recreational Shark Fishing Tournament Landings Data and Canadian Dart Tag Database	Yes	DFO	https://open.canada.ca/data/en/dataset/4309f1f7-6779-416d-9660-c02f0f99b482		
Greenland Shark	Habitat Suitability of Greenland Shark (Somniosus microcephalus) in the Newfoundland and Labrador Region	Yes	DFO	https://open.canada.ca/data/en/dataset/cb06a10b-5e4e-4682-91d1-22a22f55a488		
Sharks	White Shark SPOT Geo-location (OCEARCH 2013-2020)	No	DFO	https://gisd.dfo-mpo.gc.ca/portal/home/item.html?id=a1f51c97d3b542b08c14d1126e1b38c5		A compilation of marine species sightings data sources for Atlantic Canada.
Harp Seal	Harp seal distribution in the Gulf of St. Lawrence and Atlantic Ocean			https://open.canada.ca/data/en/dataset/7f0951a6-e2b7-4cc9-a9cd-4e1c80f410cc		

Theme	Data Title	Publicly-available	Data Source	Web Link	Associated Publications	Notes / Description
Harp Seal	Important areas for Harp seal pupping and migration in the Gulf of St. Lawrence and Atlantic Ocean			https://open.canada.ca/data/en/dataset/f291a95e-6bb2-4888-a7d6-3fc784d7dccb		

Regional Assessment of Offshore Wind Development in NL

Requested Data from Fisheries and Oceans Canada



This document provides requested commercial fishing information for the offshore wind development Focus Area. The data presented originates from a variety of sources including the Dockside Monitoring Program, hails, purchase slips and logbooks submitted by fishing enterprises[1] to Fisheries and Oceans Canada (DFO). Data was extracted from the DFO national database which includes fishing information from all DFO Atlantic Regions.

Considerations

- Data is aggregated over the 2012 to 2021 period.
- Georeferenced (i.e. records with fishing positional data) and non-georeferenced logbook records were included in the offshore wind development Focus Area data extraction from the national database. The extracted data was provided by Aquatic Ecosystems, DFO. Georeferenced records generally include vessels greater than 35 feet in length while non-georeferenced records generally include vessels less than 35 feet in length. The majority of the analysis that follows is based on the georeferenced logbook records.

[1] A fishing enterprise is defined as the fishing unit comprising all licences, vessels, gear, facilities and crew.

- However, it is understood that the Focus Area is an important fishing area for small fishing vessels, most of which are less than 35 feet in length. Generally these vessels are included in the non-georeferenced information as specific positional fishing data is largely unavailable for them other than NAFO Unit Area fished. Therefore, a separate section titled "Small Vessel Fishing Activity within the Focus Area" is presented below in an effort to ensure that the importance of the Focus Area to these vessels is not overlooked.
- An experimental redfish fishery on the west coast of the province is underway to determine the viability of a commercial fishery. The opening of a commercial fishery would potentially increase redfish catch on the west coast, including within the Focus Area.

Commercial Fishing Data Challenges

- The National database relies on regional updates, which occur at certain points during the year, thus there is a data lag.
- The extracted georeferenced data was mapped using the original logbook entry for each record. Data may contain errors such as inaccurate or nonviable coordinates, landed weights and/or species identification. Fishing activity may be incorrectly located due to inaccurate coordinates.
- Georeferenced data is largely unavailable for some fisheries (for example, lobster).
- Georeferenced and non-georeferenced data originates from logbooks provided by fishing enterprises.
- In the analysis below, scallop catch is underestimated for the less than 35 foot fleet active in Fortune Bay and Placentia Bay. Mandatory reporting requirements for this fleet were only recently introduced.
- Information on recreational and Food, Social and Ceremonial fisheries is not included in the national database.

Commercial Fishing Activity, 2012 to 2021 aggregated

Active Commercial Fisheries

Between 2012 and 2021, herring, Snow crab, Sea cucumber and capelin were the primary georeferenced commercial fisheries in terms of catch volume within the Focus Area. Snow crab, Sea cucumber, scallop and herring were the main georeferenced fisheries in terms of landed value over the same period. Other notable fisheries included whelk, Atlantic halibut, cod and mackerel. On average, just over 21,000 tonnes of catch with a landed value of approximately $39 million were attributable to the Focus Area annually (see Table 1). In total over the 2012 to 2021 period, the Focus Area accounted for over 212,000 tonnes of total catch (all species) with a total landed value of over $393 million.

Table 1: Average Annual Focus Area Catch and Landed Value by Species, 2012-2021

	Average Annual Catch (t)	Average Annual Landed Value
Snow Crab	2,800	$21,440,000
Sea Cucumber	2,800	$3,563,200
Scallop	1,400	$3,141,000
Herring	7,800	$2,410,800
Whelk	1,400	$2,391,200
Atlantic Halibut	200	$2,169,200
Cod	1,100	$1,663,600
Capelin	1,600	$658,900
Mackerel	800	$458,100
Other	1,400	$1,381,000
All Species	**21,200**	**$39,277,000**

Note: Other species includes redfish, Witch flounder, shrimp, turbot and haddock.

Gear Types

On average over the 2012 to 2021 period, about 56 per cent of total catch volume within the Focus Area was attributed to mobile gear (see Table 2). At the same time, about 80 per cent of total landed value caught was attributed to fixed gear. Within the Focus Area, pots accounted for the highest average annual landed value (see Table 3). Purse seines, Sea cucumber drags, dredges, longlines, bottom otter trawls and gillnets were also used depending on the species targeted. In general, most gear types were used across the Focus Area (see Table 4). Some gear types, such as purse seines and, to a lesser extent, Sea cucumber drags, were used only in some NAFO Unit Areas within the Focus Area (see Appendix A for a NAFO Unit Area map).

Table 2: Average Annual Focus Area Catch by Gear Category, 2012-2021

	Average Annual Catch (t)		
	AOI by Gear	**AOI Total**	**Gear Proportion**
Fixed Gear	9,400	21,200	44%
Mobile Gear	11,800	21,200	56%

Table 3: Average Annual Focus Area Catch and Landed Value by Gear Type, 2012-2021

	Average Annual Catch (t)	Average Annual Landed Value
Pot	4,200	$23,832,000
Purse Seine	2,800	$3,548,800
Sea Cucumber Drag	1,400	$3,164,000
Dredge (boat)	9,100	$3,122,700
Longline	400	$2,284,000
Bottom Otter Trawl (stern)	900	$1,263,700
Gillnet (set or fixed)	1,000	$1,194,300
Tuck Seine	900	$368,700
Other	400	$532,800
Total	**21,200**	**$39,277,000**

Note: Other gear types include Danish seine, shrimp trawl, beach and bar seine and troller lines.

Table 4: Average Annual Focus Area Landed Value by Gear Type and NAFO Unit Area, 2012-2021

	Pot	Purse Seine	Sea Cucumber Drag	Dredge	Longline	Bottom Otter Trawl	Gillnet	Tuck Seine	Other	Total
3PN	$7,500	$3,600	$0	$400	$270,300	$32,500	$300	$0	$100	**$314,800**
3PSA	$22,900	$0	$3,400	$1,900	$284,100	$28,500	$17,900	$0	$2,800	**$361,600**
3PSb	$601,400	$2,700	$8,500	$7,300	$160,300	$0	$159,400	$0	$45,200	**$984,700**
3PSc	$5,218,500	$0	$14,500	$3,800	$5,300	$0	$51,300	$0	$6,500	**$5,299,900**
3PSd	$386,600	$0	$1,458,900	$400,200	$460,300	$91,400	$74,200	$0	$9,400	**$2,881,100**
3PSe	$2,251,000	$0	$186,600	$1,570,400	$138,000	$11,600	$21,900	$0	$800	**$4,180,200**
3PSf	$11,351,200	$0	$137,200	$606,700	$202,900	$53,400	$418,800	$0	$103,500	**$12,873,800**
3Psg	$572,600	$0	$1,564,100	$540,200	$220,000	$166,800	$85,900	$0	$0	**$3,149,600**
3Psh	$1,437,100	$0	$175,600	$10,700	$360,800	$742,700	$183,000	$0	$26,000	**$2,935,900**
4Rb	$348,400	$1,969,500	$0	$0	$75,500	$12,000	$47,500	$66,600	$122,900	**$2,642,300**
4Rc	$890,700	$814,000	$0	$5,000	$64,400	$20,600	$101,000	$219,300	$26,500	**$2,141,700**
4Rd	$744,000	$332,900	$0	$17,200	$41,800	$105,300	$1,000	$82,600	$186,600	**$1,511,300**
Total	**$23,831,900**	**$3,122,700**	**$3,548,800**	**$3,164,000**	**$2,283,600**	**$1,265,000**	**$1,162,200**	**$368,500**	**$530,200**	**$39,277,000**

Note: Other gear types include Danish seine, shrimp trawl, beach and bar seine and troller lines.

Fishing Trends throughout the Year

Between 2012 and 2021, Snow crab was the highest valued georeferenced commercial fishery within the Focus Area. About 82 per cent of total Snow crab landed value was caught in April (43 per cent) and May (39 per cent) with the remainder occurring in June (17 per cent) (see Figure 1). Over half of total Snow crab landed value was caught in NAFO Unit Area 3Psf, while about 25 per cent was caught in 3Psc.

From 2012 to 2021, the Sea cucumber fishery occurred primarily in the summer and early fall with about 26 per cent of the total landed value reported in July, 33 per cent in August and 23 per cent in September. Within the Focus Area, all Sea cucumber catch was located in NAFO Division 3Ps. NAFO Unit Areas 3Psd and 3Psg each accounted for about 40 per cent of total Sea cucumber landed value.

The scallop fishery within the Focus Area was primarily active in the summer. June (20 per cent), July (29 per cent) and August (32 per cent) accounted for 81 per cent of the total landed value of scallop over the 2012 to 2021 period. About half of total scallop landed value within the Focus Area was attributed to NAFO Unit Area 3Pse. The remaining landed value was caught in NAFO Unit Areas 3Psf (19 per cent), 3Psg (17 per cent) and 3Psd (13 per cent).

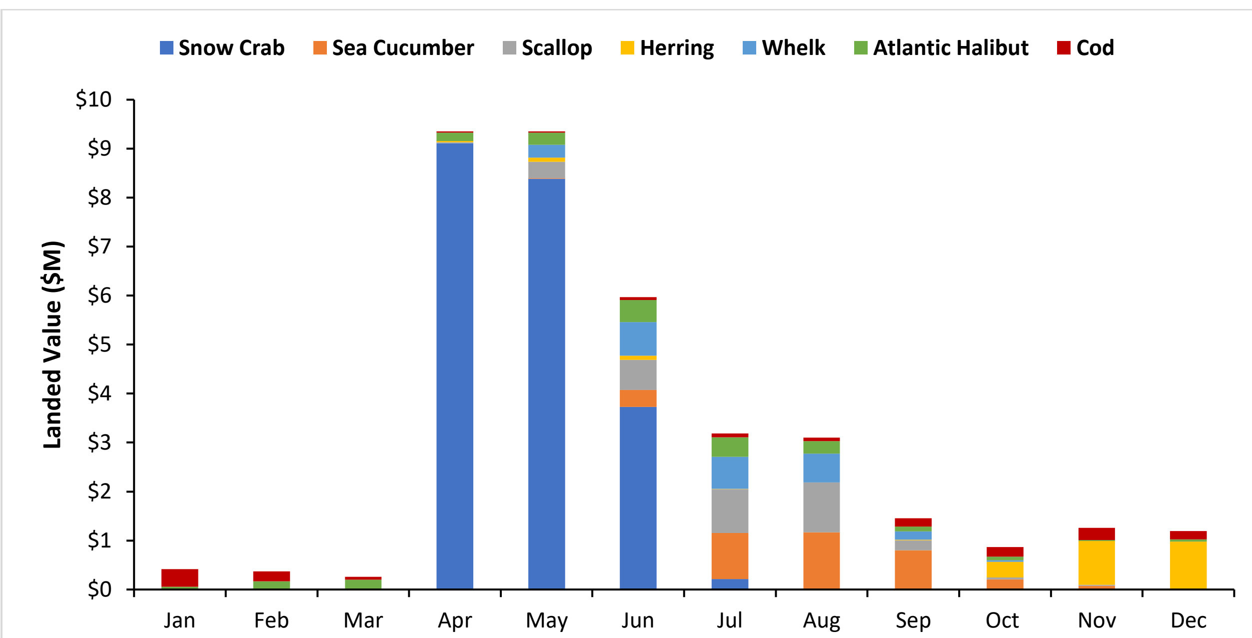
Between 2012 and 2021, about 77 per cent of total herring landed value within the Focus Area was caught in November (37 per cent) and December (40 per cent). Within the Focus Area, virtually all herring catch occurred in NAFO Division 4R. About 68 per cent of herring landed value was attributed to NAFO Unit Area 4Rb. The majority of the remaining landed value was caught in NAFO Unit Areas 4Rc (18 per cent) and 4Rd (13 per cent).

The whelk fishery, located in NAFO Area 3Ps, was active from April to October. Over the 2012 to 2021 period, about 81 per cent of total whelk landed value was caught in June (29 per cent), July (27 per cent) and August (24 per cent). The majority of whelk landed value was caught in NAFO Unit Areas 3Pse (32 per cent), 3Psh (26 per cent), 3Psg (22 per cent) and 3Psf (15 per cent).

Within the Focus Area, Atlantic halibut catch was distributed across the calendar year between 2012 and 2021. The months of June (21 per cent), July (18 per cent), August (12 per cent), May (12 per cent) and March (9 per cent) accounted for over 70 per cent of Atlantic halibut landed value. Atlantic halibut catch was spread across most of the Focus Area. NAFO Unit Areas 3Psd (21 per cent), 3Psh (18 per cent), 3Psa (13 per cent) and 3Pn (10 per cent) accounted for almost two-thirds of Atlantic halibut landed value.

The cod fishery was active from January to December, with the month of January accounting for about 22 per cent of total cod landed value between 2012 and 2021. The months of November (15 per cent), February (12 per cent), October (12 per cent), December (10 per cent) and September (10 per cent) accounted for the majority of remaining cod landed value. Cod catch was recorded in all NAFO Unit Areas within the Focus Area. About 83 per cent of cod landed value was caught in NAFO Unit Areas 3Psh (31 per cent), 3Psf (28 per cent), 3Psg (13 per cent) and 3Psb (11 per cent).

Figure 1: Average Monthly Focus Area Landed Value by Main Species Caught, 2012-2021



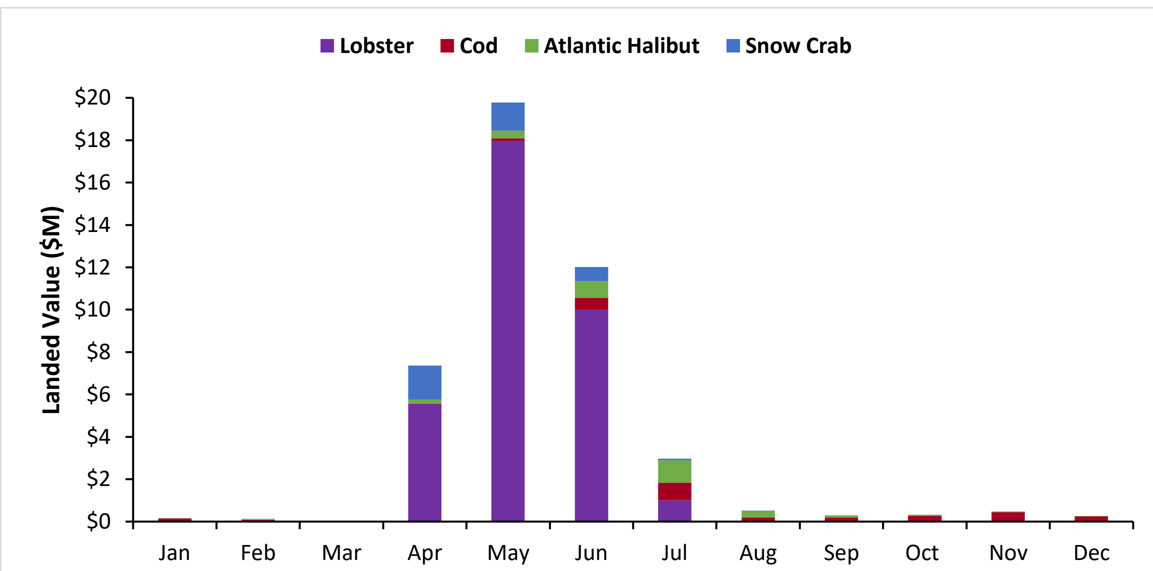
Small Vessel Fishing Activity inside the Focus Area

The above review of commercial fishing activity only considers georeferenced catch within the Focus Area and thus it is mainly focused on larger fishing vessels. However, the fishing activity of smaller vessels also overlaps with the Focus Area. Without georeferenced data it is difficult to determine with absolute certainty that this activity occurred inside the Focus Area. However, given the smaller vessel size, it is assumed that this fishing activity would be in closer proximity to shore and highly likely to be within the Focus Area.

Over the 2012 to 2021 period, this non-georeferenced fishing activity averaged approximately $43 million in annual landed value. Lobster ($34 million), Cod ($2.8 million), Atlantic halibut ($2.7 million) and Snow crab ($2.1 million) accounted for 98 per cent of the average total landed value. Given this, average annual landed value within the Focus Area could be as much as $43 million higher than the georeferenced landed value noted above ($39 million).

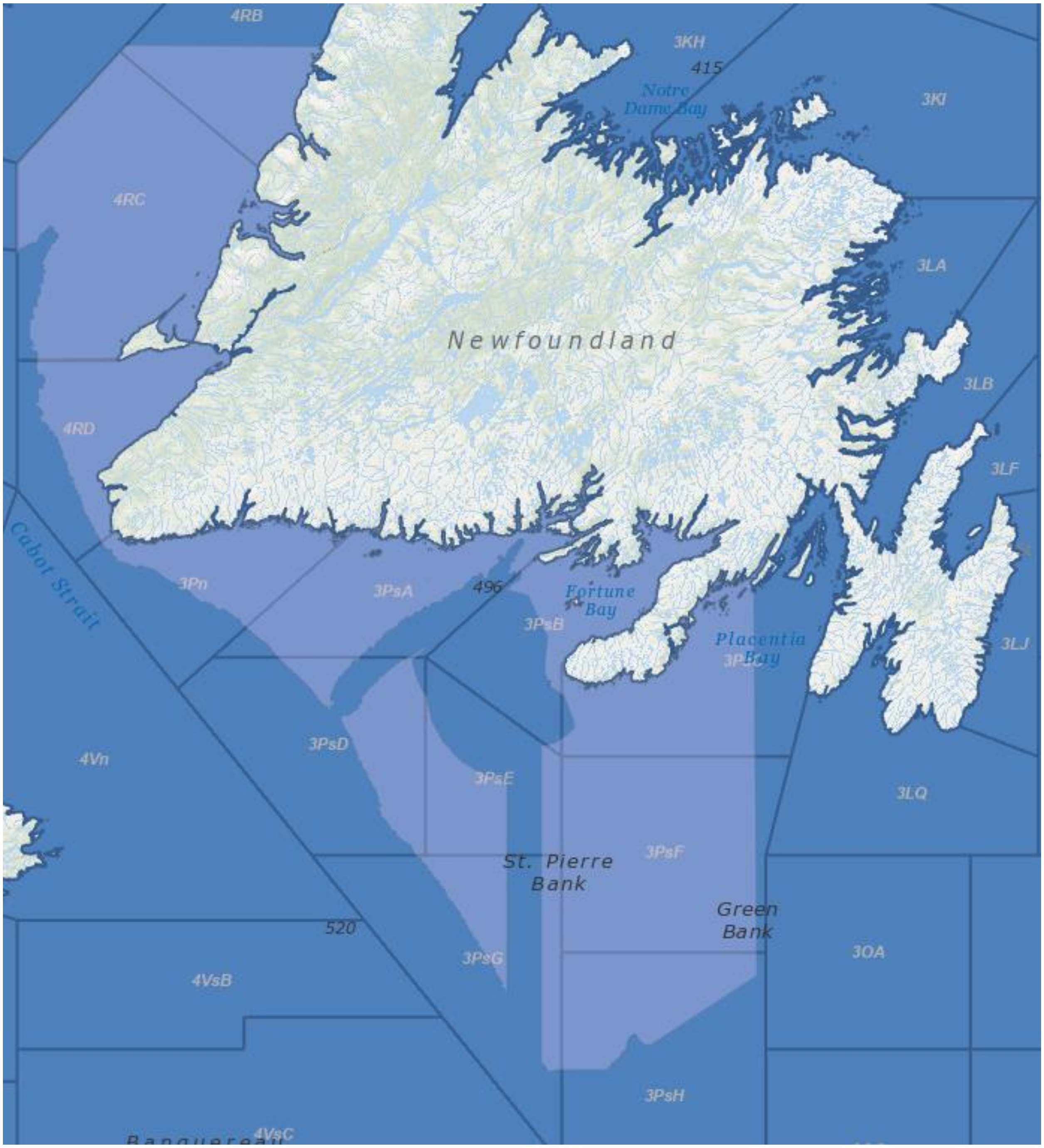
In NAFO Unit Areas that overlap the Focus Area, the lobster fishery was the highest valued fishery for small fishing vessels, accounting for 80 percent of total landed value between 2012 and 2021. Over half of the lobster catch was reported in May, while April (16 per cent) and June (29 per cent) accounted for smaller proportions (see Figure 2). All lobster catch was reported in NAFO Unit Areas located along the coast of the Province, close to shore. On average over the period, NAFO unit areas 3Psb (36 per cent), 4Rc (20 per cent), 4Rd (14 per cent) and 4Rb (14 per cent) accounted for 83 per cent of lobster landed value.

Figure 2: Average Monthly Focus Area Landed Value by Main Species Caught, 2012-2021



Appendix A

Map of Focus Area and NAFO Unit Areas



Newfoundland and Labrador Region Scallop Fishery

NAFO	SFA	Sub-division/Description	Season*	
			Open	Close
RECREATIONAL				
2GHJ, 3KLNOPs,4 R3Pn	1-14	Recreational fishery	Jan	Dec
COMMERCIAL				
3Ps	10	Pont Verde to Red Harbour	Sep	Mar
3Ps	10	Inner Bay (North of 47°25'North)	Sep	Dec
3Ps	10	Outer Bay (South of 47°00'North)	Apr	Dec
3Ps	11	The areas north of a straight line connecting Point Rosie (47 degrees 23 minutes 24 seconds North latitude, 55 degrees 17 minutes 42 seconds West longitude) to the Northwest Head of Brunette Island (47 degrees 15 minutes 49 seconds North, 55 degrees 58 minutes 1 second West) to Pass Island Tickle (47 degrees 30 minutes 21 seconds North, 56 degrees 11 minutes 12 seconds West) in water depths greater than 5 fathoms.	Oct	Dec
3Ps	11	Hermitage Bay and Southest Coast, North of 47 00 N and west of a line drawn from Dantzic Point (46 degrees 59 minutes 32.4 seconds North latitude, 55 degrees 58 minutes 34.8 seconds West longitude) to the Northwest Head of Brunette Island (47 degrees 15 minutes 49 seconds North, 55 degrees 58 minutes 1 second West) to Pass Island Tickle (47 degrees 30 minutes 21 seconds North, 56 degrees 11 minutes 12 seconds West) in water depths greater than 5 fathoms	Oct	Dec
3Ps	11	Outer Bay (South of 47° 00' North), excluding Core Area and North Bed	Apr	Dec
3Ps	11	Core Area - Outer bay (South of 47° 00' North)	May	Dec
3Ps	11	North Bed - Outer bay (South of 47° 00' North)	May	Aug
4R	13	Cape Ray to Cape St. Gregory in water depths greater than 5 fathoms	Jul	Dec
4R	13	Port au Port Bay, Bear Cove Brook Point to Broad Cove Point in water depths greater than 10 fathoms	Aug	Dec
4R	14A North		May	Dec
4R	14A South		May	Dec
4R	14B			

*Season opening and closing dates vary from year to year.

Coastal Water Recreational Fishery Information Newfoundland and Labrador Region
*Subject to changes
Taken from DFO NL webpage: https://www.nfl.dfo-mpo.gc.ca/en/coastal-water-recreational-fishery-information-newfoundland-and-labrador-region

Species that do not require a recreational licence:	Species that require a recreational licence:
Squid: Licence Required: No licence required. Season Dates: Open year round. Authorized gear: Hand held squid jigger. Reels and rollers are permitted; however, the use of mechanical/hydraulic devices to assist with the harvest is not permitted. Limit: There is no bag limit. All incidental catch of groundfish must be released in a manner which causes it the least harm.	Personal Use Seal: Licence Required: Yes, a personal use licence is required, and a licence fee is applied. Apply for a licence online via the National Online Licencing System. Persons obtaining a Personal Use Seal Licence must have: Proof of age (18 or older). A Firearms Safety/Hunter Education Certificate. Proof they have successfully completed a Seal Humane Harvesting information session. Personal Use Seal Licence holders must follow the Marine Mammal Regulations and Conditions of licence. All Sealing activity will be monitored by Fishery Officers.
Mackerel: Licence Required: No licence required. Season Dates: April 1 to December 31. Authorized Gear: Hook and line or angling gear; permitted to fish with a maximum of five lines or with a fishing line with a maximum of six hooks attached. Limit: Possession limit of 20 mackerel in any one day. Size: Minimum retention size 26.8 cm in length. All incidental catch of groundfish must be released in a manner which causes it the least harm.	Scallop: Licence Required: Yes, a recreational licence is required, and a licence fee is applied. Apply for a licence via the National Online Licencing System. Season Dates: January 1 – December 31 Authorized gear: scuba, drag (limited to Scallop Fishing Areas 1, 2, 3, 4, 10 and 11), dip-net, and/or hand rake. The use of mechanical/hydraulic devices to assist with the harvest is not permitted. Daily Limits: Daily limit – 50 scallop, Possession limit – 100 scallops. All incidental catch i.e. lobster, groundfish etc. must be released in a manner which causes it the least harm.
Capelin: Licence Required: No licence required. Season Dates: Open year round. Authorized gear: Hook and line (or angling gear), dip nets, or cast nets are permitted. Limit: There is no bag limit. All incidental catch of groundfish must be released in a manner which causes it the least harm.	Shark: Licence Required: Yes, a recreational licence is required, and a licence fee is applied. Apply for a licence via the National Online Licencing System. Reporting Requirement: Yes Season Dates: April 1 – December 31. Authorized gear: Angling gear. Catch and release only. All incidental catch of groundfish must be released in a manner which causes it the least harm.
Trout Fishery (Coastal Waters): Licence Required: No licence required. Guide Requirements: There are no guide requirements for harvesting in coastal waters. Season Dates: Open year round in coastal waters. All other Trout angling regulations apply in coastal waters, including daily bag limits and possession limits. For further information, please consult the Anglers' Guide. Authorized gear: Angling gear. Daily Limit: Bag limit and size limits - The daily bag limit is 12 fish, which can be a combination of any of these species: Speckled, Brown, Rainbow trout, Ouananiche or 5 lbs. (2.25 kg) round weight + 1 fish of any of these species, whichever is reached first. No Rainbow trout or Ouananiche less than 20 centimeters (8 inches) can be retained. Possession limit: The limit is twice the daily bag limit. All incidental catch of groundfish must be released in a manner which causes it the least harm.	
Smelt (Coastal Waters): Licence Required: No licence required. Guide Required: There are no guide requirements for harvesting in coastal waters. Season Dates: Open year round in coastal waters. All other general angling regulations apply in coastal waters; including, authorized angling gear (angling gear). For further information, please consult the Anglers' Guide. Authorized gear: Angling gear. Limits: No bag limit or possession limit applies.	
Licence Required: No licence required. Season: The season is announced annually in spring with an opening date in July. Authorized gear: Only angling gear and hand-lines, with a maximum of three hooks, are permitted. Hand-lines include artificial lures, baited hooks and feathered hooks. Artificial lures with treble hooks weighing less than five ounces, or 142 grams, are acceptable. Traditional jiggers are not permitted unless they are modified and have only one single hook. Daily Limits: The daily harvest limit is five groundfish per day (including Cod). The maximum boat limit, when three or more people are fishing, is 15 groundfish. Retention of Atlantic halibut, Spotted and Northern wolffish or any species of shark is prohibited. Sculpins and cunners may be released. All other groundfish caught must be retained and are part of the daily bag limit of five (5) groundfish. Areas/seasons 2023: Species and area The recreational groundfish fishery will occur in all NAFO areas/subareas around Newfoundland and Labrador, which includes 2GH, 2J3KL, 3Ps, 3Pn and 4R. Three exceptions are the Eastport, Gilbert Bay and Laurentian Channel Marine Protected Areas (MPA) where recreational groundfish fishing will not be permitted. Summer season: Saturday, July 01, 2023 to Monday, July 03, 2023 Saturday, July 08, 2023 to Monday, July 10, 2023 Saturday, July 15, 2023 to Monday, July 17, 2023 Saturday, July 22, 2023 to Monday, July 24, 2023 Saturday, July 29, 2023 to Monday, July 31, 2023 Saturday, August 05, 2023 to Monday, August 07, 2023 Saturday, August 12, 2023 to Monday, August 14, 2023 Saturday, August 19, 2023 to Monday, August 21, 2023 Saturday, August 26, 2023 to Monday, August 28, 2023 Saturday, September 02, 2023 to Monday, September 04, 2023 Fall season:	

Commercial Fishing Seasons in NAFO 4R3Psn *Subject to changes			
Source - Resource Management and Indigenous Fisheries NL Region	Compiled on: October 2023	Notes: - Only fisheries overlapping the focus area are included - Fishing areas are applicable to relative NAFO zones only, not bound by focus area polygon	
Fishery	Gear Type	Fishing Areas	Fishing Season
Bluefin tuna	angling, rod and reel, tended line	3Ps	June - closes when quota taken (typically by early Fall)
Capelin	trap net	3Psn, 4R	May - August (Season opening based on high percentage of roe bearing females)
Capelin	purse seine	3Psn, 4R	May - August (Season opening based on high percentage of roe bearing females)
Capelin	tuck seine	3Psn, 4R	May - August (Season opening based on high percentage of roe bearing females)
Herring	gillnet, purse seine, bar seine, trap net, tuck seine	3Psn, 4R	April - May August - December (Actual season closing dates vary by fleet and area; subject to quota availaibility / utilization)
Mackerel (moratorium 2022 - present)	bar seine, gillnet, purse seine, trap net, tuck seine	3Psn, 4R	N/A until fishery re-opens
Rock crab	pots	3Psn, 4R	June - October
Snow crab	pots	3Psn, 4R	April - June
Toad crab	pots	3Psn, 4R	May - October
Lobster	pots	3Psn, 4R	April - July
Northern shrimp (Gulf Shrimp)	otter trawl	4R (led by Quebec Region)	Year-round (subject to closure provisions)
Northern shrimp	beam trawl	3Ps	July - December
Scallop	diving	3Ps	August - October
Scallop	drag/dredge	3Ps, 4R	See additional tab - *Scallop Seasons*
Sea cucumber	drag/dredge	3Ps	June - December
Sea urchin	diving	3Psn, 4R	Year-round
Squid	trap, jigger	3Psn, 4R	August - December
Whelk	pots	3Psn, 4R	May - December
Smelt	trap, seine, gillnet, angling gear	4R	Year-round (subject to closure provisions)
Eel (coastal and inland)	Fyke net, pot	3Psn, 4R	June - October
Silver hake (exploratory fishery)	otter trawl, midwater trawl	3Ps	November - December
Winter flounder	gillnet	4R	July to Sept
White hake	longline	3Pn	July to Sept
Amercian plaice	gillnet	4R	July-Septemer
Witch flounder	Danish Seine	3Ps, 4R	April - March (3PS) May - December (4R)
Atlantic cod	handline longline gillnets pots	4R3Pn	July - December
Redfish	otter or midwater trawl	4R3Pn	Year-round (subject to closure provisions)
Atlantic cod	pots gillnets longline otter trawl	3Ps	May - February
Greenland halibut	gillnet	4R	May - October
Winter flounder	gillnet	3Ps	May-March
White hake	gillnets and longline	3Ps	May-March
Skate/monkfish	gillnet otter trawl	3Ps	April-March
Greenland halibut	gillnet	3Ps	May -March
Redfish	otter trawl gillnet	3Ps	July 1 to March 31
Atlantic halibut	longline	3Ps	May - March
Atlantic halibut	longline	3Pn	April- October
Atlantic halibut	longline	4R	June-December

Commercial Fishing Closures in NAFO 4R3Psn within Focus Area for Wind Regional Assessment *Subject to changes					
Source: legal variation orders and conditions of licsnese					
NAFO Area/ Mgmt Area	Area description	Species	Gear Type (if applicable)	Description	Time of Closure
4R	Bay of Islands Annual Salmon Migration Closure	Mackerel (fixed gear)	Gillnets, handlines and/or traps	If you are fishing with gillnets, handlines and/or traps, you are not permitted to fish the inner portion of the Bay of Islands, in the sections known as North Arm, Humber Arm, York Harbour, and Lark Harbour inside and shoreward of a straight line connecting the following points: (1) Crabb Point (49 degrees 14 minutes North, 58 degrees 12 minutes West), to (2) North Arm Point (49 degrees 11 minutes North, 58 degrees 07 minutes West), to (3) Middle Arm Point (49 degrees 08 minutes North, 58 degrees 09 minutes West), to (4) Peter Point, Woods Island (49 degrees 05 minutes North, 58 degrees 10 minutes West), to (5) Shoal Point (49 degrees 04 minutes North, 58 degrees 11 minutes West), to (6) Fleming Point (49 degrees 07 minutes North, 58 degrees 21 minutes West).	June 15 - July 28
4R	Fox Island River Annual Salmon Migration Closure	Mackerel (fixed gear)	Gillnets, handlines and/or traps	Mackerel Fishing Area 13 - that portion of Mackerel Fishing Area 13 near Fox Island River, inside a straight line from Road Point (48°55' N, 58°32' W), north to position 48°43.392' N, 58°39.634' W and the area within one nautical mile seaward of that line. (4R south)	June 15 - July 28
4R	Serpentine River Annual Salmon Migration Closure	Mackerel (fixed gear)	Gillnets, handlines and/or traps	Mackerel Fishing Area 13 - that portion of Mackerel Fishing Area 13 near Serpentine River, inside a straight line from Rope Cove (48°55' N, 58°32' W), north to Coal River Head (48°58' N, 58°31' W) and the area within one nautical mile seaward of that line. (4R south)	June 15 - July 28
4R	Cape Ray to Cape St. George Annual Salmon Migration Closure	Mackerel (fixed gear)	Gillnets, handlines and/or traps	Mackerel Fishing Area 13 - that portion of Mackerel Fishing Area 13 from a line drawn due west of Cape Ray, north to a line drawn due west of Cape St. George	June 15 - July 28
4R	The Arches to Cliffy Point Annual Salmon Migration Closure	Mackerel (fixed gear)	Gillnets, handlines and/or traps	That portion of Mackerel Fishing Area 14 inside a straight line drawn from The Arches (50°06'N; 57°40'W) to Cliffy Point (50°12'N; 57°37'W) and within 1 nautical mile seaward of the line. (4R north)	June 15 - August 1

4R	Bonnne Bay Annual Salmon Migration Closure	Mackerel (fixed gear)	Gillnets, handlines and/or traps	That portion of Mackerel Fishing Area 14 known as Bonne Bay inside a straight line drawn from Western Head (49°33'N; 58°02'W) to Lobster Cove Point (49°36'N; 57°58'W) (4R north) Annual Closure June 15 – August 1 (Salmon Migration Closure)	June 15 - August 1
4R	Bay of Islands Salmon Migration Protection Closure	Herring (fixed gear)	Seines (Barr), gillnets, trap nets	That portion of Herring Fishing Area 13 referenced as the inner portion of the Bay of Islands (North Arm, Humber Arm, York Harbour, and Lark Harbour) inside of a straight line drawn from Crabb Point to North Arm Point to Middle Arm Point to Peter Point, Woods Island to Shoal Point to Fleming Point. (4R south)	Seines (barr) - year-round Gillnets/trap nets - April 1 - Dec 31
4R	Flat Bay Spawning Closure	Herring (fixed gear)	Seines (Barr), gillnets, trap nets	That portion of Herring Fishing Area 13 inside of a straight line drawn from Indian Head, Port Harmon South (48°30'N, 58°31'W; to Harbour Point, Flat Island (48° 27'27'' N, 58°29' 18''W), and includes all of the waters of Flat Bay	Year-round
4R	Bay of Islands Annual Salmon Migration Closure	Capelin (fixed gear)	Seines (Barr), gillnets, trap nets	That portion of Capelin Fishing Area 13, inside of a straight line drawn from Crabb Point (49°14'N, 58°12'W) to North Arm Point (49°11'N, 58°07'W) to Middle Arm Point (49°08'N, 58°09'W) to Peter Point, Woods Island (49°05'N, 58°10'W) to Shoal Point (49°04'N, 58°11'W) to Fleming Point (49°07'N 58°21'W)	Year-round
Lobster Fishing Area 11 (3Ps)	Penguin Islands - Lobster Conservation Area	Lobster	Lobster pots	That portion of Lobster Fishing Area 11 bounded by lines connecting the following points: Point North Latitude West Longitude 1. 47° 22' 01.8" N 57° 01' 01.0" W 2. 47° 23' 48.6" N 57° 01' 01.0" W 3. 47° 23' 53.2" N 57° 56' 54.5" W 4. 47° 22' 01.8" N 57° 56' 54.5" W	Year round

Lobster Fishing Area 13B (4R)	Shoal Point, Outer Bay of Islands - Lobster Conservation Area	Lobster	Lobster pots	That portion of Lobster Fishing Area 13 inside a line near an area known as Shoal Point, Outer Bay of Islands defined by joining the following coordinates in the order they are listed: Point North Latitude West Longitude 1. 49° 19' 42.2112" N 58° 14' 40.8804" W 2. 49° 19' 26.1696" N 58° 14' 50.9892" W 3. 49° 19' 20.1828" N 58° 14' 44.0520" W 4. 49° 19' 43.1292" N 58° 14' 32.4024" W	Year round
Lobster Fishing Area 14A (4R)	Trout River Bay - Lobster Conservation Area	Lobster	Lobster pots	That portion of Lobster Fishing Area 14 near an area known as Trout River Bay defined by straight lines drawn from shore at East Point position 49° 29' 25.6020" N 58° 07' 40.4508" W hence to West Point position 49° 28' 59.4552" N 58° 07' 58.2168" W	Year round
Scallop Fishing Area 11 (3Psn)		Scallop (Lobster Protected Area)		That portion of Scallop Fishing Area 11 bound by straight lines drawn between the following coordinates: 47°11’24” North, 55°27’36” West (White Point) to 47°12’36” North, 55°29’24” seconds West to 47°06’00” North, 55°51’00” West to 47°04’48” North, 55°51’00” West.	Year round
Scallop Fishing Area 11 (3Psn)	White Point to Point Rosie	Scallop (Lobster Protected Area)	Scallop Gear	That portion of Scallop Fishing Area 11, bounded by a line connecting the following coordinates: 47°11’24” North, 55°27’36” West (White Point) to 47°12’36” North, 55°29’24” seconds West to 47°24’00” North, 55°19’48” West to 47°23’24” North, 55°17’24” West (Point Rosie)	Year round w/exception of dive-only fishery from August - Oct (dates can vary slightly)
Scallop Fishing Area 11 (3Psn)	White Point	Scallop (Lobster Protected Area)	Scallop Gear	That portion of Scallop Fishing Area 11 bound by straight lines drawn between the following coordinates: 47°11’24” North, 55°27’36” West (White Point) to 47°12’36” North, 55°29’24” seconds West to 47°06’00” North, 55°51’00” West to 47°04’48” North, 55°51’00” West	Year round w/exception of dive-only fishery from August - Oct (dates can vary slightly)
Scallop Fishing Area 13	Cape Ray to Cape St. George	Scallop (Lobster Protected Area)	Scallop Gear	That portion of Scallop Fishing Area 13 from Cape Ray, north to Cape St. George in water depths less than 5 fathoms	Year round

Scallop Fishing Area 13 (4R)	Port au Port Bay from Bear Cove Brook Point	Scallop (Lobster Protected Area)	Scallop Gear	That portion of Scallop Fishing Area 13, inside Port au Port Bay from Bear Cove Brook Point (48 degrees 43 minutes 37 seconds North, 58 degrees 39 minutes 38 seconds West) to Broad Cove Point (48 degrees 45 minutes North, 58 degrees 39 minutes West), in water depths less than 5 fathoms.	Year round
3Ps c	Bakers Cove to Brimstone Head	All groundfish species	All groundfish gear	That portion of 3Ps(c) inside lines drawn between the following coordinates: Point North Latitude West Longitude 1) 47º49.747'N 54º07.386'W 2) 47º49.265'N 54º08.053'W	January 1 to February 28
3Ps c	Sound Island Point to Tobin's Point	All groundfish species	All groundfish gear	That portion of 3Ps(c) inside lines drawn between the following coordinates: 1) 47º47.322'N 54º10.033'W 2) 47º42.825'N 54º12.376'W	January 1 to February 28
3Ps c	The southern tip of Bar Haven Island to the southern tip of Ship Island	All groundfish species	All groundfish gear	That portion of 3Ps(c) inside lines drawn between the following coordinates: Point North Latitude West Longitude 1) 47º40.923'N 54º14.937'W 2) 47º40.342'N 54º16.967'W	January 1 to February 28
3Ps c	Paradise Sound	All groundfish species	All groundfish gear	That portion of 3Ps(c) north of a straight line defined by joining the following coordinates: Point North Latitude West Longitude 1) 47°29.350'N 54°29.953'W 2) 47°29.657'N 54°31.100'W	January 1 to February 28
3Ps c	Ship Island Ship Island to Jigging Point	All groundfish species	All groundfish gear	That portion of 3Ps(c) inside lines drawn between the following coordinates Point North Latitude West Longitude 1) 47º40.342'N 54º16.967'W 2) 47º40.342'N 54º19.128'W	January 1 to February 28
3Ps	Cod closure	Cod	Cod directed gear	For 3Ps cod, there is a mixing closure in 3Ps units d and e from November 15 to mid-May for all fleets, and a spawning closure in all of 3Ps from March 1 to mid-May, in which the directed 3Ps cod fishery is closed to all fleets during this period.	3Ps de - November 15 - mid-May All 3Ps March 1 - mid-may
4R 3Pn	Redfish closure	Unit 1 Redfish	Redfish directed gear	For Unit 1 redfish, there is an annual mating closure from Nov 1 – March 31 and an annual spawning closure from April 1 to June 15 in 4RST and 3Pn. Unit 1 index fishery is closed to all fleets during this period.	Annual mating closure from Nov 1 – March 31 Annual spawning closure from April 1 to June 15

4R	Bay St. George Spring Spawner Area	Herring (mobile gear)	All herring mobile gear	That portion of Herring Fishing Area 13 (Bay St. George) inside of the 50 fathom contour, from a line drawn from Cape Ray to Cape St. George (4R south)	Year-round
4R	Port au Port Bay Spring Spawner Area	Herring (mobile gear)	All herring mobile gear	That portion of Herring Fishing Area 13 (Port au Port Bay) inside of a line drawn from Long Point, Port au Port Peninsula to Bluff Head (4R south)	Year-round
3Psn	Redfish closure	Unit 2 Redfish	Redfish directed gear	Annual spawning closure in which the Unit 2 redfish fishery is closed to all fleets during this period (except for 3Pn portion of Unit 2 which is closed to July 14 due to mixing).	April 1 - June 30 (July 14)
3Pn		Herring Bait		For the protection of migrating salmon, the following areas are closed to fishing Herring for bait purposes: (1) that portion of Herring Fishing Area 12 defined as follows: Channel – Port aux Basques area: inside a line drawn from the breakwater near Graveyard Point (47° 34' 23.56" N, 59° 7' 45.66" W) to Channel Head Lighthouse (47° 33' 59.96 " N, 59° 7' 18.97" W), and outside of a straight line drawn from Point 1 at shore (47° 34' 1.67" N, 59° 7' 29.33" W) and Point 2 at Channel Head Island (47° 33' 59.14" N, 59° 7' 26.64" W). (2) That portion of Herring Fishing Area 12, known as Shark Cove, defined as follows: Shark Cove area (near Harbour LeCou): inside a line drawn from Shark Cove North (47° 37' 35.83" N, 58° 40' 8.68" W) to Shark Cove South (47° 37' 31.17" N, 58° 39' 52.62" W).	Year round

3Ps	St. Pierre Bank	Sea Cucumber (Commercial	Drag	The following areas are closed to Sea cucumber fishing: (a) That portion of St. Pierre Bank lying west of 56 degrees 28 minutes West longitude, the Western Cucumber Area.	Year round
4R	Bay St. Georges and Port au Port Bay	All groundfish species	All groundfish gear	That portion of NAFO Division 4R near the entrance to Bay St. Georges and Port au Port Bay defined by straight lines drawn from the following coordinates: Point North Latitude West Longitude 1) 48°15'N 59°20'W 2) 49°10'N 59°20'W 3) 49°10'N 60°00'W 4) 48°15'N 60°00'W 5) 48°15'N 59°20'W	April 1 to June 23

Commercial Fishing Closures in NAFO 4R3Psn within Focus Area for Wind Regional Assessment *Subject to changes			
Source	**Regulation**	**Restrictions**	**Coordinates**
Oceans Act	Laurentian Channel Marine Protected Area Regulations	Recreational and commercial fishing, and oil and gas exploration and exploitation are prohibited in all zones of the MPA.	NAFO Division 3Ps that portion known as the Laurentian Channel Marine Protected Area. The Laurentian Channel Marine Protected Area is the area inside the following coordinates: 1. 47°06'05.270" 58°45'09.104" 2. 46°55'59.583" 58°27'46.773" 3. 47°01'27.019" 58°04'18.592" 4. 46°57'06.280" 57°58'59.727" 5. 46°44'26.696" 57°50'48.213" 6. 46°38'57.713" 57°43'44.706" 7. 46°39'18.058" 57°37'07.416" 8. (approx) 45°20'19.6" ± 56°24'07.2" ± 9. (approx) 44°59'49.1" ± 56°24'04.6" ±

Commercial Fishing Closures in NAFO 4R3Psn within Focus Area for Wind Regional Assessment
***Subject to changes**

Source: Atlantic Fishery Regs

Section	Page #	Schedule	Item #	Word Description	Area	Gear Type	Time of Closure	Species
Pelagics	20		42	No person shall fish for herring in the waters of St. Paul's Inlet in Herring Fishing Area 14 lying inside of the Highway 430 bridge during the period beginning on February 1 and ending on December 31.	14 (4R)	Any gear	Feb 1 - Dec 31	Herring
Miscellaneous Provisions	50		113	During the period April 15 to December 31, no per son shall fish with a gill net or trap net in that portion of Pistolet Bay, Newfoundland and Labrador inside a straight line joining Latitude 51°33′06″N., Longitude 55°45′W., (Blackberry Point) to Latitude 51°33′08″N., Longitude 55°52′19″W., (Forest Point).	4R	Gill net and Trap net	April 15 - Dec 31	
Waters Closed To Herring Fishing with Mobile Gear	99	SCHEDULE VIII	18	Waters of Fortune Bay, Newfoundland and Labrador in Herring Fishing Area 11 lying inside of a straight line joining Latitude 47°34′59″N., Longitude 55°05′10″W. (Faria Head) to Latitude 47°30′01″N., Longitude 55°02′12″W. (Big Head).	3Ps	Mobile gear	UNK	Herring
Waters Closed to Fishing for Groundfish	182	SCHEDULE XXIV	21	The waters within 55 m of the shore in that part of St. George's Bay, Newfoundland and Labrador inside of a straight line joining Latitude 48°08′30″N., Longitude 58°57′26″W. (Shoal Point) to Latitude 48°33′25″N., Longitude 58°43′12″W. (Gravels).	4R	trap nets	Jan 1 - Dec 31	Groundfish
Waters Closed to Fishing for Groundfish	182	SCHEDULE XXIV	22	The waters of the Bay of Islands, Newfoundland and Labrador enclosed by the coastline and a line joining Latitude 49°06′N., Longitude 58°21′W. (Tortoise Point) to Latitude 49°04′N., Longitude 58°11′W. (Shoal Point), thence to Latitude 49°08′N., Longitude 58°09′W. (Middle Arm Point), thence to Latitude 49°11′N., Longitude 58°07′W. (North Arm Point), and thence to Latitude 49°14′N., Longitude 58°12′W. (Crab Point).	4R	Trap nets	April 15 - Sept 15	Groundfish
Waters in Which Otter Trawl Fishing is Prohibited	196	SCHEDULE XXXI	31	The waters of Sacred Bay, Newfoundland and Labrador inside a line commencing at Latitude 51°36′52″N., Longitude 55°37′48″W. (Cape Onion), thence to Latitude 51°38′46″N., Longitude 55°34′24″N. (Great Sacred Island), thence to Latitude 51°38′30″N., Longitude 55°25′42″W. (Cape Bauld), thence south along the shore of Quirpon Island to Latitude 51°36′30″N., Longitude 55°27′24″W. (Dumenil Point), and thence to Latitude 51°36′03″N., Longitude 55°28′15″W. (Noddy Point)	4R	Otter trawl	Jan 1 - Dec 31	

Notes on Use of 'Clipped_Data.gdb.zip'

These datasets contain Community-based Coastal Resource Inventory (CCRI), Commercial Fishing by Gear Type and Commercial Fishing by Species data that appears within the Focus Area. The data has been clipped to the area of interest polygon. The Commercial Fishing data is a subset of the Eastern Canada Commercial Fishing 2012 – 2021 dataset found on Open Data ([Eastern Canada Commercial Fishing - Open Government Portal]). It is important to note that all commercial data should be viewed with a quantile based symbology. When displayed in quantiles, the data will appear differently than how it appears on the atlas and on open data, as all hexagons are measured relative to all others in the geographic scope of the data. Viewing the data in this way still provides a good indication of where targeted fishing is taking place. We advise viewing this data in both the clipped and unclipped version to fully appreciate what is happening inside and outside of the Focus Area.

There are some data layers where data appeared within the Focus Area but remain privacy screened, as such the data was not included.

These species include:

- Cusk
- Crab (other)
- Flounder (other)
- Tuna (other)
- Swordfish
- Yellowtail Flounder

These gear types include:

- Danish/Scottish Seine
- Harpoon and Spear
- Longline (Pelagic)
- Trap Gear (All Types)
- Trap Net

Also, please see information regarding the CCRI below. Since much of the inshore fishery is non-georeferenced, this is a valuable resource used to evaluate where resource use is occurring in the inshore of the province.

Updating the Community-based Coastal Resource Inventory

In 1996 DFO began a series of projects referred to as the Community-based Coastal Resource Inventory (CCRI). This was an initiative designed to collect local ecological knowledge from communities along the coast of the DFO NL region, and over the period of 1996 to 2007 the entire coastline of Newfoundland and Labrador was surveyed through 23 individual projects. This information was gathered through an interview process with both the data contributors and interviewers being local community members.

The primary focus of these CCRI projects were marine-based resource information including traditional fishing areas and species. General themes surveyed included, groundfish, pelagics, shellfish, marine mammals, birds, aquatic plants, infrastructure and culture-tourism-recreation.

Data collected since 1996 has proved invaluable to many sectors of DFO, other federal and provincial government departments and agencies as well as academia and private consultants and Environmental

Non-Governmental Organizations (ENGOs). With the passage of time questions have been asked regarding the potential of updating the information in the CCRI.