



Final Technical Report of the Nova Scotia aquaculture Coastal Classification System

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1 Introduction

This Final Technical Report presents the results and outputs of the project “The Development of a Coastal Classification System Decision-Support Tool”. The aquaculture Coastal Classification System (CCS) is a province-wide assessment of the suitability of coastal waters for marine grow-out of aquaculture developed as an online web-based mapping platform.

1.1 Aquaculture in Nova Scotia

Aquaculture, the farming of fish, shellfish, and aquatic plants, is a key part of Nova Scotia’s economy¹. In 2023, the sector employed nearly 800 people and contributed \$120 million to the provincial economy². This marks a roughly 2-fold increase in reported value over the last ten years. In 2023, four species collectively accounted for 95% of the total value of the sector in the province: Atlantic salmon (*Salmo salar*), Rainbow trout (*Oncorhynchus mykiss*), Blue mussels (*Mytilus edulis*), and American oyster (*Crassostrea virginica*). As global demand for seafood increases, Nova Scotia is well-positioned to grow the sector responsibly and sustainably.

1.2 Assessing suitability for aquaculture

Determining the suitability of areas is critical for the sustainable development of aquaculture. Aquaculture cannot occur everywhere along the coast since there is a range of environmental, regulatory, and human use factors and considerations that influence the suitability for aquaculture.

In Canada, most suitability assessments are completed at the site-scale level during the application processes, involving a thorough review of a range of criteria (e.g. [DFO 2025](#)). Various criteria are often reviewed individually but then considered collectively to inform recommendations and license and lease decisions. These site level reviews are comprehensive and rely on high-resolution data or complex models that consider proposed operations and engagement with the communities and rights-holders of interest.

In recent years, proactive assessments have become part of aquaculture strategies globally to guide where new development or expansion of industry production is possible. Compared to site-level assessments, assessments that spatially explore suitability at regional, sub-national, or national levels can provide information to guide strategic proactive planning for industry expansion, support conversations around conflict resolution, or enhance stakeholder engagement.

These assessments also can help guide aquaculture towards an integrative Ecosystem Approach to Aquaculture (Aguilar-Manjarrez et al., 2017), or similar concepts such as Integrated Coastal Zone Management principles and efforts towards Marine Spatial Planning, which require a baseline suitability understanding of a given region (Stelzenmüller et al., 2017; Morris et al., 2025).

¹ In 2023, the sector reported 16 different species of finfish, shellfish, and marine plants

² [Aquaculture statistics - Government of Nova Scotia, Canada](#)

In this context, many studies have applied a combination of Geographic Information System (GIS) and multi-criteria decision analysis (MCDA) to identify potentially suitable locations for aquaculture, by aggregating various spatial layers to produce a single integrative suitability layer (Chentouf et al., 2023). Other more specialized approaches have included scenario analysis to identify priority areas based on potential development options (Venier et al., 2021), co-occurrence mapping to identify the least conflict user space (Tlusty et al., 2018), or through Bayesian Belief Networks to analyze conflict between aquaculture and other users (Coccoli et al., 2018).

In Nova Scotia, several suitability assessments have been completed; however, many of which were conducted over 20 years ago³. Recently, some area-based suitability assessments have focused on specific inlets or bays for individual species. For example, in 2018, the Nova Scotia Community College's Applied Geomatics Research Group (NSCC-AGRG) performed a suitability assessment to assist Fisheries and Oceans Canada (DFO) with oyster aquaculture development decision-making in Little Harbour (Applied Geomatics Research Group, 2018). The results of the analysis, as well as supporting data layers, were integrated on a [web-based mapping platform](#).

In 2024, Nova Scotia released its first Aquaculture Development Area in the Municipality of the District of Argyle following a bay-level suitability assessment (Nova Scotia Department of Fisheries and Aquaculture, 2024). This process was based on Marine Spatial Planning principles and involved spatial suitability assessment with wide-ranging stakeholder engagement. A total of 784 hectares of marine space were identified for potential aquaculture development, considering environmental, social, and cultural information and consultation with stakeholders.

At the provincial-wide scale, previous suitability assessments have not been done since 2009. Stantec (2009) identified some preliminary siting criteria to assess suitability in their *A Road Map for Investment in Aquaculture in Nova Scotia* report. This report also provided high-level suitability estimations across various aquaculture zones, but it was not a detailed assessment using geographic specific data.

1.3 Developing an aquaculture Coastal Classification System

The importance of proper site selection for marine aquaculture was also highlighted in the *2014 Final Report of the Independent Aquaculture Regulatory Review for Nova Scotia*, commonly known as the "Doelle-Lahey report." The Doelle Lahey report recommended developing a Coastal Classification System for marine finfish aquaculture (Doelle and Lahey, 2014). In response, the Premier of Nova Scotia directed the Minister of Fisheries and Aquaculture in 2021 to create a system that would rate coastal areas based on their suitability for finfish aquaculture. In January of 2024, the project scope was expanded to include shellfish.

Suitability assessments can help guide strategic and development decisions by government and industry by providing a critical baseline understanding of an area's suitability, through aggregation and analysis of important information to guide planning decisions. While relevant

³ For a review of some of the early studies, see Stantec (2009)

data and information to inform siting exist for select coastal regions, there has been no province-wide tool that brings together environmental, regulatory, and marine-use considerations to support early planning.

To address this gap, the Nova Scotia Government developed the aquaculture CCS, a mapping tool that provides a consistent, province-wide view of how suitable different coastal areas may be for aquaculture development. To support the development of the CCS, the Centre for Marine Applied Research (CMAR) was contracted to complete suitability assessments and develop the online decision-support tool.

The initial development phase of the project ran between 2022 – 2025 and included several key objectives:

1. Complete broad (high-level) assessments to explore potential suitability of Nova Scotia's coastal waters for four types of aquaculture development;
2. Create an accessible platform containing information associated with aquaculture development; and
3. Identify general issues and help guide future research and data collection needed to support industry development.

1.4 CCS Outputs and Uses

The outputs of the project include suitability assessments and data layers integrated onto an online mapping tool, made available through the Government of Nova Scotia website. The tool provides a province-wide view to support early conversations about marine areas that may present more or fewer challenges for aquaculture. It is designed for a wide range of users, including the public, planners, and industry representatives. It brings together environmental and regulatory information in one accessible place.

The CCS is designed as an informational decision-support tool. It is meant to provide information to support early-stage exploration and provide regional context. It does not assess individual sites and is not used to make regulatory decisions. Decisions related to marine aquaculture sites – as per the *Aquaculture Licence and Lease Regulations* must still consider a range of site-specific environmental, regulatory, social, and cultural factors.

1.5 Report purpose and structure

This report provides a technical overview of the high-level suitability assessments for the CCS and reports on the development of the supporting mapping tool. It is designed as CMAR's final report, providing further technical detail to supplement the *Public Summary Report* and other documentation available on the [Government of Nova Scotia's CCS website](#).

This report serves as a detailed technical description of the background and methodology employed to produce the final suitability ratings and accompanying decision-support tool ([Section 2](#)). This report also details the complete list of criteria included, and how they were scored

for inclusion in the assessment (**Section 3**). The results of the assessments are presented in **Section 4**, offering a regional perspective on suitability findings across various aquaculture zones in Nova Scotia. Herein, a discussion on the project findings is also presented, considering the limitations and the intended or potential uses of the outputs, as well as how the findings may support wider future planning in Nova Scotia, or beyond (**Section 5**). The report concludes with recommendations (**Section 6**) for the Nova Scotia Department of Fisheries and Aquaculture as per the maintenance of the tool, as well as recommendations for next steps in data collection and broader long-term advancements in the tool. Attached **Appendices** are included and provide additional details, including the following:

- **Appendix I** – Data Committee membership list
- **Appendix II** – Criteria evaluations to guide selection
- **Appendix III** – Criteria descriptions and scoring
- **Appendix IV** – Accessibility audit report (Pisces Ltd.)
- **Appendix V** – User testing report (Pisces Ltd.)
- **Appendix VI** – Suitability data and statistics

2 Methodology

2.1 General approach – A spatial suitability assessment

To evaluate the overall potential for aquaculture development in Nova Scotia, CMAR applied a spatial suitability assessment (SSA), a geographic information system (GIS)-based process to designate and / or classify an area(s) with a given ranking based on the suitability of desired criteria to meet multiple objectives. These suitability assessments also drew on techniques and methods from multicriteria decision analysis (MCDA) (Malczewski and Rinner, 2015), which aim to take explicit account of multiple diverse criteria in structuring complex problems with multiple and often varying considerations (Belton and Stewart, 2002), such as aquaculture suitability.

Coupling GIS with MCDA techniques (GIS-MCDA) provides a powerful platform for resolving complex problems involving spatial data, and is becoming a well-established approach applied across a variety of planning and management situations, including aquaculture (Malczewski and Rinner, 2015; Silverthorn et al., 2025). Fundamentally, GIS-MCDA is a procedure that combines quantitative geographic data with decision-makers (experts and / or agents) preferences into a decision (output) map, and in the case of SSA, a suitability map (see **Figure 1** for a general process flow). The procedures and processes throughout this assessment were guided by consultation and feedback in collaboration with NSDFA, network partners (i.e., Fisheries and Oceans Canada (DFO)), and subject-matter experts, brought together as part of advisory committees established under the CCS project (**Appendix I**). The Nova Scotia Aquaculture Science Advisory Committee

(NSASAC)⁴ conducted the final technical review and validation of all the decisions and assumptions made during the development of the CCS.

GIS-MCDA allows for the calculation of the combined suitability of a range of criteria by standardizing criteria to a comparable scale based on suitability thresholds and characteristics, as established through scientific literature and expert advice. Suitability can thus be calculated across multiple cells within a larger area (i.e., grid), which can effectively be mapped and analyzed using GIS software.

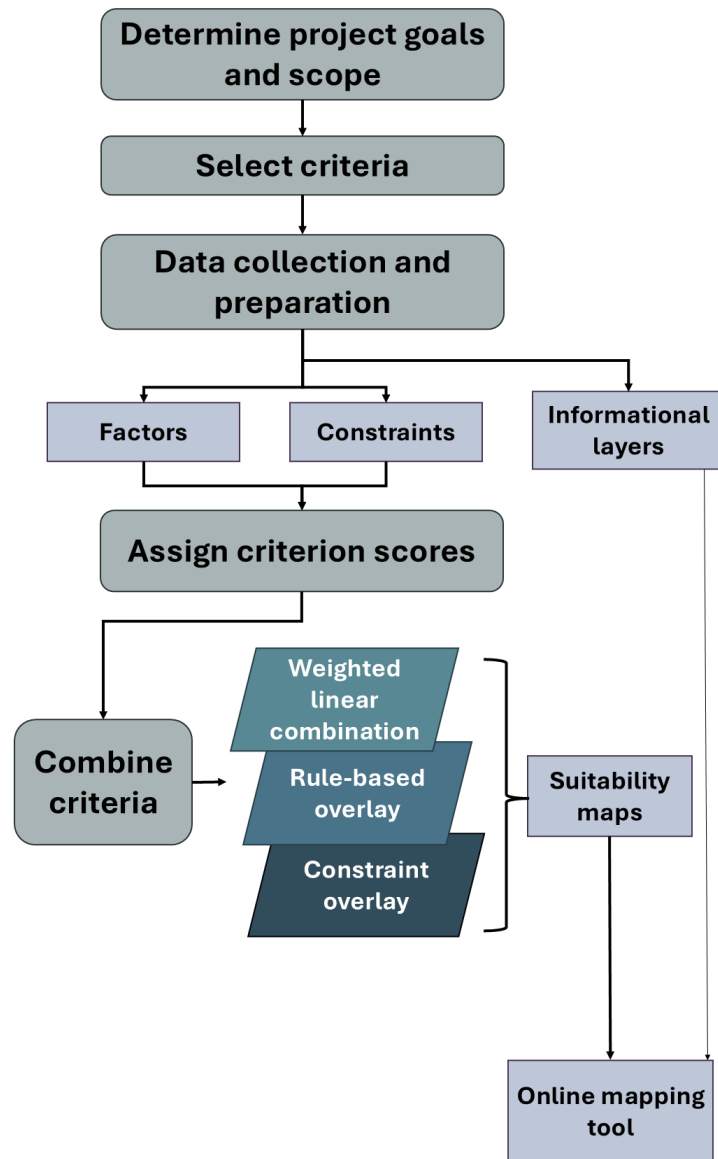


Figure 1. Process flowchart outlining key decisions, methods, and outputs involved in the suitability assessments in support of the aquaculture Coastal Classification System (CCS).

⁴ The NSASAC includes experts in scientific fields related to aquaculture regulations and provides science-based recommendations to Nova Scotia’s Minister of Fisheries and Aquaculture. Member details can be found on the [NSDFA Website](#).

2.1.1 Suitability assessments in other jurisdictions

The use of GIS-MCDA techniques for suitability assessment in aquaculture applications has steadily grown in the past 15 years to inform site selection, planning, and management around the world (Chentouf et al., 2023; Silverthorn et al., 2025). Previous assessments have explored suitability for different engineering considerations (Falconer et al., 2013), or under different development scenarios (Porporato et al., 2020). Other applications have applied similar methods to inform the selection and development of aquaculture zones (Brigolin et al., 2017; Morris et al., 2021; Yakubu et al., 2024). In some cases, suitability assessments have been used to support multi-sectoral planning in aquaculture, to identify synergies with other marine activities (Stelzenmüller et al., 2013; Gimpel et al., 2015) and evaluate multi-use considerations in the broader context of marine spatial planning (Gimpel et al., 2018). Recently, the data and findings from suitability assessments have also been integrated into decision support tools to support for efficient, transparent, and responsible planning⁵.

2.2 Project scope

The project was established to support the development of a Coastal Classification System for aquaculture in Nova Scotia. This involved a province-wide assessment to identify general opportunities or challenges for year-round marine aquaculture across Nova Scotia's coastal waters.

2.2.1 What species were assessed?

This assessment focused on year-round marine grow-out aquaculture for the most commonly farmed species in Nova Scotia, based on current aquaculture practices. In 2023, four species collectively accounted for 95% of the total value of the sector in Nova Scotia: Atlantic salmon (*Salmo salar*), Rainbow trout (*Oncorhynchus mykiss*), Blue mussels (*Mytilus edulis*), and the suspended culture of American oyster (*Crassostrea virginica*) (Figure 2).

⁵ For an example, see the Nature Conservancy and the government of Palau's [interactive mapping tool](#).

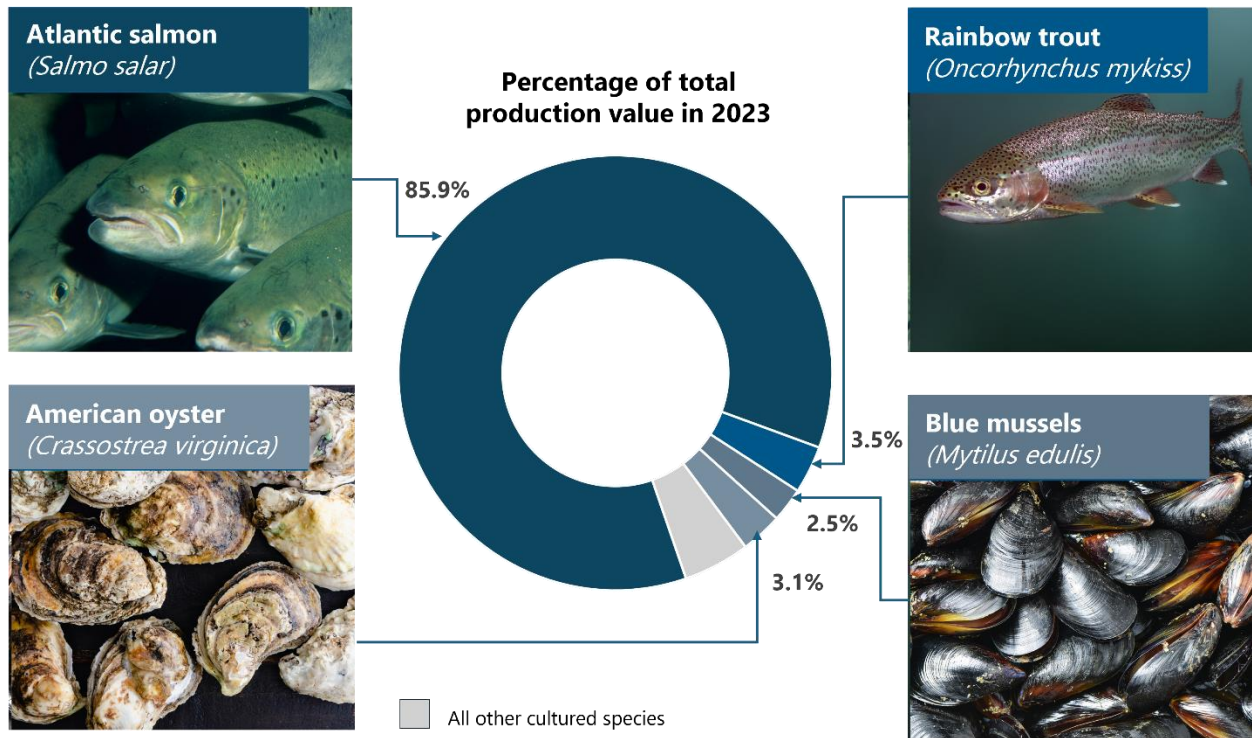


Figure 2. Species included in the aquaculture Coastal Classification System, and their contribution to the total value of the sector in Nova Scotia in 2023⁶.

This assessment and results are applicable only in consideration of established technologies, management practices, and procedures that are presently used and widely adopted within Nova Scotia. Practices and operations in other jurisdictions are used only to inform generalized scientific justification of thresholds⁷. This allows for considerations and outputs to be relevant and useful to the current state of the industry in this region. This assessment does not apply to experimental approaches, emerging technologies, and innovations, nor does it assume region-specific practices that have not been widely adopted. For example, outputs are not applicable to Integrated Multi-Trophic Aquaculture (IMTA) or marine-based closed containment culture systems. Emerging technologies like growing genetically modified organisms (GMOs) and stocking triploid fish are also not considered. Some practices, including the voluntary submerging of shellfish cages and longlines in winter, are widespread in Nova Scotia and are considered when exploring suitability. In the assessment, we do not presume any size or configuration of potential farms, nor do we assume specific mitigation practices in place. These considerations would be highly operation- and site-specific, depending on specific proposed developments.

⁶ See [Nova Scotia Aquaculture Statistics](#)

⁷ Where, as determined, scientific assessment or experiences from other areas can be seen to be comparable to Nova Scotian contexts.

Atlantic salmon

The culture of Atlantic salmon (*Salmo salar*) represents a large portion of the total economic production value of aquaculture in Nova Scotia. In 2023, 85.86% of the total production value of aquaculture in the province came from the culture of Atlantic salmon⁸. Existing sites are predominantly focused along the South Shore and within St. Mary's Bay and along the outer Bay of Fundy. In the marine environment, salmon are grown in floating cages placed in cool, well-flushed, oxygenated waters for optimal growth. Fish spend around 18 months in flexible floating marine cages, where they grow to harvestable size typically around 5 kg.

Rainbow trout

The culture of Rainbow trout (*Oncorhynchus mykiss*) can be done in both freshwater and saltwater environments (are also known as Steelhead trout when grown in seawater). However, the marine culture of trout is primarily focused within the tidally influenced Bras D'Or Lakes region, in Cape Breton, as well as within the South Shore. In marine waters, rainbow trout are cultured in cages and typically have a 9-18 month grow out period, before being harvested at around 1-3 kg.

Blue mussels

In Nova Scotia, Blue mussels (*Mytilus edulis*) are primarily cultured in the water column on ropes (longlines) suspended in the water column by surface buoys. Longlines can measure between 100 – 200 metres in length and can typically be sunk to depth in winter to avoid sea surface ice. Mature wild oyster seed is generally placed inside polyethylene 'socks' measuring up to 2-3 metres, which are hung from the longlines. Blue mussels grow on these socks for 15 to 24 months, depending on location, water temperature, and the prevalence of plankton for their diet. The average market-size Blue mussel is harvested when it reaches between 5.5 to 6 centimetres.

American oyster

The American oyster (*Crassostrea virginica*), also known as the Eastern or Atlantic oyster, is one of the main shellfish species cultured in Atlantic Canada. In Nova Scotia, oysters are primarily grown in warm, shallow bays and estuaries along the Gulf of St. Lawrence, and within parts of Cape Breton's Bras D'Or Lakes⁹. In 2023, culture of oysters was valued at just over \$3.7 million¹⁰ (3.1% of the total value of the sector). Historically, the industry employed 'on-bottom' culture practices, although most producers have shifted towards 'off-bottom' culture using cages or bags suspended in the water column. Off-bottom culture practices allow for easier access for producers

⁸ See [Nova Scotia Aquaculture Statistics](#)

⁹ Although, the sector has diminished in recent years due to high mortality from MSX

¹⁰ See [Nova Scotia Aquaculture Statistics](#)

and has been associated with reduced predation from benthic predators, and overall increased growth rates and overall yield. In addition, suspended culture practices allow for gear to be submerged within the water column to avoid risks from drifting winter ice. Oysters typically take an average of two to three years to reach marketable size but can take as long as seven years in some areas.

2.2.2 A broad-scale assessment for decision-support

This assessment seeks to assess the potential for aquaculture development at a broad, province-wide scale. At this scale, assessments are designed to explore suitability across a large geographic region, often consisting of multiple bays or areas. At this level of analysis, the assessment aims to capture key considerations that would either constrain and / or limit the culture of species or factors that growers would need to address or account for in planning or siting their aquaculture operations.

The outputs are used to understand general patterns and trends across the province and could help identify potential areas of interest for further exploration. These are not site-level, or bay-level assessments, which can support higher resolution datasets. Therefore, the outputs of these assessments are designed to provide decision support¹¹ to guide and inform potential producers and government agencies during early stages of aquaculture planning.

2.2.3 Area of assessment

The area of assessment (AOA) encompassed all of Nova Scotia's near-shore coastal waters, up to three kilometres offshore, including major jaws of land (e.g. inlets and bays) (**Figure 3**). This scope was delineated to be inclusive of coastal waters amendable for nearshore coastal farming practices, and includes all waters where aquaculture currently operates. While there is no standard definition of 'offshore' aquaculture (Buck et al., 2024), waters beyond 3 km are characterized by high wind and wave exposure and would require adaptations in culture technologies and infrastructure (Howarth et al., 2022). These waters would thus require separate considerations for suitability and cannot be generalized with the same criteria as nearshore waters. Furthermore, this assessment does not include inland waters (e.g. rivers or lakes) or terrestrial considerations and thus cannot apply to freshwater aquaculture or land-based production.

¹¹ It is not designed as a decision-making tool to inform regulatory decisions around individual sites or proposals.

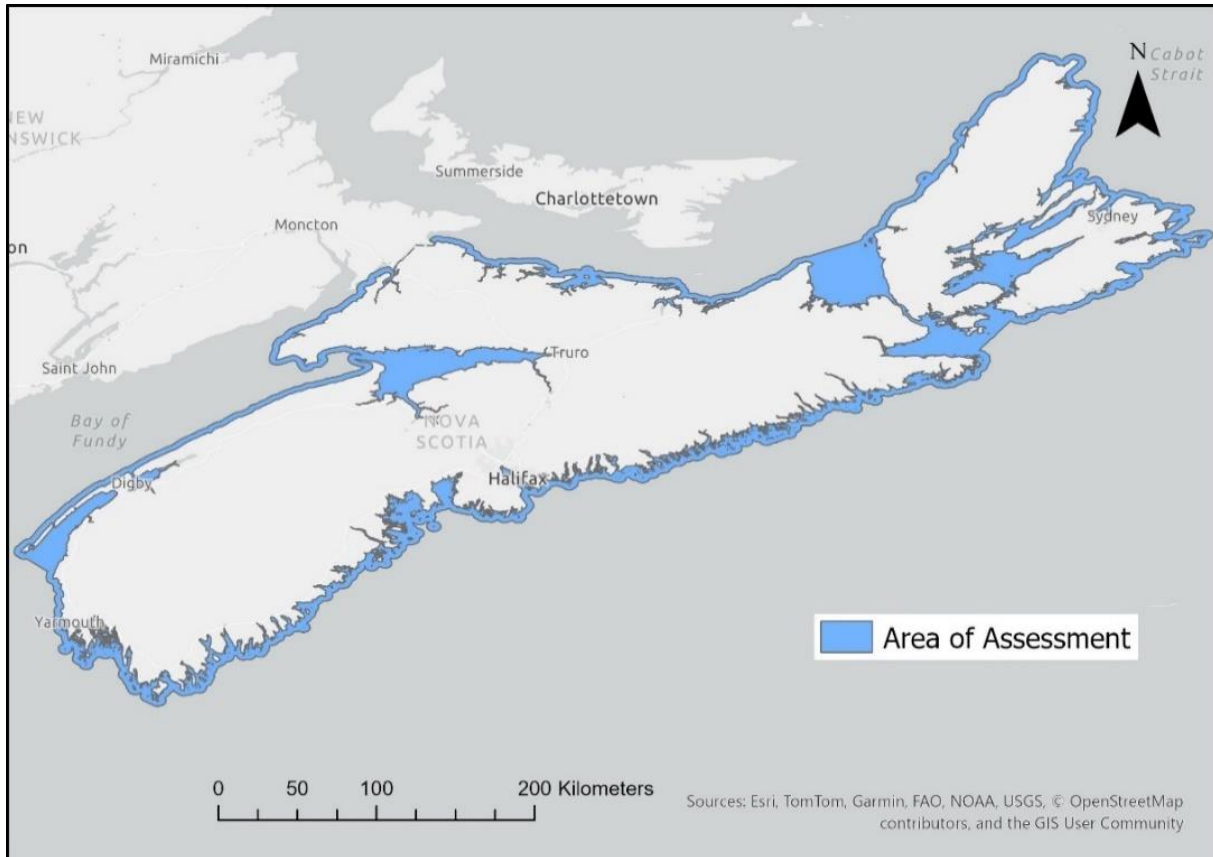


Figure 3. Area of assessment.

2.2.4 Software used

Spatial suitability analysis was completed using ESRI’s ArcGIS software. Final spatial data layer processing and analysis was completed using ArcGIS Pro V.1.18. Final suitability maps were combined using ArcGIS Pro Suitability Modeler environment and the build-in Mosaic tool. The web-based platform was developed on ArcGIS Experience Builder and ArcGIS Story Maps functionalities, hosted on CMAR servers.

2.3 Identifying criteria

Selecting a location for aquaculture development requires reviewing many important factors. However, not all criteria can be assessed at a provincial scale. This assessment aimed to capture the key considerations that would either constrain and / or limit the culture of species, or that producers would need to account for in planning or siting their aquaculture operations.

These assessments included criteria that focus on:

- a. The **biophysical conditions** required for the health and well-being of the farmed species (like exposure to extreme temperatures, ice conditions, water depth, etc.);

- b. Supporting **environmental protection and conservation** of significant habitats and species (like marine protected and conserved areas, critical habitats for species at risk, etc.); and,
- c. Reducing potential **overlaps with other marine activities** (like anchorage areas, vessel track lines, public coastal access points, etc.).

Some factors relevant to aquaculture planning and site selection were considered out of the project scope, such as those that are best derived through local consultation, or dependent on site-specific applications. The infrastructural needs of producers to operate were not considered. Furthermore, criteria related to societal preference ('social license'), the overlap with culturally significant areas, or the potential for conflict/synergies or societal impacts/benefits from aquaculture were not considered.

To select the criteria, an evidence-based and collaborative process was undertaken to propose scientifically valid and expert-informed criteria, applicable to the specific objectives and scope of the project. Criteria selection involved collaboration with network partners (i.e., Fisheries and Oceans Canada (DFO)) and subject-matter experts, brought together as part of advisory committees established under the CCS project (**Appendix I**).

Assessed species required different criteria due to different biophysical requirements, environmental interactions, and culture techniques. The criteria selection process, therefore, assessed whether to include criteria based on factors relevant to each of the four aquaculture species being assessed.

2.3.1 Guidelines for criteria selection

Ultimately, the set of criteria should be as simple as possible but comprehensive to capture the process's complexity while meeting objectives and goals (Belton and Stewart, 2002). While there are no standard rules or guidelines on the number of criteria appropriate for MCDA applications, some basic requirements have been acknowledged to support the rigour and validity of the criteria (Malczewski and Rinner, 2015; Cinelli et al., 2020). Criteria must meet the needs of this assessment, be rooted in scientific rigour, and incorporate high-quality data considering both theoretical and practical considerations required in data collection, analysis, and visualization.

Criteria selection was guided by an evaluation of several pertinent selection properties (**Figure 4**). For more information about the criteria selection evaluation process, see **Appendix II**. Each selection property is further described below.



Figure 4. Inclusion of criteria was based on information that met eight selection properties.

Relevance to scope

A criterion’s relevance to scope refers to the degree to which a criterion is pertinent, applicable, and meaningful in the context of the project. In the context of this assessment, sufficient evidence is required to validate the criterion’s importance to evaluating the potential for aquaculture (suitability), either through regulatory guidance or as identified in the scientific literature. As such, criteria should clearly measure one or more of the objectives of the project and be linked to measuring aquaculture suitability as it applies to either species health and welfare, environment and conservation, or multi-use overlaps. These criteria are designed to reflect considerations that producers would need to address or plan for during the licensing and leasing process¹². While several criteria may be relevant to aquaculture suitability, some may be excluded if they do not fit within the project’s objectives or scope.

Rateability

The rateability of a criterion refers to the strength of scientific evidence available to inform the classification of the criterion. The knowledge and information available to describe the suitability of criteria for aquaculture is a critical component of selecting criteria that are operational for use in the MCDA process (Keeney and Gregory, 2005). It must be clear how changes in the criteria

¹² Such as the eight factors to be considered in decisions related to marine aquaculture sites set forth by the Nova Scotia [Aquaculture License and Lease Regulations](#).

properties influence the potential for aquaculture development. In some cases, justification may be derived from existing guidelines, regulations, or best practices. Other justification may come from scientific evidence of established relationships or thresholds, such as the critical temperature thresholds of cultured species. The justification may be weaker in cases where scoring into suitability classes would rely solely on expert opinion or precautionary designations¹³. Additionally, justification may be weak where the criterion is challenging to justify or classify. This can occur if suitability depends highly on specific management or operational choices, or where the criterion may vary considerably over time and/or space (also see [Scale Validity](#)).

Scoring clarity

A criterion's scoring clarity refers to the extent to which explanation is required for the measurement and/or classification of a criterion. It also refers to the ease with which the criterion's data and the rationale for scoring can be communicated and understood by a variety of interest holders and end-users. To promote clear communication and useability of the analysis, criteria should be understandable to anyone interested in the analysis and outputs (Keeney and Gregory, 2005). This applies to both the data underlying the analysis, but also to the interpretation of the final classifications. Criteria should be clear to those wishing to use and interpret the outputs, and to the end-users and stakeholders who want to be informed about the analysis. Spatial datasets that are overly complex or requires specialized knowledge to understand and to be justified are less ideal as they reduce the value of the final outputs. Clearly defining the criterion is needed to be effectively assessed and classified for suitability (Dodgson et al., 2009).

Scale validity

The scale validity refers to the appropriateness of the criterion and the resolution of its dataset to the spatial scale of the project. Here, this means selected criteria should reflect considerations appropriate for a regional-level assessment. This scale does not consider specific industry practices, culture techniques/technologies, or management plans, focusing rather on variables that may influence government and producer decisions when exploring an area's potential. Criteria more relevant to site-level or bay-level suitability assessments are thus excluded. Site and bay-level criteria require higher-resolution data¹⁴ and methods of analysis¹⁵ that can accommodate the variability that is needed for a meaningful evaluation of suitability at the regional level of assessment.

Spatial resolutions at the scale of one kilometre or larger were considered too coarse for our AOA, since they would not be sufficient to capture the variability of coastal ecosystems and their interactions with aquaculture.

¹³ Such as using precautionary buffers around features, which can act as protective mechanisms to account for uncertainties or minimize risk (Holzer and Olsen, 2021).

¹⁴ Generally, within the metres to tens of metres resolution.

¹⁵ For example, through carrying capacity models or tools.

Coastal coverage

A criterion's coastal coverage refers to the availability of the criterion's data across the coast of Nova Scotia (i.e., the Area of Assessment (AOA); **Figure 3**). The suitability assessment methods used within the GIS-MCDA process involve calculating and aggregating suitability scores for all criteria across each 'cell' within a gridded AOA. To effectively compare suitability across areas (e.g. 'cells'), the analysis requires available data for every criterion within a cell to compute an aggregated suitability score. If a cell is missing data for one criterion, a combined suitability score cannot be calculated. This will ultimately lead to gaps in the coverage of suitability across the AOA. Therefore, a criterion's data should have relatively complete coverage across the AOA to minimize the extent of potential 'unassigned' areas.

Data accessibility

The data accessibility of a criterion refers to the ability or ease with which the criterion can be measured and used within the suitability assessment. Being able to generate, access, or use the criterion is critical for making the criterion operational within the GIS-MCDA analysis (Keeney and Gregory, 2005; Malczewski and Rinner, 2015). The criterion's data must be available or measurable within the project's timeline and resources and was evaluated in the context of available time, personnel and expertise. To promote transparency and access to data, the use of publicly accessible data was preferred.

Measurement reliability

The measurement reliability of a criterion refers to the confidence and uncertainty related to the criterion's measurement at the scale of assessment, including the use of scientifically robust methods and data. Where data needs to be collected and analyzed for this assessment, methods should be reliable, transparent, and clear. Methods must also be available to accurately collect or analyze datasets at the appropriate resolution for regional-level assessment of aquaculture potential. In some cases, measurement of criteria may be available, but not necessarily spatially mapped at the necessary scale (**Scale validity**). In addition, novel methods or emerging areas of research may add uncertainty to the assessment and should be considered carefully.

Redundancy

A criterion's redundancy to other criteria refers to whether criteria can be considered to be very similar to another criteria, in that the data measures a similar phenomenon. Redundancy can also happen if the criterion's data is included in the data of another criterion measuring a similar phenomenon, such that including both would consist of double counting. In GIS-MCDA applications, double counting is problematic, and redundant criteria should be removed for simplicity and accuracy (Dodgson et al., 2009; Malczewski and Rinner, 2015). Therefore, criteria should be mutually exclusive (i.e., not counted in other criteria) to avoid inflating or exaggerating the influence of an individual criterion. In addition, measuring and classifying criteria should be possible independent of the knowledge or data from other criteria. This means that judgements about suitability scoring should not require any information not contained in the criteria.

2.4 Data collection and processing

For all criteria, data were selected that represent the most authoritative and highest resolution available. Spatial data layers were acquired from public sources (e.g. the [Government of Canada Open Data Portal](#) and the [Nova Scotia Open Data Portal](#)), developed through 'in-house' analysis¹⁶, or provided through engagement with provincial and federal government agencies. Data was checked for completeness and quality, and the most up-to-date sources were used.

Some datasets were provided in 'ready to use' formats. Others required analysis, manipulation, or processing to prepare them for the suitability analysis or inclusion in the web-based platform. The full methodology of data processing, as well as the source and data download locations of all datasets can be found in [Appendix III](#).

All data were projected and analysis performed using the Transverse Mercator projection based on the North American Datum of the Canadian Spatial Reference System (NAD 1983 CSRS UTM Zone 20N) for the Atlantic Canadian region.

2.5 Criterion scoring

Scoring of the criterion focused on determining how each criterion influenced the potential for aquaculture development. Scoring allowed criteria data, which may all have different units of measurement, to be reclassified onto a consistent scale¹⁷, so they can be easily compared and aggregated, providing a combined and unified view of aquaculture development potential.

Within MCDA assessments, various functions and methods are available to score criteria, including data-driven methods based on the distribution of the data (e.g. minimum-maximum, logistic, percentile rank) or methods that discretely assign scores (e.g. ranking or categorical based on pre-defined rules). Approaches have different advantages and disadvantages depending on the underlying datasets, the desired outcomes, and communication objectives (Cinelli et al., 2020).

For this assessment, we use a discrete scoring that seeks to classify the values of each criterion into categorical ratings based on a pre-determined scale. A four point-scale (restricted, limited, moderate, and good) was selected, as it presents a balance between flexibility, and allows for clear, well-defined classifications (See section [Aggregation](#) below for description of scales).

We also identified whether a criterion has limiting conditions that might reduce the suitability of an area, regardless of any other criterion. These limiting conditions are incorporated into the rule-based overlay procedure during aggregation, automatically determining the area's final suitability rating. Factors with limiting conditions either have conditions that were considered key determinants of suitability (e.g. high risk of extreme cold exposure that could lead to significant mortality risks for finfish aquaculture) or have regulatory implications that would be enforced

¹⁶ Using data produced or contracted for, and by, CMAR for this project, such as through CMAR's [Coastal Monitoring Program](#).

¹⁷ Some common scales include integers of 10 (0-1, 1-10, 0-100), a three-class scale (1,2,3) or a combined scale.

regardless of the presence of any other criteria. For restrictions, spatial features represented either points or lines may not represent the full 'real-world' extent of the features, and thus, limiting rules were proposed.

2.5.1 Basis of scoring

Scores considered first and foremost the risks to animal health, environmental conservation, and potential overlaps with other marine activities. As criteria may also influence other aquaculture objectives (such as determining optimal growth conditions or presenting increased infrastructural challenges), these were also considered but were not used as the primary basis for designating scores.

Scoring was guided by a comprehensive and science-based process, drawing on:

- **Scientific literature:** Best practices and thresholds for each criterion, where available;
- **Government policy:** Aquaculture planning, licensing, and leasing considerations; and
- **Stakeholder input:** Feedback from scientific experts, government partners, and aquaculture industry representatives.

This approach ensures that scoring is thorough, evidence-based, and relevant to planning considerations by government and industry. For the rationale description for scoring assigned to each criterion, see [Appendix III](#).

2.5.2 Scoring criterion types

There are several different ways criteria may be incorporated into the assessment of aquaculture development potential, which can be differentiated based on the type of criteria. Index criteria, which include criteria used to calculate the final combined score for aquaculture development potential, can be distinguished into 'hard' constraints (restrictions) and 'soft' factors (Eastman, 2009), which influences how they are aggregated with other information.

Factors represent criteria that may reduce or enhance the potential for aquaculture development, depending on the specific conditions (data values). To support a weighted aggregation of all factors, these were reclassified into a common scale between 1 - 3 by assigning criterion values based on the relationship of conditions with aquaculture suitability:

Limited (1): Conditions are generally expected to have substantial challenges for aquaculture development and would require significant management or mitigation.

Moderate (2): Conditions are generally expected to be reasonable for aquaculture development, with further investigation needed to explore potential impacts or appropriate management and mitigation.

Good (3): Conditions are generally expected to be well-suited for aquaculture development.

Restrictions¹⁸ represent criteria with conditions that would be preclusive to aquaculture development were called and were scored 0 = restricted. Restrictions were designated as an area that would completely exclude aquaculture due to direct spatial overlaps with infrastructure (e.g. submerged cables and pipelines), interference with designated activities or uses (e.g. anchorage areas), or areas considered legislatively restrictive (e.g. Marine Renewable Energy Areas).

Upon further investigation of scoring, some criteria could not be scored due to a lack of reliable, consistent knowledge of appropriate scores. In some cases, data may be incomplete or not reliable enough to support consistent scoring. In others, what may make an area 'suitable' for aquaculture may vary widely, at local scales, at different times of the year, or depending on specific operations. These criteria were categorized as **informational criteria** and were not scored nor included in the final suitability score but are still incorporated into the mapping tool as informational datasets (see **Informational Criteria**).

To determine each criterion's type, a series of questions related to the criterion's reliability (i.e., there must be adequate knowledge/information to consistently and confidently score criteria into ratings), applicability (e.g. whether criterion impacts can be generalized), and restrictiveness (e.g. whether the criterion would be exclusionary for aquaculture development) were posed. The criterion type was then determined based on their taxonomy across the three features of reliability, applicability, and restrictiveness (**Figure 5**).

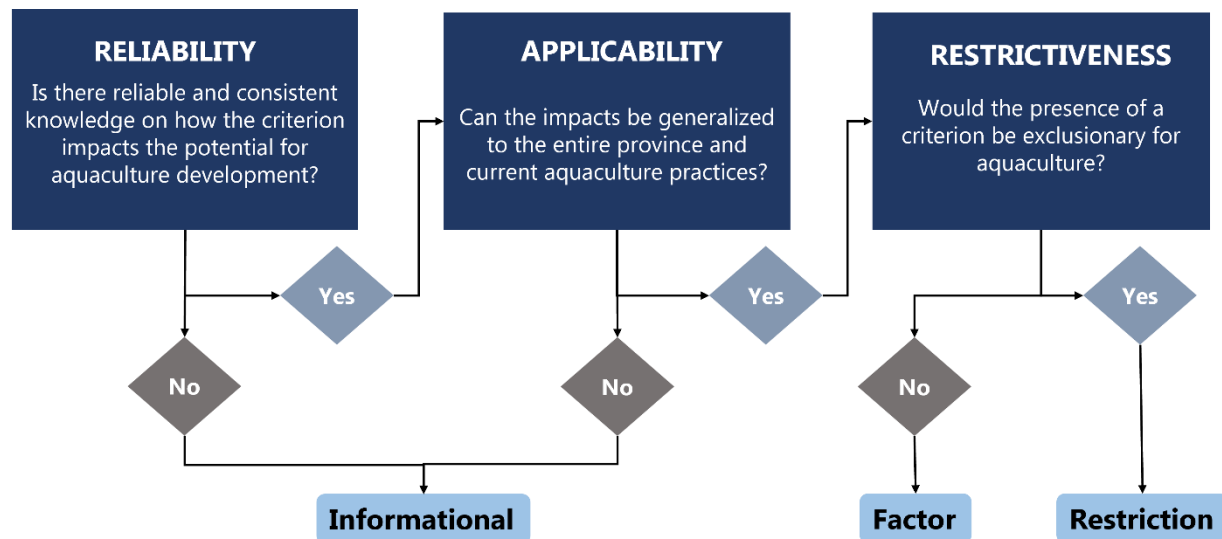


Figure 5. Guiding questions to determine whether criteria are to be included as a factor, restriction, or informational criterion.

¹⁸ These types of criteria are also often referred to as “constraints” within wider MCDA applications. Here, ‘restrictions’ is used for clarity designed for a non-technical user base.

2.6 Aggregation

The final suitability maps were created using a geospatial overlay within a GIS environment. The area of assessment was divided into a grid of 100 m-by-100 m cells (~1 hectare each), representing the spatial resolution of the outputs. The spatial resolution was determined to balance the resolution of the underlying data layers, with accuracy and uncertainty in data, and practical considerations for the outputs. At a 100 m resolution, each cell size is small enough to capture the relevant details of the features assessed, while respecting the coarsest resolution of datasets available.

Each cell was mapped and assigned a suitability rating based on its combined criteria, combining three methods commonly used in GIS-based multicriteria decision analysis (GIS-MCDA):

1. **Weighted Linear Combination (WLC)** combines factors through a weighted sum of scores, so that final ratings reflect the suitability of areas when considering multiple factors.
2. **Rule-based overlay** identifies areas that will be automatically assigned a “limited” or “moderate” rating due to the presence of critical conditions that would influence the suitability, regardless of the presence of any other factor.
3. **Restrictions overlay** identifies areas that will be automatically assigned a “restricted” rating due to the presence of exclusionary restrictions that would preclude aquaculture.

Criteria can be included through multiple methods if they have both conditions that are limiting, and separate conditions that influence suitability and need to be incorporated (either through WLC or restrictions). Together, these three MCDA methods ensure that the final classification of areas is determined by the combined effect of multiple variables, while acknowledging critical limiting factors and constraints to potential aquaculture development.

2.6.1 Weighted Combination of factors

While various methods exist for aggregating multiple criteria, the Weighted Linear Combination (WLC) is the most common approach in MCDA (Malczewski and Rinner, 2015), and is regularly applied in other aquaculture contexts (Dapueto et al., 2015; Petrosillo et al., 2023). WLC allows for a nuanced assessment of suitability, by considering the scoring and weighting of criteria for a combined suitability assessment. WLC calculates a suitability index (S) whereby the suitability scores for each criterion are multiplied by their weights and summed (see **Box 1**).

Box 1. The suitability index (S) is based on the summed product of weighted criteria scores across all factors, following the equation:

$$S = \sum_{i=1}^n w_i \times c_i$$

S = Suitability index
 w_i = Weight assigned to criterion i
 c_i = Score of criterion i
 n = Total number of criteria

Final ratings produced through WLC therefore, reflect the suitability of areas considering multiple factors. For this assessment, all factors were weighted equally¹⁹, based on the critical assumption that each criterion contributed equally to the total suitability (Ezell et al., 2021). In this case, equal weighting can be considered similar to the geometric mean of scores, which is a popular method used in other aquaculture suitability assessments (Longdill et al., 2008; Silva et al., 2011; Morris et al., 2021) to reduce subjective bias in assigning weights, which may differ based on priorities and local contexts²⁰. Previously, even aquaculture experts with similar backgrounds have been found to have inconsistencies in their assignment of weights (Aguilar-Manjarrez, 1996), resulting in variable outcomes on the final suitability maps. While functionally similar to the geometric mean, a WLC approach allows future re-assessments or expansions of the CCS to consider different weights, as determined by the needs of the project.

Equal weighting thus minimizes potential concerns around subjectivity, volatility, and variability in weighting while offering a straightforward and easy to apply method. It is also the most flexible for future iterations of the assessment; if criteria are added or removed, equal weighting would eliminate the need for elicitation processes.

The result of WLC aggregation is a continuous score from 1 - 3, based on the weighted sum of all factor scores. An equal interval reclassification is used to transform combined WLC scores into discrete suitability ratings. The equal interval approach divides the range of possible continuous scores (1 through 3) into equal-sized subranges (limited = 1 – 1.66, moderate = 1.67 – 2.33, and good = 2.34 – 3).

2.6.2 Overlaying limiting conditions

Next, a rule-based overlay (Greco et al., 2016) was used so that where a limiting condition is present, the area would be automatically rated as either limited or moderate, depending on the conditions present. In these cases, these limiting conditions can not be 'compensated for', and such are inappropriate to aggregate alongside other factors through WLC process. This step ensures that critical thresholds are enforced, and essential limitations are not overlooked or diluted through WLC. Limiting conditions can be defined for both factors and restrictions. Some criteria are incorporated only through rule-based overlay, in cases where all conditions are determined to be limiting. For example, the presence of a marine protected and conserved area (MPCA) is a limiting condition, whereby areas are automatically 'limited' for finfish aquaculture and 'moderate' for shellfish aquaculture. In these cases, the rest of the area of assessment where MPCAs are absent would be assigned a score of 3 ("good") for that criterion. Including it as both a limiting condition and through WLC would thus be redundant, as it would dilute the weight of other criteria.

¹⁹ Weights are represented as a percentile number between 0 and 1, and across all criteria, must sum to 1 (or 100%).

²⁰While criteria can influence aquaculture suitability differently, equal weighting was determined as the most appropriate given the goals of this assessment, guided by a sensitivity analysis supporting varying weighting approaches.

2.6.3 Overlaying restrictions

Restrictions identify exclusionary areas (also called constraints) that, when overlaid with ratings from WLC or rule-based overlay, the final rating would be assigned as 'restricted'. For those constraint features represented as point and line geometries, the spatial extent will be surrounding 100m² areas containing that feature²¹. These criteria are incorporated through a Boolean constraint overlay, where presence is scored to be 0. When aggregated alongside the results of the WLC and limiting conditions, all areas present as restrictions will automatically be rated as 0 ('restricted').

2.6.4 Putting it all together





Together, these three MCDA methods ensure the final classification of areas is determined by the combined effect of multiple variables. This method also acknowledges the critical limiting conditions and restrictions to potential aquaculture development.

In summary, final ratings reflect either:

- A combination of factors that make an area have a specific overall rating for development potential, as determined through WLC; or
- The presence of a key condition (restriction or limiting condition) that influences aquaculture development potential, independent of any other criterion.

The outputs of final suitability maps show each 100-m by 100-m area given one of four ratings (Table 1).

Table 1. Final suitability ratings and what they mean for potential aquaculture development.

Rating	Colour	Description
Restricted		Aquaculture development is not permitted
Limited		Low potential requiring significant management or mitigation
Moderate		Relatively suitable but requires further investigation
Good		Well-suited for aquaculture development

2.6.5 Validation and quality control processes

Several steps were taken to ensure accuracy and reliability throughout the assessment. All methods and data sources were fully documented, including any applied processing and analysis,

²¹ In some cases, more than one adjoining cell may have a final restricted rating. This is due to the original line or point features that may cross over into more than one pre-determined 100m² cell.

which can be found in [Appendix III](#). Detailed GIS workflows for data processing and for suitability analysis were also produced and are held internally with CMAR for consistency and reproducibility during future re-assessments. While every effort was made to ensure completeness and accuracy, any uncertainties and limitations are reported where relevant. If errors or omissions are identified, the tool will be revised.

Regular consultations with subject matter experts, industry stakeholders, and network partners helped ensure the most relevant and up-to-date information was included, and the methods were sound. The methodological approach applied, including criteria used and scoring was also reviewed and revised through feedback by the NSASAC²².

To explore the robustness of assessment outputs, a sensitivity analyses were conducted to explore how variations in input parameters influence the final suitability results. Sensitivity analysis can assess uncertainties within the MCDA procedure and examine the robustness of the outputs (Malczewski and Rinner, 2015). Here, we used a sensitivity analysis to compare differing weights scenarios and ensure robustness of the proposed equal weighting approach²³.

2.7 Visualization

The results of the suitability assessments in support of the aquaculture Coastal Classification System are publicly accessible through the [Government of Nova Scotia website](#). A web-based platform consists of both an online mapping tool and an accompanied ArcGIS Story Map which allows users to view the final suitability maps and obtain more information about the criteria and information used during the assessment, as well as user instructions.

2.7.1 Design and implementation

The online mapping tool was developed within [ArcGIS Experience Builder](#). ArcGIS Experience Builder is a feature within ArcGIS Online/Enterprise for creating web applications that is easy to use, adjust, and manipulate without the need for coding. The graphical user interface has several features, including a main map area and a series of tabs atop where users can navigate different portions of the tool. Tabs allow users to toggle between suitability outputs and other pertinent information, including criteria data layers and additional resources about the project. The tool also includes interactive features, such as zooming in and out of different spatial scales, or functions like measurement and drawing tools.

To provide users with additional, easily digestible information on the project inputs, data, and processes, the outputs were also aggregated onto an [ArcGIS StoryMap](#). The StoryMap shares the outputs of the suitability analysis through a combination of text, interactive maps, and other

²² Responses to science advice requests by the NSASAC can be found at <https://novascotia.ca/aquaculture-coastal-classification-system/>

²³ For a review of the sensitivity analysis applied during the project development stage, see science advice documentation submitted to the NSASAC.

multimedia content. It also explains the assessment methods, the relevance and scoring of each criterion, and information on how to use the mapping tool.

The mapping platform is hosted by ESRI but made publicly available through the Government of Nova Scotia website. The mapping platform is a 'living tool' as it will be regularly updated to maintain relevancy and provide necessary user support. See [Section 6](#) for recommendations on maintenance schedules and activities.

2.7.2 Useability and accessibility

The design of the mapping tool and StoryMap was developed with functionality and accessibility in mind. The online mapping platform was developed through iterative improvements, based on recommendations and products developed by the creative services provider [Rhyme & Reason Agency](#), and through accessibility audits and user testing conducted by [Pisces RPM](#).

Two accessibility audits were conducted by [Pisces RPM](#) throughout the development of the mapping tool and Story Map. A Final Accessibility Report is presented in [Appendix IV](#), presenting the final overview and recommendations made on the final draft of the platform. Usability testing on a 'mock'²⁴ draft platform was performed to gather potential user feedback on the functionality and design of the draft platform. This testing is not designed to gather public input on any data or criteria, or evaluate responses to the assessment outputs, but rather to understand user functionality. Findings from the user testing can be found in [Appendix V](#).

2.7.3 Engaging with the suitability results

Multiple map layers were created to represent different aspects of the assessment, and include:

- **Suitability ratings** – maps showing areas classified into "restricted", "limited", "moderate", or "good" aquaculture development potential, for each assessed species
- **Data layers** – individual layers for each criterion and restriction used in the assessment
- **Informational data** – individual layers showing informational criteria, that can be viewed alongside suitability maps to show additional considerations for determining potential for development

These map layers are integrated into the online platform so that users can view both assessment results and the types of criteria and data that was used to inform final ratings. Appropriate links to original data sources are also available within the online mapping platform.

Additional information about the assessment methods, as well as the relevance and scoring of each criterion is integrated within the ArcGIS Story Map. The Story Map also contains a tool guide that provides users with more information on how to use the mapping tool.

²⁴ The 'mock' platform did not include any real data, maps, or assessment outputs.

Determining the colours to represent ratings

The colours used to represent final ratings on suitability maps were selected based on accessibility²⁵ and overall visual appeal. Final colours performed strongly to meet required accessibility standards (contrast, combination for colour blindness) and were a preferred option based on user testing ([Appendix V](#)).

Interacting with suitability maps

To facilitate a more efficient and transparent sharing of information to allow in depth examination of specific areas, the final mapping tool allows users to zoom in to specific areas, up to a maximum zoom level of 1:10,000²⁶. At the 1:320,000 zoom level, the tool is set to change from a raster file type to a point file type, as points will begin to appear on the map. Zooming in further, points become more visible. Each point represents the centre of the 100m² 'cell' rated during the suitability analysis. Users can click on each point and see more information about the assessment results at that location. A pop-up will appear on the screen, providing some text information, as well as a table with the values of all assessment criteria. This function allows users to understand not only what contributed to the final rating, but also how that area performs in relation to other criteria.

3 Criteria

A total of 23 criteria were identified for inclusion in the CCS, as determined to meet the selection properties for the project ([Figure 4](#)). The selected criteria reflect current marine conditions, sector needs, industry regulations, aquaculture practices, and technologies, as well as the existing state of knowledge and data availability at the time of the assessment.

Additional information to describe each criterion, how it influences suitability for aquaculture and the datasets used can be found in [Appendix III](#).

3.1 Assessment Criteria














The final suitability ratings were determined through the scoring and aggregation of fifteen factors and restrictions ([Table 2](#)). The specific criteria used varied depending on the species being assessed. This is because different species have unique biophysical needs, environmental interactions, and culture techniques. For example, extreme cold exposure is only used for finfish species, as salmonid species like Atlantic salmon and Rainbow trout can suffer mortalities at temperatures at or below -0.7°C (Saunders et al., 1975).





















²⁵ For even greater accessibility, Pisces RPM recommends that the 'dark grey' basemap can improve colour contrast for users with protanopia and deuteranopia colour blindness







²⁶ A 1:10,000 zoom level means 1 cm of map display equals 10,000cm (100m) in the real world.

Table 2. Criteria (factors and restrictions) used within suitability assessments for each species including how they were scored. *Indicates limiting conditions.

Atlantic salmon  Rainbow trout  Blue mussels  American oyster 

Criteria	Data	Species	Rule/Score	Comments/Rationale
FACTORS				
Extreme Cold Exposure	Coastal Monitoring Program data - CMAR, supplemented by GHRST Level 4 MUR Global Foundation Sea Surface Temperature	 	Areas with a high risk of extreme cold exposure are automatically 'limited'* in final maps. Medium risk areas have 'moderate' potential, and low risk areas have 'good' potential.	Extreme low water temperatures can pose significant mortality risks to finfish.
Extreme heat exposure	See above	  	Areas with a high risk of extreme heat exposure have 'limited', medium risk have 'moderate', and low risk areas have 'good' potential.	Prolonged exposure to warm waters can impair growth, reduce disease immunity, and in some cases, lead to mortality.
Bathymetry	General Bathymetric Chart of the Oceans (GEBCO); Canadian Hydrographic Service Non-Navigational (NONNA) Bathymetric Data	 	Depths below 10 metres are automatically 'limited'* in final maps.	Aquaculture operations must have sufficient water depth to accommodate infrastructure. Operations in shallow waters can have elevated welfare risks to cultured species and increase risks of bio-deposition on seafloor environments.
			Depths below 5 metres have 'limited' potential, and above 5 metres have 'good' potential.	
			Depths below 2 metres have 'limited' potential, and above 2 metres have 'good' potential.	
Drift ice risk	Ice products produced by NSCC's Applied Geomatics Research Group for CMAR	 	Areas with high risk of drift ice have 'limited', medium risk have 'moderate', and low risk areas have 'good' potential.	High risk areas increase potential exposure to ice that can damage infrastructure or lead to accidental escape of farmed fish into the marine environment.
		 	Areas with a high drift ice risk are automatically 'limited'* in final maps. Areas with medium risk have 'moderate', and low risk have 'good' potential.	In areas where gear cannot be submerged, drift ice can scour equipment and lead to mechanical damage and mortality of shellfish.

Criteria	Data	Species	Rule/Score	Comments/Rationale
Wind and wave conditions	Nova Scotia Wind-generated Wave Exposure Atlas - DSA Ocean for CMAR	 	Maximum significant wave heights above 5.5 metres have 'limited', between 4 and 5.5 metres have 'moderate', and below 4 metres have 'good' potential.	High wave exposure increases the risk of exposure-induced stress, physical injuries, and potential for infrastructure damage.
		 	Maximum significant wave heights above 2 metres are automatically 'limited'* in final maps, between 1 to 2 metres have 'moderate', and under 1 metre have 'good' potential.	
Critical habitat for species at risk	Critical Habitat for Aquatic Species at Risk - Canada ; Critical Habitat for Species at Risk National Dataset - Canada	   	Areas within a critical habitat for species at risk are automatically 'moderate'* in final maps.	Critical habitats are protected under the <i>Species at Risk Act</i> and would require further investigation of potential interactions with relevant species and habitats.
Marine protected and conserved areas	Includes Marine Protected Areas, Migratory Bird Sanctuaries, National Parks, National Wildlife Areas from the Canadian Protected and Conserved Areas Database (CPCAD)	 	Marine protected and conserved areas are automatically 'limited'* in final maps.	Protected areas have regulatory preclusions that may limit aquaculture operations and require significant attention to ensure no negative impacts to protected species and habitats.
		 	Marine protected and conserved areas are automatically 'moderate'* in final maps.	
AIS vessel density patterns	Automatic Identification System (AIS) track line data from 2019, 2020, and 2021 provided by Fisheries and Oceans Canada (DFO)	   	Areas identified as 'important vessel routes' are automatically 'limited'* in final maps. Areas 'on-channel' of navigational routes have 'limited', 'near-channel' have 'moderate', and 'off-channel' have 'good' potential.	Areas of higher vessel traffic may introduce navigational hazards due to overlap with aquaculture infrastructure and activities.
VMS Fishing vessel density patterns	Vessel Monitoring System (VMS) data from 2019, 2020, and 2021 provided by DFO	   	High traffic areas have 'limited', medium traffic areas have 'moderate', and low traffic areas have 'good' potential.	Areas of higher vessel traffic may introduce navigational hazards due to overlap with aquaculture infrastructure and activities.

Criteria	Data	Species	Rule/Score	Comments/Rationale
Public coastal access	<ul style="list-style-type: none"> Coastal beaches (Ecological Land Classification, Protected beaches – Nova Scotia Department of Natural Resources (NSDNR)) Small craft harbours (DFO) Public boat launch sites (NSDFA) Marinas and yacht clubs (CMAR) 		Areas within 100 m of a public access point are automatically 'limited'* in final maps.	Aquaculture within close proximity to areas used by the public to access the ocean may interfere with access to the ocean and coastal spaces for recreation, tourism, etc.
RESTRICTIONS				
Anchorage areas	Canadian Anchorages and Anchorage areas		Areas associated with anchorage areas are 'restricted' for aquaculture. Areas within 200 m of anchorage points are automatically 'limited'* in final maps.	Specified anchorage areas have restricted access and are not suitable for co- location with aquaculture. Navigational hazards are possible within proximity to these areas, due to the drift of vessels and potential inaccuracy in mapped point data.
Designated navigation features	Vessel Traffic Routes , includes Traffic Separation Zones, ferry routes, and recommended routes.		Areas associated with designated navigation features are 'restricted' for aquaculture. Areas within 200 m of ferry routes and recommended routes are automatically 'limited'* in final maps.	It is important to avoid potential overlaps with existing areas designated for navigation. Navigational hazards are possible within proximity to these areas due to potential inaccuracy in the mapped geometries of line data.
Marine Renewable Energy Areas	Provided by Nova Scotia Department of Energy		Areas within Marine Renewable Energy Areas (MREAs) are 'restricted' for aquaculture.	As per the Marine Renewable-energy Act , MREAs cannot be designated in areas permitted/leased for aquaculture.
Submerged cables and pipelines	Provided by DFO		Areas associated with submerged cables and pipelines are 'restricted' for aquaculture. Areas within 500 m are automatically 'limited'* in final maps.	Aquaculture should avoid areas where underwater cables and pipelines are present to prevent damage, avoid conflict with maintenance activities, and minimize potential safety hazards to operators.
At-sea disposal sites	Active and Inactive Disposal at Sea Sites in Canadian Waters		Areas within at-sea disposal sites are 'restricted' for aquaculture.	Aquaculture should not interfere with the disposal, maintenance, and management of dumped materials.

3.2 Informational criteria

The suitability ratings were determined using the factors and restrictions described above. However, the CCS tool also included data layers for other considerations, allowing users to view additional information important to understanding suitability for aquaculture development.

Informational criteria are recognized as important considerations for aquaculture development but cannot be included within the suitability analysis due to data or knowledge limitations (**Table 3**). A total of eight criteria were identified as informational criteria.

Table 3. Informational criteria identified.

Informational criterion	Data source	Comments/Rationale
CFIA Disease Regulated Areas	CFIA's online map for Multinucleate sphere unknown (MSX) and Perkinsus marinus (Dermo) Regulated Areas	The health of cultured species may be impacted by potential exposure to diseases. Area-specific information on virulence and the presence of these diseases has not been mapped.
Shellfish Water Classification Program	Canadian Shellfish Sanitation Program's (CSSP) Shellfish Harvesting map (DFO)	Under the CSSP, shellfish harvest areas are classified according to their suitability for harvesting shellfish, based on water quality standards and sanitary conditions. How the area is classified, as well as existing prohibition orders, can affect a producer's ability to harvest or may impose requirements for mitigation measures.
Wild salmon rivers	River significance levels from CMAR's wild salmon river assessment	Significant rivers for wild Atlantic salmon may be sensitive to disturbance from marine activities. Potential interactions and impacts to wild salmon and their habitats from aquaculture would vary considerably based on proposed operations, and there is little evidence on appropriate distances from rivers.
Important bird habitat	Bird habitat datasets within 100 m from the coast were combined: <ul style="list-style-type: none"> • Significant Species and Habitat Database (NSDNR) • Important Bird Areas (IBA) BirdLife International • Critical Habitat for Species at Risk National Dataset (ECCC) • Migratory Bird Sanctuaries from the Canadian Protected and Conserved Areas Database 	Important migratory and protected birds are sensitive to disturbance from marine activities. Aquaculture site decisions should consider the potential for interaction with birds and their habitats. Potential interactions of aquaculture with birds and their habitats would vary considerably depending on the area, species, and type of aquaculture operation. In addition, recommended setback distances or required management and/or mitigation efforts would also vary.

Informational criterion	Data source	Comments/Rationale
Coastal wetlands	Canadian National Wetlands Inventory	Wetlands play an important role in coastal ecosystems and have various government protections. Potential interactions or impacts within these areas from aquaculture may be highly variable and required management and/or mitigations are highly site-specific.
Terrestrial protected areas/parks	Multiple layers showing protected areas and parks within the terrestrial environment were combined from: <ul style="list-style-type: none"> • The Nova Scotia Protected Areas System • Protected beaches provided by NSDNR • Wildlife Management Areas, provided by NSDNR 	Potential interactions or impacts with these areas from aquaculture may be highly variable and situation- specific depending on ecosystem type, resident species, and proposed adjacent activities
Existing aquaculture	Nova Scotia's Aquaculture and Rockweed Map Viewer	Various existing aquaculture lease areas exist around the province. New development would need to consider potential interactions and overlaps with existing sites.
Water lots	Property Identification (PID) data provided by GEONova	Water lots are parcels of marine space already owned or leased to specific entities.
Crown leases and easements	NSDNR's Crown Land dataset	Within existing crown leases and easements, aquaculture development may not be permitted, although the restrictions would vary depending on the aquaculture operation and the type of crown lease or easement.

3.3 Criteria excluded

Some relevant criteria were excluded from the assessment because they did not meet the eight selection properties used to evaluate suitability for inclusion (see [Table 4](#)). See [Appendix II](#) for full rationales of criteria considered but excluded.

Table 4. Examples (non-exhaustive list) of some criteria considered but not included.

Criterion	Test(s) failed	Rationale
Average sea surface temperatures	Relevance	Relevant to identifying optimal growth conditions – not included in scope of assessment
Currents and flushing	Scale; Coastal coverage	Data at resolutions appropriate for assessment are available for only a few areas across AOA
Commercial fisheries catch data	Scale	Public datasets are available (e.g. the Eastern Canada Commercial Fishing Data) but there are at coarse resolutions, which is inappropriate for this assessment.
Eelgrass habitat	Coastal coverage, Data accessibility	Some mapped data and estimates available, such as datasets through the National Eelgrass Dataset for Canada (NetForce) are only available for some, but not all areas.
Sources of marine pollution	Redundancy	Already accounted for in the Canadian Shellfish Sanitation Program classification areas

In some cases, criteria were considered highly relevant to aquaculture (e.g. current, primary productivity, and dissolved oxygen) but have high spatial or temporal variability at local scales, such that accurate reflection on suitability requires higher resolution data and analysis. For example, consideration for current flow, including flushing rate, is important for water quality to ensure adequate oxygen supply to cultured finfish and transport of nutrients to cultured shellfish, but can be influenced by a myriad of factors (Ministry for Primary Industries, 2013). These criteria are relevant to aquaculture suitability but were excluded since they were considered more relevant or appropriately evaluated at the site level during site-selection processes.

Other criteria considered were only available at coarse resolutions that would require substantial downscaling so that data can be represented at higher resolutions needed for this analysis. For example, commercial fisheries catch and effort data for both pelagic and inshore lobster fisheries exist, but only on coarse resolutions that are not appropriate for this level of assessment. Spatial resolutions at the scale of one kilometre or larger were considered too coarse for our AOA, since they would not be sufficient to capture the variability of coastal ecosystems and their interactions with aquaculture. Significant downscaling of datasets is not recommended as it can lead to issues influencing the accuracy, output resolution, and robustness of the data (Ramirez-Villegas and Jarvis, 2010).

Finally, some criteria considered were excluded due to lack of available data or adequate coverage of data across the AOA. For a few criteria, available data simply did not overlap or intersect the study area. This occurred where data was only available for offshore coastal areas beyond the AOA's 3-kilometre boundary²⁷. Other datasets were available but had substantial gaps in coverage

²⁷ For example, species distribution data has been mapped for several important species of fish and invertebrates, but collected through DFO research vessel surveys, which largely operate in offshore waters beyond our AOA (Bundy et al., 2017).

across the entire AOA. For example, distribution maps of eelgrass areas in Nova Scotia have recently become available through DFO's NETForce project (Gomez et al., 2021). However, this is an ongoing project, and distribution has only been mapped for the coastal areas around the Scotian Shelf, resulting in significant gaps in spatial coverage of data. As data becomes available, these criteria should be re-evaluated and reconsidered for inclusion in future iterations of the suitability assessment.

Other criteria were out of the project's scope but are part of aquaculture site-level assessments. Some excluded criteria relate to:

- Assessing optimal growing conditions (for example, average temperatures)
- Identifying production needs (for example, access to infrastructure and roads)
- Understanding potential compatibilities or conflicts of aquaculture operations with local communities, cultures, and livelihoods

We did not consider criteria related to how aquaculture impacts culturally significant areas, nor the potential for conflict/synergies or societal impacts/benefits from aquaculture. While recent scientific advances in understanding and measuring social license for aquaculture have begun to emerge (Mather and Fanning, 2019), social license remains a largely vague and undefined concept. Measuring social license is also an ongoing challenge as assessment methods and metrics are highly variable (Whitmore et al., 2022). This information requires additional knowledge of the spatial compatibility of overlapping uses (Kannen, 2014) and a strong baseline knowledge of the cultural values of areas (Gee et al., 2017). Adequately understanding and measuring social license requires site-level assessment and consultations within local communities. It is also highly dynamic, dependent on specific operations and relationships with individual operators, as well as the underlying needs and desires within specific communities.

These types of factors are better addressed at site-level assessments and/or through consultation with individuals, communities, and rights-holders who may be affected by a proposed development. Criteria excluded does not exclude its importance for aquaculture planning; but rather reflects the needs and scope of this project, and limitations in data or knowledge.

4 Results

The suitability assessments resulted in a generated suitability map for each assessed species, showing each 'cell' (100 m by 100 m area) as one of four ratings: restricted, limited, moderate, or good ([Figure 6](#), [Figure 7](#), [Figure 8](#), and [Figure 9](#)). A total of 13,262 km² of coastal waters were classified across the province's coastline.

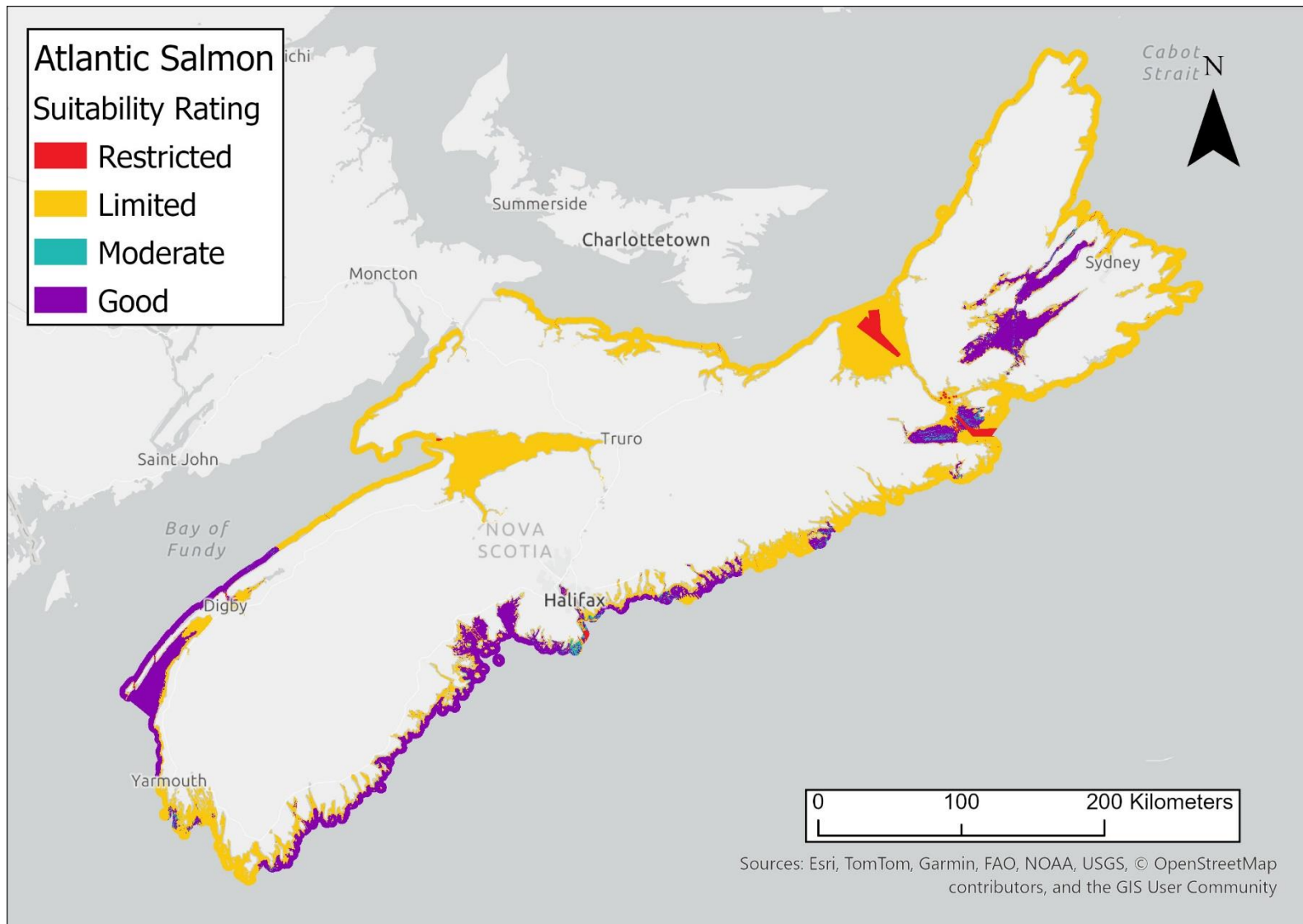


Figure 6. Suitability ratings for Atlantic salmon (*Salmo salar*) across Nova Scotia’s coastal waters.

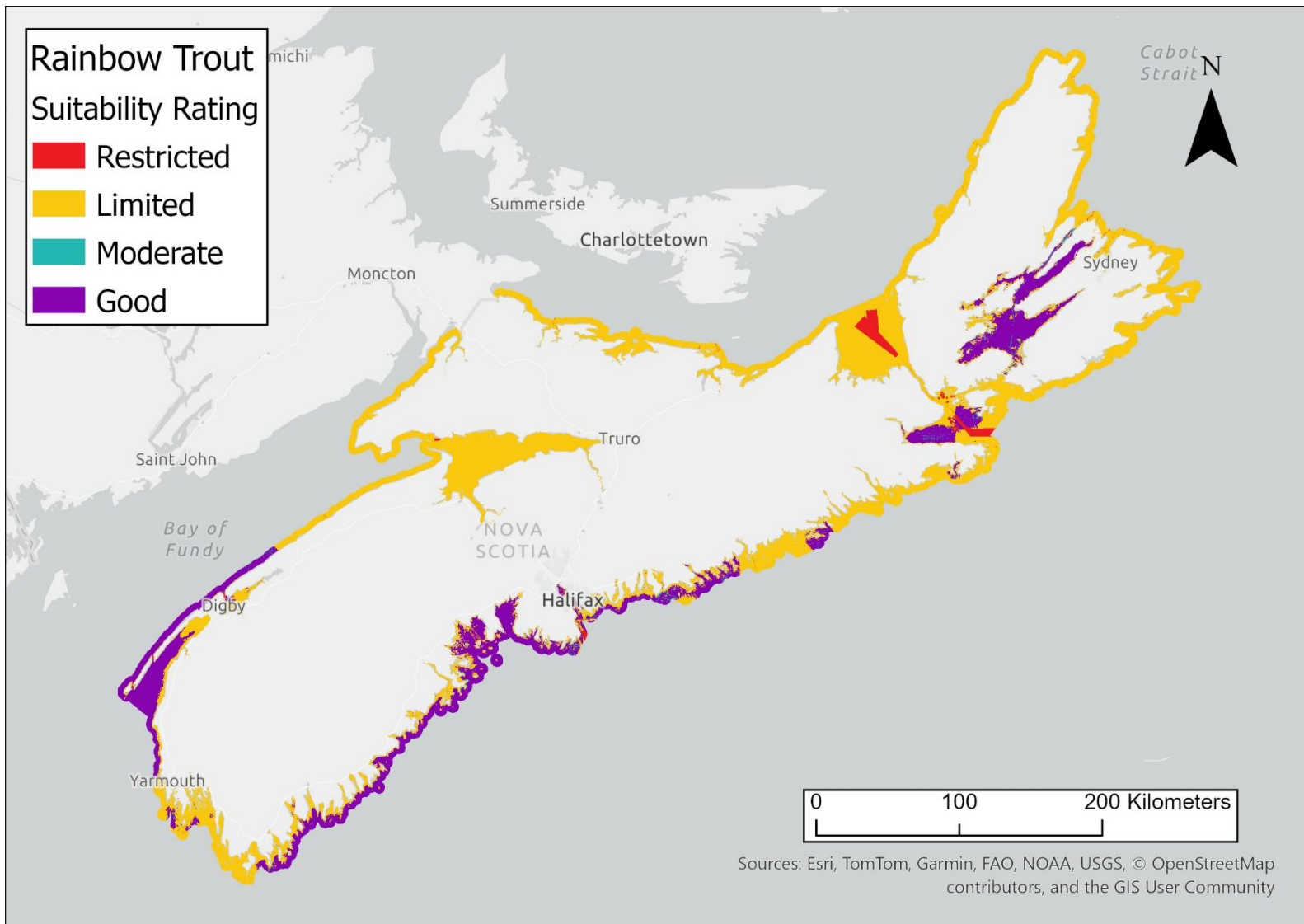


Figure 7. Suitability ratings for Rainbow trout (*Oncorhynchus mykiss*) across Nova Scotia's coastal waters.

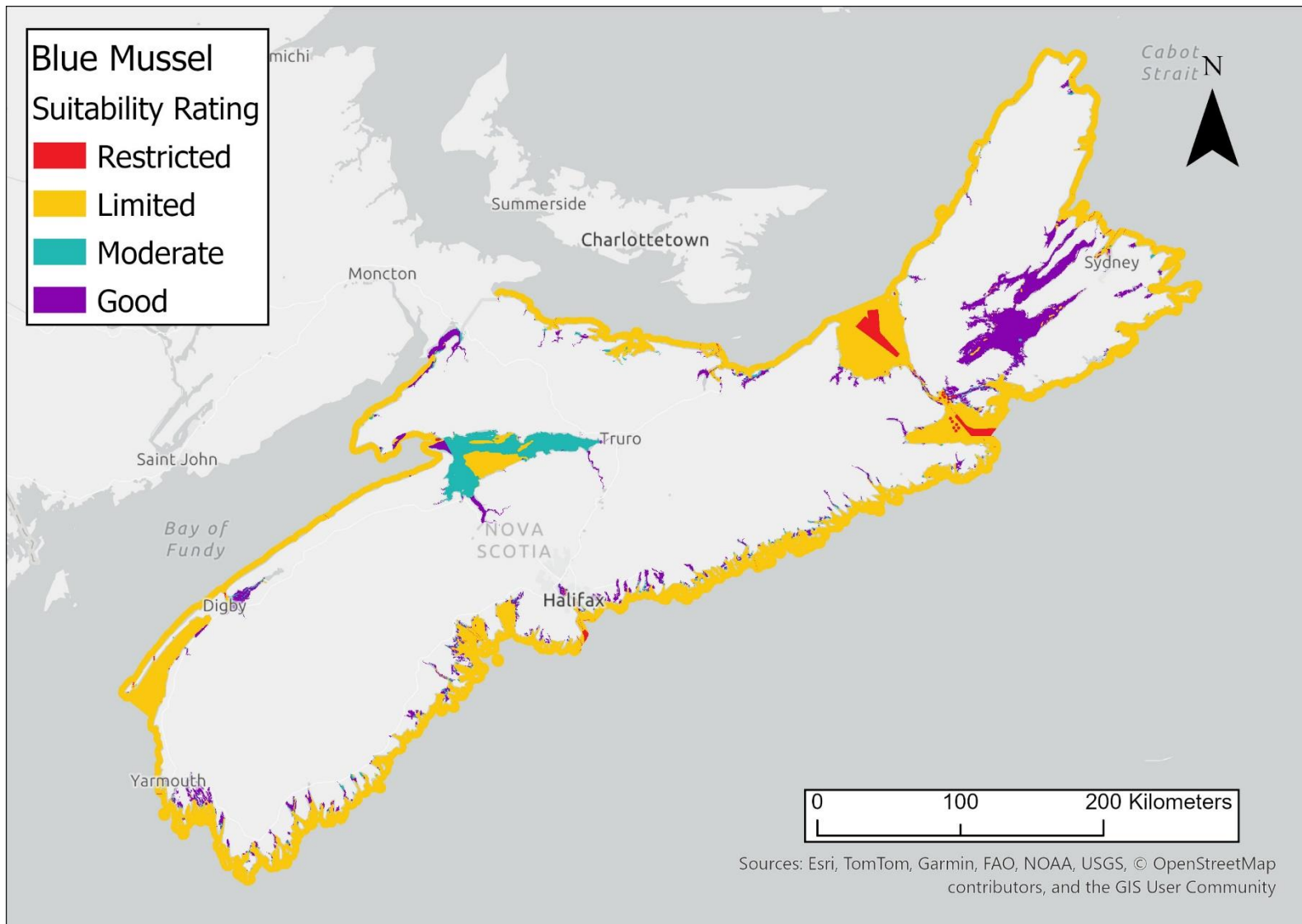


Figure 8. Suitability ratings for Blue mussel (*Mytilus edulis*) across Nova Scotia’s coastal waters.

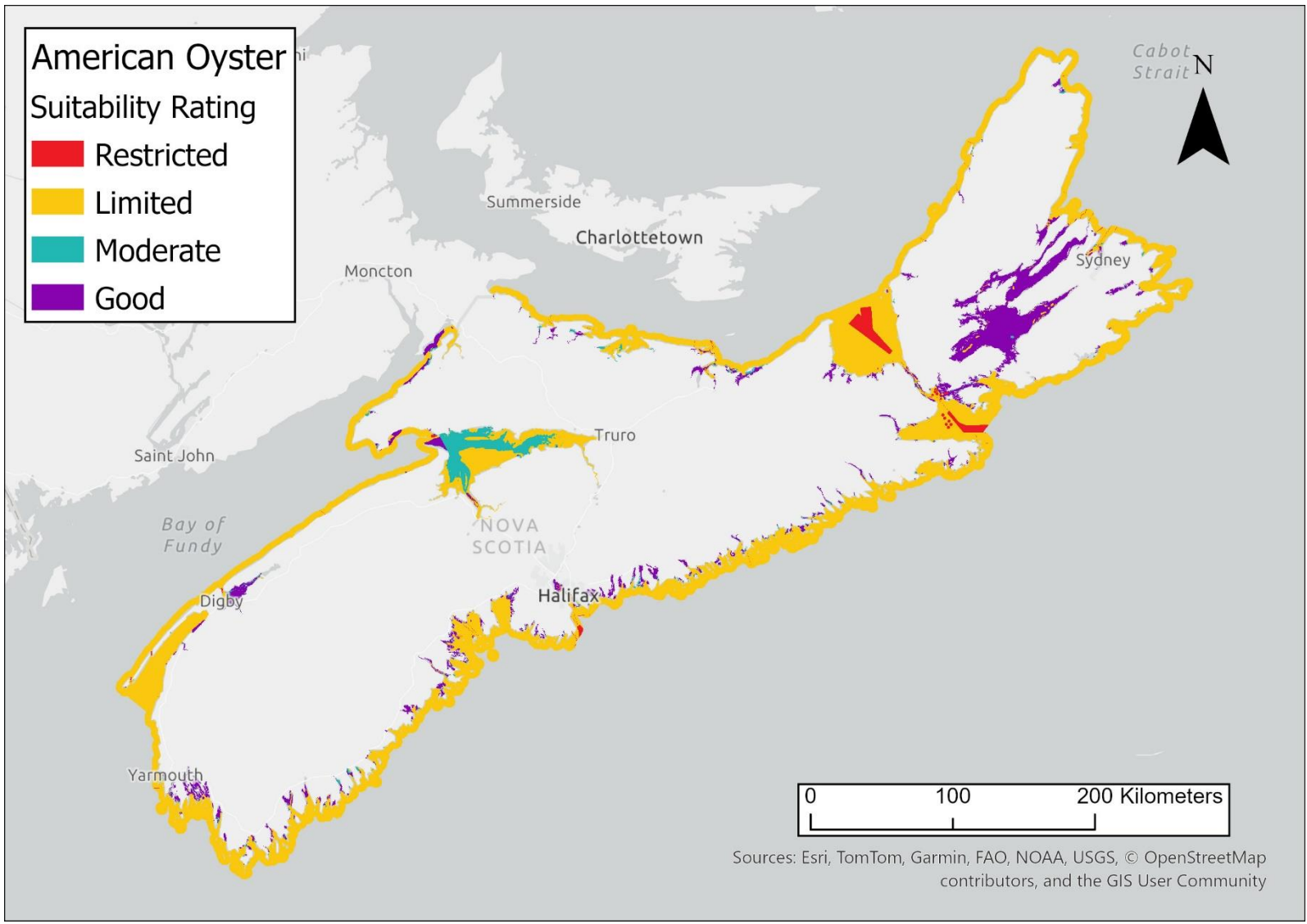
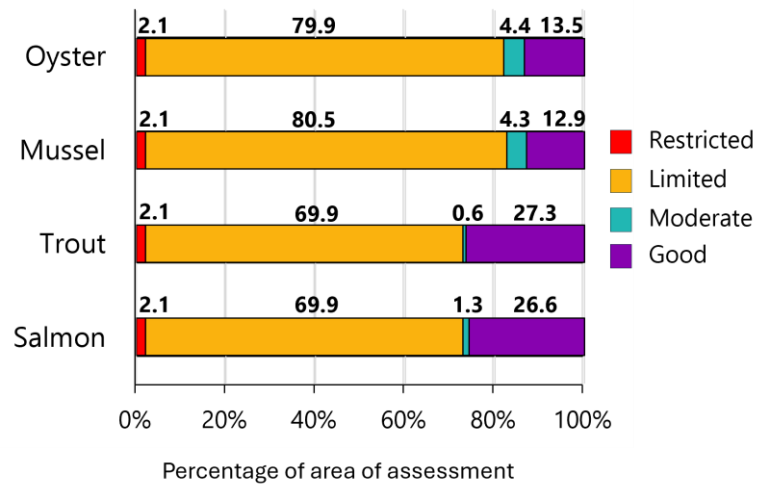


Figure 9. Suitability ratings for American oyster (*Crassostrea virginica*) across Nova Scotia’s coastal waters.

In Nova Scotia marine waters, 2.1% of the assessed area was considered 'restricted' for aquaculture development (Figure 10). Restrictions were present predominantly in major traffic separation zones adjacent to high-use ports (responsible for 87.5% of restricted area – Appendix VI). For shellfish species, ~13% of the area of assessment was classed as well-suited for aquaculture development. Significant limiting factors included wind and wave exposure (high wind and wave present in 77.11% of the AOA) (Figure 11A). For finfish species, just over a quarter of the area of assessment was classed as well-suited for potential aquaculture development (Figure 10). Significant factors limiting finfish aquaculture included exposure to extreme cold (60.44% of the AOA was high risk) and bathymetry (32.60% of the AOA was below 10m) (Figure 11B).

Figure 10. Percentage of area of assessment (AOA) assigned as either 'restricted', 'limited', 'moderate', or 'good' for the potential for aquaculture development of each of the four species assessed.



Scoring by Criteria

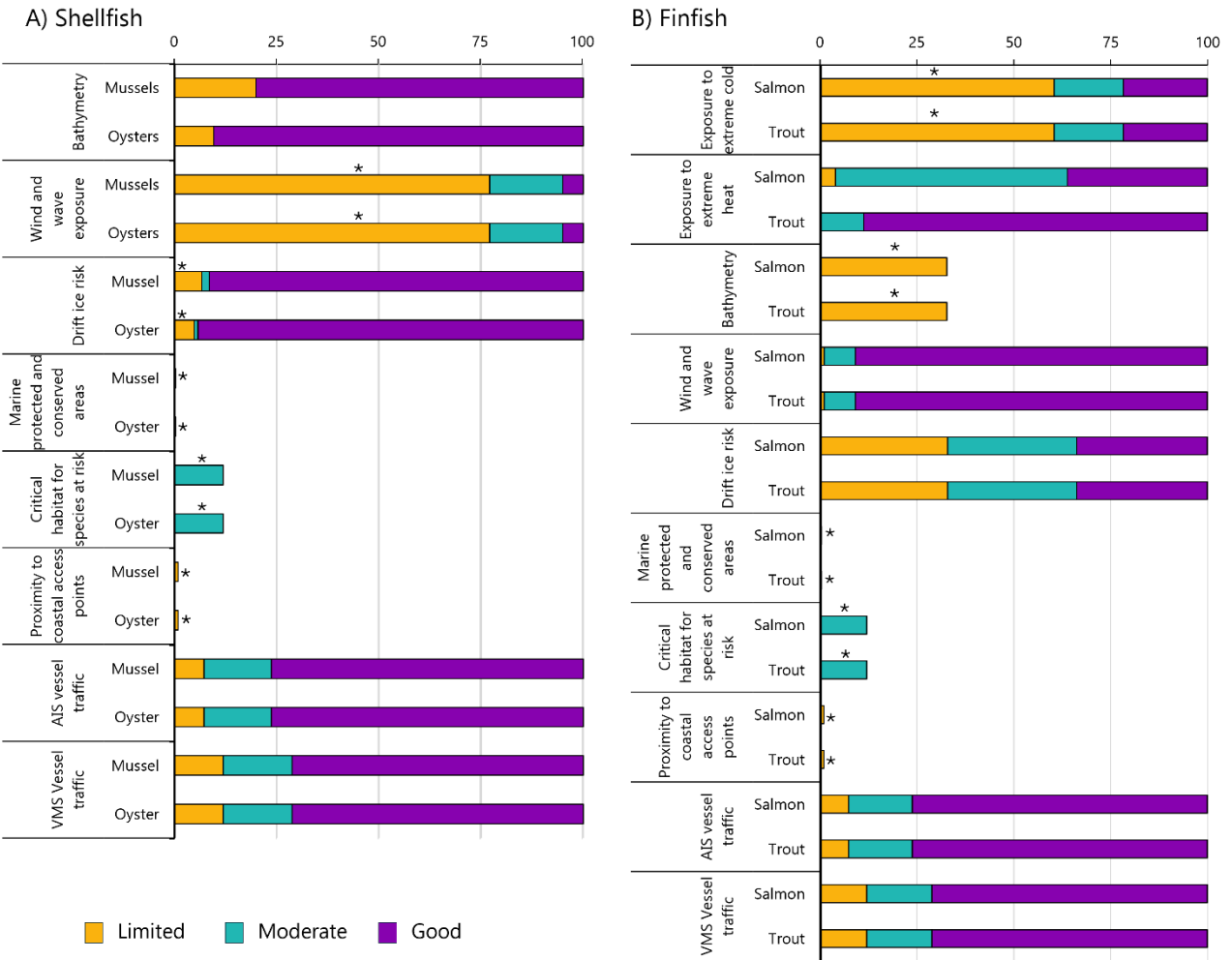


Figure 11. Percentage of the area of assessment (in hectares) each criterion was scored, for assessed A) shellfish and B) finfish species. Asterisks (*) above or beside bars indicate where scoring was a limiting condition in the aggregated suitability maps.

For each species assessed, we describe the general trends in suitability results across seven broad aquaculture regions in Nova Scotia (**Figure 12**):

- Gulf Shore;
- Bras d'Or;
- Cape Breton;
- Eastern Shore;
- South Shore;
- Fundy-Yarmouth; and
- Upper Fundy.

The regions described here, as originally presented in Stantec (2009) are offered to enable for a more consistent discussion of regional trends in data. Each region has unique biophysical and socio-economic characteristics that influence how suitability results are interpreted and considered.

Below, we first describe the general regional conditions and state of existing aquaculture, as identified and considered through the criteria assessed. We also present a discussion of the regional potential suitability trends across assessed species. Any other considerations not currently assessed or covered in this assessment are also presented.

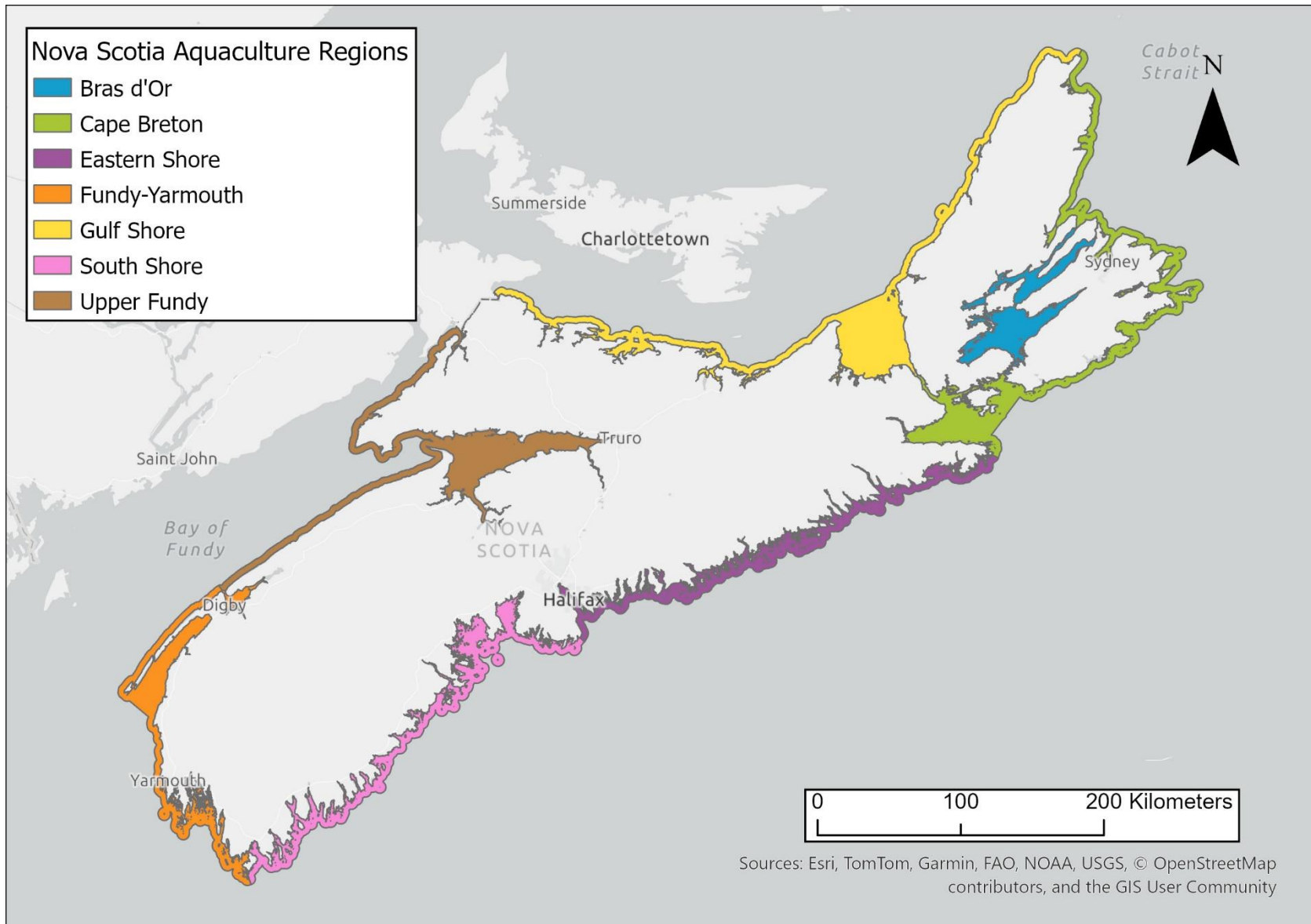


Figure 12. Aquaculture regions in Nova Scotia, as originally described by Stantec (2009).

4.1 Gulf Shore

4.1.1 General regional conditions

The Gulf Shore region includes the coastal areas spanning from the New Brunswick border up to Cape North and Bay St. Lawrence in northern Cape Breton (**Figure 12**). The coastal waters include the warm, shallow waters of the Northumberland Strait as well as the exposed open waters of the Gulf of St. Lawrence in George's Bay and along the northern side of Cape Breton. The region is characterized by extensive winter ice formation between December and March, much of which occurs as drift ice which can enter bays and create significant challenges to aquaculture gear.

The area hosts several shellfish aquaculture leases, located primarily within Tatamagouche Bay, Wallace Harbour, as well as Merigomish Harbour and surrounding bays. There are no finfish leases in the region.

Across the region, several critical habitats for birds have been identified, including the [Bank Swallow \(*Riparia riparia*\)](#), [Piping plover \(*Charadrius melodus melodus*\)](#), and [Bobolink \(*Dolichonyx oryzivorus*\)](#)²⁸. Across the region, two Ecologically and Biologically Significant Areas (EBSAs) have been designated within St. George's Bay and Western Cape Breton, largely for their role in supporting groundfish and pelagic fish species, as well as marine mammals such as seals (DFO, 2009).

The Gulf Shore region is an important throughfare for marine navigation. Ferry routes crossing the Northumberland Strait are present from Pictou to Prince Edward Island and the nearby Pictou Island, as well as important vessel traffic routes in that area (**Appendix III Figure 4**). Within St. George's Bay, there are also important vessel traffic routes leading from the Gulf into Port Hawkesbury, as well as a large traffic separation zone within the bay. The region also supports some high use commercial fishing, including fisheries for herring, snow crab, halibut, and lobster.

4.1.2 Suitability potential

The Gulf Shore region is largely limited for potential aquaculture development, with only a number of shallow, sheltered bays being rated as "good" for development of shellfish (**Figure 13**). Beyond the sheltered bays along the coast²⁹, the region is predominantly limited for shellfish by high wind and wave conditions which occur across 93.27% of the region (**Figure 14**). In some areas, risk of exposure to drift ice is high, limiting 10.09% of the region for mussel culture and 5.65% of the region for oyster aquaculture. In several harbours, potential sewage contamination from nearby municipalities may be an issue, with several areas regularly closed for shellfish harvesting under the CSSP.

²⁸ The critical habitat for Bobolink is primarily terrestrial as the species mostly occurs across grasslands. However, the defined critical habitat does intersect within the area of assessment, and thus is included here.

²⁹ Such as Tatamagouche, Pictou, and Antigonish

For finfish, the potential for development is limited or restricted across the region, primarily from high risk of exposure to extreme cold conditions, which occur consistently across the entire region (**Figure 14**). The area is also shallow, with over a quarter (29.62%) of the region being below 10 m water depths. The Gulf region has the most restrictions in the province, with navigation features present across 6.26% of the region.

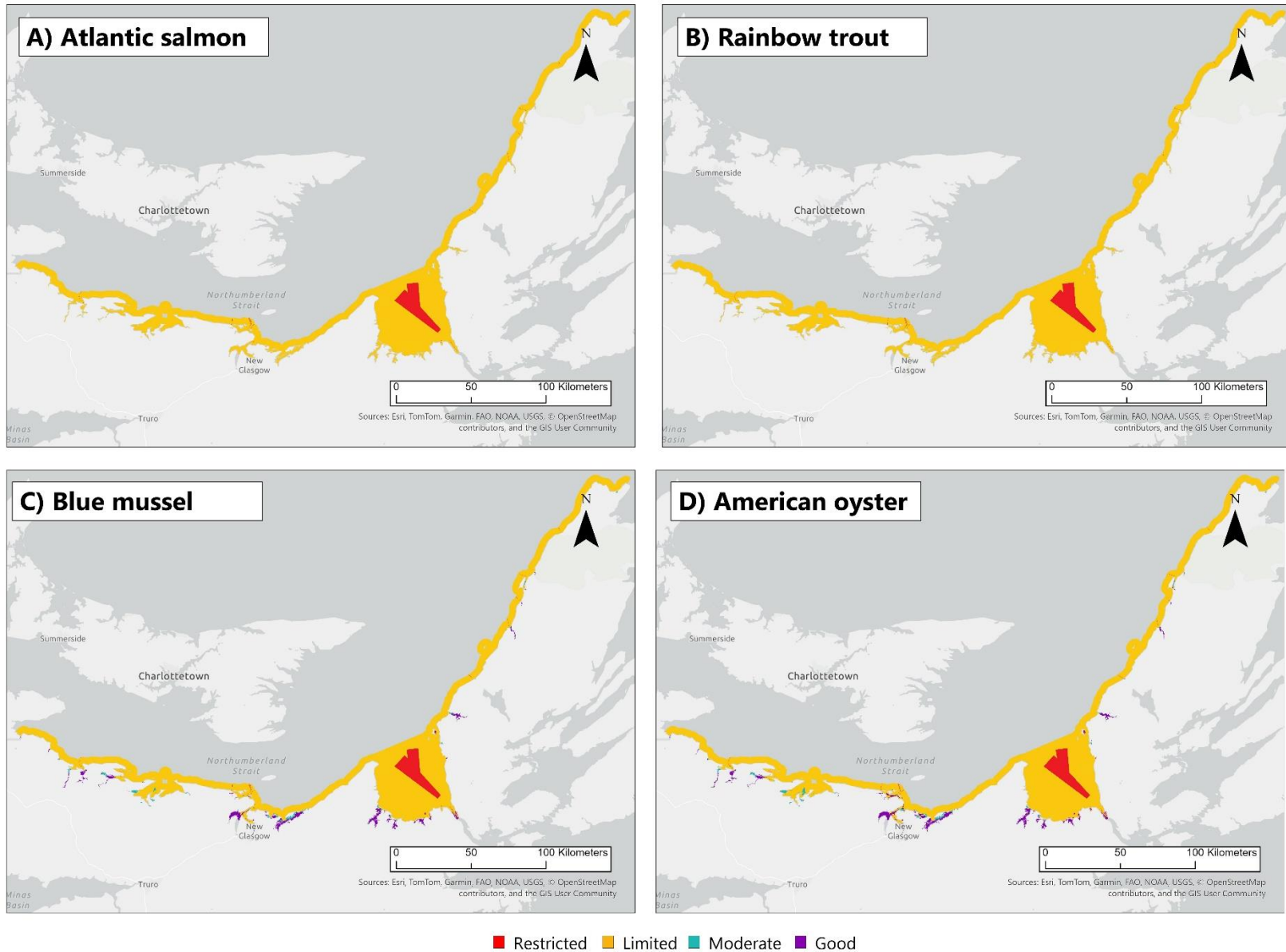
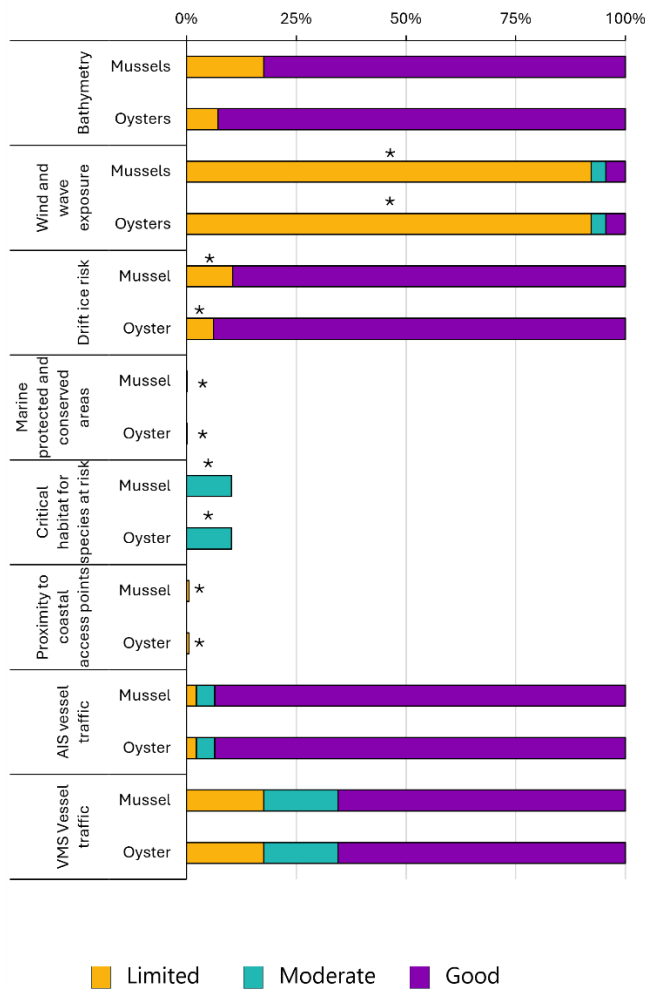


Figure 13. Suitability ratings across the Gulf Shore aquaculture region for four assessed species.

Gulf Shore scoring by criteria

A) Shellfish



B) Finfish

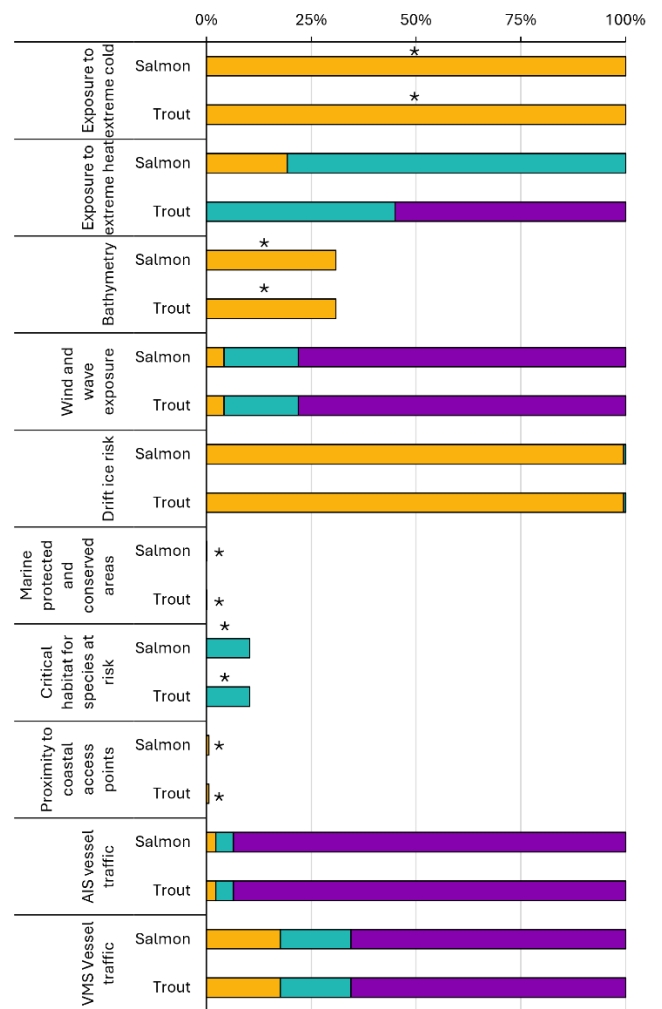


Figure 14. Percentage of the total area (in hectares) of the Gulf shore aquaculture region each criterion was scored, for assessed A) shellfish and B) finfish species. Asterisks (*) above or beside bars indicate where scoring was a limiting condition in the aggregated suitability maps.

4.2 Bras D'Or

4.2.1 General regional conditions

The Bras D'Or Lake is a unique inland estuarine ecosystem, representing a set of interconnected saltwater basins in Cape Breton Island (**Figure 12**). The lakes are connected to the Atlantic by three narrow channels, with exchange primarily through the Great Bras D'Or channel, connecting the lakes to Sidney Bight. There is wide variability in the physical environment within the Bras D'Or, with different areas ranging from shallow flat-bottomed areas to deep, steep-sided areas. Furthermore, chemical processes and water circulation vary considerably across small bays within the Bras D'Or, and may be very different than they are for the interconnected waters as a whole (Strain and Yeats, 2002). Overall, the area is considered to have low levels of natural biological productivity.

Existing finfish sites are located largely within Whycocomagh Bay and St. Patrick's Channel, culturing Rainbow trout. While various oyster culture leases are present in the region, many are underutilized due to a range of issues (Stantec, 2009). In particular, the emergence of MSX since 2002 has decimated the culture of American oyster (Parker et al., 2007), with mortality rates reaching 90-95% (Andrews and Wood, 1967; Barber et al., 1997).

Historically, much of the Bras D'Or becomes ice-covered during the winter months (Parker et al., 2007). In this region, with minimal tidal flushing, ice cover can influence temperature, salinity, and oxygen availability. Temperature profiles within the region are highly variable, influenced by a strong thermocline, and some surface waters closely following atmospheric temperatures (Parker et al., 2007). Temperatures can fall to 0 °C or lower in the winter. In summer, waters can reach up beyond 20 °C due to warm air temperatures and freshwater inputs, although cooler water may be available at depths.

The region supports a variety of habitats for important and sensitive marine species. Previous studies have found thin but consistent coverage of eelgrass along many shores within the Lakes, although many are known to be in poor shape (Vandermeulen, 2016). There are several significant wild Atlantic salmon rivers that have outflows into the Bras D'Or, such as the Baddeck River, Middle River, Skye River, and River Denys. Both the Baddeck and Middle Rivers support recreational angling, and rivers are known to have overall good habitat to support wild salmon populations.

4.2.2 Suitability potential

The assessment results indicate relatively good overall potential for aquaculture development within the Bras D'Or Lakes region (**Figure 15**). Areas within the Great Bras D'Or channel and St. Peter's Channel have areas of moderate suitability, largely due to the presence of marine vessel traffic in and out of the Bras D'Or. Within these areas, there are a few restrictions for navigation, including the presence of anchorages and recommended tracks (**Appendix VI**).

While minimal, limited areas for shellfish exist along some areas where wind and wave exposure may be high (1.45% of the region), and in nearshore areas in proximity to important public access points (0.45% of the region). For mussels, bathymetry may be limited in some areas, as 8.33% of the region is below 5 m³⁰ water depths (**Figure 16A**). Bathymetry may also limit finfish aquaculture in this region in some areas close to shore are within narrow channels, as 20.97% of the region was below 10m (**Figure 16B**). The region is also characterized by a medium risk of both exposure to extreme cold and extreme heat temperatures, which may create challenges for finfish species growth. In this region, risk ratings reflect a lack of high-resolution temperature data in the region, meaning that there may be regional variability that may make some areas exposed to temperature risks. As the region is known to regularly freeze in the winter, with some areas at high risk for exposure to drift ice (4.86% of region), this may create challenges in some areas for future finfish aquaculture.

³⁰ However, bathymetry in this region may be coarse, and there may be pockets of deeper waters within channels that are not captured in available datasets. Gaps in high resolution NONNA-10m bathymetry mean water depths are estimated using coarser datasets.

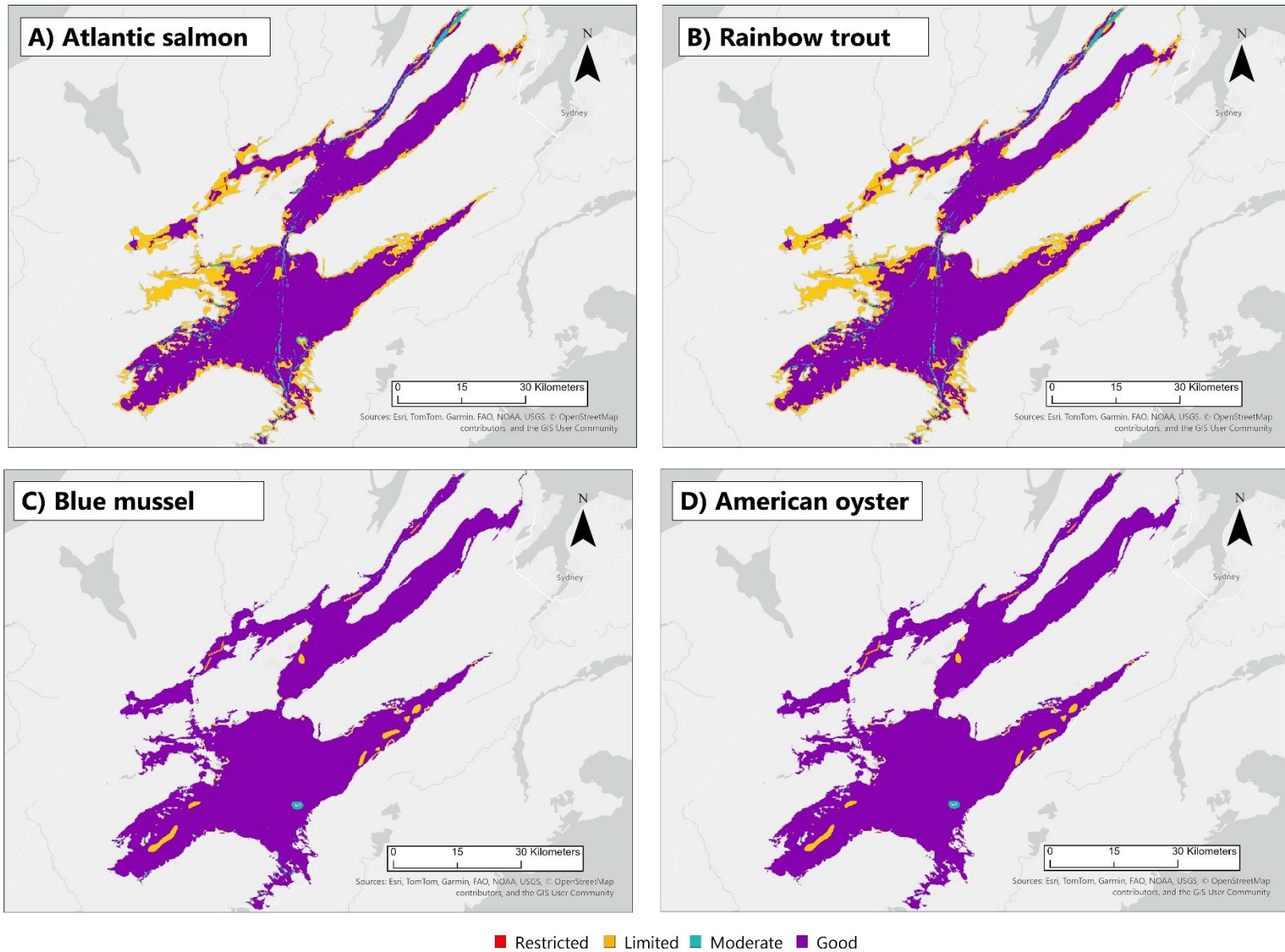
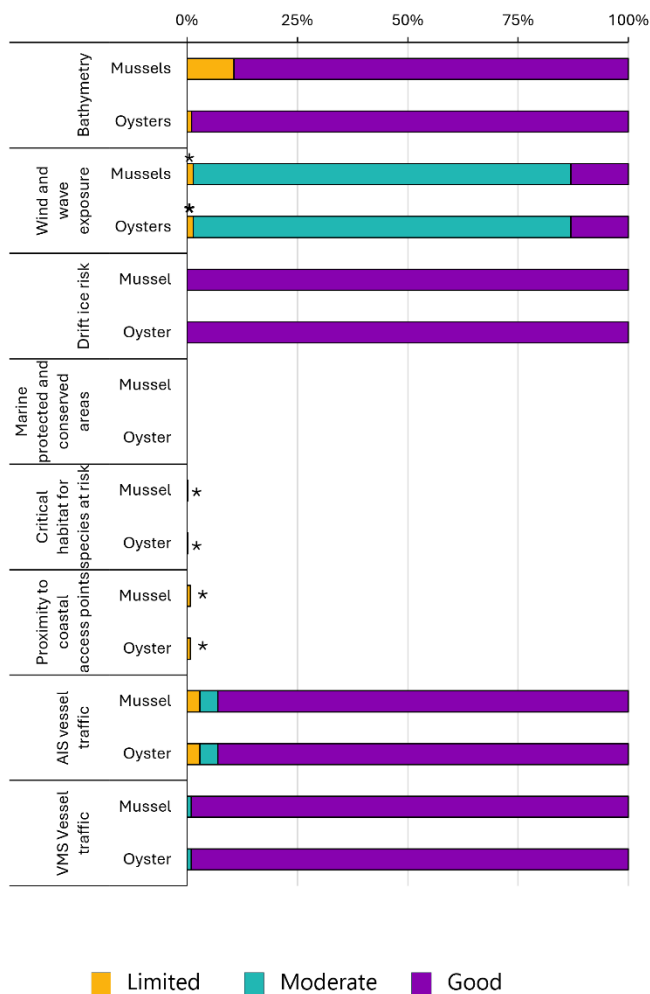


Figure 15. Suitability ratings across the Bras D'Or Lakes aquaculture region for four assessed species
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Bras D'Or scoring by criteria

A) Shellfish



B) Finfish

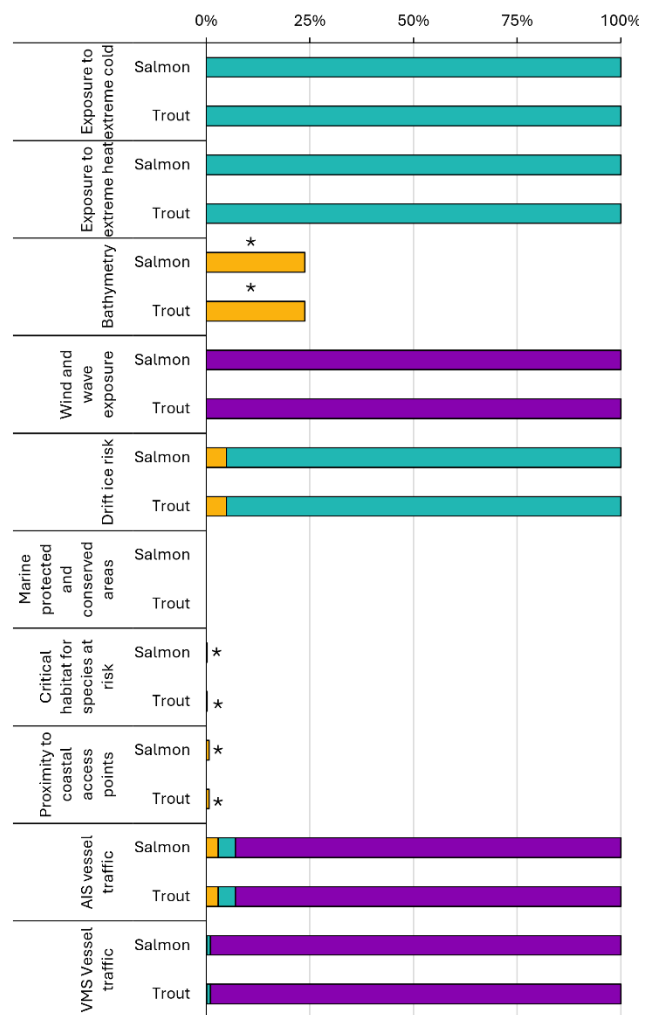


Figure 16. Percentage of the total area (in hectares) of the Bras D'Or aquaculture region each criterion was scored, for assessed A) shellfish and B) finfish species. Asterisks (*) above or beside bars indicate where scoring was a limiting condition in the aggregated suitability maps.

4.3 Cape Breton

4.3.1 General regional conditions

The region of Cape Breton encompasses coastal waters between Cape North at the tip of Cape Breton down to Canso at the edge of Guysborough County (**Figure 12**). The region contains key areas such as Chedabucto Bay and the waters of Sydney Bight. These areas are characterized by increased industrial activity and high vessel traffic into key ports such as Port Hawkesbury and Sydney, but also to an array of other smaller ports that provide recreational and commercial traffic. The area is relatively limited in terms of existing aquaculture, with most leases licensed to grow shellfish such as Blue mussels within St. Ann's Bay and scattered around the waters of Ile Madame.

The waters of Sydney Bight host regular ice coverage in the winter, mainly from drifting sea ice from the Gulf of St. Lawrence. In the summer, the Gulf also provides a source of warmer waters across the region.

Much of the Cape Breton region is along the exposed side of the Atlantic Ocean, where high wind and wave exposure is present. In the region, the 10-year maximum significant wave height (m) regularly exceeds 3 m, particularly along the eastern shores between Sydney Bight and Chedabucto Bay.

A number of protected beaches and terrestrial provincial parks border the coastline. There are a few protected marine habitats, including the Big Glace Bay Lake Migratory Bird Sanctuary, which hosts critical habitat for endangered [Piping plover \(*Charadrius melodus melodus*\)](#).

4.3.2 Suitability potential

The Cape Breton region has predominantly limited potential for aquaculture development across most coastal waters, except for clusters within particular waterbodies or bays (**Figure 17**). Compared to other regions, Cape Breton hosts several restrictions, primarily from large Traffic Separation Zones (totalling 6082 hectares). There are also anchorage areas (0.92% of the region) within Chedabucto Bay, as well as navigation routes and submerged cables within the Sydney Bight, leading across the ocean to Newfoundland. There are also several critical habitats for species at risk across the region (5.94% of the region) that may require further investigation for potential aquaculture operations.

For shellfish, "good" potential areas for development are concentrated around the shallow sheltered waters on the North-Western side of Ile Madame (**Figure 17**). Most areas across the rest of the region are limited due to high wind and wave conditions (91.08% of the region) (**Figure 18A**). In the Sydney Bight area, some shallow regions are also limited for both oysters and mussels due to regular exposure to drift ice. However, both the areas around Port Hawkesbury and Sydney are also prohibited for shellfish harvesting under the CSSP due to consistent bacterial contamination near high-use ports.

Much of the potential for finfish aquaculture development in the Cape Breton region is limited, with large portions of the region (85.12%) have a high risk of extreme cold exposure, creating

significant mortality risks to year-round culture of salmon and trout (**Figure 18B**). Within Chebaducto Bay, there are some areas of 'moderate' to 'good' potential (**Figure 17**). While this area supports well-flushed deep waters suitable for finfish growth, there remain moderate temperature and ice risks (**Figure 18B**). In addition, the area is a widely trafficked bay, with significant commercial and fishing routes into major ports as well as smaller fishing harbours.

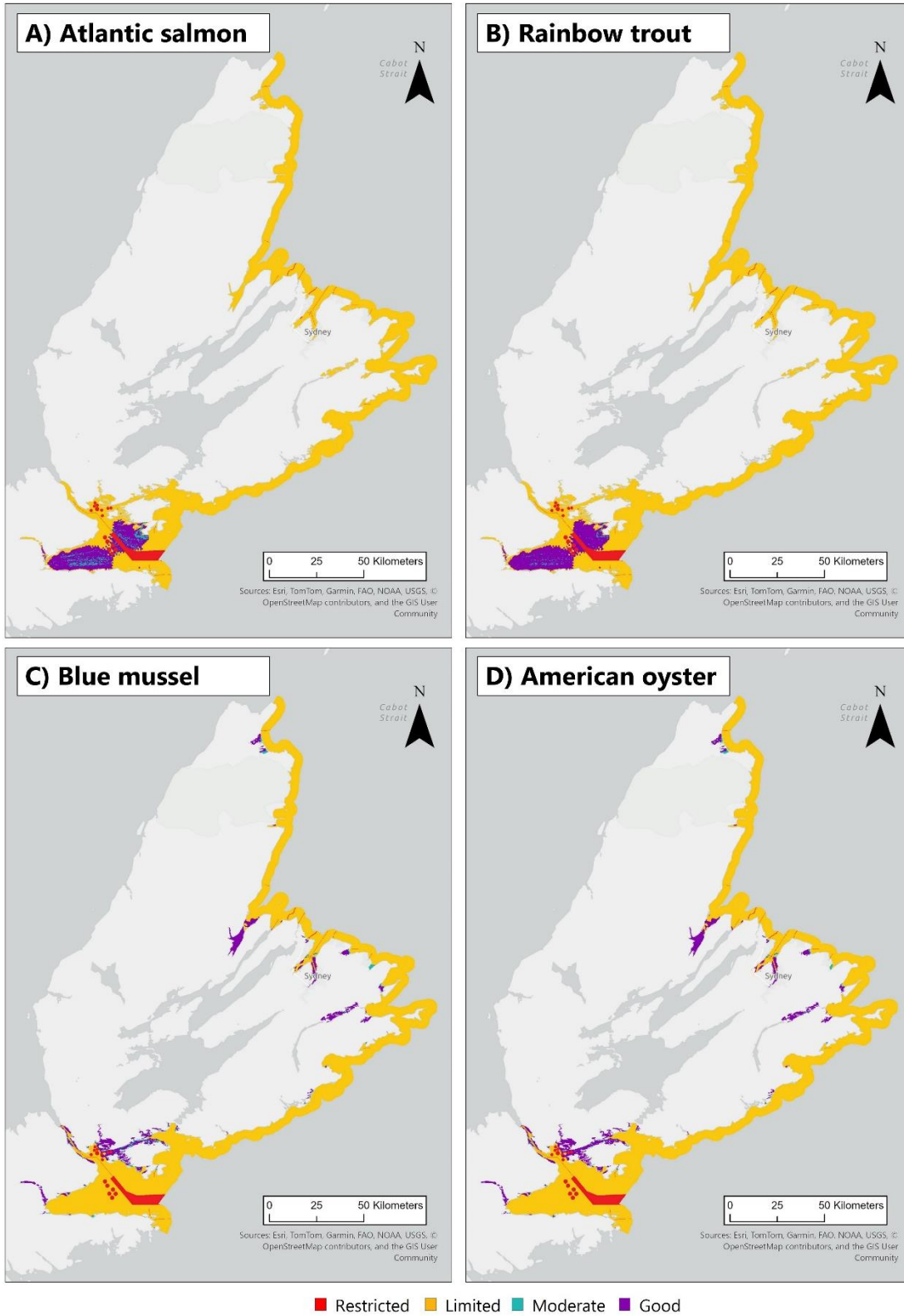


Figure 17. Suitability ratings across Cape Breton aquaculture region for four assessed species.

Cape Breton scoring by criteria

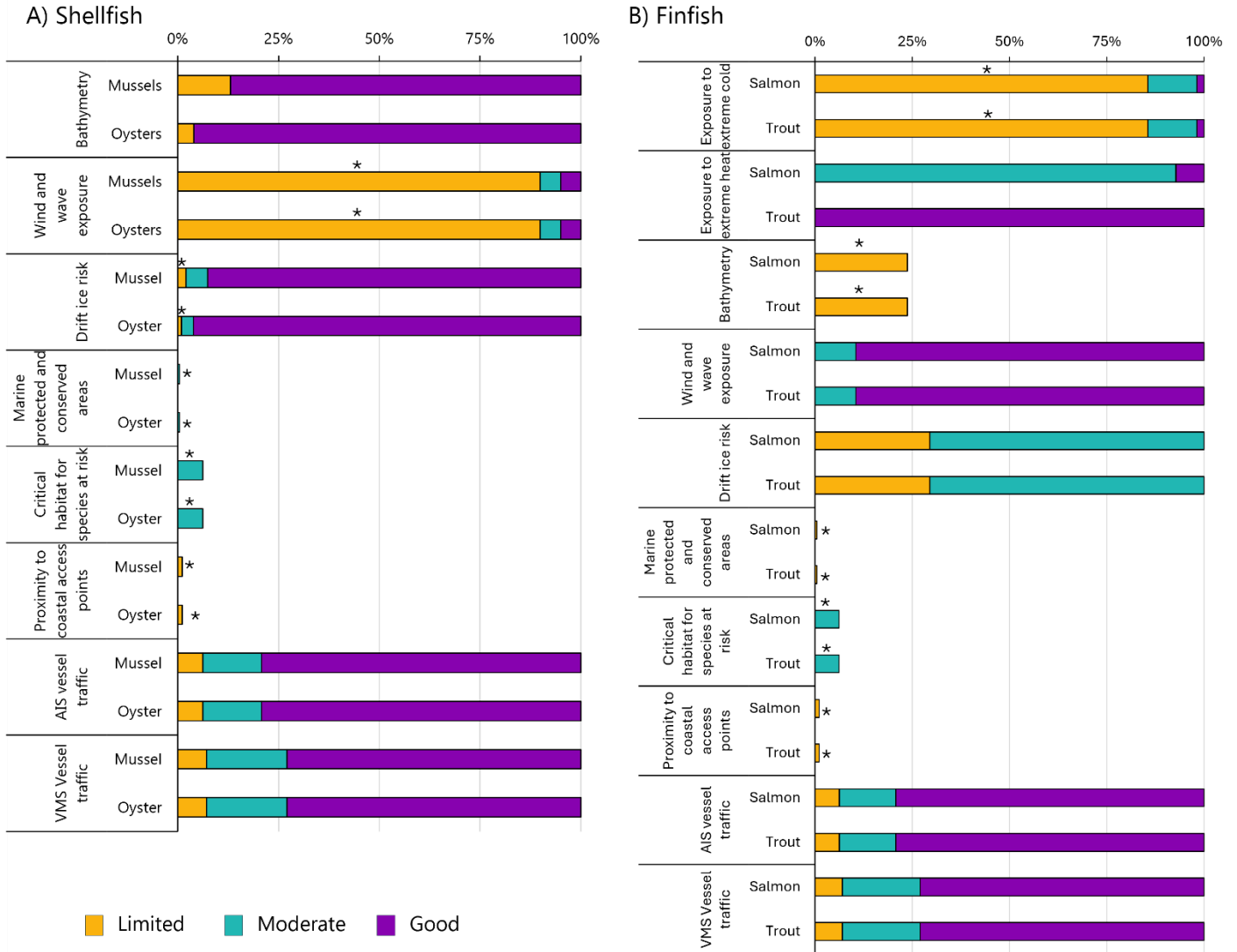


Figure 18. Percentage of the total area (in hectares) of the Cape Breton aquaculture region each criterion was scored, for assessed A) shellfish and B) finfish species. Asterisks (*) above or beside bars indicate where scoring was a limiting condition in the aggregated suitability maps.

4.4 Eastern Shore

4.4.1 General regional conditions

The Eastern Shore aquaculture region includes coastal waters from Sambro, including the Halifax Harbour, up north to Canso (**Figure 12**). Beyond the city of Halifax and its approaches, The Eastern Shore region is characterized by a complex, archipelago-dominated coastline with significant biodiversity and low population density and coastal development. Winter ice conditions and risks of cold-water temperatures may become a challenge further north along the coastline, where temperatures get below 0°C and ice may develop in the winter. Beyond the sheltered archipelagoes and inlets, the area is largely exposed to high wind and waves, with significant wave heights exceeding 3 meters across much of the region.

There are currently both finfish and shellfish leases along the Eastern Shore, with areas of interest for aquaculture being around the Country Harbour, Whitehead Harbour, Ship Harbour areas.

Within the Region, the area shown as the Eastern Shore Islands has been identified an **Ecologically and Biologically Significant Area** by DFO. This part of the region also hosts the **Eastern Shore Islands Wildlife Management Area** to protect nesting habitat for many colonial birds. The area is also known to have considerable biogenic habitats, including salt marshes, and habitat supporting eelgrass and kelps (DFO, 2019).

4.4.2 Suitability potential

The Eastern Shore has some areas of good potential for aquaculture development across its numerous smaller bays (**Figure 19**). The area has few restrictions (0.89% of the region), which are primarily related to anchorage points nearby local fishing ports. There are also areas of significant vessel traffic, particularly in the approaches of some of the important fishing ports, such as Jeddore, as well as the area around Halifax Harbour.

For finfish, some of the region has good potential for development of Atlantic salmon and Rainbow trout, located primarily within the southern half of the Eastern Shore region (**Figure 19**). Further north, there is a high risk of exposure to extreme cold, which acts as a limiting condition for just over half (55.77%) of the region (**Figure 20B**). Shallow water depths may also limit several coastal areas for finfish, as just under a third (31.80%) of the region is below 10 m.

Beyond the shallow bays, much of the area is limited for shellfish due to high wind and wave exposure (90.24% of the region) (**Figure 20A**). In this region, some more industrialized areas are also prohibited for shellfish aquaculture harvesting under the CSSP, including the Halifax Harbour and regions within Isaac's Harbour.

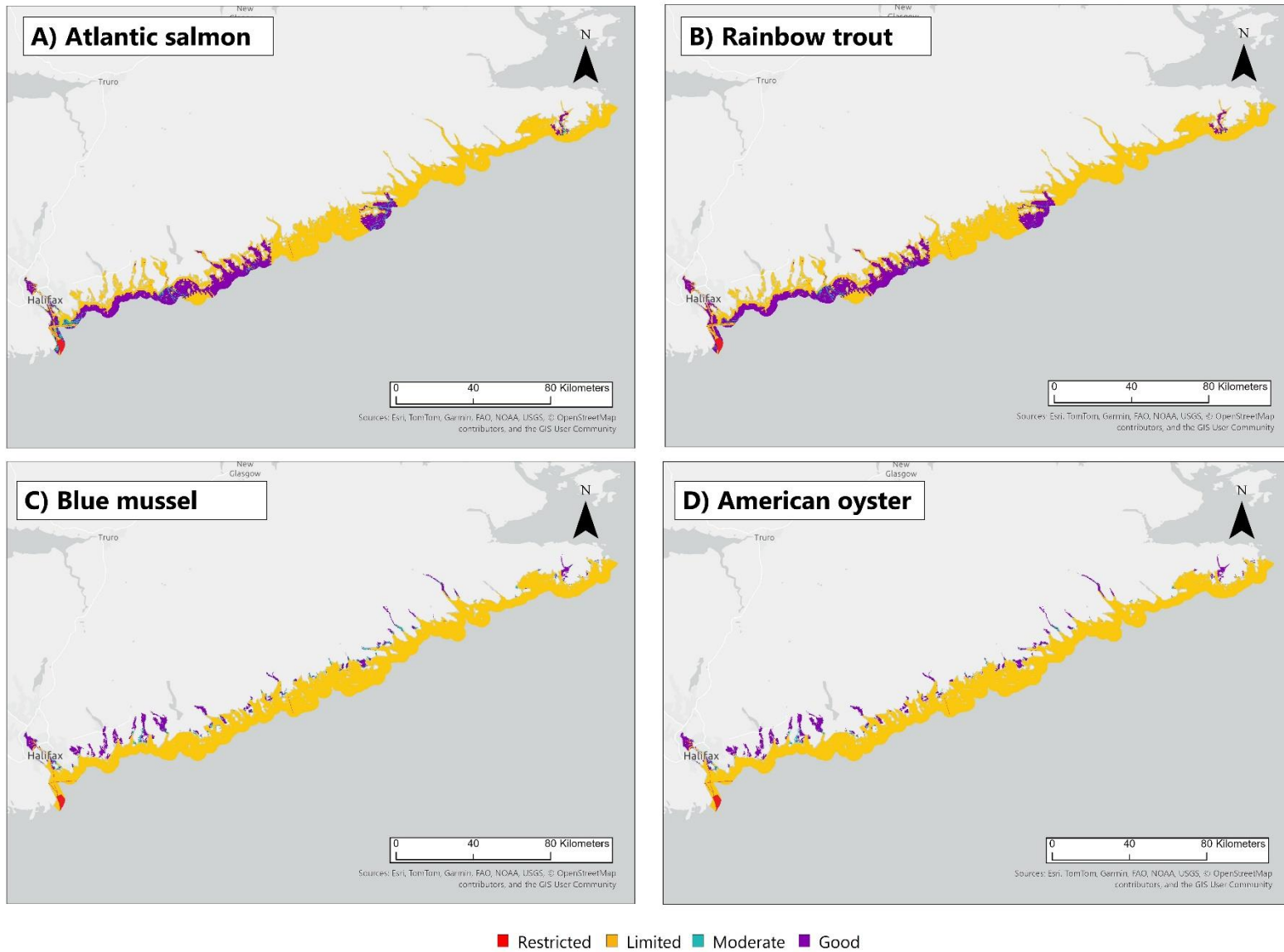
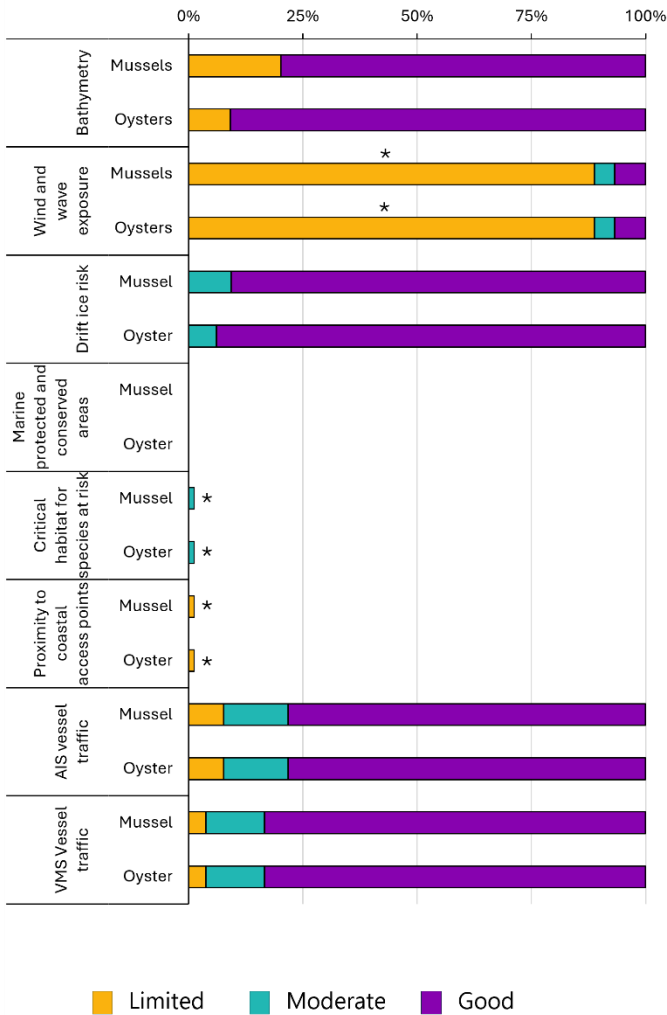


Figure 19. Suitability ratings across the Eastern Shore aquaculture region for four assessed species

Eastern Shore scoring by criteria

A) Shellfish



B) Finfish

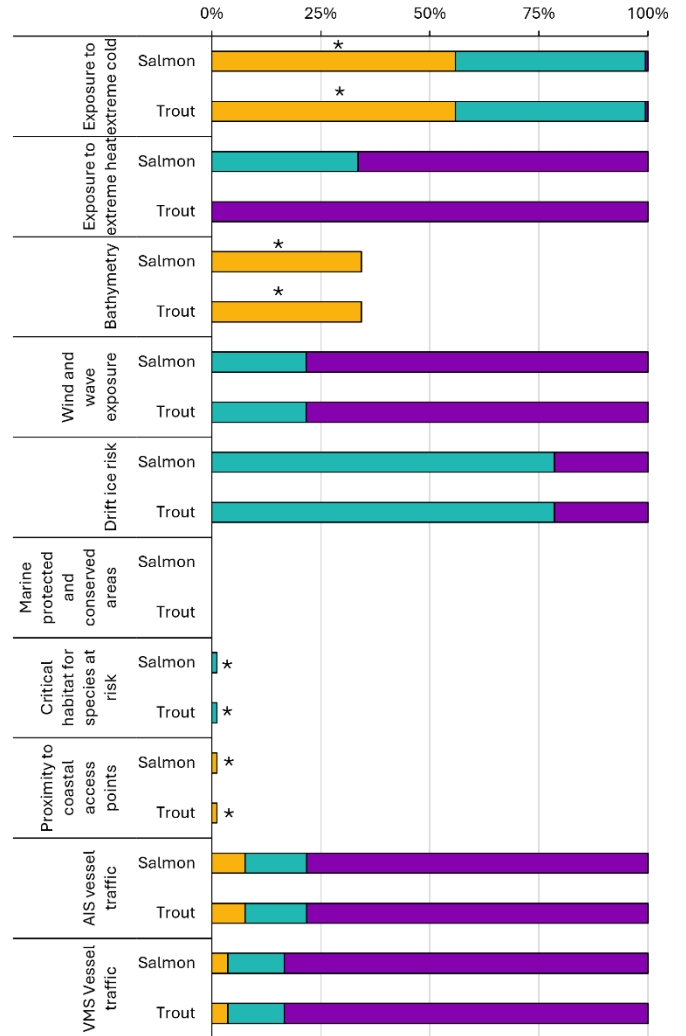


Figure 20. Percentage of the total area (in hectares) of the Eastern Shore aquaculture region each criterion was scored, for assessed A) shellfish and B) finfish species. Asterisks (*) above or beside bars indicate where scoring was a limiting condition in the aggregated suitability maps.

4.5 South Shore

4.5.1 General regional conditions

The South Shore region extends from Sambro southwest along the coastline out to the eastern edge of Cape Sable Island (**Figure 12**). The region is characterized by an irregular coastline, with many small bays, inlets, and islands, offering several sheltered intertidal areas. Coarse, sandy beaches are common, along with small, scattered wetlands. Salt marshes are scattered across the South Shore, and significant pockets of eelgrass across much of the region (Allard et al., 2014). Yet, at the mouth of embayments, the area becomes deeper and more exposed to the fetch of the Atlantic Ocean. Temperatures are relatively mild along the South Shore, with comparatively cool summer temperatures and milder winter temperatures than other regions.

There are a number of existing finfish and shellfish aquaculture leases in the region. Leases are located across several bays, including notably areas around Shelburne, Liverpool, and Mahone Bay.

The South Shore region includes the waters encompassing Lobster Fishery Area 33, the second most productive lobster fishery in the region. Other important fisheries in the area include for snow crab, haddock, halibut, and tuna. Here, a number of small craft harbours and larger ports line the coastline, including for major ports such as Lunenburg, Bridgewater and Shelburne, where increased vessel traffic across the region.

Along the South Shore, several EBSAs have been identified (DFO, 2012). Within this region, numerous sandy beaches support Critical Habitat for Endangered Piping Plover (*Charadrius melodus melodus*) and bank swallow. A number of IBAs have also been identified across the region. The Port Joli and surrounding areas EBSA encompasses three Migratory Bird Sanctuaries (Port Hebert, Port Joli, and Sable River), as well as known to have significant salt marsh and eelgrass habitat (Allard et al., 2014). The region also contains the Mahone Bay EBSA, known for high habitat heterogeneity, as well as potential suitable spawning habitat for wild Atlantic salmon from the Mushamush River and Gold River watersheds (Hastings et al., 2014). Other EBSAs within this region are described further in Hastings et al. (2014).

4.5.2 Suitability potential

The South Shore is generally a good area for potential aquaculture development (**Figure 21**), with very few restrictions across the region.

For finfish, “good” areas for potential development are present within 65.58% of region for Atlantic salmon, and 66.87% of the region for Rainbow trout. For shellfish, there are some areas of “good” suitability, although they consist less than 10% of the region. Furthermore, some of the sheltered bays in the region are at risk of contamination from nearby coastal development and regularly have prohibitions or restrictions under the CSSP program that may create challenges to shellfish development.

There are a number of bays and inlets along the South Shore that provide suitable biophysical conditions for finfish aquaculture (**Figure 21**), including adequate depth, protection from exposure and low risk of exposure to extreme temperatures (**Figure 22**). Some areas within the nearshore of bays may limit aquaculture, with depths below 10 m limiting finfish across 30.14% of the region. Depth considerations are also relevant for shellfish, as 16.55% of the area is below 5 m generally required for mussel suitability. For shellfish, however, high wind and wave exposure is the critical limiter, limiting 90.71% of the region (**Figure 22**).

However, there are also several high-use ports (like Lunenburg, Bridgewater, Shelburne) with important vessel routes (**Appendix III Figure 4**), hosting increased commercial vessel traffic (**Figure 22**). Furthermore, several areas also support high levels of fishing traffic. At times high marine vessel traffic increases the potential for overlap with navigational users in this region.

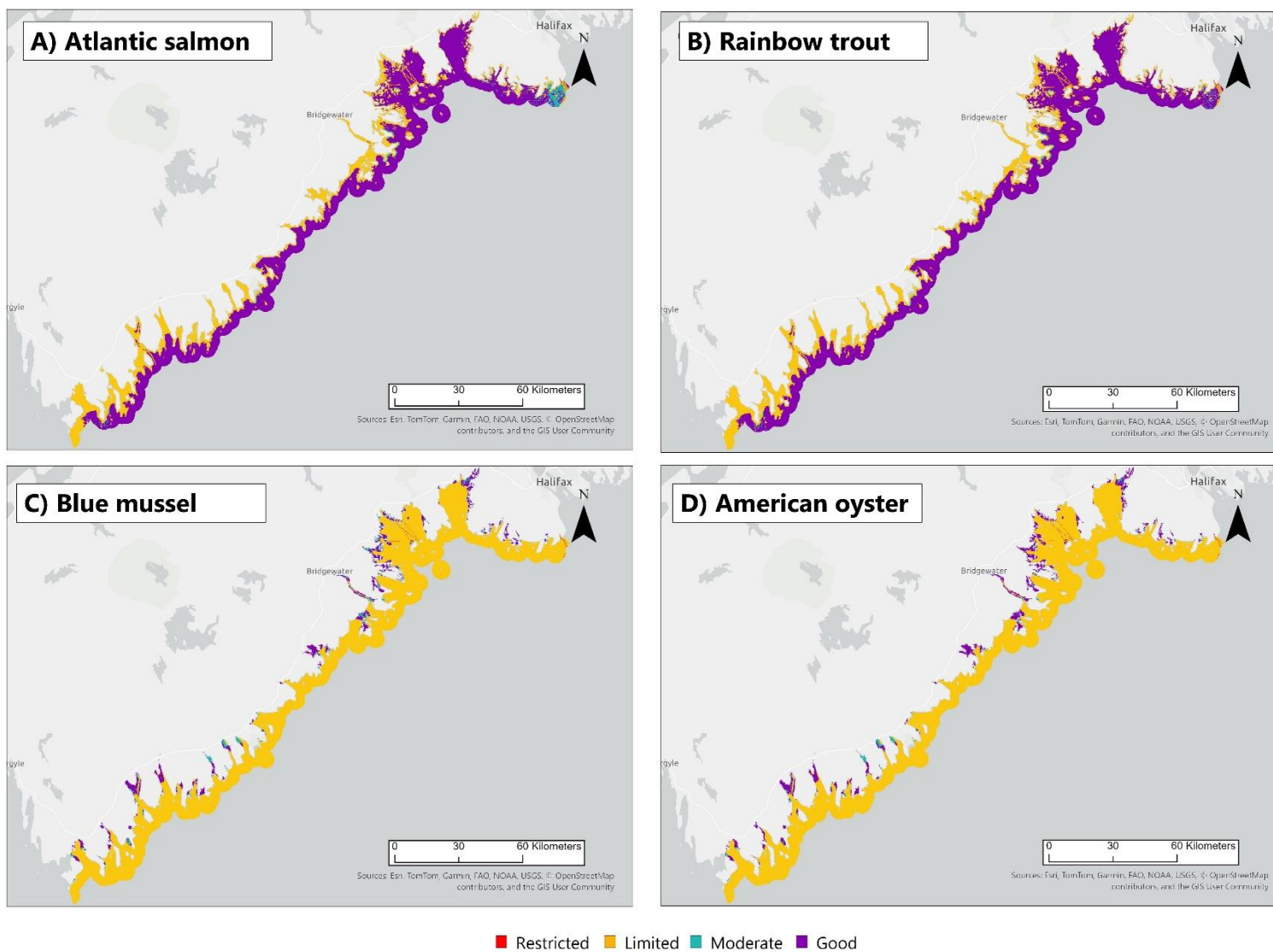
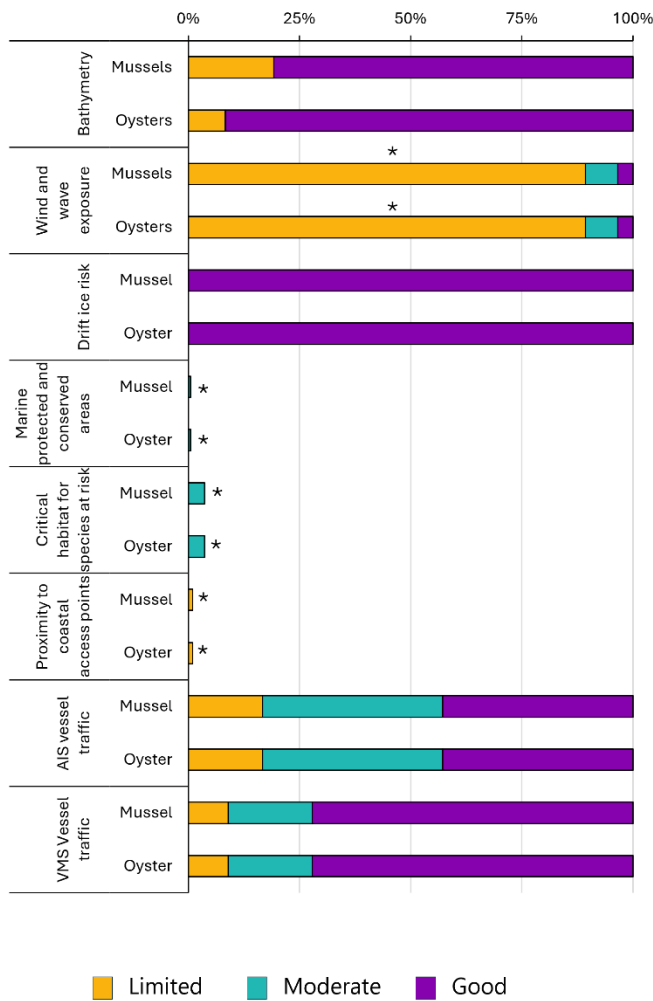


Figure 21. Suitability ratings across the South Shore aquaculture region for four assessed species.

South Shore scoring by criteria

A) Shellfish



B) Finfish

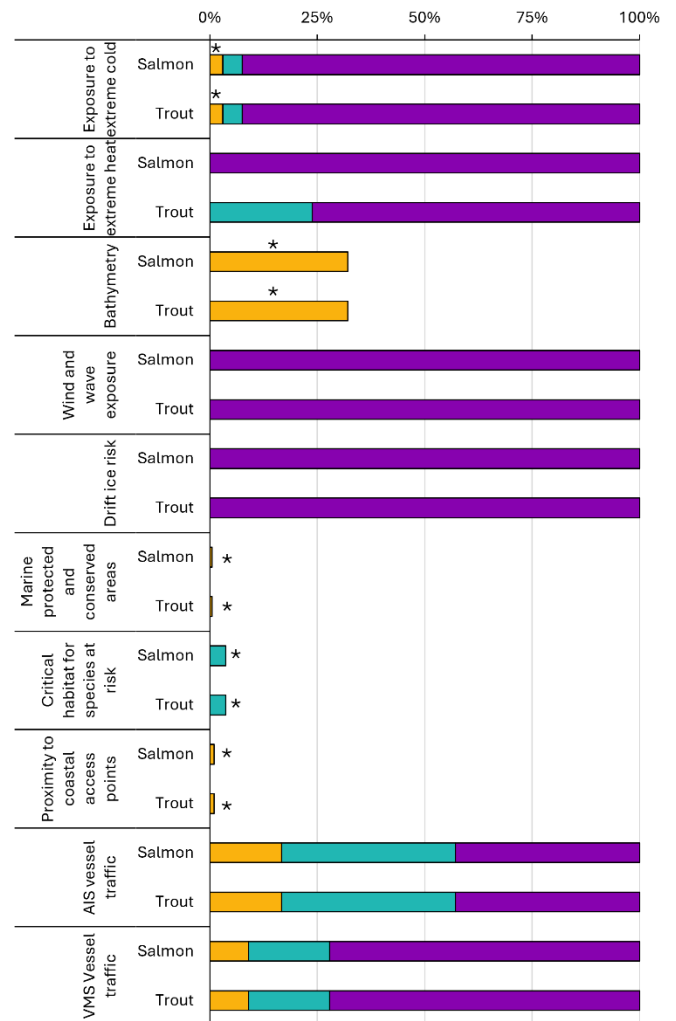


Figure 22. Percentage of the total area (in hectares) of the South Shore aquaculture region each criterion was scored, for assessed A) shellfish and B) finfish species. Asterisks (*) above or beside bars indicate where scoring was a limiting condition in the aggregated suitability maps.

4.6 Fundy-Yarmouth

4.6.1 General regional conditions

The Fundy-Yarmouth region includes the Annapolis Basin, the coastline of Digby County down towards Yarmouth out to the western side of Cape Sable Island (**Figure 12**). In the northern part of the region, conditions exhibit strong tidal influences from the Bay of Fundy, with deeper, more exposed areas within the outer Bay of Fundy and St. Mary's Bay. This part of the region also hosts three of the province's four Marine Renewable Energy Areas (MREAs), including the Digby Gut, Petit Passage, and Grand Passage. From Yarmouth south towards Lobster Bay, conditions transition to conditions similar to the South Shore, with several sheltered inlets, coves, and bays. This area has a complex physical oceanography, strongly influenced by upwelling and tidal mixing, supplying the area with nutrient-rich waters (Lane and Associates Limited, 1992).

Existing aquaculture is focused on two distinct areas in the region. In the northern part of the region, existing aquaculture is active within the Annapolis Basin and along the Digby Neck, particularly within St. Mary's Bay. Several operations also exist across the southern region, from Yarmouth to Shag harbour, including Lobster Bay³¹.

The waters in this area are also within Lobster Fishing Area 34, the largest and most productive lobster fishery in Atlantic Canada. Other important fisheries also occur in the area, including those for scallop, herring, and halibut.

The region also supports several important ecological habitats for coastal species. The Southwest Scotian Shelf is a large EBSA, encompassing several smaller EBSAs, including the Lobster Bay area, Outer Tusket Islands, Bon Portage Island, and Cape Sable Island (Hastings et al., 2014). Many large salt marshes are distributed along this region and some significant eelgrass areas have been found within discrete areas such as Lobster Bay (Allard et al., 2014) (Allard et al., 2014). The Brier Island and Digby neck area is also recognized as an Ecologically and Biologically Significant Area (Buzeta, 2014), due to significant bird, marine mammal, and benthic diversity. It is also listed as an Important Bird Area by Birdlife International, supporting migratory routes and feeding areas for a variety of birds such as plovers, shearwaters, gannets, phalaropes, and others. The region is also within the primary range of the Endangered North Atlantic Right Whale (*Eubalaena glacialis*), with historical sightings across the region, although most concentrated in offshore waters towards Grand Manan and Roseway Basin Conservation Area (Brown et al., 2009).

4.6.2 Suitability potential

The region has some areas of good potential for finfish, concentrated primarily along the northern part of the region, and within St. Mary's Bay (**Figure 23**). Along the southern part of the region past Yarmouth, cooler water temperatures limit finfish development, with high exposure to

³¹ In this region, the [Agryle Aquaculture Development Area](#) has identified a number of potentially suitable sites for further development of shellfish and marine plant aquaculture

extreme cold across 30.06% of the region (**Figure 24**). In this region, shallow bays also limit finfish development, as water depths below 10m are present across 38.40% of the entire region.

For shellfish aquaculture, potential “good” areas are concentrated to few sheltered bays and inlets around Lobster Bay, and within the Annapolis Basin (**Figure 23**). Along the rest of the region, high wind and wave exposure limits much of the area (89.82%) for shellfish (**Figure 24**). Shallow water depths may be challenging for both mussels and oysters, with nearly a quarter of the area (23.23%) under 5m recommended for mussel culture, and a further 1184% under 2m recommended for oyster culture. .

Few restrictions are present, occurring primarily to support navigation corridors including ferry routes at Yarmouth, Digby, and between islands along Digby Neck (Figure 24). While the area has three MREAs, these areas are small (totaling 369 hectares, or 0.23% of the region). Digby and Yarmouth also have considerable vessel traffic, with important vessel routes in and out of the harbours (**Appendix III, Figure 4**). Just over half of the region is either on or near a navigation channel (53.64%); (**Figure 24**), creating potential challenges for aquaculture development in the region. As an important area to support fishing activities, VMS data also shows a high portion of the region (35.21%) as high fishing vessel traffic.

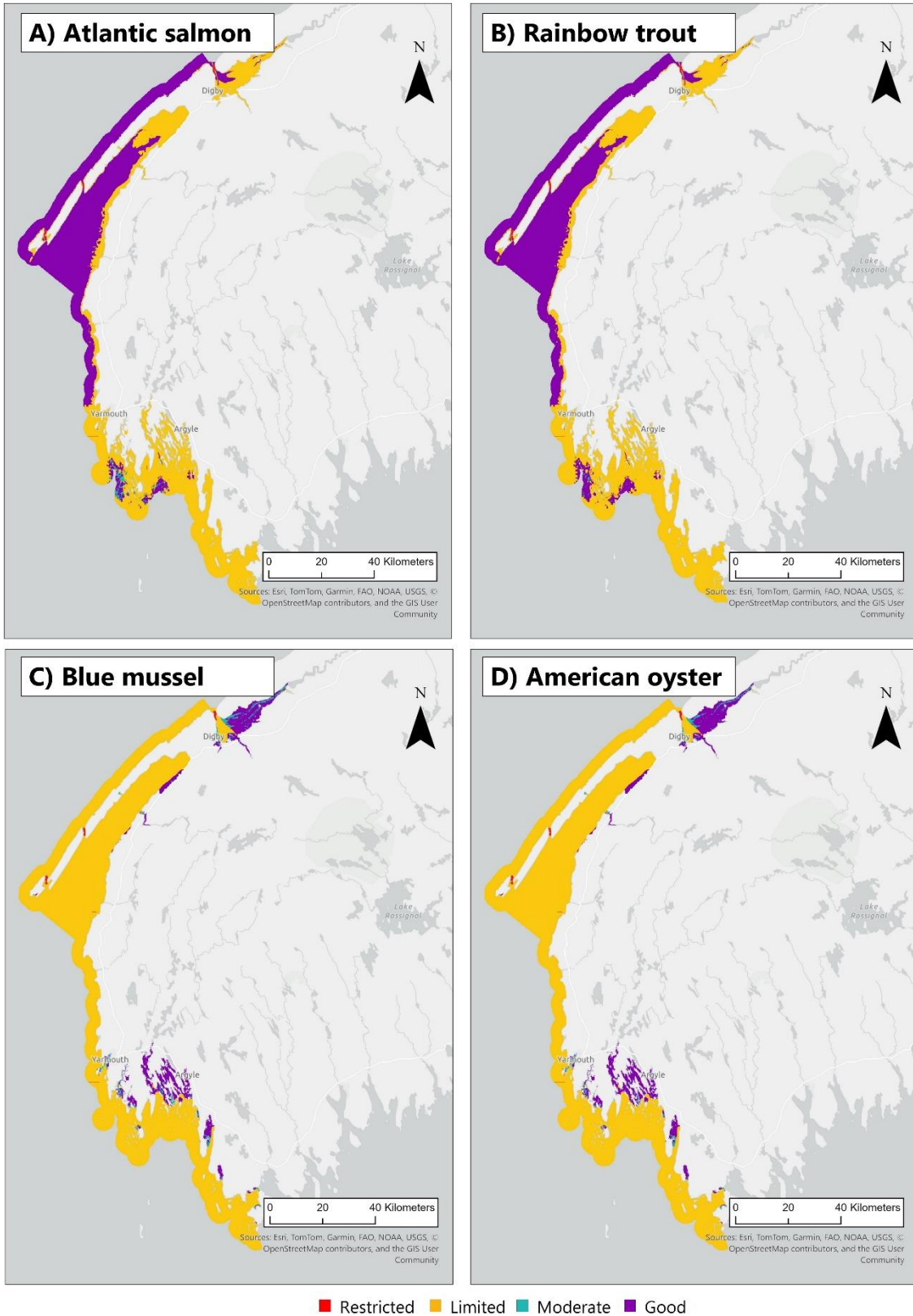
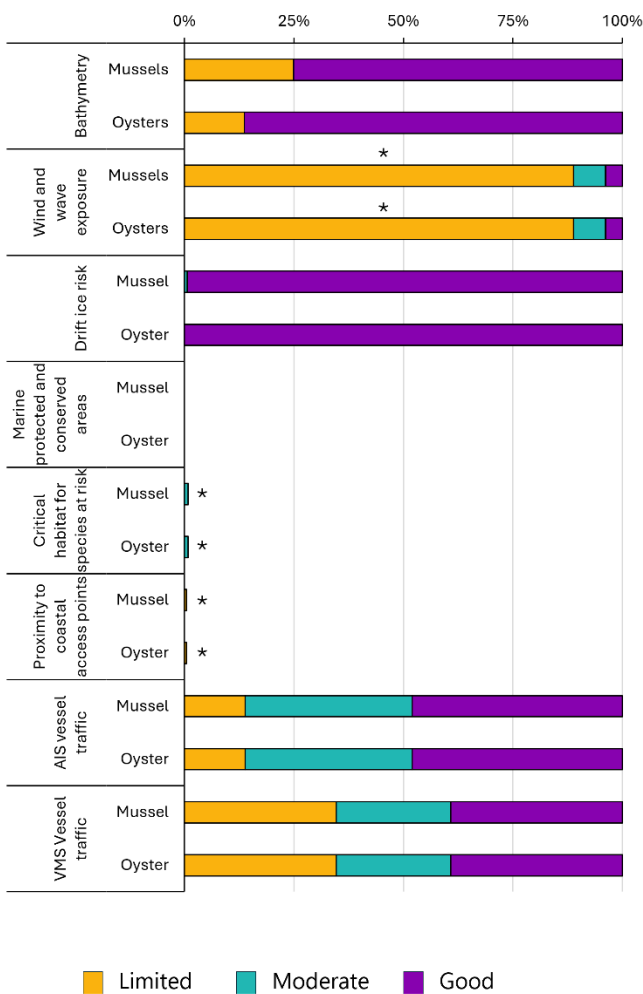


Figure 23. Suitability ratings across the Fundy-Yarmouth aquaculture region for four assessed species.

Fundy-Yarmouth scoring by criteria

A) Shellfish



B) Finfish

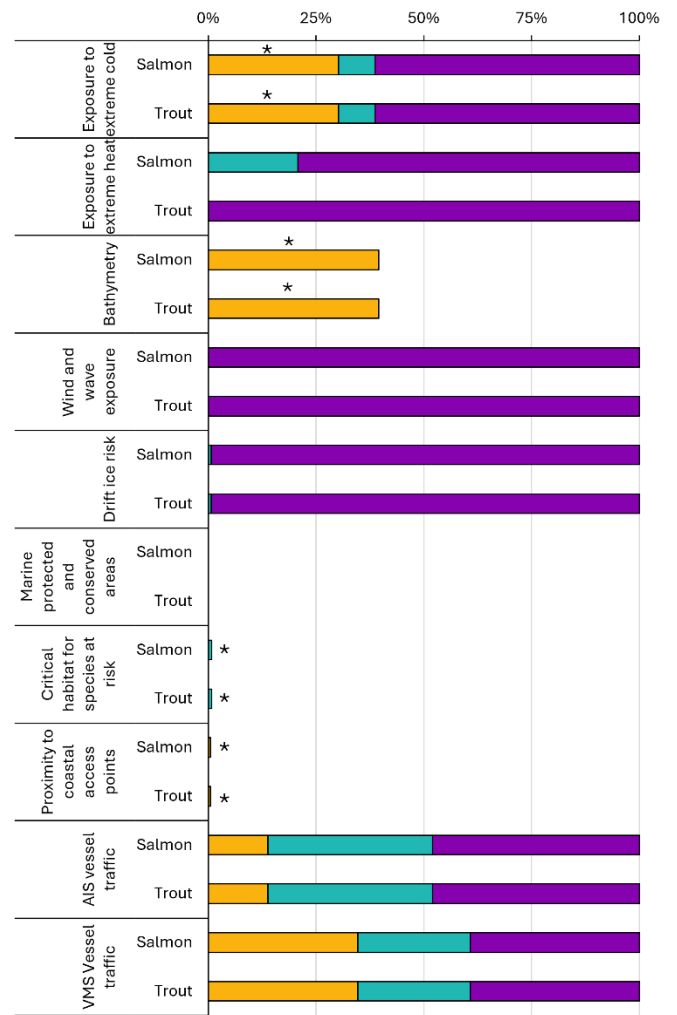


Figure 24. Percentage of the total area (in hectares) of the Fundy-Yarmouth aquaculture region each criterion was scored, for assessed A) shellfish and B) finfish species. Asterisks (*) above or beside bars indicate where scoring was a limiting condition in the aggregated suitability maps.

4.7 Upper Fundy

4.7.1 General regional conditions

The Upper Fundy region includes the tidally influenced northern part of the Bay of Fundy up into the Minas Basin and up to Chignecto Bay at the border of New Brunswick (Figure 12). Along the coastline between the Annapolis Basin and Scot's Bay, the shoreline has fewer bays and inlets protected from tidal influences. Within the region, water temperatures remain cool year-round, with strong vertical mixing from tidal action preventing temperature stratification. Winter ice is present within the region only within the embayments of the Minas Basin and Chignecto Bay.

Within the region, there are no active aquaculture leases. The area has relatively low vessel traffic, although there is some at the edges of the region towards the entrance to the Annapolis Basin. The region is also home to the [Fundy FORCE MREA](#).

The inner Bay of Fundy region is an important area for protected coastal species and wildlife. Most of the Minas Basin is listed as a critical habitat³² for the threatened Atlantic Mud Piddock (*Barnea truncata*). Landward of the coast, there are also a number of [critical habitat for endangered wild Atlantic salmon](#) particularly along Cobequid Bay, as well as [critical habitat for the endangered Bank Swallow \(*Riparia riparia*\)](#). There are also two National Wildlife Areas within the region, including [Boot Island National Wildlife Area](#) at the mouth of the Gaspereau River and the [John Lusby Marsh National Wildlife Area](#) within Cobequid Bay.

4.7.2 Suitability potential

The potential for aquaculture development in the Upper Fundy region is predominantly limited for all species assessed ([Figure 25](#)). The area has very few restricted areas, much of which is occupied by the FORCE MREA (totaling 283 hectares, 0.14% of the region), and to a lesser degree a handful of anchorage points and submerged cables leading across to New Brunswick.

For shellfish, the region is limited by a combination of shallow bathymetry, high wind and wave exposure, and drift ice risks. While wind and wave exposure is comparatively lower in this region to other parts of the province, significant wave heights beyond 2 meters are possible within just over half (51.66%) of the region. Further, for shellfish, the shallow areas throughout much of the region do not provide sufficient depth to avoid some ice risks in the area, limiting potential in 22.03% of the region for oysters and 26.99% for mussels ([Figure 26A](#)).

High risk of extreme cold is prevalent across most of the region (95.01%), which creates significant mortality risks for finfish ([Figure 26B](#)). As a region largely tidally-influenced, there are also many areas with shallow water depths (44.34%) that would be limiting for finfish infrastructure.

³² [Critical habitat](#) was identified in 2023 under the *Species at Risk Act*

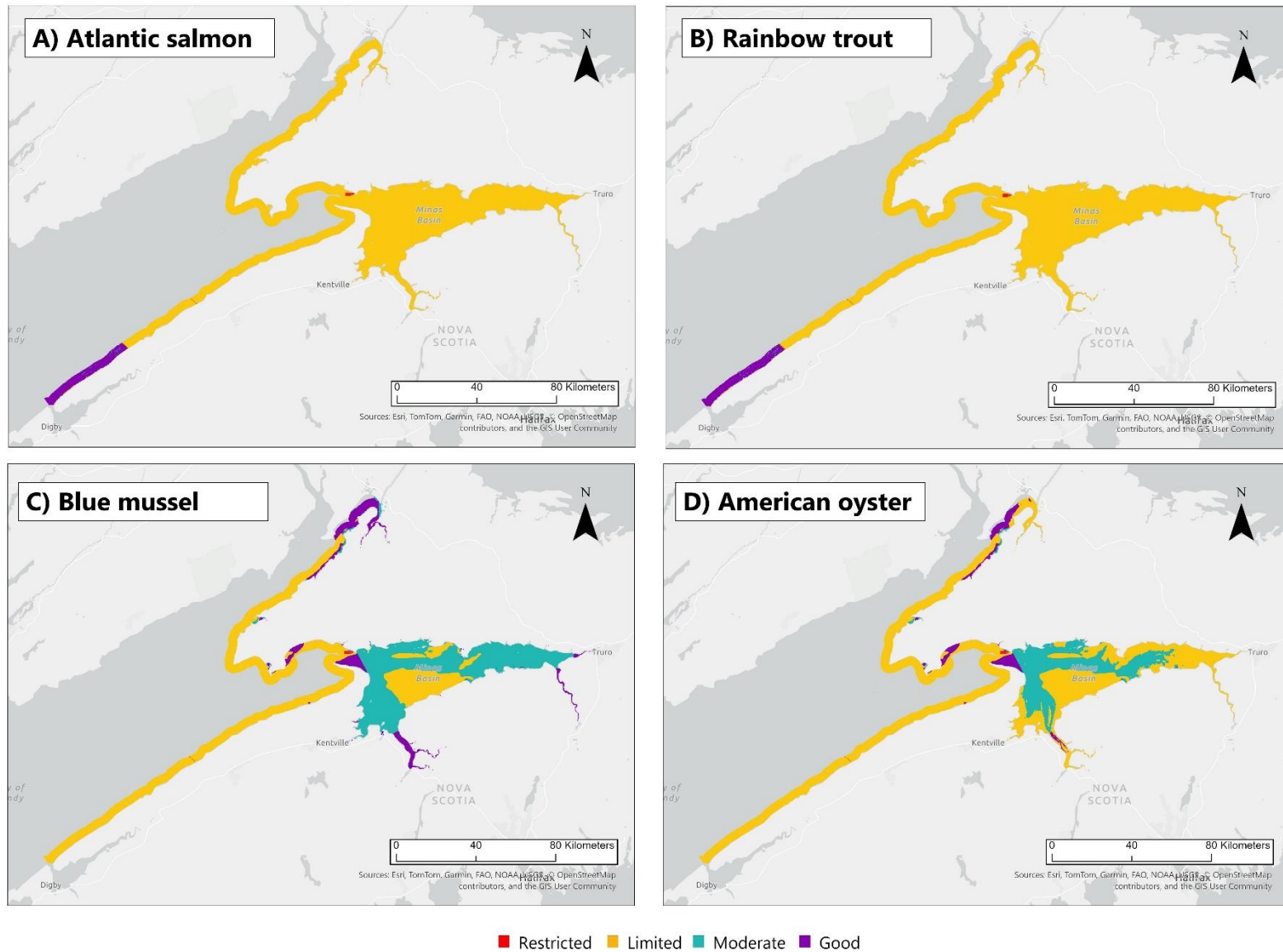
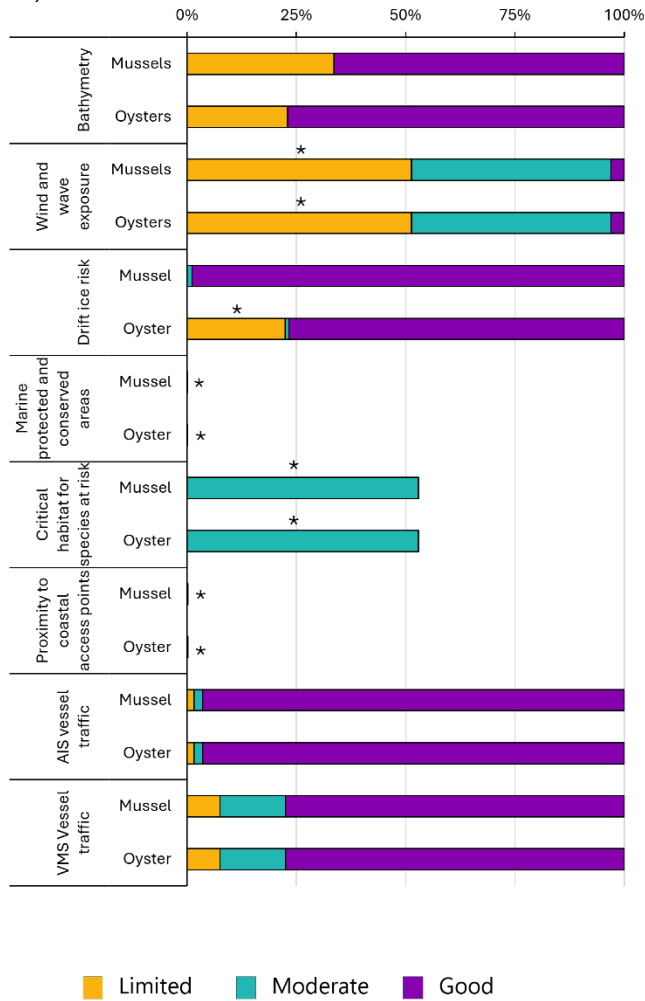


Figure 25. Suitability ratings across the Upper-Fundy aquaculture region for four assessed species.

Upper Fundy scoring by criteria

A) Shellfish



B) Finfish

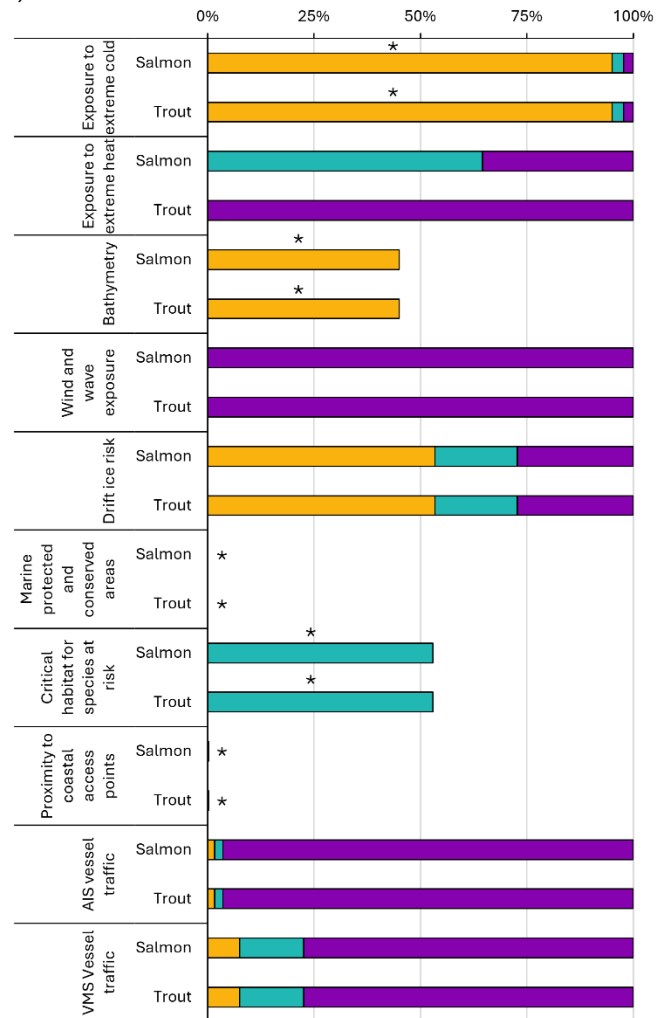


Figure 26. Percentage of the total area (in hectares) of the Upper Fundy aquaculture region each criterion was scored, for assessed A) shellfish and B) finfish species. Asterisks (*) above or beside bars indicate where scoring was a limiting condition in the aggregated suitability maps.

5 Discussion

5.1 Summary of species suitability

Patterns of suitability for potential development vary across regions (**Figure 27**) and species. Both finfish species (salmon and trout) show similar patterns of suitability across regions, as do both shellfish species (mussel and oysters) assessed.

Suitability ratings across regions

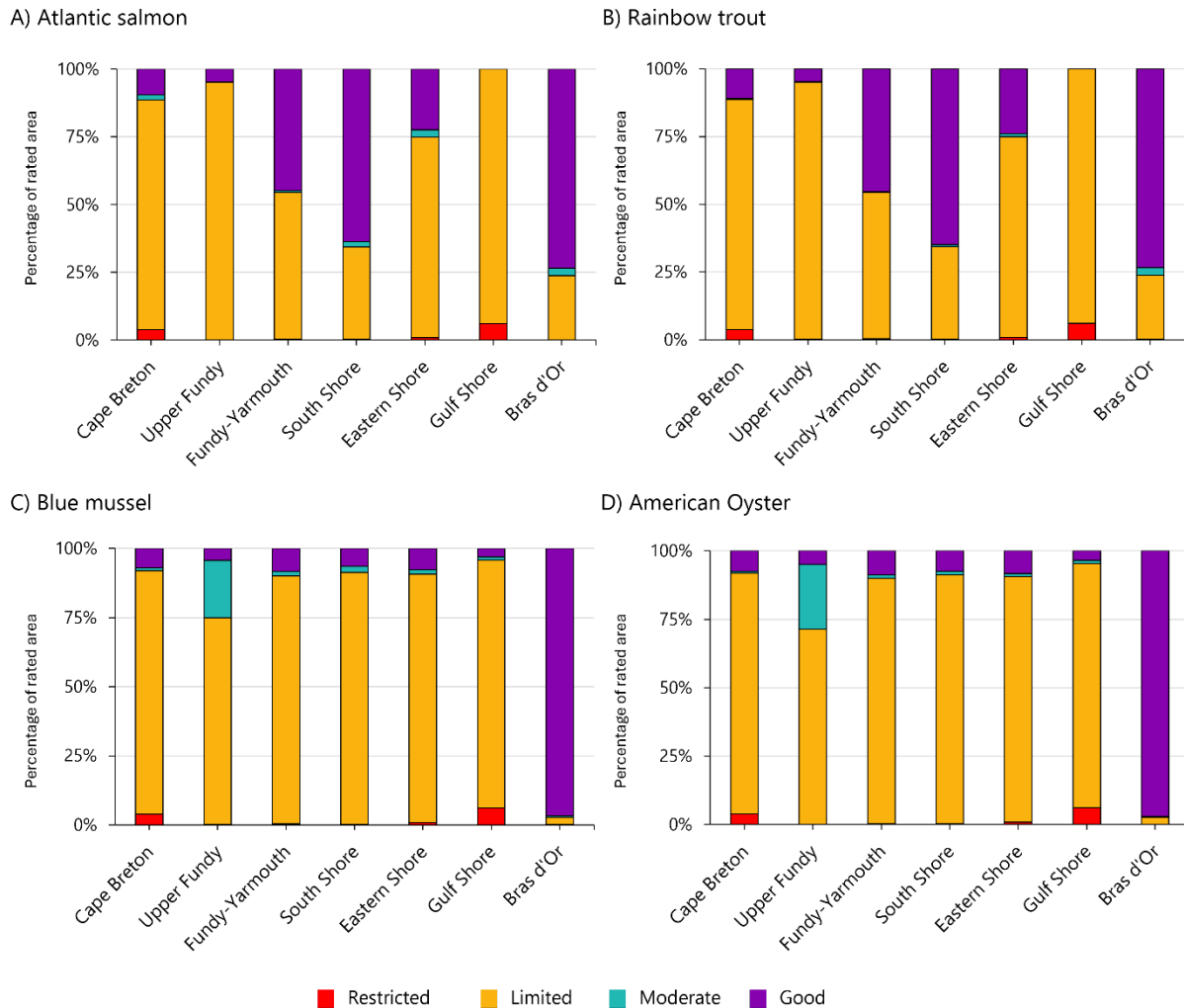


Figure 27. Percentage of each aquaculture region rated for suitability, for A) Atlantic salmon, B) Rainbow trout, C) Blue mussel, and D) American Oyster.

Results of the assessment find that there is good potential for development of Atlantic salmon along the Fundy-Yarmouth and South Shore regions. These areas have deep, cool waters that are relatively protected from high wind and waves, and risks from ice. However, the waters in these areas are also key areas for fishing vessel traffic (such as St. Mary's Bay) and other commercial vessel traffic into high use ports (such as Shelburne). Along the South Shore, there are also several protected and conserved areas. Results also indicate some potential along the Eastern Shore, although potential exposure to extreme cold temperatures and drift ice may create challenges. In these areas, potential suitability should be supplemented by bay-level analysis to further explore potential suitability. Along the rest of the province, potential development is limited by significant mortality risks from extreme cold exposure.

For Rainbow trout, areas with good potential for development are similar to Atlantic salmon. While Rainbow trout is currently predominantly cultured within Bras D'Or Lakes region, there may be opportunity for further development in the region. While this assessment only considers year-round culture, Rainbow trout can also be successfully cultured on a seasonal basis. This would likely significantly expand the potential range of suitable areas to avoid risks from extreme cold exposure and drift ice.

Across Nova Scotia, good areas for development of Blue mussel and American Oyster are similar, occurring primarily in shallow bays, protected from high wind and waves and ice exposure. Except for the Fundy region, there are bays with good potential across all other aquaculture regions. However, the highest potential is found within the Gulf Shore, South shore, and Eastern Shore. While the Bras D'Or was rated as good potential for aquaculture development, mussel culture has been previously challenging in the area³³ (Stantec, 2009). In recent years, the prevalence of diseases that can harm oysters (MSX and Dermo) has spread across many parts (i.e., North and Eastern Shores and Cape Breton) of Nova Scotia. While MSX remains a challenge for future development of oysters in the Bras D'Or Lakes, recent proliferation in Prince Edward Island may increase the risks to culture in the Gulf Shore.

For both Blue mussel and American oyster, potential for development may also be influenced by contamination from nutrient inputs. Production requires the area to be classified under the CSSP to harvest. However, many coastal waters and bays across the province regularly have prohibition orders which may decrease suitability. Furthermore, many coastal waters are not classified under the CSSP and would need to be classified before production can occur, which can take several years.

5.2 Supporting research needs for aquaculture in Nova Scotia

To support the goals of this project, several research initiatives were initiated and funded through the CCS. Some of these initiatives provided data directly to support spatial layers used in the assessment. Other initiatives were established throughout the project's development to fill research and data gaps and may be included in future tool updates or re-assessments. This section

³³ Including both market and natural factors, such as predators and the presence of *Mytilus trossolus*.

provides a brief overview of some of these major initiatives. It does not include all work or research initiated to support this project but highlights some key projects.

5.2.1 CMAR's Coastal Monitoring Program

Since early 2023, the CCS supported CMAR's ongoing [Coastal Monitoring Program \(CMP\)](#) activities and initiatives. The CMP collects and publishes high resolution ocean data from near-shore monitoring stations that collect water quality, wave, and current data at various depths (ranging from 0 – 70m). Since 2023, the CMP has deployed 188 sensor strings and expanded to include an additional 30 monitoring stations across the province.

CMP temperature datasets were used as a primary data source to develop the *Exposure to Extreme Cold* and *Exposure to Extreme Heat* data layers (see [Appendix III](#) for the procedure on how this data was used). The maintenance and expansion of the CMP will enable continued accuracy of data layers.

5.2.2 Wild Salmon River Assessments in Nova Scotia

The sustainability of wild salmon is a key factor required for consideration in aquaculture applications, relying on understanding potential risks to nearby wild salmon populations and habitats from prospective aquaculture operations. However, many rivers in Nova Scotia have incomplete, outdated, and inconsistent information and knowledge about the state of the rivers, and their significance for wild Atlantic salmon. To fill gaps in data coverage and produce outputs that offer province-wide information to inform suitability assessment, CMAR developed a project focused on rating the significance of rivers for wild Atlantic salmon. This assessment considered multiple indicators across five broad significance criteria: habitat, abundance, barriers, importance, and threats.

This assessment involved both desktop research and fieldwork to catalogue various available datasets on rivers, watersheds, and salmon populations within Nova Scotia, which were compiled into a Data Inventory. The Data Inventory provides information for the 267 rivers explored in this study, giving users access to information about what is available for each river. To fill needed data gaps, CMAR also conducted fieldwork. Temperature monitoring provided high resolution summer temperature data for thirteen rivers. CMAR also worked with the University of New Brunswick to conduct abundance assessment of three rivers³⁴ in Nova Scotia.

For all 287 rivers, each indicator was scored into low, medium, or high based on how the indicator contributed to the overall significance of the criterion. For example, low river pH can indicate acidification stress on rivers and would thus suggest a low significance since it negatively impacts the habitat quality for potential salmon populations. By considering multiple criteria, this assessment rates rivers as either low, medium, or high overall significance for wild Atlantic salmon, offering a consistent, province-wide metric for understanding potential risks to rivers. The

³⁴ Rivers assessed include the Belliveau River, Meteghan River, and Salmon Rivers within the Fundy-Yarmouth region.

significance ratings of each river can be viewed as an informational criterion that can be overlaid on salmon aquaculture suitability ratings. Additional outputs of this project, including resources (data sources for wild salmon research), indicator-specific reports, and links to the Data Inventory are available on [CMAR's website](#).

5.3 Assumptions, limitations, and use considerations

The suitability assessments are a form of an integrated model of potential suitability for aquaculture development. While working within a modelling framework, certain assumptions need to be made, and there are often uncertainties and limitations with the methods and data used. Uncertainty and assumptions can manifest at various locations within the assessment framework (Kirchner et al., 2021), relating to both how the assessment is framed, the data available that went into the assessment, and the components of the assessment process (**Table 5**). The assumptions and uncertainties have important implications for how outputs can be interpreted in the context of wider decision-making or other information.

Table 5. Reporting of uncertainty across the CCS suitability assessment, adapted from Kirchner et al. (2021).

Location			Expression	Implications
Major	Sub	Description		
Assessment framing	System boundaries	Refers to the selected system that is considered within the project (scope)	<ul style="list-style-type: none"> - Excludes some relevant considerations for aquaculture planning (infrastructure, social license) 	<ul style="list-style-type: none"> - Other considerations still needed for a comprehensive site-level assessment of suitability
	System resolution	Refers to the spatial location and extent of system	<ul style="list-style-type: none"> - Spatial resolution may not accurately reflect full heterogeneity of each cell - Does not consider long-term trends or impacts on criteria or system - Does not consider short-term, seasonal/inter-annual variability, and anomalies (e.g. extreme weather events) 	<ul style="list-style-type: none"> - Use best positioned to look overall trends over any individual cell - Re-assessments needed to keep outputs current and relevant - Best evaluated with more localized data and methods that can incorporate this variability
Data inputs	System Data	Refers to empirical data used within assessment (criteria datasets)	<ul style="list-style-type: none"> - Data accuracy may be variable across area of assessment for some layers - Data recency may be variable due to original source data 	<ul style="list-style-type: none"> - Careful consideration needs to be paid to some layers when investigating data layers individually - Highlights need for regular updates and re-assessment with more current data
	System Drivers	Refers to the external project drivers that influence the assessment	<ul style="list-style-type: none"> - Resource limitations constraint ability to address critical data gaps 	<ul style="list-style-type: none"> - Continued resources required to improve data products and outputs
Model	Parameter Calibration	Refers to processes and methods used to process and prepare datasets for assessment	<ul style="list-style-type: none"> - Spatial interpolation of some datasets creates uncertainty 	<ul style="list-style-type: none"> - Risk approach applied to accommodate for some uncertainty
	Structure	Refers to the mathematical formulations used to define the methods and their assumptions and limitations	<ul style="list-style-type: none"> - Does not incorporate interdependencies of criteria which may exist in some cases - Equal weighting assumption assumes compensation of criteria which may not be realistic - Some suitability relationships less well-understood or refined 	<ul style="list-style-type: none"> - Some relationships not captured in suitability results - Weighting can be reconsidered with policy guidance and depending on use scenarios and needs - Greater understanding of suitability thresholds and relationships needed
	Hardware & Software	Refers to the coding and software aspects used within the assessment	<ul style="list-style-type: none"> - Overlay procedures in GIS may not enable perfect spatial overlap of features 	<ul style="list-style-type: none"> - Some marine areas directly adjacent coastline may not be captured

5.3.1 Context

The context of the assessment refers to boundaries set for the assessment, including aspects of scope, scale, and objectives. Here, we constructed our model of suitability only on three objectives of a) biophysical requirements for fish health, b) conservation of key species, and c) overlaps with existing users. As such, some areas may not reflect site-level realities, as some critical considerations relevant to aquaculture planning are not included within the scope. For example, infrastructure needs and socio-economic considerations are an important part of selecting appropriate sites but were not included in the scope of the assessments.

Furthermore, the assessment does not predict long-term trends or project future changes beyond the project. It does not consider how potential environmental changes (such as climate change) will influence the criteria, nor aquaculture practices, and ultimately the suitability of areas. In addition, it does not consider short-term, seasonal/inter-annual variability, and anomalies (e.g. extreme weather events) which may affect the relevance of the results.

5.3.2 Inputs

For this assessment, it was assumed that all spatial and non-spatial data used are accurate, up-to-date, and complete. This assessment applies the most recently available data, which may vary as a function of collection or publication time and does not necessarily reflect real-time conditions. While datasets used were considered well suited to the assessment, layer-specific limitations are recognized. For example, high resolution bathymetry data was not available close to the coast, which meant some areas may have reduced accuracy in bathymetry data than others.

In addition, some datasets may not fully represent all data, based on data available or assumptions required to meet the assessment needs. For example, marine traffic datasets (VMS and AIS) may not capture all vessel traffic due to limitations in which vessels have these systems equipped³⁵. In addition, public access points identify only locations that could potentially provide public access, but does not indicate the actualized use, intensity, or marine use extent of these sites.

Some criteria important for determining aquaculture suitability were unavailable due to data limitations. For example, successful shellfish production relies on estimates of primary productivity, which are largely unavailable across the province. Further, aquatic invasive species can create significant limitations on operators. While aquatic invasive species relevant to aquaculture are known to be prevalent around the province, the spatial distribution or intensity of these invasive species needed to understand risk to producers is not available. Not all relevant datasets could be used, and the results of this assessment are directed by criteria that have available and measurable data.

³⁵ For example, VMS are not mandatory on fishing vessels for the inshore lobster sector, and so may not accurately represent vessel traffic for lobster in the province.

5.3.3 Model

There are limitations and assumptions made in the modelling workflow used to bring criteria together. To reduce subjectivity, this assessment applied an equal weighting of criteria aggregated through WLC. However, equally weighting assumes that suitability can compensate for poor-performing criteria through good-performing criteria. This may not be realistic in some areas or conditions at the site level. For example, St. Mary's Bay is a well-used area for vessel navigation, both from commercial and fishing vessels. Many areas within the region may be both on-channels and have high VMS traffic but may be rated as 'good' for finfish aquaculture. This is likely due to several other criteria being good for aquaculture, including adequate wind and wave conditions, and low risk of critical biophysical thresholds for cold, heat, and ice exposure. As all criteria were weighed equally, the low-performing navigational criteria were compensated by good biophysical conditions.

It was also assumed that the criteria used in the analysis are independent of each other, although some interdependencies may exist. For example, there are likely correlations between most biophysical criteria, including temperature, depth, wind and wave exposure and ice conditions. Combinations of these may also lead to cumulative impacts on suitability but are not explored in this analysis.

The assessment is also limited by the available knowledge, understanding, and general assumptions made when scoring criteria or identifying limiting conditions. Scoring was made on the best available information, however, acknowledging that understanding of suitability may evolve as new data becomes available. In conclusion, the methods and workflows applied, including decisions around scoring and aggregation, could, if approached differently, impact the final suitability ratings.

5.3.4 Use considerations

Given the various assumptions, limitations and uncertainties outlined from the assessment, it is important to consider the intended and appropriate use of findings.

This assessment provides broad-scale suitability assessments at a province-wide level for four commercial aquaculture species to identify the potential for aquaculture development. The suitability analysis produces findings at a 100 m² resolution. This spatial resolution is assumed to be sufficient to capture relevant patterns and support decision-making at a provincial wide scale. However, not all datasets are resolved at that spatial granularity, and there may be variability within each 100 m² 'cell'. Site-level considerations are required to validate location-specific ratings. Individual cells are thus not meant to be explored in isolation. Rather, the outputs are designed to offer sufficient resolution to assess regional patterns of suitability and identify broader areas that may or may not be suitable for aquaculture development. These regional-level insights can also act as stepping stones for more targeted assessments into particular regions of good suitability.

The assessment considers many critical criteria relevant to understanding general constraints and conditions for aquaculture suitability. This assessment is not a fully comprehensive evaluation of

all potential factors or data relevant to selecting optimal sites for aquaculture in Nova Scotia. The exclusion of some criteria does not mean that it is not important to aquaculture. Additional considerations would be evaluated during site application stages and are considered during aquaculture lease and licensing processes.

Interpreting the final suitability results needs to consider how the criteria were originally scored. Criteria were scored based on potential impacts to the three defined objectives and the need for management or mitigation, by prospective producers. In this way, higher ratings do not reflect “optimal” conditions for development but rather identify where potential impacts, mitigations, or development challenges might be lowest. Conversely, lower ratings do not represent conditions that would not allow for aquaculture development but reflect conditions that would have greater potential limitations, impacts, or development challenges. Therefore, a given rating does not guarantee a particular outcome for aquaculture. As such, this assessment is not designed to identify the most optimal sites for production, nor would it guarantee the successful development of potential operations.

Furthermore, the Coastal Classification System is one of many tools used to support planning and siting of aquaculture in Nova Scotia. Other assessment tools and regulatory processes exist to capture relevant criteria not included in these assessments. Site-level considerations, including consultation with communities, rightsholders and stakeholders, are part of aquaculture license and lease processes. Existing sites may have farm-specific management plans and operations that may mitigate against challenges that may make an area otherwise poor for aquaculture. As such, the results of this assessment and final suitability maps may not be appropriate for using the suitability ratings to assess the sustainability or suitability of existing aquaculture sites.

The outputs from the CCS are designed for information purposes only. Importantly, the CCS does not replace or change Nova Scotia’s aquaculture licencing and leasing process. All aquaculture applications must still go through full site-level regulatory review³⁶ (following the requirements and steps set out in the *Aquaculture License and Lease Regulations*). The Crown’s Duty to Consult with the Mi’kmaq of Nova Scotia remains unchanged.

By bringing the results of the suitability assessment together in an online mapping platform, the CCS provides transparency and access to information relevant to aquaculture across provincial waters. It provides a centralized location for province-wide data on key considerations at a regional level. Detailed reporting and documentation available on the Government of Nova Scotia website and the accompanying Story Map provide users with information to understand what is important in determining aquaculture suitability and sources of relevant data.

³⁶ For more information about laws and regulations related to regulatory processes for aquaculture, visit: <https://novascotia.ca/fish/aquaculture/laws-regs/>

6 Recommendations and next steps

6.1 Tool maintenance and upkeep

Ensuing ongoing accuracy and usefulness of assessment findings requires regular tool maintenance and updating. When new data becomes available, existing layers may need to be refined, or new criteria added. The assessment framework was designed to be flexible, so it can adapt to these changes through ongoing review of data and regular re-assessments, without requiring a full redesign or alteration of methods.

The proposed maintenance plan includes three central components: 1) ongoing maintenance, 2) data reviews, and 3) reassessments. Each has different time and resource considerations, but together, they ensure that data and suitability results remain relevant and up to date.

6.1.1 Ongoing maintenance

As the tool is used and applied, ongoing maintenance is required to sustain full functionality of mapped data and ensure that all data layers remain accessible and usable. For example, links to datasets may change and not work, requiring updated links or data³⁷.

Ongoing maintenance also applies to the fees and resources required to host data online. For data to remain publicly available, resources are required to ensure ongoing access and hosting of data through ESRI's online GIS platforms. Maintenance also includes annual fees for maintaining CMAR's GIS license, as well as resources for technical support staff to perform maintenance as required.

6.1.2 Data Reviews

Many datasets used for this assessment were retrieved from publicly available datasets produced by external groups and organizations³⁸. Over time, these original datasets may be updated with renewed information. For example, when new terrestrial and marine protected areas are designated, these new protected areas may be within the area of assessment, requiring updates to layers included.

It is recommended that Data Reviews occur at a regularly scheduled interval, so new information is monitored, and incorporated as needed. We recommend Data Reviews occur twice per year, consisting of a scan of original data sources to ensure that data used for the layers included in the 'Data Layers' tab and 'Informational criteria' panel are most up to date.

During Data Reviews, if any restriction layer has changed, the layers (including suitability results) will be changed at the time of the review. Some criteria require significant data analysis and

³⁷ Users can contact the Government of Nova Scotia CCS e-mail address with any technical difficulties or issues they encounter.

³⁸ For example, datasets produced by Fisheries and Oceans Canada available on the Open Government Data Portal

processing to update layers. In reviewing these layers, if it is determined that the final maps will differ very little from the previous review, or if layer updates would require significant resources, the layer update may be deferred. Deferral should not go longer than two years since the original data layers, to maintain relevance of datasets.

During reviews, if criteria layers are updated, they may not be immediately incorporated into new suitability maps (see section below for suitability re-assessments). The suitability analysis requires substantial resources to incorporate new data³⁹. However, when data layers are updated within the mapping platform, a note will be made within the criteria panel in the StoryMap as to the date of the most recent dataset. CMAR will also maintain records of any changes to layers or any inconsistencies between layers used in the suitability assessment and those available on the Data Layer tab.

Beyond official Data Review intervals, data layers can also be reviewed and updated on an ad-hoc basis throughout the year, if new data becomes available and is requested by project partners.

6.1.3 Suitability Re-Assessments

As individual data layers may become available, and data becomes outdated, the generated suitability maps may become less reliable and accurate. Assessments should be revisited every **two years**, to account for changing data, conditions, or policies/knowledge.

Thus, while individual data layers may change within the mapping platform, the generated suitability maps will not automatically change. The exception is for restrictions, whereby suitability maps will be updated with new restrictions, should they change during Data Reviews.

During re-assessments, new suitability layers will be generated using updated information. At this time, re-assessment may also consider the addition of new criteria into the assessment, if it meets previously established criteria selection properties. A full re-assessment is estimated to require approximately 3-4 months, depending on the needs and criteria added or changed.

When newly generated suitability maps are uploaded onto the web mapping platform, notes will be added to the platform. Outdated map layers will be removed from the application but retained by CMAR for reference/storage.

6.2 Future work

The initial development of the aquaculture Coastal Classification System and completion of high-level suitability analysis sets an initial framework for understanding suitability of aquaculture across the province. From the results of these assessments, consultations with industry and scientific experts, and broader stakeholder engagements, CMAR recommends future work to support the CCS focus on **three** key areas:

³⁹ Updating a layer in the tool does not automatically update the suitability layer. This process is done through analysis within ArcGIS Experience Builder and then is uploaded onto the platform.

1. Continued collection and analysis of data across Nova Scotia.

Access to provincial-wide data was a recognized limitation of the assessment. Data collection and subsequent analysis are needed to continue to improve the reliability and confidence of datasets included. For example, high resolution bathymetry (NONNA-10m) is not consistently available across the province, with notable limitations particularly in areas very close to shore. Reducing data gaps in high-resolution bathymetry can reduce potential inconsistencies and provide more accurate bathymetry, especially in shallow, nearshore areas. Similarly, temperature datasets relied on local monitoring stations across the province deployed through CMAR's Coastal Monitoring Program. While the CMP is consistently deploying sensors in new areas, continued expansion of coverage can help improve reliability and reduce uncertainties in the interpolation.

For some criteria, inadequate coverage or resolution of datasets was the primary reason for their exclusion, despite their recognized importance in suitability. Increased efforts to produce data across the province can help position them to be incorporated into future assessments.

2. Examination of suitability for other aquaculture products

In stakeholder consultations, marine plant aquaculture was noted as a particular species of interest where suitability information would be an asset. Other species of interest included scallops. In addition to other species of interest, seasonal production is being investigated by industry. For example, seasonal production of rainbow trout is possible based on shortened growing cycles, which would avoid risks from ice and extreme cold temperatures. While in this assessment, we provide suitability based on the assumption of year-round production, the framework here can be applied to further explore these opportunities, by applying similar methodologies and existing information to additional contexts.

3. Increased knowledge on critical thresholds and relationships to aquaculture

These assessments considered best available information to determine how criteria influence the suitability for aquaculture, based on either requirements for species health and welfare, conservation goals, or overlaps with marine users. For some criteria, suitability relationships were based on well-established scientific thresholds. For example, there is considerable research on thermal stressors and critical temperatures for cultured species. However, these suitability relationships are not well defined for other criteria, meaning they could not be scored consistently or reliably. For example, while proximity to wild salmon rivers is an important consideration for Atlantic salmon aquaculture, further research is needed to consistently define appropriate buffer distances that would be generalized to all potential aquaculture operations. Similarly, while some set-back distances have been proposed for oyster aquaculture in relation to bird colonies, this is not consistently applied to other aquaculture species. In these cases, they were unable to be included as criteria, many of which are currently presented as informational layers in the CCS. In these cases, further research or policy guidance is needed to understand best practices in the relationship between criteria and aquaculture.

4. Support for the option area acquisition process

Information provided from this assessment can support more efficient review and consideration of regional-level recommendations. The findings from this result can be repackaged to provide region-specific summaries across select bays, inlets or larger areas, depending on the needs and interests of decision-makers. For example, information packages could be compiled to summarize the region-level suitability, limiting factors present, and other relevant considerations, similar to as was discussed in regional overviews provided here.

6.3 Charting a path forward for the future

The objectives of this project were to develop a platform for the Coastal Classification System for aquaculture and conduct high level suitability assessments of salmon, trout, mussels, and oysters. The tools and assessments within the CCS offer a structured, evidence-based framework that can be expanded, built-upon and adjusted in the future to better support sustainable forward-thinking aquaculture planning in Nova Scotia. There is an opportunity to not only continuously add or re-adjust the criteria and datasets included to maintain relevance of the outputs, but also to apply these findings to other species of interest and scales of assessment.

The results of this assessment can show areas across the province with greater potential opportunities for aquaculture development. The findings can also support subsequent analysis to further explore the suitability of areas. Identifying areas where high suitability scores are concentrated can identify general areas of interest that could be used in subsequent, bay-level spatial assessments. While this assessment was completed at a broad province-wide level, the framework and datasets used could be applied to bay-level spatial assessments.

In the future, further assessment or analysis can support more strategic planning. For example, assessment outputs can be combined with scenario analysis to explore different development scenarios and identify suitable areas (Yakubu et al., 2025). In addition, this information could be used to support zoning or the identification of more specific areas of opportunity. Findings can be supplemented by additional site selection parameters (such as minimum area required) to define priority areas based on adjusting input parameters.

In addition, the mapping tool is built on a flexible, adaptable platform that can be continuously improved and altered to reflect the growing needs of industry and users. New GIS functionalities and features could also be added to improve the user experience and offer users new ways to engage with and use the data. For example, additions could include a wider set of data to support more broad-scale resource atlas for aquaculture planning. In this way, the CCS can be updated to be responsive to how both industries and government bodies are understanding and applying the tool.

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8 Appendices

- **Appendix I** – Data Committee membership list
- **Appendix II** – Criteria evaluations to guide selection
- **Appendix III** – Criteria descriptions and scoring
- **Appendix IV** – Accessibility audit report (Pisces Ltd.)
- **Appendix V** – User testing report (Pisces Ltd.)
- **Appendix VI** – Suitability data and statistics

Appendix I - Data Committee Membership List

Biophysical Data Committee		
Ramon Filgueira	Professor (Marine Affairs – Aquaculture)	Dalhousie University
Peter Kraska	Coastal Ecosystem Science Division Data Manager	Fisheries and Oceans Canada
Amanda Swim	Aquatic Animal Health Veterinarian - Manager	Nova Scotia Department of Fisheries and Aquaculture
Anthony Snyder	Aquatic Animal Health Veterinarian - Aquaculture Division	Nova Scotia Department of Fisheries and Aquaculture
Stephanie Hall	Aquatic Animal Health Program Specialist	Nova Scotia Department of Fisheries and Aquaculture
Melinda Watts	Aquaculture Development Advisor	Nova Scotia Department of Fisheries and Aquaculture
Anne Aubin	Seafood Industry Advisor	BC Ministry of Agriculture, Food and Fisheries
Ocean Use Data Committee		
Kasia Rozalska	Spatial Planner - Marine Planning and Conservation	Fisheries and Oceans Canada (Maritimes Region)
Scott Coffen-Smout	Oceans Management Biologist - Marine Planning and Conservation	Fisheries and Oceans Canada (Maritimes Region)
Mark Flaherty	Professor (Geography – Aquaculture)	University of Victoria
Matthew King	Aquaculture Development - Planning & GIS Officer	Nova Scotia Department of Fisheries and Aquaculture
Michael Devanney	Senior Policy Analyst / Acting Deputy Director	Agriculture and Agri-food Canada
Wild Salmon Data Committee		
Kurt Samways	Parks Canada Research Chair in aquatic restoration	University of New Brunswick
Jason LeBlanc	Fisheries Biologist, Inland Fisheries Division	Nova Scotia Department of Fisheries and Aquaculture
Sarah Tuziak	Atlantic Salmon Coordinator	Fisheries and Oceans Canada
David Hardie	Aquatic Biologist	Fisheries and Oceans Canada
Nathaniel Feindel	Manager, Aquaculture Development	Nova Scotia Department of Fisheries and Aquaculture

Appendix II – Criteria Evaluations to Guide Selection

Introduction

Evaluation of criteria for inclusion in the suitability assessment was completed by scoring each criteria based on how appropriate they meet the needs of the assessment ([Table 1](#)).

Table 1. Description of rating and scores assigned during criteria evaluation.

Rating	Description	Score
Not appropriate	Fails to meet minimum requirements to be considered for inclusion	N/A
Poor	Only somewhat appropriate to meet the needs of the suitability assessment	1
Adequate	Considered adequate to meet the needs of the suitability assessment	2
Exceptional	Highly suited for inclusion in the suitability assessment	3

Criteria were evaluated by calculating the average score across eight selection properties considered important in ensuring criteria are relevant and fit-for purpose ([Table 2](#)). Two key inclusion conditions were identified:

- 1) Criteria must not fail to meet the minimum requirements for *any* property (i.e., score \neq N/A).
- 2) For criteria that met minimum requirements (i.e., score \geq 1), the criterion must have an average score considered 'adequate' (i.e., average \geq 2) in an aim to include only the most relevant, parsimonious group of criteria.

A summary of which criteria are proposed for inclusion and exclusion for all criteria considered and their final score is provided in [Table 3](#).

Table 2. Description of ratings applicable to each of the eight criteria selection properties.

Selection Property	Rating			
	Not appropriate (N/A)	Poor (1)	Adequate (2)	Exceptional (3)
RELEVANCE TO SCOPE	Criterion can not be linked to any of the project goals/objectives.	Criterion may indirectly support one (or more) of project goals/objectives, but linkage and/or importance for aquaculture is unclear and/or indirect.	Identified as important by regulators and experts. Criterion clearly supports one (or more) of project goals/objectives.	Strong evidence that the criterion is an important consideration for identifying potential areas for aquaculture for a regional assessment.
RATEABILITY	Basis for linkage to aquaculture suitability is weak, and scant evidence/expertise exists to generate classification levels.	Little empirical evidence or justification available to generate classification levels. Scoring will rely fully on expert opinion or precautionary principles	Some empirical evidence to generate classification levels may exist, but scoring will rely primarily on expert opinion.	Strong scientific evidence available to classify the criteria or identification in legislative instruments.
SCORING CLARITY	Interpretation of data and/or classification requires significant expert knowledge to understand and incorporate.	Criterion data and/or scoring requires substantial explanation and clarification, although can be understood without expert and/or technical knowledge.	Criterion data and/or scoring may require some explanation and clarification.	Clear goals and objectives of criteria can be developed. Data and suitability classification can be easily communicated to public.
SCALE VALIDITY	Criterion is more relevant at the site selection scale or for broader-scale planning.	Dataset would require substantial manipulation to appropriate resolution. Criterion largely considered inappropriate for regional-level assessment.	Resolution of the dataset mostly aligns with the assessment but may require some interpolation. Criterion can be relevant for regional-level considerations appropriate for aquaculture siting .	The criterion measures a regional-level phenomenon relevant to aquaculture planning and the spatial resolution of dataset is available.
COASTAL COVERAGE	Data exists within ≤50% of the Area of Analysis (AOA).	Large areas of the AOA are data deficient, having significant gaps in final product.	Only minor gaps in spatial coverage of data, or AOA can be fully covered through interpolation.	Data has full spatial coverage across the AOA.
DATA ACCESSIBILITY	Spatial data does not exist and can not be expected to be gathered given the time, resources, and expertise.	Data is partially available or may have confidentiality limitations on use.	Source of data can be identified and can be collected within the project's timeline. The expertise, resources, and data are adequately available.	Data can be accessed easily and readily available for manipulation, if required.
MEASUREMENT RELIABILITY	Poor confidence in data; Large uncertainty and/or difficult to define. No appropriate methods for criterion measurement.	Potentially large uncertainty and variability in data; methods available but have unproven reliability.	Some expected uncertainty in data that can be accounted for. Data may be novel, but there is confidence that methods are considered scientifically valid.	Data has high confidence and reliability and can be measured using well-established methods applied consistently.
REDUNDANCY TO OTHER CRITERIA	The measurement and/or classification of criteria is strongly dependent on the data of other criteria.	Influence or correlation with another criterion may require choosing between criteria. Inclusion of both would consist double counting of data.	Criterion may be influenced by and/or correlated with other criteria, but the correlation does not influence the score or can be adjusted for through grouping.	Criterion can be measured and classified independently of the data or score from any other criteria. Data is not included in any other criterion layer (no double-counting).

Table 3. Summary of criteria considered for inclusion for both finfish and shellfish aquaculture, including their average evaluation score and inclusion recommendation. Superscripts indicate criteria that are included only for specific species (S- salmon, T-trout, M-mussels, O-oysters).

Criterion	Finfish		Shellfish	
	Average Score	Inclusion	Average Score	Inclusion
Exposure to Extreme Heat	2.0	Include	2.0	Include ^M
Exposure to Extreme Cold	2.0	Include	1.4	Exclude
Sea surface temperature	1.6	Exclude	1.6	Exclude
Ocean depth	2.8	Include	2.3	Include
Ocean slope	N/A	Exclude	N/A	Exclude
Substate	N/A	Exclude	N/A	Exclude
Drift ice risk	2.1	Include	2.1	Include
Wind and wave conditions	2.4	Include	2.4	Include
Ocean current	N/A	Exclude	N/A	Exclude
Ocean flushing	N/A	Exclude	N/A	Exclude
Wind/wave direction	N/A	Exclude	N/A	Exclude
Wind speed	N/A	Exclude	N/A	Exclude
Shellfish Harvest Area Classifications	N/A	Exclude	2.3	Include
Aquatic Invasive Species	1.5	Exclude	1.6	Exclude
Salinity	N/A	Exclude	N/A	Exclude
Dissolved oxygen	N/A	Exclude	N/A	Exclude
Turbidity	N/A	Exclude	1.8	Exclude
Chlorophyll	N/A	Exclude	1.8	Exclude
Primary productivity	N/A	Exclude	N/A	Exclude
Point discharges	1.9	Exclude	N/A	Exclude
River runoff	1.3	Exclude	1.4	Exclude
Agricultural runoff	N/A	Exclude	N/A	Exclude
Forestry runoff	N/A	Exclude	N/A	Exclude
Algal blooms	N/A	Exclude	N/A	Exclude
Other aquaculture sites (proximity)	N/A	Exclude	N/A	Exclude
CFIA Declared Infected areas	N/A	Exclude	2.3	Include
Wild salmon rivers	2.3	Include ^S	N/A	Exclude
Coastal wetlands	2.6	Include	2.6	Include
Terrestrial protected areas and parks	2.0	Include	2.0	Include
Eelgrass habitat	N/A	Exclude	N/A	Exclude
Critical habitat for species at-risk	2.6	Include	2.6	Include
Species migration paths	N/A	Exclude	N/A	Exclude
Important bird habitat	2.4	Include	2.4	Include
Important fish habitat	N/A	Exclude	N/A	Exclude
Important cetacean habitat	N/A	Exclude	N/A	Exclude
Important coral/sponge habitat	N/A	Exclude	N/A	Exclude
Important invertebrate habitat	N/A	Exclude	N/A	Exclude
Lobster presence	1.5	Exclude	1.3	Exclude
Ecologically and Biologically Significant Areas	N/A	Exclude	N/A	Exclude
Fishing traffic	2.3	Include	2.3	Include
Navigation routes	2.1	Include	2.1	Include
Public coastal access	2.0	Include	2.0	Include

Criterion	Finfish		Shellfish	
	Average Score	Inclusion	Average Score	Inclusion
High-use recreation and tourism areas	N/A	Exclude	N/A	Exclude
Lobster fisheries	N/A	Exclude	N/A	Exclude
Other commercial fisheries	1.6	Exclude	1.6	Exclude
Indigenous fisheries	N/A	Exclude	N/A	Exclude
Viewshed	1.8	Exclude	1.8	Exclude
Noise footprint	N/A	Exclude	N/A	Exclude
Anchorage areas	2.9	Include	2.9	Include
Designated navigation features	2.9	Include	2.9	Include
Existing aquaculture	2.9	Include	2.9	Include
Water lots	2.5	Include	2.5	Include
Submerged pipelines and cables	2.9	Include	2.9	Include
Marine Renewable Energy Areas	2.8	Include	2.8	Include
Marine protected and conserved areas	2.8	Include	2.8	Include
At-sea disposal sites	2.9	Include	2.9	Include
Dredging areas	N/A	Exclude	N/A	Exclude
Derelict vessels and shipwrecks	N/A	Exclude	N/A	Exclude
Archaeological sites	N/A	Exclude	N/A	Exclude
Oil and gas structures	N/A	Exclude	N/A	Exclude
Cumulative human impacts	N/A	Exclude	N/A	Exclude

Finfish

Criteria Included

Exposure to Extreme Heat

Rationale for consideration: Finfish exposed to prolonged periods of elevated water temperatures can experience stress, which in extreme cases can lead to mortalities.
Final decision: Include
Average score: 2.0 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Temperature is a key biophysical parameter important for siting and welfare considerations of finfish aquaculture. Heat stress directly influences the health and welfare of cultured species and, in extreme cases, can lead to mortalities.	3
<i>Rateability</i>	Heat stress thresholds are established, though there is some uncertainty.	3
<i>Scoring clarity</i>	The analysis and methods (i.e., interpolation) require some explanation.	2
<i>Scale validity</i>	Interpolation of data was required to produce datasets at the appropriate resolution.	2
<i>Coastal coverage</i>	Spatial dataset will be based on point data with disperse coverage; interpolation will be applied to areas between point data.	1
<i>Data accessibility</i>	Spatial datasets will be generated using data from CMAR's Coastal Monitoring Program for this assessment.	2
<i>Measurement reliability</i>	Measuring heat stress relies on analysis and interpolation of point data and can be estimated using likelihood calculations. Novel datasets and methods combined with interpolation, will likely introduce uncertainties.	1
<i>Redundancy to other criteria</i>	At shallow water depths, heat stress may have overlaps in trends with bathymetry, but can be assessed and classified relatively independently.	2

Exposure to Extreme Cold

Rationale for consideration: Some parts of Nova Scotia have regular periods of extreme low temperatures (e.g. superchill events) which can kill fish. This occurs when the water temperature drops to -0.7 °C.
Final decision: Include
Average score: 2.0 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Temperature is a key biophysical parameter important for siting and welfare considerations of finfish aquaculture. Superchill events can lead to fish mortality.	3
<i>Rateability</i>	Superchill thresholds are well established, and effects are well documented.	3
<i>Scoring clarity</i>	The risk-based approach and methods (i.e., interpolation) require some explanation.	2
<i>Scale validity</i>	Interpolation of data was required to produce datasets at appropriate resolution.	2
<i>Coastal coverage</i>	Spatial dataset will be based on point data with disperse coverage; Interpolation will be applied to areas between point data.	1
<i>Data accessibility</i>	Spatial datasets will be generated using data from CMAR's Coastal Monitoring Program for this assessment.	2
<i>Measurement reliability</i>	Documenting superchill temperatures spatially relies on analysis and interpolation of point data using likelihood calculations. Novel datasets and methods combined with interpolation, will likely introduce uncertainties.	1
<i>Redundancy to other criteria</i>	At relevant temperatures, the parameter may have overlaps in trends with ice exposure but can be assessed and classified relatively independently.	2

Bathymetry

Rationale for consideration: Aquaculture should be located in areas with adequate ocean depth to ensure sufficient, culture space, and water flow, which is important for dispersal of nutrient wastes and supplying for dissolved oxygen to fish.

Final decision: Include

Average score: 2.8 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Ocean depth affects water flow and waste dispersal, and adequate oxygen supply to fish.	3
<i>Rateability</i>	Minimum depth requirements for most culture techniques well established in industry. Scientific evidence of depth requirements for finfish aquaculture will be augmented by expert advice.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion relevant to regional planning and datasets are available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Data is available across the entire spatial area of analysis.	3
<i>Data accessibility</i>	Bathymetry data available from public datasets (e.g. GEBCO) and accessible.	3
<i>Measurement reliability</i>	Measurable and an accepted method of measurement	3
<i>Redundancy to other criteria</i>	There are correlations with temperature and exposure (i.e., ice, waves, and wind) but can be assessed and classified relatively independently.	2

Drift ice risk

Rationale for consideration: Aquaculture operations may be exposed to risks from different types of sea ice which can threaten infrastructure and fish welfare.

Final decision: Include

Average score: 2.1 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Sea ice develops across large areas of Nova Scotia and is a key for operational and siting considerations. Increased risks can require producers to adapt technologies and/or introduce management measures.	2
<i>Rateability</i>	Ice exposure is an operational risk for producers but can also lead to increased welfare and stress from cage deformations. The definition of ice risks and classification can be determined through industry experiences and expert feedback.	2
<i>Scoring clarity</i>	The risk-based approach and methods require explanation to explain how different ice considerations are incorporated.	2
<i>Scale validity</i>	Criterion relevant to decision-making at the regional level and data resolution is appropriate for this scale, although more local-scale ice dynamics are not captured.	2
<i>Coastal coverage</i>	Ice exposure risk generated at appropriate resolutions across the area of analysis.	3
<i>Data accessibility</i>	Spatial data generated from remote sensing data and model projections to support assessment.	2
<i>Measurement reliability</i>	Spatial data products are being developed by the Nova Scotia Community College's Applied Geomatics Research Group. Measurements use well-established methods though data will likely be analyzed based on risk, which will introduce some uncertainty.	2
<i>Redundancy to other criteria</i>	Some correlation with other criterion (e.g. temperature and depth) but can be evaluated relatively independently.	2

Wind and Wave Conditions

Rationale for consideration:	Exposure of aquaculture to high wind and waves can threaten infrastructure and affect fish welfare.
Final decision:	Include
Average score:	2.4 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Consideration of exposure (wind and waves) is an important physical parameter for site selection since given risk to infrastructure, operational management, and fish welfare.	3
<i>Rateability</i>	Some scientific evidence on the impacts of significant wave height on aquaculture, which will be supplemented by expert and industry insights to capture local contexts.	2
<i>Scoring clarity</i>	Exposure modelling and data require some explanation.	2
<i>Scale validity</i>	Criterion relevant to regional planning and dataset will be created at the appropriate spatial resolution.	3
<i>Coastal coverage</i>	Wind and wave exposure modelling generated at appropriate resolutions across the area of analysis.	3
<i>Data accessibility</i>	Spatial data generated for assessment purposes will be developed during the project timeline based on previous ocean wave modelling by DSA Ocean.	2
<i>Measurement reliability</i>	Interpolation of datasets from wave modelling has some uncertainties, though these can be accounted for.	2
<i>Redundancy to other criteria</i>	Correlations with depth although data can be classified relatively independently.	2

Wild Salmon Rivers

Rationale for consideration:	Atlantic salmon aquaculture operations in close proximity of wild salmon rivers may have the potential for negative interactions.
Final decision:	Include (Trout – Exclude*)
Average score:	2.3 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Reducing the decline of wild salmon populations while supporting population recovery is a conservation priority. Atlantic salmon aquaculture may have the potential for negative interactions with wild Atlantic salmon. Considerations for wild salmon are a key factor in Nova Scotia Aquaculture License and Lease Regulations .	3
<i>Rateability</i>	Some evidence available to support classification ranges, although it will largely be discussed through project experts. *Little evidence of interactions with trout (=N/A)	1
<i>Scoring clarity</i>	Ratings for salmon rivers require some explanation.	2
<i>Scale validity</i>	Criterion is relevant to regional planning and dataset will be created to be at the appropriate spatial resolution.	3
<i>Coastal coverage</i>	Assessments will encompass rivers from across the province, with potentially minor gaps in coverage due to lack of comprehensive data on specific rivers.	3
<i>Data accessibility</i>	Assessment of wild salmon rivers is being conducted for this assessment, which requires additional project resources but can be accomplished within the project timeline.	2
<i>Measurement reliability</i>	Recent information on salmon river population status is sparse. Data is being compiled, assessed, and classified based on significance for wild salmon. The assessment framework being established through expert review, but some uncertainty is expected.	1
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Coastal Wetlands

Rationale for consideration:	Finfish aquaculture operations may have the potential to interact with important and sensitive wetland habitats in Nova Scotia.
Final decision:	Include
Average score:	2.6 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Wetlands are important and sensitive habitats in Nova Scotia, supporting various wildlife.	3
<i>Rateability</i>	There is some evidence for interaction with aquaculture, although classification will largely rely on consultation with experts and network partners.	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	The criterion is relevant to regional planning and datasets are largely available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Data is available across the entire province.	3
<i>Data accessibility</i>	Datasets are available and publicly accessible through the Canadian National Wetlands Inventory	3
<i>Measurement reliability</i>	Measurement is straight forward, and analysis can be done through commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	There may be some overlap with other important habitat designations (including protected areas and parks).	2

Terrestrial Protected Areas and Parks

Rationale for consideration:	Aquaculture should be located to minimize potential interactions with sensitive coastal species or habitats, protected due to their high biodiversity or ecological vulnerability.
Final decision:	Include
Average score:	2.0 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Several coastal islands are protected wilderness areas or conservation easements, as they are recognized for their rich coastal biodiversity or as habitat for marine and migratory birds. The potential impacts from aquaculture may be variable and are often unclear.	2
<i>Rateability</i>	Nearshore aquaculture may have potential to interact with terrestrial habitat/species. Though the potential for impacts is unclear as are the designation of adequate buffers.	1
<i>Scoring clarity</i>	Data does not involve complex analysis, although criterion rationale requires some explanation, as there could be multiple potential variables.	2
<i>Scale validity</i>	Criterion mostly represents terrestrial habitats, and interactions are often best evaluated at a site-level (and highly operation-specific).	1
<i>Coastal coverage</i>	Data is available across the entire spatial area of analysis.	3
<i>Data accessibility</i>	Public datasets (e.g. The Nova Scotia Protected Areas System and National Parks and National Park Reserves of Canada Legislative Boundaries) are available and accessible.	3
<i>Measurement reliability</i>	Datasets are compiled, maintained, and updated by the Government of Nova Scotia and monthly by the National Research Council, respectively. Measurement is straight forward, and analysis can be done using commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	Parameter may have some overlap with other habitat and species areas (including wetlands, critical habitats, or avifauna habitats).	1

Critical Habitat for Species At-Risk

Rationale for consideration: Marine species listed as threatened or endangered under the Species at Risk Act (SARA) have critical habitats identified and are legally protected from activities that could impact habitat.

Final decision: Include

Average score: 2.6 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Proximity to marine areas recognized as important to minimize potential interactions with human activities. Critical habitat for protected species, may be located in coastal waters close to shore and therefore have the potential to overlap with aquaculture activities.	3
<i>Rateability</i>	Scoring suitability of aquaculture in relation to critical habitats should consider potential interactions with at-risk species, but may best be evaluated with species distribution, migration, or foraging habitats through more local-scale assessments. Scoring will thus rely on precautionary approaches, drawing on experts and network partners.	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Specific species-interactions and risks with aquaculture are best evaluated at more local scale assessments. Though, boundaries of critical habitats are established by DFO processes that are appropriate for regional-scale assessment.	2
<i>Coastal coverage</i>	Data is available identifying critical habitats across the entire province.	3
<i>Data accessibility</i>	Public datasets are accessible through DFO (Critical Habitat for Species at-risk).	3
<i>Measurement reliability</i>	Critical habitat for aquatic species at risk are identified by DFO.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Important Bird Habitat

Rationale for consideration: Physical structures, along with aggregation of feed and nutrients associated with aquaculture may interact with birds in a variety of ways. Several important species nest and forage in coastal areas around Nova Scotia, within critically important habitat.

Final decision: Include

Average score: 2.4 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Potential interactions of human activities with a critical bird habitat is an important consideration for aquaculture siting.	3
<i>Rateability</i>	Aquaculture has the potential to interact with bird species or their critical habitat. Based on proximity to habitats, some setback distances have been established, often at a species-specific level. Scoring will require consultation with network partners.	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Identifying key areas can be relevant to regional planning, with available datasets at appropriate spatial resolution.	2
<i>Coastal coverage</i>	Data may not represent all habitats recognized.	2
<i>Data accessibility</i>	Several important bird habitat areas are identified in public datasets (e.g. NS Significant Habitat Dataset and IBA Important Bird Areas).	3
<i>Measurement reliability</i>	Measurement is straight forward and required analysis can be done through commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	Important bird habitat may be accounted for indirectly in other layers, such as wetlands. There may also be some overlap with other habitat designations (e.g. protected areas).	2

Fishing Traffic

Rationale for consideration:	Aquaculture should consider space to accommodate navigation of high-use areas for fishing vessels.
Final decision:	Include
Average score:	2.3 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Marine developments should allow sufficient space to accommodate vessel traffic, such as those by fishing. The public right of navigation and other adjacent marine users is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations .	3
<i>Rateability</i>	Scoring can be based on distribution of density data to identify hotspots of fishing vessel traffic.	3
<i>Scoring clarity</i>	Interpreting criteria rationale and data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	Spatial data on fishing traffic hotspots is relevant to regional-level planning.	3
<i>Coastal coverage</i>	Spatial datasets have mostly complete coverage across the area of analysis, although data does have some uncertainty	2
<i>Data accessibility</i>	Fishing vessel traffic data is available (e.g., Vessel Density Mapping of 2019), although more comprehensive VMS datasets was acquired from DFO. Spatial data products will be generated for assessment purposes.	2
<i>Measurement reliability</i>	Vessel traffic data will be assessed based spatial analysis of VMS data. There is some uncertainty in available vessel traffic datasets. Using VMS data to identify vessel traffic hotspots is a common practice and established.	2
<i>Redundancy to other criteria</i>	There could be some correlation with other data sources such as coastal access points and overlap with AIS data.	1

Navigation Routes

Rationale for consideration:	Aquaculture should consider space to accommodate public navigation.
Final decision:	Include
Average score:	2.1 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Marine developments should allow sufficient space to accommodate vessel traffic. The public right of navigation and other adjacent marine users is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations .	3
<i>Rateability</i>	While some guidance is available on suggested buffers for designated traffic routes (e.g. shipping lanes, ferry routes), scoring will rely on expert input and network partner advice.	2
<i>Scoring clarity</i>	Interpreting criteria rationale and data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	Spatial data on common marine transit routes is relevant to regional-level planning.	3
<i>Coastal coverage</i>	Spatial datasets have mostly complete coverage across the area of analysis, although data may not capture all vessel traffic.	2
<i>Data accessibility</i>	Some vessel traffic data available (e.g., Vessel Density Mapping of 2019 AIS Data in the Northwest Atlantic), although more comprehensive AIS datasets was acquired from DFO. Spatial data products will be generated for assessment purposes.	2
<i>Measurement reliability</i>	Navigation routes will be identified based spatial analysis of AIS data. There is some uncertainty in available datasets. Some methods for identifying navigation corridors exist, although a novel method may be required for this project.	1
<i>Redundancy to other criteria</i>	There could be some correlation with other data sources such as coastal access points and fishing vessel traffic.	2

Public Coastal Access

Rationale for consideration: Aquaculture siting should consider space which may be accessed or shared with other users, such as tourism and recreation, as aquaculture can potentially impede access to navigable areas.
Final decision: Include
Average score: 2.0 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture may have the potential to affect navigation and access of coastal users to marine areas. The public right of navigation and other adjacent marine users is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations .	3
<i>Rateability</i>	Data provides an indicator of access to coastal areas. More comprehensive evaluation should be explored at local levels. Some recommended proximity distances have been suggested, but scoring will largely rely on expert input and precautionary designations.	1
<i>Scoring clarity</i>	Interpreting criteria rationale and data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	Key access points provide relevant information for regional level analysis and planning, although could be more comprehensively evaluated at site-level to explore variabilities of different types of access points or users.	2
<i>Coastal coverage</i>	Coverage is mostly adequate, with only some gaps in potential access points possible due to lack of available validation of points.	2
<i>Data accessibility</i>	Coastal access points will be compiled from several public datasets for the assessment.	2
<i>Measurement reliability</i>	There is some uncertainty in methods, but the approach is based on previous robust scientific methods.	2
<i>Redundancy to other criteria</i>	There is likely to be some correlation with other data (e.g., navigation channels).	2

Anchorage Areas

Rationale for consideration: Aquaculture cannot be located in areas already designated as allocated anchorage sites/areas.
Final decision: Include
Average score: 2.9 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture can not occur in existing anchorage areas (constraint) to maintain safe navigation.	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward though considerations around buffers is needed	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Datasets are available at the appropriate spatial resolution and relevant to regional-level considerations.	3
<i>Coastal coverage</i>	Spatial datasets have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	Public datasets (e.g. Canadian Anchorages and Anchorage Areas) are available and accessible.	3
<i>Measurement reliability</i>	Data is maintained and updated regularly by DFO and the Canadian Hydrographic Service (CHS). Analysis is straightforward and a buffer can be easily applied.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Designated Navigation Features

Rationale for consideration: Aquaculture would be constrained in areas already designated for navigation (e.g., shipping and ferry routes, traffic separation zones, sight lines from lighthouses etc.)
Final decision: Include
Average score: 2.9 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture is not allowed (constraint) in areas designated for traffic purposes (e.g., designated ferry routes) or to protect navigational safety (e.g., lighthouse sight lines).	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward. Consideration around buffers is required, and different buffers may be needed for different features.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion relevant to regional planning and dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Spatial datasets have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	Public datasets (e.g. Vessel Traffic Routes) are available and accessible.	3
<i>Measurement reliability</i>	Data is maintained and updated weekly by the DFO and CHS. Analysis is straight forward and requires only consideration of buffers.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Existing Aquaculture

Rationale for consideration: New aquaculture sites cannot be sited in existing aquaculture lease areas (and relevant buffers) due to physical constraints and requirements for mooring and operational logistics.
Final decision: Include
Average score: 2.9 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	New aquaculture sites cannot be placed where existing aquaculture lease areas exist.	3
<i>Rateability</i>	Some discussion required on implications for new development, as required through consultation with government departments.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	The dataset is available at the appropriate spatial resolution.	3
<i>Coastal coverage</i>	Spatial datasets have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	Public datasets (e.g. Nova Scotia Marine Aquaculture Leases) are available and accessible.	3
<i>Measurement reliability</i>	Analysis is straight forward and requires only potential buffers applied to features. Data is compiled, maintained, and updated by the NSDFA. is straight forward.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Water lots

Rationale for consideration: Aquaculture cannot legally be located in already privately-owned water lots.
Final decision: Include
Average score: 2.5 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Several coastal properties in Nova Scotia have privately owned water lots. Aquaculture cannot be located in these areas.	3
<i>Rateability</i>	Different types of water lots may have different implications for aquaculture suitability, requiring consultation with government departments	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion may be more relevant for local site selection but remains an important constraint in nearshore areas.	2
<i>Coastal coverage</i>	Spatial property data is available across the area of analysis.	3
<i>Data accessibility</i>	Spatial property identification data is available though needs to be provided by network partners (private data request).	2
<i>Measurement reliability</i>	Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Submerged pipelines and cables

Rationale for consideration: Aquaculture cannot operate over submerged infrastructure due to required substrate moorings.
Final decision: Include
Average score: 2.9 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture cannot operate over submerged infrastructures such as telecommunication cables due to interference with moorings and legal restrictions.	3
<i>Rateability</i>	As this is a constraint, classification is straightforward.	3
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion relevant to regional planning and dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Spatial datasets have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	The location of key structures is available on request from network partners.	2
<i>Measurement reliability</i>	Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Marine Renewable Energy Areas

Rationale for consideration:	Several areas in Nova Scotia are allocated as Marine Renewable Energy Areas (MREA) used for exploration of energy production. Aquaculture can not occur in these areas already allocated for this use.
Final decision:	Include
Average score:	2.8 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Several areas in Nova Scotia are allocated as Marine Renewable Energy Areas used for exploration of energy production. Aquaculture can not occur in these areas already allocated for this use.	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward. Consideration of buffers is required.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Spatial datasets include all known approved MREAs and therefore have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	Dataset is available at request through network partners.	2
<i>Measurement reliability</i>	Distinct boundaries of MREAS are allocated by Nova Scotia Department of Natural Resources and Renewables. Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Marine Protected and Conserved Areas

Rationale for consideration:	Marine protected areas represent important protected and conserved areas that aquaculture would need to consider
Final decision:	Include
Average score:	2.75 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Within legally protected marine areas, large-scale developments are generally prohibited.	3
<i>Rateability</i>	Different types of protected areas may have different restrictions. Requires consultation and input from government departments	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Dataset is available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Spatial datasets have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	Public datasets (e.g. Canadian Protected and Conserved Areas Database (CPCAD)) are available and accessible.	3
<i>Measurement reliability</i>	The CPCAD data is compiled and managed by ECCC, in collaboration with federal, provincial, territorial, and other reporting authorities that provide the data. Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

At Sea-Disposal Sites

Rationale for consideration:	Aquaculture can not be located above areas designated as at-sea disposal sites due to potential contamination risks.
Final decision:	Include
Average score:	2.9 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Several at-sea disposal sites are licensed in Nova Scotia's coastal waters. These represent allocated areas where any aquaculture operation would be excluded.	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward. Consideration of buffers is required.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Dataset is available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	At Sea Disposal Sites are regularly updated through ECCC, ensuring full coverage.	3
<i>Data accessibility</i>	Public dataset (e.g. Active and Inactive Disposal at Sea Sites in Canadian Waters) is available from ECCC.	3
<i>Measurement reliability</i>	Data is maintained and updated annually by ECCC. Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Criteria Excluded

Sea Surface Temperature

Rationale for consideration:	Aquaculture should be sited in areas where average temperatures are within established temperature ranges optimal for growth.
Final decision:	Exclude
Average score:	1.6 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Sea Surface Temperatures (SST) provide indication of average temperatures do not identify critical thresholds (e.g. heat stress, etc.). These temperatures are more relevant for identifying optimal growth conditions, which is beyond scope of assessment.	1
<i>Rateability</i>	Average temperatures are relevant to identifying general growth considerations for finfish, but they only provide an indicator at the surface (whereas fish normally in depths between 5-20 m below the surface). Therefore, SST is only a rough indicator of growth conditions, and so scoring would have some uncertainty.	2
<i>Scoring clarity</i>	The calculation of satellite-derived SST requires some explanation.	2
<i>Scale validity</i>	Available datasets are at coarse resolutions and not appropriate the scale of assessment.	1
<i>Coastal coverage</i>	Available datasets have major gaps in coverage, especially in nearshore environments close to the coast.	1
<i>Data accessibility</i>	Datasets are available through publicly accessible satellite-modeling (e.g. DFO BNAM model), though data may not be available for small time steps (e.g. daily).	3
<i>Measurement reliability</i>	Some identified limitations with using satellite-derived and modeled SST data.	2
<i>Redundancy to other criteria</i>	Data can be integrated into the calculation of temperature threshold layers (overlap).	1

Ocean Slope

Rationale for consideration: Aquaculture should be sited in areas where the slope of the bottom is suitable for construction of farms and cage drainage.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	The bottom slope of the area could affect farm construction. Mooring considerations and farm construction are beyond the scope of assessment.	N/A
<i>Rateability</i>	There is evidence of slope requirements for finfish sites, although this can be operation-specific.	2
<i>Scoring clarity</i>	The slope is calculated using bathymetry data, which would require some explanation.	2
<i>Scale validity</i>	Criterion is relevant for the site-level to capture operation-specific requirements.	N/A
<i>Coastal coverage</i>	Coverage is available around all of Nova Scotia but some areas have greater uncertainty or minor gaps.	2
<i>Data accessibility</i>	Bathymetry data is available from various sources (e.g., GEBCO).	2
<i>Measurement reliability</i>	Ocean slope can be represented from bathymetry data (e.g. GEBCO).	3
<i>Redundancy to other criteria</i>	Accounted for in bathymetry.	1

Substrate

Rationale for consideration: Aquaculture should be sited in areas with appropriate substrate type to meet mooring and operational considerations.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Different substrate types are readily accounted for by different mooring considerations with respect to substrate require high level data resolution at the site level, which is beyond the scope of assessment. Substrate type is also not considered an impediment for aquaculture site selection under most circumstances.	N/A
<i>Rateability</i>	General considerations for substrate type are well understood for different producers but may vary considerably across smaller scales and different operations. Scoring would rely on expert and industry insights.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion is best evaluated at the site-level scale. Available datasets at very coarse scale, not representative of fine-scale variability that is important for siting.	N/A
<i>Coastal coverage</i>	Substrate Classification mapping of the Inshore Scotian Shelf and the Bay of Fundy exists with coverage across the area of analysis, though at a very coarse scale.	3
<i>Data accessibility</i>	Public dataset is available (e.g., A substrate classification for the Inshore Scotian Shelf and Bay of Fundy, Maritimes Region) and accessible.	3
<i>Measurement reliability</i>	Dataset was produced by the DFO based on previous geological characterizations from NRCan. In areas where geological descriptions were unavailable digital elevation models and substrate samples from NRCan, CHS and DFO Science were used. Dataset is considered coarse with high uncertainty and local variability at smaller scales.	1
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Ocean Current

Rationale for consideration: Aquaculture should be sited in areas with adequate current to allow greater water exchange between farms and surrounding water, allowing sufficient oxygen supply to farmed fish, and enabling waste dispersal from cages.

Final decision: Exclude

Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Adequate currents are an important consideration for planning and site selection for fish welfare, and current data is typically collected at prospective locations.	3
<i>Rateability</i>	Suitable current speeds are well established and understood, but suitability also often evaluated in the context of other ocean variables.	2
<i>Scoring clarity</i>	Implications for current speed would require some explanation to non-technical users.	2
<i>Scale validity</i>	Current is highly variable at local levels and of limited applicability at regional-level scales.	N/A
<i>Coastal coverage</i>	Local-scale current speed data collection is sporadic and does not cover the entire coastline. (sparse), not are model outputs (e.g. FVCOM) available for all locations.	N/A
<i>Data accessibility</i>	Available only for some locations.	N/A
<i>Measurement reliability</i>	There is confidence in data collected, but complex ocean models are needed to estimate (interpolate) current between these locations.	2
<i>Redundancy to other criteria</i>	Related to exposure modelling and correlated to depth.	1

Ocean Flushing

Rationale for consideration: Aquaculture should not be sited in areas with poor flushing, which could increase water temperature, decrease dissolved oxygen, and cause an increase in algal blooms.

Final decision: Exclude

Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Flushing rate is recognized as an important criterion for aquaculture at local site selection scales and is better suited for application in carrying capacity models.	2
<i>Rateability</i>	The dynamics of flushing rates on aquaculture are generally well understood, but often evaluated in the context of other ocean variables.	2
<i>Scoring clarity</i>	Flushing rate can generally be calculated through a range of basic to complex modelling processes which require some explanation.	2
<i>Scale validity</i>	Criterion is relevant for the local site selection scale or bay-scale carrying capacity modelling.	N/A
<i>Coastal coverage</i>	Not available for all bays across the province.	N/A
<i>Data accessibility</i>	Where flushing rate has been calculated and published, information is easily accessible, but for most bays around the province, field data collection would be required to calculate flushing rate.	1
<i>Measurement reliability</i>	Flushing rate calculations and predictions are more accurate in clearly defined bays with, but less accurate at fine scales or in geographically complex systems.	1
<i>Redundancy to other criteria</i>	Influences many water quality metrics. Flushing rate is of limited usefulness in isolation.	N/A

Wind/Wave Direction

Rationale for consideration: Aquaculture site orientation and construction can be influenced by the direction and speed of wind and waves in the area.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Indirectly relates to the magnitude of stress on gear, which is more of an operational constraint beyond the scope of assessment.	N/A
<i>Rateability</i>	Implications for aquaculture suitability are highly operation specific and can not be taken in isolation.	2
<i>Scoring clarity</i>	Relatively easy to explain, but variation in would also need to be communicated.	2
<i>Scale validity</i>	Wind and wave directional data has greater importance at the aquaculture site selection scale and is not well qualified at this scale most locations around the province.	N/A
<i>Coastal coverage</i>	Wind direction has adequate coverage at coarse scales, but wave direction is not well defined for most locations.	2
<i>Data accessibility</i>	Some data accessible exists but would require considerable effort to adjust the scale of analysis or collect additional data where gaps exist.	2
<i>Measurement reliability</i>	It is possible to report predominant wind and wave direction at the scale of analysis, with some uncertainty.	2
<i>Redundancy to other criteria</i>	Maximum wave exposure modelling embodies this parameter.	N/A

Wind Speed

Rationale for consideration: Aquaculture site orientation and construction can be influenced by the direction and speed of wind and waves in the area.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Wind speed is recognized as an important consideration for site orientation and selection. It can indirectly relate to the magnitude of stress on gear. It is rarely an absolute limiter, but may dictate infrastructure engineering needs, which in turn affect cost and therefore, more an operational consideration beyond the scope of assessment.	N/A
<i>Rateability</i>	Maximum wind speed is important for site selection, orientation and infrastructure design. Implications are highly operation specific.	3
<i>Scoring clarity</i>	Wind speeds are often highly linked to other parameters, with mostly indirect effects on farms. Understanding the role/effects of wind would require a fair bit of explanation.	1
<i>Scale validity</i>	The scale of data for wind speed is at the provincial level.	2
<i>Coastal coverage</i>	Generating wind speed data across the entire area of analysis would require substantial interpolation from point data.	1
<i>Data accessibility</i>	Some accessible data it would require analysis to adjust to the scale of analysis.	2
<i>Measurement reliability</i>	Interpolation of wind speed data at scale would be required for assessment, but it is possible with existing data. There is some uncertainty with the use of terrestrial wind gauges.	2
<i>Redundancy to other criteria</i>	Wave exposure parameter modelling accounts for this parameter.	N/A

Shellfish Harvest Area Classifications

Rationale for consideration: In Nova Scotia, regulatory compliance of shellfish harvesting is based on water quality as regulated by the Canadian Shellfish Sanitation Program (CSSP).
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	The CSSP does not apply to finfish aquaculture.	N/A
<i>Rateability</i>	The CSSP does not apply to finfish aquaculture.	N/A
<i>Scoring clarity</i>	Areas classified are well-defined and described through the CSSP though there are potential management mitigation strategies for culture. Some explanation required.	2
<i>Scale validity</i>	Criterion is relevant to both regional planning and site selection. The dataset is available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Area classifications covers areas assessed by the CSSP across the entire province. Areas without classifications are considered "unclassified".	2
<i>Data accessibility</i>	Public datasets (e.g. Shellfish Water Classification Program – Shellfish Harvest Area Classification in Canada) are available and accessible.	3
<i>Measurement reliability</i>	The CSSP classifies areas through regular monitoring efforts. Shellfish harvest areas are classified as to their suitability for harvesting, according to accepted water quality standards, but classifications and status of closure may vary over time.	2
<i>Redundancy to other criteria</i>	Runoff inputs and outfalls are considered within CSSP designation.	2

Aquatic Invasive Species

Rationale for consideration: Aquaculture should not be located in areas susceptible to Aquatic Invasive Species (AIS) due to their detrimental impacts on water quality.
Final decision: Exclude
Average score: 1.5 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	AIS can act as biofouling organisms on finfish cage systems. This can be costly for producers to remove, and if it accumulates, can reduce water flow and oxygen provision to cages, although this largely depends on local management practices. Does not often lead to fish mortality or widespread fish health issues.	1
<i>Rateability</i>	Impacts would largely depend on management practices. Classification likely requires advice from experts and industry.	2
<i>Scoring clarity</i>	The dataset requires some clarification to explain modelling and aggregation of species.	1
<i>Scale validity</i>	Specific impacts or risks from AIS is best evaluated at the site-level. Identifying general areas where species are present or most intense can provide an indicator of additional risks producers may face, which is appropriate for regional level assessment.	2
<i>Coastal coverage</i>	Modelled data available does not extend fully across the area of analysis.	1
<i>Data accessibility</i>	Modelled distribution data available and accessible (e.g. Species distribution models and occurrence data for marine invasive species hotspot identification). However, risks to producers are more based on intensity and timing of spread, which has not been mapped.	1
<i>Measurement reliability</i>	Marine invasive hotspot modelling is done through monitoring and occurrence data through DFO. The data is based on predictive models with accepted uncertainty. Measurement would require combining multiple species hotspots with some uncertainty.	1
<i>Redundancy to other criteria</i>	While there may be some relationships with temperature and particle availability, data can be treated as largely independent.	3

Salinity

Rationale for consideration:	Finfish have defined salinity tolerances, where extreme salinity fluctuations can negatively affect water quality and influence growth and health of species.
Final decision:	Exclude
Average score:	Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Salinity outside of optimal ranges can influence fish growth and health. However, salinity ranges in Nova Scotia generally do not exhibit extreme fluctuations that would be critical for fish health.	1
<i>Rateability</i>	Cultured species have specific salinity tolerances that would affect health and welfare. Salinity tolerances are well established. High variability at local scales is more of an issue.	1
<i>Scoring clarity</i>	Salinity effects are well understood and can be clearly communicated.	3
<i>Scale validity</i>	Spatial datasets at coarse resolutions. Variations in salinity are highly site-specific (due to various inputs, local patterns in current and flushing, etc.). Consideration is more relevant at the site selection scale.	N/A
<i>Coastal coverage</i>	The data available (point locations) contains large gaps and cover multiple time frames.	1
<i>Data accessibility</i>	At the appropriate resolution, nearshore salinity is only available for point locations.	1
<i>Measurement reliability</i>	Ocean salinity mapping efforts (e.g. satellite data) at inappropriate spatial resolutions, would require significant downscaling and would introduce considerable uncertainty.	1
<i>Redundancy to other criteria</i>	Shifts in salinity may be accounted for in other layers (e.g. distance to rivers).	1

Dissolved Oxygen

Rationale for consideration:	Finfish species rely on dissolved oxygen for respiration is an important factor for optimizing growth and health
Final decision:	Exclude
Average score:	Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Inadequate levels of dissolved oxygen (DO) can lead to stress, reduced growth, and, in extreme cases, mortality. DO is a key parameter for monitoring and siting, but is often applied at the site-level. On a regional scale, DO is generally not an issue in Nova Scotia.	3
<i>Rateability</i>	DO is an important water quality parameter for finfish, with optimal ranges and thresholds well-documented. Yet, thresholds vary with other ocean parameters (e.g. temperature and salinity) and exhibit high spatial variability at local scales, depending also on culture and management practices, making assessments more relevant at the site-level.	1
<i>Scoring clarity</i>	Implications of dissolved oxygen on cultured species are relatively easy to describe, although the creation of a spatial layer may be technical and require some explanation.	1
<i>Scale validity</i>	Recognized small-scale spatial and temporal variability within coastal bays - most relevant for local assessments or bay-scale carrying capacity modelling.	N/A
<i>Coastal coverage</i>	Due to large gaps in the data available and limited data in nearshore areas a risk-based approach or interpolation would be required.	N/A
<i>Data accessibility</i>	There are no provincial-scale spatial datasets available; only point locations are available. Necessary efforts to complete coverage are not within the project timeline and resources.	1
<i>Measurement reliability</i>	DO can be measured through in-situ measurements or satellite data.	1
<i>Redundancy to other criteria</i>	DO is influenced by other parameters at the local level, including ocean mixing, temperature, current flow, flushing rate, etc.	2

Turbidity

Rationale for consideration: High turbidity may have implications for aquaculture, primarily in relation to shellfish aquaculture.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Hydrodynamic requirements for finfish aquaculture mean sites are rarely in nearshore areas where turbidity would be an issue.	N/A
<i>Rateability</i>	Consideration mostly relevant for requirements for shellfish aquaculture.	N/A
<i>Scoring clarity</i>	The inclusion of turbidity requires an explanation for why it is relevant and how it is measured.	1
<i>Scale validity</i>	Turbidity has recognized small-scale spatial and temporal variability within coastal bays.	1
<i>Coastal coverage</i>	Satellite images and data exist across the province and provide information that can be used to identify turbid waters.	2
<i>Data accessibility</i>	Satellite data is free and accessible online but may require some work to use.	2
<i>Measurement reliability</i>	Measurement is straightforward but involves complex image analysis or site-specific measurements relevant during site selection.	2
<i>Redundancy to other criteria</i>	Data is largely independent of other data. There may be some overlap with river runoff.	2

Chlorophyll

Rationale for consideration: For finfish species, high chlorophyll concentrations may be related to creation of algal blooms.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Since finfish are not filter-feeding organisms, chlorophyll is not considered a key parameter for growth of fish. May be linked to algal blooms, but generally not an issue in Nova Scotia.	N/A
<i>Rateability</i>	Consideration is mainly relevant to requirements for shellfish aquaculture.	N/A
<i>Scoring clarity</i>	Criterion would require some explanation, including how datasets were derived.	2
<i>Scale validity</i>	High variability across temporal and spatial scales means criterion is best evaluated through bay-scale assessments or assessments of carrying capacity.	1
<i>Coastal coverage</i>	Satellite data is available, although there are substantial gaps in data (due to cloud coverage).	2
<i>Data accessibility</i>	Satellite data is available online, but data format can be challenging to manipulate.	2
<i>Measurement reliability</i>	There is some uncertainty in satellite derived data, as data rely on ocean colour to generate inferences of in-situ values.	2
<i>Redundancy to other criteria</i>	Consideration within carrying capacity models.	2

Primary Productivity

Rationale for consideration: Relevant for understanding ecosystem function surrounding finfish aquaculture sites, with potential relation to creation of algal blooms, although mostly relevant to shellfish aquaculture.
Final decision: EXCLUDE
Average score: N/A (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Primary productivity refers to the rate at which photosynthetic producers convert energy from the sun into organic materials which may influence conditions surrounding finfish sites. Most appropriately considered within the context of carrying capacity and ecosystem functioning.	1
<i>Rateability</i>	Not clear; threshold values will vary between local ecosystems and bays.	1
<i>Scoring clarity</i>	Criterion would require significant explanation and context.	N/A
<i>Scale validity</i>	High variability across temporal and spatial scales means criterion is best evaluated through bay-scale assessments for determining carrying capacity.	N/A
<i>Coastal coverage</i>	Minimal data has been collected within a handful of areas of interest, but this is a small fraction of NS coastline.	N/A
<i>Data accessibility</i>	Data must be collected manually and analysis is lengthy, costly, and intensive.	1
<i>Measurement reliability</i>	Scientific methods are used to measure carbon dioxide uptake or oxygen consumption.	2
<i>Redundancy to other criteria</i>	Considered within carrying capacity models.	N/A

Point Discharges

Rationale for consideration: Aquaculture should not be located in areas where domestic effluent or industrial discharges release nutrients or contaminants into coastal areas.
Final decision: Exclude
Average score: 1.9 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Domestic effluent or industrial discharges can release nutrients or harmful contaminants into the marine environment, which can cause harm to cultured fish in close proximity.	3
<i>Rateability</i>	Impacts are likely affected by multiple variables and classification would rely heavily on expert advice.	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion considered mostly relevant at the site-selection level due to high variability.	1
<i>Coastal coverage</i>	There are some gaps in spatial data on the location of all outfalls across the area of analysis.	1
<i>Data accessibility</i>	There are some gaps in spatial data on the location of all outfalls across the area of analysis that would require additional resources to identify.	2
<i>Measurement reliability</i>	Measurement is straight forward, and analysis can be done through commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	Parameter is considered in shellfish closure areas and has some overlap with the location of small craft harbours and population centres.	1

River Runoff

Rationale for consideration: Aquaculture should not be located in areas that would be highly exposed to riverine inputs that could release nutrients or contaminants into coastal areas.
Final decision: Exclude
Average score: 1.3 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	If within very close distances, river runoff could create water quality concerns, but it is not often an issue of high importance for finfish since it often does not occur close to sources.	1
<i>Rateability</i>	Impacts to finfish can be highly variable and are likely affected by multiple factors at the site-level. Classification would rely on expert advice.	1
<i>Scoring clarity</i>	River runoff impacts may require complex analysis that would require substantial explanation to end-users.	1
<i>Scale validity</i>	Impacts from riverine inputs exhibit local-scale environmental variability to be more comprehensively captured at the site-level.	1
<i>Coastal coverage</i>	Some information required to map river runoff is available, but others require site-specific information that is not available across the entire spatial area of analysis.	1
<i>Data accessibility</i>	Spatial data could be generated for assessment. Although, more complex analysis is required to appropriately capture river-specific impacts are beyond this project.	1
<i>Measurement reliability</i>	Simple methods of measurement are available (i.e., through indirect metrics such as proximity to rivers) at regional level.	3
<i>Redundancy to other criteria</i>	The impacts from river inputs relate to other variables and can be linked to changes in salinity and turbidity. River data also captured in wild salmon river criterion.	1

Agricultural Runoff

Rationale for consideration: Aquaculture should not be located in areas where agricultural discharges release nutrients or contaminants into coastal areas.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	If within very close distances, agricultural runoff could create water quality concerns, but it is not often an issue of high importance for finfish since it often does not occur close to sources.	1
<i>Rateability</i>	Proximity to sources of agricultural runoff is not generally an issue for finfish aquaculture, since it does not often occur close to sources (to meet depth requirements). Effects would depend highly on the management of agricultural practices. Some established buffers exist which will be supplemented with additional expert opinion.	N/A
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Proximity to easements where runoff may be an issue can be adequately addressed at the provincial level since there is existing information on where these activities occur and watershed delineation, although there are local variabilities.	2
<i>Coastal coverage</i>	Data is available across the entire spatial area of analysis.	3
<i>Data accessibility</i>	Dataset is available through network partners.	2
<i>Measurement reliability</i>	Accuracy of data is high due to collection from network partners.	3
<i>Redundancy to other criteria</i>	In the context of critical sources of runoff, this is already accounted for in CSSP.	N/A

Forestry Runoff

Rationale for consideration: Aquaculture should not be located in areas where forestry discharges release nutrients or contaminants into coastal areas.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	If within very close distances, forestry runoff could create water quality concerns, but it is not often an issue of high importance for finfish since it often does not occur close to sources.	1
<i>Rateability</i>	Proximity to sources of forestry runoff is not generally an issue for finfish aquaculture, since finfish aquaculture activities are not often conducted close to sources (to meet depth requirements).	N/A
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Proximity to easements where runoff may be an issue can be adequately addressed at the provincial level since there is existing information on where these activities occur and watershed delineation, although there are local variabilities.	2
<i>Coastal coverage</i>	Data is available across the entire spatial area of analysis.	3
<i>Data accessibility</i>	Dataset is available through network partners	2
<i>Measurement reliability</i>	Accuracy of data is high due to data collection from network partners.	3
<i>Redundancy to other criteria</i>	In the context of critical sources of runoff, this is already accounted for in CSSP.	N/A

Algal Blooms

Rationale for consideration: Aquaculture operations can be impacted if within areas of high likelihood of blooms, which can lead to mechanical damage to fish gills, depletion of local oxygen levels, and exposure to toxins.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Harmful algal blooms (HABs) are relevant for monitoring and management in aquaculture. HABs have been linked to mechanical damage to fish gills, depletion of local oxygen levels, and exposure to toxins.	2
<i>Rateability</i>	Areas experiencing frequent algal blooms and HABs are not ideal for finfish aquaculture, as they can endanger finfish health and cause severe economic impacts. Classification is likely based on the risk of events occurring, which is difficult to estimate.	1
<i>Scoring clarity</i>	Criterion rationale and data products likely require some explanation.	2
<i>Scale validity</i>	Likely consideration appropriate for regional-level assessment, but would require substantial interpolation of point data.	1
<i>Coastal coverage</i>	Only localized data collection efforts.	N/A
<i>Data accessibility</i>	The necessary efforts required to complete the dataset for missing spatial coverage are beyond the time and resources available.	N/A
<i>Measurement reliability</i>	Methods for estimation are novel and emerging.	1
<i>Redundancy to other criteria</i>	Correlations with multiple parameters, likely creating redundancies across other parameters (e.g. water quality, temperature, and proximity to sources of nutrients and pollution).	1

Other aquaculture sites (proximity)

Rationale for consideration: Aquaculture should be located with adequate distance between farms to minimize potential transfer of disease between farms.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Proximity to existing aquaculture sites is considered important for potential disease transfer between farms. Disease transmission is critical for the health and welfare of cultured species.	3
<i>Rateability</i>	There is some guidance on proximity distances from other jurisdictions and existing suitability assessments but would also require input from experts and network partners.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Consideration for disease transmission is considered more relevant for site selection processes or bay-scale assessment.	N/A
<i>Coastal coverage</i>	Considering in the context of proximity to existing sites, all sites across the area of analysis are available; data is available across the entire spatial area of analysis.	3
<i>Data accessibility</i>	Public datasets on the location and extent of existing aquaculture sites are available and accessible (e.g. Nova Scotia Marine Aquaculture Leases).	3
<i>Measurement reliability</i>	If considering in the context of proximity to existing sites, data is compiled, maintained, and updated by the NSDFA. Measurement is straight forward, and analysis can be done through commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

CFIA Declared Infected Areas

Rationale for consideration: Reportable diseases such as Multinucleated sphere "X" (MSX) has caused high mortalities of oysters in the Bras D'Or area. Areas with high prevalence should be avoided for oysters.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	MSX only influences oysters, so criterion is not relevant for finfish.	N/A
<i>Rateability</i>	MSX only influences oysters, so criterion is not relevant for finfish.	N/A
<i>Scoring clarity</i>	Calculation of data and interpolation to spatial dataset requires explanation.	2
<i>Scale validity</i>	Maps of Declared Areas are somewhat coarse for the regional scale of assessment. Interpolation of data is required to produce datasets at the appropriate resolution.	2
<i>Coastal coverage</i>	Coverage only applies to Bras D'Or and surrounding areas. Some interpolation is required to extend beyond point data. Though it can be reasonably assumed that MSX is not present at other locations around the province.	2
<i>Data accessibility</i>	Maps of Declared Areas for aquatic animal disease relevant to Cape Breton (i.e., MSX) are available from CFIA to identify broad exposure areas. Higher resolution presence maps require some interpolation and quantification metrics being developed in this project.	2
<i>Measurement reliability</i>	Declared Area maps are broad. The collection of additional data and use of a novel methods for quantifying MSX spatial data will introduce considerable uncertainties.	1
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Eelgrass Habitat

Rationale for consideration: Aquaculture should be located away from critical areas for eelgrass, to reduce potential impacts from shading, sedimentation, or nutrient releases.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Eelgrass habitats are important and sensitive habitats in Nova Scotia and are a required consideration in aquaculture regulations.	3
<i>Rateability</i>	Evidence of finfish aquaculture and seagrass interactions originate largely from the Mediterranean; reporting potential losses up to 300m from farms. However impacts can be variable and sometimes positive, with limited empirical evidence in Nova Scotia.	1
<i>Scoring clarity</i>	Data products created would require some explanation.	2
<i>Scale validity</i>	Criterion could be used for regional-level planning but can be more comprehensively captured at the bay or site-level.	2
<i>Coastal coverage</i>	Presence of eelgrass data available sporadically across the province. Mapped data to identify habitat suitability or hotspots available through the National Eelgrass Dataset for Canada (NetForce) project were only created for the Scotian Shelf of Nova Scotia.	1
<i>Data accessibility</i>	Spatial datasets on eelgrass presence and habitat suitability available and accessible (e.g. NetForce). The necessary efforts required to complete the spatial dataset for missing spatial coverage are beyond the time and resources available by the project.	N/A
<i>Measurement reliability</i>	Some methods to map the suitability of habitat or habitat hotspots for eelgrass in Nova Scotia are relatively novel (e.g. see NetForce project).	2
<i>Redundancy to other criteria</i>	There may be some overlap with other important habitat designations, as some protected areas include eelgrass habitat.	2

Species Migration Paths

Rationale for consideration: Aquaculture should be sited away from key areas and paths used by species during critical migration life stages (for example, wild Atlantic salmon).
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture may be placed in critical migration path of important species (e.g., Atlantic salmon), potentially interfering with migration or transmitting diseases.	3
<i>Rateability</i>	Impacts highly variable and classification would rely on expert opinion.	2
<i>Scoring clarity</i>	Data would not necessarily require complex analysis and is anticipated to be relatively easy to communicate.	3
<i>Scale validity</i>	Criterion relevant to regional planning.	3
<i>Coastal coverage</i>	Consistent spatial data is non-existent.	N/A
<i>Data accessibility</i>	Consistent spatial data is non-existent	N/A
<i>Measurement reliability</i>	Key migration routes have not been identified.	N/A
<i>Redundancy to other criteria</i>	May be accounted for in other layers (i.e., critical habitat, salmon rivers).	1

Important Fish Habitat

Rationale for consideration: Aquaculture should not be located in areas that would have potential impacts on fish species and habitats that are important for conservation and management initiatives.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture operations may act as both deterrents or attractors for important fish species, altering migration and increasing potentially negative interactions.	3
<i>Rateability</i>	The degree and nature of interactions with aquaculture are likely highly variable based on local operations, making rating challenging.	1
<i>Scoring clarity</i>	Data would not require complex analysis, although rationale would require some explanation (species-specific consideration).	2
<i>Scale validity</i>	Potential interactions with specific fish species are best evaluated through local site selection or management practices.	N/A
<i>Coastal coverage</i>	All data in the described habitats are based on research vessel surveys from DFO trawls, all beyond the area of analysis (offshore).	N/A
<i>Data accessibility</i>	Species distribution data has been mapped for several important fish species through DFO (Bundy et al., 2017) but layers could be available by request.	2
<i>Measurement reliability</i>	Spatial data aggregated across multiple years, involves some interpolation but highlights general species distribution and habitats.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Important Cetacean Habitat

Rationale for consideration: Aquaculture should minimally impact areas recognized as important for cetacean species. Some interactions with aquaculture operations are possible (e.g. entanglement, attraction).
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Several key cetacean species inhabit waters in Nova Scotia and are a key conservation concern. Some interactions with aquaculture operations are possible (e.g., entanglement, attraction), but this is highly farm-specific.	2
<i>Rateability</i>	Infrastructure associated with finfish farming can be obstacles for the movement and migration of cetaceans. There are also risks of entanglements at the site-level, although this is highly gear-specific. There is little evidence to support the scoring.	1
<i>Scoring clarity</i>	Data would not require complex analysis, although rationale would require some explanation (species-specific consideration).	2
<i>Scale validity</i>	Potential interactions with cetaceans are best suited for local site selection or management practices.	N/A
<i>Coastal coverage</i>	Described data are largely based on species distribution models and sighting data from offshore DFO research vessels surveys from DFO, mostly beyond the AOA (e.g. offshore).	N/A
<i>Data accessibility</i>	Some datasets are publicly available based on whale sightings data , or to delineate important habitat (e.g., Blue whales , and Northern Bottlenose Whales), but not for all species of cetaceans or areas.	2
<i>Measurement reliability</i>	Data collected based on long-term datasets from DFO sighting and mapping efforts.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Important Coral/Sponge Habitat

Rationale for consideration: Aquaculture should not be located in areas that would have potential impacts on important benthic species and habitats.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Some corals and sponges are highly sensitive and recognized as a conservation priority. Organic loading from aquaculture could having potential impacts on benthic habitats containing these species.	3
<i>Rateability</i>	Organic loading on benthic environments is a consideration for aquaculture at the site selection scale. There is little existing evidence on the interactions with benthic species considered in this dataset (sponges etc.).	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	The majority of described habitat areas are beyond the 3 km spatial extent of the project.	N/A
<i>Data accessibility</i>	Public datasets identifying significant benthic habitat for corals and sponges are available through DFO and accessible (e.g. Delineation of Coral and Sponge Significant Benthic Areas in Eastern Canada (2016)).	3
<i>Measurement reliability</i>	Significant benthic areas identified and mapped by DFO based on locations of concentrations of corals and sponges from research vessel trawl data.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Important Invertebrate Habitat

Rationale for consideration: Aquaculture should minimally impact areas recognized as important or critical for invertebrate species since aquaculture may lead to organic loading on benthic environments and changes on benthic communities.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Organic loading on benthic environments is a consideration for aquaculture at the site-level. Potential impacts during production are assessed with NSDFA's Environmental Monitoring Program and compliance with the federal Aquaculture Activities Regulations .	3
<i>Rateability</i>	Organic loading on benthic environments is a consideration for aquaculture at the site selection scale. Suitable proximity distances for specific invertebrate species are not well established and are likely reliant primarily on expert advice.	2
<i>Scoring clarity</i>	Data would not require complex analysis, but rationale would require some explanation.	2
<i>Scale validity</i>	Proximity to specific invertebrates/benthic habitats is likely most relevant for site selection, since most benthic habitats occur at small spatial scales.	1
<i>Coastal coverage</i>	All data in described habitats are based on research vessel surveys from DFO trawls, all beyond the area of analysis (i.e., offshore).	N/A
<i>Data accessibility</i>	Species distribution data has been mapped for several important invertebrates through DFO (Bundy et al., 2017) but could be available by request.	2
<i>Measurement reliability</i>	Spatial data aggregated across multiple years, involves some interpolation but highlights general species distribution and habitats.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Lobster Presence

Rationale for consideration: Lobster are key species for commercial fisheries. Potential interactions with lobster is an important consideration for aquaculture siting.
Final decision: Exclude
Average score: 1.5 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Organic loading on benthic environments is a consideration for aquaculture at the site selection scale, with interactions with lobster an important consideration.	3
<i>Rateability</i>	Organic loading on benthic environments is a consideration for aquaculture at the site selection scale. There is variation in evidence on impacts to lobster. Suitable proximity distances are not well established and will likely be reliant primarily on expert advice.	1
<i>Scoring clarity</i>	Data would require explanation, as habitat suitability is based on modelled data.	1
<i>Scale validity</i>	The resolution of the dataset is coarse and likely not appropriate for the scale of analysis.	1
<i>Coastal coverage</i>	Coverage across the area of analysis, although is less accurate to nearshore waters.	1
<i>Data accessibility</i>	Habitat suitability model data available from a published paper (Greenan et al., 2019), would require a request for access (i.e., not public).	2
<i>Measurement reliability</i>	Data from research vessel surveys, which do not sample inshore waters and thus model relies on interpolation, are cited as not appropriate for inshore suitability of habitat.	1
<i>Redundancy to other criteria</i>	There are potential overlaps with other data, including navigation routes.	2

Ecologically and Biologically Significant Areas (EBSAs)

Rationale for consideration: Aquaculture operations should be sited away from areas of high biological or ecological significance
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS))

Property	Description	Score
<i>Relevance to scope</i>	EBSAs are important for conservation goals. Their designations reflect recognized important areas for conservation priorities, reflecting unique or key ecosystems.	3
<i>Rateability</i>	The broad nature of EBSAs, consisting of multiple species, habitat types, etc., would mean proximity ratings based solely on expert opinion.	1
<i>Scoring clarity</i>	The broad nature of EBSA designation would require some additional explanation on a case-by-case basis.	1
<i>Scale validity</i>	Areas are too large, and data is too coarse for the scale of assessment.	N/A
<i>Coastal coverage</i>	Data is available across the entire spatial area of analysis.	3
<i>Data accessibility</i>	Public datasets are available accessible (e.g. Ecologically and Biologically Significant Areas).	3
<i>Measurement reliability</i>	Dataset and EBSA Designation is done through a thorough designation process under DFO. Layer calculation would be simple and done through commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	Data is likely incorporated in other layers at a finer scale (e.g. other habitat layers and protected areas, etc.).	1

High-Use Recreation and Tourism Use Areas

Rationale for consideration: To minimize potential spatial overlaps, aquaculture should minimize impacts to marine areas that are of high use for recreation and tourism.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture operations can potentially interact with or create conflicts with recreation and tourism. Identifying areas used most can help aquaculture reduce negative interactions with coastal users.	2
<i>Rateability</i>	Recognition of potential interactions, but often considered on a more qualitative basis. Classification would largely be based on expert input and precautionary designations.	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	Criterion is relevant to regional planning but could be more effectively/comprehensively evaluated at the local scale.	2
<i>Coastal coverage</i>	There is sparse comprehensive data available, as only localized use-mapping efforts have been undertaken in Nova Scotia at the site-level.	1
<i>Data accessibility</i>	Adequate analysis of coastal use areas would require participatory mapping efforts beyond the available resources.	N/A
<i>Measurement reliability</i>	Measurement of use areas at the provincial scale requires large-scale participatory methods, with some uncertainty.	2
<i>Redundancy to other criteria</i>	There is likely correlation with other sources of data (i.e., proximity to access points).	1

Lobster Fisheries

Rationale for consideration: To minimize potential spatial overlaps, aquaculture should minimally impact areas with important fishing activities such as lobster.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Consideration for fishery activities in adjacent marine waters is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations . Yet, conflicts may be more relevant to the displacement of activity rather than linked to catch data.	1
<i>Rateability</i>	Few empirical studies have explored the linkage between total lobster catches and proximity to aquaculture (for a review, see Horricks et al., 2022).	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification because lack of defined impacts/interactions.	2
<i>Scale validity</i>	Criterion is relevant to regional planning but is comprehensively evaluated at a local scale. Data only available at spatial resolutions that are too coarse for this level of analysis.	N/A
<i>Coastal coverage</i>	Coarse spatial datasets have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	Public datasets are available and accessible (e.g., Inshore Lobster Landings and Fishing Effort).	3
<i>Measurement reliability</i>	Landings and effort mapping compiled by DFO, but have some inherent uncertainty associated with fisher-reported data.	2
<i>Redundancy to other criteria</i>	Spatial overlaps are possible with other data, such as navigation since fishing areas may depend on proximity to port.	1

Other Commercial Fisheries

Rationale for consideration:	To minimize potential spatial overlaps, aquaculture should minimally impact areas with important fishing activities.
Final decision:	Exclude
Average score:	1.6 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Consideration for fishery activities in adjacent marine waters is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations . Conflicts may be more relevant to the displacement of activity rather than linked to catch data.	1
<i>Rateability</i>	Few empirical studies have explored the linkage between total catches for most fish species and proximity to aquaculture.	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	Catch data spatially mapped on a 10 km ² grid; determined to be at a coarse scale that may be inappropriate for the scale of assessment.	1
<i>Coastal coverage</i>	Data resolution is coarse and there are some gaps in data close to shore.	2
<i>Data accessibility</i>	Public datasets are available and accessible (e.g. the Eastern Canada Commercial Fishing Data)	3
<i>Measurement reliability</i>	Commercial fishing catch data has been spatially mapped by DFO with some inherent uncertainty associated with calculation.	2
<i>Redundancy to other criteria</i>	Spatial overlaps possible with other data, such as navigation since fishing areas may depend on proximity to port.	1

Indigenous Fisheries

Rationale for consideration:	Indigenous Peoples in Nova Scotia have the legal right to fish for food, social, ceremonial (FSC) and moderate livelihood purposes. Aquaculture should be located in areas that would not restrict access to Indigenous fishing.
Final decision:	Exclude
Average score:	1.6 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Consideration for fishery activities in adjacent marine waters is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations . Interactions with areas used for Indigenous fisheries can be variable and best considered at the site-level. This factor is intertwined with social compatibility which is beyond the project scope.	1
<i>Rateability</i>	Considerations for displacement or impacts on Indigenous fisheries are highly variable and are most appropriately evaluated through local consultations at the site-level, specifically during site selection.	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	More appropriate for local site selection, with consultation with local communities.	N/A
<i>Coastal coverage</i>	Spatial data is not publicly available for the province.	NA
<i>Data accessibility</i>	Some Indigenous fishing activity has been mapped through broader commercial fisheries designations (i.e., Lobster Fishing Areas). However, not all Indigenous fishing activities have been mapped and the data can be considered sensitive in nature.	NA
<i>Measurement reliability</i>	Mapping may not be appropriate for wide public distribution.	2
<i>Redundancy to other criteria</i>	Spatial overlaps possible with other data, such as other fisheries data.	1

Viewshed

Rationale for consideration: Aquaculture should be sited to minimize its visual impact on the surrounding seascape and alteration of the aesthetic appeal of coastal areas.
Final decision: Exclude
Average score: 1.8 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture operations can impact viewshed appeal for some. This reflects an indirect use of seascape and reflects social uses beyond the scope of assessment.	1
<i>Rateability</i>	There are some recognized impacts of aquaculture on viewshed; Although highly variable and little empirical evidence is available to generate classification levels.	1
<i>Scoring clarity</i>	Viewshed analysis is a complex metric; and classification would require substantial explanation.	1
<i>Scale validity</i>	Parameter may be more suited to a more fine-scale, local process to identify key viewpoints in a specific area.	1
<i>Coastal coverage</i>	If collected, data could be available across the entire area of analysis.	3
<i>Data accessibility</i>	The layer generation would require additional resources but could be accomplished within the project timeline.	2
<i>Measurement reliability</i>	Can be measured through well-established methods of viewshed analysis, although there is some uncertainty associated.	2
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Noise Footprint

Rationale for consideration: Aquaculture should minimize their noise footprint as to not disrupt other marine users.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Noise footprint is best evaluated on a local scale and reflects more social conflicts which are beyond the scope of assessment.	1
<i>Rateability</i>	Recognition of the noise created through aquaculture operations, although little empirical evidence is available to generate classification levels, as much of the noise footprint is highly operation specific.	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	More appropriate for local site selection, highly dependent on gear, size of farms, etc.	N/A
<i>Coastal coverage</i>	No spatial datasets currently exist.	N/A
<i>Data accessibility</i>	Spatial data is non-existent and difficult to estimate at a regional scale.	1
<i>Measurement reliability</i>	Methods for calculating noise footprint exist, although challenging at this scale due to local farm-specific production specifics.	1
<i>Redundancy to other criteria</i>	Criterion has correlations with other proximity to land sources (coastal use areas, etc.).	2

Dredging Areas

Rationale for consideration: Aquaculture cannot be located above regularly dredged areas due to potential disturbances caused by dredging activities.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Regular dredging areas are considered unideal for aquaculture since the lease would obstruct regular maintenance, dredging barges, and high siltation rates of the environment.	3
<i>Rateability</i>	Aquaculture can not occur in areas regularly dredged. Recognition as a constraint means the classification is straightforward.	3
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Private or irregular dredging may not be well documented, compared to regular dredging locations.	1
<i>Data accessibility</i>	Some data is available publicly, while others are held privately. Up to date information on currently dredged areas that have not been mapped is currently under development.	N/A
<i>Measurement reliability</i>	Measurement accuracy is relatively good for reported/designated dredging areas.	2
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Derelict Vessels and Shipwrecks

Rationale for consideration: Aquaculture cannot be located above submerged vessels due to safety hazards and to preserve potentially culturally important sites.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Several derelict vessels and shipwrecks exist along the Nova Scotia coast, especially in shallow waters. Obstruction in the marine environment can pose safety issues when operating around aquaculture leases. These vessels can be removed, usually with some monetary cost.	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward as aquaculture is not permitted over derelict vessels and shipwrecks to ensure the historical preservation of the vessel and reduce interaction with aquaculture infrastructure.	3
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	3
<i>Scale validity</i>	Most appropriately identified during local site selection, with consultation with local communities.	N/A
<i>Coastal coverage</i>	Minimal data is available from Coast Guard Canada, but is likely incomplete across the province.	1
<i>Data accessibility</i>	Locational data is largely held privately and not appropriate for public use.	N/A
<i>Measurement reliability</i>	Reporting of locations may be unreliable and not appropriate for public use.	N/A
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data but could overlap with archeological sites.	2

Archeological sites

Rationale for consideration: Aquaculture should minimally impact marine sites with cultural and archeological importance, which are also protected legally.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Known archaeological areas are protected under the Special Places Protection Act . Aquaculture should not occur in an archeological protected area. However, many archeological sites are not identified, and appropriately accounting for these areas would require local-scale assessments more appropriate for a site-level.	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward. Consideration of buffers would be required.	2
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	3
<i>Scale validity</i>	To effectively incorporate, criteria is best considered and incorporated during local site selection processes, and with consultation with local communities.	N/A
<i>Coastal coverage</i>	Data on known sites is not publicly available. The location of unknown sites has not been mapped.	N/A
<i>Data accessibility</i>	The Nova Scotia Department of Communities, Culture, Tourism, and Heritage maintain records of known sites. Location data can be considered sensitive in nature.	N/A
<i>Measurement reliability</i>	Site mapping is not appropriate for wide public distribution due to sensitivity of data.	1
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data but could overlap with shipwrecks.	2

Oil and gas structures

Rationale for consideration: Aquaculture cannot be located within existing oil and gas structures (spatial constraint).
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Marine oil and gas exploration exists in several areas across Nova Scotian's Scotian Shelf.	3
<i>Rateability</i>	Aquaculture would be constrained in these areas. Recognition as a constraint means the classification is straightforward. Some conversations with network partners are necessary to determine the required buffer.	2
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	3
<i>Scale validity</i>	Dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	No structures exist within the boundary of the area of analysis (all beyond 3 km offshore).	N/A
<i>Data accessibility</i>	The location of active Production Licences administered by the Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) , as well as the surface locations for all wells drilled are available through CNSOPB.	2
<i>Measurement reliability</i>	Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Cumulative Human Impacts

Rationale for consideration: Cumulative human impacts in an area can suggest increased spatial overlap and potential for conflicts with proposed aquaculture development

Final decision: Exclude

Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Cumulative human impacts indicate areas of greater potential overlap and conflicts with potential aquaculture	3
<i>Rateability</i>	Greater overlap of activities does not necessarily result in reduced suitability. Rating would depend on expert opinion	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require explanation and clarification as dataset involves a number of components.	2
<i>Scale validity</i>	Dataset available is at coarse resolution inappropriate for scale of assessment (1km ²)	N/A
<i>Coastal coverage</i>	Dataset available was only mapped for the Maritimes region, notable gaps on the Gulf Shore	N/A
<i>Data accessibility</i>	To support ongoing Marine Spatial Planning initiatives, DFO Maritimes Region has produced Cumulative Human Impact Maps for Bay of Fundy and Scotian Shelf	3
<i>Measurement reliability</i>	Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Shellfish

Criteria Included

Exposure to Extreme Heat

Rationale for consideration: Blue mussels exposed to periods of high-water temperatures can experience stress, which in extreme cases can lead to mortalities. Oysters are more tolerant to prolonged high temperatures.

Final decision: Include (Oysters – Exclude)*

Average score: 2.0 (ADEQUATE)

Property	Description	Score
Relevance to scope	Temperature is a key biophysical parameter important for siting and growth considerations, with heat stress leading to mortality of blue mussels in extreme cases.	3
Rateability	Heat stress temperatures defined for blue mussels and to be supplemented by industry and expert advice. *Oysters are more tolerant to prolonged high temperatures, with Nova Scotia waters rarely exceeding temperature thresholds (relevance = N/A).	3
Scoring clarity	The analysis and methods (i.e., interpolation) require some explanation.	2
Scale validity	Interpolation of data was required to produce datasets at the appropriate resolution.	2
Coastal coverage	Spatial dataset will be based on point data with disperse coverage; interpolation will be applied to areas between point data.	1
Data accessibility	Spatial datasets will be generated using data from CMAR's Coastal Monitoring Program for this assessment.	2
Measurement reliability	Measuring heat stress relies on analysis and interpolation of point data and can be estimated using likelihood calculations. Novel datasets and methods combined with interpolation, will likely introduce uncertainties.	1
Redundancy to other criteria	At shallow water depths, heat stress may have overlaps in trends with bathymetry, but can be assessed and classified relatively independently.	2

Bathymetry

Rationale for consideration: Aquaculture is best located in areas with adequate ocean depth to accommodate gear, vertical space to sinking infrastructure avoid ice and exposure of shellfish to air at low tide.

Final decision: Include

Average score: 2.3 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Site selection must balance minimum depth requirements for gear and to avoid risks from ice and air exposure and increased complexity and cost of mooring at deeper depths.	3
<i>Rateability</i>	Minimum depth requirements for most culture techniques are well established in industry. Depth requirements for shellfish aquaculture will be augmented by expert advice.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	While data scale is relevant to regional planning, available data has uncertainty at shallow nearshore depth, decreasing accuracy in shallow nearshore coastal locations.	1
<i>Coastal coverage</i>	Data is available across most of the area of analysis, although some uncertainty and gaps in nearshore waters relevant to shellfish aquaculture.	1
<i>Data accessibility</i>	Bathymetry data available from public datasets (e.g. GEBCO) and accessible.	3
<i>Measurement reliability</i>	Measurable and an accepted method of measurement.	3
<i>Redundancy to other criteria</i>	There are correlations with temperature and exposure (i.e., ice, waves, and wind) but can be assessed and classified relatively independently.	2

Drift ice risk

Rationale for consideration: Operators must manage shellfish culture operations to avoid ice damage and reduce mortality.
Final decision: Include
Average score: 2.1 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Sea ice that develops across some nearshore areas can create risks for aquaculture, possibly crushing and killing shellfish. Increased risks can require operators to choose different areas and/or introduce management measures (i.e., sinking/removing gear).	2
<i>Rateability</i>	Assessing ice risk must consider coverage thickness, movement, and type. Risk assessment is not straight forward and must in part rely on expert/industry advice.	2
<i>Scoring clarity</i>	The risk-based approach and methods require explanation to explain how different ice considerations are incorporated.	2
<i>Scale validity</i>	Criterion relevant to decision-making at the regional level and data resolution is appropriate for this scale, although more local-scale ice dynamics are not captured.	2
<i>Coastal coverage</i>	Ice exposure risk generated at appropriate resolutions across the area of analysis .	3
<i>Data accessibility</i>	Spatial data generated from remote sensing data and model projections to support assessment.	2
<i>Measurement reliability</i>	Spatial data products are being developed by the Nova Scotia Community College's Applied Geomatics Research Group. Measurements use well-established methods though data will likely be analyzed based on risk, which will introduce some uncertainty.	2
<i>Redundancy to other criteria</i>	Some correlation with other criterion (e.g. temperature and depth) but can be evaluated relatively independently.	2

Wind and Wave Conditions

Rationale for consideration: Exposure of aquaculture to high wind and waves can threaten infrastructure and affect shellfish welfare.
Final decision: Include
Average score: 2.4 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Consideration of exposure (wind and waves) is an important physical parameter for site selection since given risk to infrastructure, operational management, and shellfish welfare.	3
<i>Rateability</i>	Some scientific evidence on the impacts of significant wave height on aquaculture, which will be supplemented by expert and industry insights to capture local contexts.	2
<i>Scoring clarity</i>	Exposure modelling and data require some explanation.	2
<i>Scale validity</i>	Criterion relevant to regional planning and dataset will be created at the appropriate spatial resolution.	3
<i>Coastal coverage</i>	Wind and wave exposure modelling generated at appropriate resolutions across the area of analysis.	3
<i>Data accessibility</i>	Spatial data generated for assessment purposes will be developed during the project timeline based on previous ocean wave modelling by DSA Ocean.	2
<i>Measurement reliability</i>	Interpolation of datasets from wave modelling has some uncertainties, though these can be accounted for.	2
<i>Redundancy to other criteria</i>	Correlations with depth although data can be classified relatively independently.	2

Shellfish Harvest Area Classifications

Rationale for consideration: In Nova Scotia, regulatory compliance of shellfish harvesting is based on water quality as regulated by the Canadian Shellfish Sanitation Program (CSSP).
Final decision: Include
Average score: 2.25 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Shellfish operators must adhere to classifications and allowable harvest areas set out through the CSSP. Areas can be restricted to harvesting if there is significant presence of fecal coliform or contaminants.	3
<i>Rateability</i>	CSSP classifications are variable, and scoring will rely on industry insights to understand risks and tolerance of classifications.	1
<i>Scoring clarity</i>	Areas classified are well-defined and described through the CSSP though there are potential management mitigation strategies for culture. Some explanation required.	2
<i>Scale validity</i>	Criterion is relevant to both regional planning and site selection. The dataset is available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Area classifications covers areas assessed by the CSSP across the entire province. Areas without classifications are considered "unclassified".	2
<i>Data accessibility</i>	Public datasets (e.g. Shellfish Water Classification Program – Shellfish Harvest Area Classification in Canada) are available and accessible.	3
<i>Measurement reliability</i>	The CSSP classifies areas through regular monitoring efforts. Shellfish harvest areas are classified as to their suitability for harvesting, according to accepted water quality standards, but classifications and status of closure may vary over time.	2
<i>Redundancy to other criteria</i>	Runoff inputs and outfalls are considered within CSSP designation.	2

CFIA Declared Infected Areas

Rationale for consideration: Diseases such as Multinucleated sphere "X" (MSX) has caused high mortalities of oysters in the Bras D'Or area. Areas with high prevalence should be avoided.
Final decision: Include
Average score: 2.25 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	MSX can cause high mortality for oyster culture and a prevalent issue in the Bras D'Or Lake, Nova Scotia. *MSX does not impact mussels (=N/A)	3
<i>Rateability</i>	MSX effects on oysters have been the subject of considerable study in recent years though there is no existing risk classification and will require development.	1
<i>Scoring clarity</i>	Calculation of data and interpolation to spatial dataset requires explanation.	2
<i>Scale validity</i>	Maps of Declared Areas are somewhat coarse for the regional scale of assessment. Interpolation of data is required to produce datasets at the appropriate resolution.	2
<i>Coastal coverage</i>	CFIA reports and produces declared maps for all across Nova Scotia	3
<i>Data accessibility</i>	Maps of Declared Areas for aquatic animal disease are available from CFIA to identify broad exposure areas.	3
<i>Measurement reliability</i>	Declared Area maps are broad. The collection of additional data and use of a novel methods for quantifying MSX spatial data will introduce considerable uncertainties.	1
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Coastal Wetlands

Rationale for consideration:	Shellfish aquaculture operations may have the potential to interact with important and sensitive wetland habitats in Nova Scotia.
Final decision:	Include
Average score:	2.6 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Wetlands are important and sensitive habitats in Nova Scotia, supporting various wildlife.	3
<i>Rateability</i>	There is some evidence for interaction with aquaculture, although classification will largely rely on consultation with experts and network partners.	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users	3
<i>Scale validity</i>	The criterion is relevant to regional planning and datasets are largely available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Data is available across the entire province.	3
<i>Data accessibility</i>	Datasets are available and publicly accessible through the Canadian National Wetlands Inventory .	3
<i>Measurement reliability</i>	Measurement is straight forward, and analysis can be done through commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	There may be some overlap with other important habitat designations (including protected areas and parks).	2

Terrestrial Protected Areas and Parks

Rationale for consideration:	Aquaculture should be located to minimize potential interactions with coastal species or habitats protected due to their high biodiversity or ecological vulnerability.
Final decision:	Include
Average score:	2.0 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Several coastal islands are protected wilderness areas or conservation easements, as they are recognized for their rich coastal biodiversity or as habitat for marine and migratory birds. The potential impacts from aquaculture may be variable and are often unclear.	2
<i>Rateability</i>	Nearshore aquaculture may have potential to interact with terrestrial habitat/species. Though the potential for impacts is unclear as are the designation of adequate buffers.	1
<i>Scoring clarity</i>	Data does not involve complex analysis, although criterion rationale requires some explanation, as there could be multiple potential variables.	2
<i>Scale validity</i>	Criterion mostly represents terrestrial habitats, and interactions are often best evaluated at a site-level (and highly operation-specific).	1
<i>Coastal coverage</i>	Data is available across the entire spatial area of analysis .	3
<i>Data accessibility</i>	Public datasets (e.g. The Nova Scotia Protected Areas System and National Parks and National Park Reserves of Canada Legislative Boundaries) are available and accessible.	3
<i>Measurement reliability</i>	Datasets are compiled, maintained, and updated by the Government of Nova Scotia and monthly by the National Research Council, respectively. Measurement is straight forward, and analysis can be done using commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	Parameter may have some overlap with other habitat and species areas (including wetlands, critical habitats, or avifauna habitats).	1

Critical Habitat for Species At-Risk

Rationale for consideration: Marine species listed as threatened or endangered under the Species at Risk Act (SARA) have critical habitats identified and are legally protected from activities that could impact habitat.

Final decision: Include

Average score: 2.6 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Proximity to marine areas recognized as important to minimize potential interactions with human activities. Critical habitat for protected species, may be located in coastal waters close to shore and therefore have the potential to overlap with aquaculture activities	3
<i>Rateability</i>	Scoring suitability of aquaculture in relation to critical habitats should consider potential interactions with at-risk species, but may best be evaluated with species distribution, migration, or foraging habitats through more local-scale assessments. Scoring will thus rely on precautionary approaches, drawing on experts and network partners.	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Specific species-interactions and risks with aquaculture are best evaluated at more local scale assessments. Though, boundaries of critical habitats are established by DFO processes that are appropriate for regional-scale assessment.	2
<i>Coastal coverage</i>	Data is available identifying critical habitats across the entire province.	3
<i>Data accessibility</i>	Public datasets are accessible through DFO (Critical Habitat for Species at-risk).	3
<i>Measurement reliability</i>	Critical habitat for aquatic species at risk are identified by DFO.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Important Bird Habitat

Rationale for consideration: Physical structures, along with aggregation of feed and nutrients associated with aquaculture may interact with birds in a variety of ways. Several important species nest and forage in coastal areas around Nova Scotia, within critically important habitat.

Final decision: Include

Average score: 2.4 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Potential interactions of human activities with a critical bird habitat is an important consideration for aquaculture siting.	3
<i>Rateability</i>	Aquaculture has the potential to interact with bird species or their critical habitat. Based on proximity to habitats, some setback distances have been established, often at a species-specific level. Scoring will require consultation with network partners.	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Identifying key areas can be relevant to regional planning, with available datasets at appropriate spatial resolution.	2
<i>Coastal coverage</i>	Data may not represent all habitats recognized.	2
<i>Data accessibility</i>	Several important bird habitat areas are identified in public datasets (e.g. NS Significant Habitat Dataset and IBA Important Bird Areas).	3
<i>Measurement reliability</i>	Measurement is straight forward and required analysis can be done through commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	Important bird habitat may be accounted for indirectly in other layers, such as wetlands. There may also be some overlap with other habitat designations (e.g. protected areas).	2

Fishing Traffic

Rationale for consideration: Aquaculture should consider space to accommodate navigation in high-use areas for fishing.
Final decision: Include
Average score: 2.3 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Marine developments should allow sufficient space to accommodate vessel traffic, such as those by fishing. The public right of navigation and other adjacent marine users is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations .	3
<i>Rateability</i>	Scoring can be based on distribution of density data to identify hotspots of fishing vessel traffic.	3
<i>Scoring clarity</i>	Interpreting criteria rationale and data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	Spatial data on fishing traffic hotspots is relevant to regional-level planning.	3
<i>Coastal coverage</i>	Spatial datasets have mostly complete coverage across the area of analysis, although data does have some uncertainty	2
<i>Data accessibility</i>	Fishing vessel traffic data is available (e.g., Vessel Density Mapping of 2019), although more comprehensive VMS datasets was acquired from DFO. Spatial data products will be generated for assessment purposes.	2
<i>Measurement reliability</i>	Vessel traffic data will be assessed based spatial analysis of VMS data. There is some uncertainty in available vessel traffic datasets. Using VMS data to identify vessel traffic hotspots is a common practice and established.	2
<i>Redundancy to other criteria</i>	There could be some correlation with other data sources such as coastal access points and overlap with AIS data.	1

Navigation Routes

Rationale for consideration: Aquaculture should consider space to accommodate public navigation.
Final decision: Include
Average score: 2.1 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Marine developments should allow sufficient space to accommodate vessel traffic. The public right of navigation and other adjacent marine users is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations .	3
<i>Rateability</i>	While some guidance is available on suggested buffers for designated traffic routes (e.g. shipping lanes, ferry routes), scoring will rely on expert input and network partner advice.	2
<i>Scoring clarity</i>	Interpreting criteria rationale and data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	Spatial data on common marine transit routes is relevant to regional-level planning.	3
<i>Coastal coverage</i>	Spatial datasets have mostly complete coverage across the area of analysis, although data may not capture all vessel traffic	2
<i>Data accessibility</i>	Some vessel traffic data available (e.g., Vessel Density Mapping of 2019 AIS Data in the Northwest Atlantic), although more comprehensive AIS datasets was acquired from DFO. Spatial data products will be generated for assessment purposes.	2
<i>Measurement reliability</i>	Navigation routes will be identified based spatial analysis of AIS data. There is some uncertainty in available datasets. Some methods for identifying navigation corridors exist, although a novel method may be required for this project.	1
<i>Redundancy to other criteria</i>	There could be some correlation with other data sources such as coastal access points and fishing vessel traffic.	2

Public coastal access

Rationale for consideration: Aquaculture siting should consider space which may be accessed or shared with other users, such as tourism and recreation, as aquaculture can potentially impede access to navigable areas.
Final decision: Include
Average score: 2.0 (ADEQUATE)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture may have the potential to affect navigation and access of coastal users to marine areas. The public right of navigation and other adjacent marine users is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations .	3
<i>Rateability</i>	Data provides an indicator of access to coastal areas. More comprehensive evaluation should be explored at local levels. Some recommended proximity distances have been suggested, but scoring will largely rely on expert input and precautionary designations.	1
<i>Scoring clarity</i>	Interpreting criteria rationale and data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	Key access points provide relevant information for regional level analysis and planning, although could be more comprehensively evaluated at site-level to explore variabilities of different types of access points or users.	2
<i>Coastal coverage</i>	Coverage is mostly adequate, with only some gaps in potential access points possible due to lack of available validation of points.	2
<i>Data accessibility</i>	Coastal access points will be compiled from several public datasets for the assessment.	2
<i>Measurement reliability</i>	There is some uncertainty in methods, but the approach is based on previous robust scientific methods.	2
<i>Redundancy to other criteria</i>	There is likely to be some correlation with other data (e.g., navigation channels).	2

Anchorage Areas

Rationale for consideration: Aquaculture cannot be located in areas already designated as allocated anchorage sites/areas.
Final decision: Include
Average score: 2.9 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture can not occur in existing anchorage areas (constraint) to maintain safe navigation.	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward though considerations around buffers is needed	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Datasets are available at the appropriate spatial resolution and relevant to regional-level considerations.	3
<i>Coastal coverage</i>	Spatial datasets have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	Public datasets (e.g. Canadian Anchorages and Anchorage Areas) are available and accessible.	3
<i>Measurement reliability</i>	Data is maintained and updated regularly by DFO and the Canadian Hydrographic Service (CHS). Analysis is straightforward and a buffer can be easily applied.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Designated Navigation Features

Rationale for consideration: Aquaculture would be constrained in areas already designated for navigation (e.g., shipping and ferry routes, traffic separation zones, sight lines from lighthouses etc.)
Final decision: Include
Average score: 2.9 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture is not allowed (constraint) in areas designated for traffic purposes (e.g., designated ferry routes) or to protect navigational safety (e.g., lighthouse sight lines).	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward. Consideration around buffers is required, and different buffers may be needed for different features.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion relevant to regional planning and dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Spatial datasets have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	Public datasets (e.g. Vessel Traffic Routes) are available and accessible.	3
<i>Measurement reliability</i>	Data is maintained and updated weekly by the DFO and CHS. Analysis is straight forward and requires only consideration of buffers.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Existing Aquaculture

Rationale for consideration: New aquaculture sites cannot be sited in existing aquaculture lease areas (and relevant buffers) due to physical constraints and requirements for mooring and operational logistics.
Final decision: Include
Average score: 2.9 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	New aquaculture sites cannot be placed where existing aquaculture lease areas exist.	3
<i>Rateability</i>	Some discussion required on implications for new development, as required through consultation with government departments.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	The dataset is available at the appropriate spatial resolution.	3
<i>Coastal coverage</i>	Spatial datasets have complete coverage across the area of analysis .	3
<i>Data accessibility</i>	Public datasets (e.g. Nova Scotia Marine Aquaculture Leases) are available and accessible.	3
<i>Measurement reliability</i>	Analysis is straight forward and requires only potential buffers applied to features. Data is compiled, maintained, and updated by the NSDFA. is straight forward.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Water lots

Rationale for consideration: Aquaculture cannot legally be located in already privately-owned water lots.
Final decision: Include
Average score: 2.5 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Several coastal properties in Nova Scotia have privately owned water lots. Aquaculture cannot be located in these areas.	3
<i>Rateability</i>	Different types of water lots may have different implications for aquaculture suitability, requiring consultation with government departments	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion may be more relevant for local site selection but remains an important constraint in nearshore areas.	2
<i>Coastal coverage</i>	Spatial property data is available across the area of analysis .	3
<i>Data accessibility</i>	Spatial property identification data is available though needs to be provided by network partners (private data request).	2
<i>Measurement reliability</i>	Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Submerged pipelines and cables

Rationale for consideration: Aquaculture cannot operate over submerged infrastructure due to required substrate moorings.
Final decision: Include
Average score: 2.9 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture cannot operate over submerged infrastructures such as telecommunication cables due to interference with moorings and legal restrictions.	3
<i>Rateability</i>	As this is a constraint, classification is straightforward.	3
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion relevant to regional planning and dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Spatial datasets have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	The location of key structures is available on request from network partners.	2
<i>Measurement reliability</i>	Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Marine Renewable Energy Areas

Rationale for consideration:	Several areas in Nova Scotia are allocated as Marine Renewable Energy Areas (MREA) used for exploration of energy production. Aquaculture can not occur in these areas already allocated for this use.
Final decision:	Include
Average score:	2.8 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Several areas in Nova Scotia are allocated as Marine Renewable Energy Areas used for exploration of energy production. Aquaculture can not occur in these areas already allocated for this use.	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward. Consideration of buffers is required.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Spatial datasets include all known approved MREAs and therefore have complete coverage across the area of analysis .	3
<i>Data accessibility</i>	Dataset is available at request through network partners.	2
<i>Measurement reliability</i>	Distinct boundaries of MREAS are allocated by Nova Scotia Department of Natural Resources and Renewables. Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Marine Protected and Conserved Areas

Rationale for consideration:	Aquaculture can not be located within marine protected areas due to conservation objectives and regulations.
Final decision:	Include
Average score:	2.75 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Within legally protected marine areas, large-scale developments are generally prohibited.	3
<i>Rateability</i>	Different types of protected areas may have different restrictions. Requires consultation and input from government departments	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Dataset is available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Spatial datasets have complete coverage across the area of analysis .	3
<i>Data accessibility</i>	Public datasets (e.g. Canadian Protected and Conserved Areas Database (CPCAD)) are available and accessible.	3
<i>Measurement reliability</i>	The CPCAD data is compiled and managed by ECCC, in collaboration with federal, provincial, territorial, and other reporting authorities that provide the data. Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

At Sea-Disposal Sites

Rationale for consideration:	Aquaculture can not be located above areas designated as at-sea disposal sites due to potential contamination risks.
Final decision:	Include
Average score:	2.9 (EXCEPTIONAL)

Property	Description	Score
<i>Relevance to scope</i>	Several at-sea disposal sites are licensed in Nova Scotia's coastal waters. These represent allocated areas where any aquaculture operation would be excluded.	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward. Consideration of buffers is required.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Dataset is available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	At Sea Disposal Sites are licensed sites regularly updated through ECCC, ensuring full coverage.	3
<i>Data accessibility</i>	Public dataset (e.g. Active and Inactive Disposal at Sea Sites in Canadian Waters) is available from ECCC.	3
<i>Measurement reliability</i>	Data is maintained and updated annually by ECCC. Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Criteria Excluded

Exposure to Extreme Cold

Rationale for consideration	Some parts of Nova Scotia have previously reported periods of extreme low temperatures (e.g., superchill events), creating risks for aquaculture.
Final decision	Exclude
Average score	1.4 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Temperature is a key biophysical parameter important for siting and growth considerations of shellfish aquaculture. While shellfish have large thermal tolerances, and mortality is only relevant at the freezing point of seawater (for ice development), producers must still consider mitigation to avoid ice risks (see ice below).	1
<i>Rateability</i>	Since shellfish have very low thermal tolerances, superchill not generally an issue and so rating would rely on precautionary or expert opinion.	1
<i>Scoring clarity</i>	The risk-based approach and methods (i.e., interpolation) require some explanation.	2
<i>Scale validity</i>	Interpolation of data was required to produce datasets at appropriate resolution.	2
<i>Coastal coverage</i>	Spatial dataset will be based on point data with disperse coverage; interpolation will be applied to areas between point data.	1
<i>Data accessibility</i>	Spatial datasets will be generated using data from CMAR's Coastal Monitoring Program for this assessment.	2
<i>Measurement reliability</i>	Documenting superchill temperatures spatially relies on analysis and interpolation of point data using likelihood calculations. Novel datasets and methods combined with interpolation, will likely introduce uncertainties.	1
<i>Redundancy to other criteria</i>	At relevant temperatures, the parameter may have overlaps in trends with ice exposure but can be assessed and classified relatively independently.	1

Sea Surface Temperature

Rationale for consideration	Aquaculture should be sited in areas where average temperatures are within established temperature ranges optimal for growth.
Final decision	Exclude
Average score	1.6 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Sea Surface Temperatures (SST) provide indication of average temperatures do not identify critical thresholds (e.g. heat stress, etc.). These temperatures are more relevant for identifying optimal growth conditions, which is beyond scope of assessment.	1
<i>Rateability</i>	Average SST can provide an indication of optimal growth conditions for shellfish. Variation in average temperatures is generally not considered an issue for shellfish in Nova Scotia, so scoring would rely heavily on precautionary approach or expert insights.	2
<i>Scoring clarity</i>	The calculation of satellite-derived SST requires some explanation.	2
<i>Scale validity</i>	Available datasets are at coarse resolutions and not appropriate the scale of assessment.	1
<i>Coastal coverage</i>	Available datasets have major gaps in coverage, especially in nearshore environments close to the coast.	1
<i>Data accessibility</i>	Datasets are available through publicly accessible satellite-modeling (e.g. DFO BNAM model), though data may not be available for small time steps (e.g. daily).	3
<i>Measurement reliability</i>	Some identified limitations with using satellite-derived and modeled SST data.	2
<i>Redundancy to other criteria</i>	Data can be integrated into the calculation of temperature threshold layers (overlap).	1

Ocean Slope

Rationale for consideration:	Aquaculture should be sited in areas where the slope of the bottom is suitable for construction of farms.
Final decision:	Exclude
Average score:	Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	The bottom slope of the area could affect farm construction. Mooring considerations and farm construction are beyond the scope of assessment.	N/A
<i>Rateability</i>	There is evidence of slope requirements for shellfish sites, although this can be highly gear and operation-specific.	2
<i>Scoring clarity</i>	The slope is calculated using bathymetry data, which would require some explanation.	2
<i>Scale validity</i>	Criterion is relevant for the site-level to capture operation-specific requirements.	N/A
<i>Coastal coverage</i>	Coverage is available around all of Nova Scotia, but some areas have greater uncertainty or minor gaps.	2
<i>Data accessibility</i>	Bathymetry data is available from various sources (e.g. GEBCO).	2
<i>Measurement reliability</i>	Ocean slope can be represented from bathymetry data (e.g. GEBCO).	3
<i>Redundancy to other criteria</i>	Accounted for in bathymetry.	1

Substrate

Rationale for consideration: Aquaculture should be sited in areas with appropriate substrate type to meet mooring and operational considerations.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Different substrate types are readily accounted for by different mooring considerations with respect to substrate require high level data resolution at the site level, which is beyond the scope of assessment. Substrate type is also not considered an impediment for aquaculture site selection under most circumstances.	N/A
<i>Rateability</i>	General considerations for substrate type are well understood for different producers but may vary considerably across smaller scales and different operations. Scoring would rely on expert and industry insights.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion is best evaluated at the site-level scale. Available datasets at very coarse scale, not representative of fine-scale variability that is important for siting.	N/A
<i>Coastal coverage</i>	Substrate Classification mapping of the Inshore Scotian Shelf and the Bay of Fundy exists with coverage across the area of analysis, though at a very coarse scale.	3
<i>Data accessibility</i>	Public dataset is available (e.g. A substrate classification for the Inshore Scotian Shelf and Bay of Fundy, Maritimes Region) and accessible.	3
<i>Measurement reliability</i>	Dataset was produced by the DFO based on previous geological characterizations from NRCan. In areas where geological descriptions were unavailable digital elevation models and substrate samples from NRCan, CHS and DFO Science were used. Dataset is considered coarse with high uncertainty and local variability at smaller scales.	1
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Ocean Current

Rationale for consideration: Aquaculture should be sited in areas with adequate current to allow greater water exchange between farms and surrounding water, allowing sufficient oxygen supply to cultured species.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Adequate currents are an important consideration for planning and site selection for the growth and welfare of cultured species.	3
<i>Rateability</i>	Suitable current speeds are well established and understood, but suitability also often evaluated in the context of other ocean variables.	2
<i>Scoring clarity</i>	Implications for current speed would require some explanation to non-technical users.	2
<i>Scale validity</i>	Current is highly variable at local levels and of limited applicability at regional-level scales.	N/A
<i>Coastal coverage</i>	Local-scale current speed data collection is sporadic and does not cover the entire coastline. (sparse), not are model outputs (e.g. FVCOM) available for all locations.	N/A
<i>Data accessibility</i>	Available only for some locations.	N/A
<i>Measurement reliability</i>	There is confidence in data collected, but complex ocean models are needed to estimate (interpolate) current between these locations.	2
<i>Redundancy to other criteria</i>	Related to exposure modelling and correlated to depth.	1

Ocean Flushing

Rationale for consideration:	Aquaculture should not be sited in areas with poor flushing, which could increase water temperature, decrease dissolved oxygen, and cause an increase in algal blooms.
Final decision:	Exclude
Average score:	Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Flushing rate is recognized as an important site selection criterion for aquaculture at local site selection scales, in conjunction with other water quality metrics.	2
<i>Rateability</i>	The dynamics of flushing rates on aquaculture are generally well understood, but often evaluated in the context of other ocean variables.	2
<i>Scoring clarity</i>	Flushing rate can generally be calculated through a range of basic to complex modelling processes which require some explanation.	2
<i>Scale validity</i>	Criterion is relevant for the local site selection scale or bay-scale carrying capacity modelling.	N/A
<i>Coastal coverage</i>	Not available for all bays across the province.	N/A
<i>Data accessibility</i>	Where flushing rate has been calculated and published, information is easily accessible, but for most bays around the province, field data collection would be required to calculate flushing rate.	1
<i>Measurement reliability</i>	Flushing rate calculations and predictions are more accurate in clearly defined bays with, but less accurate at fine scales or in geographically complex systems.	1
<i>Redundancy to other criteria</i>	Influences many water quality metrics. Flushing rate is of limited usefulness in isolation.	N/A

Wind/Wave Direction

Rationale for consideration:	Aquaculture site orientation and construction can be influenced by the direction and speed of wind and waves in the area.
Final decision:	Exclude
Average score:	Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Indirectly relates to the magnitude of stress on gear, which is more of an operational constraint beyond the scope of assessment.	N/A
<i>Rateability</i>	Implications for aquaculture suitability are highly operation specific and can not be taken in isolation.	3
<i>Scoring clarity</i>	Relatively easy to explain, but variation in would also need to be communicated.	2
<i>Scale validity</i>	Wind and wave directional data has greater importance at the aquaculture site selection scale and is not well qualified at this scale most locations around the province.	N/A
<i>Coastal coverage</i>	Wind direction has adequate coverage at coarse scales, but wave direction is not well defined for most locations.	2
<i>Data accessibility</i>	Some data accessible exists but would require considerable effort to adjust the scale of analysis or collect additional data where gaps exist.	2
<i>Measurement reliability</i>	It is possible to report predominant wind and wave direction at the scale of analysis, with some uncertainty.	2
<i>Redundancy to other criteria</i>	Maximum wave exposure modelling embodies this parameter.	N/A

Wind Speed

Rationale for consideration: Aquaculture site orientation and construction can be influenced by the direction and speed of wind and waves in the area.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Wind speed is recognized as an important consideration for site orientation and selection. It can indirectly relate to the magnitude of stress on gear. It is rarely an absolute limiter, but may dictate infrastructure engineering needs, which in turn affect cost and therefore, more an operational consideration beyond the scope of assessment.	N/A
<i>Rateability</i>	Maximum wind speed is important for site selection, orientation, and infrastructure design. Implications are highly operation specific.	3
<i>Scoring clarity</i>	Wind speeds are often highly linked to other parameters, with mostly indirect effects on farms. Understanding the role/effects of wind would require a fair bit of explanation.	1
<i>Scale validity</i>	The scale of data for wind speed is at the provincial level.	2
<i>Coastal coverage</i>	Generating wind speed data across the entire area of analysis would require substantial interpolation from point data.	1
<i>Data accessibility</i>	Some accessible data it would require analysis to adjust to the scale of analysis.	2
<i>Measurement reliability</i>	Interpolation of wind speed data at scale would be required for assessment, but it is possible with existing data. There is some uncertainty with the use of terrestrial wind gauges.	2
<i>Redundancy to other criteria</i>	Wave exposure parameter modelling accounts for this parameter.	N/A

Aquatic Invasive Species

Rationale for consideration: Aquaculture should not be located in areas susceptible to Aquatic Invasive Species (AIS) due to their detrimental impacts on water quality.
Final decision: Exclude
Average score: 1.6 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Several AIS are large fouling organisms that if present in large quantities, can reduce necessary water flow for shellfish and smother or lead to physical damage or mortality of organisms. Risks to shellfish health and to producers are based on intensity and timing, which is highly variable and context-specific, rather than presence.	2
<i>Rateability</i>	There may be variability between different species of AIS, and their intensity across areas and over time. Depending on the species, presence may not impact culture. Therefore, classification is not straight forward and requires advice from experts and industry.	2
<i>Scoring clarity</i>	The dataset requires some clarification to explain modelling and aggregation of species.	1
<i>Scale validity</i>	Specific impacts or risks from AIS is best evaluated at the site-level. Identifying general areas where species are present or most intense can provide an indicator of additional risks producers may face, which is appropriate for regional level assessment.	2
<i>Coastal coverage</i>	Modelled data that is available does not extend fully across the area of analysis, with notable gaps.	1
<i>Data accessibility</i>	Modelled distribution data available and accessible (e.g. Species distribution models and occurrence data for marine invasive species hotspot identification). However, risks to producers and shellfish health are more based on intensity and timing of spread, which has not been spatially mapped.	1

<i>Measurement reliability</i>	Marine invasive hotspot modelling is done through monitoring and occurrence data through DFO. The data is based on predictive models with accepted uncertainty. Measurement would require combining multiple species hotspots with some uncertainty.	1
<i>Redundancy to other criteria</i>	While there may be some relationships with temperature and particle availability, data can be treated as largely independent.	3

Salinity

Rationale for consideration:

Maintaining stable and suitable salinity levels within the thresholds of shellfish tolerance is essential for promoting health and productivity of shellfish aquaculture.

Final decision:

Exclude

Average score:

Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Reaching salinities beyond thresholds would affect health and welfare, although. Salinity is not considered an issue for shellfish (oysters) in Nova Scotia since they are tolerant of varying salinity conditions. Salinity highly variable and more relevant at site-level.	1
<i>Rateability</i>	Cultured species have specific salinity tolerances that would affect health and welfare. Salinity tolerances are well established. Oysters have higher salinity tolerances than mussels. High variability at local scales makes scoring complicated.	2
<i>Scoring clarity</i>	Salinity effects are well understood and can be clearly communicated.	3
<i>Scale validity</i>	Spatial datasets at coarse resolutions. Variations in salinity are highly site-specific (due to various inputs, local patterns in current and flushing, etc.). Consideration is more relevant at the site selection scale.	N/A
<i>Coastal coverage</i>	The data available (point locations) contains large gaps and cover multiple time frames.	1
<i>Data accessibility</i>	At the appropriate resolution, nearshore salinity is only available for point locations.	1
<i>Measurement reliability</i>	Ocean salinity mapping efforts (e.g. satellite data) at inappropriate spatial resolutions, would require significant downscaling and would introduce considerable uncertainty.	1
<i>Redundancy to other criteria</i>	Shifts in salinity may be accounted for in other layers (e.g. distance to rivers).	1

Dissolved Oxygen

Rationale for consideration:	Dissolved oxygen is essential for shellfish respiration and overall health and ensuring optimal growth and survival during culture.
Final decision:	Exclude
Average score:	Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Inadequate levels of dissolved oxygen (DO) can lead to stress, reduced growth, and, in extreme cases, mortality. DO is a key parameter for monitoring and siting, but is often applied at the site-level. At a regional-level, DO is generally not considered an issue since DO rarely reaches harmful levels in Nova Scotia, and due to the high tolerances species.	1
<i>Rateability</i>	DO is a key water quality parameter for shellfish aquaculture. Optimal ranges and thresholds for DO are well-documented. However, specific thresholds are highly variable based on other ocean parameters (e.g. temperature and salinity) and exhibit high spatial variability at local scales, making assessment for suitability more relevant at the site-level.	1
<i>Scoring clarity</i>	Implications of dissolved oxygen on cultured species are relatively easy to describe, although the creation of a spatial layer may be technical and require some explanation.	1
<i>Scale validity</i>	Recognized small-scale spatial and temporal variability within coastal bays - most relevant for local assessments or bay-scale carrying capacity modelling.	N/A
<i>Coastal coverage</i>	Due to large gaps in the data available and limited data in nearshore areas a risk-based approach or interpolation would be required.	N/A
<i>Data accessibility</i>	There are no provincial-scale spatial datasets available; only point locations are available. Necessary efforts to complete coverage are not within the project timeline and resources.	1
<i>Measurement reliability</i>	DO can be measured through in-situ measurements or satellite data.	1
<i>Redundancy to other criteria</i>	DO is influenced by other parameters at the local level, including ocean mixing, temperature, current flow, flushing rate, etc.	2

Turbidity

Rationale for consideration:	High turbidity can affect the welfare of cultured shellfish, as highly turbid environments can obstruct the gills of bivalves and interfere with normal respiration and feeding.
Final decision:	Exclude
Average score:	1.8 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Turbid environments are not suitable for some species of bivalves. Turbidity is relevant to the welfare of cultured bivalves since highly turbid areas may have negative effects on welfare.	2
<i>Rateability</i>	There are some established turbidity thresholds for shellfish, which would be supplemented by expert opinion.	2
<i>Scoring clarity</i>	The inclusion of turbidity requires an explanation for why it is relevant and how it is measured.	1
<i>Scale validity</i>	Turbidity has recognized small-scale spatial and temporal variability within coastal bays.	1
<i>Coastal coverage</i>	Satellite images and data exist across the province and provide information that can be used to identify turbid waters.	2
<i>Data accessibility</i>	Satellite data is free and accessible online but may require some work to use.	2
<i>Measurement reliability</i>	Measurement is straightforward but involves complex image analysis or site-specific measurements relevant during site selection.	2
<i>Redundancy to other criteria</i>	Data is largely independent of other data. There may be some overlap with river runoff.	2

Chlorophyll

Rationale for consideration: Aquaculture should be located in areas that contain adequate chlorophyll for cultured species, which are important for water quality and nutrient availability of shellfish.

Final decision: Exclude

Average score: 1.8 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Chlorophyll can be used to indicate nutrient availability and water quality for shellfish aquaculture. While not usually a limiting factor, food availability is more related to optimal growth. Food availability can become an issue with high densities, evaluated in the context of carrying capacity.	1
<i>Rateability</i>	Some empirical evidence of thresholds for chlorophyll. Highly variable on temporal and spatial scales, which would make scoring challenging and add uncertainty.	2
<i>Scoring clarity</i>	Criterion would require some explanation, including how datasets were derived.	2
<i>Scale validity</i>	High variability across temporal and spatial scales means criterion is best evaluated through bay-scale assessments, assessments of carrying capacity, or site-specific data.	1
<i>Coastal coverage</i>	Satellite data is available, although there are substantial gaps in data (i.e., due to cloud coverage).	2
<i>Data accessibility</i>	Satellite data is available online, but data format can be challenging to manipulate.	2
<i>Measurement reliability</i>	There is some uncertainty in satellite derived data, as data rely on ocean colour to generate inferences of in-situ values.	2
<i>Redundancy to other criteria</i>	Consideration within carrying capacity models.	2

Primary Productivity

Rationale for consideration: Aquaculture siting should consider primary productivity of an area, which can provide information on carrying capacity of an ecosystem for shellfish aquaculture.

Final decision: EXCLUDE

Average score: N/A (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Primary productivity refers to the rate at which photosynthetic producers convert energy from the sun into organic materials consumed by shellfish. Most appropriately considered within the context of carrying capacity and ecosystem functioning.	1
<i>Rateability</i>	Not clear; threshold values will vary between local ecosystems and bays.	1
<i>Scoring clarity</i>	Criterion would require significant explanation and context.	N/A
<i>Scale validity</i>	High variability across temporal and spatial scales means criterion is best evaluated through bay-scale assessments for determining carrying capacity.	N/A
<i>Coastal coverage</i>	Minimal data has been collected within a handful of areas of interest, but this is a small fraction of NS coastline.	N/A
<i>Data accessibility</i>	Data must be collected manually, and analysis is lengthy, costly, and intensive..	1
<i>Measurement reliability</i>	Scientific methods are used to measure carbon dioxide uptake or oxygen consumption.	2
<i>Redundancy to other criteria</i>	Considered within carrying capacity models.	N/A

Point Discharges

Rationale for consideration: Aquaculture should not be located in areas where domestic effluent or industrial discharges release nutrients or contaminants into coastal areas.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Domestic effluent or industrial discharges can release nutrients or harmful contaminants into the marine environment, which can cause harm to shellfish if very nearby.	3
<i>Rateability</i>	Impacts on water quality and shellfish health are variable and highly dependent on outfall management practices. Critical buffers have been established (through CSSP) but can be supplemented with expert opinion.	2
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Criterion considered mostly relevant at the site-selection level due to high variability.	1
<i>Coastal coverage</i>	There are some gaps in spatial data on the location of all outfalls across the area of analysis.	1
<i>Data accessibility</i>	There are some gaps in spatial data on the location of all outfalls across the area of analysis that would require additional resources to identify.	2
<i>Measurement reliability</i>	Measurement is straight forward, and analysis can be done through commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	Parameter is considered in shellfish closure areas and has some overlap with the location of small craft harbours and population centres.	N/A

River Runoff

Rationale for consideration: Aquaculture should not be located in areas that would be highly exposed to riverine inputs that could release nutrients or contaminants into coastal areas.
Final decision: Exclude
Average score: 1.4 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Riverine inputs are important for water quality monitoring and changes to salinity and turbidity. River outputs (nutrients etc.) can cause harm to cultured shellfish (mussels) if within close distances, or with prolonged exposure, depending on the contents of the runoff (chemical or organic).	2
<i>Rateability</i>	Impacts to shellfish can be highly variable and are likely affected by multiple factors at the site-level. Classification would rely on expert advice.	1
<i>Scoring clarity</i>	River runoff impacts may require complex analysis that would require substantial explanation to end-users.	1
<i>Scale validity</i>	Impacts from riverine inputs exhibit local-scale environmental variability to be more comprehensively captured at the site-level.	1
<i>Coastal coverage</i>	Some information required to map river runoff is available, but others require site-specific information that is not available across the entire spatial area of analysis.	1
<i>Data accessibility</i>	Spatial data could be generated for assessment. Although, more complex analysis is required to appropriately capture river-specific impacts are beyond this project.	1
<i>Measurement reliability</i>	Simple methods of measurement are available (i.e., through indirect metrics such as proximity to rivers) at regional level.	3
<i>Redundancy to other criteria</i>	The impacts from river inputs relate to other variables and can be linked to changes in salinity and turbidity. River data also captured in wild salmon river criterion.	1

Agricultural Runoff

Rationale for consideration: Aquaculture should not be located in areas where agricultural discharges release nutrients or contaminants into coastal areas.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Agricultural runoff can cause harm to cultured shellfish if within close distances. Agricultural runoff is an important water quality consideration and is incorporated in CSSP analysis and designations.	3
<i>Rateability</i>	Effects would highly depend on agricultural management practices. Some established buffers exist, which will be supplemented with additional expert opinion.	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Proximity to easements where runoff may be an issue can be adequately addressed at the provincial level since there is existing information on where these activities occur and watershed delineation, although there are local variabilities.	2
<i>Coastal coverage</i>	Data is available across the entire spatial area of analysis.	3
<i>Data accessibility</i>	Dataset is available through network partners.	2
<i>Measurement reliability</i>	Accuracy of data is high due to collection from network partners.	3
<i>Redundancy to other criteria</i>	In the context of critical sources of runoff, this is already accounted for in CSSP.	N/A

Forestry Runoff

Rationale for consideration: Aquaculture should not be located in areas where forestry discharges release nutrients or contaminants into coastal areas.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Forestry runoff can cause harm to cultured shellfish if within close distances. Forestry runoff is an important water quality consideration and is considered in CSSP designations.	3
<i>Rateability</i>	Effects would depend highly on the management of forestry practices. Some established buffers exist, which will be supplemented with additional expert opinion.	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Proximity to easements where runoff may be an issue can be adequately addressed at the provincial level since there is existing information on where these activities occur and watershed delineation, although there are local variabilities.	2
<i>Coastal coverage</i>	Data is available across the entire spatial area of analysis.	3
<i>Data accessibility</i>	Dataset is available through network partners	2
<i>Measurement reliability</i>	Accuracy of data is high due to data collection from network partners.	3
<i>Redundancy to other criteria</i>	In the context of critical sources of runoff, this is already accounted for in CSSP.	N/A

Algal Blooms

Rationale for consideration: Aquaculture operations can be impacted if within areas of high likelihood of blooms, which can lead to depletion of local oxygen levels and exposure to toxins.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance</i>	Harmful algal blooms (HABs)-related toxins can accumulate in shellfish tissue potentially leading to health risks for consumers.	3
<i>Rateability</i>	Areas experiencing frequent algal blooms and HABs are not ideal for shellfish culture, as they can endanger shellfish and consumer health and cause severe economic impacts. Classification is likely based on the risk of events occurring, which is difficult to estimate.	1
<i>Scoring clarity</i>	Criterion rationale and data products likely require some explanation.	2
<i>Scale validity</i>	Likely consideration appropriate for regional-level assessment, but would require substantial interpolation of point data.	1
<i>Coastal coverage</i>	Only localized data collection efforts.	N/A
<i>Data accessibility</i>	The necessary efforts required to complete the dataset for missing spatial coverage are beyond the time and resources available.	N/A
<i>Measurement reliability</i>	Methods for estimation are novel and emerging.	1
<i>Redundancy to other criteria</i>	Correlations with multiple parameters, likely creating redundancies across other parameters (e.g. water quality, temperature, and proximity to sources of nutrients and pollution).	1

Other aquaculture sites (proximity)

Rationale for consideration: Proximity to existing sites can create operational hazards, and if shellfish aquaculture occurs in high densities, may lead to overloading carrying capacity of environment.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Distance to existing sites is a consideration for operational needs. Shellfish sites that are too close may compete for food, affecting the welfare of each site.	2
<i>Rateability</i>	There is some potential for overloading of the environment's carrying capacity in high biomass, but this is highly based on the scale of operation and carrying capacity of the area (best evaluated at site level). Classification would rely on expert or industry advice.	1
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Consideration for other sites in the context of carrying capacity is considered more relevant for site selection processes or bay-scale assessment.	N/A
<i>Coastal coverage</i>	Considering in the context of proximity to existing sites, all sites across the area of analysis are available; data is available across the entire spatial area of analysis.	3
<i>Data accessibility</i>	Public datasets on the location and extent of existing aquaculture sites are available and accessible (e.g. Nova Scotia Marine Aquaculture Leases).	3
<i>Measurement reliability</i>	If considering in the context of proximity to existing sites, data is compiled, maintained, and updated by the NSDFA. Measurement is straight forward, and analysis can be done through commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	1

Wild Salmon Rivers

Rationale for consideration: Shellfish aquaculture operations in proximity of rivers with high significance for salmon may increase the likelihood of potential interactions with wild Atlantic salmon.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Impacts from shellfish aquaculture are more related to species migration routes, and there is little evidence of shellfish aquaculture as a threat to river habitats.	N/A
<i>Rateability</i>	Interactions most likely depends on the scale and size of operations. Interactions are more related to species migration routes and little guidance for shellfish exist.	1
<i>Scoring clarity</i>	Ratings for salmon rivers require some explanation.	2
<i>Scale validity</i>	Criterion is relevant to regional planning and dataset will be created to be at the appropriate spatial resolution.	3
<i>Coastal coverage</i>	Assessments will encompass rivers from across the province, with potentially minor gaps in coverage due to lack of comprehensive data on specific rivers.	3
<i>Data accessibility</i>	Assessment of wild salmon rivers is being conducted for this assessment, which requires additional project resources but can be accomplished within the project timeline.	2
<i>Measurement reliability</i>	Recent information on salmon river population status is sparse. Data is being compiled, assessed, and classified based on significance for wild salmon. The assessment framework, being established through expert review, but some uncertainty is expected.	1
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Eelgrass Habitat

Rationale for consideration: Aquaculture should be located away from critical areas for eelgrass, to reduce potential impacts from shading, sedimentation, or nutrient releases.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Eelgrass habitats are important and sensitive habitats in Nova Scotia and are a required consideration in aquaculture regulations.	3
<i>Rateability</i>	Impacts of shellfish aquaculture on eelgrass are highly localized (e.g. due to shading) and considered to be variable (i.e., negative, neutral, and positive). Scoring would rely on expert opinion.	2
<i>Scoring clarity</i>	Data products created would require some explanation.	2
<i>Scale validity</i>	Criterion could be used for regional-level planning but can be more comprehensively captured at the bay or site-level.	2
<i>Coastal coverage</i>	Presence of eelgrass data available sporadically across the province. Mapped data to identify habitat suitability or hotspots available through the National Eelgrass Dataset for Canada (NetForce) project were only created for the Scotian Shelf of Nova Scotia.	1
<i>Data accessibility</i>	Spatial datasets on eelgrass presence and habitat suitability available and accessible (e.g., NetForce). The necessary efforts required to complete the spatial dataset for missing spatial coverage are beyond the time and resources available by the project.	N/A
<i>Measurement reliability</i>	Some methods to map the suitability of habitat or habitat hotspots for eelgrass in Nova Scotia are relatively novel (e.g. see NetForce project).	2
<i>Redundancy to other criteria</i>	There may be some overlap with other important habitat designations, as some protected areas include eelgrass habitat.	2

Species Migration Paths

Rationale for consideration: Aquaculture should be sited away from key areas and paths used by species during critical migration life stages (for example, wild Atlantic salmon).
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Infrastructure associated with shellfish farming can provide opportunity for interactions for movement and migration of fish, which are critical habitats for some species.	3
<i>Rateability</i>	Impacts highly variable and classification would rely on expert opinion.	2
<i>Scoring clarity</i>	Data would not necessarily require complex analysis and is anticipated to be relatively easy to communicate.	3
<i>Scale validity</i>	Criterion relevant to regional planning.	3
<i>Coastal coverage</i>	Consistent spatial data is non-existent.	N/A
<i>Data accessibility</i>	Consistent spatial data is non-existent	N/A
<i>Measurement reliability</i>	Key migration routes have not been identified.	N/A
<i>Redundancy to other criteria</i>	May be accounted for in other layers (i.e., critical habitat, salmon rivers).	1

Important Fish Habitat

Rationale for consideration: Aquaculture should not be located in areas that would have potential impacts on fish species and habitats that are important for conservation and management initiatives.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture activities near or over fish habitats may impact migration and the presence of important species. Pseudofeces accumulation in poor flushing and low current environments is a potential. Parameter is likely best evaluated at the bay or local scale.	3
<i>Rateability</i>	The degree and nature of interactions with aquaculture are likely highly variable based on local operations, making rating challenging.	1
<i>Scoring clarity</i>	Data would not require complex analysis, although rationale would require some explanation (species-specific consideration).	2
<i>Scale validity</i>	Potential interactions with specific fish species are best evaluated through local site selection or management practices.	N/A
<i>Coastal coverage</i>	All data in the described habitats are based on research vessel surveys from DFO trawls, all beyond the area of analysis (offshore).	N/A
<i>Data accessibility</i>	Species distribution data has been mapped for several important fish species through DFO (Bundy et al., 2017) but layers could be available by request.	2
<i>Measurement reliability</i>	Spatial data aggregated across multiple years, involves some interpolation but highlights general species distribution and habitats.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Important Cetacean Habitat

Rationale for consideration: Aquaculture should not be located in areas recognized as important for cetacean species. Some interactions with aquaculture operations are possible (e.g., entanglement, attraction).
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Several key cetacean species inhabit waters in Nova Scotia and are a key conservation concern. Some interactions with aquaculture operations are possible (e.g., entanglement, attraction), but this is highly farm-specific.	2
<i>Rateability</i>	Infrastructure associated with finfish farming can be obstacles for the movement and migration of cetaceans. There are also risks of entanglements at the site-level, although this is highly gear-specific. There is little evidence to support the scoring.	1
<i>Scoring clarity</i>	Data would not require complex analysis, although rationale would require some explanation (species-specific consideration).	2
<i>Scale validity</i>	Potential interactions with cetaceans are best suited for local site selection or management practices.	N/A
<i>Coastal coverage</i>	Described data are largely based on species distribution models and sighting data from offshore DFO research vessels surveys from DFO, mostly beyond the AOA (e.g. offshore).	N/A
<i>Data accessibility</i>	Some datasets are publicly available based on whale sightings data , or to delineate important habitat (e.g., Blue whales , and Northern Bottlenose Whales), but not for all species of cetaceans.	2
<i>Measurement reliability</i>	Data collected based on long-term datasets from DFO sighting and mapping efforts.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Important Coral/Sponge Habitat

Rationale for consideration: Aquaculture should not be located in areas that would have potential impacts on important benthic species and habitats.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Some corals and sponges are highly sensitive and recognized as a conservation priority. The high biomass of shellfish aquaculture in an area could potentially exceed the carrying capacity to assimilate pseudofeces in areas with low flushing and currents. This needs to be evaluated at the site-level.	1
<i>Rateability</i>	Shellfish aquaculture is not likely compatible with areas for key coral/sponge significant habitat (most at depth, offshore). There is little existing evidence for interactions with benthic species considered in this dataset (e.g., sponges, etc.).	N/A
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	The majority of described habitat areas are beyond the 3 km spatial extent of the project.	N/A
<i>Data accessibility</i>	Public datasets identifying significant benthic habitat for corals and sponges are available through DFO and accessible (e.g. Delineation of Coral and Sponge Significant Benthic Areas in Eastern Canada (2016)).	3
<i>Measurement reliability</i>	Significant benthic areas identified and mapped by DFO based on locations of concentrations of corals and sponges from research vessel trawl data.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Important Invertebrate Habitat

Rationale for consideration: Aquaculture should minimally impact areas recognized as important or critical for invertebrate species since aquaculture may lead to organic loading on benthic environments and changes on benthic communities.

Final decision: Exclude

Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Invertebrates are important for the overall health of benthic communities. Pseudofeces accumulation in areas of poor flushing and low currents is a potential problem, especially at high biomass. This parameter is likely best evaluated at the site-level.	1
<i>Rateability</i>	Some evidence of localized impacts on benthic habitats below shellfish farms (e.g., for shading or biofouling). Yet, these impacts are often gear-specific and best evaluated during site application or through management processes.	1
<i>Scoring clarity</i>	Data would not require complex analysis, but rationale would require some explanation.	2
<i>Scale validity</i>	Proximity to specific invertebrates/benthic habitats is likely most relevant for site selection, since most benthic habitats occur at small spatial scales.	1
<i>Coastal coverage</i>	All data in described habitats are based on research vessel surveys from DFO trawls, all beyond the area of analysis (i.e., offshore).	N/A
<i>Data accessibility</i>	Species distribution data has been mapped for several important invertebrates through DFO (Bundy et al., 2017) but could be available by request.	2
<i>Measurement reliability</i>	Spatial data aggregated across multiple years, involves some interpolation but highlights general species distribution and habitats.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Lobster Presence

Rationale for consideration: Lobster are key species for commercial fisheries. Potential interactions with lobster is an important consideration for aquaculture siting.

Final decision: Exclude

Average score: 1.3 (POOR)

Property	Description	Score
<i>Relevance</i>	Pseudofeces accumulation in areas of poor flushing and low currents is a potential problem, especially at high biomass where there is to overload the environment's carrying capacity. This parameter is likely best evaluated at the site-level.	1
<i>Rateability</i>	Some evidence of localized impacts on benthic habitats below shellfish farms (e.g. for shading or biofouling). However, these are often gear-specific and best evaluated during site application or through management processes.	1
<i>Scoring clarity</i>	Data would require explanation, as habitat suitability is based on modelled data.	1
<i>Scale validity</i>	The resolution of the dataset is coarse and likely not appropriate for the scale of analysis.	1
<i>Coastal coverage</i>	Coverage across the area of analysis, although is less accurate to nearshore waters.	1
<i>Data accessibility</i>	Habitat suitability model data available from a published paper (Greenan et al., 2019), would require a request for access (i.e., not public).	2
<i>Measurement reliability</i>	Data from research vessel surveys, which do not sample inshore waters and thus model relies on interpolation, are cited as not appropriate for inshore suitability of habitat.	1
<i>Redundancy to other criteria</i>	There are potential overlaps with other data, including navigation routes.	2

Ecologically and Biologically Significant Areas (EBSAs)

Rationale for consideration: Aquaculture operations should be sited away from areas of high biological or ecological significance.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS))

Property	Description	Score
<i>Relevance to scope</i>	EBSAs are important for conservation goals. Their designations reflect recognized important areas for conservation priorities, reflecting unique or key ecosystems.	3
<i>Rateability</i>	The broad nature of EBSAs, consisting of multiple species, habitat types, etc., would mean proximity ratings based solely on expert opinion.	1
<i>Scoring clarity</i>	The broad nature of EBSA designation would require some additional explanation on a case-by-case basis.	1
<i>Scale validity</i>	Areas are too large, and data is too coarse for the scale of assessment.	N/A
<i>Coastal coverage</i>	Data is available across the entire spatial area of analysis.	3
<i>Data accessibility</i>	Public datasets are available and accessible (e.g. Ecologically and Biologically Significant Areas).	3
<i>Measurement reliability</i>	Dataset and EBSA Designation is done through a thorough designation process under DFO. Layer calculation would be simple and done through commonly applied path-distance methods in GIS.	3
<i>Redundancy to other criteria</i>	Data is likely incorporated in other layers at a finer scale (e.g. other habitat layers and protected areas, etc.).	1

High-Use Recreation and Tourism Areas

Rationale for consideration: To minimize potential spatial overlaps, aquaculture should minimize impacts to marine areas that are of high use for recreation and tourism.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS))

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture operations can potentially interact with or create conflicts with recreation and tourism. Identifying areas used most can help aquaculture reduce negative interactions with coastal users.	2
<i>Rateability</i>	Recognition of potential interactions, but often considered on a more qualitative basis. Classification would largely be based on expert input and precautionary designations.	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	Criterion is relevant to regional planning but could be more effectively/comprehensively evaluated at the local scale.	2
<i>Coastal coverage</i>	There is sparse comprehensive data available, as only localized use-mapping efforts have been undertaken in Nova Scotia at the site-level.	1
<i>Data accessibility</i>	Adequate analysis of coastal use areas would require participatory mapping efforts beyond the available resources.	N/A
<i>Measurement reliability</i>	Measurement of use areas at the provincial scale requires large-scale participatory methods, with some uncertainty.	2
<i>Redundancy to other criteria</i>	There is likely correlation with other sources of data (i.e., proximity to access points).	1

Lobster Fisheries

Rationale for consideration:	To minimize potential spatial overlaps, aquaculture should minimally impact areas with important fishing activities such as lobster.
Final decision:	Exclude
Average score:	Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Consideration for fishery activities in adjacent marine waters is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations . Yet, conflicts may be more relevant to the displacement of activity rather than linked to catch data.	1
<i>Rateability</i>	Few empirical studies have explored the linkage between total lobster catches and proximity to aquaculture (for a review, see Horricks et al., 2022).	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification because lack of defined impacts/interactions.	2
<i>Scale validity</i>	Criterion is relevant to regional planning but is comprehensively evaluated at a local scale. Data only available at spatial resolutions that are too coarse for this level of analysis.	N/A
<i>Coastal coverage</i>	Coarse spatial datasets have complete coverage across the area of analysis.	3
<i>Data accessibility</i>	Public datasets are available and accessible (e.g. Inshore Lobster Landings and Fishing Effort).	3
<i>Measurement reliability</i>	Landings and effort mapping compiled by DFO, but have some inherent uncertainty associated with fisher-reported data.	2
<i>Redundancy to other criteria</i>	Spatial overlaps are possible with other data, such as navigation since fishing areas may depend on proximity to port.	1

Other Commercial Fisheries

Rationale for consideration:	To minimize potential spatial overlaps, aquaculture minimally impact areas with important fishing activities
Final decision:	Exclude
Average score:	1.6 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Consideration for fishery activities in adjacent marine waters is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations . Conflicts may be more relevant to the displacement of activity rather than linked to catch data.	1
<i>Rateability</i>	Few empirical studies have explored the linkage between total catches for most fish species and proximity to aquaculture.	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	Catch data spatially mapped on a 10 km ² grid, determined to be at a coarse scale that may be inappropriate for the scale of assessment.	1
<i>Coastal coverage</i>	Data resolution is coarse and there are some gaps in data close to shore.	2
<i>Data accessibility</i>	Public datasets are available and accessible (e.g. the Eastern Canada Commercial Fishing Data)	3
<i>Measurement reliability</i>	Commercial fishing catch data has been spatially mapped by DFO with some inherent uncertainty associated with calculation.	2
<i>Redundancy to other criteria</i>	Spatial overlaps possible with other data, such as navigation since fishing areas may depend on proximity to port.	1

Indigenous Fisheries

Rationale for consideration: Indigenous Peoples in Nova Scotia have the legal right to fish for food, social, ceremonial (FSC) and moderate livelihood purposes. Aquaculture should be located in areas that would not restrict access to Indigenous fishing.

Final decision: Exclude

Average score: 1.6 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Consideration for fishery activities in adjacent marine waters is a key decision-making factor in the Nova Scotia Aquaculture License and Lease Regulations . Interactions with areas used for Indigenous fisheries can be variable and best considered at the site-level. This factor is intertwined with social compatibility which is beyond the project scope.	1
<i>Rateability</i>	Considerations for displacement or impacts on Indigenous fisheries are highly variable and are most appropriately evaluated through local consultations at the site-level, specifically during site selection.	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	More appropriate for local site selection, with consultation with local communities.	N/A
<i>Coastal coverage</i>	Spatial data is not publicly available for the province.	NA
<i>Data accessibility</i>	Some Indigenous fishing activity has been mapped through broader commercial fisheries designations (i.e., Lobster Fishing Areas). However, not all Indigenous fishing activities have been mapped and the data can be considered sensitive in nature.	NA
<i>Measurement reliability</i>	Mapping may not be appropriate for wide public distribution.	2
<i>Redundancy to other criteria</i>	Spatial overlaps possible with other data, such as other fisheries data.	1

Viewshed

Rationale for consideration: Aquaculture should be sited to minimize its visual impact on the surrounding seascape and alteration of the aesthetic appeal of coastal areas.

Final decision: Exclude

Average score: 1.8 (POOR)

Property	Description	Score
<i>Relevance to scope</i>	Aquaculture operations can impact viewshed appeal for some. This reflects an indirect use of seascape and reflects social uses beyond the scope of assessment.	1
<i>Rateability</i>	Recognized impacts of aquaculture on viewshed; although little empirical evidence is available to generate classification levels.	1
<i>Scoring clarity</i>	Viewshed analysis is a complex metric; and classification would require substantial explanation.	1
<i>Scale validity</i>	Parameter may be more suited to higher resolution bay or site level assessments, with local processes to identify key viewpoints in a specific area.	1
<i>Coastal coverage</i>	If collected, data could be available across the entire area of analysis.	3
<i>Data accessibility</i>	The layer generation would require additional resources but could be accomplished within the project timeline.	2
<i>Measurement reliability</i>	Can be measured through well-established methods of viewshed analysis, although there is some uncertainty associated.	2
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Noise footprint

Rationale for consideration: Aquaculture should minimize their noise footprint as to not to disrupt other marine users.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Noise footprint is best evaluated on a local scale and reflects more social conflicts which are beyond the scope of assessment.	1
<i>Rateability</i>	Recognition of the noise created through aquaculture operations, although little empirical evidence is available to generate classification levels, as much of the noise footprint is highly operation specific.	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	2
<i>Scale validity</i>	More appropriate for local site selection, highly dependent on gear, size of farms, etc.	N/A
<i>Coastal coverage</i>	No spatial datasets currently exist.	N/A
<i>Data accessibility</i>	Spatial data is non-existent and difficult to estimate at a regional scale.	1
<i>Measurement reliability</i>	Methods for calculating noise footprint exist, although challenging at this scale due to local farm-specific production specifics.	1
<i>Redundancy to other criteria</i>	Criterion has correlations with other proximity to land sources (coastal use areas, etc.).	2

Dredging Areas

Rationale for consideration: Aquaculture cannot be located above regularly dredged areas due to potential disturbances caused by dredging activities.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Regular dredging areas are considered unideal for aquaculture since the lease would obstruct regular maintenance, dredging barges, and high siltation rates of the environment.	3
<i>Rateability</i>	Aquaculture can not occur in areas regularly dredged. Recognition as a constraint means the classification is straightforward.	3
<i>Scoring clarity</i>	Data does not involve complex analysis and can be communicated to various end-users.	3
<i>Scale validity</i>	Dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	Private or irregular dredging may not be well documented, compared to regular dredging locations.	1
<i>Data accessibility</i>	Some data is available publicly, while others are held privately. Up to date information on currently dredged areas that have not been mapped is currently under development.	N/A
<i>Measurement reliability</i>	Measurement accuracy is relatively good for reported/designated dredging areas.	2
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Derelict Vessels and Shipwrecks

Rationale for consideration: Aquaculture cannot be located above submerged vessels due to safety hazards and to preserve potentially culturally important sites.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Several derelict vessels and shipwrecks exist along the Nova Scotia coast, especially in shallow waters. Obstruction in the marine environment can pose safety issues when operating around aquaculture leases. These vessels can be removed, usually with some monetary cost.	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward as aquaculture is not permitted over derelict vessels and shipwrecks to ensure the historical preservation of the vessel and reduce interaction with aquaculture infrastructure.	3
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	3
<i>Scale validity</i>	Most appropriately identified during local site selection, with consultation with local communities.	N/A
<i>Coastal coverage</i>	Minimal data is available from Coast Guard Canada around the province.	1
<i>Data accessibility</i>	Locational data is largely held privately and not appropriate for public use.	N/A
<i>Measurement reliability</i>	Reporting of locations may be unreliable and not appropriate for public use.	N/A
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data but could overlap with archeological sites.	2

Archeological sites

Rationale for consideration: Aquaculture should minimally impact marine sites with cultural and archeological importance, which are also protected legally.
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Known archaeological areas are protected under the Special Places Protection Act . Aquaculture should not occur in an archeological protected area. However, many archeological sites are not identified, and appropriately accounting for these areas would require local-scale assessments more appropriate for a site-level.	3
<i>Rateability</i>	Recognition as a constraint means the classification is straightforward. Consideration of buffers would be required.	2
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	3
<i>Scale validity</i>	To effectively incorporate, criteria is best considered and incorporated during local site selection processes, and with consultation with local communities.	N/A
<i>Coastal coverage</i>	Data on known sites is not publicly available. The location of unknown sites has not been mapped.	N/A
<i>Data accessibility</i>	The Nova Scotia Department of Communities, Culture, Tourism, and Heritage maintain records of known sites. Location data can be considered sensitive in nature.	N/A
<i>Measurement reliability</i>	Site mapping is not appropriate for wide public distribution due to sensitivity of data.	1
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data but could overlap with shipwrecks.	2

Oil and Gas Structures

Rationale for consideration: Aquaculture cannot be located within existing oil and gas structures (spatial constraint).
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Marine oil and gas exploration exists in several areas across Nova Scotia's Scotian Shelf.	3
<i>Rateability</i>	Aquaculture would be constrained in these areas. Recognition as a constraint means the classification is straightforward. Some conversations with network partners are necessary to determine the required buffer.	2
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require some explanation and clarification.	3
<i>Scale validity</i>	Dataset available at appropriate spatial resolution.	3
<i>Coastal coverage</i>	No structures exist within the boundary of the area of analysis (all beyond 3 km offshore).	N/A
<i>Data accessibility</i>	The location of active Production Licences administered by the Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) , as well as the surface locations for all wells drilled are available through CNSOPB.	2
<i>Measurement reliability</i>	Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Cumulative Human Impacts

Rationale for consideration: Cumulative human impacts in an area can suggest increased spatial overlap and potential for conflicts with proposed aquaculture development
Final decision: Exclude
Average score: Not Applicable (DOES NOT MEET MINIMUM REQUIREMENTS)

Property	Description	Score
<i>Relevance to scope</i>	Cumulative human impacts indicate areas of greater potential overlap and conflicts with potential aquaculture	3
<i>Rateability</i>	Greater overlap of activities does not necessarily result in reduced suitability. Rating would depend on expert opinion	1
<i>Scoring clarity</i>	Interpreting data does not require expert knowledge but would require explanation and clarification as dataset involves a number of components.	2
<i>Scale validity</i>	Dataset available is at coarse resolution inappropriate for scale of assessment (1km ²)	N/A
<i>Coastal coverage</i>	Dataset available was only mapped for the Maritimes region, notable gaps on the Gulf Shore	N/A
<i>Data accessibility</i>	To support ongoing Marine Spatial Planning initiatives, DFO Maritimes Region has produced Cumulative Human Impact Maps for Bay of Fundy and Scotian Shelf	3
<i>Measurement reliability</i>	Analysis is straight forward and requires only potential buffers applied to features.	3
<i>Redundancy to other criteria</i>	Data is largely independent of other types of data.	3

Appendix III – Criteria Descriptions and Scoring

A summary of details for criteria included in the assessment is provided, including descriptions of data layers and any processing required to transform data for scoring. We also include criteria maps showing the values of each criterion across the area of assessment (AOA).

FACTORS

Extreme cold exposure

Importance: Identifying areas likely to experience extreme low water temperatures is important for aquaculture as extreme low temperature conditions ($< -0.7^{\circ}\text{C}^1$) can kill finfish, even in brief occurrences lasting only a few hours (Saunders et al., 1975).

Data: Temperature data was obtained from continuous temperature monitoring sensors deployed within the [Centre for Marine Applied Research's \(CMAR\) Coastal Monitoring Program \(CMP\)](#). Data-poor areas were supplemented with Sea Surface Temperature (SST) data from the [GHRSSST Level 4 MUR Global Foundation Sea Surface Temperature Analysis](#)².

Exposure to extreme cold was measured by calculating a risk rating to bring together considerations of the likelihood of extreme cold temperatures, the severity of impacts, and the inherent uncertainty in the datasets. First, the number of years where water temperatures were observed to at least once in the year, reach at or below -0.7°C^3 during winter months (January, February, and March) was identified. This was calculated for CMP temperature monitoring stations (measured at $\sim 5\text{m}$ water depth at low tide⁴) with at least two years of data. Stations vary in data length, ranging from 2 to 7 years, with data collected between 2017 and 2023. For data-poor areas, additional "stations" were added to the dataset by drawing from six years (2018 – 2023) of SST data. An annual likelihood value was then calculated (0 to 1) based on the number of extreme cold years over the total number of years of data for each station. Likelihood values from point locations were then interpolated spatially using Inverse Path Distance Weighting (IPDW) algorithm (Stachelek and Madden, 2015) to achieve coverage across the entire AOA ([Figure 1](#)).

Risk ratings were assigned based on annual likelihood, such that:

- **Low risk:** Extreme cold temperatures occur rarely, if at all (< 0.1 annual likelihood). While producers should monitor temperatures, it is unlikely to significantly disrupt operations.
- **Medium risk:** Extreme cold temperatures may occur, potentially 1-2 times every 10 years (0.1 - 0.25 annual likelihood). While these events pose a substantial risk, these less frequent

¹ Only temperatures below -0.7°C are considered, as cold-related impacts above this threshold do not pose the same level of urgent or severe risk.

² JPL MUR MEaSURES Project. 2015. GHRSSST Level 4 MUR Global Foundation Sea Surface Temperature Analysis (v4.1). Ver. 4.1. PO.DAAC, CA, USA. Dataset accessed [2024-03-21] at <https://doi.org/10.5067/GHGMR-4FJ04>.

³ Determined as the temperature at which fish die from cold temperatures, applicable to both Atlantic salmon and trout (Saunders et al., 1975; Fletcher et al., 1988; LGL Limited, 2019).

⁴ 5 m temperature measurements are taken to be representative of conditions at cage depth.

events are potentially more manageable with careful planning, monitoring, and implementation of mitigation measures.

- **High risk:** Extreme cold temperatures are highly likely (>0.25 annual likelihood). In these cases, producers must plan for multiple events over the lifespan of their operation (Hargrave et al., 2005). In these areas, operations could be exposed to two or more extreme cold temperature events within each 10-year licensing period and could potentially impact every other production cycle⁵.

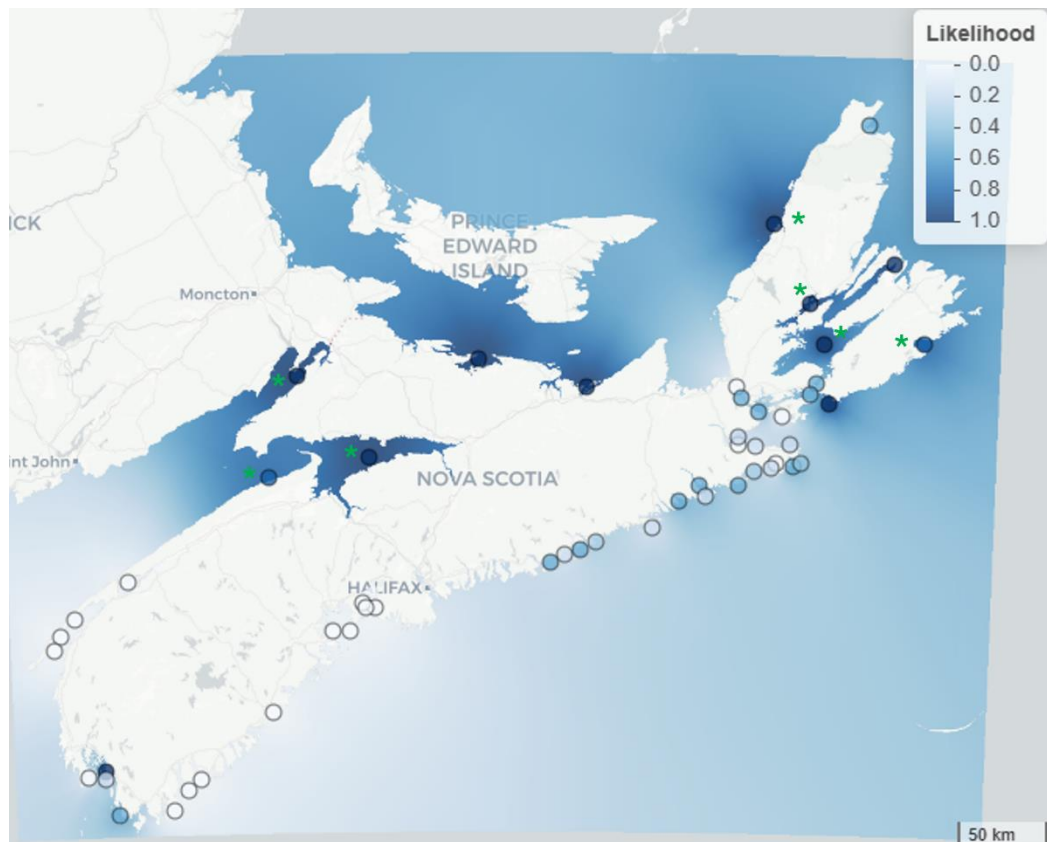


Figure 1. Annual likelihood of extreme cold events based on both CMP and SST (denoted by green asterisks) stations.

This approach was taken for the entire AOA, except within the Bras d'Or area. The Bras d'Or is a highly complex environmental area where temperature profiles have significant spatial variability across its diverse subregions. In the Bras d'Or, there is a lack of reliable high-resolution temperature data across all subregions to adequately capture temperature dynamics in this area.

⁵ For example, given an 18-month grow out period and 3 month-fallow cycle for salmon.

Here, the entire region⁶ was given a medium-risk rating⁷, indicating that further evaluation is needed to understand specific risks within the area.

Derived data products have some inherent uncertainty due to limitations in original data sources as well as assumptions made during processing. Risk ratings and likelihood calculations were based on interpolated values from point data, which may be poorly represented in some areas due to lack of full province coverage of data points. Interpolation tends to be less accurate at the edges of the study area where there is a lack of surrounding values. It can also be influenced by outliers, especially if they are isolated in space. Local-scale temperature variability may not be reflected accurately through interpolated models at this scale. While SST data was used to fill gaps in CMP data to reduce this, SST represents only ‘surface-level’ estimates available at a 1km resolution (Chin et al., 2017).

Scoring: Although mitigation measures to reduce mortality from extreme cold exposure events, such as using deeper netting and pausing activities that bring fish to the surface, may help reduce exposure, they come with challenges and limitations (LGL Limited, 2019). While fish naturally avoid cold surface waters by swimming deeper, prolonged submergence at greater depths can result in poor growth and welfare conditions, as well as increased mortality (Warren-Myers et al., 2022). Modifying cage systems for deeper netting or submerged use can require significant investment and may increase operational complexities. Depth strategies may only work if there is temperature stratification with a ‘warmer band’ of water. As such, the most effective approach remains avoiding placing sites in areas with a history of extreme cold (Dempsey et al., 2023).

Scoring			
Type	“Limited”	“Moderate”	“Good”
Salmon	High risk – limiting condition	Medium risk	Low risk
Trout	High risk – limiting condition	Medium risk	Low risk
Mussels	N/A	N/A	N/A
Oysters	N/A	N/A	N/A

Regions with **high risk** were considered a limiting condition and thus were automatically rated as **“limited”** for aquaculture development in final maps due to the considerable risk of recurring extreme cold events and their potentially severe or catastrophic effects on fish health and welfare as well as the lack of effective mitigation options. Areas with **medium risk** were scored as **“moderate”** for aquaculture development, reflecting the potential risks and challenges as well as the reduced likelihood of an event. Areas with **low risk** were scored as **“good”** for aquaculture as extreme low temperatures are likely rare in these areas. Since extreme cold temperatures result in significant mortality of both Atlantic salmon and trout, similar scores were proposed for both species.

⁶ The Bras d’Or region was delineated based on aquaculture regions boundaries outlined in Stantec (2009).

⁷ Industry data from current lease areas highlight that extreme cold temperatures are unlikely but may have been observed within the last 10 years.

Extreme heat exposure

Importance: Identifying areas where heat stress is likely to occur is important for aquaculture as heat stress may lead to negative health effects and poor welfare outcomes, including increased stress, impaired growth, and reduced immunity to diseases (Gamperl et al., 2020; Beemelmans et al., 2021b; Jiang et al., 2021). Prolonged elevated water temperatures during the summer months may at times be lethal, especially when they co-occur with hypoxia (Thyholdt, 2014; Forseth et al., 2017).

Data: Temperature data was obtained from continuous temperature monitoring sensors deployed within the [Centre for Marine Applied Research's \(CMAR\) Coastal Monitoring Program \(CMP\)](#). Data-poor areas were supplemented with Sea Surface Temperature data from the [GHRSSST Level 4 MUR Global Foundation Sea Surface Temperature Analysis](#)⁸.

Exposure to extreme heat was measured by calculating a risk rating to bring together considerations of the likelihood of heat stress occurring, the severity of impacts, and the inherent uncertainty in temperature datasets⁹. The risk of exposure to extreme heat was determined based on identifying heat stress events present within summer months (July, August, and September). This was calculated for CMP temperature monitoring stations (measured at ~5m water depth at low tide) with at least two years of data. Stations vary in data length, ranging from 2 to 7 years, with data collected between 2017 and 2023. For data-poor areas, additional "stations" were added to the dataset by drawing from six years (2018 – 2023) of SST data.

Each species have different thermal tolerances; for each, a heat stress event was defined as:

- Salmon: 24 hours following a temperature observation $\geq 18^{\circ}\text{C}$ (Dempsey et al., 2023)
- Trout: 24 hours following a temperature observation $\geq 20^{\circ}\text{C}$ (Currie et al., 2000; Jiang et al., 2021; Li et al., 2022)
- Mussels: Temperatures were at or above 25°C , for 5 or more consecutive days (Clarke et al., 2025)

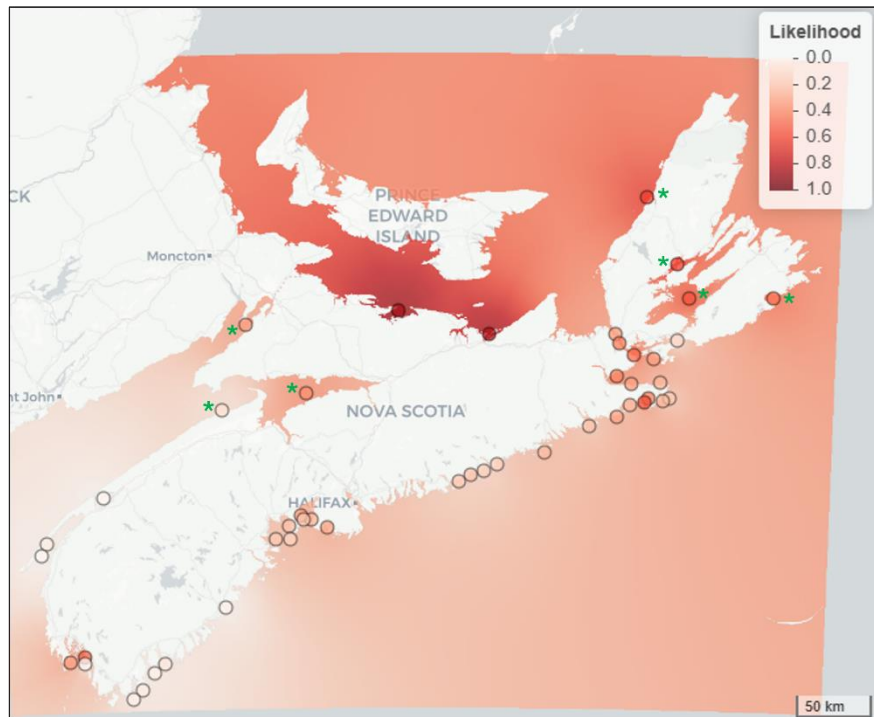
The likelihood of heat stress (0-1) was then calculated based on the total number of days within a heat stress event period over all potential heat stress days available for that station¹⁰. Likelihood values from point locations were then interpolated spatially using Inverse Path Distance Weighting (IPDW) algorithm (Stachelek and Madden, 2015) to achieve coverage across the entire AOA ([Figure 2](#)).

⁸ JPL MUR MEaSURES Project. 2015. GHRSSST Level 4 MUR Global Foundation Sea Surface Temperature Analysis (v4.1). Ver. 4.1. PO.DAAC, CA, USA. Dataset accessed [2024-03-21] at <https://doi.org/10.5067/GHGMR-4FJ04>.

⁹ For a description of limitations with this type of data and methods used to derive, see Exposure to Extreme Cold

¹⁰ This approach only considers the total number of heat stress days and does not account for the differing welfare impacts of prolonged versus short-duration heat stress events.

A) Atlantic salmon



B) Rainbow trout

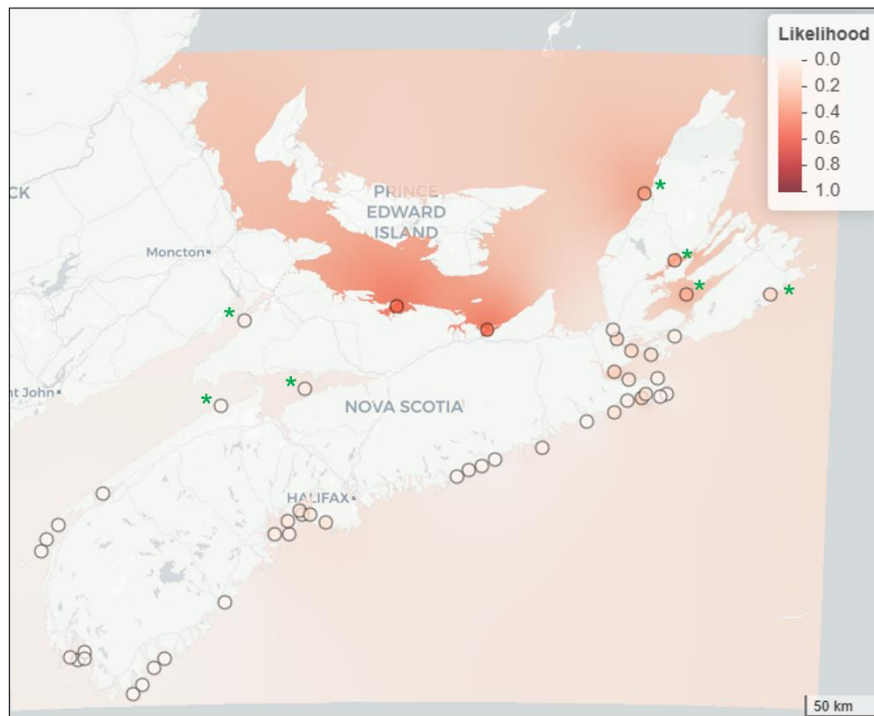


Figure 2. Likelihood of extreme heat events based on both CMP and SST (denoted by green asterisks) stations for A) Atlantic salmon, and B) Rainbow trout.

Risk ratings were then determined based on annual likelihood, such that:

- **Low risk:** Heat stress events seldom occur (< 0.25 likelihood), minimizing the need for intervention, making it easier to maintain growth and welfare.
- **Medium risk:** Heat stress events may be a regular occurrence (0.25 – 0.75 likelihood) but may not be widespread or persistent. While still potentially impactful, these conditions are likely more manageable with proper planning and existing mitigation strategies.
- **High risk:** Summer temperatures regularly and consistently reach stressful conditions for species beyond their preferred range (likelihood above 0.75). Management of prolonged or chronic heat stress may require long-term adaptation strategies, such as technological advancements or selective breeding (Calado et al., 2021).

This approach was taken for the entire AOA, except within the Bras d’Or area. The Bras d’Or is a highly complex environmental area where temperature profiles have significant spatial variability across its diverse subregions. In the Bras d’Or, reliable high-resolution temperature data across all subregions is not available to appropriately capture temperature dynamics in this area. The entire region¹¹ was given a risk rating based on relevant data specific to each species¹² and considering the need for further evaluation to understand specific risks within the area.

Scoring: The marine-based aquaculture industry has limited capacity to influence water temperatures, and mitigation measures, such as supplemental oxygenation, modified feeding, providing deeper nets (or sinking gear), and ensuring nets have been cleaned (increasing water flow through the cage), may not always be effective (Sajid et al., 2024). As such, it is recommended that producers avoid sites with high likelihoods of encountering heat stress conditions.

Scoring			
Type	“Limited”	“Moderate”	“Good”
Salmon	High risk	Medium risk	Low risk
Trout	High risk	Medium risk	Low risk
Mussels	High risk	Medium risk	Low risk
Oysters	N/A	N/A	N/A

Areas with **high risk** to heat exposure are rated as “**limited**” potential for aquaculture development due to the significant risks posed to the health and welfare of cultured species, as well as the limited capacity to mitigate these impacts effectively over time without significant effort and financial investments (Gamperl et al., 2020; Beemelmans et al., 2021a; Jiang et al., 2021). **Medium risk** areas are scored as “**moderate**” potential as conditions potentially present fewer and less severe risks to aquaculture compared to higher-stress areas. Areas of **low risk** are “**good**” for aquaculture potential, as temperature conditions pose significantly less heat-related

¹¹ The Bras d’Or region was delineated based on aquaculture regions boundaries outlined in Stantec (2009).

¹² For salmon and trout, the Bras D’Or was categorized as “medium risk” as current temperature data (from CMP and SST datasets) suggest some areas may be exposed to heat stress. For mussels, data indicates currently no areas in the province likely to be exposed to heat stress for mussels, and as such the Bras d’Or was also categorized as “low risk”.

risks. As the definition of heat stress events was defined for each species, the risk of extreme heat exposure can be scored similarly for all species.

To note, current analysis of temperature data shows no areas within Nova Scotia that reach heat stress events for mussels; the entire AOA would be rated as “good” for aquaculture. However, local knowledge suggests that there are local areas that do reach heat stress temperatures and thus remains a relevant criterion for suitability. For this assessment, the exposure to extreme heat layer was not included in the final suitability assessment map, as it would dilute the contribution of other layers. Still, the criterion remains important for inclusion, as re-assessments may reveal previously undetected areas of heat stress, or account for environmental changes in the future.

Bathymetry

Importance: Water depth is an important consideration for aquaculture, as it acts as a compounding factor, and influences oxygen availability, and temperature stability which can influence the health and welfare of cultured species. Water depth may also be correlated with water flow, which is important for the thermal regulation of finfish, especially in sites where water temperatures vary at different depths (Oppedal et al., 2011b). Higher water flow can also help transport waste away from cages, maintaining the health of benthic marine habitats below cages (Sara et al., 2006; Borja et al., 2009; Sanz-Lazaro et al., 2021). While shellfish often occupy shallow intertidal zones, at shallow depths, cultured shellfish may be exposed to air, which during hot summer temperatures, can lead to mortality (Clements et al., 2018).

Data: Bathymetry (in meters below sea level at low tide¹³) was mapped by combining two sets of bathymetric data. The [Canadian Hydrographic Service Non-Navigational \(NONNA\) Bathymetric Data](#) provides high-resolution water depths at 10 m resolution for parts of the province. Areas with missing data, amounting to 5% of the study area, were filled using bathymetry from the [General Bathymetric Chart of the Oceans \(GEBCO\)](#) dataset. GEBCO’s global gridded bathymetric data measures the underwater topography and water depth of the seabed at 15 arc-second intervals (~300m resolution). Inverse path distance weighting (IPDW) interpolation¹⁴ was then applied to create a continuous, smooth surface, resulting in a final grid resolution of 10 m².

As this dataset is a combination of datasets, there may be inaccuracies in data due to resolution differences of the source data, and assumption of interpolation methods. GEBCO datasets used to fill in data gaps are at a coarse resolution; therefore, the bathymetry of some areas may only be approximate. Furthermore, water depths may also be less accurate at very shallow depths near the edges of the coastline due to an edge effect where the 100m resolution raster cell does not fit tight to the coastline.

¹³ Tidal variations are not captured by either data source included in this layer.

¹⁴ The IPDW method, an extension of inverse distance weighting (IDW), was chosen as it is a well-known and relatively simple, deterministic spatial interpolation method. This extension modifies the IDW method, which is typically unsuitable for coastal applications due to its inability to differentiate between land and water, by incorporating land as a barrier (i.e., making the cost of travelling over land is prohibitive), thus making it suitable for coastal applications.

Scoring: While water depth is a functional requirement for infrastructure, scores were based primarily on how depth interacts with species health and welfare, and then functional requirements. No ‘moderate’ depths were proposed for any of the species, as the primary considerations for potential ‘moderate’ depths were largely related to cost and infrastructure requirements¹⁵ or were more closely related to consideration with exposure, which are considered within other criteria. While there may be additional variability in suitability beyond the depth thresholds presented here, these are best captured in site-level or bay-level assessments.

Scoring			
Type	“Limited”	“Moderate”	“Good”
Salmon	<10 m – limiting condition	N/A	N/A
Trout	<10 m – limiting condition	N/A	N/A
Mussels	<5 m	N/A	>5 m
Oysters	<2 m	N/A	>2 m

Salmon and Trout

In Nova Scotia, most finfish producers operate with net depths of 8 to 10 m, (Brewer-Dalton et al., 2015) but require water depths of at least 7 m to accommodate sub-surface netting (Stantec, 2009). Producers must also consider depth-related risks to fish health and welfare. As coastal waters frequently stratify, siting farms in shallow depths may limit fish access to deeper, more temperature-stable waters (Warren-Myers et al., 2022; Sajid et al., 2024), reducing the ability of fish to avoid potentially harmful surface water temperatures in both summer (Remen et al., 2016; Wade et al., 2019) and winter (Warren-Myers et al., 2022). Depth is also often positively correlated with water flow, which is important for the thermal regulation of finfish, especially in stratified conditions (Oppedal et al., 2011a). Additionally, shallow depths can hinder organic matter dispersal, potentially increasing waste accumulation near cages and negatively impacting benthic environments, local water quality, and fish welfare (Holmer and Kristensen, 1992; Hargrave, 1994; Holmer et al., 2005). Consequently, finfish aquaculture generally requires a minimum depth of 10 meters to reduce health and welfare risks and accommodate gear. As such **depths below 10 meters** were identified as a limiting condition, as areas would be **“limited”** in final suitability maps.

Mussels

Mussel longlines typically range in length from 1 to 3 meters (Drapeau et al., 2006); yet, depth considerations also include risks to mussel health and welfare. At shallow depths, producers may have limited abilities to lower gear potentially increasing exposure to elevated surface temperatures and ice-related risks. Shallow depths also raise the risk of longlines contacting the seabed, which may heighten starfish predation (Fisheries and Oceans Canada, 2003; Minnhagen et al., 2019). Furthermore, bio-deposition, which can negatively affect benthic environments and water quality, is heavily influenced by hydrodynamic conditions and depth, with shallow areas at greater risk of accumulation and adverse effect (Chamberlain et al., 2001; Hartstein and Stevens,

¹⁵ Which are factors considered beyond the scope of this assessment.

2005; Barnes, 2006). Consequently, a minimum **depth of 5 meters** may reduce health and welfare risks and accommodate longlines, beyond which can be considered **“good”** for mussel aquaculture. As such **depths below 5 meters** are considered **“limited”**.

Oysters

Suspended oyster culture can operate in very shallow waters, yet might be exposed to depth-related risks to oyster health and welfare. In shallow waters, oysters are more vulnerable to temperature fluctuations and exposure to air during hot summer months, which can lead to mortality (Clements et al., 2018). Additionally, shallow depths limit producers' ability to sink gear effectively¹⁶, increasing the risk of ice-related harm. Consequently, a minimum depth of 2 meters is typically necessary to reduce welfare risks. As such, **depths below 2 meters** are considered **“limited”**, while conditions **beyond 2 metres** can be considered **“good”** for oyster aquaculture.

Ice Conditions

Importance: Risks from sea ice, particularly from drift ice¹⁷, can threaten infrastructure and affect aquatic animal health and welfare in aquaculture. Damage and/or failure of cage infrastructure can result in economic losses for producers or accidental escape of farmed fish into the marine environment. For shellfish, ice can scour equipment and crush the animals, leading to mechanical damage and mortality of shellfish.

Data: Sea ice data was retrieved from the International Ice Charting Working Group for the World Meteorological Organization as vectorized Sea Ice Grid (SIGRID-3) layers representing Canadian Ice Service weekly maps from 2006 to 2023. Data was acquired and processed by the Nova Scotia Community College's Applied Geomatics Research Group (NSCC-AGRG). A total of 394 weekly ice charts were compiled and extracted onto a 100 m x 100 m grid to identify drift ice observations within the last 10-years (2014-2024). Due to missing spatial coverage of original datasets (e.g. original sea ice charts), the ice observation dataset was interpolated into select nearshore areas to ensure complete coverage of ice frequency across the AOA. Ice frequency data was then reclassified to identify “low ice” (0-2 observations), “medium ice” (2-28), and “high ice” (28-162) areas (**Figure 3**). To inform shellfish risk ratings, the maximum ice thickness¹⁸ of drift ice across the AOA was extracted.

Ice exposure risk was determined for each species, based on the type and considerations for ice risks, and categorized into “high risk”, “medium risk”, and “low risk” classes. For salmon and trout, various ice conditions can create risks to producers and aquatic animal health. These risks may vary spatially and temporally and are specific to local conditions or operations, which are most appropriately considered during site-level assessment/scoping. Here, all types of drift ice were considered, as any thickness of drift ice poses a risk to surface-based aquaculture gear. As such,

¹⁶ A minimum of 2 meters depth is generally required for effective gear sinking (Fiendel, 2020).

¹⁷ Drift ice (or pack ice) is mobile and drifting, and can be distinguished from fast ice which remains fixed to the coast (Fisheries and Oceans Canada, 2022)

¹⁸ As a proxy for keel depth (i.e., the depth of ice below the water's surface) during ice break up.

high risk was equivalent to high ice areas, medium risk to medium ice, and low risk to low ice areas.

For shellfish species (mussels and oysters), risks from ice are primarily due to thick drifting ice during the spring break up, which can scour and damage equipment, and lead to physical damage and mortality. Risk ratings were determined by overlaying three considerations:

1. The frequency of drift ice in the area (i.e., 'high ice', 'medium ice', or 'low ice')
2. Whether there is sufficient bathymetry in the area to avoid the thickest¹⁹ ice, based on species-specific culture practices
 - Shellfish operators regularly sink their gear during the winter to avoid thick ice presence. However, in very shallow areas, exposure may be unavoidable as there is not sufficient space below ice to sink gear.
 - Required depth was calculated for each 100m² area based on adding the maximum thickness of drift ice with the minimum recommended depth for suspended oyster culture (1 m) or mussel culture (3 m).
 - If water depths are less than the depths required for sinking, then culture in the area may be exposed to risks from drift ice.
3. Whether the area may be 'sheltered' from drift ice intrusion²⁰.
 - In highly sheltered bays, surrounding land masses may prevent drift ice from entering the bay, reducing potential exposure to drift ice.
 - To identify bays that are sheltered, we delineated all bay openings by digitizing a line across the narrowest part of the mouth for each bay or where bathymetry and the shoreline indicated a natural boundary.
 - We consulted the Marine Infrastructure Liaison Officer (MILO) for the region to help identify which of the bays were protected from drifting pack ice.
 - Through this we were able to establish that bays with narrow and/or shallow openings are less likely to allow large drift ice to enter. As well, sheltered bays often freeze over with fast ice in winter, forming a protective barrier against thick drifting pack ice. These areas are classified as 'sheltered' while open and more exposed bays that are more likely to experience thick drifting ice are classified as 'unsheltered' (at risk from drifting ice).

Combining these three considerations, we assigned risk such that:

¹⁹ Here, the maximum ice thickness is used as a precautionary proxy to account for 'worst-case' conditions, recognizing there is likely spatial and temporal variability in what a specific area may experience.

²⁰ For this assessment, we only apply this consideration for bays along the Gulf shore, where drift ice frequency was determined to be high.

- High risk = Areas within the high frequency zone that are not sheltered and shallower than the required depth.
- Medium risk = Areas within medium frequency drift ice zone that are shallower than the required depth or sheltered.
- Low risk = Everywhere else, includes low frequency drift ice zones or areas in medium or high zones that are deeper than the required depth or in high frequency zones and sheltered by fast ice formation.

These layers were developed to inform a province-wide, high-level assessment of risks to aquaculture development from drift ice. Data relied on weekly ice charts information. There are some areas, particularly in small bays, where original datasets were missing. Original data is also at a relatively coarse resolution, such that local scale ice dynamics can not be inferred. Ice patterns and dynamics are heavily influenced by local oceanographic characteristics, including local flow rates, tides, and currents. This data can not capture those dynamics, and thus there may be local variations in ice risk at a bay or site-level.

This assessment also combines ice observations across a 10-year period (2014-2024) to identify areas that are likely to have consistent ice. The risk was based on past observations but can not be seen to be accurate to any individual year, as ice dynamics fluctuate largely from year to year. Furthermore, ice risks may vary across the year, as there can be rapid freeze-thaw dynamics that can not be fully captured in this type of summary assessment.

For the assessment of risk for shellfish, we relied on experiential observations of ice presence for select areas in the North Shore to describe the bay as 'sheltered'. This consideration was not available across the entire province, and could be supplemented with ground-truthing or better consideration for the presence of fast ice.

Scoring: Scoring was based on generalized exposure to drift ice and the assumed increased risk posed to cultured species, as well as the need for mitigation and management in ice-prone areas. As species-specific considerations for risks from ice are considered in how the ice risk was calculated, the proposed scoring for suitability assessment applies to all species.

Scoring			
Type	"Limited"	"Moderate"	"Good"
Salmon	High	Medium	Low
Trout	High	Medium	Low
Mussels	High – limiting condition	Medium	Low
Oysters	High – limiting condition	Medium	Low

Salmon and Trout

Ice can damage cages through accumulation on structures, collisions, or ice flow impingement; all of which can reduce the structural stability of cage systems, leading to deformation, shifting, or even collapse (Marsden, 2021; Sun et al., 2024). These impacts are of particular concern as cage damage or deformation can negatively impact the health and welfare of cultured species through injuries and increased stress (Jensen et al., 2010; Sun et al., 2024). Additionally, if damage is severe enough there is also the risk of fish escapes (Getchis et al., 2015; Sun et al., 2024). In areas where drift ice can be expected to occur, producers must be well-prepared. **High-risk** areas are those where drift ice occurs regularly and persistently and were rated as “**limited**” for finfish. **Medium-risk** areas are those where drift ice occurs very infrequently but has been observed on occasion within the last 10 years. Producers would have to monitor for risks, and as such would be “**moderate**” for aquaculture development. **Low-risk** areas for finfish (salmon and trout) are identified where drift ice is rare (low ice frequency) and would have “**good**” suitability.

Mussels and Oysters

For shellfish, moving ice can scour equipment and crush animals, leading to mechanical damage and mortality of shellfish. In addition, mussels exposed to ice-cover have been shown to display signs of nutritional stress and reduced respiration rates (Hatcher et al., 1997).

High-risk areas are those where drift ice occurs regularly and persistently, where bathymetry is also within depths where aquaculture would be exposed to drift ice, and the area is within an unsheltered bay. Since these areas pose significant mortality and infrastructure risks to cultured shellfish, these areas were identified as a limiting condition and rated as “**limited**” in final suitability maps. **Medium-risk** have moderate drift ice frequency and bathymetry within ranges where drift ice could impact animals. In these areas, producers would need to be aware of and monitor risks and thus be “**moderate**” for aquaculture development. For shellfish, **low-risk** areas occur when either a) shellfish may be exposed due to bathymetry but are in low ice areas, or b) where bathymetry is sufficient to avoid risks posed by thick drifting ice (even in high ice areas). As risks are expected to be minimal, these areas are thus scored as “**good**” suitability for aquaculture.

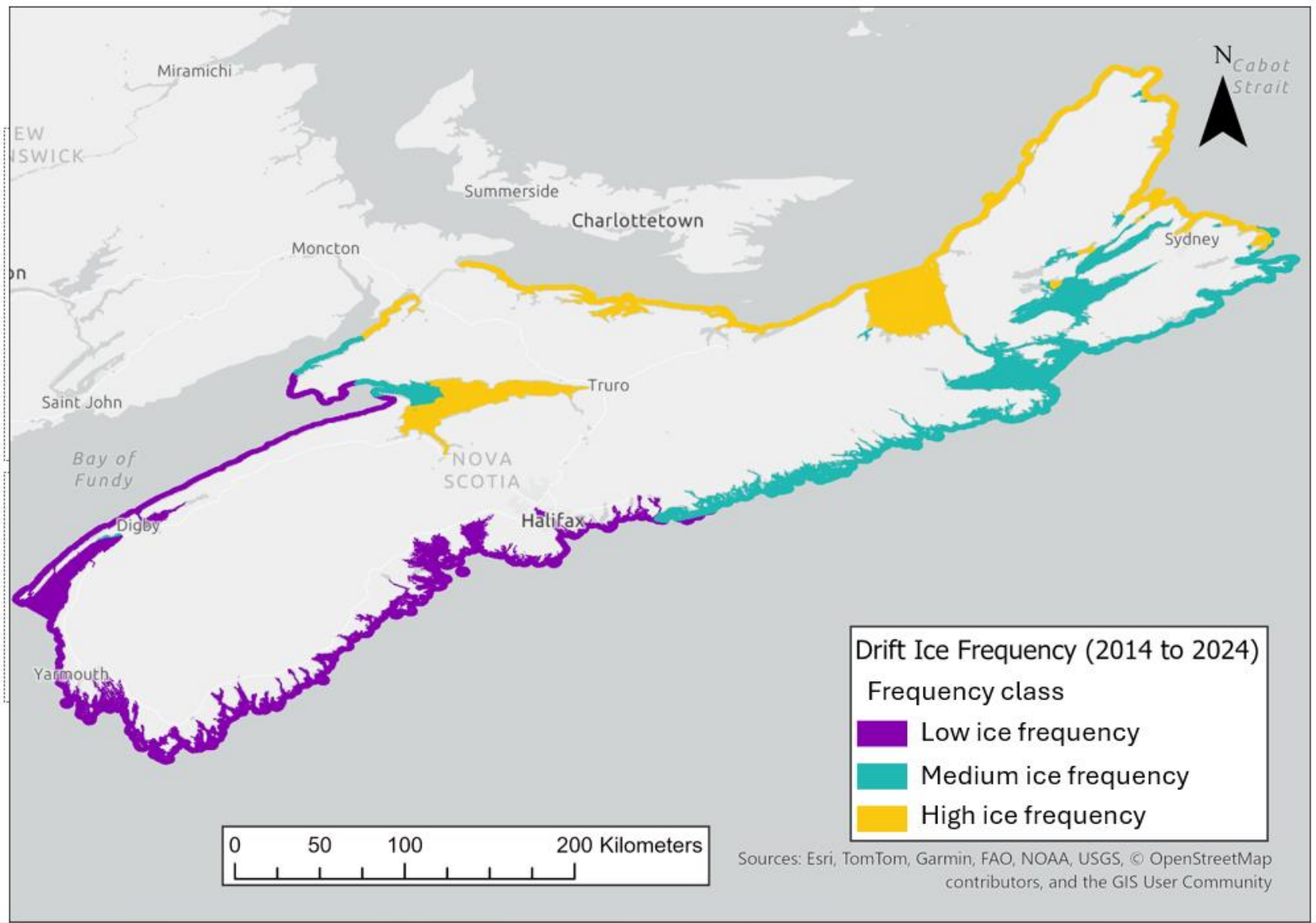


Figure 3. Drift ice frequency classes based on observations of drift ice between 2014 and 2024 in Atlantic Canada.

Wind and wave conditions

Importance: Understanding how 'exposed' an existing or potential site is to waves and wind is important, as strong waves can create stress for aquatic animals, disrupt feeding or behaviour of animals, and influence water quality (Johannesen et al., 2020; Johannesen et al., 2022). For finfish, exposure can damage cages and lead to fish escapes (Dempster et al., 2018). For shellfish aquaculture, exposure can negatively affect shellfish growth, as strong wave movements can affect shellfish feeding or lead to shell damage (Campbell and Hall, 2019). Exposure to strong wind and waves may also exert excess stress on aquaculture systems (i.e., cages, long lines, etc.). This excess stress can potentially result in damage to the system, escapes of cultured organisms, and health and safety risks for employees (Brister and Kapuscinski, 2000). As such, it is crucial to consider wind and wave exposure conditions at potential sites as these environmental factors directly impact engineering and design requirements and investment needed.

Data: Wind and wave exposure data was obtained from the [Nova Scotia Wind-generated Wave Exposure Atlas](#) produced by DSA Ocean for CMAR. The wave exposure levels were evaluated based on 10-year maximum significant wave heights (m) calculated from wind speeds (obtained from an ECMWF ERA5 dataset)²¹. Wave exposure was modelled for coastal waters up to 5 km off Nova Scotia and mapped at a 25 m resolution. The wave exposure dataset was updated to include the most recent data, representing 10-yr significant wave heights²² based on data from 2013-2023 and expanded to include all areas within our AOA.

The 10-year maximum significant wave heights (m) identified serve as a proxy to understand wind and wave exposure at this scale of assessment. While not representative of daily conditions these wave heights provide an estimate of the highest wave heights producers may encounter under relatively normal conditions. There are many other exposure-relevant considerations, such as swell, fetch, and depth, that are not included, as they require more fine-scale hydrodynamic modelling that is not available at this scale. Additionally, storm events are not considered, as their intensity, frequency, and location are unpredictable.

²¹ The influence of ocean swell is not considered in this model, but swell information was used to help validate the model (using MSC 50 wave hindcast model in select areas).

²² 10-year significant wave heights are defined as the average height of the highest one-third of all waves that occur within a 10-year period.

Scoring: Scoring was generally guided by considerations that increased significant wave heights can be associated with increased risk of exposure-induced stress, physical injuries, and potential for infrastructure damage. While Nova Scotia’s leasing regulations do not provide specific guidance regarding appropriate levels of wind and wave exposure, the Norwegian government has developed a classification system for aquaculture sites based on significant wave height, categorizing the degree of exposure as medium (1–2 m), high (2 –3 m), and extreme (>3 m) (Ryan, 2004; Wang et al., 2023).

Scoring			
Type	“Limited”	“Moderate”	“Good”
Salmon	> 5.5 m	4 – 5.5 m	< 4 m
Trout	> 5.5 m	4 – 5.5 m	< 4 m
Mussels	> 2 m – limiting condition	1 - 2 m	< 1 m
Oysters	> 2 m – limiting condition	1 - 2 m	< 1 m

Salmon and trout

Exposure to strong wind and waves may exert excess stress on aquaculture systems, potentially resulting in infrastructure damage, escapes of cultured organisms, and health and safety risks for employees (Brister and Kapuscinski, 2000). There is no universal ‘safe’ maximum significant wave heights for marine aquaculture cages, although some studies suggest that damage and deformation may occur when maximum significant wave heights reach 5.5 meters or more (Zhang et al., 2024). Beyond gear-related risks, producers must consider exposure-related risks to fish health and welfare. Strong waves can deform cages, decreasing the space available to the fish (Johannesen et al., 2022). Additionally, it has been suggested that increased wave exposure may act as a chronic stressor, contributing to the accumulation of allostatic load in farmed fish and increased mortality (Davis, 2010; Szewczyk et al., 2024). For example, turbulent and chaotic water conditions created by waves near the surface may force collisions between animals or between an animal and the net (Johannesen et al., 2020; Barbier et al., 2024), potentially leading to physical injuries. These turbulent conditions could also impact appetite and feeding (Barbier et al., 2024). Wave-related welfare impacts may be intensified in more exposed or offshore conditions (i.e., areas with significant wave heights of ≥ 5 m) than in coastal environments (i.e., areas with significant wave heights ≤ 4 m) (Bridger et al., 2015; Morro et al., 2021). As such, **significant wave heights below 4 meters** are considered “**good**” for finfish aquaculture development as they represent lower welfare and infrastructural risks. **Significant wave heights exceeding 5.5 meters** are considered “**limited**” due to the increased health and welfare risks and the potential for infrastructure damage or deformation. Significant wave heights between 4 and 5.5 meters still present potential challenges that require management and careful planning, however, infrastructure is expected to withstand these wave heights and conditions potentially present fewer and less severe risks to health and welfare (Karathanasi et al., 2022). As such, areas with **significant wave heights between 4 and 5.5 meters** are scored as having “**moderate**” suitability for salmon and trout aquaculture.

Mussels and oysters

Exposure to strong wind and waves may result in damage to shellfish culture systems and health and safety risks for employees (Brister and Kapuscinski, 2000). Beyond gear-related risks, producers must consider exposure-related risks to the cultured species' health and welfare. Strong waves can contribute to turbulent conditions that may dislodge shellfish from substratum (Baltic Blue Growth project, 2019), reduce feeding efficiency, and cause shellfish to collide with each other or with rearing infrastructure (i.e., cages) potentially leading to damage of shells, poor growth, and reduced harvests (Cranford et al., 2011; Campbell and Hall, 2019). The risks posed by exposure to strong waves are further supported by Wang et al. (2023), who investigated the effects of current and wave exposure on longline shellfish culture systems and found that welfare declines began at significant wave heights of 2 meters. Given the risk to cultured species' health and welfare and the existing guidance provided by the Norwegian exposure classification system, **significant wave heights exceeding 2 meters** were considered a limiting condition, and would be automatically **"limited"** in final suitability maps. **Significant wave heights of 1 to 2 meters** are scored as **"moderate"** suitability for shellfish aquaculture. While these wave heights pose some risk to producers and cultured species' health and welfare, this risk is likely able to be managed during operation and through proper planning and mitigation measures, such as allowing for slack in suspended lines²³. **Significant wave heights less than 1 meter** can be considered **"good"** for shellfish aquaculture.

²³ Slack reduces the force experienced on the lines and anchors, reducing the risk of losing gear.

Critical habitat for Species at Risk

Importance: Under the *Species at Risk Act* (SARA), critical habitat is defined as “the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species’ critical habitat in the recovery strategy or action plan for the species”, making them crucial in supporting conservation efforts (Canadian Wildlife Service, 2016). Marine species listed as threatened or endangered under SARA have critical habitats identified and are legally protected from activities that could impact said habitat.

Data: Data on defined critical habitats within the marine environment were retrieved from the Open Government Data Portal and includes: [Critical Habitat for Aquatic Species at Risk - Canada](#), and [Critical Habitat for Species at Risk National Dataset - Canada](#). SARA critical habitat areas are defined by relevant authoritative bodies including DFO, Environment and Climate Change Canada (ECCC), and Canadian Wildlife Services (CWS). Critical habitats with areas in the marine environment were extracted²⁴ across the AOA, which included some marine areas for migratory birds. Critical habitats meant to identify freshwater or inland aquatic critical habitats, such as those for wild Atlantic salmon were not included. This layer does not include SAR distribution ranges. Areas identified as critical habitat were reclassified as “present”, and any area beyond the habitat boundaries was reclassified as “absent”.

Scoring: Critical habitats for species at risk (SAR) are legally protected under SARA, which restricts activities that could lead to habitat destruction. Aquaculture may not necessarily create negative impacts on protected species or lead to habitat destruction, and any interactions are highly location and species-specific. However, there is evidence that negative interactions are possible. For example, marine aquaculture can introduce risks to nearby bird populations through exclusion from critical habitats, altered prey availability, and benthic disturbances that increase turbidity and reduce foraging success (Sagar, 2013; Bath et al., 2023). As such, within areas containing critical habitat for species at risk, additional assessment and consideration would be required to understand potential risks for negative interactions between aquaculture operations and protected species. Therefore, these areas were considered a limiting condition, and rated as “**moderate**” in final suitability maps for all cultured species.

Scoring			
Type	“Limited”	“Moderate”	“Good”
Salmon	N/A	Present – limiting condition	N/A
Trout	N/A	Present – limiting condition	N/A
Mussels	N/A	Present – limiting condition	N/A
Oysters	N/A	Present – limiting condition	N/A

²⁴ Included areas within 100m from the coastline.

Marine protected and conserved areas

Importance: Protected and conserved areas encompass protected areas as defined by the International Union for Conservation of Nature (IUCN), as “a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values” (Dudley, 2008). As such, these areas are an important consideration in aquaculture suitability assessments²⁵ and to acknowledge the conservation objectives relevant to aquaculture planning in Nova Scotia.

Data: Marine protected and conserved areas were identified through the [Canadian Protected and Conserved Areas Database \(CPCAD\)](#). The CPCAD consists of the most up-to-date spatial data on marine and terrestrial protected areas compiled and managed by Environment and Climate Change Canada (ECCC), in collaboration with federal, provincial, territorial, and other reporting authorities that provide the data. The presence of a marine protected and conserved area was identified by extracting any protected area with boundaries within the marine environment, and within our AOA²⁶. Within the AOA, protected and conserved areas included those designated as National Wildlife Areas (NWAs), Migratory Bird Sanctuaries (MBS), and *Oceans Act's* Marine Protected Areas (MPAs)²⁷. The dataset also includes Other Effective Area-based Conservation Measures (OECMs) across the country, but these were excluded as they are designed to provide highly specified protections and restrictions²⁸. Areas identified as protected or conserved were reclassified as “present”.

There are other protected areas within the marine environment, including those protected by the Nova Scotia Department of Natural Resources (DNR). These include Provincial Wildlife Management Areas and protected beaches. The protections in these areas are highly site specific, and therefore were not included in this layer.

Scoring: Areas containing marine protected and conserved areas, which may present potential risks for negative interactions between aquaculture operations and protected species or habitats, require additional evaluation, attention, and mitigation based on regulatory standards and policies specific to each protected area. Other regulations may have preclusions for aquaculture or restrictions determining the activities allowed in designated areas.

²⁵ Protected and conserved areas are commonly considered a constraint in most aquaculture suitability assessments (e.g., (Morris et al., 2021); Petrosillo et al., 2023; Porporato et al., 2020; Ross et al., 2020; Silva et al., 2011; Vianna & Filho, 2018), with the exclusion of aquaculture (specifically finfish) being recommended by international conservation groups (e.g., CPAWS) and incorporated in certification standards (e.g., ASC).

²⁶ As the database also includes terrestrial protected areas

²⁷ Although all existing *Oceans Act's* Marine Protected Areas in Nova Scotia are in waters offshore, beyond the AOA.

²⁸ Currently in Nova Scotia, none of the OECM restrictions apply to aquaculture.

Scoring			
Type	“Limited”	“Moderate”	“Good”
Salmon	Present – limiting condition	N/A	N/A
Trout	Present – limiting condition	N/A	N/A
Mussels	N/A	Present – limiting condition	N/A
Oysters	N/A	Present – limiting condition	N/A

Salmon and Trout

In MPAs, aquaculture is not explicitly prohibited; however, the *Marine Protected Areas (MPA) Protection Standards* prohibit activities that pose risks to achieving their conservation objectives, including dumping, depositing, or discharging any substance that could harm organisms or habitats. Finfish aquaculture may introduce waste, feed, and chemicals (i.e., pesticides and drugs) that may meet the definition of “deleterious substances”²⁹. Furthermore, finfish aquaculture would be unlikely to be permitted within NWAs, as *Wildlife Area Regulations* permits other activities only if there is a benefit to the conservation of wildlife within an NWA. Likewise, aquaculture within an MBS would require a permit or would have to implement mitigation to ensure no disturbance³⁰. As such, areas where **marine protected and conserved areas are present** were considered a limiting condition and were rated as “**limited**” in final suitability maps.

Mussels and Oysters

Shellfish farming, including mussels and oysters, is a less intensive practice, as it does not require external inputs such as feed or other deleterious substances that could potentially be prohibited under MPA regulations. Furthermore, shellfish aquaculture can have positive environmental effects³¹, promoting biodiversity when managed sustainably. As such, shellfish farming is likely more compatible with MPA conservation efforts however, it will still require additional evaluation and attention and may pose fewer risks to protected and conserved species and habitat. Obtaining approval to operate in these areas would still be assessed on a case-by-case basis, requiring additional effort to ensure farming practices align with the specific environmental and regulatory conditions of the protected area. As such, areas where **marine protected and conserved areas are present** were considered a limiting condition whereby the area was rated as “**moderate**” for shellfish aquaculture in final suitability maps.

²⁹ May not apply to all operations but would need to be evaluated in specific applications.

³⁰ Which would need to be carefully evaluated and further assessed during site-specific applications.

³¹ Bivalves, like mussels and oysters, can serve as bio-filters, improving water quality, and can enhance the structure and function of faunal communities by creating structured habitats (Azra et al., 2021; Theuerkauf et al., 2021)

Automatic Identification System (AIS) vessel density patterns

Importance: Aquaculture activities in heavily navigated areas can increase the risk of maritime accidents (Yoo and Jeong, 2020; European Boating Association, 2021). Inadequate spacing between an aquaculture site and established shipping routes or navigable channels may lead to collisions between vessels and the aquaculture infrastructure (Du et al., 2024). Such spatial overlaps could result in damage to equipment, safety risks, operational disruption, and potential loss of stock, but also potentially increase liability risks for operators.

Data: Marine traffic data was obtained from Automatic Identification System (AIS) track line data provided by the Department of Fisheries and Oceans (DFO) for the years 2019 to 2021³². The AIS system consists of very high frequency (VHF) transponder units that automatically collect data on the location and characteristics of vessels and was initially developed to support maritime safety and promote ship collision avoidance. Under the *Navigation Safety Regulations (2020)*, vessels requiring AIS include those over 20 meters (excluding pleasure crafts), with a capacity of greater than 50 passengers, transporting dangerous goods or pollutants, posing a collision hazard (i.e., dredges), engaged in non-sheltered voyages, or towboats over 8 meters. AIS data can thus be used to identify routes used by commercial vessels and estimate patterns in navigation traffic.

To identify navigation routes that represent areas used most frequently by vessels to safely traverse waterways, the density of track lines was calculated across the AOA. A modified landform analysis tool within GIS was used to generate a layer showing relative density of traffic within the AOA³³, which was classified into “on-channel”, “near-channel”, and “off-channel” areas. Furthermore, the bounds of the on-channel traffic lanes entering and exiting ports³⁴ were mapped manually for eleven ports³⁵ to identify “important vessel routes” that represent high density traffic to major ports (**Figure 4**).

³² For privacy and confidentiality purposes, all identifying information was removed from data. As such, we are unable to separate vessels by type or size.

³³ This analysis tool used local relative density of vessel traffic to identify whether the area is more or less dense relative to its surroundings, allowing to identify ‘peaks’ and ‘valleys’ in density.

³⁴ Identified as where the central lane of traffic dissipates, splits into multiple routes, or becomes a traffic separation zone.

³⁵ Ports included: Halifax, Strait of Canso, Sydney, Yarmouth, Shelburne, Bridgewater, Louisbourg, Pictou, Digby, Lunenburg, and Pugwash.

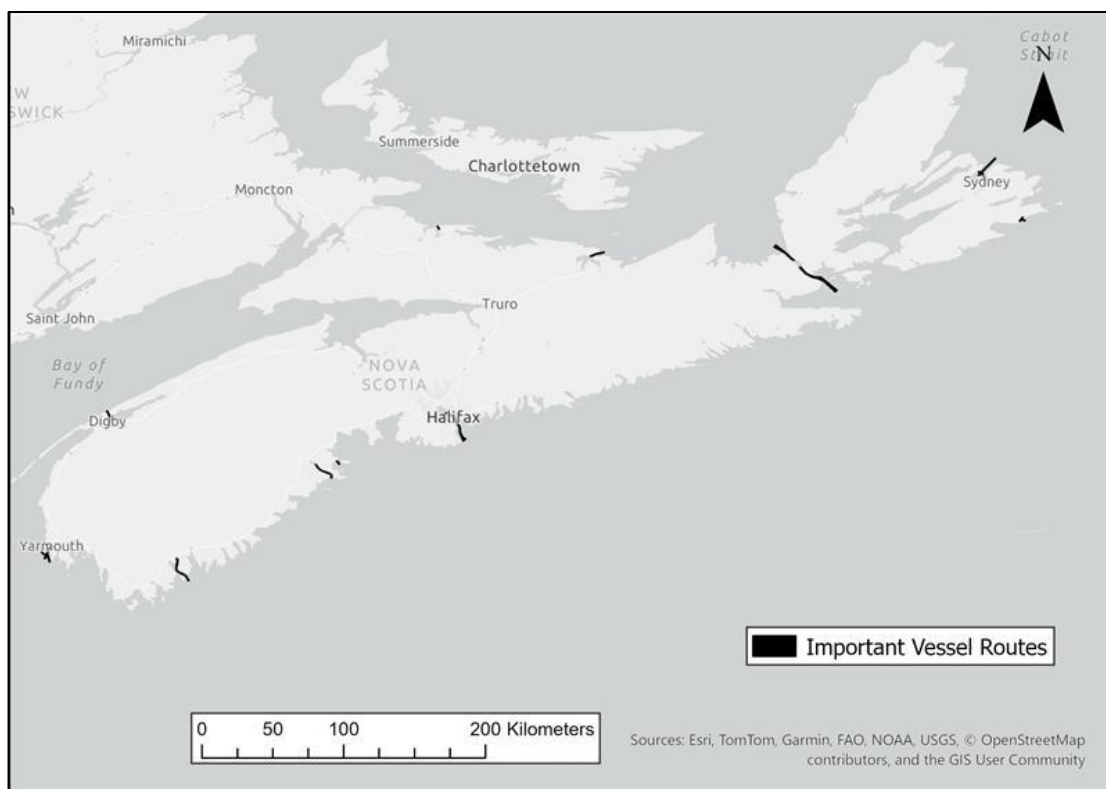


Figure 4. Important vessel routes identified around eleven major ports in Nova Scotia.

Limitations exist when using AIS vessel data. Certain vessels are not required by regulations to carry AIS transponders (e.g., small recreational vessels, some fishing vessels). As a result, not all vessel traffic is represented within the dataset. However, AIS is carried by some boats used in existing aquaculture, and so marine traffic channels may also identify traffic around existing sites. Furthermore, this dataset represents only a 3-year period, based on data available at the time of the assessment. General patterns were cross-validated by comparing to longer time-series AIS information and are considered generally representative of channels. However, usage paths may change over time, and new transponders may be added, and so some vessel channels may not be represented in the data.

Scoring: Scoring was based on the intensity of navigation activity occurring in the area. Vessel traffic data from AIS is commonly used to identify and minimize potential navigation-related spatial overlaps among ocean industries/user groups (i.e., commercial shipping, fishing, recreation, etc.) and marine aquaculture, ensuring that vessel-related factors are properly incorporated into spatial analyses (Metcalf et al., 2018; Tlusty et al., 2018; Jossart et al., 2020). This practice is particularly relevant for assessing aquaculture potential in Nova Scotia, where the public’s right to navigable waters is protected under the [Canadian Navigable Waters Act \(CNWA\)](#) and is a key consideration in siting decisions under Nova Scotia’s [Aquaculture License and Lease Regulations](#). If aquaculture is proposed in navigable waters, operators must comply with the CNWA and apply for approval from Transport Canada to ensure that navigation rights are upheld, and safety concerns are adequately addressed.

Since the implications and requirements for operating in these areas are similar across all types of aquaculture, they can be scored uniformly for all species.

Scoring			
Type	“Limited”	“Moderate”	“Good”
Salmon	Important vessel routes – limiting condition ; On-channel	Near-channel	Off-channel
Trout	Important vessel routes – limiting condition ; On-channel	Near-channel	Off-channel
Mussels	Important vessel routes – limiting condition ; On-channel	Near-channel	Off-channel
Oysters	Important vessel routes – limiting condition ; On-channel	Near-channel	Off-channel

Important vessel routes were considered a limiting condition for aquaculture. If present, the area would be automatically **“limited”** in final suitability maps, as these routes represent major high-traffic ports in Nova Scotia with significant marine traffic density. **On-channel areas** represent main transportation and navigation corridors where data shows that navigation is most densely concentrated. In these areas, commercial vessel traffic can be expected and is likely a regular occurrence. Aquaculture within on-channel areas would have significantly increased risk of maritime accidents and associated safety, operational damage, containment management risks, or hinder other users’ right to navigable waters, and thus represent **“limited”** potential for aquaculture development.

Near-channel areas represent waters positioned near densely navigated channels. These areas experience a fair amount of marine traffic and may act as thoroughfares to main navigation channels. As these areas reflect key areas for navigation and would likely meet conditions for being defined as ‘navigable waters’, near-channel areas reflect **“moderate”** potential for aquaculture as producers would still need to consider how operations influence navigational safety and overlaps with navigational users.

Off-channel areas represent waters that are not densely navigated and are thus scored as **“good”** for aquaculture development. With fewer navigation concerns, these areas offer a safer environment for aquaculture operations, reducing the potential for accidents or conflicts with other users’ rights to navigable waters.

Vessel Monitoring System (VMS) fishing vessel density patterns

Importance: Aquaculture siting should consider the space necessary to accommodate navigation in high-use areas for fishing vessels. The development of aquaculture sites can limit access to potentially valuable fishing areas and/or displace existing fishing activities (Wiber et al., 2012). Additionally, aquaculture gear, such as anchorage chains, mussel rafts, and floating/sinking oyster cages, can create navigational hazards (European MSP Platform; Westoby, 2023). These navigational hazards can result in increased maritime accidents potentially damaging aquaculture infrastructure and/or fishing vessels. Other gear conflicts include potential damage to fishing gear from aquaculture vessels (Wiber et al., 2012).

Data: Fishing vessel traffic data was obtained from Vessel Monitoring System (VMS) records provided by the Department of Fisheries and Oceans (DFO) for the years 2019 to 2021³⁶. VMS is a satellite-based vessel tracking monitoring system that captures the location of commercial fishing vessels at regular (often every hour) intervals. These systems are required by DFO for most fishing vessels in Nova Scotia. The density of VMS points within a 250-meter grid cell was calculated to identify areas where fishing vessels frequently travel. Data were then reclassified based on quartile distribution into meaningful density classes, representing relative levels of fishing vessel traffic into “high” (>3 observations), “medium” (1-3 observations), and “low” (0 observations) traffic classes.

It is important to note that while VMS data captures many, but not all fishing vessels. For example, the inshore lobster fishery is not required to carry VMS. For a description of which commercial fishing vessels require VMS, see Iacarella et al. (2020). The dataset also represents only a three-year period up to 2021, based on data available at the time of the assessment. Vessel traffic patterns may change and some present-day traffic data may not be captured in this layer.

Scoring: Scoring was based on the intensity of fishing activity/traffic occurring in the area. Vessel traffic information identified from VMS data is often used to characterize and minimize navigation-related spatial overlaps of ocean uses (Tlusty et al., 2018; Jossart et al., 2020). Quantifying vessel traffic from VMS data ensures vessel-related factors are properly incorporated into spatial analyses (Metcalf et al., 2018; Tlusty et al., 2018; Jossart et al., 2020). This practice is particularly relevant for assessing aquaculture potential in Nova Scotia, where the right to navigable waters is protected under the *Canadian Navigable Waters Act* and is a key consideration in siting decisions under Nova Scotia’s *Aquaculture License and Lease Regulations*. If aquaculture is proposed in navigable waters, operators must comply with the CNWA and apply for approval from Transport Canada to ensure that navigation rights are upheld and that safety concerns are adequately addressed. It is important to note that while VMS data included in this assessment can identify areas used by fishing vessels, it is used only to indicate potential marine space use

³⁶ For privacy and confidentiality purposes, all identifying information was removed from data. As such, we are unable to calculate track lines that show the specific paths of individual vessels.

overlaps and is not used to assess potential interactions on commercially fished species or effects on fishing catches.

Scoring			
Type	“Limited”	“Moderate”	“Good”
Salmon	High traffic	Medium traffic	Low traffic
Trout	High traffic	Medium traffic	Low traffic
Mussels	High traffic	Medium traffic	Low traffic
Oysters	High traffic	Medium traffic	Low traffic

High traffic density areas, which represent key areas where fishing vessel traffic congregates, are scored as having “**limited**” suitability for aquaculture due to increased potential for spatial and navigational overlaps. The presence of aquaculture in these areas can limit access to important fishing grounds, disrupt fishing operations, or create hazards for both activities.

In **medium traffic areas**, fishing vessels are present in relatively low densities. As VMS systems capture positional data at semi-regular intervals (often once every hour), medium traffic areas may represent waters where vessels are navigating to or from or transiting between fishing spots. While these do not represent the most highly used areas, there is still some potential for spatial overlap with aquaculture activities that producers should consider, making medium traffic areas “**moderate**” for aquaculture development.

Low traffic areas represent waters with no observed vessel traffic density across the dataset. These areas can thus be considered rarely trafficked. These areas likely present minimal safety concerns, navigational overlaps or spatial conflicts with fishing vessels, and can be considered “**good**” for aquaculture development.

Since the implications of fishing traffic on aquaculture siting are similar across all types of aquaculture, they can be scored uniformly for all species.

Public coastal accessibility

Importance: Aquaculture introduces structures in the marine environment and on adjacent lands that can potentially impact the public’s access to important marine waters, potentially displacing existing recreational and tourism users (Shafer et al., 2010). Therefore, considering key areas that provide coastal access to the public, for recreation, tourism, or other activities can provide an indicator of potential overlap with other users, and is thus an important criterion for the overall suitability of aquaculture (Perez et al., 2003).

Data: Coastal access data was obtained from multiple sources to identify areas that provide public access to marine waters. Coastal access points included were:

- Coastal beaches – [Ecological Land Classification](#) and protected beaches³⁷ provided by Nova Scotia Department of Natural Resources (NSDNR)
- [Small craft harbours \(Fisheries and Oceans Canada\)](#)
- Public boat launch sites – provided by the Nova Scotia Department of Fisheries and Aquaculture
- Marinas and yacht clubs – point locations digitized from Google Maps

The distance (m)³⁸ to the nearest public coastal access point was calculated across the AOA.

It is important to note that the data included in this layer represents locations where the public may have the opportunity to access the coast, based on reliable datasets available around the province. The areas represented do not consider the differences in social/cultural value of specific locations, the specific user groups utilizing areas, how many people or how often people use the access sites, or other site-level considerations. These factors are important but must be explored at a bay or site-level assessment. Site-level assessment may also identify additional access points based on local knowledge that were not able to be captured here.

Scoring: Potential impacts from aquaculture on coastal accessibility refers to potential interactions and overlaps that may impact the ease of access for public users in the marine coastal environment. Consideration of other users of the public waters and the public right of navigation are both acknowledged as required considerations in decisions related to marine aquaculture sites under Nova Scotia’s [Aquaculture License and Lease Regulations](#). Nova Scotia’s leasing regulations do not include specific requirements regarding the proximity of aquaculture operations to coastal access points.

Scoring			
Type	“Limited”	“Moderate”	“Good”
Salmon	< 100 m – limiting condition	N/A	N/A
Trout	< 100 m – limiting condition	N/A	N/A
Mussels	< 100 m – limiting condition	N/A	N/A
Oysters	< 100 m – limiting condition	N/A	N/A

Coastal access sites provide the public with access to use of marine waters for activities such as kayaking, canoeing, paddleboarding, and swimming. While public users may occasionally travel considerable distances from access points, they typically remain close to the shoreline for safety reasons and easy access to land (Paddle Canada, 2013). Even when traveling beyond coastal access points, these areas represent key junctures that boaters and recreational users must transit. As such, it has been assumed that potential impacts to access and spatial overlap with users are highest in closer proximity to access points (Ross et al., 2020).

³⁷ The data available intended only to provide an approximate digital representation of the extent of named protected beaches designated pursuant to the *Beaches Regulations*.

³⁸ Using Distance Accumulation tool, which calculates ‘as the fish swims’ distances.

Since public users generally tend to remain close to the shoreline, **within 100 meters of access points** was considered a limiting condition; these areas were automatically rated as **“limited”** in final suitability maps. This is due to the high potential for spatial overlap with public users. Within this proximity, aquaculture infrastructure and vessels are very close to areas where the public access and use marine spaces, posing the greatest risk of navigational and safety hazards to public users, and potentially reducing or limiting safe access to coastal access points. Since the implications of public access points on aquaculture siting are similar across all types of aquaculture, they can be scored uniformly for all species.

RESTRICTIONS

All restrictions were scored similarly across all types of aquaculture and represent areas that would be **“restricted”** in final suitability maps. For some restrictions, limiting conditions are also identified, and described below.

Anchorage areas

Importance: Anchoring is a critical and legally protected (under *The Common Law Right of Navigation*) activity for commercial, recreational, and governmental vessels (Transport Canada, 2020). Specified anchorage areas have restricted access and are not suitable for co-location with aquaculture due to potential spatial conflicts with anchored vessels.

Data: Anchorage areas and single ship anchorages were retrieved from data files on the Open Government Data Portal ([Canadian Anchorages and Anchorage Areas](#)). Anchorage areas are designated zones on navigational charts where vessels can anchor and includes anchorage areas and single-ship anchorages. These files are a comprehensive dataset of anchorages and anchorage areas in Canadian navigable waters. The data is represented by both polygon features of anchorage areas, and point data that represents locations of anchorage points. Since point data does not have spatially defined boundaries, the accommodating 1 cell (100m² area) was considered as the boundary of the anchorage point.

Scoring: These features represent areas already designated for other uses (i.e., anchoring of commercial and/or public vessels), and thus represent a restriction. However, mapped point data is potentially inaccurate to real-world spatial extent of features. **Areas within 200 m of anchorage points** were automatically **‘limited’** in final suitability maps. This distance provides sufficient space for the movement or drift of vessels around anchorages and accommodates vessels approaching and leaving anchorage areas.

Designated navigational features

Importance: In Nova Scotia, the public's right to navigable waters is protected under the *Canadian Navigable Waters Act* and is a key consideration in siting decisions under Nova Scotia's *Aquaculture License and Lease Regulations*. Designated navigational features represent defined, delineated features that represent key navigational safety uses, and include traffic separation zones, recommended routes, sight lines between navigational aids, and ferry routes.

Data: Designated navigational features were identified from [Vessel traffic routes - CHS/DFO datasets](#) available on the Open Government Data Portal. Established and mapped designated navigational features by the Canadian Hydrographic Service included: i) traffic separation zones, ii) recommended traffic routes³⁹, and iii) ferry routes. For features represented as lines, the surrounding 100m² 'cell' was used to define the feature.

Scoring: It is important to avoid potential overlaps with existing areas designated for navigation. These features represent areas already designated for other uses (i.e., navigational safety) and therefore represent a restriction for aquaculture development. **Areas within 200 m of ferry routes and recommended routes**⁴⁰ were considered limiting conditions and were rated as "limited" in final suitability maps, as navigational hazards are possible within proximity to these areas and due to potential inaccuracy in the mapped geometries of line data.

Marine Renewable Energy Areas

Importance: Several areas in Nova Scotia are allocated as Marine Renewable Energy Areas (MREA) for exploration of energy production. As per the *Marine Renewable-energy Act*, MREAs can not be designated in areas permitted/leased for aquaculture. Consequently, new aquaculture developments are would not be permitted in existing MREAs, reflecting these areas as constraints.

Data: MREAs are large areas designated by the provincial government to allow companies to explore and establish marine renewable energy production. Currently, four areas have been designated in Nova Scotia; FORCE Marine Renewable-electricity Area, Digby Gut Marine Renewable-electricity Area, Grand Passage Marine Renewable-electricity Area, and Petit Passage Marine Renewable-electricity Area. Boundaries of existing MREAs were provided as digital maps by the Nova Scotia Department of Energy⁴¹. This does not include Offshore Wind Areas which are beyond the area of assessment. Digitized map images were brought into GIS. No additional processing was required.

³⁹ Which identify tracks recommended for certain or all vessels.

⁴⁰ Traffic Separation Zones are delineated by polygons, and considered to be spatially representative of the area restricted, with buffers already incorporated into the area.

⁴¹ These areas do not include the larger Areas of Marine Renewable Energy Priority (AMREP) which do not have similar regulatory restrictions.

Scoring: MREAs represent areas are considered legislatively restrictive and therefore represent a restriction for aquaculture development.

Submerged cables and pipelines

Relevance: Aquaculture development should avoid areas where underwater cables and pipelines are present to prevent damage, avoid conflict with maintenance activities, minimize potential safety hazards to operators⁴², and to avoid potentially significant disturbances that may arise from damage to the cables or pipelines. As submerged cables and pipelines would pose a direct overlap with aquaculture mooring and anchoring infrastructure, aquaculture would be restricted around or overtop these features.

Data: The location of known active telecom and power cables were provided by the Department of Fisheries and Oceans (DFO). Spatial files for cables making landfall in Nova Scotia were extracted from data files provided. As these files are represented as line data, the surrounding 100m² 'cell' was used to define the restriction.

This dataset does not represent a complete list of potential submerged cables and pipelines. Additional cables are identified on DFO's [Electronic Navigational Chart \(ENC\) Maritime Chart Service](#). However, these cables can not be included in this layer, as there is no data available on which are currently active, or which have been decommissioned or removed. Further consideration for these features should be evaluated during a site level assessment.

Scoring: These features represent areas posing direct spatial overlaps with submerged cables and pipelines and therefore represent a restriction for aquaculture development. In addition, **areas within 500 m** from cables were identified as a limiting condition and rated as **"limited"** in final suitability maps. The [Canadian Hydrographic Service](#) advises mariners and fishing gear to maintain 1/4 nautical mile from surface buoys marking cables. This distance also ensures adequate space for necessary vessel access for maintenance and repairs, and accounts for potential inaccuracies in line data.

At-sea disposal

Relevance: Areas demarcated for "at-sea disposal" are areas legally permitted for dumping of dredged and other approved materials (i.e., fish processing waste, ships or platforms, inert inorganic geological matter, uncontaminated organic matter of natural origin, and bulky substances primarily composed of iron, steel, concrete or other similar) (Environment and Climate Change Canada, 2017). Developing aquaculture in these zones could interfere with disposal of materials, as well as the monitoring and management of the disposed materials.

Data: Data on active at-sea disposal sites were retrieved from [Active and Inactive Disposal at Sea Sites in Canadian Waters](#). At-sea disposal sites are designated areas for the disposal of various

⁴² Cutting of high voltage submarine cables poses serious risk of loss of life or severe burns.

substances in the ocean, such as dredging material. These areas have been determined to be the most environmentally preferable and practical alternative to disposal, and are regulated to prevent contamination, protect marine habitats, and avoid adverse effects on the marine ecosystem (Environment and Climate Change Canada, 2017; Environment and Climate Change Canada, 2020).

Scoring: These features represent areas already designated for other uses (i.e., disposal activities), and therefore represent a restriction for aquaculture development.

INFORMATIONAL CRITERIA

CFIA Disease Regulated Areas

Relevance:

The Canadian Food Inspection Agency (CFIA) monitors the presence and spread of reportable diseases. Reportable diseases, as outlined in the *Health of Animals Act* and the *Reportable Diseases Regulations* are diseases of significant importance to aquatic animal health and to the Canadian economy.

Since September 2, 2025, Multinuclear sphere unknown (MSX; *Haplosporidium nelsoni*) and perkinsosis (also known as Dermo) were reported as present or likely present throughout the province. Movement controls for MSX and Dermo in eastern Canada are in place through the aquatic animal [Domestic Movement Control Program \(DMCP\)](#).

Multinuclear sphere unknown (MSX; *Haplosporidium nelsoni*) is a parasitic disease that leads to high incidence of mortalities in oysters and has been a major issue for oyster growers and harvesters in the Bras d'Or Lake and has recently been identified in Prince Edward Island and elsewhere across Atlantic Canada. While MSX causes mortality in both juvenile⁴³ and adult oysters, cohorts over 2 years old are more affected, with mortality rates reaching 90 to 95 % (Andrews and Wood, 1967; Barber et al., 1997). Dermo is a parasitic oyster disease caused by the protistan *Perkinsus marinus* (Bidegain et al., 2017; Silvy et al., 2020). The disease can cause oyster mortality rates of 50-75% and has historically been responsible for mass mortalities along the Atlantic and Gulf coasts of the United States of America (Bidegain et al., 2017; CFIA, 2025).

Areas within declared infected zones may pose significant challenges for oyster aquaculture due to the high risk of mortality posed by MSX as well as the significant effort that would be required to achieve a commercial operation that adheres to mandated CFIA disease containment protocols (Ford and Haskin, 1982; Burreson et al., 2000). Operating within a CFIA-declared infected zone imposes significant restrictions on producers seeking to grow and harvest shellfish. Producers are

⁴³ Juvenile oysters can be heavily infected with MSX spores, as these spores are predominantly produced in smaller oysters due to their growth efficiency, however, the pathogenic effects may not manifest until later life stages (Ford et al., 1999).

prohibited from moving susceptible animals out of the infected area for depuration, relay, dry storage, wet storage, or commercial processing (Canadian Food Inspection Agency, 2022). Any such activity must be conducted within the infected zone or another area infected with the same disease. This requires producers to establish or utilize designated processing facilities within infected zones.

While CFIA-declared zones delineate areas where the disease is known to occur, they do not adequately capture spatial variability in the presence, prevalence, and exposure risk of declared diseases. This lack of detailed spatial data limits the ability to assess and address the varying levels of risk these diseases pose to aquatic animal health across the span of the declared zones. As a result, the current zoning framework may fail to identify localized hotspots of disease presence or areas that may present lower risk, leading to significant knowledge gaps regarding exposure risk. As such, exposure could not be consistently and reliably scored but should be included as important information for aquaculture development.

Data: CFIA's online map for *Multinucleate sphere unknown (MSX) and Perkinsus marinus (Dermo) Regulated Areas* was brought into the online mapping tool as a REST layer⁴⁴. It includes both Declared Infected Zones and Primary Control Zones for MSX and Dermo.

Shellfish Harvest Classifications

Relevance: In Nova Scotia, shellfish aquaculture water quality is regulated under the Canadian Shellfish Sanitation Program (CSSP). Under the CSSP shellfish harvest areas are classified as to their suitability for harvesting shellfish, according to water quality standards and sanitary conditions (CFIA, 2019). These harvest area classifications have significant implications for producers, potentially affecting their ability to harvest, and imposing requirements for mitigation measures, such as relay or depuration (CFIA, 2020). Shellfish intended for human consumption cannot be harvested from prohibited, nor from areas that have not been classified by CFIA. As there is potential variability and uncertainty in the water quality of unclassified areas, it is unclear how to appropriately score these areas, meaning shellfish classification areas are more appropriately included as an informational layer.

Data: The Canadian Shellfish Sanitation Program's (CSSP) [Shellfish Harvesting map](#) (DFO) was brought into the mapping tool as a REST layer. The map includes classification areas as approved or prohibited, as well as any prohibition or variation orders in place. Any area not identified on the map means the area has not been classified.

⁴⁴ Bringing the data into the CCS tool as a REST layer directly links the data to the original online source, such that as the original layer is updated, the data is automatically updated in the CCS tool.

Wild salmon rivers

Relevance: The sustainability of wild salmon is a required consideration in decision-making related to marine aquaculture siting under Nova Scotia's *Aquaculture Licence and Lease Regulations*. Through accidental escapes (from cage damage or inclement weather), farmed salmon can enter freshwater rivers, where they may compete with wild salmon for resources, or may interbreed and lead to genetic changes in natural populations (Bradbury et al., 2020a; Bradbury et al., 2020b). Escaped salmon pose the greatest risk in areas near rivers supporting wild populations, as their numbers and survival generally decrease with distance from aquaculture sites. The proximity of aquaculture sites to wild salmon rivers may also increase the risk of bilateral disease and parasite spread (i.e., transmission from wild to farmed; and farmed to wild) (Johansen et al., 2011; Gardner et al., 2014; Mordecai et al., 2021). Although proximity to wild salmon populations is not a definitive measure of potential impacts, it is a key indicator of increased risk, making consideration of the distance between aquaculture operations and wild salmon rivers an important consideration for the conservation of wild salmon. However, provincial regulations in Nova Scotia do not prescribe recommended distances from salmon rivers, and existing guidance from other regions⁴⁵ and scientific literature⁴⁶ is highly variable (Porter, 2003; Porter, 2006). As such, proximity to wild salmon rivers could not be consistently and reliably scored. Furthermore, many rivers could not be evaluated for significance due to lack of data available, leading to gaps in data coverage across the AOA. Still, understanding the significance of rivers in Nova Scotia for wild Atlantic salmon can provide important information for understanding the potential risks of aquaculture development.

Data: To explore potential implications for aquaculture and wild salmon interactions, CMAR assessed wild salmon rivers across Nova Scotia to understand the significance of rivers based on multiple criteria relevant to the viability, importance, and status of rivers. Data on the significance of wild Atlantic salmon rivers in Nova Scotia was compiled by CMAR for this assessment through a combination of desktop research⁴⁷ and field data collection (Weitzman et al., 2025). In this context, significance refers to the role of the river in supporting the long-term viability of salmon populations and the broader sustainability goals associated with their conservation and management. The assessment aggregated numerous indicators across five significance criteria, including measures of river habitat, abundance, barriers, importance, and threats. The final significance ratings of 287 rivers across Nova Scotia range from low to high, with some remaining unclassified due to insufficient data.

⁴⁵ For example, previous guidance in British Columbia stated aquaculture should be sited at least 1 km from the mouth of a salmonid bearing stream determined as significant in consultation with DFO and the province. However, this recommendation is largely out of date, and in review was considered to be inadequate and lack scientific backing (Porter, 2006).

⁴⁶ Within scientific literature the extent of aquaculture impacts on wild salmon is largely debated (Ford and Myers, 2008).

⁴⁷ Compiling existing publicly available published datasets.

Coastal wetlands

Relevance: Wetlands play an important role in coastal ecosystems by providing habitat for wildlife, improving water quality, and protecting shorelines from erosion, and deliver other valuable ecosystem services (Li et al., 2018). Many coastal wetlands around Nova Scotia are protected provincially ([Nova Scotia Wetland Conservation Policy](#)) or federally ([The Federal Policy on Wetland Conservation](#)). Human activities such as fisheries and aquaculture should be located to minimize the potential for interaction with sensitive coastal wetland habitats. However, current guidance on appropriate buffers or setbacks applies only to terrestrial developments. There are no specific buffers established for fisheries, aquaculture or other marine sectors. The potential for interaction is considered highly variable as it depends on the wetland ecosystem type, location and the proposed activities. Consequently, there is no overarching guidance, and licence applications are considered on a case-by-case basis by NSDFA and network partners. As a result, wetlands can not be reliably scored but are included as important information for aquaculture development.

Data: Coastal wetlands were identified through the [Canadian National Wetlands Inventory \(CNWI\)](#). CNWI is a publicly available national geodatabase consisting of the best available wetland maps. The database was developed by the Canadian Wildlife Services (CWS), in collaboration with various government levels (i.e., federal, provincial, territorial), academia, Indigenous groups, and non-governmental organizations (NGOs). Only wetlands within 100m of the coast were extracted.

Terrestrial protected areas and parks

Relevance: Terrestrial protected areas and parks serve to protect wildlife, natural features, ecological processes (Province of Nova Scotia, 2019), and are important for land conservation and biodiversity goals (Province of Nova Scotia, 2013; Province of Nova Scotia, 2019). While legal protections and restrictions vary based on the designation (i.e., Provincial Nature Reserve versus National Parks), these areas are protected due to their natural heritage, scenery, and significant ecological value (Crowell, 2023; Province of Nova Scotia, 2023). As such, human activities such as aquaculture should be sited to minimize the potential for interaction with these areas. However, there is currently limited scientific knowledge on recommended buffer to reduce interaction potential with protected, coastal terrestrial ecosystems. The potential for interaction or impacts is highly variable and situation specific depending on ecosystem type⁴⁸, resident species and proposed adjacent activity, such as aquaculture. As a result, this criterion could not be consistently and reliably scored but warrants inclusion as important information for aquaculture development.

Data: Multiple layers showing protected areas and parks within the terrestrial environment were combined from:

⁴⁸ For example, a low energy area may be more susceptible to the dispersal of nutrients and smothering as compared with a protected area with a predominantly high-energy rocky coastline.

- Nova Scotia Environment and Climate Change's [The Nova Scotia Protected Areas System](#) (REST link) which includes National Parks, National Wildlife Areas, Provincial Wilderness Areas, Provincial Nature Reserves, selected Provincial Parks, land trust properties, and easements.
- Protected beaches provided by NSDNR
- Wildlife Management Areas, provided by NSDNR

These lands help preserve Nova Scotia's natural values through a blend of legislation, ownership, and management.

Important bird habitat

Relevance: Marine activities (such as fishing, aquaculture, oil and gas) can introduce disturbances to nearby bird populations through exclusion from critical habitats, alter prey availability, ingestion of foreign objects, the threat of entanglement or collision with infrastructure and netting (Sagar, 2013; Bath et al., 2023) and potential disturbances to breeding (Connor-McClean, 2020). These risks are largely mitigated through effective management⁴⁹ and by situating farms away from seabird colonies and key foraging areas, especially those identified as critical or sensitive (Surman and Dunlop, 2015; Connor-McClean, 2020; Bath et al., 2023). Consequently, it is important that aquaculture site decisions consider the potential for interaction with birds and their habitats. As per [ECCC Guidelines to avoid harm to migratory birds](#), buffers and set-back distances are evaluated on a case-by-case basis. Recommended on-water setbacks described within the scientific literature are inconstant due to the variable nature of different species, habitat types (nesting, migrating, foraging), and proposed activities. As a result, this criterion could not be consistently and reliably scored but is important information to include for aquaculture development.

Data: Important bird habitats are areas that are crucial for bird nesting, feeding, and migration. These areas have been recognized locally, nationally, or internationally to represent important areas that support coastal birds⁵⁰. Bird habitat datasets were extracted and combined into a single layer. Important bird habitats are identified from various sources, including: the Nova Scotia [Significant Species and Habitat Database](#) by The Department of Natural Resources and Renewables, [Important Bird Areas \(IBA\)](#) Program coordinated by BirdLife International, Critical Habitat for Species at Risk (ECCC), and Migratory Bird Sanctuaries. Only habitat areas within 100m of the coast were extracted.

⁴⁹ Such as wildlife interaction protocols in the mandatory Farm Management Plan.

⁵⁰ While recognized as key areas for birds, the designated areas included are not legislatively protected through regulations. However, this information may be used by network partners when evaluating a site application to assess potential impacts on protected bird species.

Existing aquaculture leases

Relevance: New aquaculture developments cannot be sited in areas already leased to other shellfish or finfish aquaculture operators due to interference with infrastructure and designation of lease areas. However, the suitability of areas with existing aquaculture would vary significantly based on whether the proponent wants to expand their existing lease area, or if an additional party is looking to develop a separate site. Furthermore, new sites should consider proximity to existing sites for disease management and to account for overall carrying capacity of the surrounding environment. Currently, policies in Nova Scotia have not prescribed specific buffers or recommended setbacks between sites, and proximity should be considered best at a site level to consider broader application-specifics like stocking densities, disease management, and carrying capacity of a given waterbody.

Data: The Nova Scotia Government's [Aquaculture and Rockweed Map Viewer](#) was brought into the tool as a REST link. The map viewer shows the locations of current and proposed aquaculture leases, as well as rockweed licenses across the province.

Water lots

Relevance: Water lots are specific parcels of land located on a lake or the coast that are either entirely or partially submerged underwater (Traves, 2023). These lots are distinct in that their ownership titles can be individually conveyed, similar to land-based properties. Essentially, water lots represent sections of the seabed that are treated as property. Ownership of these lots is not limited to private individuals; water lots in the province are also held by a variety of entities, including different government departments and corporations. Water lots may include boundaries delimiting small craft harbours, commercial ports/activities, and privately owned sections of water. As these lots are already owned or leased to specific entities for particular activities or uses, the suitability of areas within water lots would vary significantly based on whether the aquaculture operator owns the lot or if the lot owner is willing to sell or lease it to the aquaculture operator. As a result, water lots could not be consistently and reliably scored but should be included as important information for aquaculture development.

Data: Locations of privately-owned and federally owned (Crown) parcels were identified from Parcel Identification (PID) data provided by [GEONova](#). Only lots within the marine environment were extracted. Due to data limitations and confidentiality, ownership details are not included. For more information on the ownership details of any individual lot, visit [Property Online](#).

Crown leases and easements

Relevance: Submerged land along the coast of Nova Scotia is owned by the province as provincial Crown Land, unless it has already been sold by way of a provincial or federal grant, or it is a federal public harbour. Submerged land can be leased by the Nova Scotia Department of Natural Resources for commercial purposes such as a wharf, marina, tidal power generation, or utility

cable landing site. Furthermore, the province may issue easements for submerged utility cables or bridges and utility services to private properties. Within existing Crown leases, easements, and coastal permits aquaculture development may not be permitted, although the restrictions would vary depending on the proposed operation and the type of lease, easement or permit.

Data: Datasets regarding issued Crown leases and easements were obtained through the Nova Scotia Department of Natural Resources (NSDNR)'s [Crown Land - Open Government Portal](#). Only crown land parcels at the coastline or within 100 m land-wards of the coastline are displayed.

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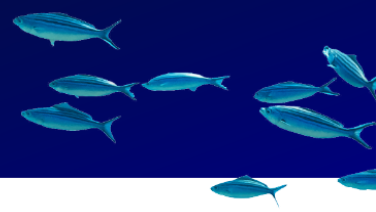
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Appendix IV – Accessibility Audit Report



Aquaculture Suitability Mapping Tool: Accessibility Report

Prepared for the Centre for Marine Applied Research

by

Pisces Research Project Management

July 7, 2025

Executive Summary

Contracted by the Government of Nova Scotia, the Centre for Marine Applied Research (CMAR) has developed an online mapping tool to screen coastal aquaculture site suitability as a means to increase science-based aquaculture capacity, and aid informed decision-making and planning for sustainable finfish and shellfish aquaculture development. Throughout their development, the set of aquaculture Coastal Classification System (CCS) mapping tools, including a StoryMap, have undergone an initial accessibility audit, end-user testing by targeted users in various ocean sectors, and a final accessibility audit to ensure compliance with accessibility standards. This report presents the accessibility features included within the final mapping tools, along with details on the approach used to ensure the final developed product is accessible and inclusive to the widest range of users possible, and across various devices. It specifically addresses key accessibility factors, including colour and contrast, typography and text clarity, the visibility of plain text, the accessibility of images and multimedia (such as alternative text and video descriptions), navigation and interaction for users with visual impairments, responsiveness across various devices and screen sizes, as well as the overall consistency and predictability of the tools. These features ensure that people across Nova Scotia, regardless of age, ability, or device, can access information about coastal aquaculture in a way that is clear, consistent, and empowering. Overall, the final accessibility audit confirmed that the tools, in their current state, are accessible to the majority of users across various devices.

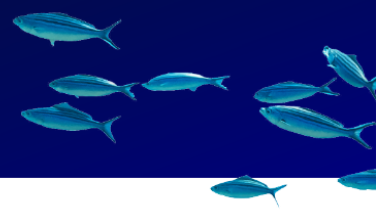
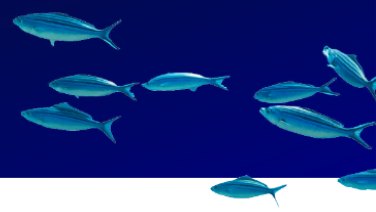


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Emphasizing Accessibility

From the outset, accessibility was considered a core value in the development of the Aquaculture Coastal Classification System Mapping Tool. CMAR recognized that for this tool to be well used and impactful, it needed to work for everyone, across ages, abilities, and devices. The mapping tool supports decisions that affect coastal communities and marine development across Nova Scotia, so ensuring equitable access was not an afterthought, it was a guiding design principle.

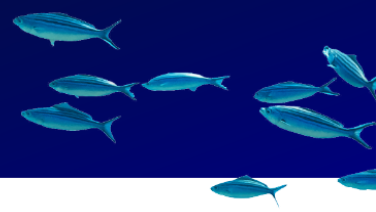
As part of the development of the mapping tools, including the StoryMap, it was determined that an expert evaluation of visual design elements, language, and minimum compliance with accessibility standards needed to be completed at two stages throughout the lifespan of the project; first after the initial draft of the tools were completed, and second following end-user testing of the draft tools to ensure target audience needs were met, that the tools were easy to use, and were responsive across various devices and screens. In addition, the tools were evaluated to ensure accessibility to all users, including those with age-related vision decline, varying degrees of colour-blindness, along with other visual impairments or neurological conditions. As such, accessibility audits were completed by project subcontractor, Pisces, at both stages based on the criteria from the [W3 Web Content Accessibility Guidelines \(WCAG\) 2.1](#)¹, therefore supporting CMAR in their development of the mapping tools.

The WCAG requires a minimum contrast ratio of 4.5:1 for normal text and 3:1 for large text. Any deviation may impact users over the age of 40 due to natural age-related contrast sensitivity decline, according to [peer-reviewed and published research on the progression of contrast sensitivity](#)². As such, in Nova Scotia, there could be as many as 548,735 individuals impacted by natural age-related contrast sensitivity decline, based on the total population size of those individuals aged 40+ living in the province (according to [Statistics Canada](#)³). This represents over

¹ *Web Content Accessibility Guidelines (WCAG) 2.1*. W3C, 6 May 2025, <https://www.w3.org/TR/WCAG21/>. Accessed 16 June 2025.

² Zhuang, Xiaohua, et al. "Aging Effects on Contrast Sensitivity in Visual Pathways: A Pilot Study on Flicker Adaptation." *PLoS One*, vol. 16, no. 12, 2021, article e0261927, doi:10.1371/journal.pone.0261927. PMC 8719693. Accessed 16 June 2025.

³ "Census Profile, 2021 Census of Population, Nova Scotia." *Statistics Canada*, Catalogue no. 98-316-X2021001, released November 15, 2023, <https://www12.statcan.gc.ca/census-recensement/2021/dp->



half the population, and therefore the WCAG minimum contrast ratio is a key criterion to apply to the mapping tools being developed, to be accessible to the widest range of potential users.

Furthermore, given approximately 1 in 12 men (8%) and 1 in 200 women experience red/green colour vision deficiency ([Colour Blindness Awareness n.d.](#)⁴), ensuring that accessibility is considered for those people experiencing protanopia and deuteranopia colour-blindness (i.e., red-green colour vision deficiency) also ensures that the mapping tools are accessible to the greatest number of people in a population. According to the [Government of Nova Scotia's Quarterly Population Estimate](#)⁵ the population of NS was 1,079,627 as of January 1st, 2025. According to the [World Population Review statistics](#)⁶ the gender distribution of NS is 51.2% female and 48.8% male. Considering the provincial population statistics and given the above statistics from Colour Blind Awareness, this would indicate that there are approximately 44,913 people in NS living with red-green colour deficiency.

Moreover, individuals with visual impairments or neurological conditions, such as dyslexia, may rely on the use of screen readers to help interpret information online. Screen readers can only function effectively when all website features are properly labeled, such as by using alternative text. This applies to the interactive map features of the CCS tool and the example images in the StoryMap.

Accessibility Audit Scope and Methodology

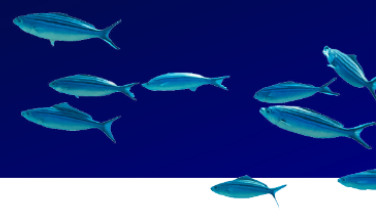
The draft aquaculture CCS mapping platform systems consist of two tools. The first is a StoryMap designed to help users understand the mapping platform, its use, the criteria that determine suitability for aquaculture development, a description of the different suitability ratings, and platform navigation tips. The second CCS tool is the classification tool (i.e, the mapping platform).

[pd/prof/details/page.cfm?Lang=E&SearchText=Nova%20Scotia&DGUIDlist=2021A000212&GENDERlist=1,2,3&STATISTIClist=1,4&HEADERlist=0](#). Accessed June 16, 2025

⁴ "Colour Blind Awareness." *Colour Blind Awareness*, www.colourblindawareness.org. Accessed 16 June 2025.

⁵ "Nova Scotia Quarterly Population Estimates as of January 1, 2025." *Economics and Statistics Division*, Government of Nova Scotia, 19 Mar. 2025, www.novascotia.ca/finance/statistics/archive_news.asp?id=20843. Accessed 16 June 2025.

⁶ "Nova Scotia Population 2024." *World Population Review*, <https://worldpopulationreview.com/canadian-provinces/nova-scotia>. Accessed 16 June 2025.

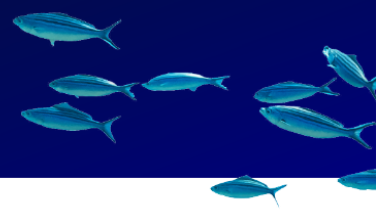


Both were created using ArcGIS.

The mapping tools were developed by CMAR in accordance with the standards outlined in the [W3C Web Content Accessibility Guidelines \(WCAG\) 2.1](#). Specifically, the set of criteria in Table 1 guided the accessibility measurements implemented into the CCS Tool and the StoryMap, ensuring the final tools meet accessibility standards.

Table 1. Criteria applied in the accessibility audit of the aquaculture Coastal Classification System (CCS) mapping tools following the W3C Web Content Accessibility Guidelines (WGAC) 2.1, and whether or not the criteria has been met based on the second audit.

Audit Category	Criteria	Meets Accessibility Standards?
Colour and Contrast	Ensure all colours are visible (for protanopia and deuteranopia colour blindness).	●
	Ensure contrast between colours so that text is legible.	●
	Ensure that colour alone is not being used to share information.	●
Typography and Fonts	Ensure that fonts are legible and follow best practices for font sizes.	●
	Ensure the text is resizable and can be zoomed in on.	●
	Ensure text descriptions are provided when necessary.	●
Images and Multimedia	Make sure that all images have alternative text that describes them effectively for screen readers.	●
Navigation and Multimedia	Ensure all elements of the maps can be interacted with via keyboard.	●
	Ensure proper heading tags so that the site and map can be navigated in the correct sequence.	●
	Accessible Rich Internet Applications (ARIA) as defined by the W3C (World Wide Web Consortium) – attributes that can be added to HTML elements to improve the accessibility of web content and applications, especially for users who rely on assistive technologies like screen readers.	●



User Experience Recommendations	Tools are intuitive, functional, and easy to navigate.	●
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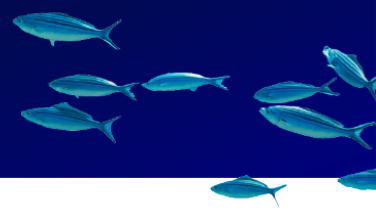
Accordingly, the accessibility audits conducted at both stages of the tools' development assessed their accessibility using the five key sections outlined above. This approach ensured that all critical aspects of user interaction, including visual design, content clarity, ease of navigation, multimedia accessibility, and responsiveness across devices, were carefully considered, resulting in final mapping tools that are usable and inclusive for the widest possible range of users, including those with visual impairments or neurological conditions.

The following details outline the approach used to ensure an overall commitment to an inclusive and accessible design of the mapping tools:

Step 1: Stage 1 accessibility audit completed by Pisces. Contracted by CMAR, Pisces completed an initial accessibility audit of the draft mapping tools produced by CMAR, focusing on the five criteria listed above, and based on the WCAG.

Step 2: Accessibility recommendations provided. Recommendations for improving the accessibility of the mapping tools were provided to CMAR based on the initial accessibility audit. At a high level, these included recommendations on the use of colour palettes with high contrast to ensure all text and elements of the tools were legible, along with being visible to those users with protanopia and deuteranopia colour-blindness. Consistent hover effect formatting was also recommended to ensure visually sensitive users do not become disoriented while using the tools. Additionally, adding alternative text to all images used within the tools was recommended for those users relying on screen readers, and changes in font sizing and formatting were suggested to ensure consistency across the tools and to align with the WCAG. Moreover, general recommendations to improve the overall clarity and flow of the StoryMap, and to allow for keyboard navigation within the classification tool were provided, again following WGAC Guidelines⁷.

⁷ *Web Content Accessibility Guidelines (WCAG) 2.1.* W3C, 6 May 2025, <https://www.w3.org/TR/WCAG21/>. Accessed 16 June 2025.



Step 3: Stage 1 revisions made. Revisions were made by CMAR to the draft mapping tools based on the recommendations provided by Pisces after the initial accessibility audit. These revisions included producing maps using four different colour palettes (Figure 1) and three different interface styles (Figure 2), to be used in Step 4 of the approach.

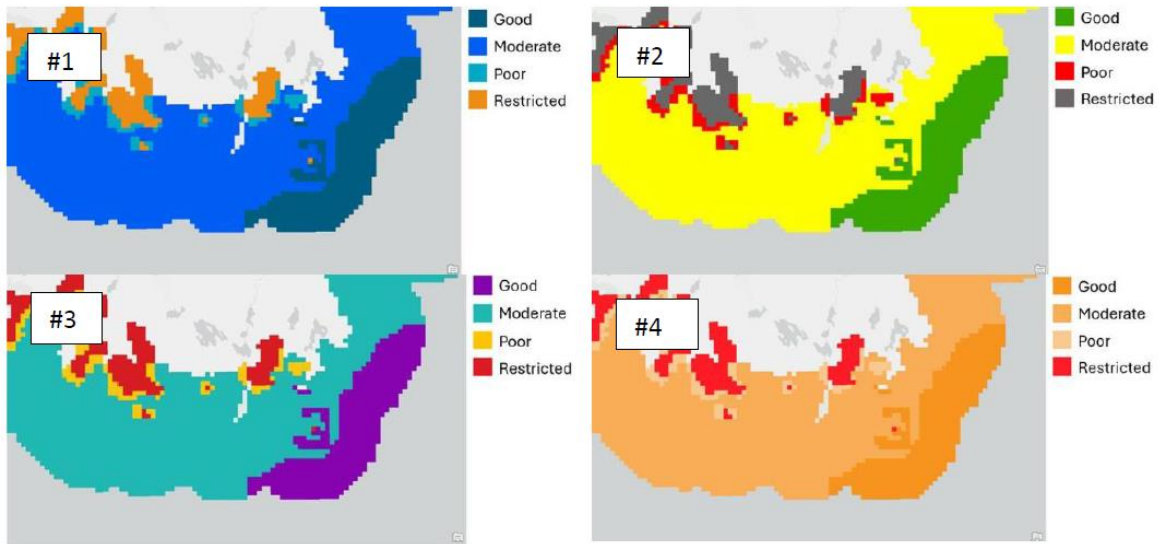


Figure 1. The four different colour-palette options assessed by participants as part of the draft aquaculture Coastal Classification System mapping platforms assessment survey.

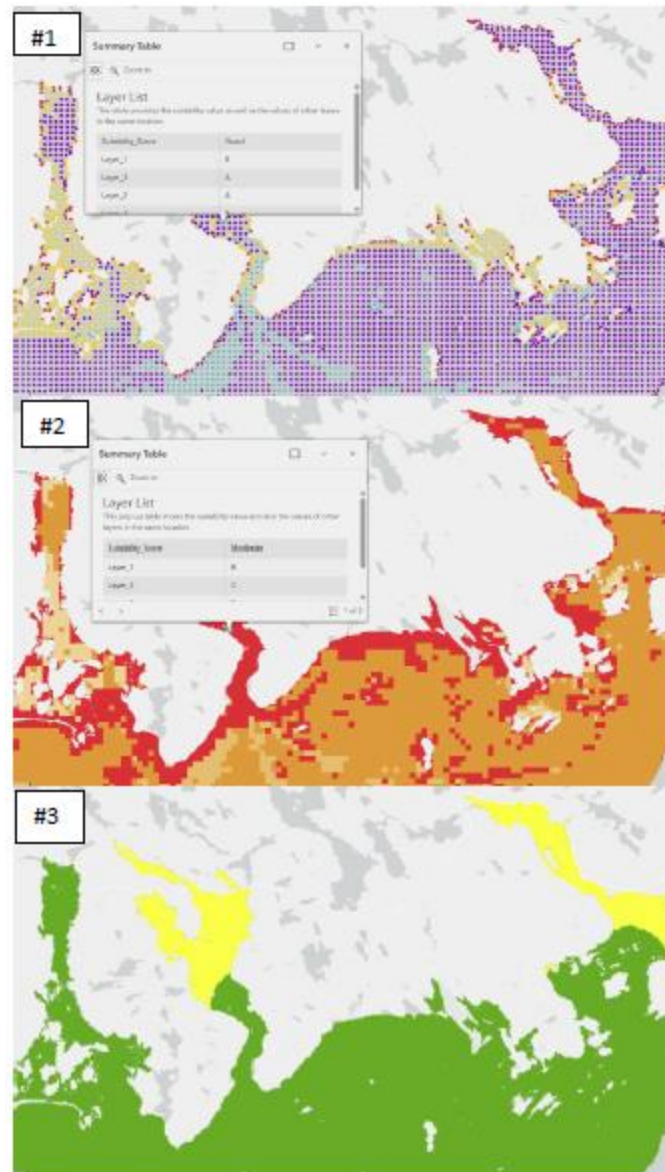
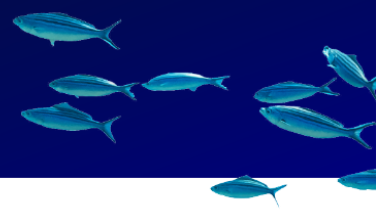
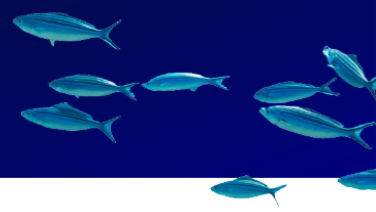


Figure 2. The three different visual interfaces assessed by participants as part of the draft aquaculture Coastal Classification System mapping platforms assessment survey.

Step 4: End-user testing review. To understand the useability of the draft mapping tools, an assessment survey was distributed by CMAR to individuals in varying ocean-related sectors, including industry, government, and research organizations. The aim of this survey was to gain insight into the intuitiveness of the mapping tools, determine the effectiveness



of the different visual elements, have users provide feedback and insights while navigating the mapping tools, and gauge overall user satisfaction. Survey responses were then used to inform refinements to the mapping tools prior to the second accessibility audit and their final implementation.

Step 5: Stage 2 accessibility audit completed by Pisces. A second accessibility audit was completed on the refined mapping tools following the end-user testing feedback, again focusing on the five criteria listed above, and based on the WCAG⁸.

Step 6: Stage 2 revisions made. Final revisions were made to the mapping tools ensuring their inclusive and accessible design. Accessibility features of the final version of the tools are described in the following section.

Accessibility Features of the Final Mapping Tools

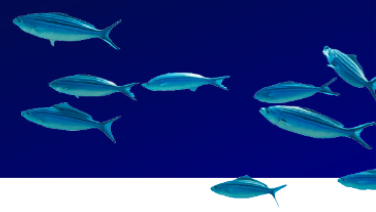
Colour and Contrast

- All colour and colour contrast criteria pass the WCAG.
- Colour palettes and contrast were tested using Adobe Accessibility Tools and found to pass.
- Colour palettes of the Classification Tool and StoryMap are all accessible for users with protanopia and deuteranopia colour-blindness and have appropriate contrast for those individuals with visual impairments.

Classification Tool

Two colour palettes were produced for the classification tool. One using a self-described “accessible colour palette” and the other using NS brand colours. Both colour palettes pass the accessibility test, as per the WCAG. For both colour palette scenarios being audited, colour alone was not used to share information. This is important to 1) ensure people with colour vision

⁸ *Web Content Accessibility Guidelines (WCAG) 2.1.* W3C, 6 May 2025, <https://www.w3.org/TR/WCAG21/>. Accessed 16 June 2025.



deficiencies do not misinterpret information portrayed; 2) ensure people with age-related contrast sensitivity loss and other visual impairments are able to find clarity in the data being presented through text, patterns and icons; and 3) ensure that screen readers and other assistive technologies can interpret the information correctly.

The screenshot shows the Adobe Color website interface. At the top, there are navigation tabs: "Color Wheel", "Extract Theme", "Extract Gradient", and "Accessibility Tools". The "Accessibility Tools" tab is active. Below the navigation, there are "Tools" and "Color Blind Safe" options. A central color wheel is displayed with four colored circles (yellow, red, blue, purple) indicating selected colors. A message states: "No conflicts found. Swatches are color blind safe." Below the wheel is a color palette with five swatches: purple (#8704B0), teal (#31B986), yellow (#FBC910), red (#DA3225), and grey (#A0A3A3). Each swatch has a corresponding RGB color bar and numerical values for Red, Green, and Blue. Below the palette is a "Color Blind Simulator" section with three rows: "Deuteranopia", "Protanopia", and "Tritanopia", each showing a horizontal bar with color segments. At the bottom of the page, there is a footer with "Language: English", "User Forums", "Community Guidelines", "Copyright © 2025 Adobe. All rights reserved.", "Privacy", "Terms of Use", "Cookie preferences", and the Adobe logo.

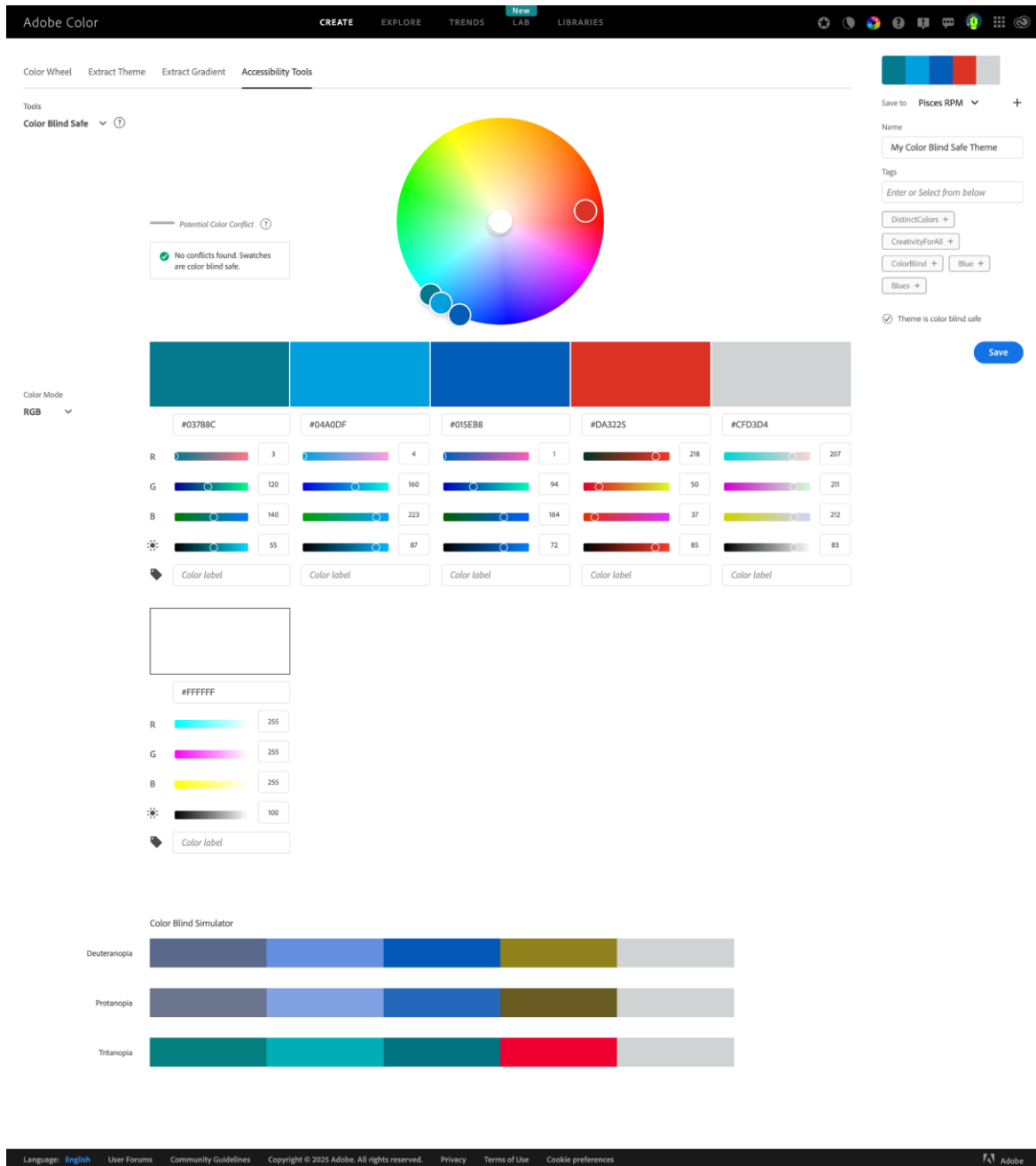
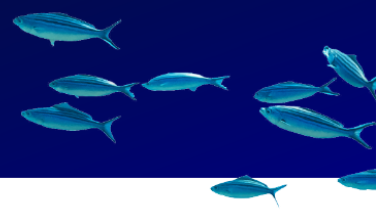


Figure 3. Screenshots of colours used in the classification tool, demonstrating that the palettes are colour-blind safe.

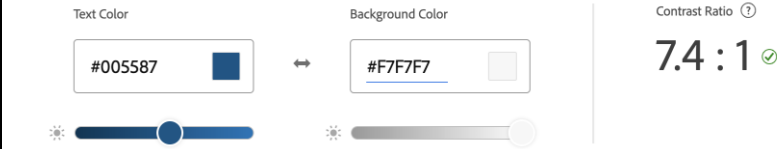


StoryMap

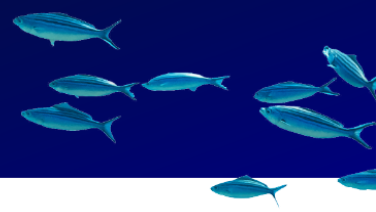
The accessibility audit completed on the StoryMap found that contrast between colours did not affect text legibility (Table 2), and that colour alone was not being used to share information. This is important because the difference in brightness between text and its background can affect how users perceive the content. Low contrast, such as light grey text on a white background, can make reading the content difficult or impossible for some users, particularly those users with vision degeneration and colour vision deficiencies. Situational limitations such as screen glare, poor lighting, and using a mobile device in bright environments can also make low-contrast text harder to read.


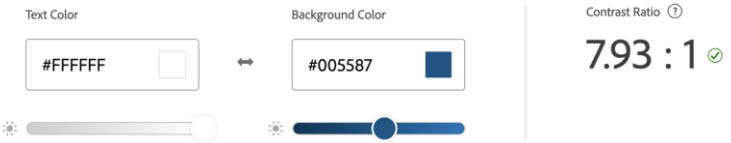

The contrast ratio provides a numerical comparison of the difference between foreground and background colours, and provides clarity as to whether or not visual elements, like text, are distinguishable from the background. A 1:1 contrast ratio would indicate no contrast (i.e., white text on a white background) and a 21:1 contrast ratio would indicate maximum contrast (i.e., black text on a white background). For normal text, the WCAG⁹ requires body text and other standard-sized fonts to have a minimum contrast ratio of 4.5:1, and large text (> 18pt or 14pt bold) to have a minimum contrast ratio of 3:1. Table 2 outlines the contrast ratios assessed for the finalized StoryMap, which all meet accessibility compliance.

Table 2. Colour contrast ratios in the StoryMap, demonstrate that contrast does not affect text legibility.

Colours Used	Contrast Ratio
Blue on light grey Background: #F7F7F7 Text: #005587	

⁹ Web Content Accessibility Guidelines (WCAG) 2.1. W3C, 6 May 2025, <https://www.w3.org/TR/WCAG21/>. Accessed 16 June 2025.

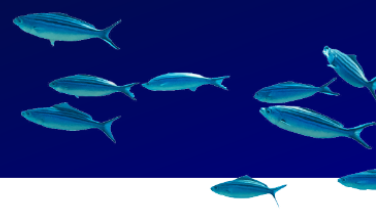


<p>Black on light grey Background: #F7F7F7 Text: #222222</p>	
<p>White on blue Background: #005587 Text: #ffffff</p>	
<p>White on dark grey Background: #666666 Text: #ffffff</p>	

Typography and Fonts

- All fonts used throughout the Classification Tool and StoryMap meet the minimum text requirements of 16pt for on-screen text, as per the WCAG¹⁰.
- Font selections are simple and legible and avoid complex fonts like cursive ones.
- Font variation is minimal, keeping the tools clean and easy to read.
- The StoryMap incorporates font size variability for headers and subheaders, ensuring that it is easy for users to visually navigate the page and its content.
- Fonts used on embedded images are clean and clear.
- Text descriptions of figures are provided.

¹⁰ Web Content Accessibility Guidelines (WCAG) 2.1. W3C, 6 May 2025, <https://www.w3.org/TR/WCAG21/>. Accessed 16 June 2025.



Classification Tool

Overall, the text within the Classification Tool was found to be resizable and zoomable, and text descriptions were provided when necessary. This is important for those users with decreased vision or vision degeneration who may rely on the ability to increase text size and/or zoom in without losing content or functionality. Of this user group, individuals may also rely on assistive technologies that aid in text resizing and zooming while ensuring information is not lost. Moreover, users accessing the mapping tool on smaller screens such as mobile devices and tablets, will benefit from the ability to increase text size or zoom in. This not only makes the tool accessible to a wider user group, but also makes the tool accessible across multiple devices.

StoryMap

Similar to the Classification Tool, the accessibility audit also found the text in the StoryMap to be resizable and zoomable, and text descriptions were provided when necessary.

Images and Multimedia

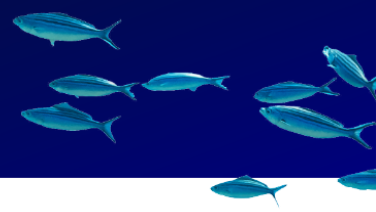
- Images used in the StoryMap are all prescribed with alternative text describing the images in detail so that people using screen readers have access to the information contained visually within those images.
- The use of text on embedded images was minimized, wherever possible, and when text on an image was required (such as in an infographic), alternative texts and figure descriptions provided accurate written details of those images.

Classification Tool

The accessibility audit of the Classification Tool determined that all images and multimedia criteria were met.

StoryMap

The StoryMap can be accessed by those users relying on screen readers to access information on a webpage.



Navigation and Interaction

This portion of the audit was completed to ensure ease of access to the StoryMap and Classification Tool for users requiring screen readers or keyboards to navigate. Navigational and interactive accessibility features in the final mapping tools include:

- Header tags applied throughout the StoryMap.
- Non-header text sections that were labelled appropriately (as body, caption, quote, etc.).
- ARIA attributes that were added throughout the Classification Tool and StoryMap to ensure ease of access to the sites for those using assistive technologies.

Classification Tool

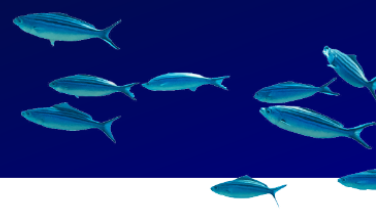
The accessibility audit of the Classification Tool found that all elements of the maps are easy to interact with via a keyboard. Not only is having all functionality operable through a keyboard interface mandated by the WCAG¹¹, it is particularly important for users with motor disabilities that have impaired dexterity which can impact their mouse usage. It is also critical for screen reader users that navigate web content solely through use of a keyboard. Additionally, ensuring 100% keyboard interaction for the map helps avoid technical issues for users, like a malfunctioning mouse.

The accessibility audit of the Classification Tool also confirmed the use of ARIA attributes, which is critical for providing meaning to custom components of the interactive maps and their elements, such as pop-ups and expandable menus that do not have built-in HTML semantics. In essence, the confirmation of ARIA attributes means that the Classification Tool is accessible to those users relying on screen readers or keyboard navigation.

StoryMap

The accessibility audit of the StoryMap found that heading tags were used properly in such a way that the site can be navigated in the correct sequence, therefore mitigating confusion caused by mislabeled heading tags.

¹¹ *Web Content Accessibility Guidelines (WCAG) 2.1*. W3C, 6 May 2025, <https://www.w3.org/TR/WCAG21/>. Accessed 16 June 2025.



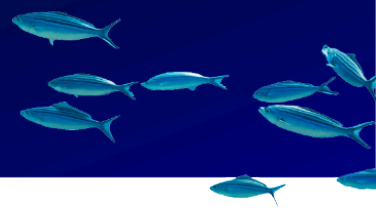
User Experience

This second accessibility audit of the mapping tools determined an overall improvement in user experience from the initial audit. Whereas the initial audit found the mapping tools to be riddled with inconsistent spacing and formatting of bullet points, was awkward to scroll through, contained offset elements that would have benefitted from being centred, and an illogical flow through the different sections and map elements, there was marked improvement in these areas as of the second accessibility audit. These accessibility improvements, in combination with the end-user testing (accessed [here](#)) that was used to trial the various features of the mapping tools, following revision of the draft tools after the initial accessibility audit, further highlight that the tools are intuitive, functional, and easy to navigate.

Summary

Based on the results of this second accessibility audit of the CCS tools developed by CMAR, the majority of Nova Scotian users will be able to utilize the full scope of the tools. Considerations into the development of the tools were clearly considered for those individuals with protanopia and deuteranopia colour-blindness, natural age-related contrast sensitivity decline, other visual impairments or neurological conditions such as dyslexia that require the use of a screen reader, and motor disabilities that impair dexterity. The tools were also developed to be used across a variety of devices such as laptops, tablets and mobile devices, further increasing their overall accessibility.

Appendix V – User Testing Report



End-user testing report for an aquaculture coastal classification system mapping platform

Prepared for the Centre for Marine Applied Research

by

Pisces Research Project Management

May 22, 2025

Executive Summary

Contracted by the Government of Nova Scotia, the Centre for Marine Applied Research (CMAR) is developing an online mapping tool to screen coastal aquaculture site suitability as a means to increase science-based aquaculture capacity. Once developed, this tool will aid informed decision-making and planning for sustainable finfish and shellfish aquaculture development. Currently, a mock set of coastal classification system (CCS) mapping tools, including a StoryMap has been developed and tested by targeted users in various ocean sectors. This report discusses the responses of the end-user testing survey distributed to willing participants and provides modification recommendations based on survey participant responses, such as using bright, bold, contrasting colour palettes, and restructuring the map layers for improved functionality. A full list of recommendations is provided at the end of this report, along with the survey that was provided to respondents. It is recommended that these modification suggestions be implemented into the CCS tools prior to making the platform open-access.

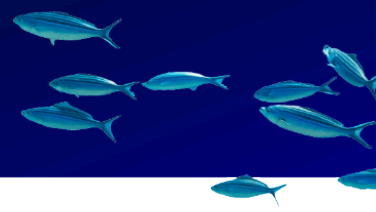


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Introduction

The Centre for Marine Applied Research (CMAR), contracted by the Government of Nova Scotia, is developing an online mapping tool designed to screen coastal waters for their potential suitability for aquaculture development. This initiative aims to establish a coastal Classification System that streamlines access to science-based information relevant to aquaculture. The tool is intended to assist in identifying areas that may be suitable for finfish and shellfish aquaculture development, ultimately supporting informed decision-making and contributing to the planning of responsible and sustainable aquaculture development.

To understand the usability of the draft aquaculture Coastal Classification System mapping platforms (herein CCS tools), an assessment survey was distributed by CMAR to individuals in varying ocean-related sectors, including industry, government, organized community groups, and research organizations. The aim of this survey was to gain insight into the intuitiveness of the CCS tools, determine the effectiveness of the different visual elements, have users provide feedback and insights while navigating the CCS tools, and gauge overall user satisfaction. Survey responses are presented in this report and will be used to inform refinements to the CCS tools prior to their final implementation.

Methodology

The draft aquaculture CCS mapping platform systems consist of two tools. The first is a StoryMap designed to help users understand the mapping platform, its use, the criteria that go into determining aquaculture site suitability, a description of the different site-suitability scales, and platform navigation tips. The second CCS tool is the classification tool (i.e, the mapping platform). Both were created using ArcGIS.

An invitation to complete a survey to aid CMAR in understanding the usability of two CCS tools was distributed to targeted participants in different ocean sectors. These participants were chosen as those most likely to have use for the tools once developed, and included the following demographics:



- Coastal community members
- Members of an organized community group
- Individuals in Industry (Aquaculture)
- Individuals in Industry (other ocean-related)
- Researchers
- Government personnel

Moreover, members from the project's CCS Data Committees (Biophysical, Ocean Use, and Wild Salmon) and Technical Oversight Committee were invited to participate and provide formal feedback.

Members of the Project Committees were sent an email invitation to participate, along with the survey and login information to access the mock CCS tools online. Respondents were then asked to email their completed surveys to a member of Pisces RPM, who is supporting CMAR in collecting and summarizing responses. In total, survey invitations were sent to 26 members of the Project Committees.

End-user testing with industry members took place as a virtual meeting with a Pisces RPM representative as a way to record real-time feedback from individuals with experience and expertise in the industry. An email invitation was sent to finfish aquaculture representatives, shellfish aquaculture representatives and industry consultants. Those wishing to participate were asked to attend a virtual meeting with a member of Pisces RPM to navigate through the CCS tools with their screen-shared, while completing the survey and providing real-time feedback on the usability of the CCS tools. Answers were recorded by the Pisces RPM member to be used in this report. In total, survey invitations were sent to 11 industry members.

Survey invitations were emailed to members of the Project Committees and to industry members on April 28th, 2025, and those individuals wishing to provide feedback were asked to complete their survey responses by May 9th, 2025.

In addition to the survey invitations sent to members of the Project Committees and to industry members, tenants at the Centre for Ocean Ventures and Entrepreneurship (COVE) were invited to



an engagement session held in the Boardroom of COVE’s South Building on May 2nd, 2025, where they could complete the survey online in real-time, with members from CMAR and Pisces RPM present to answer any questions and garner feedback. The invitation to participate was advertised in the COVE Community News bi-weekly letter prior to the engagement session. Given COVE’s multi-institutional consortium of organizations and researchers, the in-person engagement session was designed to gather a wide range of expert feedback on the CCS tools.

The survey itself consisted of multiple-choice, short-answer, Likert scale, and ranking-type questions, and can be found in the Appendix at the end of this report. Participants completing the survey found that the mock classification tool consisted of three different map styles, all with differing colour schemes. This set-up of the mock platform was done intentionally for participants to provide feedback on the different types of maps and layers, and to provide opinions on colour schemes. Results, including colour and style preferences, are presented below and will aid the development of the final CCS tools.

Survey Results

User Demographics

Individuals from six ocean-related sectors (Table 1) were invited to participate in the end-user testing of the mock CCS tools. Of the six sectors, there were no coastal community members, members of organized community groups, or individuals in industry outside of aquaculture that responded to the survey request. In total, the survey had 17 respondents, the majority of whom identified as working in the government (47.1%), followed by individuals in the aquaculture industry (29.4%), researchers (17.6%), and one respondent who preferred not to specify their sector (Figure 1).



Table 1. The number of respondents in each sector that participated in the draft aquaculture Coastal Classification System mapping platforms assessment survey.

Sector	No. of Respondents
Coastal Community Members	0
Members of an Organized Community Group	0
Industry - Aquaculture	5
Industry - Other	0
Researchers	3
Government	8
Other	1

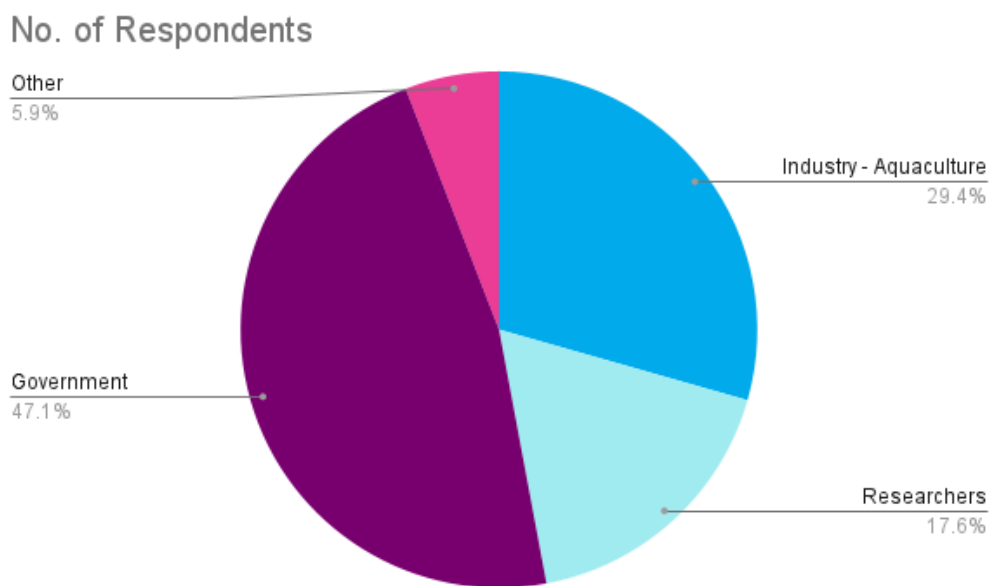


Figure 1. The proportion of respondents in each sector that participated in the draft aquaculture Coastal Classification System mapping platforms assessment survey.



Usability and Navigation

Mock StoryMap

As part of the survey, participants were first asked to navigate the mock StoryMap CCS tool. Once comfortable with the layout, they were then asked a skill-testing question with only one correct answer as a means to gauge how easy or difficult it is to quickly find sought-after information in the StoryMap. Specifically, participants were asked:

How many tests must each criterion pass to be included in the assessment?

While most participants (13/17) were able to determine the correct answer – eight tests – respondents noted that navigating to the correct section in StoryMaps where this answer could be found was not intuitive. Seven respondents specifically stated having initially navigated to the “Criteria” section of StoryMaps, which felt intuitive to them based on the wording of the above skill-testing question. However, the answer was nested in the “Assessing Aquaculture Potential” section.

Survey participants were also asked about the specific features that made the StoryMap easy or difficult to use. Table 2 represents an exhaustive compilation of the responses.

Table 2. Participant responses to being asked: “What features make the StoryMap easy or difficult to use?” as part of the draft aquaculture Coastal Classification System mapping platforms assessment survey.

Easy-to-use Features	No. of respondents in agreement	Difficult-to-use Features	No. of respondents in agreement
Plain language (i.e., no jargon) and simple visuals	2	Headings and toolbar should be renamed/adjusted. The order of the sections is confusing. Desired information is hard to find quickly.	2
Material covered is thorough/informative	4	Too much text. The information presented is too dense (difficult).	3
Nice layout. Good flow from one section to the next.	4	Interactive plots are awkward to move and resize. It wasn't intuitive	2



		to know which figures were interactive and which were not.	
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While providing feedback on the various features that made the StoryMap CCS tool easy or difficult to use, some respondents also used the opportunity to make suggestions. These suggestions include:

- Adding a section to the StoryMap CCS tool about what the classification tool “does not do”.
- Changing the term “restricted” to “restrictions in place”.
- Adding a site search tool.
- Defining key terminology before using it.
- Using section background colours to visually separate content.

Mock Classification Tool

Survey participants were asked various question types, such as skill-testing, opinion and rating-style questions, to gauge the usability and ease of navigation of the mock classification tool. At its surface, the mock classification tool gave participants the opportunity to click through three different map types (i.e., visual interfaces): one created using dot layers, one created using polygon layers, and one created as a raster (Figure 2). Participants were able to zoom into the dot and polygon interface maps and click on a single layer to obtain more information on aquaculture site suitability at a specific location, but were unable to do this with the raster-style map. Instead, the raster-style map offered participants a legend to refer to as a means to get additional information about the different map colours and what they meant in terms of aquaculture site suitability.

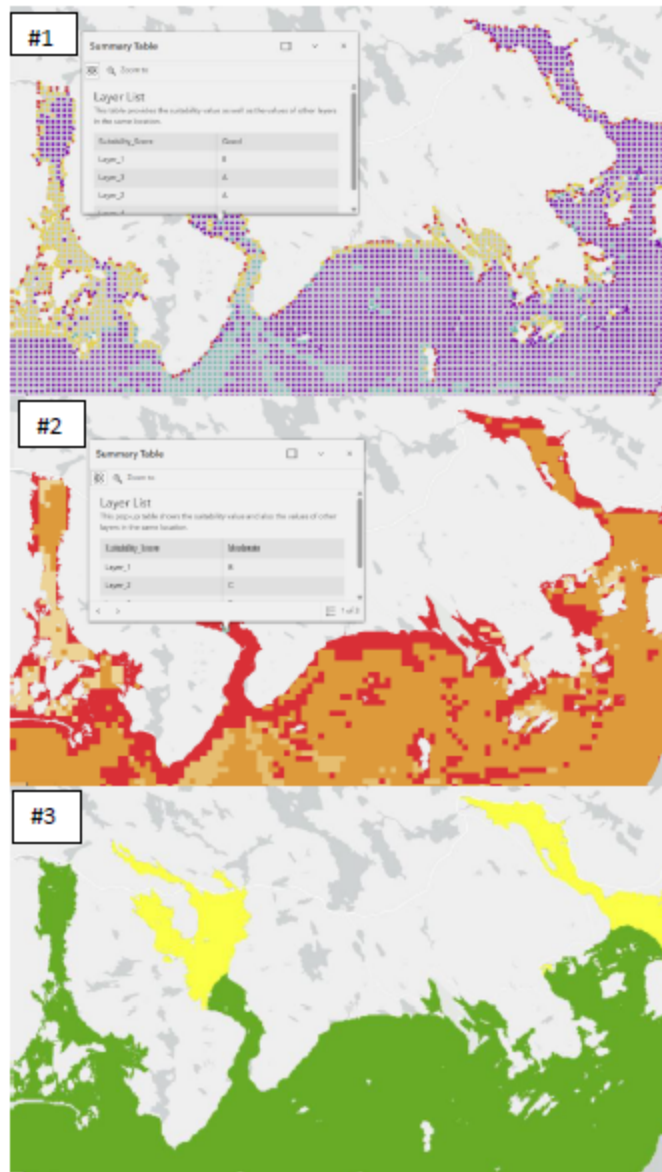
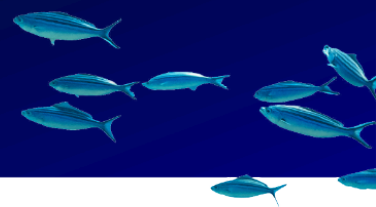


Figure 2. The three different visual interfaces were assessed by participants as part of the draft aquaculture Coastal Classification System mapping platforms assessment survey.

Questions 3d, 6b, 6d, 6e, and 7d of the assessment survey (see Appendix for questions) were skill-testing questions designed to see if users of the mock classification tool could easily navigate the maps to find specific information. This was to determine if the classification tool is intuitive to use. Based on the responses, most respondents were able to correctly navigate and interpret the



maps to determine the correct answers to the questions (see Figure 3). Primary challenges when navigating the classification tool included the following:

- **Question 6b** → Respondents noted that it was not intuitive to navigate to the constraints data (i.e., areas where aquaculture development cannot occur), and found it through trial-and-error by clicking around on the classification tool. One respondent noted that this question took the longest to answer from the survey, and another user did not understand the difference between the constraints layers and the restricted area layers.
- **Question 6e** → One respondent who completed their survey with a member of the Pisces RPM team was unable to answer this specific question because they could not see the restricted area polygons on the map. Notably, the colour used to delineate restricted areas for aquaculture development on the map was light blue, and the background colour of the map was light grey. After some discussion, it was assumed that this respondent could not see the difference in colour, whether that is a factor of their vision or a factor of their computer/device settings, is unclear. Four of the 17 respondents clicked “I don’t know” when answering this question. It is also unclear whether these respondents were also unable to distinguish between the two colours.



% of correct responses for the Useability and Navigation skill-testing questions

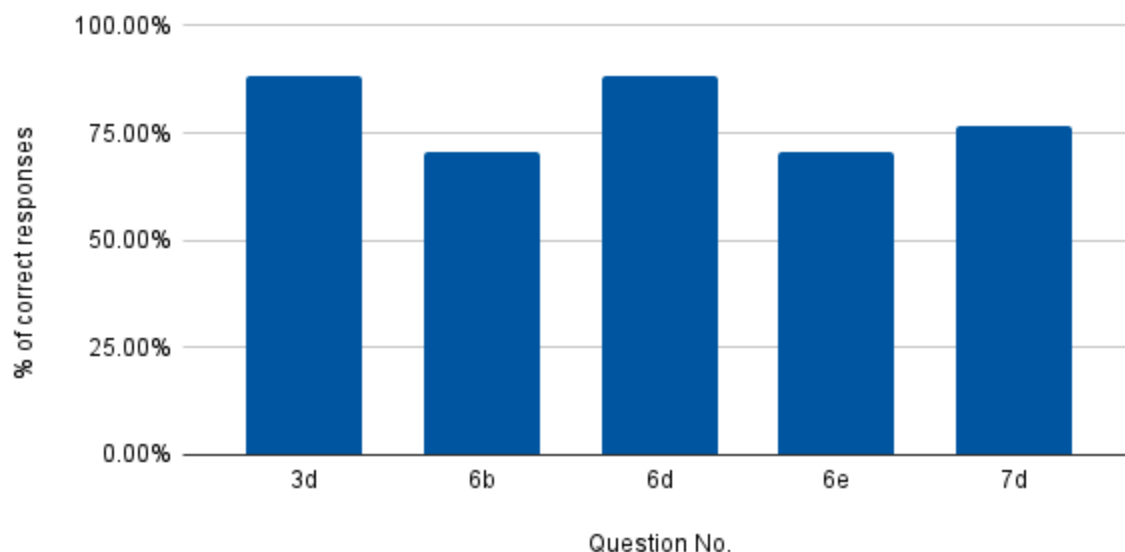
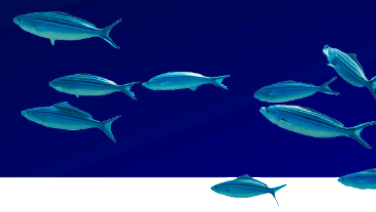


Figure 3. Skill-testing question numbers from the draft aquaculture Coastal Classification System mapping platforms assessment survey (see Appendix for survey) and the percentage of respondents to answer each question correctly. These specific questions were asked to participants to assess if users of the classification tool can easily navigate the maps to find specific information (i.e., if the location of the information within the classification tool is intuitive and easy to interpret).

Questions 4c, 6c, and 7c of the assessment survey (see Appendix for full survey questionnaire) asked participants to rate various aspects of the usability and navigation of the classification tool. Questions were scaled from 1 (very difficult) to 5 (very easy), and overall respondent scoring is shown in Figures 4, 5, and 6 below.



Survey Question 4c Responses

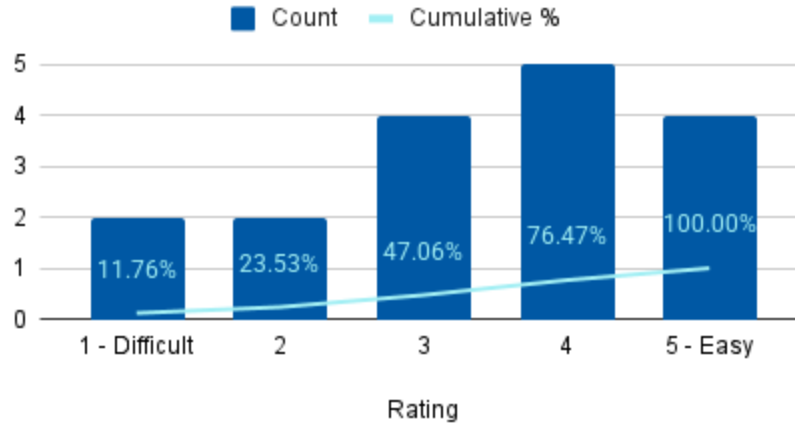


Figure 4. Participant responses to being asked: “On a scale of 1 (very difficult) to 5 (very easy), how intuitive is it to determine a suitable area for mussel aquaculture?” (survey question 4c) as part of the draft aquaculture Coastal Classification System mapping platforms assessment survey.

Survey Question 6c Responses

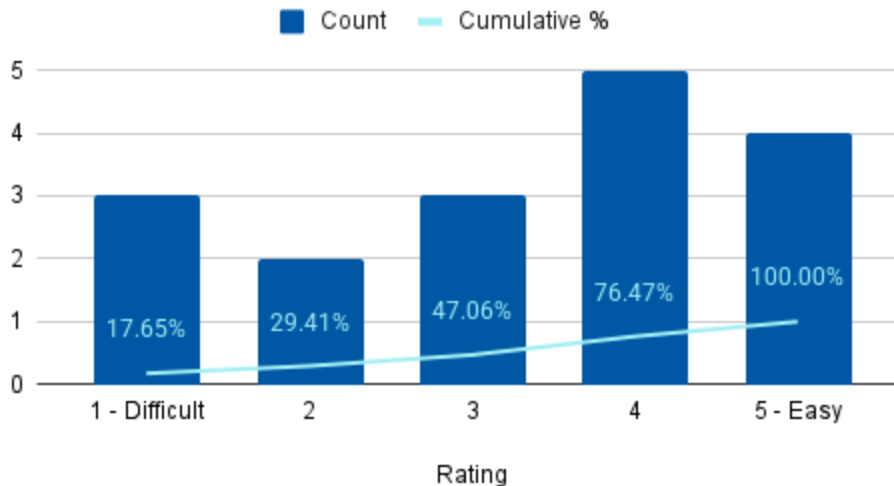
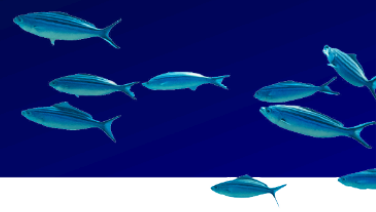


Figure 5. Participant responses to being asked: “On a scale of 1 (very difficult) to 5 (very easy), was this information difficult to find? Rate from 1 to



5.” (survey question 6c – referring to looking for constraints on the CCS mapping tool) as part of the draft aquaculture Coastal Classification System mapping platforms assessment survey.

Survey Question 7c Responses

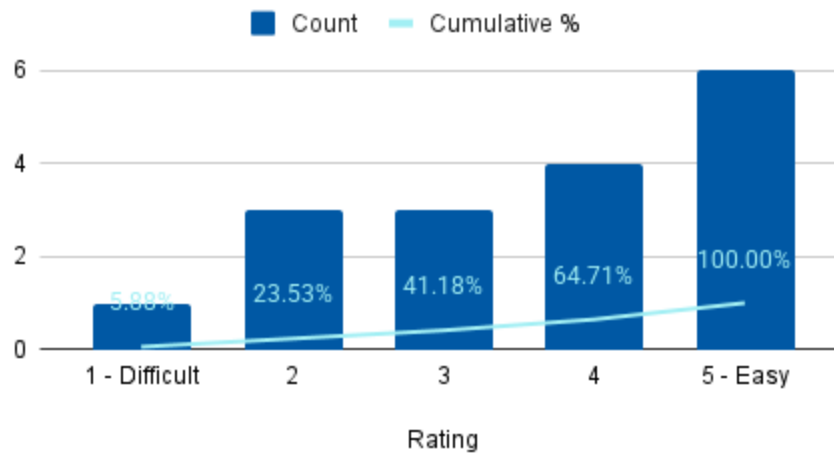
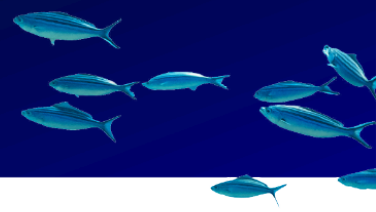


Figure 6. Participant responses to being asked: “Was this information difficult to find? Rate from 1 to 5.” (survey question 7c – referring to looking for areas with high potential for trout aquaculture development and other related informational data available on the CCS mapping tool) as part of the draft aquaculture Coastal Classification System mapping platforms assessment survey.

Based on the cumulative percentage of the participant responses to survey questions 4c, 6c, and 7c, respectively, the majority of respondents felt the mock classification tool was easy/very easy to navigate and intuitive to find specific information sought after.

Lastly, to assess the usability and navigation of the classification tool, survey participants were asked if they found the layer attribute tables associated with the dot and polygon interfaces to be useful. Overall, most respondents found the attribute table to be “potentially useful”, “useful”, “very useful”, “good” or “excellent” (11/17 respondents). While most respondents saw the potential benefits of the layer attribute tables, common concerns were brought forward about standardizing the suitability scores numerically, as some users felt the alphabetical suitability scoring (A, B, C) was



not clear. Respondents were also confused by what “Layer” meant within the layer attribute table, but this is likely to become clearer when the final version of the CCS tools has been developed, and each layer is renamed.

Functionality and Performance

Similar to the *Useability and Navigation* section above, survey participants were asked various question types such as multiple choice, opinion and rating-style questions to gauge the functionality and performance of the mock StoryMap and mock classification tool – again while clicking through three different visual interfaces; dots, polygons and raster-style (Figure 2).

Respondents found the overall experience of using the StoryMap tool to be easy/very easy (Figure 7).

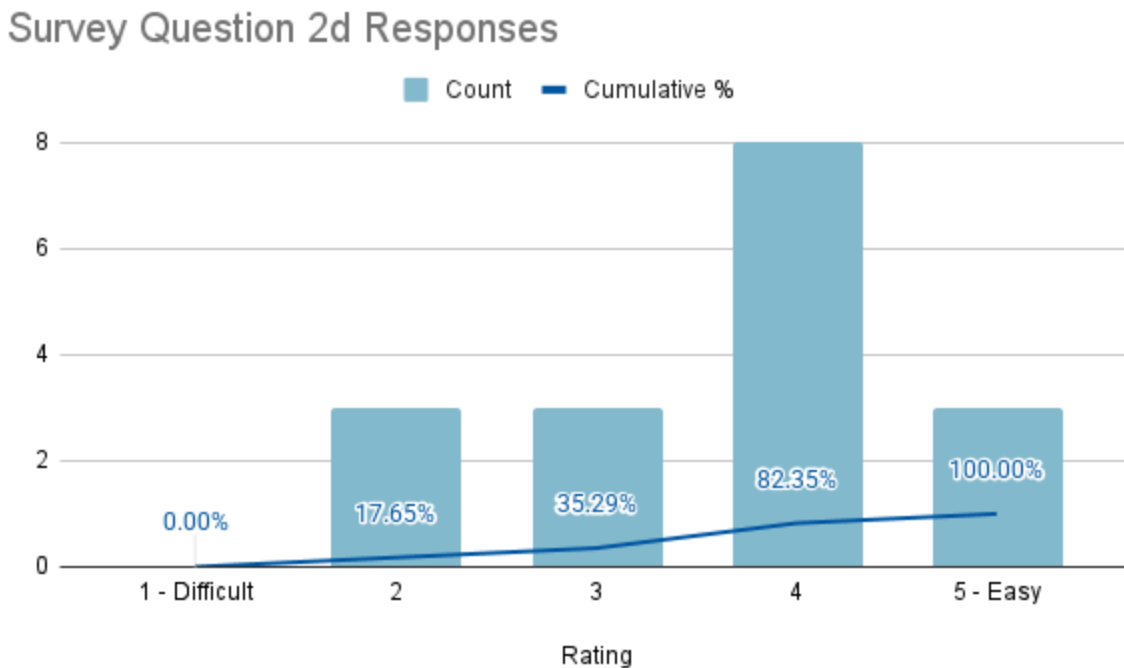
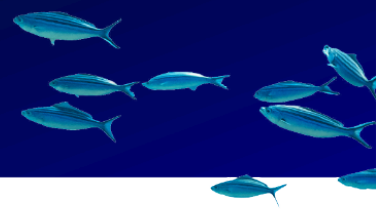


Figure 7. Participant responses to being asked: “On a scale of 1 (very difficult) to 5 (very easy), how would you rate your experience with using the story map?” (survey question 2d) as part of the draft aquaculture Coastal Classification System mapping platforms assessment survey.



Responses were varied when survey participants were asked about the intuitiveness of the dot interface (Figure 8) and polygon interface (Figure 9). Most participants found the functionality of the dot interface to be easy/very easy, while just over half of the participants found the polygon interface difficult/intermediate in terms of being intuitive to use.

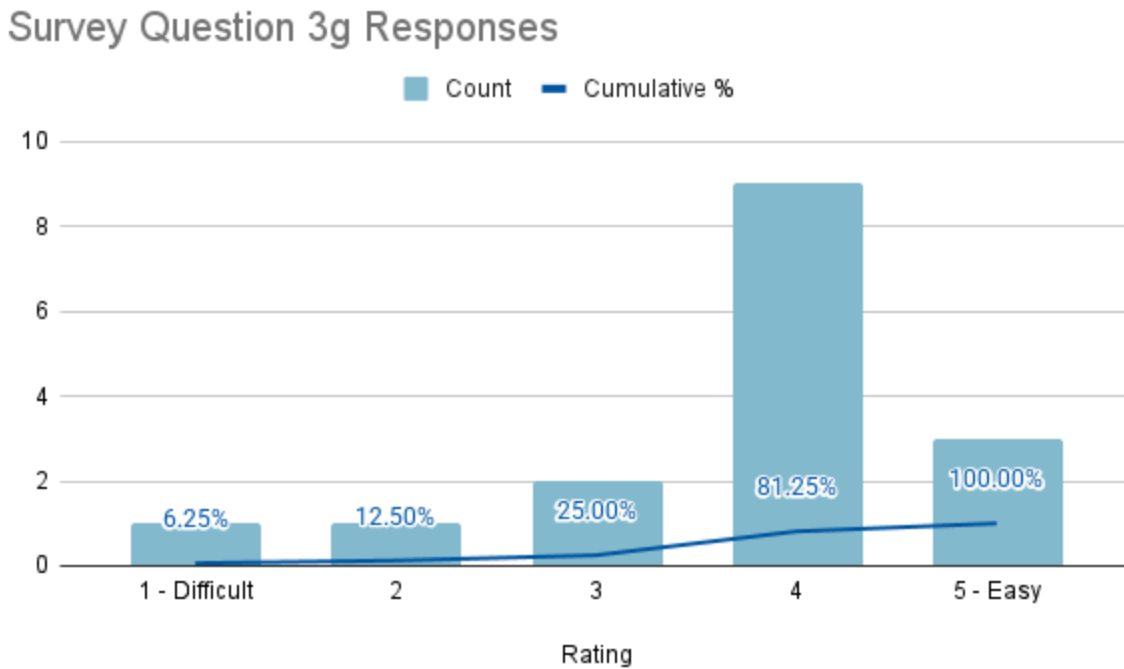
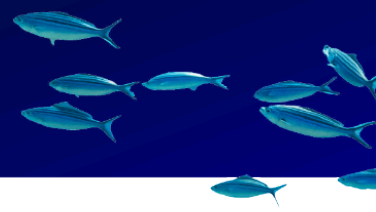


Figure 8. Participant responses to being asked: “On a scale of 1 (very difficult) to 5 (very easy), how intuitive do you find the dot interface to be?” (survey question 3g) as part of the draft aquaculture Coastal Classification System mapping platforms assessment survey.



Survey Question 4d Responses

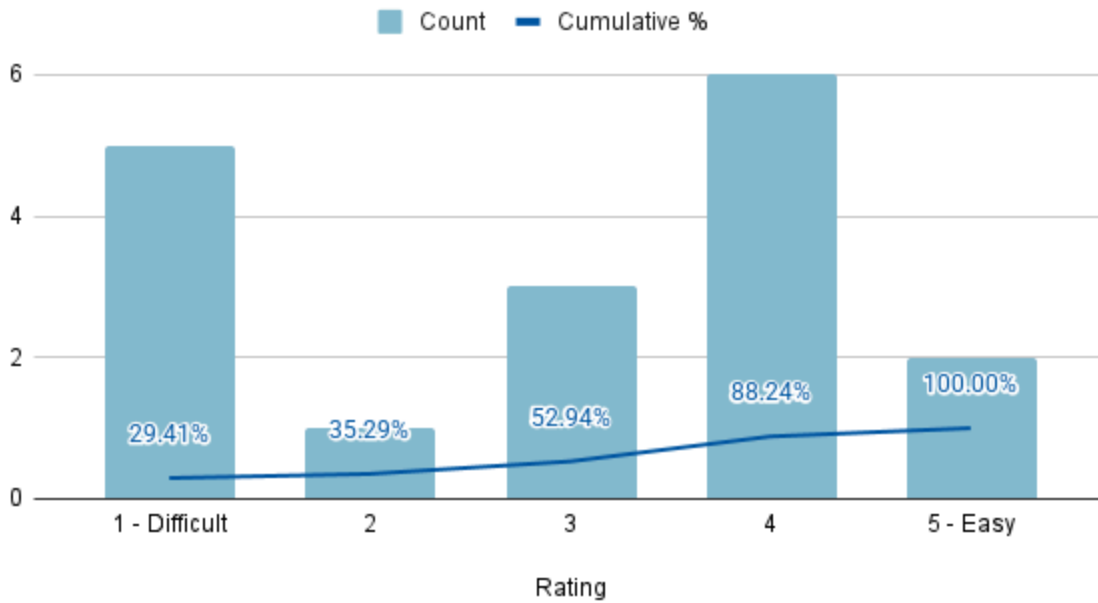


Figure 9. Participant responses to being asked: “On a scale of 1 (very difficult) to 5 (very easy), how intuitive do you find the polygon interface to be?” (survey question 3g) as part of the draft aquaculture Coastal Classification System mapping platforms assessment survey.

Participants were then asked to compare the raster-style map interface to the dot and polygon interfaces. Ten of the 17 respondents noted that there is no layer attribute table that pops up when clicking on specific areas of the map to get additional layer information, like the dot and polygon interfaces have. While respondents generally seemed to like the clear delineation between different aquaculture suitability sites of the raster-style interface, five respondents specifically mentioned preferring the option to click on a specific area to see additional information about site suitability scores.

Question 8 of the assessment survey asked participants the following:



“Are there specific functions you think could enhance the user experience of this mapping tool?”

The following is an exhaustive list of participant responses, with some responses edited for length and clarity:

- Set the classification tool up in a way such that the maps load faster (two respondents suggested this).
- Have a “help” or question mark button for users to click on to get additional information on the different functions of the tools.
- More granular data is needed in general, such as information about tides, waves, currents, etc.
- Provide a download option for downloading data at a specific point/area.
- A search function for the CCS tools would be helpful.
- Provide a description of the constraints layers (e.g., shipping lanes, navy, etc.).
- Complete a full editorial review of content. The first sentence on the mock classification tool reads: *“This interactive tool provides a platform for users to view and navigate data about the suitability of finfish aquaculture along the Nova Scotia coast.”* – but the classification tool also includes shellfish aquaculture suitability site information.
- Develop a short video or reference guide to show users how to navigate the CCS tools (two respondents suggested this).
- Include a disclaimer within the CCS tools that clearly communicates to users that “poor” does not mean no aquaculture can occur, and “good” does not mean a green light for aquaculture development.
- Provide a link to the department's licensing and decision-making processes.
- All the layers (species-specific suitability maps, information criteria, constraints layers, and criteria layers) should be available together in one mapping tab so that a user can explore everything in one place rather than going between two tabs. Or have one tab for each species, combining all the relevant layers into the species-specific suitability maps.



- Provide further descriptions of the different layers/criteria when you click on a dot or a polygon.
- Allow users the ability to change the display order of the enabled layers.
- Keep the raster-style map, but add in layer attribute tables when clicking on a certain area of the map.

Question 9 of the assessment survey asked participants the following:

“Did you experience any difficulties using the tool due to the text size, colour contrast, or interface design?”

Five of the 17 respondents did not experience any difficulties. The following is an exhaustive list of all other participant responses, with some responses edited for length and clarity:

- The darker blues and purples are too close to black, making them difficult to distinguish between at times (i.e., poor contrast).
- The polygon interface is not user-friendly because the polygons obscure the lines between land and water (i.e., no clear delineation between areas).
- The “constraints” polygons were difficult to see because their colouration is too close to the background colour of the map.
- The orange/red map interface colours are difficult to distinguish between (i.e., very little colour contrast)(six respondents noted this).
- The terminology used within the different species maps is different from one map to another. This should be standardized across all maps.
- Dot interfaces of certain colours might give people with colour-blindness a tough time when zooming in, as the dots may become indistinguishable from the map background.

Within the survey distributed by CMAR, there were also two questions that focused solely on determining the user’s visual preferences – the first focused on the user’s colour preference (Figure 10) and the second focused on the user’s preferred interface design (Figure 11).



Question #10

Please review the colour palette options shown below. Starting from your favourite, to least favourite, rank the palettes in the text box below. (for example – 1, 4, 3, 2 – with 1 being the best and 2 being the worst).

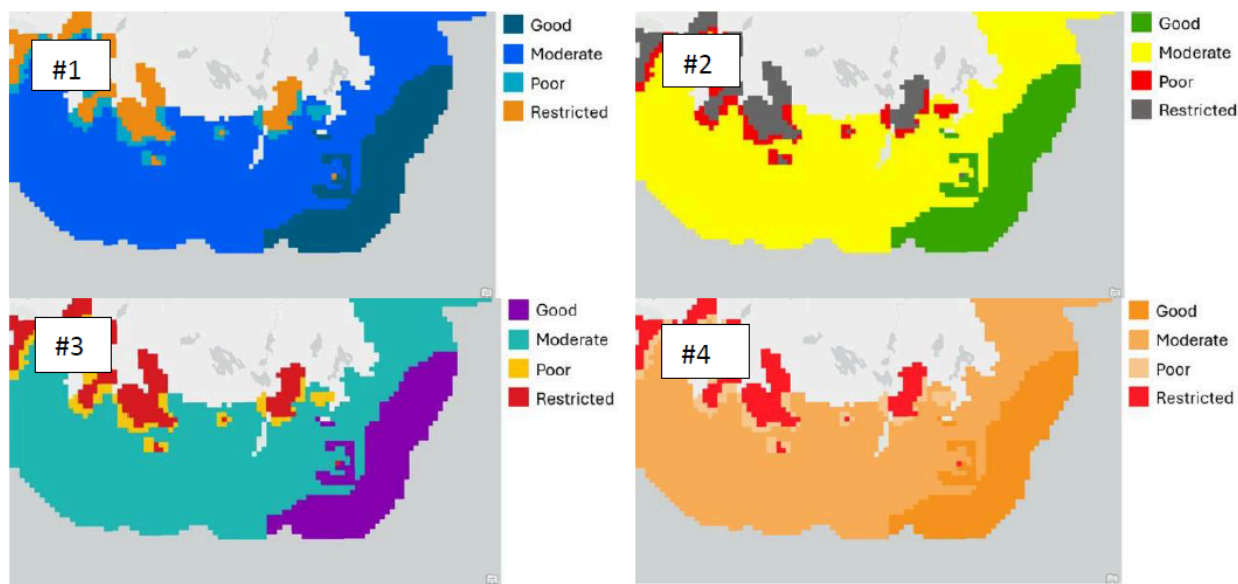


Figure 10. Question #10 from the user assessment survey of the draft aquaculture coastal classification system mapping platform developed by The Centre for Marine Applied Research for the Government of Nova Scotia.



Question #11

When navigating and reviewing the maps, which visual interface did you prefer?

- 1 (Dots) 2 (Polygons) 3 (Raster)

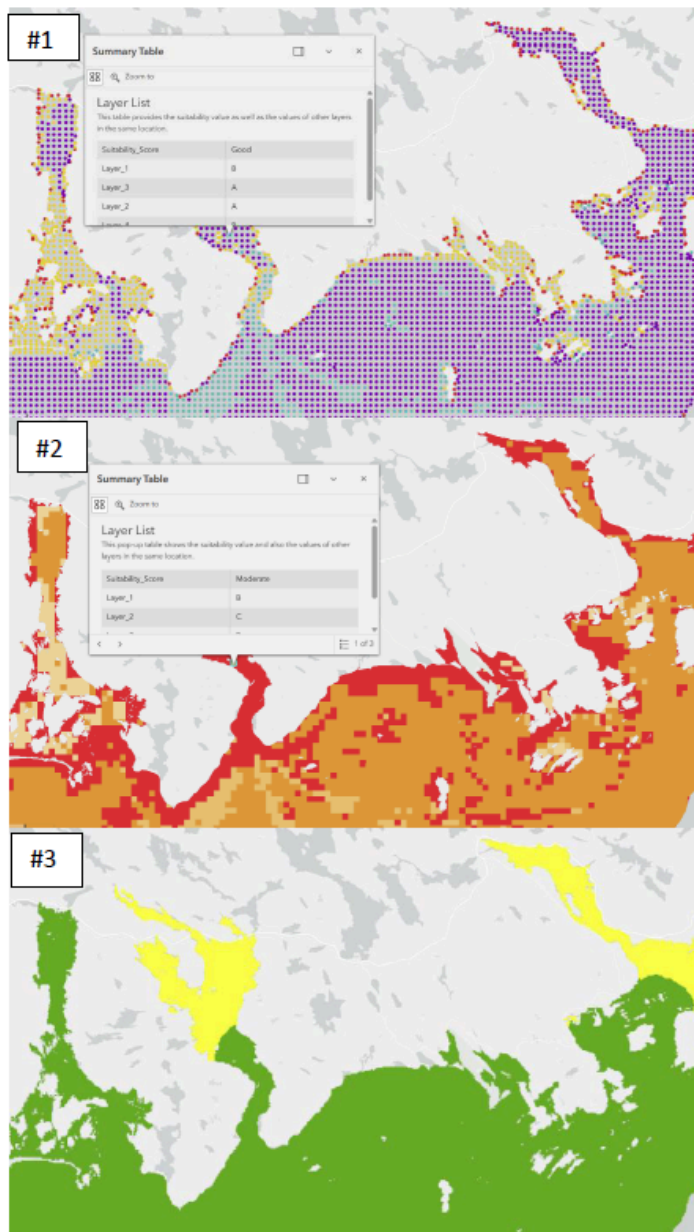
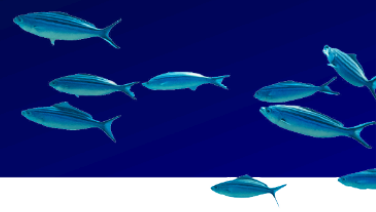


Figure 11. Question #11 from the user assessment survey of the draft aquaculture coastal classification system mapping platform developed by The Centre for Marine Applied Research for the Government of Nova Scotia.



In total, there were 15 respondents for Question #10 of the survey – five in the industry - aquaculture sector; three researchers; six in government; and one respondent who preferred not to specify their sector (other).

Overall survey results indicate respondents felt a strong aversion to the colours in Map #4, with Map #2 having the most preferred colour palette, and Maps #3 and #1 having the second and third most appealing colour palettes, respectively (Figure 12).

Question #10 Results - All Participants

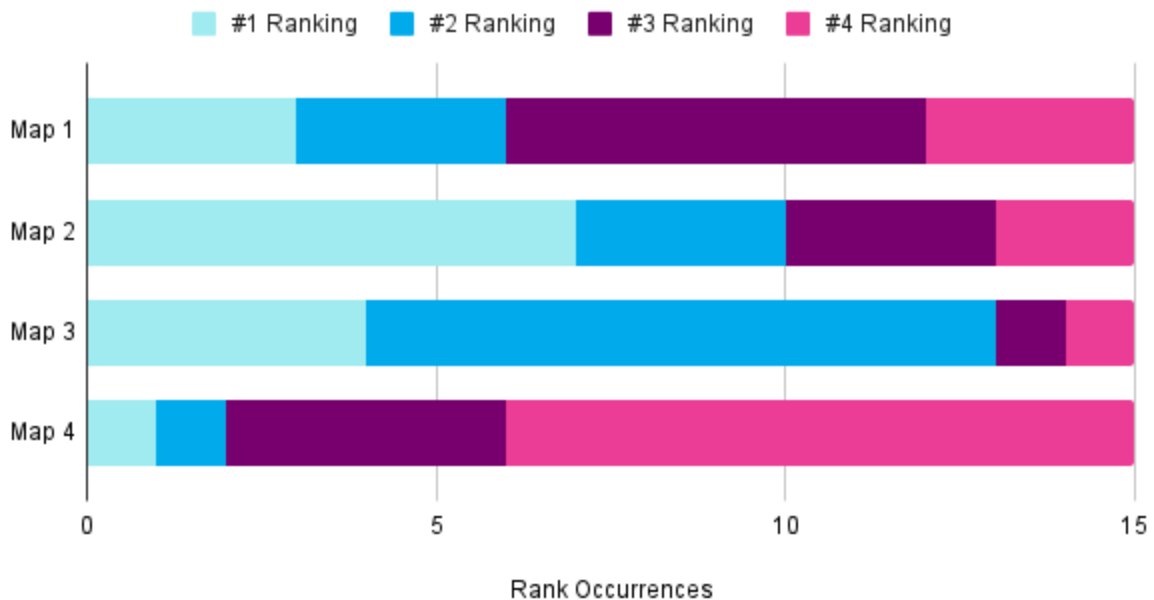


Figure 12. Rank occurrences by survey respondents for Question #10 of the aquaculture coastal classification system mapping platform user assessment survey. Participants were asked to rank four maps in order of preference based only on their colour-palettes (see Figure 10).

In total, there were 16 respondents for Question #11 of the survey – five in the industry - aquaculture sector; three researchers; seven in government; and one respondent who preferred not to specify their sector (other).

Of the three visual interface options presented to respondents, 56.3% (9/16) preferred the dot interface, 31.3% (5/16) preferred a raster-style interface, and 12.5% (2/16) preferred the polygon



interface (Figure 13). Notable comments included respondents liking the clear delineation between areas of the raster-style interface, but preferring the ability to click on an individual dot to see more layer information in a specific area of the map (an option not provided to users in the raster-style interface).

Survey Question 11: Visual Interface Preference Overall

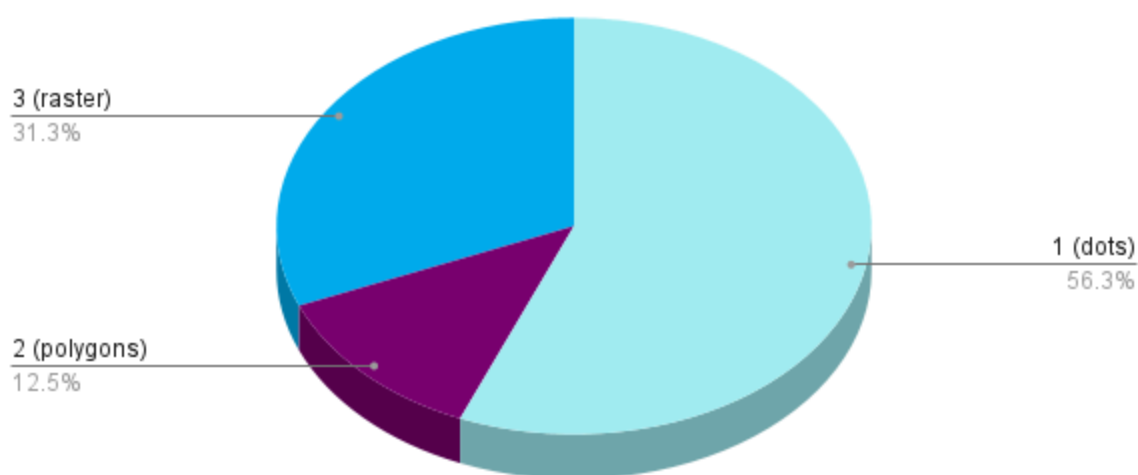


Figure 13. Overall visual interface preferences of survey respondents for Question #11 of the aquaculture coastal classification system mapping platform user assessment survey. Participants were asked to choose between three interface designs; dots, polygons, and raster (see Figure 11).

Overall User Satisfaction: Analysis and Interpretation

From the rating-style questions that had survey participants rate different aspects of the usability, navigation, functionality, intuitiveness and ease-of-use of the CCS tools, overall user satisfaction was high. These rating-style questions were based on a scale of 1 (being very difficult)



to 5 (being very easy), and the most common rating across the questions was a 4, indicating that users were mostly satisfied with the overall performance of the CCS tools.

Based on the participant responses from the survey, Table 3 highlights the aspects of the CCS tools that respondents were most satisfied with and the aspects they were least satisfied with.

Table 3. Most-liked and least-liked platform features, along with those features that left respondents with mixed feelings, based on responses from the aquaculture coastal classification system mapping platform user assessment survey, and 17 respondents.

Most-liked platform features	Least-liked platform features	Mixed Feelings
<p><u>Layer Attribute Tables:</u></p> <p>Respondents liked the option to click on a specific area of the aquaculture site suitability maps to see additional information about the layers and how the site suitability was scored. Respondents noted missing the option to do this in the raster-style interface.</p>	<p><u>Data layers tab:</u></p> <p>While respondents liked the type of information that could be accessed under this tab, it was not intuitive for the respondents to click to as a means to look for information such as “constraints”. Having one tab/map for each species with layers that can be turned on and off (such as constraints) was suggested by one respondent to be more intuitive.</p>	<p><u>Red-yellow-green colour palette:</u></p> <p>Some respondents loved the “traffic-light” colour palette for its intuitiveness (red = bad, green = good), while others strongly disliked this colour palette because the red colour could be misinterpreted by users as indicating a site that can <i>never</i> be used for aquaculture (i.e., a “full stop”) and the green colour indicating a site that is <i>always</i> appropriate for aquaculture to occur.</p>
<p><u>StoryMaps Layout:</u></p> <p>Respondents liked that the layout made scrolling through StoryMaps easy, flowing from one section to the next.</p>	<p><u>Yellow-orange-red colour palette:</u></p> <p>The different “orange” shades were difficult for respondents to tell apart and were not as clearly delineated as the other colour palettes (i.e., there was not enough colour contrast in this palette).</p>	
<p><u>Plain language used in StoryMaps:</u></p> <p>Respondents liked that StoryMaps avoided using internal jargon, and the language was easy to understand.</p>	<p><u>Polygon-style interface:</u></p> <p>Compared to the dot and raster interfaces, the polygon interface was rated the least-preferred by the 17 respondents (see Figure 13).</p>	



Recommendations and Conclusion

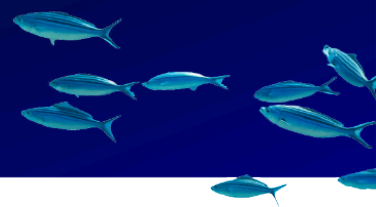
Based on the responses and results of the end-user testing survey, the interviews conducted by a member of the Pisces RPM team, and the engagement session held at COVE, it is recommended that minor modifications be made to the CCS tools to improve overall user-friendliness. In the following section, issues that should be addressed before finalization of the CCS tools are discussed in terms of having high, medium and low impact.

High Impact:

- **Ensure that users have access to layer attribute tables**, independent of the map interface style.
- **Use either the dot interface or the raster-style interface.** The polygon interface does not clearly delineate between different suitability sites (is not high enough resolution), and the polygons often overlap with land, making features such as the shoreline, rivers and inlets hard to distinguish.
- Do not use muted colours within the map interface or for any of the layers. Some users may not be able to distinguish between these colours and the grey map background colour. **Stick to bright, bold and contrasting colours.**
- **Develop a short video or reference guide** to show users how to navigate the CCS mapping tool.

Medium Impact:

- In Storymaps, **add a site search tool.**
- **Adjust and rename the headings and toolbar in StoryMaps** to better reflect the information provided in each section.
- In the layer attribute tables, **standardize the suitability scores numerically.** Alphabetical scoring is less intuitive.
- **Have a “help” or question mark button** for users to click on to get additional information on the different functions of the map features.



Low Impact:

- In StoryMaps, **differentiate each section with alternating background colours** to ensure each section stands out when scrolling through.
- **Provide a download option** for downloading data at a specific point/area on the CCS tool.

Overall, respondents seemed enthusiastic about the development of an aquaculture site suitability mapping tool. While respondents of the end-user testing surveys evaluating the mock StoryMap and mock classification tool seemed to find the tools relatively intuitive, once the above minor modifications are made, the CCS tools will become more accessible to the average user, regardless of the sector they work in.

Upon completion of the above suggestion modifications, a final accessibility audit of the CCS tools should be completed to ensure no outstanding barriers inhibit use and functionality.

Appendix

 UserExperiences_Survey_FINAL.pdf

Appendix VI – Suitability Data and Statistics

Table 1. Total area (in hectares) of each defined aquaculture region and their classification.

Region	Total area (ha)	Restricted		Species	Limited		Moderate		Good	
		Area (ha)	% total		Area (ha)	% total	Area (ha)	% total	Area (ha)	% total
Gulf Shore	255436	16053	6.28	Salmon	239383	93.72	0	0.00	0	0
				Trout	239383	93.72	0	0.00	0	0
				Mussel	229575	89.88	2032	0.80	7776	3.04
				Oyster	228293	89.37	2236	0.88	8854	3.47
Bras D'Or	103695	118	0.11	Salmon	22076	21.29	2977	2.87	78524	75.73
				Trout	22076	21.29	2981	2.87	78520	75.72
				Mussel	2354	2.27	608	0.59	100615	97.03
				Oyster	2347	2.26	356	0.34	100874	97.28
Cape Breton	235295	9227	3.92	Salmon	198387	84.31	4554	1.94	23127	9.83
				Trout	198387	84.31	1280	0.54	26401	11.22
				Mussel	207475	88.18	2266	0.96	16327	6.94
				Oyster	207128	88.03	1285	0.55	17655	7.50
Eastern Shore	169620	1512	0.89	Salmon	123827	73.00	4614	2.72	39667	23.39
				Trout	123827	73.00	2050	1.21	42231	24.90
				Mussel	152447	89.88	2621	1.55	13040	7.69
				Oyster	152413	89.86	1579	0.93	14116	8.32
South Shore	192531	537	0.28	Salmon	61653	32.02	4078	2.12	126263	65.58
				Trout	61653	32.02	1603	0.83	128738	66.87
				Mussel	175541	91.18	4083	2.12	12370	6.42
				Oyster	175450	91.13	2323	1.21	14221	7.39
Fundy-Yarmouth	163846	515	0.31	Salmon	86571	52.84	1294	0.79	75466	46.06
				Trout	86571	52.84	282	0.17	76478	46.68
				Mussel	146920	89.67	2782	1.70	13629	8.32
				Oyster	146891	89.65	2042	1.25	14398	8.79
Upper Fundy	205771	326	0.16	Salmon	195313	94.92	242	0.12	9890	4.81
				Trout	195313	94.92	242	0.12	9890	4.81
				Mussel	153825	74.76	42625	20.71	8995	4.37
				Oyster	146511	71.20	48903	23.77	10031	4.87
TOTAL Area of Assessment	1326194	28288	2.13	Salmon	927210	69.92	17759	1.34	352937	26.61
				Trout	927210	69.92	8438	0.64	362258	27.32
				Mussel	1068137	80.54	57017	4.30	172752	13.03
				Oyster	1059033	79.86	58724	4.43	180149	13.58

Table 2. Total area (in hectares) scored for each criterion across the area of assessment. Numbers in bold indicate areas that were a limiting condition in final suitability maps. NA indicates no scores are applicable for that criterion.

Criterion	Species	Restricted		Limited		Moderate		Good	
		Area (ha)	% total	Area (ha)	% total	Area (ha)	% total	Area (ha)	% total
Exposure to extreme cold	Salmon	NA	NA	800951	60.39	236858	17.86	288385	21.75
	Trout	NA	NA	800951	60.39	236858	17.86	288385	21.75
Exposure to extreme heat	Salmon	NA	NA	48726	3.67	797413	60.13	480055	36.20
	Trout	NA	NA	0	0.00	146410	11.04	1179784	88.96
Bathymetry	Salmon	NA	NA	415609	31.34	NA	NA	NA	NA
	Trout	NA	NA	415609	31.34	NA	NA	NA	NA
	Mussels	NA	NA	242256	18.27	NA	NA	1083938	81.73
	Oysters	NA	NA	110110	8.30	NA	NA	1216084	91.70
Wind and wave exposure	Salmon	NA	NA	10850	0.82	109588	8.26	1205756	90.92
	Trout	NA	NA	10850	0.82	109588	8.26	1205756	90.92
	Mussels	NA	NA	1035243	78.06	233907	17.64	57044	4.30
	Oysters	NA	NA	1035243	78.06	233907	17.64	57044	4.30
Drift ice risk	Salmon	NA	NA	437918	33.02	441018	33.25	447258	33.72
	Trout	NA	NA	437918	33.02	441018	33.25	447258	33.72
	Mussel	NA	NA	85576	6.45	22076	1.66	1218542	91.88
	Oyster	NA	NA	61376	4.63	9578	0.72	1255240	94.65
Marine protected and conserved areas	Salmon	NA	NA	2120	0.16	NA	NA	NA	NA
	Trout	NA	NA	2120	0.16	NA	NA	NA	NA
	Mussel	NA	NA	NA	NA	2120	0.16	NA	NA
	Oyster	NA	NA	NA	NA	2120	0.16	NA	NA
Critical habitat for species at risk	Salmon	NA	NA	NA	NA	158612	11.96	NA	NA
	Trout	NA	NA	NA	NA	158612	11.96	NA	NA
	Mussel	NA	NA	NA	NA	158612	11.96	NA	NA
	Oyster	NA	NA	NA	NA	158612	11.96	NA	NA

Criterion	Species	Restricted		Limited		Moderate		Good	
		Area (ha)	% total	Area (ha)	% total	Area (ha)	% total	Area (ha)	% total
Proximity to coastal access points	Salmon	NA	NA	6628	0.50	NA	NA	NA	NA
	Trout	NA	NA	6628	0.50	NA	NA	NA	NA
	Mussel	NA	NA	6628	0.50	NA	NA	NA	NA
	Oyster	NA	NA	6628	0.50	NA	NA	NA	NA
AIS vessel traffic	Salmon	NA	NA	95990	7.24	220562	16.63	1009642	76.13
	Trout	NA	NA	95990	7.24	220562	16.63	1009642	76.13
	Mussel	NA	NA	95990	7.24	220562	16.63	1009642	76.13
	Oyster	NA	NA	95990	7.24	220562	16.63	1009642	76.13
VMS Vessel traffic	Salmon	NA	NA	159585	12.03	227229	17.13	939380	70.83
	Trout	NA	NA	159585	12.03	227229	17.13	939380	70.83
	Mussel	NA	NA	159585	12.03	227229	17.13	939380	70.83
	Oyster	NA	NA	159585	12.03	227229	17.13	939380	70.83
AIS Important Vessel Routes	All	NA	NA	7286	0.55	NA	NA	NA	NA
Designated traffic routes	All	24689	1.86	8331	0.63	NA	NA	NA	NA
At-sea disposal sites	All	27	0.00	NA	NA	NA	NA	NA	NA
Marine Renewable Energy Areas	All	652	0.05	NA	NA	NA	NA	NA	NA
Anchorage areas	All	2376	0.18	1193	0.09	NA	NA	NA	NA
Submerged cables and pipelines	All	665	0.05	5272	0.40	NA	NA	NA	NA

Table 3. Total area (in hectares) scored for each criterion within the Gulf Shore aquaculture region. Numbers in bold indicate areas that were a limiting condition in final suitability maps. NA indicates no scores are applicable for that criterion.

Criterion	Species	Restricted		Limited		Moderate		Good	
		Area (ha)	% total	Area (ha)	% total	Area (ha)	% total	Area (ha)	% total
Exposure to extreme cold	Salmon	NA	NA	255436	100.00	0	0.00	0	0.00
	Trout	NA	NA	255436	100.00	0	0.00	0	0.00
Exposure to extreme heat	Salmon	NA	NA	48726	19.08	206710	80.92	0	0.00
	Trout	NA	NA	0	0.00	113060	44.26	142376	55.74
Bathymetry	Salmon	NA	NA	75667	29.62	NA	NA	NA	NA
	Trout	NA	NA	75667	29.62	NA	NA	NA	NA
	Mussels	NA	NA	40963	16.04	NA	NA	214473	83.96
	Oysters	NA	NA	15376	6.02	NA	NA	240060	93.98
Wind and wave exposure	Salmon	NA	NA	10850	4.25	46891	18.36	197695	77.40
	Trout	NA	NA	10850	4.25	46891	18.36	197695	77.40
	Mussels	NA	NA	238239	93.27	7743	3.03	9454	3.70
	Oysters	NA	NA	238239	93.27	7743	3.03	9454	3.70
Drift ice risk	Salmon	NA	NA	254474	99.62	962	0.38	0	0.00
	Trout	NA	NA	254474	99.62	962	0.38	0	0.00
	Mussel	NA	NA	25766	10.09	0	0.00	229670	89.91
	Oyster	NA	NA	14443	5.65	0	0.00	240993	94.35
Marine protected and conserved areas	Salmon	NA	NA	171	0.07	NA	NA	NA	NA
	Trout	NA	NA	171	0.07	NA	NA	NA	NA
	Mussel	NA	NA	NA	NA	171	0.07	NA	NA
	Oyster	NA	NA	NA	NA	171	0.07	NA	NA
Critical habitat for species at risk	Salmon	NA	NA	NA	NA	24652	9.65	NA	NA
	Trout	NA	NA	NA	NA	24652	9.65	NA	NA
	Mussel	NA	NA	NA	NA	24652	9.65	NA	NA
	Oyster	NA	NA	NA	NA	24652	9.65	NA	NA

Criterion	Species	Restricted		Limited		Moderate		Good	
		Area (ha)	% total	Area (ha)	% total	Area (ha)	% total	Area (ha)	% total
Proximity to coastal access points	Salmon	NA	NA	967	0.38	NA	NA	NA	NA
	Trout	NA	NA	967	0.38	NA	NA	NA	NA
	Mussel	NA	NA	967	0.38	NA	NA	NA	NA
	Oyster	NA	NA	967	0.38	NA	NA	NA	NA
AIS vessel traffic	Salmon	NA	NA	5721	2.24	10853	4.25	238862	93.51
	Trout	NA	NA	5721	2.24	10853	4.25	238862	93.51
	Mussel	NA	NA	5721	2.24	10853	4.25	238862	93.51
	Oyster	NA	NA	5721	2.24	10853	4.25	238862	93.51
VMS Vessel traffic	Salmon	NA	NA	44891	17.57	43572	17.06	166973	65.37
	Trout	NA	NA	44891	17.57	43572	17.06	166973	65.37
	Mussel	NA	NA	44891	17.57	43572	17.06	166973	65.37
	Oyster	NA	NA	44891	17.57	43572	17.06	166973	65.37
AIS Important Vessel Routes	All	NA	NA	966	0.38	NA	NA	NA	NA
Designated traffic routes	All	16000	6.26	1867	0.73	NA	NA	NA	NA
At-sea disposal sites	All	13	0.01	NA	NA	NA	NA	NA	NA
Marine Renewable Energy Areas	All	0	0.00	NA	NA	NA	NA	NA	NA
Anchorage areas	All	6	0.00	40	0.02	NA	NA	NA	NA
Submerged cables and pipelines	All	34	0.01	325	0.13	NA	NA	NA	NA

Table 4. Total area (in hectares) scored for each criterion within the Bras D'Or aquaculture region. Numbers in bold indicate areas that were a limiting condition in final suitability maps. NA indicates no scores are applicable for that criterion.

Criterion	Species	Restricted		Limited		Moderate		Good	
		Area (ha)	% total	Area (ha)	% total	Area (ha)	% total	Area (ha)	% total
Exposure to extreme cold	Salmon	NA	NA	0	0.00	103695	100.00	0	0.00
	Trout	NA	NA	0	0.00	103695	100.00	0	0.00
Exposure to extreme heat	Salmon	NA	NA	0	0.00	103695	100.00	0	0.00
	Trout	NA	NA	0	0.00	103695	100.00	0	0.00
Bathymetry	Salmon	NA	NA	21745	20.97	NA	NA	NA	NA
	Trout	NA	NA	21745	20.97	NA	NA	NA	NA
	Mussels	NA	NA	8635	8.33	NA	NA	95060	91.67
	Oysters	NA	NA	839	0.81	NA	NA	102856	99.19
Wind and wave exposure	Salmon	NA	NA	0	0.00	0	0.00	103695	100.00
	Trout	NA	NA	0	0.00	0	0.00	103695	100.00
	Mussels	NA	NA	1505	1.45	90092	86.88	12098	11.67
	Oysters	NA	NA	1505	1.45	90092	86.88	12098	11.67
Drift ice risk	Salmon	NA	NA	5039	4.86	98655	95.14	0	0.00
	Trout	NA	NA	5039	4.86	98655	95.14	0	0.00
	Mussel	NA	NA	0	0.00	0	0.00	103694	100.00
	Oyster	NA	NA	0	0.00	0	0.00	103694	100.00
Marine protected and conserved areas	Salmon	NA	NA	0	0.00	NA	NA	NA	NA
	Trout	NA	NA	0	0.00	NA	NA	NA	NA
	Mussel	NA	NA	NA	NA	0	0.00	NA	NA
	Oyster	NA	NA	NA	NA	0	0.00	NA	NA
Critical habitat for species at risk	Salmon	NA	NA	NA	NA	193	0.19	NA	NA
	Trout	NA	NA	NA	NA	193	0.19	NA	NA
	Mussel	NA	NA	NA	NA	193	0.19	NA	NA
	Oyster	NA	NA	NA	NA	193	0.19	NA	NA

Criterion	Species	Restricted		Limited		Moderate		Good	
		Area (ha)	% total	Area (ha)	% total	Area (ha)	% total	Area (ha)	% total
Proximity to coastal access points	Salmon	NA	NA	467	0.45	NA	NA	NA	NA
	Trout	NA	NA	467	0.45	NA	NA	NA	NA
	Mussel	NA	NA	467	0.45	NA	NA	NA	NA
	Oyster	NA	NA	467	0.45	NA	NA	NA	NA
AIS vessel traffic	Salmon	NA	NA	3070	2.96	4267	4.11	96358	92.92
	Trout	NA	NA	3070	2.96	4267	4.11	96358	92.92
	Mussel	NA	NA	3070	2.96	4267	4.11	96358	92.92
	Oyster	NA	NA	3070	2.96	4267	4.11	96358	92.92
VMS Vessel traffic	Salmon	NA	NA	58	0.06	960	0.93	102677	99.02
	Trout	NA	NA	58	0.06	960	0.93	102677	99.02
	Mussel	NA	NA	58	0.06	960	0.93	102677	99.02
	Oyster	NA	NA	58	0.06	960	0.93	102677	99.02
AIS Important Vessel Routes	All	NA	NA	0	0.00	NA	NA	NA	NA
Designated traffic routes	All	104	0.10	462	0.45	NA	NA	NA	NA
At-sea disposal sites	All	0	0.00	NA	NA	NA	NA	NA	NA
Marine Renewable Energy Areas	All	0	0.00	NA	NA	NA	NA	NA	NA
Anchorage areas	All	14	0.01	54	0.05	NA	NA	NA	NA
Submerged cables and pipelines	All	0	0.00	0	0.00	NA	NA	NA	NA

Table 5. Total area (in hectares) scored for each criterion within the Cape Breton aquaculture region. Numbers in bold indicate areas that were a limiting condition in final suitability maps. NA indicates no scores are applicable for that criterion.

Criterion	Species	Restricted		Limited		Moderate		Good	
		Area (ha)	% total	Area (ha)	% total	Area (ha)	% total	Area (ha)	% total
Exposure to extreme cold	Salmon	NA	NA	200272	85.12	30651	13.03	4372	1.86
	Trout	NA	NA	200272	85.12	30651	13.03	4372	1.86
Exposure to extreme heat	Salmon	NA	NA	0	0.00	218893	93.03	16402	6.97
	Trout	NA	NA	0	0.00	0	0.00	235295	100.00
Bathymetry	Salmon	NA	NA	52063	22.13	NA	NA	NA	NA
	Trout	NA	NA	52063	22.13	NA	NA	NA	NA
	Mussels	NA	NA	26414	11.23	NA	NA	208881	88.77
	Oysters	NA	NA	6904	2.93	NA	NA	228391	97.07
Wind and wave exposure	Salmon	NA	NA	0	0.00	24930	10.60	210365	89.40
	Trout	NA	NA	0	0.00	24930	10.60	210365	89.40
	Mussels	NA	NA	214317	91.08	10977	4.67	10001	4.25
	Oysters	NA	NA	214317	91.08	10977	4.67	10001	4.25
Drift ice risk	Salmon	NA	NA	68799	29.24	166496	70.76	0	0.00
	Trout	NA	NA	68799	29.24	166496	70.76	0	0.00
	Mussel	NA	NA	4264	1.81	8315	3.53	222716	94.65
	Oyster	NA	NA	1596	0.68	2837	1.21	230862	98.12
Marine protected and conserved areas	Salmon	NA	NA	1067	0.45	NA	NA	NA	NA
	Trout	NA	NA	1067	0.45	NA	NA	NA	NA
	Mussel	NA	NA	NA	NA	1067	0.45	NA	NA
	Oyster	NA	NA	NA	NA	1067	0.45	NA	NA
Critical habitat for species at risk	Salmon	NA	NA	NA	NA	13988	5.94	NA	NA
	Trout	NA	NA	NA	NA	13988	5.94	NA	NA
	Mussel	NA	NA	NA	NA	13988	5.94	NA	NA
	Oyster	NA	NA	NA	NA	13988	5.94	NA	NA

Criterion	Species	Restricted		Limited		Moderate		Good	
		Area (ha)	% total	Area (ha)	% total	Area (ha)	% total	Area (ha)	% total
Proximity to coastal access points	Salmon	NA	NA	1725	0.73	NA	NA	NA	NA
	Trout	NA	NA	1725	0.73	NA	NA	NA	NA
	Mussel	NA	NA	1725	0.73	NA	NA	NA	NA
	Oyster	NA	NA	1725	0.73	NA	NA	NA	NA
AIS vessel traffic	Salmon	NA	NA	15058	6.40	35069	14.90	185168	78.70
	Trout	NA	NA	15058	6.40	35069	14.90	185168	78.70
	Mussel	NA	NA	15058	6.40	35069	14.90	185168	78.70
	Oyster	NA	NA	15058	6.40	35069	14.90	185168	78.70
VMS Vessel traffic	Salmon	NA	NA	16981	7.22	48217	20.49	170097	72.29
	Trout	NA	NA	16981	7.22	48217	20.49	170097	72.29
	Mussel	NA	NA	16981	7.22	48217	20.49	170097	72.29
	Oyster	NA	NA	16981	7.22	48217	20.49	170097	72.29
AIS Important Vessel Routes	All	NA	NA	3504	1.49	NA	NA	NA	NA
Designated traffic routes	All	6873	2.92	3193	1.36	NA	NA	NA	NA
At-sea disposal sites	All	0	0.00	NA	NA	NA	NA	NA	NA
Marine Renewable Energy Areas	All	0	0.00	NA	NA	NA	NA	NA	NA
Anchorage areas	All	2155	0.92	100	0.04	NA	NA	NA	NA
Submerged cables and pipelines	All	263	0.11	1839	0.78	NA	NA	NA	NA

Table 6. Total area (in hectares) scored for each criterion within the Eastern Shore aquaculture region. Numbers in bold indicate areas that were a limiting condition in final suitability maps. NA indicates no scores are applicable for that criterion.

Criterion	Species	Restricted		Limited		Moderate		Good	
		area (ha)	% total	area (ha)	% total	area (ha)	% total	area (ha)	% total
Exposure to extreme cold	Salmon	NA	NA	94604	55.77	74151	43.72	865	0.51
	Trout	NA	NA	94604	55.77	74151	43.72	865	0.51
Exposure to extreme heat	Salmon	NA	NA	0	0.00	56636	33.39	112984	66.61
	Trout	NA	NA	0	0.00	0	0.00	169620	100.00
Bathymetry	Salmon	NA	NA	53947	31.80	NA	NA	NA	NA
	Trout	NA	NA	53947	31.80	NA	NA	NA	NA
	Mussels	NA	NA	28776	16.96	NA	NA	140844	83.04
	Oysters	NA	NA	10670	6.29	NA	NA	158950	93.71
Wind and wave exposure	Salmon	NA	NA	0	0.00	37767	22.27	131853	77.73
	Trout	NA	NA	0	0.00	37767	22.27	131853	77.73
	Mussels	NA	NA	153061	90.24	22447	13.23	10023	5.91
	Oysters	NA	NA	153061	90.24	22447	13.23	10023	5.91
Drift ice risk	Salmon	NA	NA	0	0.00	133719	78.83	35901	21.17
	Trout	NA	NA	0	0.00	133719	78.83	35901	21.17
	Mussel	NA	NA	0	0.00	10580	6.24	159040	93.76
	Oyster	NA	NA	0	0.00	4474	2.64	165146	97.36
Marine protected and conserved areas	Salmon	NA	NA	0	0.00	NA	NA	NA	NA
	Trout	NA	NA	0	0.00	NA	NA	NA	NA
	Mussel	NA	NA	NA	NA	0	0.00	NA	NA
	Oyster	NA	NA	NA	NA	0	0.00	NA	NA
Critical habitat for species at risk	Salmon	NA	NA	NA	NA	1738	1.02	NA	NA
	Trout	NA	NA	NA	NA	1738	1.02	NA	NA
	Mussel	NA	NA	NA	NA	1738	1.02	NA	NA
	Oyster	NA	NA	NA	NA	1738	1.02	NA	NA

Criterion	Species	Restricted		Limited		Moderate		Good	
		area (ha)	% total	area (ha)	% total	area (ha)	% total	area (ha)	% total
Proximity to coastal access points	Salmon	NA	NA	1408	0.83	NA	NA	NA	NA
	Trout	NA	NA	1408	0.83	NA	NA	NA	NA
	Mussel	NA	NA	1408	0.83	NA	NA	NA	NA
	Oyster	NA	NA	1408	0.83	NA	NA	NA	NA
AIS vessel traffic	Salmon	NA	NA	13190	7.78	24330	14.34	132100	77.88
	Trout	NA	NA	13190	7.78	24330	14.34	132100	77.88
	Mussel	NA	NA	13190	7.78	24330	14.34	132100	77.88
	Oyster	NA	NA	13190	7.78	24330	14.34	132100	77.88
VMS Vessel traffic	Salmon	NA	NA	6437	3.79	22447	13.23	140736	82.97
	Trout	NA	NA	6437	3.79	22447	13.23	140736	82.97
	Mussel	NA	NA	6437	3.79	22447	13.23	140736	82.97
	Oyster	NA	NA	6437	3.79	22447	13.23	140736	82.97
AIS Important Vessel Routes	All	NA	NA	1110	0.65	NA	NA	NA	NA
Designated traffic routes	All	1274	0.75	1178	0.69	NA	NA	NA	NA
At-sea disposal sites	All	0	0.00	NA	NA	NA	NA	NA	NA
Marine Renewable Energy Areas	All	0	0.00	NA	NA	NA	NA	NA	NA
Anchorage areas	All	61	0.04	472	0.28	NA	NA	NA	NA
Submerged cables and pipelines	All	226	0.13	2037	1.20	NA	NA	NA	NA

Table 7. Total area (in hectares) scored for each criterion within the South Shore aquaculture region. Numbers in bold indicate areas that were a limiting condition in final suitability maps. NA indicates no scores are applicable for that criterion.

Criterion	Species	Restricted		Limited		Moderate		Good	
		area (ha)	% total	area (ha)	% total	area (ha)	% total	area (ha)	% total
Exposure to extreme cold	Salmon	NA	NA	5845	3.04	8966	4.66	177720	92.31
	Trout	NA	NA	5845	3.04	8966	4.66	177720	92.31
Exposure to extreme heat	Salmon	NA	NA	0	0.00	45130	23.44	147401	76.56
	Trout	NA	NA	0	0.00	0	0.00	192531	100.00
Bathymetry	Salmon	NA	NA	58025	30.14	NA	NA	NA	NA
	Trout	NA	NA	58025	30.14	NA	NA	NA	NA
	Mussels	NA	NA	31858	16.55	NA	NA	160673	83.45
	Oysters	NA	NA	11238	5.84	NA	NA	181293	94.16
Wind and wave exposure	Salmon	NA	NA	0	0.00	0	0.00	192531	100.00
	Trout	NA	NA	0	0.00	0	0.00	192531	100.00
	Mussels	NA	NA	174648	90.71	12636	6.56	5247	2.73
	Oysters	NA	NA	174648	90.71	12636	6.56	5247	2.73
Drift ice risk	Salmon	NA	NA	0	0.00	0	0.00	192531	100.00
	Trout	NA	NA	0	0.00	0	0.00	192531	100.00
	Mussel	NA	NA	0	0.00	0	0.00	192531	100.00
	Oyster	NA	NA	0	0.00	0	0.00	192531	100.00
Marine protected and conserved areas	Salmon	NA	NA	877	0.46	NA	NA	NA	NA
	Trout	NA	NA	877	0.46	NA	NA	NA	NA
	Mussel	NA	NA	NA	NA	877	0.46	NA	NA
	Oyster	NA	NA	NA	NA	877	0.46	NA	NA
Critical habitat for species at risk	Salmon	NA	NA	NA	NA	6644	3.45	NA	NA
	Trout	NA	NA	NA	NA	6644	3.45	NA	NA
	Mussel	NA	NA	NA	NA	6644	3.45	NA	NA
	Oyster	NA	NA	NA	NA	6644	3.45	NA	NA
Proximity to coastal access points	Salmon	NA	NA	1240	0.64	NA	NA	NA	NA

Criterion	Species	Restricted		Limited		Moderate		Good	
		area (ha)	% total	area (ha)	% total	area (ha)	% total	area (ha)	% total
AIS vessel traffic	Trout	NA	NA	1240	0.64	NA	NA	NA	NA
	Mussel	NA	NA	1240	0.64	NA	NA	NA	NA
	Oyster	NA	NA	1240	0.64	NA	NA	NA	NA
	Salmon	NA	NA	32690	16.98	78685	40.87	81156	42.15
	Trout	NA	NA	32690	16.98	78685	40.87	81156	42.15
	Mussel	NA	NA	32690	16.98	78685	40.87	81156	42.15
	Oyster	NA	NA	32690	16.98	78685	40.87	81156	42.15
VMS Vessel traffic	Salmon	NA	NA	17699	9.19	37331	19.39	137501	71.42
	Trout	NA	NA	17699	9.19	37331	19.39	137501	71.42
	Mussel	NA	NA	17699	9.19	37331	19.39	137501	71.42
	Oyster	NA	NA	17699	9.19	37331	19.39	137501	71.42
	All	NA	NA	948	0.49	NA	NA	NA	NA
Designated traffic routes	All	366	0.19	1348	0.70	NA	NA	NA	NA
At-sea disposal sites	All	0	0.00	NA	NA	NA	NA	NA	NA
Marine Renewable Energy Areas	All	0	0.00	NA	NA	NA	NA	NA	NA
Anchorage areas	All	61	0.03	354	0.18	NA	NA	NA	NA
Submerged cables and pipelines	All	110	0.06	756	0.39	NA	NA	NA	NA

Table 8. Total area (in hectares) scored for each criterion within the Fundy-Yarmouth aquaculture region. Numbers in bold indicate areas that were a limiting condition in final suitability maps. NA indicates no scores are applicable for that criterion.

Criterion	Species	Restricted		Limited		Moderate		Good	
		area (ha)	% total	area (ha)	% total	area (ha)	% total	area (ha)	% total
Exposure to extreme cold	Salmon	NA	NA	49256	30.06	13966	8.52	100624	61.41
	Trout	NA	NA	49256	30.06	13966	8.52	100624	61.41
Exposure to extreme heat	Salmon	NA	NA	0	0.00	33483	20.44	130363	79.56
	Trout	NA	NA	0	0.00	0	0.00	163846	100.00
Bathymetry	Salmon	NA	NA	62914	38.40	NA	NA	NA	NA
	Trout	NA	NA	62914	38.40	NA	NA	NA	NA
	Mussels	NA	NA	38065	23.23	NA	NA	125781	76.77
	Oysters	NA	NA	19405	11.84	NA	NA	144441	88.16
Wind and wave exposure	Salmon	NA	NA	0	0.00	0	0.00	163846	100.00
	Trout	NA	NA	0	0.00	0	0.00	163846	100.00
	Mussels	NA	NA	147169	89.82	11367	6.94	5310	3.24
	Oysters	NA	NA	147169	89.82	11367	6.94	5310	3.24
Drift ice risk	Salmon	NA	NA	0	0.00	1202	0.73	162644	99.27
	Trout	NA	NA	0	0.00	1202	0.73	162644	99.27
	Mussel	NA	NA	0	0.00	1084	0.66	162762	99.34
	Oyster	NA	NA	0	0.00	746	0.46	163100	99.54
Marine protected and conserved areas	Salmon	NA	NA	0	0.00	NA	NA	NA	NA
	Trout	NA	NA	0	0.00	NA	NA	NA	NA
	Mussel	NA	NA	NA	NA	0	0.00	NA	NA
	Oyster	NA	NA	NA	NA	0	0.00	NA	NA
Critical habitat for species at risk	Salmon	NA	NA	NA	NA	1277	0.78	NA	NA
	Trout	NA	NA	NA	NA	1277	0.78	NA	NA
	Mussel	NA	NA	NA	NA	1277	0.78	NA	NA
	Oyster	NA	NA	NA	NA	1277	0.78	NA	NA

Criterion	Species	Restricted		Limited		Moderate		Good	
		area (ha)	% total	area (ha)	% total	area (ha)	% total	area (ha)	% total
Proximity to coastal access points	Salmon	NA	NA	615	0.38	NA	NA	NA	NA
	Trout	NA	NA	615	0.38	NA	NA	NA	NA
	Mussel	NA	NA	615	0.38	NA	NA	NA	NA
	Oyster	NA	NA	615	0.38	NA	NA	NA	NA
AIS vessel traffic	Salmon	NA	NA	22880	13.96	63219	38.58	77747	47.45
	Trout	NA	NA	22880	13.96	63219	38.58	77747	47.45
	Mussel	NA	NA	22880	13.96	63219	38.58	77747	47.45
	Oyster	NA	NA	22880	13.96	63219	38.58	77747	47.45
VMS Vessel traffic	Salmon	NA	NA	57688	35.21	43420	26.50	62738	38.29
	Trout	NA	NA	57688	35.21	43420	26.50	62738	38.29
	Mussel	NA	NA	57688	35.21	43420	26.50	62738	38.29
	Oyster	NA	NA	57688	35.21	43420	26.50	62738	38.29
AIS Important Vessel Routes	All	NA	NA	757	0.46	NA	NA	NA	NA
Designated traffic routes	All	72	0.04	283	0.17	NA	NA	NA	NA
At-sea disposal sites	All	14	0.01	NA	NA	NA	NA	NA	NA
Marine Renewable Energy Areas	All	369	0.23	NA	NA	NA	NA	NA	NA
Anchorage areas	All	66	0.04	86	0.05	NA	NA	NA	NA
Submerged cables and pipelines	All	0	0.00	0	0.00	NA	NA	NA	NA

Table 9. Total area (in hectares) scored for each criterion within the Upper Fundy aquaculture region. Numbers in bold indicate areas that were a limiting condition in final suitability maps. NA indicates no scores are applicable for that criterion.

Criterion	Species	Restricted		Limited		Moderate		Good	
		area (ha)	% total	area (ha)	% total	area (ha)	% total	area (ha)	% total
Exposure to extreme cold	Salmon	NA	NA	195495	95.01	5472	2.66	4804	2.33
	Trout	NA	NA	195495	95.01	5472	2.66	4804	2.33
Exposure to extreme heat	Salmon	NA	NA	0	0.00	132911	64.59	72860	35.41
	Trout	NA	NA	0	0.00	0	0.00	205771	100.00
Bathymetry	Salmon	NA	NA	91248	44.34	NA	NA	NA	NA
	Trout	NA	NA	91248	44.34	NA	NA	NA	NA
	Mussels	NA	NA	67545	32.83	NA	NA	138226	67.17
	Oysters	NA	NA	45678	22.20	NA	NA	160093	77.80
Wind and wave exposure	Salmon	NA	NA	0	0.00	0	0.00	205771	100.00
	Trout	NA	NA	0	0.00	0	0.00	205771	100.00
	Mussels	NA	NA	106304	51.66	94556	45.95	4911	2.39
	Oysters	NA	NA	106304	51.66	94556	45.95	4911	2.39
Drift ice risk	Salmon	NA	NA	109606	53.27	39984	19.43	56181	27.30
	Trout	NA	NA	109606	53.27	39984	19.43	56181	27.30
	Mussel	NA	NA	55545	26.99	2097	1.02	148129	71.99
	Oyster	NA	NA	45336	22.03	1521	0.74	158914	77.23
Marine protected and conserved areas	Salmon	NA	NA	5	0.00	NA	NA	NA	NA
	Trout	NA	NA	5	0.00	NA	NA	NA	NA
	Mussel	NA	NA	NA	NA	5	0.00	NA	NA
	Oyster	NA	NA	NA	NA	5	0.00	NA	NA
Critical habitat for species at risk	Salmon	NA	NA	NA	NA	110120	53.52	NA	NA
	Trout	NA	NA	NA	NA	110120	53.52	NA	NA
	Mussel	NA	NA	NA	NA	110120	53.52	NA	NA
	Oyster	NA	NA	NA	NA	110120	53.52	NA	NA

Criterion	Species	Restricted		Limited		Moderate		Good	
		area (ha)	% total	area (ha)	% total	area (ha)	% total	area (ha)	% total
Proximity to coastal access points	Salmon	NA	NA	206	0.10	NA	NA	NA	NA
	Trout	NA	NA	206	0.10	NA	NA	NA	NA
	Mussel	NA	NA	206	0.10	NA	NA	NA	NA
	Oyster	NA	NA	206	0.10	NA	NA	NA	NA
AIS vessel traffic	Salmon	NA	NA	3381	1.64	4139	2.01	198251	96.35
	Trout	NA	NA	3381	1.64	4139	2.01	198251	96.35
	Mussel	NA	NA	3381	1.64	4139	2.01	198251	96.35
	Oyster	NA	NA	3381	1.64	4139	2.01	198251	96.35
VMS Vessel traffic	Salmon	NA	NA	15831	7.69	31282	15.20	158658	77.10
	Trout	NA	NA	15831	7.69	31282	15.20	158658	77.10
	Mussel	NA	NA	15831	7.69	31282	15.20	158658	77.10
	Oyster	NA	NA	15831	7.69	31282	15.20	158658	77.10
AIS Important Vessel Routes	All	NA	NA	0	0.00	NA	NA	NA	NA
Designated traffic routes	All	0	0.00	0	0.00	NA	NA	NA	NA
At-sea disposal sites	All	0	0.00	NA	NA	NA	NA	NA	NA
Marine Renewable Energy Areas	All	283	0.14	NA	NA	NA	NA	NA	NA
Anchorage areas	All	11	0.01	87	0.04	NA	NA	NA	NA
Submerged cables and pipelines	All	32	0.02	315	0.15	NA	NA	NA	NA