Memorial University – ENSU 4201 & ENVP 6055

Comments on the Draft Agreement and Terms of References for the Regional Assessment of Offshore Wind Power for Newfoundland and Labrador

Background research, evaluations, and recommendations for selected valued components.

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1 EXECUTIVE SUMMARY

Offshore wind power development will provide many opportunities for the people of Newfoundland and Labrador. However, the development of these opportunities will have impacts on a variety of valued components that needs to be understood, accounted for, and, ultimately, avoided or mitigated.

The regional assessment of Offshore Wind Development for Newfoundland and Labrador provide the opportunity for the public to express their concerns regarding the development. In turn, the impact assessment agency must consider these concerns and address them as appropriate.

This document answers the call for comments on the draft agreement and terms of references for Newfoundland and Labrador by the impact assessment agency launch in October 2022. We present a compendium of background research, evaluation, and recommendations for selected valued components, specifically:

- Aquatic Habitat and Health
- Marine Species
- Migratory Birds
- Newfoundland and Labrador Fisheries
- Tourism and Aesthetics
- Inuit and Innu Rights and Consultation

It should be noted that they are other valued components that are of interest for the regional assessment, including community well-being, mental health, cultural identity, and Mi'kmaq rights and consultations. Despite the importance of these valued components, these are currently out of the scope of this document because of time considerations. The work included in this document are part of the requirement for the ENSU 4201 and ENVP 6055 courses completion. ENSU 4201 in part of the required course work for students in the Bachelor of Environment Sciences and Environment and Sustainability. ENVP 6055 is part of the required work for students in the Master of Arts in Environmental Policy.

We have key recommendations as follow:

1. We recommend that a species advisory group concerning Tourism be created and integrated in the RA.
2. We recommend that the DA and TOR include more specific languages regarding:
    a. The design and geographic arrangement of the turbine, impacts of noise to migratory and resident species, best practices for the design of wind farms, and what will the policy regarding usage of this area;
    b. Migratory species and Species at Risk;
    c. Baselines study and what they should entail for each valued component; and,
    d. Composition of each advisory group and representation from each indigenous group in the province for each advisory group
3. We recommend the exclusion of the surrounding area of Gros More National Park, including viewsheds from the shoreline of the park and mountain peak, from the study area and designate it an offshore wind development-free zone.

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2 KEY RECOMMENDATIONS

2.1 ADVISORY GROUPS

2.1.1 Tourism

- We recommend creating a Tourism Advisory Group, just as there is a proposed Advisory Group for "Fisheries Information and Analysis". The scope of the role of this Tourism Advisory Group would mirror that of Fisheries Information and Analysis, but with a focus on tourism; that is, to seek knowledge, information and advice from the tourism industry on current and potential tourism activity, as well as potential interactions and impacts resulting from offshore wind development activities in the Study Area, and approaches for avoiding or minimizing adverse effects and creating or maximizing opportunities for positive effects (Impact Assessment Agency of Canada, 2022b). We recommend consulting with the following, but not limited to, tourism stakeholders in the Regional Assessment:
    - Destination Management Organizations (DMOs);
    - Hospitality Newfoundland and Labrador (HNL);
    - Municipalities Newfoundland and Labrador (MNL);
    - Newfoundland and Labrador Indigenous Tourism Association (NLITA);
    - Parks Canada; and,
    - Newfoundland and Labrador Department of Tourism, Culture, Arts and Recreation.

2.1.2 Fisheries

- The fisheries advisory groups should ensure that the fisheries advisory group includes a broad spectrum of people engaged with fisheries activity, with Indigenous rights and fisheries, and with expertise marine ecosystems health. This should include more specifically:
    - At least one member from each Indigenous group in Newfoundland and Labrador to the Fisheries Advisory Committee. Their different experiences, skills, knowledge, and interests will be very important in the evaluation process. Also, there should be more detailed information about how indigenous people can be a part of the advisory groups.
    - Participants with expert and/or traditional knowledge of Newfoundland and Labrador marine ecosystems, including the role of top predators, such as sharks,
    - including fish harvester, like individuals and community associations (Association of Seafood Producers, The NL Fishing Harvesting Safety Association) in this assessment (Section C, TOR, p.2).
        - Their experience will be vital to understanding the limitations of the current offshore areas and help to make an effective way to minimize the adverse effects of it on their life. A finding from Alexander et al., 2013 study, as a suggestion for is that "the fishing industry and the renewables industry should be able to work together, but that this should include two-way communication, the need for compromise, and a method of 'suggesting, not telling' fishermen about potential developments"to focus on predator species in the study area.

- The socio-cultural aspects of fisheries in Newfoundland and Labrador should also be considered as Offshore Wind Power development might be a threat to this way of life.
    - The advisory group should there also include social scientists, historian, folklorists, and other experts in traditional way of life for Newfoundland and Labrador to assess the potential impacts of this development on the cultural identify and community well-being.

2.2 GEOGRAPHIC AREAS OF CONCERNS

- **We recommend the exclusion of the surrounding area of Gros More National Park, including viewsheds from the shoreline of the park and mountain peak, from the study area and designate it an offshore wind development-free zone** to maintain and comply with Gros Morne National Park's tourism industry, ecological goals and its UNESCO World Heritage Site designation.
    - Furthermore, offshore wind turbines often require onshore infrastructure, which would not normally be permissible under the National Parks Act. The exclusion area should extend to a distance where any offshore wind turbines are not visible from any point in the park; including the highest point, which is at 806m.
- The TOR and DA in their current form do not discuss the on-land components that will be necessary to the development of offshore wind power. We recommend that the provincial and federal governments expand the scope of the RA to include these terrestrial counterpart. With the expansion of the scope should include a broader inclusion of terrestrial ecosystems and associated valued components.
- It is also a concern that the current TOR and DA did not put into consideration the special marine areas that are along the study area for offshore wind development. We would therefore like to see some changes in the TOR and DA pertaining to additional protective measures being placed in accordance with the Fisheries and Oceans Canada's *Oceans Act*, that seeks to protect special marine areas. For this case, we would like to see appropriate buffer zones around the special marine areas so as to protect the aquatic habitat from potential exploration or construction impacts.
- Furthermore, we recommend the TOR should include the location and nature of natural reefs. As well, the TOR should lay out the intent to conserve rich reef habitats and protect the vulnerable and poor reef habitats, through the installation of artificial reefs (offshore wind farm devices) at the distances proposed in the above paragraph.

2.3 BASELINE STUDIES

- Concrete and specific studies of aquatic habitat and health including components such as electromagnetic fields, underwater sound levels and frequencies, sedimentation, and reefs should be requested in the TOR. This should include specific information on what are the best practices to undergo baseline studies for these components.
    - This baseline study should include the current types of species present and migratory species, analysis of migration routes, determination of EMF-sensitive species,

sedimentation disruption, sound levels and frequencies, as well as current marine environment conditions, such as turbidity, conductivity, and water chemistry.
    - To monitor the wellbeing of the ecosystem from top predators, sharks could be either tagged and tracked, or have their activity monitored with aerial or nautical surveys.

2.4 INCLUSION OF VARIOUS SPECIES INCLUDING SPECIES AT RISK AND ENDANGERED SPECIES.

- The TOR should make specific mentioned of species of importance to Newfoundland and Labrador, including species at risk and endangered species. More specifically, this would include:
    - There is no mention of leatherback sea turtle habitat specifically in the terms of reference, and with them being classified as an endangered species, that should be included.
    - Top predators, such as sharks, should be recognized for their important role and function in marine ecosystems and be included in the assessment.
    - Regarding impacts on fisheries stocks, the TOR should provide an understanding of which fish species are drawn to wind turbines and which are scared away by them; the terms of reference must include more information about how specific preferences will be found and what needs to be done to protect valuable species.
    - Bats and other migratory mammals.
    - Coastal and shoreline seabirds.
- Based on current scientific research it is likely that noise emitted from turbines will negatively impact marine and aerial migratory species. The lack of in-depth research and understanding regarding the impact of noise throughout the construction, operation and decommissioning phases of offshore wind development provides an opportunity for future research.
- There is an overall lack of knowledge, information, and research on the impacts offshore wind developments have on migratory vertebrates. Past and present requirements for large-scale developments largely focus on monitoring and data collection. We recommend future offshore wind developments focus on mitigation efforts because of the lack of information. **In doing so Newfoundland and Labrador can become a leader in research for reducing the negative impacts** these developments have. This research, and implementation of mitigation strategies will also lower the long-term costs associated with any retroactive implementation of mitigation strategies.

2.5 PROJECT DESIGN

- We recommend that the final TOR lays out the request for detailed information and specifications on the design and construction of the wind farms. This should include:
    - The size and geographical arrangement of the turbines.
    - The TOR should request information on the turbine number, size, generator type, location, and overall time in operation as they are needed to help protect the aquatic habitat and health and describe best practices.

        - It is worth noting that based on previous studies of offshore wind farm development, it is recommended that these devices be placed near each other, as well as near natural reefs to increase habitat connectivity (Draget, 2014).
    - We recommend that there be more emphasis and effort placed on the review of marine transportation to and from the selected location. Marine transportation and increases in traffic have not been discussed in these documents. If we take this factor into account, then we would be able to gauge the extent to which marine traffic would be increasing and then assess any potential implications from that which might negatively impact the whale population in that area.
    - Terrestrial *transportation* expansion is not discussed properly, even though Newfoundland has greater transportation routes than Northern Labrador and may have important impacts on Inuit and Innu communities. To identify and evaluate information and knowledge on greater transportation routes, land use will have to be looked at before transporting large equipment onshore for the development of wind turbines. Construction of expanding roads will increase noise pollution along with spills of oil and gas if not looked at properly.

2.6 MIGRATORY BIRDS

- The TOR should provide the ground for the identification of specific areas of concern with reference to migratory pathways and how they interact with wind turbines.
- Additionally, it is important that the TOR discuss best practices and research on how to construct safe wind turbines (to alleviate the outlined stresses). An expert panel may inform on how to construct wind turbines which will cause the least negative behaviors in encounters with migratory birds.
- As it can be observed that endangered migratory bird species and their habitats are present within the study area, exclusion zones should be used as a tool in areas of high population density as a means of mitigating risks imposed on these species.
- The committee should aim to construct an advisory panel of reputable local and commercial fishery operators in addition to a panel of experts to measure specific areas of avian displacement and habitat degradation and monitor changes in aquatic activity within 100m of offshore wind turbines.

2.7 IMPACTS ON COASTAL COMMUNITIES AND RESIDENTS

- The Regional Assessment should collect and consider the opinion of nearby residents when spatial planning for the construction of the wind turbines to prevent any visual discomfort of nearby residents. The final Impact assessment should include concrete actions to support people impacted.
- The TOR and DA should provide instruction how best practices for compensating residents that prefer to move after the construction of the farm and to compensate individuals who see a decrease in their property value after the turbines are built.

- Marine spatial planning surrounding offshore wind farms should be informed by coastal and ocean users so as to allow for them to continue utilizing the area for recreational activities.
- The Regional Assessment should ensure that there is a support system in place for residents that are suffering from mental illnesses incurred from the construction/establishment of a local wind farm.
- There should be a clear forum to discuss how the benefits of these wind farms will be share with communities and with the province.
    - This should include what are the legal mechanism and jurisdictional power to ensure just and equitable benefit sharing.
    - Clear actions expected from proponents regarding Equality-Diversity-Inclusion, Anti-Racism and Anti-Sexism best and effective practices.
    - Description of best practices for proponents and communities to ensure and/or develop high quality health care, childcare and other community services.
    - Clear directions for proponents on how to ensure gender equality in the workplace and how to minimize gender-imbalance and negative experience for women and girls.
- The document does not reference the social effects on indigenous women and communities. There is also no advisory group for women or any other minority groups, and no mention of the inclusion of minorities as members of other advisory groups. **We recommend that an Advisory Group by created to assess the impacts and opportunities for Women, BIPOC, and Indigenous groups**

2.8 INNU AND INUIT RIGHTS, KNOWLEDGES AND COMMUNITIES

- In section 6.1 where they state “that In addition, the Committee will include a summary of its Report in plain language and available in English, French, Mi'kmaw, Innu-aimun and Inuktitut.
    - Providing the documents in languages such as French Mi'kmaw, Innu-aimun and Inuktitut is good but it is not enough to have these communities engage with the process and future plans of the proponent.
    - Each document should be translated and be available in the beginning of the comment period as well as before the consultations begin with these communities.
- In the Terms of Reference in section A1.6 they speak about the plans for developing the Public, Fisheries and Stakeholder Participation plan and the Indigenous Participation Plan but they do not go into enough detail to know what exactly that entails. For future documents and plans it would be better for the Indigenous communities and the public to know what to expect from these types of plans. One suggestion that was made during another assessment was that if the Indigenous communities like the Innu in this situation, that a member of the local indigenous communities should be a part of the Fishers Committee to be consulted in their fishery rights.

3 AQUATIC HABITAT AND HEALTH

Claire Parsons, Meaghan O'Neill, Kiana Jacobs, Swaiba Chanyika

3.1 Summary

- Aquatic habitat and health is an important component to consider when conducting the regional assessment of offshore wind farms in Nova Scotia and Newfoundland & Labrador.
- One specific component to consider is the creation of anthropogenic electromagnetic fields (EMFs) from subsea cables which carry electrical energy from turbines to substations.
- Anthropogenic EMFs can alter migration patterns and movement, predator-prey relationships, and behavioural patterns within marine species.
- Another specific component that is important to consider is the underwater sound levels and frequencies created during the construction, production, and decommissioning of wind farms as they can have significant impacts on aquatic habitats and health.
- Understanding the full impact of underwater sound levels and frequencies created from wind farms are important, as they can cause confusion in multiple marine species that use their own underwater noises for processes such as foraging, orientation, and communication.
- Sedimentation and benthic organisms are another crucial component in aquatic ecosystems, as they are a key part in many ecological processes, such as nutrient cycling and primary production.
- Disturbances to both the sedimentation and benthic organisms can disrupt these aforementioned ecological processes, which in turn can alter the aquatic habitat.
- With appropriate design and management, offshore wind turbines have the potential to produce positive impacts on aquatic habitat and health.
- Wind turbines provide a hard substrate for organisms to accumulate on (i.e., biofouling) and thus, act as artificial reefs in the marine environment.
- Artificial reefs provide shelter and food sources to aquatic species, thus contributing to a healthy aquatic habitat.
- The current terms of reference and draft agreement for this project includes several potential activities and evaluations which can encompass aquatic habitat and health, including; advisory groups evaluating scientific and technological information about the environment, committee evaluations of potential environmental impacts, and a committee report which analyses impacts and provides recommendations.
- Furthermore, based upon an evaluation of the terms of reference, it is recommended that the regional assessment includes; further evaluation of the long-term impacts on the environment, a review and analysis of the potential types of wind turbines, baseline studies of the current marine environment, and further consideration of special marine areas.

3.2 ANTHROPOGENIC ELECTROMAGNETIC FIELDS (EMFS)

3.2.1 Background

Earth contains many naturally occurring electromagnetic fields (EMFs) which people and animals interact with everyday in a variety of environments. In the marine environment, the most predominant electromagnetic fields are produced by: (1) Earth's geomagnetic field and (2) electric fields which are created by the movement of ocean water and marine species (Hutchison et al., 2020a). Natural electromagnetic fields can be detected by numerous aquatic species and can be used for a number of processes (Bailey et al., 2014). For example, several elasmobranch species (i.e., sharks, skates, and rays) use their magnetoreceptors to detect Earth's geomagnetic field to determine their location and to provide a sense of direction (Hutchison et al., 2020b). Likewise, some elasmobranch species, benthic invertebrates, and teleost fish (i.e., Atlantic salmon, Atlantic cod, and halibut) rely on the geomagnetic fields for annual migration and habitat selection (Hutchison et al., 2020b). In addition to using magnetoreceptors, some species use electroreceptors to detect weak bioelectric fields produced by the movement of other organisms in a marine environment (Normandeau Associates, 2011). The ability to detect bioelectric fields allows predators to detect their prey more easily than using traditional sensory inputs (Hutchison et al., 2020b).

Most turbines in an offshore wind farm are connected to offshore substations and onshore substations via a series of subsea power cables. The cables are able to transport electrical energy from the location of the turbine to onshore, where the energy can then be used as an electricity source (Normandeau Associates, 2011). The voltage of the electrical energy moving through the cable produces an electric current within the cable; however, a cable which carries a current also produces a magnetic field which becomes emitted to the surroundings (Hutchison et al., 2020b). This produces an anthropogenic EMF into the marine environment which aquatic species can interact with. Furthermore, the location of the cables (i.e., on top of the seabed versus below the seabed), as well as additions around the cable (i.e., concrete surrounding or rock armour) can alter the shape and strength of the EMF produced (Hutchison et al., 2020b). Additionally, the type of current (alternating versus direct) can impact the fields produced as alternating currents have the ability to induce electric fields (Hutchinson et al., 2020b).

The addition of anthropogenic EMFs to a marine environment can have a variety of impacts on natural processes and interactions. For instance, the creation of anthropogenic EMFs may alter migration patterns and make areas surrounding the subsea cables inhabitable, as fish species rely on natural EMFs to provide direction and spatial orientation (Ohman et al., 2007). Changes in migration patterns can have impacts on species diversity and interactions between species (Bailey, 2014). Furthermore, depending on the type of migratory species affected, there may be significant socio-economic impacts. For example, Atlantic salmon are migratory fish which many people in the province of Newfoundland rely on heavily for recreational fishing (Whoriskey & Glebe, 2002).

Moreover, many species rely on natural EMFs and bioelectric fields to determine where and what their prey is. Species such as those belonging to the elasmobranch can detect the weak bioelectric fields created by prey; however anthropogenic EMFs created by nearby cables can mask or alter the bioelectric fields created by prey, preventing their capture (Hutchison et al., 2020b). Disruptions to natural predator-prey cycles can have significant impacts on the community structure and thus, the marine food chain (Karakoc et al., 2017). Additionally, the presence of anthropogenic EMFs can alter

marine organisms' behavioural patterns. The changes in behaviour varies between species; however, some general trends exist and they include; (1) changes in burrowing patterns of benthic invertebrates, (2) changes in vertical movement in pelagic species , and (3) alterations in the dwelling times of migratory species (Hutchison et al., 2020a; Normandeau Associates, 2011).

3.2.2 Evaluation

Many past impact assessments for offshore wind farms throughout the world include sections detailing the potential environmental risks and impacts that an offshore wind farm can have on the marine environment and habitat (Galparsoro et al., 2022). Nonetheless, many impact assessments lack the data, both baseline and future, needed to perform a thorough and cumulative assessment of the potential environmental impacts (Galparsoro et al., 2022). In addition to the lack of data pertaining to the environment, there are challenges associated with balancing the needs and recommendations of all stakeholders, especially in the planning phase (Bailey, 2014).

In early 2022, the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) released a term of reference (TOR) as part of the regional assessment for offshore wind development in Brazil. This term of reference provided a thorough evaluation of the planning, assessment, impacts, and reporting associated with offshore wind development (IBAMA, 2022). For instance, this TOR provided specific regulations to evaluate the impacts that offshore wind farms can have on aquatic habitat and health including, but not limited to; evaluation of the turbines and cables used, site characteristics, species present, environment sensitivity, benthic habitats, noise and vibrations, and baseline studies (IBAMA, 2022).

The current TOR and draft agreement (DA) for Nova Scotia and Newfoundland & Labrador released in October 2022 details the activities, report, and schedule of the regional assessment committee which will be evaluating the potential offshore wind development in these two locations. In the TOR, there are several potential activities and evaluations that can include the aquatic habitat and health. Firstly, section A1.6 states that there will be an advisory group which will analyse the scientific and technical information, and therefore, this group can potentially evaluate the impacts of offshore wind farms on the aquatic habitat (IAAC, 2022a). Likewise, section A1.6, T details that the committee will evaluate all impacts, both positive and negative, that the development of an offshore wind farm can have on marine fish and fish habitats, as well as the impacts on marine mammals and sea turtles (IAAC, 2022a). Furthermore, objective A and B of the committee report detailed in the TOR is said to provide analysis and knowledge pertaining to potential environmental impacts, as well as providing information for future offshore wind farm planning and activities (IAAC, 2022a). Moreover, section A2.4 also states the committee report will provide, "a high-level, generic description of the types of offshore wind development activities…This will include fixed technologies, as well as newer floating technologies" (IAAC, 2022a).

The DA for Newfoundland & Labrador includes a much broader description of the processes, assessments, committees, reports, and cost. Nonetheless, the document outlines that both the committee and advisory groups will evaluate the potential environmental impacts that offshore wind development can have (IAAC, 2022b).

3.2.3 Recommendations

Based upon an evaluation of the TOR and DA for the Newfoundland & Labrador regional assessment offshore wind, one recommendation for the TOR would be that the final report should include specific instructions for the committee to perform baseline studies on the aquatic environment for the proposed development area. This baseline study should include the current types of species present and migratory species, analysis of migration routes, determination of EMF-sensitive species, as well as current marine environment conditions, such as turbidity, conductivity, and water chemistry. A comprehensive baseline study would be beneficial for predicting potential impacts, as well as determining potential cumulative effects (Bailey, 2014). Likewise, the committee report outline in the TOR should be more specific in its assessment of the types of turbines used. The committee report would benefit from a more detailed evaluation of the types of potential turbines that can be used, as well as an evaluation of the subsea cables used. A more thorough analysis of the number, size, material, location, voltage, and frequency of the subsea cables would benefit not only the economic assessment of the project, but also help predict potential aquatic environment impacts.

3.3 Underwater Sound Levels and Frequencies

3.3.1 Background

Recently, there has been a surge of interest in the use of greener energy. One way that people are acquiring their green energy is through the use of wind turbines. With this rise in creating greener energy, it is no surprise that Newfoundland & Labrador is also looking into getting involved with their own offshore wind farm. While the project of the Newfoundland & Labrador wind farm is still in its early stages, at the present a draft agreement and terms of reference (TOR) has been created. While reviewing these documents, some questions and concerns can be posed. One concern is the lack of information regarding the aquatic habitat and health. The use of offshore wind turbines can have various impacts on the aquatic habitat; however, one area of interest is underwater sound levels and frequencies.

Results from a study done by Stöber & Thomsen (2021) showed that the overall impact of underwater sound that has been researched and regulated has been related to the construction work of building wind warms, not from operational wind farms. Additionally, the same study from Stöber & Thomsen (2021) stated that impact assessments have not been done for wind turbines larger than 6 MW. It is important to understand the types and levels of underwater sound and frequencies produced by operational wind turbines because multiple marine species use sound for activities like foraging, orientation, and communication (Madsen et al., 2006). Since marine species use underwater noise for various reasons in their lives, they are susceptible to negative effects of anthropogenic noise that can be created during the construction and operation of wind turbines (Madsen et al., 2006).

Regarding the construction of offshore wind turbines, there are various activities that occur during the construction process that are known to produce underwater noise of varying intensity, duration, and spectra (Madsen et al., 2006). The greatest noise-producing process of the construction phase tends to be pile-driving, which is the process of installing a pile into the seabed, and it can

generate intense sound impulses and vibrations that can disrupt the behaviour of marine species within a wide radius (Madsen et al., 2006). In a study done by Tougaard et al. (2020), each pile that was placed required about 5000-7000 blows of a hammer, which resulted in the mean total energy of 1,912,100 kJ per pile. For larger wind farms that have many wind turbines, pile driving is a process that generates a large amount of sound over a broad bandwidth (Madsen et al., 2006). Even though Madsen et al. (2006) found that the noise impact on marine species is more severe during construction than during operation, it cannot be overlooked that underwater noise is still produced during the operation of offshore wind turbines.

In both studies done by Madsen et al. (2006) and Stöber & Thomsen (2021), it was concluded that the noise levels of turbines presently in operation can be identified but, there is little reason to believe they have a significant impact on marine animals, especially in areas near main shipping traffic routes. However, the study by Stöber & Thomsen (2021) also highlighted a paper written by Thomsen et al. (2006) that found that noise greater than 142dB and 160Hz (centre frequency) exceeded the ambient noise up to a distance of 3.3 km. Furthermore, a paper written by Tougaard et al. (2009) estimated the maximum distance that seals could perceive noise from wind farms was between 2.5-10 km and, for porpoises, 63 m; therefore, making them susceptible to noise produced by near-by wind farms.

When in operation, much of the noise created by wind turbines is created by vibrations in the gearbox (Madsen et al., 2006). The vibrations are then coupled to the water column and the seabed through the turbine foundations, causing a strong propagation of sound at a variety of sound levels (Madsen et al., 2006; Bailey et al., 2010). Although, it can be argued that wind turbines would create no more noise than passing marine traffic. Unlike ships just passing through, wind turbines are static and permanent, and therefore, cause a permanent and local impact to the environment (Stöber & Thomsen, 2021; Tougaard et al., 2020). Additionally, wind turbines are rarely isolated – their combined and cumulative impact must be taken into consideration (Tougaard et al., 2020). Furthermore, there has been a rapid increase in the size of offshore wind farms (Tougaard et al., 2020) and wind turbines (Stöber & Thomsen, 2021). As the size of farms increases, so does the level of noise and as the size of the turbine increases, so does the mechanical forces working on the gears and bearings; therefore, increasing the noise levels (Tougaard et al., 2020).

As mentioned before, these underwater sound levels and frequencies created from wind turbines are important to consider before starting the offshore wind project. Many aquatic species, such as crustaceans, fish, and marine mammals, that are capable of generating and detecting sounds, will be impacted (Bailey et al., 2010). It has been shown in the study done by Stöber & Thomsen (2021) that the noise generated from wind turbines can cause masking of communication and orientation signals in fish, rather than physiological damage or consistent avoidance. However, the same study also points out that there is still little known about how sound impacts fishes (Stöber & Thomsen, 2021). It is also important to point out that Madsen et al. (2006) argued that if an animal remains close to a turbine for a prolonged period of time, it might risk a temporary threshold shift.

3.3.2 Evaluation

As previously mentioned in this report, there has been many impact assessments for offshore wind farms that have included sections on the potential environmental risks and impacts they can have

on the environment, however these past assessments lack the data to perform a comprehensive assessment of the potential impacts on the aquatic habitat and health (Galparsoro et al., 2022). Furthermore, there was a noticeable trend across multiple studies which showed that most impact assessments for offshore wind farms only focus on the sound levels and frequencies during construction, not during operation or decommission (Green et al., 2022; Stöber & Thomsen, 2021; Madsen et al., 2006). It is important to note that Stöber & Thomsen (2021) stated that more attention should be placed on taxa that are sensitive to low frequency sounds, such as baleen whales and fishes, as most studies focus on marine mammals exclusively.

Moreover, the current TOR and DA released in October 2022 detailed the activities, report, and schedule of the regional assessment committee which will be evaluating the potential offshore wind development in Nova Scotia and Newfoundland & Labrador. In the TOR, section A1.6 T detailed committee evaluations which will analyse the possible impacts that the development of an offshore wind farm can have on marine fish and fish habitats, marine mammals, and sea turtles (IAAC, 2022a). For the draft agreement for Newfoundland & Labrador, as previously stated, it included a much broader description of the processes, assessments, committees, reports, and cost. Regardless, the DA still outlines that both the committee and advisory groups will help the process by evaluating the potential environmental impacts that offshore wind development can have (IAAC, 2022b).

3.3.3 Recommendations

Based upon an evaluation of the TOR and DA for the Newfoundland & Labrador regional assessment offshore wind, one overall recommendation that was also mentioned above was that the committee report should include specific instructions for the committee to perform baseline studies on the current sound levels and frequencies, as well as the species present in the proposed development area. As of 2021, there are two main ways to help operate a wind turbine; gear boxes, which are known to be noisier, and direct drive technology, which has been found to reduce sound levels by 10 dB (Stöber & Thomsen 2021). Furthermore, there has not been any impact assessments performed for turbines that are larger than 6 MW (Stöber & Thomsen, 2021). Therefore, the committee report should include a better evaluation of the turbine number, size, generator type, location, and overall time in operation as they are needed to help protect the aquatic habitat and health.

When looking over the draft agreement and TOR for this offshore wind project in Newfoundland, it is alarming how little is being looked into regarding aquatic habitat and health. Changes in underwater sound levels and frequencies have a large effect on marine species, and wind turbines have shown to cause these changes. As a province that prides itself on its marine life, noise levels from the turbines are essential to look into and understand before this project moves any further.

3.4 Potential Disturbances to Sediment and Benthic Organisms

3.4.1 Background

During the construction of wind farms, many offshore wind turbines are installed along the seabed**.** This has raised many concerns on how the construction process of wind turbines could be impacting the marine ecosystem (Draget, 2014). The installation of wind turbines can cause disturbances to the seabed, directly affecting the organisms that depend on the area for habitat, food, and reproduction

(Draget, 2014). Disturbances to sediment have cumulative effects on the aquatic environment, and they begin with benthic organisms.

When looking at aquatic habitat and health, sedimentation and benthic organisms are crucial components to consider (Draget, 2014). It can be argued that benthic organisms and sediment are the building blocks of every marine ecosystem. Sedimentation covers the sea floor and provides important habitats for benthic organisms such as bivalves, crabs, and many others (Ruffner, 2022). Benthic organisms are a source of food for many other organisms; therefore, should any disruptions occur, it could affect the species diversity or abundance of other organisms further up the food chain (Ruffner, 2022). Additionally, benthic organisms are important to many ecological processes and disruptions can affect the following; cycling of nutrients such as carbon, nitrogen, and sulphur, water column processes, fate of pollutants, marine production, and the movement of sediments (Snelgrove et al., 1997*)*.

It is important to consider the potential impacts that each phase (construction, operation, and decommissioning) of the project's offshore wind turbines would present on sedimentation and benthic organisms. Disturbances to sedimentation can negatively affect benthic organisms as habitats are disturbed, displacing large communities of benthic organisms (Draget, 2014). Furthermore, this can cause changes to species diversity which in turn would cause alterations to the productivity and composition of the ecosystem (Draget, 2014).

There has been an abundance of research done on the impacts that offshore wind turbines have on a variety of marine species and related components. In a recent article reviewing the ecological impacts of offshore wind farms, Galparsoro et al. (2022) showed that the frequency of scientific findings reported on invertebrates was significantly lower compared to that of larger species and components. Furthermore, the short-term effects of offshore wind turbines on sedimentation and benthic organisms have been researched more frequently than long-term effects, where the short-term effects include a primary focus on the construction and operation phase (Draget, 2014).

Overall, the effects that the construction process of offshore wind turbines has on sedimentation and benthic organisms is negative due to the disturbance to sedimentation. The preferred seabed type to construct offshore wind turbines on is gravel or sand (Draget, 2014). The seabed type is relevant because, during the construction phase, sedimentation can become suspended and may disperse throughout the water column (Draget, 2014). Research has shown that dispersed sedimentation and biological diversity have an inverse relationship - as the dispersion of sedimentation increases, biological diversity decreases (Vaselli et al., 2008, as cited in Draget, 2014). This relationship is also affected by the size of particles, intensity, life history of a species, and dispersal distance of the particles (Airoldi, 2003, as cited in Draget, 2014). Furthermore, a decrease or change in species diversity could have significant effects on the ecosystem's functional traits, such as its resistance to disturbances, productivity, and susceptibility to biological invasion (Draget, 2014).

However, there are some potential positive effects on benthic organisms that can occur both after the construction and during the operational phases of offshore wind farms. Many benthic organisms seek habitats further away from the shoreline due to human activity and pollution, and therefore, turbines could potentially support refuge for these organisms (Draget, 2014). After the construction phase of the wind turbines, it is predicted that the microorganisms will reestablish quickly, but it is difficult to determine how long it will take for colonisation of sessile communities to develop, as they may be affected by a number of factors including; age of seabed, type of seabed, seasonal

variation, or predation (Draget, 2014). Once colonisation of sessile communities occurs, it can lead to a number of positive outcomes, as offshore wind turbines can support a large number of sessile organisms (Draget, 2014). An increase in the population of sessile organisms could then lead to an increase in food availability, and thus a potential increase in species diversity and abundance (Draget, 2014).

3.4.2 Evaluation

Most of the research conducted specifically on the offshore wind turbines' effects on sedimentation and benthic organisms is focused on the early stages (Draget, 2014). Additionally, the long-term effects of disturbance to sedimentation and benthic organisms by offshore wind turbines has not been researched as heavily as the short-term effects have been (Coates et al., 2015). Therefore, these two points should be considered and investigated further when assessing the potential disturbances of offshore wind energy. As stated earlier, sedimentation and benthic organisms are equivalent to building blocks in their ecosystem and potential disturbances to them should be considered as it would have cumulative effects. Although there are potential positive impacts in the short term, there should still be research done on the negative effects and the long-term effects that would occur during decommissioning and afterward.

The recently released TOR includes a number of sections which highlight that the potential evaluation of the aquatic habitat and health (section A1.6 and Objective A and B) (IAAC, 2022a). Although the descriptions provided use somewhat general and vague language, it is impossible for the disruption of sedimentation and benthic organisms to be included in this evaluation. Furthermore, it is possible for the advisory groups and reports detailed in the DA to include aquatic habitat and health (IAAC, 2022b).

3.4.3 Recommendations

As mentioned above, with regard to the draft agreement and TOR for the Newfoundland & Labrador regional assessment of offshore wind power, a recommendation would be for the committee report to include specific instructions on how to perform baseline studies. The baseline studies would pertain to potential species that could be affected by the turbines during the construction phase in the study area, as well as the potential short-term and long-term effects on benthic organisms. Furthermore, the baseline study should also include potential impacts of sedimentation disruption. Currently, there is a lot of research on the short-term effects that offshore wind turbines have on benthic organisms, so a deeper look at the potential long-term effects would be helpful.

3.5 Assessment of Aquatic Habitat and Health Components

3.5.1 Background

Appendix A shows a map of the study area (Figure A.2) for the offshore wind farm regional assessment (IAAC, 2022b), and it also shows a map of the special marine areas in Newfoundland & Labrador (Figure A.1) based on bioregional eco-units developed for *Canada's National Framework for Marine Protected Area*s (White et al., 2018). Marine protected areas can be defined as legally designated areas that provide long-term protection of marine ecosystems, processes, habitats, species, and biodiversity (White et al., 2018). When comparing the two maps, it is obvious that the study area for the offshore wind regional assessment encompasses all, if not most, of the special marine areas.

Along the red line shown on the map in appendix A, there exists several special marine areas, including; Newfoundland & Labrador's continental shelf, Labrador sea, Northern Grand Banks, Southern Grand

Banks, Laurentian Chanel/South Coast, Gulf of St. Lawrence, and the Laurentian Fan (White et al., 2018). The study area for the offshore wind farm covers all the marine protected areas with the exception of the Laurentian fan (IAAC, 2022b).

The water surrounding Newfoundland & Labrador is home to vital and diverse aquatic habitats, which have supported the people of Newfoundland & Labrador for decades. Therefore, it is critical to assess how the proposed offshore wind farm project can affect the habitat and health of these special marine areas.

The information shown in appendix B illustrates why these special marine areas are under the marine protected area framework and provides further insight into the impacts offshore wind farms can have on the health of such aquatic habitats.

Taking into account the loss of sediment within habitats that can arise from constructing offshore wind farm devices such as turbines, there has also been increasing evidence that suggests, with appropriate design and management, offshore wind farm devices have the potential to create positive impacts on aquatic habitat and health (Inger et al., 2009). Wind turbines can increase local biodiversity through artificial reefs. Artificial reefs are formed when turbines are placed on the seabed and attract many marine organisms (Inger et al., 2009). The presence of these wind turbines on the seabed create a new habitat capable of supporting more epibiota (an organism that lives on the surface of another living organism) and fish, increasing both fish density and biomass (Wilhelmsson & Malm, 2008). The attraction of marine life and the nature of the species attracted to the turbines will largely be shaped by the design of the components of the installation (Petersen & Malm, 2006).

Offshore wind turbines, depending on the scour protection used and type of foundation, can form two artificial habitats; a vertical habitat and a horizontal habitat (Langhamer, 2012 as cited in Degraer et al., 2020). The vertical habitat consists of species in the splash, intertidal, shallow, and deeper subtidal zones (Degraer et al., 2020). On the other hand, the horizontal habitat consists of a range of complex habitats (Degraer et al., 2020).With time, the accumulation of these species on the structure of the turbine produces a highly biodiverse community (Degraer et al., 2020). This then becomes an advantage for species in higher trophic levels as they profit from an increased availability of food and shelter. In the end, all these factors contribute to a healthy aquatic habitat.

3.5.2 Evaluation

As previously stated, a persistent issue with the current TOR and draft agreement for this project is its poor approach on specific components of aquatic habitat and health such as electromagnetic fields, underwater sound levels and frequencies, sedimentation, and reefs. In section T)i, the TOR only briefly mentions that, in identifying and considering potential negative and positive effects, the committee is going to focus on fish habitats (IAAC, 2022a). The TOR not only failed to include the health of the habitat, but it also failed by not providing detailed information on what specific aspects of aquatic habitat and health are to be looked at.

In comparison to another regional assessment performed in Brazil, the current regional assessment for this project is worse. The TOR for offshore wind farms in Brazil perfectly describes aquatic health and habitat. It further describes specific components to be looked at when it comes to aquatic habitat and health. For instance, section 6.2.1.1 of the Brazilian TOR included the coral reef environments (IBAMA, 2022). When coral reef environments are taken into consideration, the TOR will seek to identify both

rich reef habitats, and also vulnerable reef habitats that must be avoided during the setting up of offshore wind farms (IBAMA, 2022). It further seeks to identify the specific geo-spatialized areas which house such reefs. Said components in the TOR were represented as follows (IBAMA, 2022):

3.5.2.1 Coral reefs environments

This topic aims to identify rich, vulnerable and poorly resilient habitats, such as coral and sandstone reefs, algae banks (calcareous or not), mollusks and marine phanerogams for which the enterprise must avoid interference. The National Action Plan for the conservation of coral environments is used as a reference.

a) Identify, describe and geospatialize areas of occurrence of coral reefs (including deep water corals) and sandstone, algae banks (calcareous or not), mollusks and marine phanerogams.

3.5.2.2 Coral reefs, Reef Formations and/or Coralline Communities

This topic aims to identify rich, vulnerable and poorly resilient habitats, such as corals and algal banks, for which the venture should avoid interference. It is recommended, as a reference, the use of the National Plan of Action for the Conservation of Coral Environments.

a) Identify, describe and geospatialize the coral reefs' areas of occurrence (including deep-water corals) and banks of algae or mollusks.

3.5.3 Recommendations

Even though offshore wind structures contribute to a healthy aquatic habitat, it is crucial to consider ways in which we can maximise these benefits without causing adverse effects. According to Inger et al. (2009), habitat loss due to offshore wind farm devices is governed by factors such as the size of the devices, the location in which the device is set and the stage of the life cycle of the device. Therefore, we recommend that the final TOR lays out detailed information on how the offshore wind farm devices would be set and what size they are hoping these devices to have. It is worth noting that based on previous studies of offshore wind farm development, it is recommended that these devices be placed in close proximity to each other, as well as near natural reefs to increase habitat connectivity (Draget, 2014). Furthermore, we recommend the TOR should include the location and nature of natural reefs. As well, the TOR should lay out the intent to conserve rich reef habitats and protect the vulnerable and poor reef habitats, through the installation of artificial reefs (offshore wind farm devices) at the distances proposed in the above paragraph.

It is also a concern that the current TOR and DA did not put into consideration the special marine areas that are along the study area for offshore wind development. We would therefore like to see some changes in the TOR and DA pertaining to additional protective measures being placed in accordance with the Fisheries and Oceans Canada's *Oceans Act*, that seeks to protect special marine areas. For this case, we would like to see appropriate buffer zones around the special marine areas so as to protect the aquatic habitat from potential exploration or construction impacts.

3.6 About the Authors

Claire Parsons is a fourth-year Environmental Science (Honours) student specialising in the chemistry stream. She is a 2022 recipient of a Natural Sciences and Engineering Research Council (NSERC) Undergraduate Research Award and is currently working on a project pertaining to the climate change mitigation potential of Newfoundland seaweed in agricultural practices. Born and raised in Corner Brook, Newfoundland, Claire has a passion for the environment and understanding the critical role it plays throughout our lives.

Meaghan O'Neill was born and raised in Corner Brook, Newfoundland, and she is currently a fourth-year student at Memorial University - Grenfell Campus. She is working towards completing a Bachelor of Science in the Environmental Science program in the biology stream. Her goals for the future are to help in some way with the conservation efforts either on the island or elsewhere in Canada. As a long-time admirer of nature, she is thrilled to be taking even a small part in this regional assessment for offshore wind. Helping give a voice for affected creatures who cannot speak for themselves is her ultimate goal.

Kiana Jacobs was born in Ontario and raised in Newfoundland. She is currently a fourth year Environmental Science student specialising in the biology stream at Memorial University - Grenfell Campus. Kiana graduated valedictorian of her high school, Hampden Academy and achieved the Governor General's academic medal. Kiana has always been enthusiastic about learning more about the environment and ecosystems, particularly related to Newfoundland. Through her gained knowledge at Memorial University - Grenfell, her future goals are to learn more about terrestrial ecosystems and help conservation efforts in Newfoundland and Canada.

Swaiba Chanyika is an international student taking a Bachelor of Science in Environmental Science (Biology stream). She's currently in her third year at Memorial University - Grenfell Campus. Born and raised in Dar es salaam, Tanzania she's always been passionate about making an impact when it comes to protecting the environment. Participating in the commentary of the TOR and DA for the regional assessment was a big step towards achieving that.

3.7 REFERENCES

Airoldi, L., Gibson, R. N., & Atkinson, R. (2003). The effects of sedimentation on rocky coast assemblages. *Oceanography and marine biology:an annual review, 41*, 161–236 .https://www.researchgate.net/publication/228458759_The_Effects_of_Sedimentation_on_Rocky_Coast_Assemblages

Bailey, H., Brookes, K.L. & Thompson, P.M. (2014). Assessing environmental impacts of offshore wind farms: lessons learned and recommendations for the future. *Aquatic Biosystems, 10*(8), 1-13. https://doi.org/10.1186/2046-9063-10-8.

Bailey, H., Senior, B., Simmons, D., Rusin, J., Picken, G., & Thompson, P. M. (2010).

Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. *Marine Pollution Bulletin*, *60(*6), 888–897. https://doi.org/10.1016/j.marpolbul.2010.01.003

Brazilian Institute of Environment and Renewable Natural Resource-IBAMA. (2022). *Term of Reference: Offshore Wind Farms* (File no. 02007.003499/2019-91). http://www.ibama.gov.br/phocadownload/licenciamento/publicacoes/2022-02-14_Ibama_Term-of-Reference-Offshore_wind_farms.pdf

Coates, D. A., van Hoey, G., Colson, L., Vincx, M., & Vanaverbeke, J. (2015). Rapid

macrobenthic recovery after dredging activities in an offshore wind farm in the Belgian

part of the North Sea. *Hydrobiologia*, *756(*1), 3–18. https://doi.org/10.1007/s10750-014-2103-2

Degraer, S., D.A. Carey, J.W.P. Coolen, Z.L. Hutchison, F. Kerckhof, B. Rumes, & J. Vanaverbeke. 2020. Offshore wind farm artificial reefs affect ecosystem structure and functioning: A synthesis. *Oceanography,* 33(4):48–57, https://doi.org/10.5670/oceanog.2020.405.

Draget, E. (2014). Environmental Impacts of Offshore Wind Power Production in the Northern Sea. World Wildlife Fund. https://media.wwf.no/assets/attachments/84-wwf_a4_report___havvindrapport.pdf

Galparsoro, I., Menchaca, I., Garmendia, J.M., Borja, A., Maldonado, A.D., Iglesias, G., & Bald, J. (2022). Reviewing the ecological impacts of offshore wind farms. *NPJ Ocean Sustainability, 1*(1), 1-8.https://doi.org/10.1038/s44183-022-00003-5

Green, R. E., Gill, E., Hein, C., Couturier, L., Mascarenhas, M., May, R., Newell, D., &

Rumes, B. (2022). International assessment of priority environmental issues for land-based and offshore wind energy development. *Global Sustainability,* 5. https://doi.org/10.1017/sus.2022.14

Hutchison, Z., Gill, A.B, Sigray, P., He, H., & King, J.W. (2020a) Anthropogenic electromagnetic fields (EMF) influence the behaviour of bottom-dwelling marine species. *Scientific Reports, 10*(4219), 1-15. https://doi.org/10.1038/s41598-020-60793-x

Hutchison, Z., Secor, D.H. & Gill, A.B. (2020b). The Interaction Between Resource Species and Electromagnetic Fields Associated with Electricity Production by Offshore Wind Farms. *Oceanography, 33*(4), 97-107. https://tos.org/oceanography/assets/docs/33-4_hutchison2.pdf

Inger, R., Attrill, M.J., Bearhop, S., Broderick, A.C., Grecian, W.J., Hodgson, D.J., Mills, C., Sheehan, E., Votier, S.C., Witt, M.J., & Godley, B.J. (2009). Marine renewable energy: potential benefits to biodiversity? An urgent call for research. *British Ecological Society 46*(6): 1145-1153. https://doi.org/10.1111/j.1365-2664.2009.01697.x

Impact Agency of Canada-IAAC. (2022a, October 12). *Regional Assessment of Offshore Wind Development in Newfoundland and Labrador and Nova Scotia Draft Terms of Reference* (Ref no. 83514). https://iaac-aeic.gc.ca/050/documents/p83514/145236E.pdf

Impact Agency of Canada-IAAC. (2022b, October 12). *Draft Agreement to Conduct A Regional Assessment Of Offshore Wind Development in Newfoundland and Labrador* (Ref no. 83514. https://iaac-aeic.gc.ca/050/documents/p83514/145234E.pdf

Karakoc, C., Singer, A., Johst, K., Harms, H., & Chatzinotas, A. (2017). Transient recovery dynamics of a predator-prey system under press and pulse disturbances. *BMC Ecology, 17*(13), 1-9. https://doi.org/10.1186/s12898-017-0123-2

Langhamer, O. (2012). Artificial reef effect in relation to offshore renewable energy conversion: State of the art. *The Scientific World Journal*, *2012*.

https://doi.org/10.1100/2012/386713.

Madsen, P., Wahlberg, M., Tougaard, J., Lucke, K., & Tyack, P. (2006). Wind turbine

underwater noise and marine mammals: implications of current knowledge and data needs. *Marine Ecology Progress Series*, *309*, 279–295. https://doi.org/10.3354/meps309279

Normandeau Associates INC., Exponent, INC., Tricas, T. & Gill, A. (2011). *Effects of EMFs From Undersea Power Cables on Elasmobranchs and Other Marine Species* (Contract no.M09PC00014). U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement. https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/2011-09-EMF-Effects.pdf

Ohman, M.C., Sigray, P. & Westerberg, H. (2007). Offshore Windmills and the Effects of Electromagnetic Fields on Fish. *AMBIO: A journal of the Human Environment, 36*(8), 630-633. DOI: 10.1579/0044-7447(2007)36[630:OWATEO]2.0.CO;2.

Petersen, J.K. & Malm, T. 2006. Offshore wind farms: threats to or possibilities for the marine environment. AMBIO: *A Journal of the Human Environment* 35(2): 75-80. https://doi.org/10.1579/0044-7447(2006)35[75:OWFTTO]2.0.CO;2

Ruffner, J. (2022). *Puget Sound sediments.* Department of Ecology State of Washington. https://ecology.wa.gov/Water-Shorelines/Puget-Sound/Sound-science/Marine-

sediments#:~:text=Sediments%20provide%20critical%20habitat%20for,and%20the%20marine%20food%20web

Snelgrove, P. (1997). The importance of marine sediment biodiversity in ecosystem processes. *Ambio*, 26(8), 578–583.

Stöber, U., & Thomsen, F. (2021). How could operational underwater sound from future

offshore wind turbines impact marine life? *The Journal of the Acoustical Society of America*, *149*(3), 1791–1795. https://doi.org/10.1121/10.0003760

Thomsen, F., Lüdemann, K., Kafemann, R., & Piper, W. (2006). Effects of offshore wind farm noise on marine mammals and fish. *Biola, Hamburg, Germany on behalf of COWRIE Ltd*, *62*, 1-62. https://www.researchgate.net/profile/Frank-Thomsen/publication/228653581_Effects_of_Offshore_Wind_Farm_Noise_on_Marine_Mammals_and_Fish/links/548856140cf289302e309045/Effects-of-Offshore-Wind-Farm-Noise-on-Marine-Mammals-and-Fish.pdf

Tougaard, J., Henriksen, O. D., and Miller, L. A. (2009). Underwater noise from three types of

offshore wind turbines: Estimation of impact zones for harbor porpoises and harbor seals. *The Journal of the Acoustical Society of America, 125(*6), 3766-3773. https://doi.org/10.1121/1.3117444

Tougaard, J., Hermannsen, L., & Madsen, P. T. (2020). How loud is the underwater noise from

operating offshore wind turbines? *The Journal of the Acoustical Society of America*, *148*(5), 2885–2893. https://doi.org/10.1121/10.0002453

Vaselli, S., Bertocci, I., Maggi, E., & Benedetti-Cecchi, L. (2008). Effects of mean intensity and

temporal variance of sediment scouring events on assemblages of rocky shores. *Marine*

Ecology. Progress Series (Halstenbek), 364, 57–66. https://doi.org/10.3354/meps07469

White, N., Edwards, T., and Dooley, S. (2018). Special Marine Areas in Newfoundland and

Labrador. (2nd edition). *Canadian Parks and Wilderness Society*. https://cpawsnl.org/wp-content/uploads/2018/07/SMA-Guide-FINAL-2018-2-20-compressed-ilovepdf-compressed-1.pdf

Whoriskey, F.G., & Glebe, J. (2002). The Atlantic salmon recreational angling industry: economic benefits. *Sustaining North American salmon: perspectives across regions and disciplines.* American Fisheries Society. https://fisheries.org/docs/books/x55039xm/4.pdf

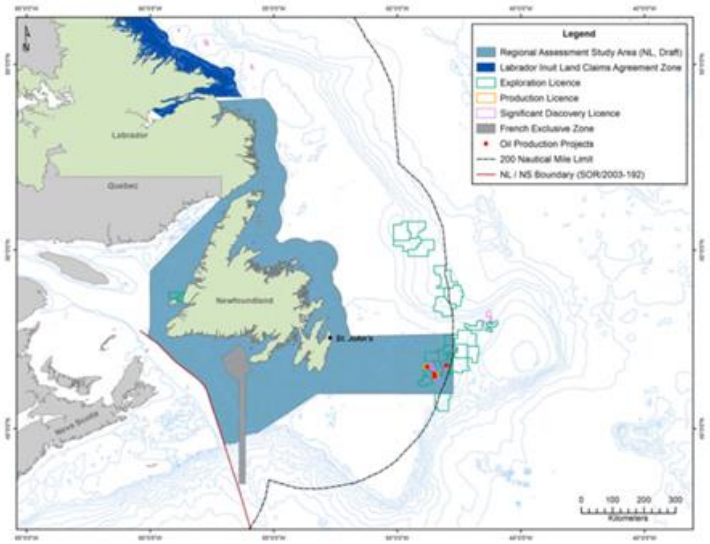
Wilhelmsson, D. & Malm, T. (2008). Fouling assemblages on offshore wind power plants and adjacent substrata. *Estuarine, Coastal and Shelf Science, 79*(3), 459-466. https://doi.org/10.1016/j.ecss.2008.04.020

3.8 APPENDICES

3.8.1 Appendix A

Adapted from (White et al., 2018)

Figure A.1 Special Marine Areas in Newfoundland & Labrador.



Adapted from (IAAC, 2022a)

Figure A.2 Study area for the regional assessment of offshore wind development in Newfoundland & Labrador and Nova Scotia.

3.8.2 Appendix B

Location	Map	Description
Newfoundland & Labrador Shelf	 Adapted from (White et al., 2018)	In this habitat, there exists deep water coral communities (White et al., 2018). The converging area at the Davis Strait and Hudson Strait has a high coral abundance and diversity (White et al., 2018). On the Southern part (Labrador slope, Hawke Channel and Orphan Spur), there are productive coral hotspots (White et al., 2018). Corals forming in this region are not reef-forming but they still provide a habitat and nutrient for fish species (White et al., 2018). Threats facing these areas target benthic communities (White et al., 2018). Since these species are immobile and cannot move away from a disturbance, disruption of seabed sediment by offshore wind turbines has a potential of destroying them.
Northern Grand Banks	 Adapted from (White et al., 2018)	There is a major fish migration route between the Northeastern shelf and slope and Trinity and Conception Bay during which fish species spawn (White et al., 2018). Cable-generated electromagnetic fields and sound levels from offshore wind turbines tend to drive fish species away from their habitat. Therefore if offshore wind farms are set up in this area, there is a high chance that they will interfere with the habitat. Even though the area is protected under the *Ocean Act*, some areas like the Petty Harbour-Maddox Cove are not directly protected, so it becomes a potential threat to aquatic health and habitat if wind farms were to be established here (White et al., 2018).

Southern Grand Banks	 Adapted from (White et al., 2018)	Due to the interaction of ocean current with the continental shelf in this area, most nutrients get taken up to the surface (White et al., 2018). This provides a rich and unique habitat for aquatic species. Additionally, productive benthic communities with the rarest of species exist at the Southeast shoal and tail and at the Lilly Canyon-Carson area (White et al., 2018). If wind turbines are to be developed in this area, they have the potential to disrupt such productive benthic communities. However, wind turbines can also act as artificial reefs, which can cause an increase in biofouling. Furthermore, artificial reefs can act as a food source and a source of productivity.
Laurentian Channel/South Coast	 Adapted from (White et al., 2018)	The Laurentian Channel is a coast with the largest tides in NL and is rich in nutrients (White et al., 2018). Deep water from the Gulf Stream mixes with water from the St. Lawrence river, thus creating productive habitats for aquatic species and an important location for protection (White et al., 2018). Recently, there has been construction on a Marine Link by Emera Inc. that worked on developing a transmission line between Granite Canal, Newfoundland and Woodbine, Nova Scotia (White et al., 2018). This transmission line was known to be a disturbance to coral benthic communities (White et al., 2018). It is expected that cables from offshore wind turbines will cause similar effects as those from the transmission line.

Gulf of St. Lawrence	 Adapted from (White et al., 2018*)*	This area is a large estuary which touches 5 provinces: Quebec, New Brunswick, Prince Edward Island, Nova Scotia and Newfoundland & Labrador (White et al., 2018). Specifically in Bonne Bay and the St. Paul's Inlet, there exists a diverse coastal habitat (White et al., 2018). The development of wind turbines in this area has the potential to negatively affect the aquatic habitat and health. The Lower Churchill Labrador Island Link project involved laying marine cables across the Strait of Belle from Forteau Point, Labrador to Shoal cove, Newfoundland (White et al., 2018). This project caused disturbances to many benthic communities (White et al., 2018), and it is highly likely that similar effects can be felt by the development of offshore wind farms.

4 MARINE SPECIES

Ryan Purcell-Pilgrim, Aaron Wayne Rideout, and Shane Turner

4.1 SUMMARY

Leatherback Sea Turtle

- The Leatherback Sea Turtle is the only sea turtle commonly found in the waters around Newfoundland and Labrador.
- This species of sea turtle is relevant to the offshore wind project because it spends the late summer and early fall in the planned area of the offshore wind development.
- Leatherbacks are listed as an endangered species by multiple sources, making them a greater concern.
- The terms of reference makes mention of sea turtles as a component to be looked at, but makes no further mention of any specific species.
- There should be some mention of how much noise will be generated by the construction and operation of the offshore wind development.
-

North Atlantic Right Whale

- The North Atlantic Right Whale is a critically endangered species which frequents coastal waters of Newfoundland.
- Mortality rates in large whale populations

Sharks

- Sharks have been fished from areas around the project site.
- Sharks are a key species near the top of the food chain in most marine systems.
- Blue sharks are recreationally fished in Newfoundland through a fishery and previously spiny dogfish were commercially fished and may be again in the future.
- The terms of reference gives no mention of sharks or specification of shark fisheries as an advisory group.
- There is no mention for establishing baseline presence or monitoring of shark presence and methods of mitigating negative impacts to them specifically. These things may come out of advisory meetings with fisheries, but otherwise should be considered regardless.

4.2 SHARK SPECIES

4.2.1 Background

Sharks are a top predator of the ocean and are critical for maintaining balance in the marine ecosystem and therefore should be firmly considered as an important component to study and maintain throughout the project lifespan. Blue sharks are the only currently fished species in Newfoundland and the entirety of recorded catches are from the south and eastern sides of the island (DFO, 2020). The project location is within the range of recorded sharks fished and therefore calls for more deeper consideration since we have a diverse population of them. Most sharks here are species that migrate to waters within their temperature range: blue, porbeagle, mako, Greenland, basking and recently the great white shark. There have been sightings of great white sharks in recent years, and this is a sign of growth in the diversity of top predators. The addition of offshore wind turbines may help or hinder the growth and sustaining of shark populations depending on design. Some projects used a design that gave an artificial habitat like a reef (A. Raoux, et al 2016). These artificial habitats can protect prey aquatic life from bigger predators and encourage small and medium sized predators (Mavraki, N, et al 2021). There are many instances where offshore wind turbines have been part of an artificial reef habitat that attracted higher trophic level population increases and changed the diets of these predator species (Wilber, DH., et al, 2022). Without any kind of design in mind for creating such habitats it is likely that noise production will disturb lower trophic levels of benthic and fish species in the area driving them away and possibly messing with their lateral line systems (Solé, M., 2022). These complex interactions warrant some extra consideration such as monitoring for top of the food chain monitoring in case changes on the lower trophic levels are read inaccurate or do not show the whole picture (Alsahwa, B, 2016). Given that blue sharks are recreationally fished, and spiny dogfish were once fished it could impact the future of fisheries for sharks or other fish as trophic stability is shaken from top-down or bottom-up changes.

4.2.2 Evaluation

In the TOR and draft agreement there is a lack of specific species detail including apex predators like sharks. In the “o)” section of the TOR they mention an advisory group for fisheries as information and analysis. Considering this advisory group is the one they use for the information on parts “p), q), r), s)” this one group has many responsibilities to research and find information on potential interactions between fisheries, find gaps in knowledge, potential malfunctions or accidents, any cumulative effects and how to mitigate these negative impacts. I think these terms are rather general and broad since interactions and cumulative effects can be caused from either top or bottom of the trophic levels and having a focus on each end and maybe in the middle would cover the scoping much more precisely. I think the scoping is about average for this kind of project, but with some more depth could be more vigilant to the changes this project may cause. Moving down the TOR we see a variety of identified components from environmental, health, social, and economic standpoints in the “t)” section: Marine fish and fish habitat, marine and migratory birds, marine mammals and sea turtles, protected and special areas, fisheries and other ocean uses, communities and economy. These components are also rather broad and general, but do come close to the areas of research needed for the impact on sharks. Without knowing the impact on fish and fish habitat it is impossible to narrow down the changes that may be observed in shark species.

The draft agreement mainly addresses the methods of achieving the goals set in the TOR. Overall it is not a bad consideration of wildlife impact, but could benefit from a further division of the marine ecosystem considerations from just fish to prey and predator species as it produces a more clear picture of the impacts. Other divisions may be more helpful as well, but I found sharks to be less represented then most marine life.

4.2.3 Recommendation

For recommendations as this project develops, I would suggest the division of the fisheries advisory group to focus on predator species in the study area. Besides the division I think the draft agreement and TOR look good and cover a broad range of wildlife. Although it was covered by mentioning cumulative effects it was not clearly stating any consideration of the benthic community, which may impact fish and higher trophic level organisms. The potential artificial habitat created by the submerged portion may lead to increased bivalve and benthic life leading to an increase in secondary consumers and higher-ranking predator species if it is designed well. Using direct drive motors or other noise efficient technology may minimize noise disruption and using connection rods with simulated coral it could intentionally fix disruption from noise and lateral line confusion in predator species. To monitor the wellbeing of the ecosystem from top predators, sharks could be either tagged and tracked, or have their activity monitored with aerial or nautical surveys. Many of these suggestions might naturally come up in the process of researching and proceeding naturally with the project, but these are some I thought of regarding the wellbeing of all sharks near Newfoundland.

4.3 Leatherback Sea Turtles in the Area

4.3.1 Background

The leatherback sea turtle is the only sea turtle that is commonly found in the waters surrounding Newfoundland and Labrador. They have the widest range of any marine turtle, and they can be found from the waters surrounding Newfoundland and the rest of Atlantic Canada all the way down near Florida and the Caribbean. (World Wildlife Fund, n.d.) The waters off the south and west coasts of Newfoundland serve as part of the late summer and early fall habitat for leatherback sea turtles, which would be the concern for the offshore wind project. Under the species at risk act in Canada, leatherback sea turtles are listed as an endangered species. In Quebec they are listed as threatened under the Act Respecting Threatened or Vulnerable Species, and are listed as critically endangered by the International Union for Conservation of Nature (COSEWIC, 2012). There have been sightings of leatherback sea turtles around Newfoundland for a number of years, including 20 sightings all the way back in 1976-1985. (James, Sherrill-Mix, Martin, & Myers, 2006). The population of leatherback sea turtles on a global level has been declining rapidly over the past number of years. Since 1980, the estimated population of adult female leatherbacks worldwide has gone down from over 115,000 to less than 25,000. (Center for Biological Diversity, n.d.)

4.3.2 Evaluation

The draft terms of reference for the regional assessment of offshore wind development in Newfoundland and Labrador and Nova Scotia makes mention of “Sea Turtles” as a component that will be evaluated by the committee for potential effects, both positive and adverse. It is good that this is

included, because it shows that sea turtles, and therefore leatherback sea turtles, are being considered as a valued component. The terms of reference also talks about how it will look at any components that may be impacted, whether it be positive or negative, which will include leatherback sea turtles. It then outlines how any circumstances where either the nature, location, or timing may be affected. This could cover the concerns regarding if they will be active in the area with construction or maintenance during the late summer and early fall when the leatherback sea turtles would be living in the area. The terms of reference also mentions that they intend to make decisions regarding this project as well as any other offshore wind project that may come up in the future in a manner that fosters sustainability, which is a good way to know that the project will focus on the long term health of species that live in the area. The draft agreement for this project shows the Regional Assessment Study Area. The area that is outlined reaches the entire way around the island of Newfoundland, stretching further towards the southeast end of the province as well as directly south. It extends up the eastern coast of Labrador as well, and as a result, the study area covers almost the entirety of the range of leatherback sea turtles around the province.

4.3.3 Recommendations

There are a number of different recommendations I would have with regards to the leatherback sea turtle in the terms of reference and draft agreement for this project. One recommendation I would make would be to take into account where leatherback sea turtles are known to frequent more often, and try to avoid these areas for wind turbines and for traveling to and from the turbines for construction, maintenance, and eventually the decommissioning of the turbines. There is no mention of leatherback sea turtle habitat specifically in the terms of reference, and with them being classified as an endangered species, that should be touched upon. As was discussed in the previous section, there is mention of nature, location, and timing being considered, so this would likely cover all different species, but it would be nice to have an outline of which species will be considered specifically, not just for the sake of the leatherback sea turtle but also for any other at risk species that could be impacted. Another recommendation I would make would be to give specifics on which areas are being considered for this project as opposed to outlining the entire province, so there would be a more clear idea of which areas will be impacted. There is also no mention of the noise that would be produced by the constant operation of the wind turbines, as well as the travel to and from for maintenance and setup. Noise pollution could impact leatherbacks, as both constant and abrupt noise can disrupt turtles or cause damage to their hearing (The Leatherback Trust, n.d.), therefore I think it would be important to disclose how much noise would be created by this project. The main recommendation that I would make for the terms of reference and the draft agreement would be to describe more of what is planned for the protection of wildlife in the study area as a whole. As it is, the terms of reference only briefly makes mention of wildlife impacts, and the rest of what is discussed is very broad and generalized to cover all components. While it is nice that this is outlined, it would be far better and more effective at keeping concerns at bay if they had described more plans for specific species like the leatherback sea turtles.

4.4 North Atlantic right whale

4.4.1 Background

The North Atlantic Right Whale was deemed to be a critically endangered species according to Fisheries and Oceans Canada (2016). North Atlantic Right Whales are a species of baleen whales which can be found in coastal waters of North America. According to Hunt, Rolland and Kraus (2015), this species typically feeds at slow speeds and surface level depths and feed on small marine organisms. Their slow speed and surface level feeding habits make them especially vulnerable to dangers such as marine shipping traffic and entanglement in fishing gear. Crowe, Brown, Corkeron, Hamilton, Ramp, Ratelle, Vanderlaan and Cole (2021) discusses research which has been conducted on this species and its habitats, and how one of the most important habitats for this species is the Gulf of St. Lawrence. These whales have been studied through aerial photography and survey and have been identified as having a high annual return rate each year, meaning that transiting the area in which the proposed offshore wind energy development project would be taking place. Especially considering the vulnerable nature of the population of whales which reside and frequent the Cabot Strait, Gulf of St. Lawrence and the coastal waters of Newfoundland, an increase in high speed shipping and traffic in this area would likely lead to increased whale fatalities.

4.4.2 Evaluation

The draft terms of reference for this project make reference to marine mammals and sea turtles, however, there is little to no mention of whales specifically or what kinds of assessment, if any would be done to determine the risk to populations of North Atlantic Right Whales in the development area. Some of the activities which have been identified as potentially being threats to whale populations pertaining to these activities are noise pollution and collisions with ships, Reeve (2012). Studies which have been conducted on other populations of right whales and other species of large whales in relation to the development of offshore wind energy infrastructure have shown that these developments have resulted in changes in behavior, residency, and population demographics of whales in the region, Quintana-Rizzo, Leiter, Cole, Hagbloom, Knowlton, Nagelkirk, O'Brien, Khan, Henry, Duley, Crowe, Mayo, and Kraus (2021). According to Quintana-Rizzo et al. (2021), research was conducted in an area off the coast of New England in the United States, where offshore wind energy development is currently being developed. That study included aerial surveys counting sightings and groups of whales in that area has shown that there is a correlation between negative impacts on whales from this development in key areas of whale activity. In some areas frequented by both whales and commercial shipping traffic, governments have implemented speed limits restricting vessels to a speed of ten knots or lower while transiting through the area in which whales have been spotted. This is in an attempt to decrease the risk of fatal collision should a ship cross paths with a whale, however, mariners have not been observed to frequently observe this regulation and many ships continue to speed through these zones, Quintana-Rizzo et al. (2021).

4.4.3 Recommendations

The terms of reference and the draft agreement for this project include many key points of things which should be taken into consideration during the process, however, I would like to recommend that there be more emphasis and effort placed on the review of transportation to and from the selected location. Transportation and increases in traffic have not been discussed in these documents. If we take this factor into account then we would be able to gauge the extent to which marine traffic would be increasing and then assess any potential implications from that which might negatively impact the whale population in that area.

It has also been established in other studies that wind energy creates noise pollution. This is another point which should be receiving more attention. Being offshore, noise pollution may not have much if any impact on human populations so this may not be as much of an issue, but the noise emitted by this project is more likely to have an impact on the natural environment and wildlife in the vicinity. Overall, while this project is to be located away from residential areas, it is important to not still likely to have a great impact on the fragile marine environment. This should be taken into consideration at every opportunity.

4.5 ABOUT THE AUTHORS

My name is Ryan Purcell-Pilgrim and I am a student at Grenfell Campus in Corner Brook. I am majoring in Environmental Studies, in the Environment and Sustainability program. I am in my 4th year of post secondary studies, as I completed the two year Forest Resource Technician program at CNA before starting at Grenfell. I have family that live in small, coastal communities across the province, so this factors into my interest in the offshore wind project. I am also interested in the conservation of wildlife, which made it an easy choice to evaluate the potential impacts of this project on wildlife.

I am Shane Taker, a student at Grenfell Campus in Corner Brook. I am in my final year with a major in environmental science and minor in biology. I am from a small coastal town on the west coast and therefore will not directly see this project daily, but still find it interesting. As a biology minor I have a particular interest in wildlife in all forms especially ecology related topics. I have done work on testing oil content of soil for remediation purposes and knowing the level of contamination maintenance would create is another area of interest for me. The expansion of green energy is another significant area of interest for me.

My name is Aaron Rideout. I am studying environmental studies and geography and I am currently in my fifth and final year of study at Memorial University's Grenfell Campus, Corner Brook. I am originally from the North East Coast of Newfoundland and so I have always had a connection to the sea. Outside of my academic career, I am also a mariner, so I have dual interests in this topic as a stakeholder.

4.6 REFERENCES

Alsahwa, B., Maussang, F., Garello, R., Chevallier, A., (2016) "Marine life airborne observation using HOG and SVM classifier," OCEANS 2016 MTS/IEEE Monterey, pp. 1-5, doi: 10.1109/OCEANS.2016.7761242

Raoux, A., Tecchio, S., Pezy, J-P., Lassalle, G., Degraer, S., Wilhelmsson, D., Cachera, M., Ernande, B., Le Guen, C., Haraldsson, M., Grangeré, K., Le Loc'h, F., Dauvin, J-C., Niquil, N., (2017) Benthic and fish aggregation inside an offshore wind farm: Which effects on the trophic web functioning?, Ecological Indicators, 72, pp. 33-46, https://doi.org/10.1016/j.ecolind.2016.07.037.

Wilber, DH., Brown, L., Griffin, M., DeCelles, GR., Carey, DA., (2022) Offshore wind farm effects on flounder and gadid dietary habits and condition on the northeastern US coast. Mar Ecol Prog Ser 683, pp. 123-138. https://doi.org/10.3354/meps13957

Mavraki, N., Degraer, S. & Vanaverbeke, J. (2021) Offshore wind farms and the attraction–production hypothesis: insights from a combination of stomach content and stable isotope analyses. Hydrobiologia 848, pp. 1639–1657. https://doi.org/10.1007/s10750-021-04553-6

Solé, M., De Vreese, S., Fortuño, J-M., van der Schaar, M., M. Sánchez, A., André, M., (2022) Commercial cuttlefish exposed to noise from offshore windmill construction show short-range acoustic trauma, Environmental Pollution, 312, 119853, pp. 1-13 https://doi.org/10.1016/j.envpol.2022.119853.

Canadian department of fisheries (DFO, 2020) https://www.dfo-mpo.gc.ca/species-especes/sharks/info/fisheries-eng.html

Hunt, Rolland, R. M., & Kraus, S. D. (2015). Conservation Physiology of an Uncatchable Animal: The North Atlantic Right Whale (Eubalaena glacialis). Integrative and Comparative Biology, 55(4), 577–586. https://doi.org/10.1093/icb/icv071

Crowe, L. M., Brown, M. W., Corkeron, P. J., Hamilton, P. K., Ramp, C., Ratelle, S., Vanderlaan, A. S. M., & Cole, T. V. N. (2021). In plane sight: a mark-recapture analysis of North Atlantic right whales in the Gulf of St. Lawrence. Endangered Species Research, 46, 227–251. https://doi.org/10.3354/ESR01156

Report on the progress of recovery strategy implementation for the North Atlantic right whale (Eubalaena glacialis) in Canadian waters for the period 2009-2014. (2016). Fisheries and Oceans Canada.

Reeve, L. L. N. (2012). Of whales and ships: impacts on the great whales of underwater noise pollution from commercial shipping and proposals for regulation under international law. Ocean and Coastal Law Journal, 18(1), 127–166.

Quintana-Rizzo, E., Leiter, S., Cole, T. V. N., Hagbloom, M. N., Knowlton, A. R., Nagelkirk, P., O'Brien, O., Khan, C. B., Henry, A. G., Duley, P. A., Crowe, L. M., Mayo, C. A., & Kraus, S. D. (2021). Residency, demographics, and movement patterns of North Atlantic right whales Eubalaena glacialis in an offshore wind energy development area in southern New England, USA. Endangered Species Research, 45, 251–268. https://doi.org/10.3354/esr01137

Atlantic Leatherback Sea Turtle. Center for Biological Diversity. (n.d.). Retrieved November 11, 2022, from https://www.biologicaldiversity.org/campaigns/esa_works/profile_pages/AtlanticLeatherbackSeaTurtle.html

Committee on the Status of Endangered Wildlife in Canada. (2012). Leatherback Sea Turtle. Retrieved November 9, 2022, from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/cosewic/sr-LeatherbackSeaTurtle-v00-2012-eng.pdf

James, M. C., Sherrill-Mix, S. A., Martin, K., & Myers, R. A. (2006). Canadian waters provide critical foraging habitat for leatherback sea turtles. Biological Conservation, 133(3), 347–357. https://doi.org/10.1016/j.biocon.2006.06.012

Leatherback Sea Turtles in Canada's Atlantic. (n.d.). Retrieved November 10, 2022, from https://wwf.ca/wp-content/uploads/2022/07/WWF_Turtle_Fact_Sheet_Rev_June_29.pdf

Pollution. Leatherback.org. (n.d.). Retrieved November 12, 2022, from https://www.leatherback.org/threats/pollution

5 MIGRATORY VERTEBRATES

Riley Henniffent, Katelyn Corbett, Will Rauch-Davis, and Kathryn Patterson

5.1 SUMMARY

- This document expresses concern about migratory vertebrates and asks for their explicit consideration in the updated version of the Terms of Reference and Draft Agreement.

- The authors have identified three distinct subcomponents impacting migratory vertebrates which should be clarified in the Terms of Reference, and Draft Agreement with more direct language. The following three aspects are discussed in detail:

    1) Species at Risk
    2) Noise
    3) Knowledge Gaps

- Numerous migratory marine and aerial vertebrate species utilize the study area as defined in the Draft Agreement. Many are classified as species at risk. The federal and provincial government has a legal obligation to protect any species at risk.

- Based on current scientific research it is likely that noise emitted from turbines will negatively impact marine and aerial migratory species. The lack of in-depth research and understanding regarding the impact of noise throughout the construction, operation and decommissioning phases of offshore wind development provides an opportunity for future research.

- There is an overall lack of knowledge, information, and research on the impacts offshore wind developments have on migratory vertebrates. Past and present requirements for large-scale developments largely focus on monitoring and data collection. We recommend future offshore wind developments focus on mitigation efforts because of the lack of information. In doing so Newfoundland and Labrador can become a leader in research for reducing the negative impacts these developments have. This research, and implementation of mitigation strategies will also lower the long-term costs associated with any retroactive implementation of mitigation strategies.

5.2 INTRODUCTION

The Regional Assessment of Offshore Wind Development in Newfoundland and Labrador and Nova Scotia Draft Terms of Reference (TOR) and Draft Agreement (DA) was released on the 12th of October 2022. A broad range of local valued components (VC) were acknowledged within these two documents. They provide an overview for identifying, studying, and mitigating areas of potential impact from future offshore development. This document will evaluate development impact on migratory vertebrates with the goal of future consideration for any Impact Assessments required for offshore wind development.

Aerial and marine migratory vertebrates are impacted during the construction, operation, and decommission of offshore wind development (Cabrera-Cruz et al., 2020; Furness et al., 2013). Many of the migratory vertebrates utilizing the surrounding coastlines in both terrestrial and marine ecosystems, are considered species at risk and therefore the Government of Canada has a legal obligation to prevent their extinction or extirpation (Species, n.d). Noise travels at a range of distances and speeds within different mediums and impacts the behaviour of aerial and marine migratory vertebrates (Carstensen et al., 2006; Sound, n.d.). The extent of short and long-term impacts offshore wind development has on migratory vertebrates is difficult to assess as minimal research exists on the topic (Brabant et al., 2015). Careful consideration must be taken for future offshore wind developments due to their impacts to migratory vertebrates, and the lack of data available to make informed decisions.

5.3 BACKGROUND

5.3.1 Species at risk

5.3.1.1 Aerial Vertebrates

Birds and bats are two classes of migratory aerial vertebrates threatened by the presence of offshore wind development in Newfoundland and Labrador. Migratory birds have been studied extensively, and the impact of offshore wind development on avian mortality is well documented (Furness et al., 2013; Martín et al., 2018; Cabrera-Cruz et al., 2020). Migratory bats, though severely under-studied relative to birds, are also known to be impacted by offshore wind development (Cabrera-Cruz et al., 2020; Choi et al., 2020). In the coastal plains of the Isthmus in Tehuantepec, Mexico, Cabrera-Cruz et al. (2020) observed the monthly bat mortality rate exceed that of birds at the convergence of three major avian migratory routes. While Tehuantepec has a different climate and a far greater number of bat species than Newfoundland, these findings show how offshore wind developments can impact bat survival.

For the full list of threatened migratory species in Newfoundland, see Appendix A1. The following section will focus on one migratory shorebird species and two bat species found on the island of Newfoundland, all listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and Species at Risk Act (SARA).

5.3.1.2 Charadrius melodus

The piping plover is a small shorebird native to North America (Species, 2022) that nests on the bayside of the shore in wet environments (Stantial and Cohen, 2018). The plover was first listed as threatened by COSEWIC in 1978 (Committee, 2019), and then endangered in 1985. After being split into two geography-based subspecies, the inland *Charadrius melodus circumcinctus*, and the Eastern *Charadrius melodus melodus* were listed as endangered in 2001 by COSEWIC and SARA (Species, 2022). This designation was confirmed in 2013 and remains in place (Committee, 2019). Habit loss, human activity and predation all threaten the eastern *melodus* (Species, 2022). Coastline communities exacerbate these threats by introducing predators such as house cats into the plover's habitat (Species, 2022). *Melodus* migrate from Newfoundland and Labrador to the south Atlantic coast and the Caribbean where they spend the winter months (Species, 2022).

Stantial and Cohen (2018) observed the piping plover will spend more time in the air when its nesting area is separated from foraging sites, as it needs to commute between the two. One of the six factors that affect the likelihood of bird-turbine collisions and presumably bat-turbine collisions, is flight time (Furness et al., 2013). The more time the animal spends airborne the greater the chance of encounter with a wind turbine (Furness et al., 2013). Specific habitats characteristics must be taken into consideration.

5.3.1.3 Myotis lucifugus and Myotis septentrionoalis

The little brown bat (*Myotis lucifugus*) and the Northern myotis (*Myotis septentrionalis*) are both small migratory bats found in Newfoundland and Labrador (Van Zyll de Jong, 1985). COSEWIC and SARA listed both bat species as endangered primarily due to high mortality rates caused by the fungal disease, white-nose syndrome (Species, 2018). Like the eastern melodus, *M. lucifugus* and *M. septentrionalis* are threatened by habitat loss because of anthropogenic activities (Species, 2018). Studies show that bats are drawn to wind developments (Arnett & Baerwald, 2013). It has been hypothesized that they are mistaking the turbines for roosting spots (Kunz et al., 2007) or for trees where they might mate during the migration season (Cryan & Barclay, 2009) but neither has been confirmed. Out of forty-five North American bat species, *M. lucifugus* and *M. septentrionalis* are among eleven observed species to experience fatalities at wind developments (Kunz et al., 2007).

5.3.1.4 Thunnus thynnus

The Atlantic bluefin tuna (*Thunnus thynnus*) is listed as an endangered species by COSEWIC (Committee, 2011). Despite this classification, it is not listed or protected by Canada's Species at Risk Act, and Fisheries licenses are still issued in Atlantic Canada (Fisheries, 2019). The bluefin's range includes the Mediterranean Sea, the Black Sea, and the Atlantic Ocean (Fisheries, 2018). There are several local and international governing bodies regulating and managing the fishery (Fisheries, 2019). The International Commission for the Conservation of Atlantic Tunas (ICCAT) oversees the Atlantic region and splits the Atlantic bluefin population into eastern and western stocks (Fisheries, 2018). There are 89 bluefin licenses allotted to Newfoundland and Labrador with 6 licenses held by one Indigenous organization (Fisheries, 2019). As shown in Figure 1.1, bluefin move through and are caught within the Regional Assessment Offshore Wind Development study area (Fisheries, 2019). The endangered classification, and economic value of this fish make bluefin a species of interest for the Regional Assessment.

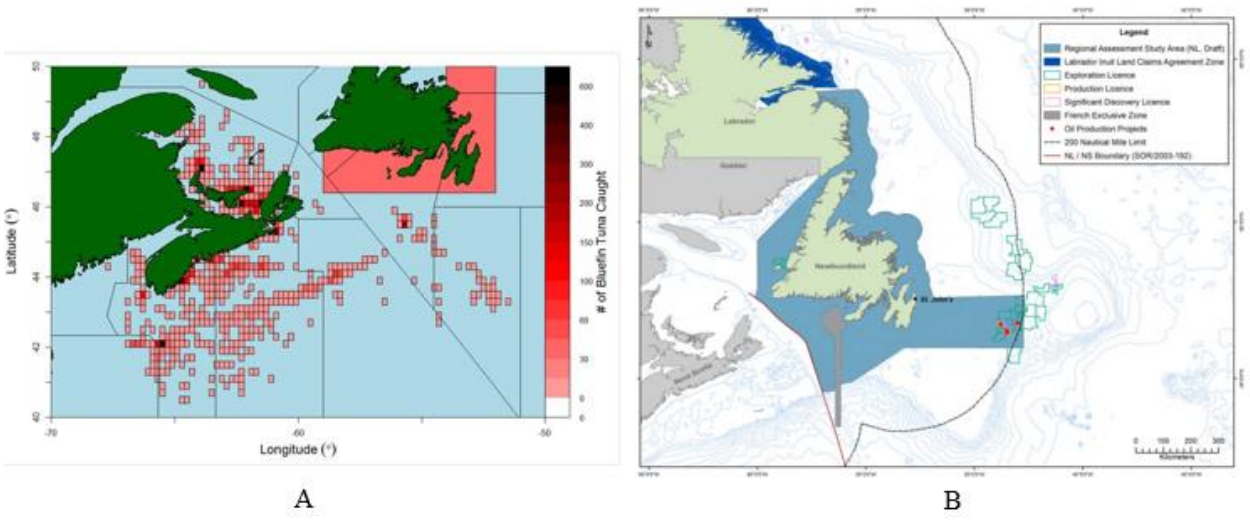


Figure 1.1 A) Bluefin catch distribution from 2012-2016 highlighted in pink (Fisheries, 2019)

B) Regional Assessment study area for offshore wind highlighted in blue (Draft, 2022)

Atlantic bluefin stocks migrate south during winter months where they spawn in the Gulf of Mexico (Fisheries, 2018). Stocks then move north during the summer to feed on smaller fish such as mackerel and herring (MacKenzie et al., 2014). Bluefin are warm-blooded and can tolerate a wide range of temperatures (Puig-Pons et al., 2021) and as a result, have large caloric requirements to regulate their body temperature and high metabolism (Fisheries, 2018; Puig-Pons et al. 2021). Bluefin stock migration has had observed expansions northward during summer, potentially caused by warming northern waters, expanded prey distribution, and rising bluefin populations (MacKenzie et al., 2014). Current migration routes run parallel to coastlines, making interactions likely between future offshore turbines and bluefin tuna (Puig-Pons et al., 2021). Minimal scientific research exists observing tuna behavior in response to offshore turbines. The Tunnidae Family to which the bluefin belong, is a challenging taxonomic group to study due to their size, range, speed, and intolerance to handling (Puig-Pons et al., 2021). A study by Puig-Pons et al. (2021) found that bluefin will deviate from regular swimming patterns and schooling behavior when subjected to a recording of underwater noise emitted from offshore turbines. Alarm, avoidance, disorientation, and increased speed were observed in response to the projected sound (Puig-Pons et al., 2021). These disrupted swimming patterns could have implications for feeding efficiency and route-finding during stock migration (Sarà et al., 2007).

5.3.1.5 Salmo salar

Atlantic Salmon (*Salmo salar*) are divided into distinct populations according to specific migration patterns (Fisheries, 2020). Each population has its own unique designation by COSEWIC to acknowledge their specific level of risk (Committee, 2010). The most recent species assessment of Atlantic salmon by COSEWIC was reported in 2010, therefore, current published classifications on risk level may be considered outdated for any future offshore wind developments and their impact to Atlantic salmon populations. The closure of the Atlantic salmon fishery in 1992 and 1998 in Newfoundland and Labrador respectively had cultural and economic impacts, but has remained open to

Recreational Fishery and Indigenous Food, Social, and Ceremonial (FSC) Fishery (Fisheries, 2020). An annual total of 17,200 salmon tags are split between the Nunatsiavut Government, Innu Nation, and NunaKutavut Community Council in Labrador (Fisheries, 2020). In Newfoundland, the recreational fishery issued 2,592 non-resident and 24,474 resident licenses in 2017 with no Indigenous groups holding any Atlantic salmon tags (Fisheries, 2020). Atlantic salmon are anadromous, and so face challenges both within freshwater and marine ecosystems. Daniels and Mather (2017) provide a nuanced examination of the relationship between Newfoundlanders and Atlantic salmon. They relate the cultural importance Atlantic salmon has, alongside the boom of catch-and-release anglers, as an economically (but controversial with respect to conservation) valuable resource (Daniels & Mather, 2017). A knowledge gap exists regarding the effects offshore wind development will have on Atlantic salmon populations. Atlantic salmon utilize several freshwater systems with entry points all around the province's coastline (see Figure 1.2) (Fisheries, 2020). The migration routes utilized by Newfoundland and Labrador's Atlantic salmon populations may intercept future offshore wind development. The lack of knowledge regarding the impacts of this interaction should be considered an opportunity for further research about the health of Atlantic salmon populations in this province.

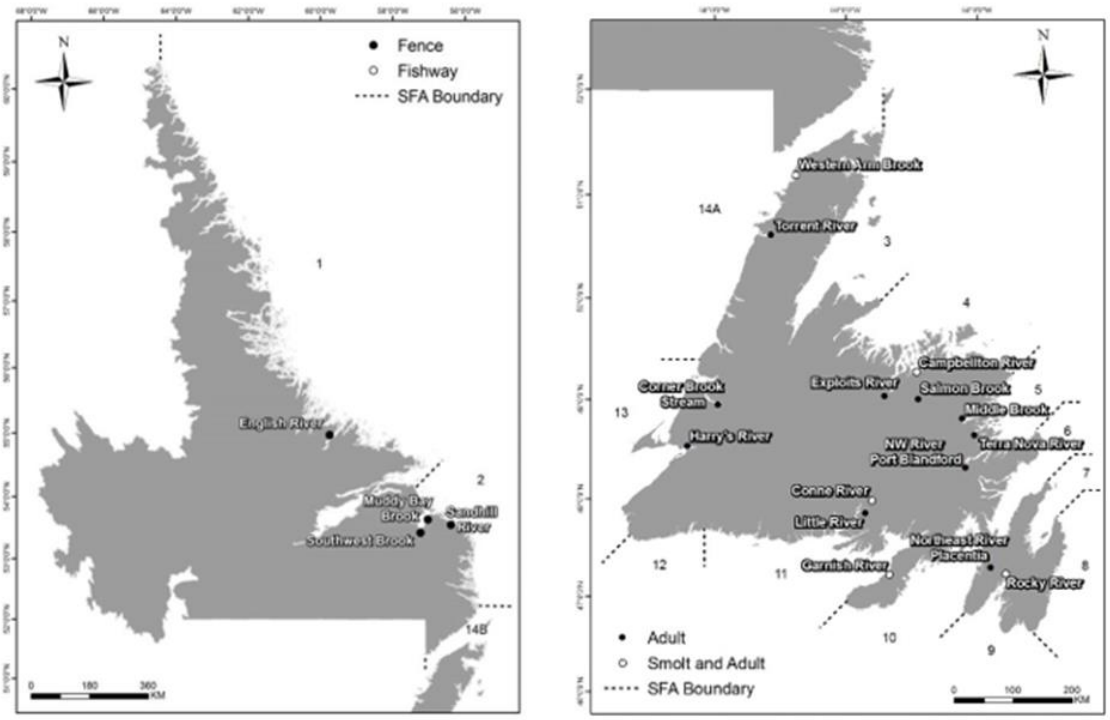


Figure 1.2 Map of Atlantic Salmon fishing areas in Newfoundland and Labrador (Fisheries, 2020)

5.3.2 Noise

When assessing noise, it is important to note the differences of sound travel through atmospheric and aquatic environments. Sound is a mechanical wave within a medium resulting from back-and-forth vibration of particles that transfer energy away from the source to neighboring particles (Sound, n.d.). The speed of sound depends on the density and other variables of the medium (Sound, n.d.). Sound travels via longitudinal waves, meaning the wave vibrates and travels horizontally from the source. These waves form regions in the medium where the particles are compressed together and where they are dispersed, known as compressions (high pressure) and rarefactions (low pressure) respectively (Sound, n.d.). The atmosphere is a low-density medium, meaning a considerable amount of energy is lost during the collision and vibration of particles. In comparison, water is a significantly denser medium, meaning more energy is retained during the vibration and collision of particles, thus, sound travels at a greater rate within water (Sound, n.d.). The distance that sound travels is also dependent on temperature and pressure, however this is of greater concern in marine environments considering the density of the medium (Understanding, 2021).

5.3.2.1 Myotis septentrionalis

The Northern long eared bat (*Myotis septentrionalis*) migrates over short distances from summer habitats to winter hibernacula (caves and abandoned mines) (Kaarakka et al., 2022). In the summer this species is found throughout the boreal forest, typically roosting in the cavities of trees or under loose bark (Northern, 2014). These bats typically return to the same hibernacula sites for multiple hibernations; however, they may have various hibernaculum and not return to the same location for consecutive winter seasons (US, 2014). Bat species use echolocation, emitting high frequency sound waves through their mouth or noise by contracting their larynx or clicking their tongue (Department, n.d.). Northern long eared bats are considered whispering bats as they produce sounds of approximately 60 decibels (Department, n.d.). Because of its nocturnal hunting behaviour, this species strongly depends on echolocation.

5.3.2.2 Phocoena phocoena

The harbor porpoise (*Phocoena phocoena)* is listed as a species at risk by COSEWIC due to the high amounts of bycatch in gillnets in the fishing industry. In the Gulf of St. Lawrence and Newfoundland, the annual mortality of this species by gillnets is estimated to be in the thousands (Committee, 2006). This species typically inhabits inland waters less than 650 feet deep within northern temperate, subarctic and arctic waters (US, 2014) Porpoises are relatively small mammals in cold waters and as such, partake in a significant amount of hunting to sustain their metabolism, which contributes to their role as a top predator (Kingdon, 2018). Harbor porpoises do not appear to undertake coordinated migrations; however, individual populations of porpoises have exhibited seasonal migratory patterns (North, n.d.). Recent studies suggest that there are two subpopulations of the porpoise of the coast of Newfoundland and Labrador, one of which is present in the Gulf of St. Lawrence (Committee, 2006; Richardson et al., 2003). There is little research on this subpopulations' migratory patterns, however it is expected that it migrates offshore during the winter as the region freezes over (Richardson et al., 2003). Harbor porpoises use biosonar (echolocation), for navigation, hunting, and communication (Villadsgaard et al., 2007). Sound waves are emitted using a special pair of organs called the phonic lips, located in the nasal air passage (Linnenschmidt et al., 2015). The emitted sound reflects off potential prey or

surrounding landscapes or obstacles and returns to the porpoise. It is then used to determine the direction, distance, size and speed of any object (Villadsgaard et al., 2007). Emitting and

receiving these sound waves is extremely important for this species' behavior functions and navigation and allows them to fulfill their ecological niche.

5.3.3 Knowledge gaps

Research focused on the impacts offshore wind development has on migratory vertebrates has increased in the past decade, but there remains a lack of information on impact extent (Piorkowski et al., 2011; Schuster et al., 2015). The migratory behaviour of many vertebrates remains unclear creating challenges to Impact Assessment effectiveness (Piorkowski et al., 2011; Brabent et al., 2015). Some studies suggest that the fatalities of migratory vertebrates at offshore wind developments would be lower than those onshore (Ahlén et al., 2009), while other studies suggest that the fatality rate at these sites could be comparable (Sjollema et al., 2014). This general uncertainty indicates that more research is needed to obtain a more holistic understanding of current and future development impacts (Piorkowski et al., 2011).

Part of the difficulty in studying migratory species, which contributes to a lack of available data, is the variation of monitoring techniques. The main methods used to track animal migration is through intrinsic markers (e.g., stable isotope analysis), extrinsic markers (e.g., radio telemetry), and passive monitoring (e.g., acoustic monitoring), and each of these monitoring methods comes with a unique set of strengths and challenges (Hobson et al., 2008). Intrinsic marking is expensive, and many knowledge gaps exist, yet it provides data from the past ranging from minutes to a lifetime depending on if the tissues sampled are metabolically active or inert (Brewer et al., 2021). Extrinsic markers produce precise data but are invasive because the specimens need to be captured (and often recaptured), a device needs to be physically attached to them, and they may rely on the continual operation of a battery (Hobson et al., 2008). Passive monitoring techniques are promising because they can operate without human input, but they produce a lot of data, which does not distinguish between species (Hobson et al., 2008).

The number of fatalities of migratory vertebrates at offshore wind developments is based on estimations provided by models, or existing onshore sites, because of the difficulties of studying offshore (Brabant et al., 2015; Piorkowski et al., 2011; Schuster et al., 2015). The dead specimens are difficult to retrieve because they fall into the water or are taken by scavengers (Schuster et al., 2015). Models do not reflect the actual numbers of fatalities because of the complexity of all the weather variables such as humidity, prevailing winds, or temperature, which influence the timing of migration (Schuster et al., 2015).

5.4 EVALUATION

5.4.1 Species at risk

5.4.1.1 Aerial Vertebrates

In section A1.6(m, n, and t) of the TOR, one of the components mentions the advisory group responsible for providing information on “marine and migratory birds” is the Scientific and Technical Information and Analysis (Regional, 2022). It is satisfying that migratory birds are mentioned in the TOR, however, bats are excluded, and should be a component directly named given the high mortality rates at offshore wind developments previously mentioned.

5.4.1.2 Thunnus thynnus

Section A1.6 of the TOR states that a specific Advisory Group is mandated to seek and gather information about Fisheries Information and Analysis from fishers and industry representatives (Regional, 2022). As bluefin is a valuable stock despite the limited number of licenses distributed, this species should be given special attention by this subcommittee. Also, under Section A1.6(s, t, u, v, w), it states that the Committee will identify and consider the “effects, mitigation, and follow-up” regarding several listed components (Regional, 2022). Listed valued components which bluefin tuna should be included in are: (i) marine and migratory species; (ii) marine fish and fish habitat; (iii) fisheries and other ocean uses; and (vi) Indigenous communities, activities, and rights (Regional, 2022).

5.4.1.3 Salmo salar

A key provision in the *Fisheries Act* (1985): (35) “which prohibits the carrying on of a work, undertaking or activity that results in a harmful alteration, disruption of destruction (HADD) of fish habitat without an authorization from the Minister” (Government, 1985). This provision combined with the mandates, knowledge gaps, and activities of the Committee in the proposed projects TOR, suggests Atlantic salmon should be prioritized as a species of interest and subject to focused scientific research. Listed valued components highlighted within the TOR which should explicitly represent Atlantic salmon are: (i) marine and migratory species; (ii) marine fish and fish habitat; (iii) fisheries and other ocean uses; (iv) communities and economy (Regional, 2022)

5.4.2 Noise

In section A1 of the TOR, it clarifies that advisory groups will be assigned to conduct research and gather knowledge regarding Scientific, Technical and Fisheries Information Analysis. Due to a lack of clarification, it is assumed these broadly defined categories will include the research of noise impacts on migratory species. In the same section it states the Committee will identify/consider the effects, mitigation, and follow-up regarding listed components. Mentioned components that potentially include migratory species are: Marine Fish and Fish Habitat, Marine and Migratory Birds, Marine Mammals and Sea Turtles, and Protected/Special Areas. There is no clarification of what effects, including noise, will be assessed or to what extent the enquiry will go. This lack of information regarding the assessment has resulted in a broad component critique.

5.4.2.1 Myotis septentrionalis

The Northern long eared bat is likely to be impacted in multiple ways by offshore wind development including barotrauma, direct collisions, and habitat change (Taber, 2018). Regarding noise, the greatest impact will be the disruption of winter hibernation (Taber, 2018). There are little to no studies on the impacts of offshore wind development on bat hibernation, however other sources of anthropogenic noise have been shown to disrupt hibernation. For example, Tuttle (2017) reviewed that the little brown bat was aroused during high inputs of sound which resulted in decreased hibernation time prior to their next arousal, along with a loss of 108 mg of body fat. The studied impacts on the little brown bat could be considered a model for potential impacts to the northern long eared bat as these

species show similarities in life cycle patterns. A cascade effect was also observed in response to sound disturbance (Tuttle, 2017). In Tuttle's 2017 study, male bats were initially aroused by sound and attempted to copulate with the females, further triggering more arousals with peak activity occurring as much as seven hours later (Tuttle, 2017). Similar impacts can be expected to occur from the offshore wind development on Northern long eared bat populations as this species is known to hibernate in caves along the coastline. The impacts of offshore development on the populations within these caves would likely vary by distance from a development. The operation and maintenance of offshore turbines and the onshore processing plants are likely to be the main sources of disruptive noise impacting Northern long eared bat populations in Newfoundland and Labrador.

5.4.2.2 Phocoena phocoena

Offshore wind development projects are known to cause a shift in daily frequency sightings of porpoises (National, 2005). This has been attributed to behavioural changes; with shorter, fewer dives being observed, reduced predation, and a lack of echolocating during periods of excessive noise pollution rendering the porpoises blind (Kingdon, 2018). Conflicting findings exist within this area of research. The National Environmental Research Institute (NERI) states that porpoise behavior will not be significantly impacted (National, 2005), while research by Carstensen et al. (2006) showed that porpoise habitat use changed substantially with the population under study observed to completely abandon the construction location. During operation, Teilmann and Carstensen (2012) found that harbor porpoises may return to a windfarm location after construction, at a small percentage of the previous population numbers. Scheidat et al. (2011) revealed an increase in porpoise activity after construction, concluding the reef effect and decreased boat activity to be responsible for this response. It is obvious that the impacts of offshore wind development will vary among porpoise populations. The majority of these studies have detected porpoise populations by recording emitted sound calls, which as noted, is significantly decreased with large inputs of sound. This confounding factor may mean that not all individuals were accounted for in studies (Kingdon, 2018). Porpoises are frequently caught as bycatch. Despite their ability to detect nets, they often become entangled due to their tendency to focus their echolocation below them in search of prey (Linnenschmidt et al., 2015). The lack of echolocation being used by individuals in response to nearby offshore development noise, leads to an increase of their being caught as bycatch in gillnets (Linnenschmidt et al., 2015).

5.4.3 Knowledge gaps

Minimal research exists comparing estimated avian fatalities to observed fatalities (Marques et al., 2014). One study observed a weak relationship between the estimated and observed fatalities of migratory birds, which suggests a lack of information, or the presence of unknown factors contributing to collisions (Marques et al., 2014). Individual wind turbines will have different mortality rates due to variance amongst the turbines (i.e., location, size, speed of blade etc.) or due to species behaviour (i.e., avoidance rate, species density, migratory behaviour etc.) (Brabant et al., 2015; Marques et al., 2014; Schuster et al., 2015). These factors make collision risk modelling difficult.

In both the TOR, and DA, the exchange of information and knowledge is repeatedly mentioned. Section 1.2a of the Draft Agreement states an objective of the Regional Assessment is to provide information, knowledge and analysis to potential environmental, economic, and social impacts while incorporating both Indigenous knowledge and Western science (Draft, 2022; Regional, 2022). Sections A2.6 and A2.7 states the Committee will have knowledge or experience in offshore wind development,

Impact Assessments, Regional Assessments, as well as the environmental, economic, and social impacts. Section A1.6(h, i, j, k, l, m, n, o, and p) of the TOR all refer to obtaining or sharing information and knowledge with the Committee from various advisory groups of the RA (e.g., Indigenous groups, or Fisheries) (Regional, 2022). The exchange of information is essential for a sustainable wind operation, but it is difficult to provide a holistic representation of the impacts when there is very little, or no, information.

Sections A1.6(q, and r) of the TOR address knowledge gaps (Regional, 2022). These sections state the RA will identify and evaluate potential knowledge gaps and make recommendations based on the findings (Regional, 2022). There is no mention of how they will handle existing knowledge gaps, and the language used is indirect. The TOR does not mention whether these existing, and future, knowledge gaps will be studied, but rather recommends addressing the gaps which arise. Recommendations allow for the proponent to decide whether they will address these concerns, there should not be this choice especially when endangered species are threatened.

Researchers are experimenting with different methods to reduce fatalities at wind energy developments. Acoustic deterrents have been used to deter birds and bats from the development area with limited success (Dorey et al., 2019; Marques et al., 2014; Weaver et al., 2020). This suggests that acoustics has the potential to be used in mitigation strategies, but continued research is required to identify a more effective implementation, or to determine a method where it can be used in combination with other deterrents (Dorey et al., 2019). Niemi and Tanttu (2019) suggest using radar and camera to automatically detect and capture images of birds approaching wind turbines. Marques at al. (2014) also suggest a promising mitigation strategy which uses radar to detect incoming birds and bats and triggers the temporary shutdown of the wind turbines. For a full list of mitigation efforts being researched, and potential areas for future research see Appendix B.

5.5 RECOMMENDATIONS

5.5.1 Species at risk

5.5.1.1 Aerial Vertebrate

The RA should require future project Impact Assessments to undertake shoreline surveys for nearby shorebird habitats and identify the presence or absence of fracturing occurring between nesting and foraging sites. To minimize bird-turbine collisions, we recommend that fractured shorebird habitats be given attention and scientific research be undertaken to identify whether these fractured habitats need conservation.

Other factors impacting the risk of aerial vertebrate collisions are the quantity and design of the wind turbines (Johnston et al., 2013; Marques et al., 2014; Schuster et al., 2015). Johnston et al. (2013) found that turbines built close to sea level are less likely to be involved in collisions. Additionally, they found that a single large turbine results in fewer collisions than multiple small turbines .In designing these wind turbines, we recommend characteristics of height and density be taken into consideration.

Santos et al. (2022) found that black kites, a migratory bird of prey found in Asia, Africa, Australia, and Europe, learned to recognize, and react to wind turbines to avoid collisions. It may be helpful to construct and begin operation of only a few turbines at a time, observe site specific variations in mortality rates, and study the effects on the learning and avoidance behavior of aerial vertebrates (Marques et al., 2014). The gradual increase in turbines allows for site specific adaptation and mitigation while also providing data which could hopefully reduce the collision mortality rate (Marques et al., 2014; Schuster et al., 2015). The careful planning and studying of impacts while also being adaptable to site specific locations of the turbines, can be more cost effective in the long run by preventing costly future mitigation efforts (Marques et al., 2014; Schuster et al., 2015).

5.5.1.2 Thunnus thynnus

It is difficult to recommend specific mitigations for potential impacts to the Atlantic bluefin stock as there is little to no scientific research on the interaction between bluefin tuna and offshore wind turbines. The migratory routes and resulting presence of bluefin along the coasts of Newfoundland and Labrador could be considered under the environmental, and economic components defined in the TOR.

5.5.1.3 Salmo salar

Salmon monitoring programs currently exist at 18 river systems in Newfoundland and Labrador (Fisheries, 2019). It is recommended that partnership and collaboration be fostered with these existing programs to expand the scope of the Impact Assessment recommendations. The lack of understanding as to how Atlantic salmon will interact with turbines provides an opportunity for scientific research. Freshwater systems used by Atlantic salmon are already distributed around the island of Newfoundland and along the coast of Labrador (Fisheries, 2020). Offshore projects will undergo different phases of construction and decommissioning throughout a project lifespan and disruption to salmon habitat should be minimized. Local disruption is inevitable, so it is recommended that an increased knowledge of salmon routes and timing of migrations be a goal of the Regional Assessment.

5.5.2 Noise

To properly mitigate the potential noise impacts on migratory species caused by the offshore wind development, an assessment of the impacts on a wide array of species must be completed to account for the difference in life cycles and effects. With reference to bat species, the location of the offshore wind development is paramount in determining impact significance (Taber, 2018). When assessing a potential site, it is important to identify areas with large cave systems and avoid these locations to protect potential hibernacula of bat species. Another tactic to mitigate potential impacts on bat species is the use of ultrasonic acoustic transmitters, which emit sound waves that deter bats from a specific location (Taber, 2018). Emerging research has shown that lights may deter bat species from a specific location (Taber, 2018).

Focusing on the impacts of noise on harbor porpoises, further research needs to be completed on the migratory patterns and habitats of the populations present around coastal Newfoundland and Labrador. An assessment would allow for identification of important locations utilized by the harbor porpoise and provide data for future recommendations for development locations. Past research about the impacts of turbine-porpoise interaction often results in mixed conclusions. To determine potential confounding variables and identify other interacting factors, it may be important to compare offshore developments that have observed an increase in porpoise populations with those observing a decline in populations. This data could then be used to counter negative impacts through regulated mitigation as

future offshore development begins. Like bats, acoustic deterrents can also be installed underwater that emit specific frequencies that have been shown to deter porpoise populations from desired areas (Königson et al., 2021).

5.5.3 Knowledge gaps

The impacts offshore wind developments have on migratory vertebrates is an emerging subject, with little information available (Brabant et al., 2015). Our overall recommendation to achieve better data is to shift away from monitoring techniques and implement mitigation, and adaptation efforts. Monitoring techniques are important to understand the impacts offshore wind turbines have on migratory species; however, there is plenty of data from onshore wind turbines suggesting that the impacts will be significant (Schuster et al., 2015). Furthermore, the popular monitoring techniques are often cheaper than mitigation efforts, leading them to be used as an excuse to make it appear that they are mitigating the impact but, when they are only contributing more data. The data we do have is clear: windfarms impact migratory vertebrates (Brabant et al., 2015; Schuster et al., 2015). By concentrating resources on mitigation efforts rather than monitoring techniques we can seize the opportunity to be leaders in the emerging research field of offshore windfarms.

Monitoring will be necessary to provide data for mitigation efforts, but the focus of future research for offshore wind development should not be on improving monitoring techniques, because innovation of these techniques is widely studied (Hobson et al., 2008), and instead should focus on mitigation strategies. Studies are already acknowledging knowledge gaps and making suggestions about how to innovate our monitoring techniques to get a better understanding of the fatality rates of migratory vertebrates at wind development (Niemi & Tanttu, 2019; Schuster et al., 2015). Investing in monitoring should only be to supplement mitigation efforts.

5.6 CONCLUSION

The inclusion of marine and aerial migratory vertebrates within the revised edition of the Terms of Reference and Draft Agreement for offshore wind development is supported by the detailed discussion in this document. While the prospect of wind energy being generated in Newfoundland and Labrador is an exciting step toward reducing fossil fuel dependence in the province, countless studies worldwide have found evidence of the potential harm to migratory vertebrates. As offshore wind development projects become a reality, it is vital that the Regional Assessment provide a substantial framework for responsible renewable energy development.

Three distinct subcomponents impacting migratory vertebrates have been identified by the authors: species at risk, noise, and knowledge gaps, all of which should be addressed in the revised edition of the Terms of Reference, and Draft Agreement utilizing more direct language. There is an overall lack of knowledge, information, and research on the impacts offshore wind developments have on migratory vertebrates which have been reviewed in this document. To account for these knowledge gaps, we recommend future offshore wind developments focus on mitigation efforts rather than the surveillance and collection of mortality rates at the project location. With adequate information and knowledge of the full extent of impacts from offshore wind developments, steps can be made during the planning phases of these projects to ensure that the negative impacts are reduced. With these considerations wind developments will become more sustainable, as innovative research continues in this emerging field of energy generation.

5.7 ABOUT THE AUTHORS

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5.8 REFERENCES

Ahlén, I. (2003, December 11). Wind turbines and bats — a pilot study. *National Wind Watch*. Retrieved November 2022, from https://docs.wind-watch.org/Ahlen-windturbines-bats-2003.pdf.

Brabant, R., Vanermen, N., Stienen, E. W., & Degraer, S. (2015). Towards a cumulative collision risk assessment of local and migrating birds in North Sea Offshore Wind Farms. *Hydrobiologia*, *756*(1), 63–74. https://doi.org/10.1007/s10750-015-2224-2

Brewer, C. T., Rauch-Davis, W. A., & Fraser, E. E. (2021). The use of intrinsic markers for studying the migratory movements of bats. *Animals*, *11*(12), 3477. https://doi.org/10.3390/ani11123477

Cabrera-Cruz, S. A., Cervantes-Pasqualli, J., Franquesa-Soler, M., Muñoz-Jiménez, Ó., Rodríguez-Aguilar, G., & Villegas-Patraca, R. (2020). Estimates of aerial vertebrate mortality at wind farms in a bird migration corridor and Bat Diversity Hotspot. *Global Ecology and Conservation*, *22*. https://doi.org/10.1016/j.gecco.2020.e00966

Carstensen, J., Henriksen, O., & Teilmann, J. (2006). Impacts of offshore wind farm construction on harbour porpoises: acoustic monitoring of echolocation activity using porpoise detectors (T-PODs). *Marine Ecology Progress Series*, *321*, 295–308. https://doi.org/10.3354/meps321295

Committee on the Status of Endangered Wildlife in Canada. (2021, October). *Canadian Wildlife Species at Risk.* https://species-registry.canada.ca/indexen.html#/documents?documentTypeId=33&sortBy=documentTypeSort&sortDirection=asc&pageSize=10 [accessed 20 Oct 2022]

Committee on the Status of Endangered Wildlife in Canada . (2019, August 27). *COSEWIC assessment and update status report on the Mountain Plover Charadrius montanus in Canada (2000)*. Retrieved November 2022, from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/mountain-plover-2000.html

Committee on the Status of Endangered Wildlife in Canada. (2006). *COSEWIC assessment and update status report on the Harbour Porpoise (Phocoena Phocoena) Northwest Atlantic population in Canada*. Retrieved from https://registrelep-sararegistry.gc.ca/default.asp?lang=En&n=736E0799-1&printfullpage=true

Committee on the Status of Endangered Wildlife in Canada (2011, May). *Atlantic bluefin tuna (Thunnus thynnus): COSEWIC assessment and status report*

2011. https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/atlantic-bluefin-tuna-2011.html

Committee on the Status of Endangered Wildlife in Canada . (2010). *Atlantic salmon (Salmo salar): COSEWIC assessment and status report*. Retrieved November 2022, from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/atlantic-salmon.html

Daniels, J., & Mather, C. (2017). Conservation and care: Material politics and Atlantic Salmon on Newfoundland's gander river. *Maritime Studies*, *16*(1). https://doi.org/10.1186/s40152-017-0072-6

Department of Natural resources. (n.d.*) Bat Echolocation*. Maryland Government. Retrieved from https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/bats/batelocu.aspx#:~:text=%E2%80%8B%E2%80%8BBats%20can%20see,and%20listening%20to%20the%20echo.

Draft Agreement To Conduct a Regional Assessment of Offshore Wind Development in Newfoundland and Labrador. Impact Assessment Agency of Canada. (2022, October). Retrieved November 2022, from https://iaac-aeic.gc.ca/050/documents/p83514/145234E.pdf

Dorey, K., Dickey, S., & Walker, T. R. (2019). Testing efficacy of bird deterrents at wind turbine facilities: A pilot study in Nova Scotia, Canada. *Proceedings of the Nova Scotian Institute of Science (NSIS)*, *50*(1), 91. https://doi.org/10.15273/pnsis.v50i1.8874

Fisheries and Oceans Canada (2018, June 7). *Bluefin Tuna.* Government of Canada. Retrieved October 27, 2022, from https://www.dfo-mpo.gc.ca/species-especes/profiles-profils/bluefin-tuna-thon-rouge-eng.html

Fisheries and Oceans Canada. (2019, January). *Canadian Atlantic Bluefin Tuna (thunnus thynnus)- NAFO Fishing Areas 3KLNOP, 4RSTVWX and 5YZ - 2017*. Government of Canada. Retrieved Nov, 2022, from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp /bluefin-tuna-thon-rouge/bluefin-tuna-thonrouge2017-eng.html#toc1

Fisheries and Oceans Canada. (2020, Nov 3). *Atlantic Salmon - Newfoundland and Labrador Region*. Government of Canada. https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/ salmon-saumon/2020/index-eng.html

Furness, R. W., Wade, H. M., & Masden, E. A. (2013). Assessing vulnerability of marine bird populations to offshore wind farms. *Journal of Environmental Management*, *119*, 56–66. https://doi.org/10.1016/j.jenvman.2013.01.025

Government of Canada. (1985). *Fisheries Act*. Retrieved Nov, 2022, from https://laws-lois.justice.gc.ca/eng/acts/f-14/FullText.html

Government of Canada. (n.d.). *Species at risk: the act, the accord and the funding programs.* Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html

Hobson, K. A., Norris, D. R., Yohannes, E., & Kardynal, K. J. (2008). Animal migration: A context for using new techniques and approaches. *Tracking Animal Migration with Stable Isotopes*, 1–19. https://doi.org/10.1016/s1936-7961(07)00001-2

Huso, M. (2019). Wildlife mortality at wind facilities: How we know what we know, how we might mislead ourselves, and how we set our future course. *Wind Energy and Wildlife Impacts*, 27–41. https://doi.org/10.1007/978-3-030-05520-2_2

Johnston, A., Cook, A. S., Wright, L. J., Humphreys, E. M., & Burton, N. H. (2013). Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. *Journal of Applied Ecology*, *51*(1), 31–41. https://doi.org/10.1111/1365-2664.12191

Kaarakka, H. M., Peloton, E. M. and Redell, D. N. (2022). Northern Long-Eared Bat (Myotis septentrionalis) Species Guidance. Retrieved from https://dnr.wi.gov/files/PDF/pubs/er/ER0700.pdf

Kingdon, A. (2018). *Porpoises Flee from Noise Pollution*. Hakai Magazine. https://hakaimagazine.com/news/porpoises-flee-from-noise-pollution/

Königson, S., Naddafi, R., Hedgärde, M., Pettersson, A., Östman, R., Benavente Norrman, E., & Amundin, M. (2021). Will harbor porpoises (Phocoena phocoena) be deterred by a pinger that cannot be used as a “dinner bell” by seals? Marine Mammal Science, *38*(2), 469–485. https://doi.org/10.1111/mms.12880

Linnenschmidt, M., Madsen, P., Miller, L., Wahlberg, M., & Wisniewska, D. (2015). The Acoustic World of Harbor Porpoises. *American Scientist*, *103*(1), 46. https://doi.org/10.1511/2015.112.46

MacKenzie, B. R., Payne, M. R., Boje, J., Høyer, J. L., & Siegstad, H. (2014). A cascade of warming impacts brings bluefin tuna to Greenland waters. *Global Change Biology*, *20*(8), 2484–2491. https://doi.org/10.1111/gcb.12597

Martín, B., Perez-Bacalu, C., Onrubia, A., De Lucas, M., & Ferrer, M. (2018). Impact of wind farms on soaring bird populations at a migratory bottleneck. *European Journal of Wildlife Research*, *64*(3). https://doi.org/10.1007/s10344-018-1192-z

National Environmental Research Institute (NERI). (2005). *Effects of the Nysted Offshore Wind Farm on harbour porpoises. - Annual status report for the T-POD monitoring program*. Ministry of the Environment. Retrieved from https://tethys.pnnl.gov/sites/default/files/publications/Effects_of_the_Nysted_Offshore_Wind_Farm_on_Harbour_Porpoises.pdf

National oceanic and atmospheric administration (n.d.). *Harbor porpoise.* United States department of commence. Retrieved from https://oceanservice.noaa.gov/facts/sound.html

National oceanic and atmospheric administration. (2021). *How far does sound travel in the ocean?* United States department of commence. Retrieved from https://oceanservice.noaa.gov/facts/sound.html

Niemi, J., & Tanttu, J. T. (2019). Automatic bird identification for offshore wind farms. *Wind Energy and Wildlife Impacts*, 135–151. https://doi.org/10.1007/978-3-030-05520-2_9

Northern myotis. ontario.ca. (2014). Retrieved November 2022, from https://www.ontario.ca/page/northern-myotis#:~:text=Northern%20long%2Deared%20bats%20are,in%20caves%20or%20abandoned%20mines

Piorkowski, M. D., Farnsworth, A. J., Fry, M., Rohrbaugh, R. W., Fitzpatrick, J. W., & Rosenberg, K. V. (2011). Research priorities for wind energy and Migratory Wildlife. *The Journal of Wildlife Management*, *76*(3), 451–456. https://doi.org/10.1002/jwmg.327

Puig-Pons, V., Soliveres, E., Pérez-Arjona, I., Espinosa, V., Poveda-Martínez, P., Ramis-Soriano, J., Ordoñez-Cebrián, P., Moszyński, M., de la Gándara, F., Bou-Cabo, M., Cort, J. L., & Santaella, E. (2021). Monitoring of caged bluefin tuna reactions to ship and offshore wind farm operational noises. *Sensors*, *21*(21), 6998. https://doi.org/10.3390/s21216998

Regional Assessment of Offshore Wind Development in Newfoundland and Labrador and Nova Scotia. Impact Assessment Agency of Canada. (2022, October 12). Retrieved November 2022, from https://iaac-aeic.gc.ca/050/documents/p83514/145236E.pdf

Richardson, S. F., Stenson, G. B., & Hood, C. (2003). Growth of the harbour porpoise (*Phocoena phocoena*) in eastern Newfoundland, Canada. *NAMMCO Scientific Publications*, *5*, 211. https://doi.org/10.7557/3.2748

Santos, C. D., Ramesh, H., Ferraz, R., Franco, A. M., & Wikelski, M. (2022). Factors influencing wind turbine avoidance behaviour of a migrating soaring bird. *Scientific Reports*, *12*(1). https://doi.org/10.1038/s41598-022-10295-9

Sarà, G., Dean, J. M., D'Amato, D., Buscaino, G., Oliveri, A., Genovese, S., Ferro, S., Buffa, G., Martire, M. L., & Mazzola, S. (2007). Effect of boat noise on the behaviour of Bluefin Tuna *Thunnus thynnus* in the Mediterranean Sea. *Marine Ecology Progress Series*, *331*, 243–253. https://doi.org/10.3354/meps331243

Scheidat, M., Tougaard, J., Brasseur, S., Carstensen, J., van Polanen Petel, T., Teilmann, J., & Reijnders, P. (2011). Harbour porpoises (*Phocoena phocoena*) and wind farms: a case study in the Dutch North Sea. *Environmental Research Letters*, *6*(2), 025102. https://doi.org/10.1088/1748-9326/6/2/025102

Schuster, E., Bulling, L., & Köppel, J. (2015). Consolidating the state of knowledge: A synoptical review of Wind Energy's wildlife effects. *Environmental Management*, *56*(2), 300–331. https://doi.org/10.1007/s00267-015-0501-5

Sjollema, A. L., Gates, J. E., Hilderbrand, R. H., & Sherwell, J. (2014). Offshore activity of bats along the Mid-Atlantic Coast. *Northeastern Naturalist*, *21*(2), 154–163. https://doi.org/10.1656/045.021.0201

Sound waves. PASCO scientific. (n.d.). Retrieved November 13, 2022, from https://www.pasco.com/products/guides/sound-waves#:~:text=Sound%20is%20produced%20when%20an%20object%20vibrates%2C%20creating%20a%20pressure,sound%20further%20through%20the%20medium.

Species at Risk Act: Recovery Strategies. (2022). *Recovery Strategy (Amended) and Action Plan for the Piping Plover melodus subspecies (Charadrius melodus melodus) in Canada*. Retrieved Nov, 2022, from http//:www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/piping-plover-2022.html#toc10

Species at Risk Act: Recovery Strategies. (2018). *Recovery Strategy for the Little Brown Myotis (Myotis lucifugus), the Northern Myotis (Myotis septentrionalis), and the Tri-colored Bat (Perimyotis subflavus) in Canada*. Retrieved Nov, 2022 from http://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/little-brown-myotis-2018.html#toc8

Stantial, M. L., & Cohen, J. B. (2018). The influence of habitat, tidal stage, temperature, and breeding status on the flight behavior of piping plovers (charadrius melodus). *Journal of Ornithology*, *159*(3), 723–732. https://doi.org/10.1007/s10336-018-1536-1

Taber, A. D. (2018). *Bats and Wind Energy: Impacts, Mitigation, and Tradeoffs*. American Wind Wildlife Institute. Retrieved from https://rewi.org/wp-content/uploads/2018/11/AWWI-Bats-and-Wind-Energy-White-Paper-FINAL.pdf

Teilmann, J., & Carstensen, J. (2012). Negative long term effects on harbour porpoises from a large scale offshore wind farm in the Baltic—evidence of slow recovery. *Environmental Research Letters*, *7*(4), 045101. https://doi.org/10.1088/1748-9326/7/4/045101

Tuttle, M. (2017). *How disturbance harms hibernating bats.* Conservation resources. Retrieved from https://www.merlintuttle.org/disturbance-harms-hibernating-bats/

Understanding ocean acoustics. NOAA Ocean Explorer Podcast RSS. (n.d.). Retrieved November 13, 2022, from https://oceanexplorer.noaa.gov/explorations/sound01/background/acoustics/acoustics.html#:~:text=When%20underwater%20objects%20vibrate%2C%20they,the%20surface%20of%20a%20pond

US Department of Commerce, NOAA. (2014, September 23). *How far does sound travel in the ocean?* NOAA's National Ocean Service. Retrieved November 13, 2022, from https://oceanservice.noaa.gov/facts/sound.html

US fish and wildlife services. (2014). *Northern Long Eared bat interim conference and planning guidance.* Endangered species act. Retrieved from https://www.nrc.gov/docs/ML1507/ML15070A304.pdf

Van Zyll de Jong, C. G. (1985). *Handbook of Canadian mammals: Bats* (Vol. 2). National Museum of Natural Sciences.

Villadsgaard, A., Wahlberg, M., & Tougaard, J. (2007). Echolocation signals of wild harbour porpoises, *Phocoena phocoena*. *Journal of Experimental Biology*, *210*(1), 56–64. https://doi.org/10.1242/jeb.02618

Weaver, S. P., Hein, C. D., Simpson, T. R., Evans, J. W., & Castro-Arellano, I. (2020). Ultrasonic acoustic deterrents significantly reduce bat fatalities at wind turbines. *Global Ecology and Conservation*, *24*. https://doi.org/10.1016/j.gecco.2020.e01099

5.9 APPENDICES

5.9.1 Appendix A. Migratory species found in Newfoundland and Labrador or in the surrounding waters listed as endangered or threatened by COSEWIC

ENDANGERED MIGRATORY SPECIES
Myotis lucifugus (Myotis, Little Brown)
Myotis septentrionalis (Myotis, Northern)
Delphinapterus leucas (Whale, Beluga), St. Lawrence Estuary population (range includes Gulf of St. Lawrence) & Ungava Bay population (range includes Labrador sea)
Balaenoptera musculus (Whale, Blue), Atlantic population
Eubalaena glacialis (Whale, North Atlantic Right)
Balaenoptera borealis (Whale, Sei), Atlantic population
Numenius borealis (Curlew, Eskimo) – maybe extinct
Calidris canutus rufa (Knot rufa subspecies, Red), Southeastern USA /Gulf of Mexico /Caribbean wintering population
Charadrius melodus melodus (Plover melodus subspecies, Piping)
Dermochelys coriacea (Sea Turtle, Leatherback), Atlantic population
Caretta caretta (Sea Turtle, Loggerhead)
Thunnus thynnus (Bluefin Tuna, Atlantic)
Isurus oxyrinchus (Mako, Shortfin), Atlantic population
Lamna nasus (Porbeagle)
Sebastes mentella (Salmon, Atlantic), certain Atlantic populations
Carcharodon carcharias (Shark, White), Atlantic populations
Malacoraja senta (Skate, Smooth), Funk Island Deep population
Leucoraja ocellata (Skate, Winter), Eastern Scotian Shelf- Newfoundland population
THREATENED
Delphinapterus leucas (Whale, Beluga), Eastern Hudson Bay population
Dolichonyx oryzivorus (Bobolink)
Loxia curvirostra percna (Crossbill percna subspecies, Red)
Limosa haemastica (Godwit, Hudsonian)
Oceanodroma leucorhoa (Storm-Petrel, Leach's), Atlantic population
Riparia riparia (Swallow, Bank),
Tringa flavipes (Yellowlegs, Lesser)
Anguilla rostrata (Eel, American)

5.9.2 Appendix B. Different mitigation strategies currently being researched at offshore, and onshore wind energy developments. It is important to note that there is significant overlap between mitigation strategies for birds and bats. (Marques et al., 2015)

Mitigation strategy	Technique	Short description	Effectiveness	Financial cost	Target bird species/groups	Target collision risk factor
Avoidance	Siting new wind-farms	Strategic planning, pre-construction assessment and EIA Whenever a new wind project is planned	Proven	+/++	– All groups and species, with a focus on species vulnerable to collision or endangered species	– Bird abundance – Phenology – Landscape features – Flight paths – Food availability – Wind farm-specific factors
	Repowering	Whenever a new wind project is remodeled and based on post-construction monitoring programs	Proven	+/++	– All groups and species. Opportunity to have a new wind farm layout, problematic turbines and areas can be decommissioned	
Minimization	Turbine shutdown on demand	Selective and temporary shutdown of turbines during at risk periods Observers or automatic devices detect birds at risk and selective shutdown of turbines is undertaken	Proven	++/+++	– All bird species, particularly large birds or during pronounced migratory events	– Bird abundance – Flight paths – Weather – Phenology
	Restrict turbine operation	Turbine shutdown during periods with high collision risk, identified through collision risk modeling	High potential	+++	– Species highly vulnerable to collision or endangered species – Pronounced migratory periods	
	Habitat management	Promote bird activity in areas away from the turbines and decrease bird activity near the turbines	High potential	+/++/+++	– Species with marked preferences regarding habitat selection	– Bird abundance – Food availability – Flight paths
	Increasing turbine visibility	Blades painted with colored patterns or ultraviolet-reflective paint	High potential	+	– Only a limited range of species (not an option for vultures or other species that constantly look down when flying)	– Sensorial perception – Blade visibility
	Ground devices	Conspecific models that attract birds Decoy towers to displace birds	Possible	+/++	– Conspecific models may be applicable to social or gregarious species – Decoy towers may be applied for species exhibiting avoidance behaviors for such structures	– Bird behavior – Avoidance behaviors
	Deterrents	Auditory and laser deterrents that displace birds	Possible	++	– May benefit only a small range of species – Lasers applicable only to nocturnally-active birds	– Bird abundance – Flight paths

6 MIGRATORY BIRDS

Hayley Myers, Lucas Hoyles & Claire Brenton

6.1 SUMMARY

Renewable energy is an efficient method for combatting the climate crisis, with industry attempting to address this by shifting from burning fossil fuels to offshore wind energy through installation of wind turbines. Impacts of such development projects are examined in the context of the Valued Component (VC) considered by the authors: Migratory birds. This report makes comments on and recommendations for the Case Study of the Offshore Wind Energy Development in Newfoundland and Labrador and Nova Scotia Regional Assessment (RA) with reference to the Valued Component. Furthermore, the authors elaborate on how the Case Study addresses three primary affected components of migratory birds as identified by the literature. These components include, affects to migratory bird pathways and subsequent avoidance, habitat loss and degradation, and specific at-risk species. An in-depth review of background literature is presented for each component, which presents primary threats and suggestions by past research. In conjunction with the background, an evaluation of the Terms of Reference (TOR) and Draft Agreement documents put forward is performed. The results of the evaluation, having considered migratory birds as a valued component of TOR, revealed three areas of significance evident in the research performed by the authors.

6.2 EVALUATION OF THE PROJECT'S CONSIDERATION OF MIGRATORY BIRDS.

Background

Renewable energy has been promoted as an efficient method for combatting the climate crisis. One way industry has tried to address this is to shift from burning fossil fuels to offshore wind energy through installation of wind turbines. This report comments on and makes recommendations for the Case Study of the Offshore Wind Energy Development in Newfoundland and Labrador and Nova Scotia Regional Assessment (RA). The province of Newfoundland and Labrador has been recognized as being a significant habitat to many migratory bird species. With offshore wind power development, the threat imposed on seabirds is put into question. To begin, background information will be provided about endangered migratory bird species in Newfoundland, their habitats, and their importance on a global scale. This will be followed by an evaluation of how the TOR addresses areas concerning these species. Comments will be made as it relates to migratory birds, which is broken down into three components. This report focuses on how the Case Study addresses three primary components as identified by the literature: affects to migratory bird pathways (and subsequent avoidance), habitat loss and degradation, and specific at-risk species.

6.3 MIGRATORY PATHWAYS

Newfoundland and Labrador host crucial stopover and breeding habitat for many migratory birds (Wright, J. R. et al., 2018). During the spring, birds will migrate to the island, and in the fall return south, flying over the Atlantic Ocean, sometimes over the Cabot Strait (Wright, J. R. et al., 2018). Birds that migrate over this part of North America follow what is called the 'Atlantic Flyway' (Nature Conservancy of Canada, 2022). Some migratory species are consistent on their migratory path and others fly a unique path each time (Nature Conservancy of Canada, 2022).

The province sees almost 300 species of migratory birds, which claim different parts of the island as stopover or breeding sites (Newfoundland and Labrador Tourism, 2022). Migratory birds play an important role in global conservation by dispersing seeds, controlling insects, and as natural indicators of ecological health (Nature Conservancy of Canada, 2022). Some examples of migratory bird species which migrate across these areas and may be affected by this development project include, but are not limited to, Rusty Blackbirds, Red Knots, Bicknell's thrush, Piping Plovers, and Semipalmated sandpipers (Mactavish, B. et al., 2016).

In the past, scientists have attempted to understand the threats that wind power development poses to migratory birds. A review by Allison et al. in 2008 examined studies on the effects of offshore wind development on birds in Europe and found that potential threats to birds as it relates to migration include, "[B]barriers to movement causing deflection of birds around turbine arrays" (p. 30) and "[D]direct mortality resulting from collision with rotating turbine blades and turbine towers" (p. 30). Additionally, in reviewing literature knowledge gaps, the authors identified a need for understanding how wind turbines affect birds in an offshore environment, because most research from this time only focused on the effects of inshore or land-based wind energy development (Allison et al., 2008, p. 35).

Avoidance appears to be a primary issue when examining birds and how they react to wind turbines and wind farms (Schuster, E. et al., 2015, p. 305). A review of inshore wind energy research in 2015 identified

collisions with wind turbines as a threat for migratory birds, but that it was still a rare occurrence at this time (Schuster, E. et al., 2015, p. 315). Furthermore, the researchers concluded that certain species will accumulate in or around different areas of a wind farm because they are displaced from avoiding the construction activity or the windmills themselves (Schuster, E. et al., 2015, p. 305). The researchers explain this in behavioral terms, stating, "[A]avoidance behavior may result from birds perceiving the vertical structures as potential perches for raptors" (Kreuzinger, 2008, as cited in Schuster, E. et al., 2015, p. 307) or alternatively, birds are not familiar with these structures, and they get confused (Schuster, E. et al., 2015, p. 307). Another impact identified by literature is direct obstruction of flyways which may inhibit a migrating bird from reaching their resting or breeding grounds (Schuster, E. et al., 2015, p. 309). Additionally, this may cause exhaustion (as a direct result of increased energy consumption) or even injury (Schuster, E. et al., 2015, p. 309).

Suggestions have been put forward by researchers to help alleviate wind energy development stress on migratory birds. Wind farm design and layout is promoted as having a primary effect on helping birds avoid negative impacts. The review from 2015 found that birds are not as threatened by windmills which were green on the bottom (as opposed to all white or gray structures) (Durr, 2011, as cited in Schuster, E. et al., 2015, p. 307) and which were arranged linearly or in smaller groups (as opposed to spread out with large distances between structures) (Larsen and Madsen, 2000, as cited in Schuster, E. et al., 2015, p. 307).

In total, primary impacts to migratory birds and their flyways that should be prioritized include, direct collisions with windmills (Allison, T. D. et al., 2008; Desholm, 2009; Plonczkier & Simms, 2012; Schuster, E. et al., 2015), obstruction from resting or breeding grounds (Schuster, E. et al., 2015), avoidance (Schuster, E. et al., 2015), subsequent accumulation (Schuster, E. et al., 2015), and exhaustion or injury (Schuster, E. et al., 2015). Literature from the last two decades indicates a need for an increase in wind energy development in an offshore context, as well as a more robust system for windmill and wind farm design which has the potential to alleviate certain stresses on migratory birds. This will help to conserve and protect our bird species migrating over the Study Area identified in the RA while allowing for safe and efficient renewable energy

6.4 HABITAT

Global overreaching sustainable development challenges have evolved over the last few decades. Obstacles to sustainable development approaches, such as climate change, have become heavily correlated to economic, social, and environmental difficulties on all scales and in many locations. According to a case study conducted on the economic effects of climate change by Tol (2009), the influence of Greenhouse Gas (GHG) Emissions such as C02 from global energy and food production systems often falls outside merely monetary ramifications. Instead, obstacles to sustainable development, such as climate change, frequently carry a cascading impact that usually exceeds just one sector, often influencing everything from the social components of individual health and community to energy consumption and ecological wellbeing.

Regarding Canada, investigation on the latter subjects of renewable energy production, such as wind energy, and the magnitude of its influences on ecological integrity, are becoming more desired. The demand for investigation is likely due to Canada's motivation to extend its renewable energy sector in reply to objectives in the 2030 emissions reduction plan and an overall goal of reaching net zero

emissions by 2050 (Government of Canada, 2022). This increasing trend of energy display has been evident since the late 1990s, which saw the operation of 60 wind turbines on 8 wind farms, yielding a total of 27 megawatts (MW) of energy. In 2014, 5130 turbines worked on 225 wind farms and generated 9,694 MW, and by 2017, renewable energy production would yield up to 18.9 percent of Canada's primary energy sourcing, with 3.5 percent attributed to wind energy. (Natural Resources Canada, 2017). According to the Canadian Renewable Energy Association (2022), by the end of 2021, Canada had produced around 14,304 MW of electricity from wind energy production alone, with the combination of wind and solar meeting 6.5 percent of total Canadian energy demand in 2020. Canada's trend in increasing renewable energy production can be supported by its recent introduction of wind energy to smaller provinces. For instance, the offshore wind project proposed for the west coast of Newfoundland and Labrador and along Nova Scotia has been an exciting topic of late. Introducing an offshore wind project could bolster socioeconomic sectors through increased job availability, social development, and job income (Breyer, 2017). In Newfoundland, this can mean significant benefits across socioeconomic sectors. However, with new economic growth, there must be an understanding of the expected environmental degradation.

One interesting topic is how Offshore wind projects affect avian waterbird habitats. According to a study conducted by Fox (2006), considering avian habitat degradation is a somewhat gray but essential aspect of Offshore wind development. For example, the displacement from ideal feeding distributions and the destruction or modification of feeding habitats are notable forms of avian water bird habitat degradation concerning offshore wind production. Fox (2006) suggests that displacement from offshore projects can cause displacement from feeding locations and create effective habitat loss leading to an overall decrease in avian population size. More effects can be seen in the destruction of feeding habitats surrounding offshore wind energy production, resulting in increased energy expenditure and fluctuations in population sizes. Similar results can be seen in a study conducted by Exo et al. (2003), which noted that high levels of disturbance from offshore can affect breeding, roosting, and feeding tendencies that can snowball into long-term changes for avian habitat. It is also important to note that Offshore wind production may affect avian habitats through sub-sea acoustic noise and vibrations. According to a study conducted by Nedwell et al. (2003), the likely effects of sub-sea acoustics can cause avoidance and injury to aquatic species within 77 meters. While there is little research into the long-term range of influence of underwater vibrations caused by offshore wind activity, it is also important to note that on a large scale, sub-sea acoustics may substantially affect avian habitats through the displacement of fishing resources.

6.5 Species at Risk (SAR)

Migratory seabirds differ from other avian species as they spend a portion of their lives on land and a portion at sea, as well as oftentimes traveling long distances across the globe for the purpose of mating, nesting and feeding. Due to the unique nature of this species, they can offer important insights into the sustainability of their habitat and have been used as an environmental indicator across the globe (Piatt et al., 2007). Unlike other marine species, seabirds are highly visible to humans allowing them to be utilized to observe other conditions in the environment such as coinciding fish stocks. For example, reproductive failures of the Atlantic puffin foreshadowed the collapse of herring stocks off the coast in Norway during the 1970s (Piatt et al., 2007).

With migratory seabirds having the capacity to grant further insight into the health of their surroundings, through protecting these species they can be used as a fundamental tool in observing phenomena associated with climate change. Migratory seabird colonies are located in what are described as “hotspots” (Piatt et al., 2007) around the globe. A region that is recognized as being one of these hotspots is Eastern Canada (Allard et al., 2014). Part of this hotspot region is along the coast of the province of Newfoundland & Labrador. The figures below display the distribution of two species, the northern gannet (priority species) (Garthe et al., 2017) and the ivory guy (endangered) around the province (*NCC: Ivory Gull*, n.d.). As can be observed in these figures, both species exist in dense colonies spread along the province’s coastline.

While the northern gannet and ivory gull are not the only migratory bird species to inhabit the province’s coastlines, looking at their distribution establishes the fact that migratory bird colonies of priority or endangered status will potentially be impacted by offshore wind development if it were to be located in areas of high population density. Other endangered migratory bird species that can be found along Newfoundland & Labrador coastlines include the Barrows Golden Eye, Eskimo Curlew. Harlequin duck, Piping Plover and Red Knot. If careful consideration is not given towards these vulnerable species and their habitats then the proposed wind energy development could impose further stress on previously threatened species. By imposing further threats on these species, not only is the biodiversity of local ecosystems jeopardized but also those at the global scale.

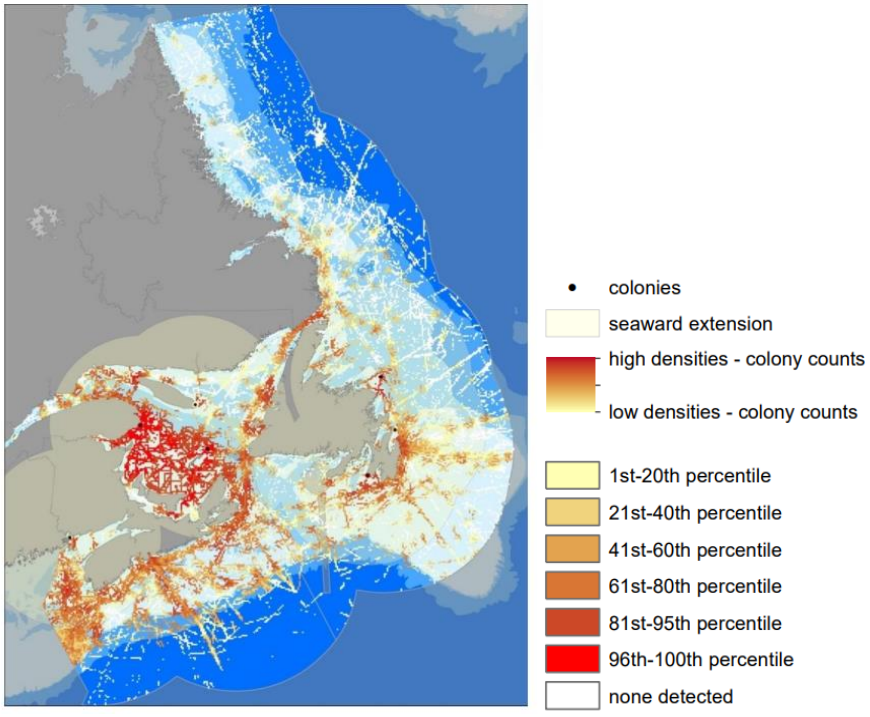

Figure 1. Locations of Northern Gannet nesting colonies are represented by black dots. Deeper red cells represent higher relative densities of Northern Gannet at sea. Transparent areas, where the bathymetry is shown, constitute survey gaps. Areas in white show where surveys occurred but the species was not detected (true zeroes) (Allard et al., 2014).

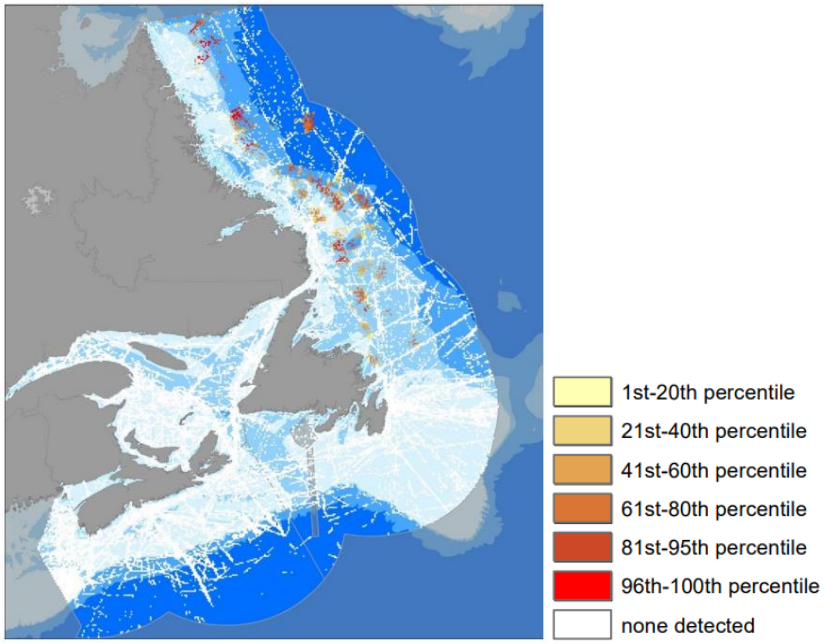

Figure 2. Deeper red cells represent higher relative densities of Ivory Gull at sea. Transparent areas, where the bathymetry is shown, constitute survey gaps. Areas in white show where surveys occurred but the species was not detected (true zeroes) (Allard et al., 2014).

6.6 Evaluation

Within the Terms of Reference (TOR), Migratory Birds are given only a single mention and the endangered species that exist within this group are not mentioned at all. Similarly, within the *Draft Agreement to Conduct A Regional Assessment of Offshore Wind Development in Newfoundland and Labrador,* migratory birds are not explicitly mentioned. With both the TOR and Draft Agreement failing to adequately acknowledge the importance of migratory birds, specifically the presence of endangered species within the province, what has currently been put forward needs to be analyzed and recommendations that address these concerns proposed.

Section A1.6, under Information and Analysis, subsection 'Analysis of Effects, Mitigation and Follow-up', section t page A-5, the Committee outlines a draft list of components which includes marine and migratory birds (point ii) for consideration of any potential negative effects. Subsequent sections v and w continue to describe that affects to this component (marine and migratory birds) will be mitigated, that potential positive effects will be increased, and the consideration of existing policies that may influence adverse effect mitigation will be calculated (with regards to the migratory bird component). Section A1.6, under Advisory Groups, subsection 'Advisory Groups: Scientific and Technical Information and Analysis', section m page A-3, describes how professional advice and scientific information will be solicited from government and non-governmental groups (the 'Advisory Group') on each component, which includes marine and migratory birds as one component. Section A1.6, under Advisory Groups, subsection 'Advisory Groups: Scientific and Technical Information and Analysis', section n page A-4, describes how the Advisory Group will aid the Committee (as described in A1.1, p. A-1) in the performance of analyses of the professional advice and scientific information with regards to marine and migratory birds as one component. Section A1.6, under Information and Analysis, subsection 'Other

Considerations and Requirements' section x page A-5, the Committee outlines how they will address adverse and positive effects with respect to climate change and environmental obligations. This is relevant to the effects described on migratory birds, which are considered affected under the umbrella of the climate crisis, as all wildlife in the Study Area will be influenced by climate change. There is no direct reference to migratory birds or any potential impacts from wind energy development in the Draft Agreement.

6.7 RECOMMENDATIONS

Having considered migratory birds as a valued component of TOR, three areas of significance became evident in the research: migratory pathways, habitat destruction and endangered species. Through giving each of these areas thorough consideration, the following recommendations have been proposed as a means of further guiding the RA:

- It is advantageous that the Terms of Reference recognizes migratory birds as a component of special concern. In the Terms of Reference, identification of specific areas of concern with reference to migratory pathways is crucial. It is important that, since the scope of the RA is so large, there are many potentially affected birds. It is difficult to understand how, and which migratory birds may be affected, and are therefore of special concern, so that impact analysis can be more targeted to certain species.
- Additionally, it is important that the Committee perform more research on how to construct safe wind turbines (to alleviate the outlined stresses). An expert panel may inform on how to construct wind turbines which will cause the least amount of negative behaviors in encounters with migratory birds.
- As it can be observed that endangered migratory bird species and their habitats are present within the study area, exclusion zones should be used as a tool in areas of high population density as a means of mitigating risks imposed on these species.
- The committee should aim to construct an advisory panel of reputable local and commercial fishery operators in addition to a panel of experts to measure specific areas of avian displacement and habitat degradation and monitor changes in aquatic activity within 100m of offshore wind turbines.

6.8 ABOUT THE AUTHORS

Claire Brenton is a first-year graduate student in the Master of Arts in Environmental Policy (MAEP) program at Grenfell Campus, Memorial University of Newfoundland, located in Corner Brook, Newfoundland and Labrador. Claire holds a Bachelor of Science (Honours) in Biology, with a concentration in molecular biology, from Memorial University of Newfoundland. Additionally, before her admission to graduate school, she worked for Intervale Associates, an environmental non-governmental organization (ENGO) specializing in community-based research, wildlife conservation, and sustainability. During her time at Intervale, Claire studied at-risk species like the Piping Plover and Bank Swallow on the southwest coast of Newfoundland and Labrador. Claire is from Corner Brook, and shares lived experiences with those affected by development projects in the west and southwest coasts of the province.

Lucas Hoyles is a First-year graduate student in the Master of Arts in Environmental Policy (MAEP) program at Grenfell Campus, Memorial University in Corner Brook Newfoundland and Labrador. Lucas holds a Bachelors of Sustainable Resource Management with a Minors in Geography. Before his admittance, Lucas had attained experience in multiple fields through teaching as a water safety instructor, lifeguarding, labor within the mining industry of Labrador, and as an Environmental Field Technician. Lucas is from Deer Lake, Newfoundland and strives to work with clean energy production with a focus on wind energy.

Hayley Myers is a first-year graduate student in the Master of Arts in Environmental Policy (MAEP) program at Grenfell Campus, Memorial University of Newfoundland, located in Corner Brook, Newfoundland and Labrador. Hayley has a Bachelor of Arts (Honours) in Geography, from Memorial University of Newfoundland which she uses to engage with human dimensions of wildlife resources (HDWR) research. Additionally, before her admission to graduate school, she worked for the Environmental Education Commission, an environmental non-governmental organization (ENGO) specializing in engaging school-age children with nature related studies, wildlife conservation, and sustainability. Hayley is from Chapel's Cove, Newfoundland and takes personal interest in the future of green energy in Newfoundland & Labrador.

6.9 REFERENCES

Allard, K., Mahoney, M. & Hanson, A. R. (2014). *Summary: important marine habitat areas for* migratory birds in eastern Canada. Canadian Wildlife Service.

Allison, T. D., Jedrey, E., & Perkins, S. (2008). Avian issues for offshore wind development. *Marine Technology Society Journal*, *42*(2), 28–38. https://doi.org/10.4031/002533208786829115.

Birdwatching. (2022). Newfoundland and Labrador Tourism. https://www.newfoundlandlabrador.com/things-to-do/birdwatching#sc-92F184E44F6E436384125FD12C952CC3.

Breyer, S., Cornet, M., Pestiaux, J., & Vermeulen, P. (2017). The Socioeconomic impact of the Belgian offshore wind industry. The Belgian Offshore Platform (BOP). URL: http://www. belgianoffshoreplatform. be/app/uploads/The-socio-economic-impact-of the-Belgian-offshore-wind-industry. pdf. https://www.belgianoffshoreplatform.be/app/uploads/The-socio-economic-impact-of-the-belgian-offshore-wind-industry.pdf

By the numbers. Canadian Renewable Energy Association. (2022, January 26). https://renewablesassociation.ca/by-the-numbers/

Canada, S. (2022, August 26). *Government of Canada*. Canada.ca. https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050.html

Desholm, M. (2009). Avian sensitivity to mortality: Prioritising migratory bird species for assessment at proposed wind farms. *Journal of Environmental Management*, *90*(8), 2672–2679. https://doi.org/10.1016/j.jenvman.2009.02.005.

Exo, K. M., Huppop, O., & Garthe, S. (2003). Birds and offshore wind farms: a hot topic in marine ecology. *Bulletin-Wader Study Group*, *100*, 50-53.https://offshorewindenergy.tudelft.nl/COD/reports/report-files/report_009.pdf

Fox, A. D., & Petersen, I. K. (2019). Offshore wind farms and their effects on birds. *Dansk Ornitologisk Forenings Tidsskrift*, *113*, 86-101.https://www.researchgate.net/profile/A-Fox-2/publication/335703152_Offshore_wind_farms_and_their_effects_on_birds/links/5d769211299bf1cb8095256e/Offshore-wind-farms-and-their-effects-on-birds.pdf

Garthe, S., Markones, N., & Corman, A.-M. (2017). Possible impacts of offshore wind farms on seabirds: A pilot study in Northern Gannets in the southern North Sea. *Journal of Ornithology*, *158*(1), 345–349. https://doi.org/10.1007/s10336-016-1402-y

Johnston, A., Cook, A. S., Wright, L. J., Humphreys, E. M., & Burton, N. H. (2014). Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. *Journal of Applied Ecology*, *51*(1), 31-41.https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/1365-2664.12191

Mactavish, B., Clarke, J., Wells, J., Buckley, A., & Fifield, D. (n.d.). *Checklist (2016) of the Birds of Insular Newfoundland*. https://research.library.mun.ca/1944/1/Checklist_2003_of_the_Birds_of_Insular_Newfoundland_and_Its_Continental_Shelf.pdf

Masden, E. A., McCluskie, A., Owen, E., & Langston, R. H. (2015). Renewable energy developments in an uncertain world: the case of offshore wind and birds in the UK. *Marine Policy*, *51*, 169-172. https://www.sciencedirect.com/science/article/abs/pii/S0308597X1400222X

NCC: Ivory gull. (n.d.). Retrieved November 18, 2022, from

https://www.natureconservancy.ca/en/what-we-do/resource-centre/featured-species/birds/

Ivory-gull.html

Nedwell, J., Langworthy, J., & Howell, D. (2003). Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore windfarms; and comparison with background noise. *Subacoustech Report ref: 544R0423, published by COWRIE*, *725*. http://users.ece.utexas.edu/~ling/2A_EU1.pdf

On the flyway to home: Get to know Canada's migratory birds. (2022). Nature Conservancy of Canada. https://www.natureconservancy.ca/en/feature-stories/migratory-birds.html.

Piatt, J. F., Sydeman, W. J., & Wiese, F. (2007). Introduction: a modern role for seabirds as indicators. *Marine Ecology. Progress Series* (Halstenbek), 352, 199–204. https://doi.org/10.3354/meps07070

Plonczkier, P., & Simms, I. C. (2012). Radar monitoring of migrating pink-footed geese: Behavioural responses to offshore wind farm development. *Journal of Applied Ecology*, *49*(5), 1187–1194. https://doi.org/10.1111/j.1365-2664.2012.02181.x.

Schuster, E., Bulling, L., & Köppel, J. (2015). Consolidating the State of Knowledge: A Synoptical Review of Wind Energy's Wildlife Effects. *Environmental Management*, *56*(2), 300–331. https://doi.org/10.1007/s00267-015-0501-5.

Wright, J. R., Powell, L. L., & Tonra, C. M. (2018). Automated telemetry reveals staging behavior in a declining migratory passerine. *Auk*, *135*(3), 461–476. https://doi.org/10.1642/AUK-17-219.1.

7 NEWFOUNDLAND AND LABRADOR FISHERIES

Lawrence Nditsi, Nathaniel Abanyin, and Tithy Dev

7.1 SUMMARY

This report by Tithy Dev, Lawrence Nditsi, and Nathaniel Abanyin comment on the Newfoundland draft agreement and terms of reference (TOR). In general, we agree with the development of offshore energy production due to reducing carbon pressure on the environment. As Impact Assessment students, we are concerned about the development of offshore wind energy because these activities will have an impact (both positively and negatively) on NL fisheries, either directly or indirectly. Beginning in the late 1800s and still today, the fisheries sector has been integral to Newfoundland and Labrador's heritage and is the basis of the province's socioeconomic development. We analyzed the draft agreement and TOR by identifying three specific valued components (VCs) of fisheries. These VCs are the economy, socio-culture, and stock of fisheries, and there are different sub-valued components of these VCs.

The gross domestic product (GDP), the number of jobs available, and the standard of living are all macroeconomic factors used to evaluate NL's fisheries industry. The fishery industry has increased its contribution to the provincial GDP because 2021 marks the seventh consecutive year the value of fish products has surpassed $1 billion. The possible problem of offshore wind energy development is loss of access to fishing grounds and damage to fishing gear, decreasing fish production. In addition, offshore wind energy development's possible positive impact is creating employment opportunities for local people and fishing communities. However, the fishermen may need more qualifications to get jobs in offshore wind energy projects; most have left school early and been involved in fishing. Another aspect of the economy is fishers' living standard, which is directly dependent on their employment and income. If their expenditure for offshore development increases, their living standard will be lower than it was.

Offshore wind energy can also affect marine species by distorting their hearing abilities, as most species depend on sound to navigate deep waters. In the same way, wind turbines can distort the aesthetics of preserved landscapes, most of which serve as tourist sites along the west coast and culturally preserved landscapes.

We recommend a comprehensive representation of indigenous communities in the impact assessment process, including fishermen and Indigenous Knowledge holders, for their experience, will be vital to understanding the limitations of the current offshore areas and helping to make an effective way to minimize adverse effects on their life. NL has excellent potential for offshore wind power, so the offshore wind power regional assessment can play a significant role in establishing offshore wind farms to complement energy generation and a sustainable energy future for Canada.

7.2 Background – Fish Species

Among renewable energies, the wind is one of the most prominent ones, which at present is an added capacity to meet the world's energy demands. It is estimated that 20% of wind power is available to meet electricity needs, whereas offshore wind energy is 90% greater than onshore wind energy worldwide (Eamer, Shaw, King and MacKillop, 2021). In Atlantic Canada, there are a significant number of locations for high-quality offshore wind energy, especially around Eastern Nova Scotia and Newfoundland (Eamer et al., 2021); its ability to account for 21% of national energy demand in 2011(Barrington-Leigh & Ouliaris, 2017; Eamer et al., 2021). More importantly, Mercer et al. (2017) mentioned that NL is full of wind energy resources in their study "NL is theoretically capable of producing 117 times the amount of its 2006 electricity demand through wind energy" and "[NL] could generate almost 20% of Canada's 2010 energy demand by making use of only 25% of its high potential [wind development] area" (Mercer et al., p.674; Fisher et al., 2009; Barrington-Leigh & Ouliaris, 2017). The development of offshore wind energy is one of the reasons for the increasing demand for the use of ocean space. The marine environment is becoming one of the major concerns associated with the development of offshore wind energy in Newfoundland and Labrador, and offshore wind energy operations affect ecosystems which could be alarming for NL marine fisheries. So it is vital to assess offshore wind development activities (including all aspects, namely, construction, expansion, operation, discharging, identifying and analyzing of its valued components as well as cumulative effects) for NL's sustainable economic development (Draft agreement, 2022, p.1).

7.2.1 Stocks of Fish

Historically, Newfoundland's cod, bluefin tuna, salmon, and herrings fishery, according to Rose and Rowe (2022), employed over 40,000 people and produced tons of cod each year until the Government of Canada imposed a moratorium in 1992 in response to industrialized overfishing by Canadians and foreigners on the Grand Banks. After an extended period of fishing moratorium, there are mixed reactions about whether Atlantic cod numbers will increase. After nearly 20 years of bans on Atlantic cod fishing, researchers believe other factors may explain why the population of Atlantic cod has not improved despite Jenn Verna's emphasis that "the moratorium on cod fishing was to last for only two years." (Verma, 2022). Atlantic cod's lack of recovery could be explained better by environmental factors affecting it and its food chain. (Jamieson et al., 2018). Scholars agree that the decline in cod is primarily due to predation by various harp species, mortality, and the lack of prey for cod, with cod numbers still below the acceptable threshold after several years of decline; supposedly, the cod population decline may indeed be attributed to overfishing. Therefore, pointing out that enough time has passed to begin to see improvements in the population will help determine how long it will take to see the desired result. Similarly, Rose & Rowe (2022) state that previous research agrees to some degree with the change in Atlantic cod spawning behaviour, as the Labrador current, which affects the cod ecosystem, has resulted in a shift from the north to the south of the cod population. Several factors beyond climatic stressors in the literature have explained aquatic species' habitat changes.

7.2.2 Offshore Wind Energy and Marine species

Methratta (2020) reports that the first installed wind turbine was in Europe in 1991, and it has since attracted attention from many countries. As of 2018, 23.1 GW of offshore wind capacity was installed worldwide. In 2019, the United Kingdom contributed 34% of the world's wind energy, followed by China (20%) and Germany (28%), with many other countries also making progress in integrating wind energy into their power networks (Global Wind Energy Council (GWEC), 2019). In 2021 a total of 93.6 GW of

wind turbine installations saw the total global capacity increase to 837, representing a 12 percent increase from the year before, with China currently taking the lead (GWEC, 2022).

Global marine management plans indicate that offshore wind energy can grow in popularity as it becomes clear that renewable energy can be increased; however, concerns are raised regarding other uses of the marine environment and conservation issues (Bergström et al., 2014). In the 21st century, however, this has coincided with the desire by countries to move towards environmentally efficient ways of meeting their energy need, as various countries have set very ambitious targets of meeting a net zero energy production before the year 2050. (Karydis, 2013) Canada has committed to reaching net zero by 2035 with various benefits to harnessing if this ambitious plan goes as planned, the country will pride itself as the global leader in clean energy by reducing the carbon footprints of its citizens (Binnu, 2022). However, it is essential to maintain sight of the fact that projects of such nature do not occur in isolation. The total contribution of wind energy to the national grid currently stands around 3.5 percent, with prospects for more given its extensive shoreline (Terra, 2022). Even though wind energy is among the most appealing renewable sources in terms of production costs and environmental effects, the public has many reservations about its development due to the combination of various factors stretching across its benefits and implications (Karydis, 2013). Mahratta (2020) agrees that offshore project areas often coincide with fertile marine ecosystems, productive communities and protected species and often overlap with economically valuable and culturally rich fishing grounds. Wind farms may affect marine species through various means, but agreements about the actual impacts of wind farms on marine species are mixed. Some studies have documented that wind farms are beneficial to aquatic species.

7.2.3 Offshore Wind Turbine Effect on Marine Ecosystem

There is increasing evidence that Offshore wind farms are related to higher fish abundance; it is still unknown if fish are drawn to the Offshore Wind turbine to help with fish production (Andersson & Öhman, 2010). It is believed that offshore wind energy development has increased the occurrence of artificial structures in the marine environment. These artificial structures may create new habitat opportunities for fish and snarling organisms. However, little scientific information exists on how marine organisms are affected by such structures (Andersson & Ohman, 2010; Sigray & Andersson, 2011). (Andersson & Öhman, 2010) Sigray & Andersson, 2011). Various species are affected differently based on their biological composition and location, as fish in the deep sea and the intertidal wave might exhibit distinct reactions (Bergstrom et al., 2014; Sigray & Andersson, 2011). Thus, fish are affected in various ways depending on the exposure sounds. Sound is essential for all fishes regarding orientation, feeding purposes, and behavioural interactions.

According to Wahlberg & Westerberg (2005), fish react to sound in attractive and aversive ways. He also notes that Cod Gadus morhua is more sensitive to sound due to its larger swim bladder. Subsequently, the possible effects of windmill sounds on fish are evaluated regarding detection distances, communication masking, and hearing damage. Studies on fish reaction to anthropogenic noise have been carried out for several decades, and wind farms are not well understood and need further investigation (Sigray & Andersson, 2011). (Bergström et al., 2014). Auditory disturbances and increased sediment dispersion were the primary forces during construction. In contrast, habitat gain, fisheries exclusion, acoustic disturbance, and electromagnetic fields were the critical pressures throughout the operation. Fish species, including cod (Gadus morhua), herring (Clupea harengus), eels (Anguilla

Anguilla), and flatfishes, are frequently mentioned about OWF effects. The overall research revealed that noise significantly impacts fish and marine animals in all subarea's vulnerable populations of fish species that rely on shallow waters for recruitment, such as cod. The excessive noise from pile-driving, typically employed in deploying OWF based on monopile or jacket foundations, was linked to the high scores.

In these situations, acoustic disruption is mainly anticipated from sea floor preparation operations, such as drilling or dredging, and increased vessel traffic. The noise produced by wind turbines during installation and operation can also have an impact on marine life. (Andersson & Öhman, 2010). Sigray and Andersson (2011) revealed that a wind turbine generated broadband vibrations, with amplitudes increasing at higher wind speeds monitoring particle motion close to a wind turbine using a buoyant sphere. The sound generated by a wind farm is reported to be much lower during the operational phase than during construction (Hawkins et al., 2015; see also Madsen et al., 2006; Thomsen et al., 2006). When pile driving is used to lay the foundations for wind farms, Hawkins et al. (2015) report that it produces the most powerful sound; however, the sound produced during the construction phase is with temporary effects on marine animals than the continuous operational sound from a turbine. During wind turbine rotation, vibration is produced, along with underwater sound, transmitted to the water by the tower wall and support structure supporting the seabed; substrate vibration can be continuous when the wind turbine operates (Hawkins et al., 2021). Tougaard et al. (2020), as cited by Hawkins et al. (2021), noted that the noise transmitted into the water through the turbine's foundation and that the noise from different turbines will vary depending on the foundations utilized.

In conclusion, research shows that building operations should not be encouraged in critical regions for fish and marine mammal recruitment, with measures to lower exposure to harmful noise levels factored in. Because the predicted impact depends on current management objectives, which cannot be evaluated as good or bad. These extensive techniques are unquestionably required to ensure the sustainable management of maritime landscapes because humans use them within specific bounds. Karydis (2013) claims that noise and vibrations, distinct noise from construction, are the main factors affecting marine habitats. The sound is produced when large pile hammers or pile-driving drives monopoles into the seafloor. Marine animals may be affected by ramming, other construction activities, increased sea traffic, trenching, dredging, and blade and gearbox noise. Karydis (2013) suggests more research to (1). identify background noise, (2) specify the effect zone for sea mammals, and (3) consider noise's potential effects on marine life types in biological surveys and monitoring studies.

The ability of fish to hear and react to noises needs to be better understood, making marine wind turbine installations and their impact on aquatic organisms a new field in environmental impact assessment studies. The increased concentration of fish near artificial structures is explained in two different ways. First, according to the attraction hypothesis, fish in the area converge on the systems, but the overall fish population does not grow. Second, the production hypothesis says that fish populations in the area benefit from artificial structures by having higher growth rates, reproduction, and survival, which leads to a net increase in biomass and number.

7.2.4 Recommendations on the TOR

Various species may benefit from the unique habitat opportunities wind turbine foundations offer due to their structural characteristics. Although wind turbines' effects on the substrate have been studied, only some measurements have been made of the levels of vibration and particle motion generated by

an operational wind turbine. As we are sure of the foundation type for the turbine installation to determine the magnitude of noise and vibration transmitted during the operational phase, the terms of reference should include a structure specific to how the sound will not impact the species during the operational stage.

We need to find out which species are drawn to wind turbines and which are scared away by them; the terms of reference must include more information about how specific preferences will be found and what needs to be done to protect them.

That would mean identifying species that would be attracted and those that would not be due to noise from the turbines and vibration from the installation and how the offshore wind project intends to provide solutions to the species that may be affected.

7.3 Economy of Newfoundland and Labrador Fisheries

Fishing is an integral part of Newfoundland and Labrador's heritage. This industry is an integral component due to vital economic contributors to rural regions in the province of Newfoundland and Labrador (NL) (Araf, 2021). About 90% of the fish harvested in the province is exported; this sector employs over 17,500 people from over 400 communities, so the fishery is important for the province's GDP (Govt. of NL, 2018, 2021). NL has a vast coastal area (29,000 km), and the people of NL rely on this large water body for growth and economic development (Govt. of NL, 2021). NL is one of the provinces in Canada where fishing has the most significant value in the provincial economy. The economic impact of the provincial fisheries industry focuses on three macroeconomic variables, the GDP, employment, and living standard. Foremost, we tried to analyze fisheries' present contribution to the NL economy, then what types of problems are faced by introducing offshore wind projects and finally, we suggested some recommendations for achieving maximum benefits with minimum drawbacks to the provincial economy of NL from offshore wind energy projects.

7.3.1 Gross Domestic Product (GDP)

NL has a vast coastal area (29,000 km), and the people of NL rely on this large water body for growth and economic development (Govt. of NL, 2021). GDP impacts generated by the fishing sector grew between 2011 and 2021. In 2021, the province's total seafood production was valued at $1.6 billion, up 69.85% from $942 million in 2010. More importantly, 2021 marks the seventh consecutive year the value of fish products has surpassed $1 billion. In addition, more than $11 million (including 36 projects) was allocated for the modernization of equipment and improving productivity and sustainability in the NL fisheries sector by Fisheries and Oceans and the Province of NL (Govt. of NL, 2021).

We know offshore wind energy is a non-carbon-emitting energy source that has a lot of positive impacts on the socioeconomic environment; specifically, it needs to be clarified what it impacts on the fish habitats. It is assumed that loss of access to fishing grounds and damage to fishing gear are the main reasons for decreasing fish production due to offshore wind energy development (Wilber et al., 2018). This adverse impact on fisheries is most likely to be affected by the construction and operation of offshore wind energy. Because the turbine's construction and operation of the offshore wind energy project could be raised complexity for the fish habitat (Wilber et al., 2018; Wahlberg & Westerberg, 2005), the construction and installation of platforms, as well as other equipment may be responsible for sound pollution, fish and other aquatic animals' habitat destruction, coral reefs destruction, and aquatic

pollution (Araf, 2021; Wahlberg & Westerberg, 2005). Another critical issue that needs to be investigated is whether the noise from offshore energy production affects fisheries, especially fish eggs, larvae, and juveniles' stage of fish (Methratta, 2020; Wahlberg & Westerberg, 2005), since the noise from turbines may decrease sound communication of fish. However, it needs to be known to what extent this decrease affects the behaviour and fitness of fish. Table 1 shows the effects on Fish associated with offshore wind farms related to fisheries production. In addition, the hatching and growing of different fish species depend on food availability for fish, specific areas, weather, and periods effects by season (Wilber et al., 2018; Reubens et al., 2013).

Table 1: Effects on fish associated with offshore wind farms

Direct effects	Indirect effects
Habitat provision via turbine structures	Altered nutrient cycling due to benthic species growing on turbine structures via suspension feeding, excretion, biodeposition, etc.
Food provision for benthivorous and piscivorous fish via species growing on/near turbines	Change in abundance and composition of benthic forage for benthivorous fish due to sediment enrichment from organisms associated with turbine structures
Attraction to turbine structures	Change in fishing behaviour
Electromagnetic field effects on movement or behaviour	Altered food web dynamics due to food subsidy from organisms associated with turbine structures
Alteration of seabed habitat	Hydrodynamic effects on primary/secondary production and particle movement
Obstruction to fishing	Spillover of finish from inside of wind farm where fishing may be reduced to outside the wind farm
Pile driving effects on behaviour or Physiology	
Source: Adapted from Methratta, 2020, p.891	

We mention some findings from reviewed literature. For instance, before starting the project, a pilot survey must be run for the wind turbine to minimize environmental impacts on marine habitats by federal and provincial resource agencies, so that fish production is not hampered. Again it should be

tried to link between nearshore and offshore habitats for fish to support commercial and recreational fisheries. Block Island Wind Farm (BIWF) in the USA is a revenant example of the protection of marine fisheries by offshore wind farms (Wilber et al., 2018).

7.3.2 Employment Opportunities

Total employment in the fisheries sector was 17,500 persons in 2021, representing a 17.80% decline since 2011 (Govt. of NL, 2020). The number of fish harvesters in the province was down 7.0%, to 10,802 harvesters, while the number of fish processing workers declined by 3.5%, to 10,340 persons (Govt. of NL, 2020). A person year is a variable that estimates the equivalent number of full-time positions generated by the industry but does not indicate the total number of people employed in the industry. Moreover, fish production increases year-over-year, and employment decreases in this sector.

Another positive impact of offshore wind energy development on the NL economy is to create employment opportunities for local people that help to generate a provincial property. This assessment will considerably impact the NL employment sector, particularly the fisheries sector of the province that lives in the coastal area. For example, the expectations of local people (one interviewer) are "If we got one big local [wind turbine/component] manufacturer here in Newfoundland… we would be looking at 2500 full-time jobs" (Mercer et al., 2017, p.679). Although Gagnon et al., 2009 explained that most job creation benefits would occur during the construction phase of wind projects (Mercer et al., 2017, p.679). However, we try to compare job creation from the perspective of renewable and non-renewable energy sources. Found to Kammen et al., 2004 and Sastresa et al. 2010 study, the renewable energy industry generated more employment opportunities (1.8–4 times more jobs) compared to the non-renewable-based industries (Mercer et al., 2017, p.679).

Although the development of the offshore wind industry is an alternative employment source for the fishing community, that is questionable due to much uncertainty (Alexander et al., 2013). The main reason is the qualifications lacking fishers which would prevent them from getting a job from undertaking alternative employment (Alexander et al., 2013, p.7)—because of the entry into this sector through family, having left school at an early age (Alexander et al., 2013, p.7). From their point of view, potentially suitable jobs are connected to fishing, such as fish farm crew. However, getting jobs related to offshore development will require different experience or revenant training. For example, vessel compliance certificates would be needed for safety reasons because they do not hold transferable skills to the offshore energy industry. Transferring to other professions by fishers is difficult owing to a lack of education, fishing skills not being efficiently converted into other professions, and little opportunity for developing skills due to living in rural areas (Alexander et al., 2013, p.8 & 9).

Alexander et al. (2013) mentioned, "Although Scotland has a high level of employees with degree level or professional qualifications, there are also a high proportion of non-qualified school leavers, which many fishers are. This mismatch between employment opportunities and skills shortages may link to the suggested island clearances as those living in remote communities have to move elsewhere to work or develop skills." (Weedon et al., 2011).

7.3.3 Living Standard

The living standard of fishers is directly dependent on the security of employment and income (Alexander et al., 2013) as an influential VC of the fishery economy in NL. Alexander et al. (2013) found

that "fishers believe that their potential to secure the necessities of life is diminishing as development in the marine space expands" (p.8).

If fishing is not possible in offshore development locations, fishermen will face losses in terms of income and time. Because they live in or around the area where the fish are available, they will have to find new and alternative places to get more fish for offshore development. The cost of these will affect their quality of life, like using more fuel which will increase the cost, spending more time on fishing, and others. Another effect known as a 'knock-on' effect will affect the local economy. For example, many onshore jobs, from processors and gear manufacturers to salesclerks and accountants, will depend on the fishing industry's success. The offshore development will affect the fishing industry's success, and its impact will also fall in the indirect sector of the fishing industry.

7.3.4 Recommendation on the TOR

The goal of the regional assessment is not only to provide and analyze information and knowledge but also to evaluate the effects of future offshore wind development activities and to find recommendations for future planning to achieve sustainable economic development of NL (Draft agreement, 2022, p.4). Based on our analysis of the VCs mentioned above, specific guidelines are required to protect the fisheries economy in the Other Considerations and Requirements section of TOR (p.5). Participation of fishermen, like individuals and community associations (Association of Seafood Producers, The NL Fishing Harvesting Safty Association) in this assessment (Section C, TOR, p.2) should be ensured so that they can give their opinion because their experience will be vital to understanding the limitations of the current offshore areas and help to make an effective way to minimize the adverse effects of it on their life. A finding from Alexander et al., 2013 study, as a suggestion for is that "the fishing industry and the renewables industry should be able to work together, but that this should include two-way communication, the need for compromise, and a method of 'suggesting, not telling' fishermen about potential developments" (p.8). Because they know the sea and hold relevant data regarding seabed types, water movement, weather conditions, and fishing practices. NL is a whole source of offshore wind power, so the offshore wind power regional assessment can play a significant role in establishing offshore wind farms soon that are involved in NL's sustainable socioeconomic and environmental development.

7.4 Socio-culture Aspects of Newfoundland and Labrador Fisheries

The first Europeans who explored the Grand Banks off the island of Newfoundland, according to Bavington (2010), reported that the ocean had so much cod fish and was so thick that it slowed the passage of ships and could be harvested from the sea in baskets. However, approximately 500 years later, it was reported that fishing vessels could find no cod in what was once one of the wealthiest fishing sites in the world, resulting in the closure of the fishing industry in 1992. By the beginning of the 1990s, almost 70% of the world's conventional species were over-exploited or already depleted (Milich, 1999; Murphy & Neis, 2012). To prevent cod stock decrease, a moratorium was imposed, which resulted in the collapse of the fishing industry, impacting the living standards of Newfoundlanders; thus, both the industry and the way of life of Newfoundland's fishermen have since vanished. (Milich, 1999; Bavington, 2010).

Studies conducted in some fishing towns in Newfoundland revealed the troubling effects that the North Atlantic fisheries crisis has had on those who have made a living from the sea and who, according to

Davis, are unable to do so through no fault of their own (Davis, 2000).The unemployment rate as of the time the industry collapsed doubled that of the rest of Canada, prompting the migration of people westward as 30,000 Newfoundlanders and Labradorians lost their jobs as a result of the ban representing 12% of the labour force in the province, the largest layoff in its history, with ten times more indirectly affected (Milich, 1999).

7.4.1 Fisheries and Socio-cultural life in NL

Nearly every household in coastal fishing towns had a member working in the sector, which provided them with a source of money, access to seafood, and countless other advantages.

A study by Baum (1999) of Iceland and Newfoundland found fishing ties closely to the history and culture of the islands and their maritime communities, where few other forms of employment or livelihood existed or were considered for generations. As such, he believed fishing represents much more to the communities of the two islands than just an economic necessity. Additionally, it could be a compelling emblem for heritage tourism. Milich (1999) argued that the fishermen and their families might not be in danger of going hungry because of a compensation plan. However, a way of life has gone as most fishing communities have disappeared over time with their cultures, and unique identities in what (Davis, 2014) referred to as "an ecological disaster and the death of a rural way of life that had endured for years."

"Pacific salmon are a cultural and ecological keystone species, irreplaceable and core to the identities and ways of life of Indigenous communities throughout the Pacific." (Earth Economics, 2021, p.3) The Native Nations of Canada's Pacific Northwest identify themselves as Salmon People. Salmon is regarded as an exceedingly important food gift from the Creator, and each year, special ceremonies are held in its honour (Native knowledge 360). A participant during an interview conducted on the Socio-cultural Significance of Pacific Salmon for Tribes and First Nations described Salmon as

"…the first one when, before our people were created here, the salmon is the one that is the first one that stood up to take care of our people. Providing the food, the help. And he would come back yearly if we took care of him… It means they will care for us if we take care of them. All animals have a role in this world, in our beliefs. …… To provide the cooking and the bathing and be involved with the rock to do the steam for the sweat lodge, so they are all connected…… (Earth Economics, 2021; p 3).

The health and survival of salmon and Indigenous communities are interdependent, as they are integral to the health of ecosystems and the well-being and identity of Indigenous Nations. Indigenous Peoples continue to be spiritually nourished and physically sustained through responsible relationships with fish and other food such as game, salmon, eulachon, herring, groundfish, and shellfish. These belief systems and practices reinforce an appreciation for salmon as more than a resource; they see salmon as family and relations gifted by the Creator. (Earth Economics, 2021).

Before the cod, crises could be resolved and explanations sort into what led to its depletion, the debate on the development of wind farms in the province is gaining momentum.

7.4.2 Wind Energy and Tourism

Hirsh and Sovacool (2013) noted that energy policy discussions frequently centre on financial issues, and energy use has long been associated with economic progress and societal well-being. Policymakers have typically believed that both factors drive rising energy use. However, basing energy policy solely on

economic concerns leaves out crucial nuances in how people view and perceive energy options (Hirsh & Sovacool, 2013).

Davis (2000) argued that tourism and fisheries have existed independently in Newfoundland and advocated for the synergizing of both industries. However, he quickly mentioned how important it is to note that both sectors have played strategic roles in keeping the communities together over centuries and have served as a key defining and identifying factor of these communities.

Tourism's role in the economic regeneration of communities and regions is a theme that has received increasing attention from policymakers, planners and academics in recent years. This is particularly true in urban environments or situations where a major industry has declined, leaving high levels of unemployment and other forms of socioeconomic deprivation (Baum, 1999).

In some areas of Newfoundland and Labrador, especially in rural areas, it is believed that the tourism industry was indirectly dependent on the existence of a thriving local fishing industry, as the opportunities to consume locally produced seafood, to observe and interact with industry personnel, boats, fish plants, and other infrastructure, and to experience fisheries-related tangible and intangible cultural heritage were a significant factor in attracting visitors to the province (Murphy & Neis, 2012).

7.4.3 Wind Turbines and Community Landscape

Wind energy development has been thought of to have negative impacts on community landscape and way of life though some researchers believe these stems from people's inherent perception and potential benefits they might get from such projects as those who seem to benefit directly are less likely to resent the project as those who enjoy no direct benefits (Frantál & Kunc, 2011).

Existing research on the visual impact of wind turbines indicates that this is a crucial criterion for public acceptance in most situations, as well as for the planning process and approval of proposed windmills (Betakova et al., 2015).

The main factors that cut across literature, even in instances where community folks accepted wind turbines, are the proximity of the turbine (distance factors), the characteristics of the structures themselves, and the landscape quality in terms of what it represents to the community (Molnarova et al., 2012).

Wind turbines could affect property values in situations with proximity to buildings. A town's landscape is a vital aspect of its local fabric and identifies it as unique. As a result, it may permeate the daily lives of people and the larger communal consciousness, fostering a feeling of place and identity. Thus, even if a specific wind energy project has little or no influence on local property prices, it may be unsettling to people living there (Firestone et al., 2015).

Opponents of wind turbines point out that the presence of the equipment interferes with a variety of human activities, such as invading what was once an aesthetically untouched landscape. People may also resist wind turbines for reasons that are difficult to express, such as their love for nature a sheer resentment towards city officials whom they believe are there only intending to exploit the natural environment (Hirsh & Sovacool, 2013).

People's affinity might also influence preferences for wind turbines for aesthetics and the visual quality of the landscape where they are to be located. In most instances, these landscapes have been

determined to be essential aspects of society, giving visual satisfaction to both communities and tourists (Betakova et al., 2015).

Sometimes objects that residents might often find irritating could have an attraction to tourists. Attraction to tourists can be based on any unfamiliar element, depending only on the tourists' interests and preferences of which objects are perceived and experienced as tempting (Frantál & Kunc, 2011). A survey conducted by (Frantál & Kunc, 2011) in earlier research in the Czech found that the construction of wind turbines in suitably selected locations may have only a minor or negligible negative impact on tourists' perception and experience of landscape, and their destination choice.

Wind turbines and distance as to how far off they should be from communities have also emerged as significant discussions in what became known as "not in my backyard" (NIMBY) (Betakova et al., 2015). Compared to the amount of research done on the number of wind turbines, only a few studies have so far evaluated the distance factor as a visual threshold (Betakova et al., 2015).

7.4.4 Wind Turbines and Noise Generation

Public opinion on wind farms is divided: on the one hand, there is a desire for renewable energy sources, while on the other hand, there is a significant worry about the visual impact of wind turbines used for electricity generation. This concern for aesthetic effect has a significant role in how the public feels about the construction of new wind farms (Molnarova et al., 2012).

Wind turbines are believed not to generate noise that could distract humans. However, evidence suggests ancillary economic and social factors are associated with interpretations of or reactions to wind turbine sound (Firestone et al., 2015).

Respondents who economically benefitted from wind turbine rents reported significantly less annoyance (Pedersen et al., 2009, as in Firestone et al., 2015). Moreover, in another study, despite both noticing the sound more frequently and experiencing augmented sound levels, respondents who economically benefitted from nearby wind turbines reported significantly less annoyance compared to respondents that did not benefit economically (Firestone et al., 2015).

This calls for research that unearths things that need to be known, as there are varying opinions and preferences for wind farms—based on visual preference, understanding the various sections of society is needed to know which sections are more likely to resent wind farms and which sections will be receptive to their presence in their neighbourhood. It is important to mention that getting everyone "dancing to the tune of wind turbine preference" will be challenging, so a compromise would have to be reached at a certain point. However, those compromises must be cognizant of what elements are to be affected and which are to be preserved.

7.4.5 Recommendations on the TOR

The province has hardly recovered from the collapse of the fishing industry, and its cascading effects are still in the minds of people just like yesterday, as they see how it has affected every aspect of society, leading to the collapse of communities with their distinct cultures and ways of life. Most people consider the collapse as the result of inadequacies, or rather, the untimely intervention of the federal government in the situation, making the possibility of community resentment of any project that could affect the remaining aspect of society more probable.

Section 4.0 of the Draft Agreement mentioned establishing an advisory committee, which is crucial for providing advice to the impact assessment team of fisheries. Section "E" of the Terms of Reference (TOR) gives more information about the setup of the advisory committee. It includes indigenous groups "who have knowledge or experience deemed relevant to the regional assessment by the committee," such as with fisheries and other vital parts that Indigenous communities think are essential.

However, the TOR is very silent, first of all, on what experiences the committee will regard as relevant. Secondly, there is a high possibility that what constitutes relevant knowledge to the committee based on the kind of information they are looking for might not necessarily constitute relevance within various local groups due to varying priorities.

There needs to be clarity on the criteria for qualification and how representativeness will be achieved among the various groups present within the province. Secondly, there needs to be clarity on the basis of affiliation.

Because different things are important to different people, it is essential to ensure equal representation to help prevent any future anger or disagreements that might arise when a project like offshore wind energy is established.

Some empirical research has shown that different people have different ideas about offshore wind farms, which could be because of how they are predisposed. Past unpleasant experiences could cloud people's preferences for things, not precisely because they had prior experiences with those things per say.

Notably, there could be some indigenous groups that have been more affected and so will have greater resentment for such projects than others. All these things should be considered when making decisions that will inform the impact assessment process to ensure everyone is happy with the result.

We suggest the committee add at least one member from each Indigenous group in Newfoundland and Labrador to the Fisheries Advisory Committee. Their different experiences, skills, knowledge, and interests will be very important in the evaluation process. Also, there should be more detailed information about how indigenous people can be a part of the advisory groups.

7.5 Final Thoughts and Recommendations

Species are influenced differently depending on their genetic and natural makeup. As stated above, certain species may be negatively affected while others are not. In the same way, there are different ways to look at how people like wind energy projects or do not like them. However, nothing is certain: anything that impacts the fish population will have consequences for those who depend on them. For this reason, it is essential to undertake the evaluation with a thorough understanding of the pathways by which different species and people may be influenced.

The objective of the regional evaluation is not only to offer and analyze information and expertise but also to evaluate the consequences of future offshore wind development operations and make recommendations for future planning to ensure sustainable economic growth in NL (Draft agreement, 2022, p.4).

Some empirical studies have demonstrated that different people have diverse opinions towards offshore wind farms, possibly due to their predispositions. People's preferences for things may be clouded by negative past experiences, not necessarily because they have had prior experiences with the items in question. There is a need to understand these perspectives, which could be achieved by allowing various interest groups to share their opinions and make their voices heard.

7.6 About the Authors

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7.7 REFERENCE

Alex. (2022). Global Wind Report 2022. *Global Wind Energy Council*. https://gwec.net/global-wind-report-2022/

Alexander, K. A., Potts, T. and Wilding, T. A. (2013). Marine renewable energy and Scottish west coast fishers: Exploring impacts, opportunities and potential mitigation. *Ocean & Coastal Management, 75,*1-10.

Andersson, M. H. and Öhman, M. C. (2010). Fish and sessile assemblages associated with wind-turbine constructions in the Baltic Sea. *Marine and Freshwater Research*, *61*(6), 642. https://doi.org/10.1071/MF09117

Araf, T. (2021). Lessons from Hydrocarbon Industries' Impact on Ecological and Biological Significant Areas: A Comparison Between Two Coastal Zones. MA research paper. Memorial University of Newfoundland, NL, Canada.

Barrington-Leigh, C. and Ouliaris, M. (2017). The renewable energy landscape in Canada: a spatial analysis. *Renew. Sustain. Energy Rev. 75*, 809–819.

Baum, T. (1999). The Decline of the Traditional North Atlantic Fisheries and Tourism's Response: The Cases of Iceland and Newfoundland. *Current Issues in Tourism, 2*(1), 47–67. https://doi.org/10.1080/13683509908667843

Bavington, D. (2010). From Hunting Fish to Managing Populations: Fisheries Science and the Destruction of Newfoundland Cod Fisheries. *Science as Culture, 19*(4), 509–528. https://doi.org/10.1080/09505431.2010.519615

Bergström, L., Kautsky, L., Malm, T., Rosenberg, R., Wahlberg, M., Åstrand Capetillo, N., and Wilhelmsson, D. (2014). Effects of offshore wind farms on marine wildlife—A generalized impact assessment. *Environmental Research Letters*, *9*(3), 034012. https://doi.org/10.1088/1748-9326/9/3/034012

Betakova, V., Vojar, J., and Sklenicka, P. (2015). Wind turbines location: How many and how far? *Applied Energy, 151*, 23–31.

Binnu, J. (2022). *Achieving a Net-Zero Canadian Electricity Grid by 2035*. Pembina Institute. https://www.pembina.org/pub/achieving-net-zero-canadian-electricity-grid-2035

Davis, D. (2000). Gendered cultures of conflict and discontent: Living 'the crisis' in a newfoundland community. *Women's Studies International Forum, 23*(3), 343–353. https://doi.org/10.1016/S0277-5395(00)00092-3

Davis, R. (2014). A Cod Forsaken Place? Fishing in an Altered State in Newfoundland. *Anthropological Quarterly, 87*(3), 695–726.

Eamer, J. B. R., Shaw, J., King, E. L. and MacKillop, K. (2021). The inner shelf geology of Atlantic Canada compared with the North Sea and Atlantic United States: Insights for Atlantic Canadian offshore wind energy. *Continental Shelf Research, 213*, 104297. https://doi.org/10.1016/j.csr.2020.104297

Earth Economics. (2021). Importance of Salmon—Pacific Coast | Teacher Resource. http://nmai.si.edu/pnw-history-culture-regions/pacific-coast.cshtml

Firestone, J., Bates, A. and Knapp, L. A. (2015). See me, Feel me, Touch me, Heal me: Wind turbines, culture, landscapes, and sound impressions. *Land Use Policy, 46*, 241–249. https://doi.org/10.1016/j.landusepol.2015.02.015

Fisher, K., Iqbal, M.T. and Fisher, A. (2009). Small Scale Renewable Energy Resources Assessment for Newfoundland. Project Report. The Harris Centre.

Frantál, B. and Kunc, J. (2011). Wind turbines in tourism landscapes: Czech Experience. *Annals of Tourism Research, 38*(2), 499–519. https://doi.org/10.1016/j.annals.2010.10.007

Gagnon, Y., Leclerc, A. and Landry, M.A. (2009). Economic Impact Assessment of a 100MW Wind Farm Project in New Brunswick. Retrieved from http://www.shearwind.com/ media/pdf/eco_100mw_2009.pdf.

Government of Newfoundland and Labrador (2021). Offshore exploration Initiative. https://www.gov.nl.ca/iet/funding/offshore-exploration-incentive

Government of Newfoundland and Labrador (2021). The Economic Review 2021. https://www.gov.nl.ca/fin/files/The-Economic-Review-2021.pdf

Government of Newfoundland and Labrador. (2018). The Economy 2018. Retrieved from: https://economics.gov.nl.ca/E2018/TheEconomy2018.pdf

Govt. of Newfoundland and Labrador (2010). Seafood- Newfoundland and Labrador, https://www.gov.nl.ca/ffa/files/Seafood-Year-in-Review-2010.pdf

Govt. of Newfoundland and Labrador (2018). Seafood- Newfoundland and Labrador, Canada.https://www.findnewfoundlandlabrador.com/buy/seafood/#:~:text=Newfoundland%20and%20Labrador%20produces%20over,and%20technological%20advances%20in%20harvesting

Govt. of Newfoundland and Labrador (2020). Seafood- Newfoundland and Labrador https://www.gov.nl.ca/ffa/files/2020-SIYIR-WEB.pdf

Hawkins, A. D., Hazelwood, R. A., Popper, A. N. and Macey, P. C. (2021). Substrate vibrations and their potential effects upon fishes and invertebrates. *The Journal of the Acoustical Society of America*, *149*(4), 2782–2790. https://doi.org/10.1121/10.0004773

Hawkins, A. D., Pembroke, A. E. and Popper, A. N. (2015). Information gaps in understanding the effects of noise on fishes and invertebrates. *Reviews in Fish Biology and Fisheries*, *25*(1), 39–64. https://doi.org/10.1007/s11160-014-9369-3

Hirsh, R. F. and Sovacool, B. K. (2013). Wind Turbines and Invisible Technology: Unarticulated Reasons for Local Opposition to Wind Energy. Technology and Culture, 54(4), 705–734.Jamieson, R., Bernier, R. and Moore, A. (2018). *State of the Atlantic Ocean Report*,

154.

Jenn, V. (2022). *The cod delusion*. https://canadiangeographic.ca/articles/the-cod-delusion/

Kammen, D.M., Kapadia, K. and Fripp, M. (2004). Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate. University of California, Berkele, (RAEL Report).

Karydis, M. (2013). Public attitudes and environmental impacts of wind farms: A review. *Global NEST Journal*, *15*(4), 585–604. https://doi.org/10.30955/gnj.000932

Kikuchi, R. (2010). Risk formulation for the sonic effects of offshore wind farms on fish in the EU region. *Marine Pollution Bulletin*, *60*(2), 172–177. https://doi.org/10.1016/j.marpolbul.2009.09.023

Kirchhoff, T., Ramisch, K., Feucht, T., Reif, C. and Suda, M. (2022). Visual evaluations of wind turbines: Judgments of scenic beauty or of moral desirability? Landscape and Urban Planning, 226, 104509. https://doi.org/10.1016/j.landurbplan.2022.104509

Mercer, N., Sabau, G. and Klinke, A. (2017). Wind energy is not an issue for government": Barriers to wind energy development in Newfoundland and Labrador, Canada. *Energy Policy,108,* 673-683

Methratta, E. T. (2020). Food for Thought Monitoring fisheries resources at offshore wind farms: BACI vs. BAG designs**.** *ICES Journal of Marine Science, 77*(3), 890–900. doi:10.1093/icesjms/fsaa026

Milich, L. (1999). Resource Mismanagement Versus Sustainable Livelihoods: The Collapse of the Newfoundland Cod Fishery. *Society & Natural Resources, 12*(7), 625–642. https://doi.org/10.1080/089419299279353

Molnarova, K., Sklenicka, P., Stiborek, J., Svobodova, K., Salek, M. and Brabec, E. (2012). Visual preferences for wind turbines: Location, numbers and respondent characteristics. *Applied Energy, 92*, 269–278. https://doi.org/10.1016/j.apenergy.2011.11.001

Murphy, I. and Neis, B. (2012). Navigating the Legislative Requirements for Fisheries-Tourism Initiatives in Newfoundland and Labrador [Report]. Memorial University of Newfoundland. http://www.curra.ca/documents/TCR_Fisheries_Tourism_Regulations_Report_Feb_14_Final_to_TCR_revised.pdf

Neis, B., Gerrard, S. and Power, N. G. (2013). Women and Children First: The Gendered and Generational Social-ecology of Smaller-scale Fisheries in Newfoundland and Labrador and Northern Norway. Ecology and Society, 18(4). https://www.jstor.org/stable/26269429

Offshore Wind Draft Agreement for Newfoundland (2022). at: https://iaac-aeic.gc.ca/050/documents/p83514/145234E.pdf

Reubens, J. T., Vandendriessche, S., Zenner, A. N., Degraer, S. and Vincx, M. (2013). Offshore wind farms as productive sites or ecological traps for gadoid fishes? e Impact on growth, condition index and diet composition. *Marine Environmental Research, 90*, 66-74.

Rose, G. A. and Rowe, S. (2022). Congruence of stock production and assessment areas? A historical perspective on Canada's iconic Northern cod. *Canadian Journal of Fisheries and Aquatic Sciences*, *79*(7), 1173–1187. https://doi.org/10.1139/cjfas-2021-0230

Sastresa, E.L., Uson, A., Bribian, A.Z. and Scarpellini, S. (2010). Local impact of renewable on employment: assessment methodology and caste study. *Renew. Sustain. Energy Rev. 14*, 689–690

Schrank, W. E. (2005). The Newfoundland fishery: Ten years after the moratorium. Marine Policy, 29(5), 407–420. https://doi.org/10.1016/j.marpol.2004.06.005

Sigray, P. and Andersson, M. H. (2011). Particle motion measured at an operational wind turbine in relation to hearing sensitivity in fish. *The Journal of the Acoustical Society of America*, *130*(1), 200–207. https://doi.org/10.1121/1.3596464

Stoddart, M. C. J. and Sodero, S. (2015). From Fisheries Decline to Tourism Destination: Mass Media, Tourism Mobility, and the Newfoundland Coastal Environment. *Mobilities, 10*(3), 445–465. https://doi.org/10.1080/17450101.2013.860281

Term of References (2022). Offshore Wind Draft Agreement for Newfoundland at: https://iaac-aeic.gc.ca/050/documents/p83514/145236E.pdf

Terra, N. (2022). *Top 5 wind energy projects in Canada*. https://www.airswift.com/blog/wind-energy-canada

Wahlberg, M., & Westerberg, H. (2005). Hearing in fish and their reactions to sounds from offshore wind farms. *Marine Ecology Progress Series*, *288*, 295–309. https://doi.org/10.3354/meps288295

Weedon, E., Riddell, S., Tett, L. and McGovern, M. (2011). Skills for Scotland: Learning in and for Businesses. Centre for Research in Education Inclusion and Diversity, Edinburgh.

Wilber, D.H., Carey, D.A. and Griffin, M. (2018). Flatfish habitat use near North America's first offshore wind farm*. Journal of Sea Research, 139*, 24-32.

8 SOCIO- ECONOMIC IMPACTS

Sarah Dumaresque, Hailey Martin, Taylor Holloway and Izek Walters

8.1 EXECUTIVE SUMMARY

- Newfoundland and Labrador's offshore wind development has the potential to have a number of social and economic impacts.
- Women, indigenous people, people with disabilities and other minority groups do not receive equal access to the benefits of resource development projects, and are disproportionately affected by the negative impacts.
    - Representation of minority communities among advisory groups and careful consideration of the impacts on minorities is needed to minimize these impacts ensure that these groups can share in the benefits.
- Jobs generated from offshore wind development in Newfoundland and Labrador have the potential to contribute to economic growth through the increase in job opportunities.
    - The proponent has insufficiently addressed direct employment created from offshore wind development in Newfoundland and Labrador.
    - Direct employment information should be provided to the public from the proponent, including hiring methodology, length of employment and educational support.
- Fisheries and oceans have both social and economic importance in Newfoundland and Labrador, both in terms of high employment numbers and generating income for the province.
    - The offshore wind project has the potential to affect fisheries. Danger, loss of gear and changes in species diversity and distribution can threaten the livelihoods and economy of the province. All these possible effects should be considered and addressed in this project.
- While the proponent has addressed fisheries as an advisory group, we would recommend this group consist of both fish harvesters in the area and indigenous communities that will be directly affected by this project.
- Public opinion of this project may have adverse effects on future economic implementations, a stigma may exist which may cause opposition to the creation of more windmills.
- Some environmental stressors may not have been fully considered, this can lead to degradation and failure of important mechanical parts in windmills such as motors, this in turn leads to unplanned costs.
- Biofouling occurs on almost all submerged structures; in terms of windmill maintenance this could lead to high value costs when considering anti-fouling or damaged equipment.

8.2 Economic and Social Impacts of Newfoundland and Labrador Offshore Wind Development

8.2.1 Social Impacts of Offshore Wind Development on Women and Minorities

There are many economic and social benefits that come with resource development projects, but in many cases, women, indigenous peoples, racial minorities, people with disabilities, LGBTQ+ individuals, and other minority groups do not receive equal opportunities to reap the benefits of these projects. In fact, women and minorities frequently bear the brunt of the negative impacts resulting from resource development projects, so it is vital to ensure that these groups are sufficiently represented in the impact assessment process.

The development of offshore wind energy will create many new job opportunities in the province, but it is important to consider who those jobs will go to. In most resource development projects, the majority of the jobs created go to men. Jobs available to women tend to be lower-paying, low-skilled, and temporary (Manning et. al. 2018). The energy sector, in particular, has a larger than average disparity in male and female workers. The difference in the number of men and women working in the energy sector is twice as large as the difference in non-energy sectors, with 76% fewer women than men working in the sector. There is also a significant gap in the wages received by male and female workers, with women receiving wages almost 20% lower than wages received by men (IEA, 2022). Members of racial minorities are also underrepresented in the energy sector. Only 5% of Canadians working in the energy sector identified as Indigenous and 18% identified as a visible minority (Government of Canada, 2021).

Social Services and infrastructures can suffer as a result of the influx of workers that comes with resource development projects. Services such as food banks, housing and employment resources centers, public transportation and health care can become strained by increasing populations. Seniors, people with disabilities, and low-income individuals are particularly affected by inaccessible or inadequate services. Resource development projects can also put strain on housing resources, making it difficult or even impossible for vulnerable and low-income people to find affordable housing (Manning et. al., 2018).

Resource development projects have been linked to adverse effects on mental and physical health. Environmental contamination that could occur during the construction and/or operation of the offshore turbines and associated onshore infrastructures can have serious health consequences. Women and minorities are at a particular risk of negative health impacts. Women are more susceptible to negative effects from environmental contamination than men, because women metabolize pollutants more quickly than men, resulting in higher levels of toxicity (Fuentes, 2017). Indigenous communities are also at higher risk of adverse health effects due to above average levels of exposure to environmental contaminants through traditional and country food sources (Manning et. al, 2018, DesBrisay, 1994). Adverse effects on mental health, increased suicide rates, and increased alcohol and substance abuse can also occur with resource development projects, all of which are issues that have been found to impact minorities more seriously. (Manning et. al., 2018; Seydlits et. al., 1993; DesBrisay, 1994).

There can also be an increase in racialized, gender-based, and sexual violence in the vicinity of resource development projects. Indigenous women have reported racialized and sexualized harassment and discrimination on job sites. Areas in the vicinity of resource development projects can also see an increase in occurrences of domestic violence and domestic abuse (Manning et. al., 2018; Ruddell et. al. 2014, DesBrisay 1994). In general, there is often an increase in rates of violent crime in the area surrounding resource development projects (Komarek, 2014; Freudenburg & Jones, 1991; Ruddell et. al., 2014; Seydlits et. al, 1993). Rising crime rates are a threat to the entire community but pose a particular threat to women and minorities, as they are more likely to be victimized by violent crime. Women are two times more likely than men, people with disabilities are three times more likely than people without disabilities, and indigenous people are more than two times more likely than non-indigenous people to be victims of violent crimes (Cotter, 2021).

The issues listed above are potentially serious adverse effects that could result from and affect every community within the vicinity of a development project. But women, minorities and vulnerable people are at the highest risk of being affected by these impacts and could suffer the most serious consequences. So it is important that the possible effects on women and minorities be carefully considered in the assessment of impacts.

8.2.2 Recommendations

In the current draft Terms of Reference, under the list of advisory groups in section A1.6, there is an advisory group included for Indigenous Knowledge and Perspectives. However, the role of this advisory group is focused on the consideration of Aboriginal Treaty rights and the collection and sharing of indigenous knowledge of the environment. **The document does not reference the social effects on indigenous women and communities. There is also no advisory group for women or any other minority groups, and no mention of the inclusion of minorities as members of other advisory groups.**

In addition to the advisory groups for Indigenous Knowledge and Perspectives, Scientific and Technical Information and Analysis, and Fisheries Information and Analysis, we would recommend the inclusion of advisory groups for women and minority groups. These advisory groups should seek knowledge, perspective, and advice from members of minority groups regarding the impacts of offshore wind development on minority communities, including adverse health effects, availability of employment opportunities, and potential increases in violence and crime. These groups could also recommend possible approaches for minimizing negative effects and maximizing the opportunity for minority communities to receive the benefits of positive effects, such as implementation of diversified hiring processes, job site gender-sensitivity and cross-cultural training, development of policies to address racial, sexual, and other types of harassment or discrimination, provision of health and wellness supports, and allocation of police and community resources to deal with increased rates of crime and abuse (Manning et. al. 2018; Hoogeveen et. al. 2020). We also recommend the TOR require all advisory groups to include representation of women and minorities, to ensure that women and minorities are included and offer their perspectives on every aspect of this assessment.

Additionally, there are no specific references in the TOR to analyzing or gathering information on the issues faced by women and minorities. Under section A1.6.t of the TOR, the issues faced by women and minorities would likely fall under component ix. Communities and Economy. However, this is very broad

and vague as a component. We feel that the potential adverse effects on women and people of minority groups should be given more specific focus and consideration. More specific language referring to the issues outlined above may be more effective in ensuring these issues are properly addressed and receive the attention and consideration they merit (Manning et. al. 2018; Hoogeveen et. al. 2020).

8.3 Insufficiency addressing direct employment generated from offshore wind development in Newfoundland and Labrador

The offshore wind development in Newfoundland and Labrador has the potential to supply local communities with good-paying jobs. Job creation generated directly from offshore wind farms according to Davies, et al., (2020) has a main supply chain of five elements that explains direct employment created from offshore wind farms. Development and project management job roles consist of development of surveys and studies including port studies, geotechnical and geophysical surveys, and wildlife surveys. Turbine towers generate job roles consisting of welders, platers, a quality controller, specialist coating technician and blasting technician. The balance of the plant is another supply chain element that can provide a variety of job roles consisting of structural engineers and riggers contributing to foundation supply, as well as, joining supervisors, cable testing engineers, cable jointers. Installation and commissioning of offshore wind development job roles consist of operations manager, crane operators and electrical technicians. Operations, maintenance, and service provide long-term job roles consisting of a control room technician, an operations controller, operations and maintenance manager, rope and blade manager, supervisors, technicians, ships agent and marine coordinator. The proponent is unclear in hiring methodology, length of employment and education for the offshore wind development jobs in Newfoundland and Labrador.

The variety of jobs generated from offshore wind farms have significant differences in length of employment. Job roles in the beginning supply chain, such as development and project management are temporary types of employment to offshore wind compared to job roles at the end of the supply chain that include operations, maintenance and service that are long term types of employment. Length of employment can fluctuate economic growth if the majority of job roles for offshore wind are temporary employment compared to long term employment.

The hiring methodology behind these good-paying jobs is unclear. Is priority given to locals/settlers? Will Indigenous groups be given a fair chance at these jobs? Will an expert team be hired out of province that will flown in to maintain and construct the wind farm? These questions should be clarified as it will have major impacts on the local economy, job opportunities and public support. Locals, including Indigenous groups could dramatically benefit by gaining temporary and long-term employment. Aiding to support the local economy as well as supporting many local families. If the proponent's hiring methodology includes locals and Indigenous groups, the proponent has the potential to increase public support as Newfoundland and Labrador is seeking employment.

Job roles in offshore wind development likely will require education and(or) on-site experience. An offshore wind farm in Newfoundland and Labrador is newly introduced to these areas therefore, education and experience is lacking. Will this affect the priority of local and Indigenous groups in the hiring stage? Will the proponent acknowledge lack of education and experience in locals and Indigenous groups in the hiring process by addressing responsibilities in providing education and experience to locals and Indigenous groups? If so, acknowledging education support should be stated by the

proponent, denoting responsibilities to either the Government of Newfoundland and Labrador, the proponent, or individuals, etc. In past years, the executive council for Newfoundland and Labrador has helped Indigenous groups in Labrador get vital job skills and work experience to have an opportunity of employment at the Vale mine site in Vosiey's Bay, NL provided in the Vosiey's Bay Development Agreement (2022) under Article 3, subsection 3.3 and 3.4.

On June 26, 2018 the Honourable Dwight Ball, Premier of Newfoundland and Labrador, and Yvonne Jones, Member of Parliament for Labrador and Parliamentary Secretary to the Minister of Crown-Indigenous Relations and Northern Affairs, on behalf of the Honourable Patty Hajdu, Minister of Employment, Workforce Development and Labour, along with representative from Vale, the Nunatsiavut government, Innu Nation, and NunatuKavut Community Council, announced a $23.6 million project led by the Aboriginal Training Partnership (LATP). This includes approximately $3 million from the Provincial Government and over $9.6 million from the federal Skills and Partnership Fund (Executive Council, 2018). In this project, LATP provided skills and development and training-to-employment opportunities assisting over 400 Indigenous participants in Labrador to have the opportunity to work at the Vale mine site (Executive Council, 2018). This initiative delivers on commitments in The Way Forward to strengthen the province's economic foundation and deliver better services and better outcomes for residents (Executive Council, 2018). The Way Forward outlines all actions the Provincial Government is initiating to achieve a strong, diversified province with a high standard of living ("The Way Forward Plan", n.d.).

Newfoundland and Labrador supports' equality of Indigenous groups in Newfoundland and Labrador, acknowledging their rights for a fair chance at employment. Patty Hajdu, Minister of Employment, Workforce Development and Labour quotes "Breaking down barriers to employment for Indigenous people will ensure that everyone has a real and fair chance at success. Helping Indigenous people get the skills and training they need to find good jobs will grow the economy, strengthen the middle class, and help those working hard to join it." The Honourable Dwight Ball, Premier of Newfoundland and Labrador quotes "Indigenous people in Newfoundland and Labrador must benefit from the development of provincial natural resources. Our government is pleased to contribute to play a vital role in Vale's workforce at Voisey's Bay. Through the Way Forward, my government will continue to collaborate with all levels of government, industry players, and Indigenous Governments and Organizations to encourage meaningful career opportunities and economic growth." Yvonne Jones, Member of Parliament for Labrador quotes "By providing more opportunities and training for Indigenous people, the Government of Canada is demonstrating the importance of helping all Canadians get the skills and experience they need to help build strong communities like ours across the country and to contribute to growing the middle class." All quotes can be found on the Government of Newfoundland and Labrador website under "New Releases", section "Executive Council" article titled, "Helping Indigenous People in Labrador Get Vital Job Skills and Work Experience".

Will programs and funding for education and experience similarly to the Vosiey's Bay mine project be generated to ensure inclusion of Indigenous groups of Newfoundland and Labrador for the Offshore Wind Development Project, further enforcing The Way Forward?

Recommendations for the proponent that should be addressed in The Committee's Terms of Reference, established under subsection 93(1) of the *IAA*. The proponent fails to consider direct employment generated from offshore wind farms. Direct employment information should be provided

for public knowledge. Specifically, the proponent should consider providing information on hiring methodology, length of employment for public knowledge and educational support.

8.4 Evaluation and recommendation of the project's consideration on the social and economic importance of Newfoundland and Labrador Fisheries

Fisheries and oceans are a very important aspect of Newfoundland and Labrador's economy. In 2021 the commercial fishery employed over 17,500 people in 400 communities across the province: including the workers from the 92 active fish processing plants (Seafood industry 2021). There were 10,432 registered fish harvesters and 6,511 fish processing plant employees. In 2021, The value of Newfoundland's seafood topped 1.1 billion dollars (Seafood industry 2020,2021). We can expect that these numbers would be relatively the same today if not more as the number of people employed by the commercial fishery increased from 15,800 in 2020 to 17,500 people in 2021 (Seafood industry 2020,2021). The total value of the province's fishing sector in 2021 was 1.6 billion dollars (Seafood industry 2021). Having such an economic importance, it would be crucial to assess any changes and effects the offshore wind turbines will have on Newfoundland's commercial fish harvesters. If offshore fish harvesters had lower catch numbers or were unable to fish, there is a possibility this would also affect the processing plants, fish trucks and restaurants as many of these businesses depend on the fish harvesters.

Aboriginal fisheries are an important part of both Newfoundland's fisheries and aboriginal communities. Aboriginal groups have the right to fish, for food, social and ceremonial purposes, this takes priority, after conservation, over all other use of the fishery (Fisheries Licensing Policy Newfoundland and Labrador Region 2022). Having such an importance and high priority it is important the aboriginal fishing community be considered in this project.

There are several operating wind farms in the eastern Irish sea, a location that also provides fishing grounds for many commercial fish harvesters. While there's a lot of uncertainty on just how these wind farms will affect commercial fish harvesters in different proposed areas. The National federation of fishermen organization investigated the impacts of the existing offshore wind farms in the eastern Irish sea, by interviewing the fish harvesters in the area. Many of these fish harvesters were not legally permitted to fish in the areas of the wind turbines due to boat size or have stopped fishing in these areas by choice due to the danger (Gray 2016) from the chances of getting caught on the cables, loss of gear, and risk of collision. The danger of fishing in this area has deterred many, forcing them to fish other grounds. Being forced to fish outside these normal areas means longer steaming distances to other fishing grounds, costing them more money. They also informed interviewers about lack of communication from the wind farm developers when it comes to maintenance vessels in the area, which may interfere with fishing. Although, most reported little or no change in the number of fish caught after the offshore wind farms were built (Gray 2016).

The submerged structures in the offshore wind farms have been a concern for many fish harvesters and the effects they may have on the habitat and ecosystem needed to sustain the fishery (Stone 2021). These structures in fact change the local environment, but this may not be a negative effect. While highly migratory species such as tuna may be disturbed by operation noise and habitats will be lost during construction, these structures act as artificial reefs. Suspension feeders will begin this process colonizing the hard substrate, their fecal matter will alter the seafloor community and increase

food availability (Dagraer 2020). This could extend species distribution and or strengthen populations of both nonindigenous and local species, but the climax of this succession could take more than six years (Dagraer 2020). While increased food availability could increase the population of fish harvesters target species, it needs to be assessed whether the loss of harvest during and before the succession climax is worth the possibility of increased populations and diversity over time. This also brings up the possibility that nonindigenous predator species being attracted to the area due to the increase in food availability, could pose a threat to these target species.

Most commercial fish harvesters depend on radars that give skippers valuable information about the location of other vessels operating in the water. The operating turbines can impact the performance of these radars. A turbine located in the line of sight of a radar system can interfere with the system and cause clutter and degrade performance (Karlson 2018). When the radars are not working at high performance it can create danger to skippers and their vessels. Without the radar showing other vessels' location properly there is the possibility of increased risk of collision with other vessels especially traveling during the night.

In the Terms of Reference and Draft Agreement fisheries is considered as an Advisory Group that the proponent will seek knowledge, information and advice from fishing industry representatives and fishers regarding current and potential fishing activity, as well as potential interactions between fishing activity and offshore wind development activities in the Study Area and approaches for avoiding or minimizing adverse effects and creating or maximizing opportunities for positive effects. In this advisory group, we would recommend that the fish harvesters that will be directly impacted in the proposed area be considered in the group along with aboriginal groups in the area to be included. These are the groups most likely to be impacted by this change and their concern and input should be prioritized.

While there are some possible positive and negative effects to oceans and fisheries in the offshore wind project, we would recommend that all the possible effects be researched and presented to this advisory group. Fish harvesters affected by other offshore wind farms expressed concern for lack of communication. We would recommend the proponent maintain good communication with fish harvesters before, during, and after construction to mitigate danger and effects.

The proponent from the Vineyard Wind project in Massachusetts proposed a mitigation package that included providing financial compensation for any direct impacts to commercial fish harvesters. To provide the funds necessary to promote safe and effective fishing. **We would recommend that proponent also consider this mitigation package. Financial compensation for loss of gear, lower catch numbers, longer steam distances would help mitigate the economic effect of this project. (Vineyard Wind Fisheries Mitigation Proposal to the FAB 2019).**

Overall, this project has the possibility to affect offshore fishermen. Danger, damage and loss of gear, change in species distribution and biodiversity and loss of fishing grounds could be threatening the livelihood of many fish harvesters. When it comes to the proponent choosing a location for this project, we recommend fishing grounds be considered in this decision. Avoiding fishing grounds of the fish harvesters in the area could mitigate most of these effects. If this avoidance is not possible, we would recommend the proponent consider all these possible effects and the steps to mitigate them.

8.5 Environmental and public factors that may have economic effects on offshore windmill production in Newfoundland

The regional assessment of offshore wind development in Newfoundland and Labrador and Nova Scotia can have several economic impacts, these impacts although mostly positive have not been well defined or discussed in the draft terms of agreement. In order to balance economy and the environment careful consideration must be taken. As a province Newfoundland looks to benefit from these windmills and boost the economy, however we cannot just neglect the environment as we build roads for transportation, batteries to store the created energy, and cables that will link the entire electrical system to our power grid. The regional assessment acknowledges this aspect and the proposed advisory group in A1.6m seems to be the main group that will deal with these factors. Windmills are of course a great way to produce sustainable green energy but negative public views stemming from past renewable energy projects may lead to some negative economic effects in the future. Furthermore, the cost to build and maintain these wind turbines may not be fully understood and could lead to unexpected outcomes.

The provinces of Newfoundland and Labrador have not seen many windmill farms in the past and this offshore windmill farm would be the first of its kind. Newfoundland however, is not new to sustainable energy methods, and some of these past projects may affect public view of the construction of these windmills. Take for example Muskrat falls, a giant hydroelectric generating facility that began construction back in 2013 (Barnard-Chumik et al. 2022), this project like any other large-scale operation needed an environmental impact assessment prior to its production. This IA was of course carried out but some problems with the way it was carried out were soon discovered, it was proposed that there was a knowledge hierarchy that led to contrasting ideas in groups and unbalanced power dynamics (Barnard-Chumik et al., 2022). It also led to neglect of indigenous groups as well as many other problems such as methyl-mercury spills (Barnard-Chumik et al. 2022). This information is relevant to the Regional assessment (and impact assessment) for the offshore windmill farms because it shows that we must carefully consider each group and any unbalanced power dynamic that could exist must be eliminated. This in turn relates to the economic factor of these windmill farms because if the public carries a stigma about renewable energy projects, then factors like funding, jobs and future production of more windmills may be affected as people may directly oppose its progress. It should be mentioned that there are huge differences between these two projects and directly comparing them is unfair. At any rate the offshore windmills are being funded by a proponent, this means there is not a heavy connection to the newfoundland government, whether this will change public view has yet to be seen.

Another economic aspect that must be discussed is Maintenance, in order to keep windmills running they need constant upkeep. The regional assessment acknowledges that there will be many jobs created that revolve around windmill maintenance and this may very well be all the consideration this aspect needs. However, there can and will always be unforeseen problems that occur either in production or in post-production, and offshore windmills are not exempt from this. Take for example the motor systems of a windmill, there has been a study indicating that subsurface cracks from rolling contact fatigue cause micro pitting and then spalling, this in turn leads to the destruction of gear teeth in the windmills motor, which would subsequently need to be replaced (Rajinikanth et al. 2021). Although

this specific situation may not occur, we must keep in mind that newfoundland can be a harsh environment and if it constantly damages these windmills it may lead to failure of energy production and thus failure of the project altogether, this is of course quite an extreme assumption but it must be considered as such if the project is to succeed.

Continuing with the topic of maintenance, a factor that may lead to unforeseen problems in the future of offshore windmills could be biofouling. Biofouling is the buildup of marine species on submerged structures. It has been proven that biofouling does occur in offshore windmills and that it leads to a diversity of aquatic life (Kerckhof et al. 2010). However, biofouling also damages underwater devices, this could lead to problems when building the submerged parts of these windmills. On top of this bio-fouling has not yet been studied on offshore windmills in newfoundland and this may lead to unforeseen and unwanted biological effects. This relates to the economic side of the regional assessment because if the proponent has to spend some of its budget on anti-fouling, then it could lead to slower production rates and possibly reduced construction of off shore windmills in the future.

One recommendation for the current regional assessment would be the introduction of a new advisory group that assesses the other advisory groups, this may seem redundant but as we have seen in the past its possible that some groups may be neglected. This group should have one member from each advisory group along with a few other who have no ties to the project and can adequately asses the regional assessment from an outside perspective. The members from each advisory group that have already been created can provide knowledge and perspective but must not be able to influence the group as a whole. This of course is not likely necessary as the regional assessment already has many mitigation features that prevent power dynamics from developing but extra piece of mind is always valued.

Another recommendation for the regional assessment that can be created would be based on maintenance. Perhaps in the sections titled “Identification of information and knowledge gaps” or “Analysis of effects, mitigation and follow up” a new sub-heading could be created. The purpose of this sub-heading would be to carefully consider environmental stressors like wind, waves and salt from the water that could cause subsurface cracks and subsequently motor failure. It would also include a portion that accounts for bio-fouling as the build-up of marine organisms can have many unforeseen impacts on underwater equipment or the windmill itself. Both points should be considered by the Scientific and Technical Information and Analysis advisory group because each of these factors can have economic effects.

In conclusion the regional assessment considers a massive amount of environmental, economic, social and mitigation factors. It is a system that has flaws but still works exceptionally well. This means my recommendations and critiques for regional assessment may have already been considered, nonetheless it is critiques and recommendations like these that continue to improve this dynamic system.

8.6 ABOUT THE AUTHORS

Sarah Dumaresque is a fourth-year student at MUN Grenfell Campus, studying at the School of Science and The Environment. She is in the final year of completing a Bachelor of Science degree, majoring in Environmental Science Biology. Through the course of her degree, Sarah has extensively studied the biology of natural ecosystems and wildlife and how they are impacted by human activities. Having been born and raised in Newfoundland she has seen the effects, both positive and negative, that resource development can have on the local environment and rural communities, and as a woman, she has personal, first hand experience of the difficulties and obstacles women can face.

Hailey Martin is a fourth-year student completing a Bachelor of Science Honours Program, majoring in Environmental Science Biology at Memorial University of Newfoundland. Hailey Martin's education goals include educating intermediate and secondary students in a variety of sciences. She comes from a family working in a resource-related industry. Many of her close family members work in the oil and gas industry, however acknowledgments are made that oil and gas is having a negative impact on our environment and that renewable energies are remediations to combat this global problem. Along with being familiar to the resource-industry and previous education, Hailey is currently enrolled in a fourth-year environmental assessment course, providing a knowledgeable background for authoritative weight in her submission.

Taylor Holloway is a 4th year Environmental science student at Grenfell. She is from Glovertown, a small town in central Newfoundland. She has always enjoyed the outdoors and had an interest in biology; therefore, she chose to study Environmental science biology stream. Taylor has been working a student position with Parks Canada at Terra Nova national park with the resource conservation team for the last two summers. This job has given her lots of experience in field work in both land and ocean studies. The fishery's aspect of wind turbines piqued an interest with her as her partner and his family are registered fish harvesters. Taylor was immediately concerned about how this project could affect the fish harvesters and their families in these areas who rely on the ocean and fishery for their livelihood.

Izek Walters is currently enrolled at memorial university, he is in his 4th year of an environmental science undergrad, with hopes to finish this year and pursue a career in his field. At a young age he has always been interested in the environment and its complex systems. This early interest in life has led to many opportunities, he has worked a student job in the Department of Fisheries, Forestry and Agriculture, this job helped build knowledge and gave him a firsthand experience of how a government body deals with environmental policies, acts, laws, and many other factors. This job and his numerous environmental science courses have allowed him to develop a fundamental understanding of the interactions between people and the environment and the necessary steps that must be taken.

8.7 REFERENCES

Canadian Impact Assessment Registry. (2022). Draft Agreement to Conduct a Regional Assessment of Offshore Wind Development in Newfoundland and Labrador. Government of Canada. Retrieved November 8, 2022, from https://iaac- aeic.gc.ca/050/documents/p83514/145234E.pdf

Canadian Impact Assessment Registry. (2022). Draft Regional Assessment Terms of Reference. Government of Canada. Retrieved November 3, 2022, from https://iaac-aeic.gc.ca/050/evaluations/proj/83514.

Cotter, A. (2021). Criminal victimization in Canada, 2019. *Canadian Centre for Justice and Community Safety Statistics. Statistics Canada*.

Davies, C., Logan, A., Roberts, A. (2020). Job Roles in Offshore Wind. Green Port Growth. Retrieved November 3, 2022, from https://www.bluegemwind.com/wp- content/uploads/2020/07/Job-Roles-in-Offshore-Wind.pdf.

Degraer, S., D.A. Carey, J.W.P. Coolen, Z.L. Hutchison, F. Kerckhof, B. Rumes, and J. Vanaverbeke.(2020) Offshore wind farm artificial reefs affect ecosystem structure and functioning: A synthesis. *Oceanography* 33(4):48–57, https://doi.org/10.5670/oceanog.2020.405

DesBrisay, D. (1994). Impact of Major Resource Development Projects on Aboriginal Communities: a Review of the Literature. Prepared for the Royal Commission on Aboriginal Peoples.

Executive Council. (June 26, 2018). Helping Indigenous People in Labrador Get Vital Job Skills and Work Experience. Government of Newfoundland and Labrador. Retrieved November 3, 2022, from https://www.gov.nl.ca/releases/2018/exec/0626n05/

Fisheries Licensing Policy Newfoundland and Labrador Region. (2022). Government of Canada. https://www.dfo-mpo.gc.ca/reports-rapports/regs/licences-permis/nfld-Labrador-tn-labrador-eng.htm#part_4

Fuentes, N. (2017). Why Does Air Pollution Affect More Women than Men*? American Physiological Society*. Retrieved November 12, 2022 from, https://ispyphysiology.com/2017/10/26/why-does-air-pollution-affect-more-women-than-men/

Freudenburg, W. R., Jones, R. E. (1991). Criminal Behavior and Rapid Community Growth: Examining the Evidence. *Rural Sociology*, **56**(4), 619-645.

Government of Canada (2021). Skills, diversity and community. *Natural Resources Canada*. Retrieved November 12, 2022 from https://www.nrcan.gc.ca/science-and-data/data-and-analysis/energy-data-and-analysis/energy-facts/skills-diversity-and-community/23930

Gray.M.,Stromberg.P-L.,Rodmell.D. (2016) Changes to fishing practices as a result of the development of offshore windfarms -Phase 1. The Crown Estate.

International Energy Agency (2022) Energy and gender: Critical issue in energy sector employment and energy access.Retreived November 10, 2022 from https://www.iea.org/topics/energy-and-gender

Karlson.B.,Miler.B.(2018). Turbine Radar Interference Mitigation (WTRIM) Modeling and Simulation Tools Catalog. United states. https://doi.org/10.2172/1528816

Hoogeveen, D., Gislason, M., Hussey, A., Western, S., Williams, A. (2020). Gender Based Analysis Plus: A knowledge synthesis for the implementation and development of socially responsible impact assessment in Canada.

Komarek, T. (2014). Crime and Natural Resource Booms: Evidence from Unconventional Natural Gas Production.

Manning, S., Nash, P., Levac, L., Stienstra, D., & Stinson, J. (2018). *Strengthening Impact Assessments for Indigenous Women. Canadian Research Institute for the Advancement of Women.* Prepared for the Canadian Environmental Assessment Agency.

Ruddell, R., Jayasundara, D. S., Mayzer, R., Heitkamp, T. (2014). Drilling Down: An Examination of the Boom-Crime Relationship in Resource Based Boom Counties. *Western Criminology Review* **15**(1):3-17 (http://wcr.sonoma.edu/v15n1/Ruddell.pdf).

Seafood industry. Government of Canada. (2020). Seafood Industry Year in Review 2020.Retrieved from https://www.gov.nl.ca/ffa/files/2020-SIYIR-WEB.pdf

Seafood industry. Government of Canada. (2021). Seafood Industry Year in Review 2021. Retrieved from https://www.gov.nl.ca/ffa/files/22322-Seafood-Industry-Year-in-Review-2021-Sept-22.pdf

Seydlits, R., Laska, S., Spain, D., Triche, E. W., Bishop, L. K. (1993). Development and Social Problems: The Impact of the Offshore Oil Industry on Suicide and Homicide Rates. *Rural Sociology*, **58**(1), 93-110.

Stone.M. (2021).'I can see the industry disappearing US fishermen sound alarms at plans for offshore wind (2021).The Guardian. https://www.theguardian.com/environment/2021/jul/24/offshore-wind-development-new-jersey-us-fishermen-ocean-life

The Way Forward. (n.d.). Government of Newfoundland and Labrador. Retrieved November 8, 2022, from https://www.gov.nl.ca/thewayforward/.

Vineyard Wind Fisheries Mitigation Proposal to the FAB.(2019). Vineyard Wind http://www.crmc.ri.gov/windenergy/vineyardwind/VW_FisheriesMitigation_20190116.pdf

Vosiey's Bay Development Agreement Among Her Majesty the Queen in Right of Newfoundland and Labrador and Vosiey's Bay Nickel Company Limited and INCO Limited. Government of Newfoundland and Labrador. Retrieved November 8, 2022, from https://www.gov.nl.ca/iet/files/royalties-legal.pdf

Barnard-Chumik, Cappe, N., & Giang, A. (2022). Knowledge hierarchy and mechanisms of power in environmental impact assessment: Insights from the Muskrat Falls hydroelectric project. *The Canadian Geographer*, *66*(3), 462–484. https://doi.org/10.1111/cag.12758

Rajinikanth, Soni, M. K., Mahato, B., & Rao, M. A. (2021). Microstructural investigation of rolling contact fatigue (RCF) on a failed planetary gear of a windmill gearbox. *Engineering Failure Analysis*, *121*, 105167–. https://doi.org/10.1016/j.engfailanal.2020.105167

Kerckhof, Rumes, B., Jacques, T., Degraer, S., & Norro, A. (2010). Early development of the subtidal marine biofouling on a concrete offshore windmill foundation on the Thornton Bank (southern North Sea): first monitoring results. *Underwater Technology*, *29*(3), 137–149. https://doi.org/10.3723/ut.29.137

9 TOURISM AND AESTHETICS IN THE REGIONAL ASSESSMENT FOR OFFSHORE WIND DEVELOPMENT IN NEWFOUNDLAND AND LABRADOR

Jacob Moriarty, Jen Shears, Jennifer Anil Vettukuzhiyil, Shyamal Petiot

9.1 SUMMARY

- The goal of the Regional Assessment for Offshore Wind Development in Newfoundland and Labrador is to help inform and improve future planning, licensing and impact assessment processes for Offshore Wind Development activities in a way that helps protect the environment and health, social and economic conditions while also creating opportunities for sustainable economic development.
- This paper reviews the Draft Terms of Reference and Draft Agreement from the perspective of Tourism and Aesthetics, and offers recommendations to ensure these valued components are well represented in the Regional Assessment.
- There is no direct mention of Tourism in the Regional Assessment's Draft Terms of Reference and Agreement. Given tourism's value and its susceptibility to being impacted by nearby energy projects, it should be a key consideration throughout the Regional Assessment.
- A study that analyzed the impacts of renewable energy infrastructure on tourism in Iceland emphasized the importance of including tourism stakeholder perceptions and knowledge into the early stages of renewable energy planning.
- The authors recommend that the Regional Assessment for Offshore Wind Development in Newfoundland and Labrador include a Tourism Advisory Group, which would be composed of major stakeholders and representatives from the provincial tourism industry, and would bring knowledge and perspectives from this economically critical and socially diverse sector.
- The Draft Agreement and Terms of Reference vaguely mentioned World Heritage Sites in the coastal areas. It is important to recognize that they are tourist destinations and they must be protected and preserved. Gros Morne National Park is one such site. Its management is guided by the Canada National Parks Act SC 2000 c. 32. This Act must be considered when conducting the Regional Assessment for Offshore Wind Development for Newfoundland and Labrador.
- The authors recommend excluding the area surrounding Gros Morne National Park from the Regional Assessment study area, as construction and operation of offshore wind farms could interfere with the tourism sector, as well as infringe on the National Park's development limitations. The exclusion area should extend to a distance where offshore wind infrastructure is not visible from anywhere in the National Park's viewshed (including from its highest point).
- There are no details in the Terms of Reference as to which aesthetic and social components will be examined. The authors recommend that resident aesthetics and recreational activities be considered during the Regional Assessment.
- The authors recommend that spatial planning for Offshore Wind Developments consider residents' opinions on how far developments should be from residential areas, so as to prevent issues related to visual discomfort that can occur due to wind turbines.
- The authors recommend that the Regional Assessment consider recreational activities such as recreational fishing and boating activities, coastal onshore activities (visiting beaches, swimming), and the effects that access restrictions will have on them.

9.2 INTRODUCTION

The goal of the Regional Assessment for Offshore Wind Development in Newfoundland and Labrador is to help inform and improve future planning, licensing and impact assessment processes for Offshore Wind Development activities in a way that helps protect the environment and health, social and economic conditions while also creating opportunities for sustainable economic development (Impact Assessment Agency of Canada, 2022a). In undertaking this Regional Assessment, the Impact Assessment Agency of Canada has committed to working with the provincial government, Indigenous groups, federal authorities, non-government organizations, and the public to maximize its effectiveness (Government of Canada, 2022b). The Regional Assessment is currently in its early stages, with a draft Terms of Reference and a draft Agreement available for public input. These documents will guide the Regional Assessment, so ensuring they are relevant and complete is of great importance.

This paper reviews the Draft Terms of Reference (Impact Assessment Agency, 2022b) and Draft Agreement (Impact Assessment Agency, 2022a) from the perspective of Tourism and Aesthetics/Recreation, and offers recommendations to ensure these valued components are adequately represented in the Regional Assessment.

9.3 TOURISM AND THE REGIONAL ASSESSMENT FOR OFFSHORE WIND DEVELOPMENT IN NEWFOUNDLAND AND LABRADOR

In order to achieve the goals of engagement, sustainability, and favourable social and economic conditions as outlined by the Impact Assessment Agency of Canada (Government of Canada, 2022b), the Regional Assessment for Offshore Wind Development should involve major industries that have obvious potential to be impacted by future offshore wind projects. One such industry is Tourism. Upon review of the draft Terms of Reference and Agreement, the authors found there is no direct mention of Tourism, and given its value to the province and its susceptibility to being impacted by nearby energy projects it should be a key consideration throughout the Regional Assessment.

9.3.1 Why Involve Tourism in the Regional Assessment?

9.3.1.1 Economic Impact

The Tourism industry is an economic driver in Newfoundland and Labrador. Prior to the pandemic, it generated approximately $1.14 billion in spending annually with almost 20,000 jobs and 2,800 businesses in tourism industries, representing nine per cent of all jobs in the province (Government of Newfoundland and Labrador, 2021). In comparison to other sectors, tourism has the widest provincial economic reach. The tourism industry holds a vital role in economic diversification, providing employment opportunities, especially in rural areas where economic opportunities are limited (The Premier's Advisory Council on Tourism, 2021). The economic importance of tourism throughout the province underscores the necessity of understanding Tourism in the context of Offshore Wind Development, and ensuring measures are in place to protect and bolster it.

9.3.1.2 Workforce Diversity

Tourism jobs not only represent a large proportion of the province's workforce; they have historically included a higher percentage of underrepresented groups like women, youth, new Canadians, and Indigenous populations than most economic sectors (Government of Canada, 2022c; Mondor, 2020). Gender Based Analysis + is now a required component in Impact Assessments at the Federal level (Government of Canada, 2022a), and this should be carried through the Regional Assessment for Offshore Wind. By including Tourism in the Regional Assessment, the Committee will get perspective from multiple demographics that might not otherwise be captured from typically male-dominated energy sectors.

9.3.1.3 Visitor Motivations

When determining whether tourism might be impacted by offshore wind projects in Newfoundland and Labrador, it is critical to acknowledge what visitors enjoy about the province. Based on visitor exit surveys conducted by the Government of Newfoundland and Labrador in 2016, travelers showed high levels of satisfaction with most aspects of their trip, but the highest levels of satisfaction rested with their ability to experience a "diverse and inspiring **natural landscape**" and to "enjoy the great outdoors", with 92% and 88% respectively of travel parties rating their satisfaction of these two elements at 8 to 10 on a 1-10 point scale (Government of Newfoundland and Labrador, 2018). Newfoundland and Labrador Tourism's priority target market is visitors who are interested in discovering and experiencing the **unspoiled natural environment** and rich authentic local culture (Government of Newfoundland and Labrador, n.d.-b).

Tourist motivations are very linked to the province's natural landscape, and development of offshore wind infrastructure has a very real potential of impacting that. For this reason, the tourism industry should be involved as a major stakeholder in the Offshore Wind Development Regional Assessment.

9.3.1.4 Early Involvement of Tourism in Energy Planning

Large-scale renewable energy projects have existed for decades, and we can learn a lot from the experiences of other jurisdictions. For the Regional Assessment it would be useful to understand how tourism has been impacted in areas with renewable energy/offshore wind. More specifically, it would be beneficial to study places that had a pre-existing "inspiring natural landscape" nature-based tourism product like Newfoundland and Labrador. A prime example of this is Iceland, where there is an abundance of renewable energy resources and nature-based tourism is of a high importance to the local economy (Tverijonaite et al., 2022).

The results of a study that analyzed the impacts of renewable energy infrastructure on tourism in Iceland emphasized the importance of including tourism stakeholder perceptions and knowledge into the **early stages** of energy planning. The findings argue that early involvement of Tourism stakeholders helps to ensure sustainable development of both the tourism and energy industries (Tverijonaite et al., 2022). This Regional Assessment is, by definition, the early stage of offshore wind energy planning, so it is advisable to incorporate Tourism players in the process.

9.4 How to Involve Tourism in the Offshore Wind Development Regional Assessment

In the current draft versions of the Regional Assessment's Terms of Reference and Agreement, there is virtually no mention of Tourism, and the authors believe this is an oversight that should be rectified.

9.4.1.1 Tourism Advisory Group

The authors recommend creating a Tourism Advisory Group, just as there is a proposed Advisory Group for "Fisheries Information and Analysis". The scope of the role of this Tourism Advisory Group would mirror that of Fisheries Information and Analysis, but with a focus on tourism; that is, to seek knowledge, information and advice from the tourism industry on current and potential tourism activity, as well as potential interactions and impacts resulting from offshore wind development activities in the Study Area, and approaches for avoiding or minimizing adverse effects and creating or maximizing opportunities for positive effects (Impact Assessment Agency of Canada, 2022b).

The authors recommend consulting with the following tourism stakeholders in the Regional Assessment:

Destination Management Organizations (DMOs): there are five DMOs across Newfoundland and Labrador, and each is responsible for supporting the continued growth and sustainability of the provincial tourism industry through regional marketing, destination development and market readiness initiatives that will attract more visitors, increase length of stay, and provide more experiences that are aligned with the Newfoundland and Labrador brand (Go Western Newfoundland, n.d.). The five regional DMOs in the province are: Destination St. John's, Legendary Coasts (Eastern), Adventure Central Newfoundland, Go Western Newfoundland, and Destination Labrador (Government of Newfoundland and Labrador, n.d.-a).

Hospitality Newfoundland and Labrador (HNL): a non-profit membership association that leads, supports, represents and enhances the province's tourism industry. HNL represents the interests of more than 2,600 tourism-related businesses across the province and is the largest industry association in Newfoundland and Labrador (Hospitality Newfoundland and Labrador, n.d.).

Municipalities Newfoundland and Labrador (MNL): represents the interests of 276 incorporated municipalities in the province. Some municipalities are currently dependent on Tourism, and others that do not currently benefit directly from tourism may benefit from increased tourism due to nearby offshore wind projects (Municipalities Newfoundland and Labrador, n.d.).

Newfoundland and Labrador Indigenous Tourism Association (NLITA): an Indigenous-led group dedicated to the Indigenous Tourism potential in Newfoundland and Labrador. It aims to conserve and promote Indigenous culture, knowledge and places in Newfoundland and Labrador through leadership and support for community-led, grassroots tourism (Newfoundland and Labrador Indigenous Tourism Association, n.d.).

Parks Canada: Responsible for National Parks, National Historic Sites and National Marine Conservation Areas. It has a mandate of protecting and presenting nationally significant examples of Canada's natural and cultural heritage, and fostering public understanding, appreciation and enjoyment in ways that protect these places for present and future generations (Parks Canada, 2022). There are three National

Parks, one National Park Reserve, and ten National Historic Sites in Newfoundland and Labrador – three of which are UNESCO World Heritage Sites (Newfoundland and Labrador Tourism, n.d.).

Department of Tourism, Culture, Arts and Recreation: a department of the Government of Newfoundland and Labrador, with responsibilities that include marketing Newfoundland and Labrador as a destination, overseeing Provincial Parks, establishing and operating provincial historic sites, and visitor information centers, and supporting economic growth and employment in the tourism industry through research, opportunity identification and strategic development (Tourism, Culture, Arts and Recreation, n.d.).

9.5 Other Tourism Considerations for the Regional Assessment's Terms of Reference and Agreement

9.5.1.1 Onshore Infrastructure

Although offshore wind turbines are not located on land, there are onshore substation and transmission infrastructure requirements (Wasser, 2022). The Regional Assessment's Draft Terms of Reference and Agreement do not directly mention onshore components required for offshore wind energy, but this is a significant factor to consider, particularly through the lens of Tourism and Visitor Experience. The Regional Assessment's study area should consider important tourism locations, and the potential impact on these areas due to the presence of **both** offshore and onshore infrastructure.

9.5.1.2 Protected Areas

Some coastal protected areas are dependent on tourism, and they have their own regulations and applicable legislation. Those located on the West Coast of Newfoundland include Gros Morne National Park, Port au Choix National Historic Site, and L'Anse aux Meadows National Historic Site. These places are bound by the Parks Canada Agency Act, and have special considerations and limitations that should be factored when determining the Study Area of the Regional Assessment.

9.6 Gros Morne National Park - A Coastal Protected Area and World

9.6.1 Heritage Site

One of the coastal protected areas that depends on tourism is Gros Morne National Park, which is situated on the west coast of Newfoundland (UNESCO n.d.). The western coastal area is included in the study area for the Regional Assessment of Offshore Wind Development, which is in accordance with the Accord Act, that is the Canada-Newfoundland and Labrador Atlantic Accord Implementation Act (Impact Assessment Agency of Canada, 2022b). The construction and operation of offshore wind turbines can have a significant impact on businesses that rely on tourism from the National Park.

9.6.2 Gros Morne National Park's Significance for Tourists

Gros Morne National Park encompasses an area measuring 180,500 hectares. Within this area, the park illustrates textbook examples of monumental earth-building. The park's high scenic value stems from the prevalence of mountains thanks to the geological process of plate tectonics. Gros Morne National Park provides an outstanding demonstration of wilderness environments, including spectacular landlocked, freshwater fjords, waterfalls, and geological structures (UNESCO, n.d.).

Gros Morne National Park is home to many wildlife species such as Moose, Woodland Caribou, Black Bears, Red Fox and Arctic hare. The park not only offers exceptional natural beauty, it also offers ecological significance that attracts tourists from all over the world.

Most people want to get away from the busyness of city life to experience nature in Gros Morne National Park (Visit Gros Morne, n.d.). Experiencing the scenic beauty of the park helps people to relax and have a mental detox. According to the National Park Service (2019), just 5 minutes walking in nature improves mood, self-esteem and relaxation. Physical activity like hiking in green spaces can reduce stress and lower cortisol levels by 15%. A 30-minute visit to a park can improve heart health circulation and lower cholesterol and blood pressure. Walking in nature reduces inflammation and boosts the immune system. The positive aspects provided by national parks are crucial to mental and physical wellbeing and this is what attracts tourists from all over the world. Examples of activities enjoyed by tourists include camping, hiking, bird watching and festivals. The positive aspects provided by national parks are crucial to mental and physical wellbeing, and this is what attracts tourists from all over the world. Examples of activities enjoyed by tourists include camping, hiking, bird watching and festivals.

9.6.3 Job opportunities Created by Gros Morne National Park's Tourism

Job opportunities like tour guides, and those who work in the entertainment industry and accommodation industry rely on tourists visiting the national park, in order to have flourishing businesses. The construction and operation of offshore wind turbines may have a significant impact on businesses that rely on tourism of national parks.

9.6.4 Suggested Regional Assessment Modifications to Mitigate Adverse Effects on Gros Morne National Park's Tourism

The Regional Assessment's Draft Agreement and Terms of Reference vaguely mentions World Heritage Sites on coastal areas. It is important to recognise that world heritage sites are tourist destinations that have to be preserved and protected. They offer significance in many ways, such as historical and archaeological but in the case of Gros Morne national park it offers ecological and geological significance that attracts tourists.

Under the Parks Canada Agency Act is the Canada National Parks Act SC 2000 c.32, which was implemented for Gros Morne on October 1st 2005 (Explore Gros Morne National Park, n.d.). The Act holds accountability in terms of wildlife conservation, ecological protection, and mitigation of environmental damage. The authors recommend, at a minimum, that the Regional Assessment ensure any offshore wind projects in the vicinity of Gros Morne National Park do so in accordance with the Canada National Park Act SC 2000 c.32, and that they consider how any offshore wind farms would impact the National Park's tourism sector and how to mitigate any adverse effects.

The authors, however, believe that the *best* way to ensure Gros Morne National Park's tourism industry, ecological goals and its UNESCO World Heritage Site designation are not compromised, is to completely exclude the surrounding area of the park from the study area and designate it an offshore wind development-free zone. Furthermore, offshore wind turbines often require onshore infrastructure, which would not normally be permissible under the National Parks Act. The exclusion area should

extend to a distance where any offshore wind turbines are not visible from any point in the park; including the highest point, which is at 806m.

9.7 Resident Perspectives on Aesthetics and the Regional Assessment for Offshore Wind Development in Newfoundland and Labrador

Newfoundland and Nova Scotia have experienced an increase in tourism since 2020, after a drastic decrease because of COVID-19 (Canadian Tourism Activity Tracker, 2021). Newfoundland needed about a year to recover its tourism sector and is now experiencing a slight increase (Canadian Tourism Activity Tracker, 2021). Similarly, Nova Scotia required about the same time to recover but the industry is advancing a little slower (Canadian Tourism Activity Tracker, 2021). Out of a myriad of reasons why tourists like visiting these provinces, the ample opportunity of experiencing unique and aesthetically pleasing environments is always considered rewarding for most and has been for a long time (Judd, 1877). Additionally, locals also like having access to such naturally attractive environments and some choose to reside near them for that very reason.

The study area for the offshore wind development includes areas surrounding many coastal communities; and therefore, the Regional Assessment should consider the opinions and interests of residents who happen to reside near or are within viewing distance of any potential wind farm areas. The authors also agree that it is likely that access to local roads, docks or ports that are situated near coastal residential areas, are going to be utilized for the construction and maintenance of the site. With this in mind, the authors believe that the aesthetic of the environment and nearby properties, and the opinion of residents should be given considerable attention. In correlation to that, on page 5 of the draft Terms of Reference, there was a brief mention of an interest in finding out possible ways that the aesthetics or viewscapes are likely to be affected by this development and the authors look forward to having it considered throughout the Regional Assessment because it is an important component to consider.

9.8 How can offshore wind projects affect the aesthetics of nearby residents?

9.8.1 Visual Discomfort

According to a survey conducted in Norway in 2016 by Klæboe and Sundfør, residents that resided near wind farms for more than a year claimed to have experienced visual discomfort during sunsets and sunrises. In their claims, they specified that the spinning of turbines caused the sunlight to appear as if it was flickering and flashing. In addition, the same survey also corroborated that the closer the farm was built to residential areas, the worse the visual discomfort was experienced (Klæboe and Sundfør, 2016); (Lee et al., 2020). The authors recommend that the Terms of Reference for the Regional Assessment to consider the opinions of nearby residents when spatial planning for the construction to ensure that the chosen area is within a good distance from residential areas to reduce the chances of this or similar issues emerging.

9.8.2 Property Value

According to Klæboe and Sundfør (2016), about 46% of people that resided near wind farms agreed to be afraid of a decrease in their property's value. Beachfront properties or properties that face the sea

might see a decrease in their value if the view is obstructed or degraded by the wind farm since such properties rely on scenic environments to increase their overall value. The authors would recommend that the Terms of Reference for the Regional Assessment consider compensating individuals that see a decrease in their property value due to the construction of any turbines.

9.8.3 Natural Scenery and its Effects on Mental Health

Klæboe and Sundfør also confirmed, through their survey, that 72% of residents that resided near wind turbines agreed that the aesthetics of the viewscapes degraded after the wind farm was constructed. In addition, some residents look forward to purchasing and enjoying dwellings situated near scenic environments especially if they live and work in cities or towns that are further away from nature (Cox et al., 2017). This is the case because of rapid urbanization that forces natural environments to be rendered scarce, forcing people to move or purchase properties that exist near aesthetically pleasing environments (Cox et al., 2017). Moreover, according to Cox et al. (2017), people that live in cities choose to travel or stay in scenic areas to reduce mental stress, reduce anxiety, improve mood, and promote psychological restoration through various recreational activities such as hiking, mountain biking, walking and much more. Therefore, the authors would like to suggest that the Terms of Reference for the regional Assessment consider compensating residents that prefer to relocate because the construction of wind turbines are disturbing their connection with nature or their view.

9.9 How can Resident Recreational Activities be affected by Offshore Wind Farms?

In the Terms of Reference there is mention of impacts to residents from the wind farm on page A-7 under objective A- Section D (referred to as social). Recreational activities are an integral part of a community. They are the means by which a community relaxes, and for this reason it is important that the various activities that are considered to be recreational are taken into consideration when evaluating the impact of an offshore wind farm. In the United States the first offshore wind farm in North America was built in the state of Rhode Island. By examining the effects of the offshore wind farm on the community, certain assumptions can be made as to the impact of an offshore wind farm on coastal communities in Newfoundland and Labrador. The major recreational activities that have been identified as being impacted by wind farms are water-based activities - mainly fishing and boating; however, the implications of restrictions to recreational activities should also be considered.

9.9.1 Mental Health and Restrictions to Recreational Activities

A study that analyzed the effect of wind turbines in general on mental health found that residents living around the turbines had symptoms ranging from sleep deprivation, anxiety, depression and increased blood pressure. These symptoms were found through the use of testing blood pressure, heart rate and other factors (Office for Science and Society, 2017). In this same study, the effects of recreational activity on mental health were explained. Some of the findings from the program were that participants had increased self-esteem, opportunities for success were more readily found, increased levels of energy, and lastly coping and problem-solving skills were developed. From these results it can be inferred that if residents' access to recreational forms of activity are compromised then their mental health will suffer further. The impact of restrictions to popular recreational activities in the affected communities should be determined and mitigating measures should be taken if extreme impacts are identified.

9.9.2 Recreational Fishers

In the U.S, a place called Block Island has implemented an offshore wind farm project and there are no restricted zones around the turbines; however, through a study conducted by a professor from the University of Rhode Island it was found that recreational fishers were found to gravitate towards the turbines because of the artificial reefs that were found to grow/develop around the turbine foundations (Smythe et al., 2021). This information was collected through the use of interviews and a survey. The findings indicated that those who fished at or around the turbines believed that rather than the turbines being a nuisance, they are seen as a step forward in terms of green energy process (Smythe et al., 2021).

9.9.3 Recreational Boaters

In a similar study to the above mentioned, the impact of offshore wind turbines on recreational boaters was examined. The findings were that those who went closer than 100ft to the turbines would feel that their "boating experience" was being degraded (Dalton et al., 2020). As mentioned above, those who intended to fish on top of boating did not find their "experience" degraded. The increased safety risks that come from traveling around the turbines was found to impact the enjoyment of those boating in the area, along with the visual aesthetics having been altered on top of the noise generated by the turbines (Dalton et al., 2020).

9.9.4 Swimming and Recreational Beach Use

The use of a beach for recreational activities is generally seen as popular in communities. In a study evaluating the impact of offshore wind farms on recreational use of coastal areas such as beaches, participants commented that if wind turbines were visible from their beach or coastal area, they would be perceived as being negative (Ladenburg & Dubgaard, 2009). Whereas those who could not see turbines from where they were on the beach or coast, did not perceive the turbines as being negative. To summarize, those who visited beach or coastal areas frequently did not perceive the turbines to be negative, but they did feel that they negatively impacted their recreational experiences/activities (Ladenburg & Dubgaard, 2009). Therefore, the general consensus was that those who frequented the beaches in question, were willing to pay twice the amount originally estimated to be required for construction, in order to have the turbines moved further away to a point at which they would not impact the recreational value of the coastal areas (Ladenburg & Dubgaard, 2009).

9.10 Key Recommendations

The Regional Assessment for Offshore Wind Development in Newfoundland and Labrador will be an important step to ensure that future offshore wind projects are planned and executed in a sustainable manner. In order to achieve this, the authors recommend the following:

- The Regional Assessment for Offshore Wind Development in Newfoundland and Labrador should include a **Tourism Advisory Group**. This Tourism Advisory Group would be composed of major stakeholders and representatives from the provincial tourism industry, and would bring knowledge and perspectives from this economically critical and socially diverse sector.

- The Regional Assessment should consider the **opinion of nearby residents** when spatial planning for the construction of the wind turbines to prevent any visual discomfort of nearby residents.

- The Regional Assessment should consider **compensating residents** that prefer to move after the construction of the farm and to compensate individuals who see a decrease in their property value after the turbines are built.

- Marine spatial planning should be informed by coastal and ocean users so as to allow for them to continue utilizing the area for **recreational activities.**

- The Regional Assessment should ensure that there is a **support system** in place for residents that are suffering from mental illnesses incurred from the construction/establishment of a local wind farm.

- The Regional Assessment, at a minimum, should ensure any offshore wind projects in the vicinity of Gros Morne National Park do so in accordance with the Canada National Park Act SC 2000 c.32, and that they consider how any offshore wind farms would **impact the National Park's tourism** sector and how to mitigate any adverse effects to it and to ecological and geological integrity.

- Ideally though, the **area surrounding Gros Morne National Park should be completely excluded** from consideration for offshore wind development. The exclusion area should extend to a distance where any offshore wind turbines are not visible from any point in the park; including the highest point which is at 806m.

9.11 About the Authors

Jacob Moriarty: A fourth year student in Environmental Studies at Memorial Universities' Grenfell Campus. He lives on a lake in a rural community, currently the dam that has been in place on for as long as he has lived there, is being repaired and improved. The development has received a lot of input from the community and has benefited because of it, for this reason he believes that community development is always benefited by comments from residents in the affected scope.

Jen Shears is a mature student who began her undergraduate degree in Environmental Science (Biology) at Memorial University's Grenfell Campus more than two decades ago. With only two courses remaining for program completion, she took a hiatus to begin a career at Parks Canada in Gros Morne National Park, where she worked for 15 years. Jen owns and operates several tourism businesses, including a wildlife museum and one of the largest tourist accommodation offers in the Gros Morne area. Jen lives in Rocky Harbour, where she is also a municipal Councillor. She is an avid outdoorswoman and writer, whose pieces advocate for sustainable hunting, fishing, and wild food and clothing, which she attributes to her Mi'kmaq roots and upbringing. At Grenfell, Jen was awarded the Gervase C. Hollander Prize in Biology and the Refreshments Canada Scholarship for Excellence in Environmental Science. She was also awarded Parks Canada Agency's most prestigious honour, a CEO Award of Excellence, for her role in developing a Visitor Experience and Service training program.

Jennifer Anil.V is a third year international student studying Environmental Science (chemistry) at Grenfell Campus, Memorial University of Newfoundland. She is originally from India but grew up in Bahrain. She moved to Corner Brook in January of 2021 and realized how different it was compared to Bahrain. She has grown to appreciate the place especially for its scenic beauty. Jennifer enjoys hiking and spending time alone in nature. She worked as a laboratory assistant for a semester and is now interested in researching climate and weather patterns in Newfoundland and recording every news article. She hopes to increase her experience in working in relation to environmental jobs. She also hopes to work for Natural Resources Canada or WSP global.

Shyamal Petiot is a fourth-year international student who lives in Corner Brook, Newfoundland. He is studying Environmental Studies with a minor in Environmental Science (Biology) at Grenfell Campus of Memorial University of Newfoundland. He is originally from Tanzania and has been pursuing an undergraduate degree from Memorial University since 2017 and looks forward to graduating next year. He believes that Corner Brook and Newfoundland, in general, are prime assets for building wind farms because the weather here almost always consists of wind ranging from breezy to strong.

9.12 REFERENCES

Cox, D. T. C., Shanahan, D. F., Hudson, H. L., Plummer, K. E., Siriwardena, G. M., Fuller, R. A., Anderson, K., Hancock, S., & Gaston, K. J. (2017). Doses of Neighborhood Nature: The Benefits for Mental Health of Living with Nature. BioScience, biw173. https://doi.org/10.1093/biosci/biw173

Dalton, Weir, M., Calianos, A., D'Aversa, N., & Livermore, J. (2020). Recreational boaters' preferences for boating trips associated with offshore wind farms in US waters. Marine Policy, 122, 104216–. https://doi.org/10.1016/j.marpol.2020.104216

Explore Gros Morne National Park (n.d.). Retrieved November 12, 2022 from http://www.grosmorne.com/

Go Western Newfoundland. (n.d.). *Meet the Team*. https://www.gowesternnewfound land.com/team

Government of Canada. (2022a). *Gender-Based Analysis Plus in Impact Assessment*. https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/gender-based-analysis-plus-impact-assessment-fact-sheet.html

Government of Canada. (2022b). Regional Assessment of Offshore Wind Development in Newfoundland and Labrador and Nova Scotia. https://iaac-aeic.gc.ca/050/ evaluations/proj/83514

Government of Canada. (2022c, June 2). Prince Edward Island tourism operators will benefit from modernized offerings to help the sector recover and attract visitors to the region [Press release]. https://www.canada.ca/en/atlantic-canada- opportunities/news/2022/06/prince-edward-island-tourism-operators-will-benefit-from-modernized-offerings-to-help-the-sector-recover-and-attract-visitors-to-the-region.html

Government of Newfoundland and Labrador. (n.d.-a). *Destination Management Organizations*. https://www.gov.nl.ca/tcar/tourism-operators/destination-management-organizations/

Government of Newfoundland and Labrador. (n.d.-b). *Tourism Marketing Strategy.* https://www.gov.nl.ca/tcar/tourism-division/marketing/tourism-marketing-strategy

Government of Newfoundland and Labrador. (2018). *2016 Exit Survey - Result Highlights.*

Government of Newfoundland and Labrador. (2021, July 8). *Provincial Government Committed to Recovery of Tourism and Hospitality Industry* [Press release]. https://www.gov.nl.ca/releases/2021/exec/0708n03/

Hospitality Newfoundland and Labrador (HNL). (n.d.). About HNL. https://hnl.ca/about -hnl/

Impact Assessment Agency of Canada. (2022a). Draft Agreement to Conduct a Regional Assessment of Offshore Wind Development in Newfoundland and Labrador. https://iaac -aeic .gc.ca/050/documents/p83514/145234E.pdf

Impact Assessment Agency of Canada. (2022b). Regional Assessment of Offshore Wind Development in Newfoundland and Labrador. *https://iaac-aeic.gc.ca/050/documents/p8 3514/145236E.pdf*

Judd, J. (1877). Geology and Scenery of Newfoundland. Geological Magazine, 4(7), 336-336. doi:10.1017/S0016756800149519

Klæboe R, Sundfør HB. (2016). Windmill Noise Annoyance, Visual Aesthetics, and Attitudes towards Renewable Energy Sources. Int J Environ Res Public Health, 13(8), 746. doi: 10.3390/ijerph13080746.

Ladenburg, J., & Dubgaard, A. (2009). Preferences of coastal zone user groups regarding the siting of offshore wind farms. *Ocean & Coastal Management, 52*(5), 233-242. doi:https://doi.org/10.1016/j.ocecoaman.2009.02.002

Lee, H., Seung-Hoon, Y., & Sung-Yoon, H. (2020). Public perspectives on reducing the environmental impact of onshore wind farms: A discrete choice experiment in South Korea. Environmental Science and Pollution Research International, 27(20), 25582-25599. doi:https://doi.org/10.1007/s11356-020-08949-0

Mondor, P. (2020). A look at inclusivity in the Canadian travel industry. *Travel Courier*. https://travelcourier.ca/a-look-at-inclusivity-in-the-canadian-travel-industry/

Municipalities Newfoundland and Labrador (MNL). (n.d.). *About MNL*. https://municipalnl .ca/about/

National Park Service. (2019, May 17). *Nature makes you…* Retrieved November 12, 2022 from https://www.nps.gov/articles/naturesbenefits.htm#:~:text=Healthier,of%20certain%20diseases%20and%20cancers

Newfoundland and Labrador Indigenous Tourism Association (NLITA). (n.d.). *About NLITA*. https://nlita.ca/industry/

Newfoundland and Labrador Tourism. (n.d.). The 5 UNESCO designated cultural and natural wonders of Newfoundland & Labrador. https://www.newfoundland labrador.com/trip-ideas/travel-stories/five-unesco-sites

Office for Science and Society. (2017, July 21). *Are wind farms really bad for People's Health?* https://www.mcgill.ca/oss/article/environment-health-you-asked/are-wind-farms-really-bad-peoples-health)

Parks Canada. (2022). *The Parks Canada mandate and charter*. https://www.pc.gc.ca /en/agence-agency/mandat-mandate

Smythe, T., Bidwell, D., & Tyler, G. (2021). Optimistic with reservations: The impacts of the United States' first offshore wind farm on the recreational fishing experience. Marine Policy, 127, 104440–. https://doi.org/10.1016/j.marpol.2021.104440

The Premier's Advisory Council on Tourism. (2021). The Impacts of the Covid-19 Pandemic on the Newfoundland and Labrador Tourism Industry and the Pathway to Recovery.

Tourism, Culture, Arts and Recreation. (n.d.). *Tourism, Culture, Arts and Recreation.* https://www.gov.nl.ca/tcar/

Tverijonaite, E., Sæþórsdóttir, A.D., Ólafsdóttir, R., & Hall, C.M. (2022). How close is too close? Mapping the impact area of renewable energy infrastructure on tourism. *Energy Research & Social Science, Volume 90*

UNESCO World Heritage Centre. (n.d.). *Gros Morne National Park*. https://whc.unesco.org/en/list/419/

Visit Gros Morne (n.d.) Retrieved November 12, 2022 from

https://visitgrosmorne.com/festivals/

Wasser, M. (2022). As offshore wind plans grow, so does the need for transmission. *WBUR*. https://www.wbur.org/news/2022/10/18/offshore-wind-transmission -lines-grid

Western Health. (2013, Nov). *Recreation for Mental Health - Home | Western Health.* https://westernhealth.nl.ca/uploads/Addictions%20Prevention%20and%20Mental%20Health%20Promotion/Recreation%20for%20Mental%20Health%20-%20Sigmunds%20Guide%20to%20a%20Healthy%20Mind%20Healthy%20Body%202013.pdf.

10 Inuit and Innu Rights and Consultation

Peter Dicker and Madison Dicks

10.1 SUMMARY

Inuit

The Nain Wind Micro-Grid Project has been greenlit for development and could be used as a example of community-driven project as a potential benchmark. The Nunatsiavut Government selected Natural Forces as their partner to develop clean renewable electricity with the wind turbines, store the electricity when it is not needed with the battery system. The Project would consist of (1) 1-2 wind turbines, (2) A battery energy storage system, and (3) And a micro-grid controller.

Innu

There were two different documents to understand the Innu peoples valued components in terms of an offshore development. One of the main valued components found in regard to the Innu peoples of Labrador was to be able to participate and be consulted on the impact assessments properly.

- For educated participation and consultation with this assessment it needs to be available not just in English but in other native languages as well. Such as French, Mi'kmaw, Innu-aimun and Inuktitut.
- There were also some concerns regarding how accessible the information would be. For proper engagement these documents need to be accessible to all peoples regardless of their technology backgrounds.
    - An example would be if some information is on GIS software it might not be accessible to all people.
- They are also concerned about the health of waterfowl, Salmon and Marine species in the area. The Innu have communal commercial licenses for
        - ground fish,
        - mackerel,
        - Capelin,
        - Shrimp,
        - halibut.
        - And in their culture salmon are very important culturally.
- With these concerns they would like to see assessments done on the habitats, plans for mitigation of these adverse effects, and a plan put in place to continuously monitor and prevent negative effects to these important species around the study area.

10.2 Evaluation of the Project's consideration for First Nations, Innu, Inuit and Metis

The peoples of the Arctic are collectively known as Inuit, which means "the people" in the Inuktitut language. The term Métis refers to a collective of cultures and ethnic identities resulting from unions between Aboriginal and European people in what is now known as Canada.

Nain is a rural community that is isolated from other coastal communities in Northern Labrador. But the Project will hire local consultants and contractors, along with local services that should create positive impacts. The evaluation of the project's consideration for Indigenous Groups should allow First Nations, Inuit, Innu, and Metis to be involved since (Northern) Labrador is home to both Inuit and the Innu Nation.

It is important to continue to research and communicate with community members in order to understand the lands that the project will be built on and how the project will affect those using the area and lands surrounding the project (Draft Nain Micro-Grid Environmental Registration Summary, November 2021).

10.2.1 Background

Nain's Wind Micro-Grid Project would decrease the community's reliance on burning diesel fuel to produce electricity. The Project has been under review through the Nunatsiavut Environmental Protection Act for a bit. The comment period has been extended over the summer, and officially ended at the end of October. During the comment period, people were invited to send comments in writing or to their local Community Liaison Officer. A round table was held in Nain with the Minister of Lands and Natural Resources. The environment division is preparing a report on the Project and the consultations for the Minister and a decision about approval. Conditions are expected thirty business days from the end of the consultation period.

The Innu Nation of Labrador has around 3200 peoples who mostly reside around Sheshatshiu and Natuashish ("Innu.ca," 2022). Innu Nation has claims to Indigenous rights and title to most of Labrador and parts of Quebec. In September 2008, Innu Nation and the Government of NL signed the Tshas Petapen ("New Dawn") Agreement (Labrador Shelf Offshore Area Strategic Environmental Assessment Update, 2021). The Innu people have participated in multiple studies before such as the Labrador Shelf Offshore Area Strategic Environmental Assessment (Labrador Shelf Offshore Area Strategic Environmental Assessment Update, 2021). Some of these main concerns regarded the animals in the area and this project's impact on them as well as how they would properly engage with this assessment.

10.3 Evaluation

10.3.1 Potential Mitigations and Impacts

Circulating information onshore (land), water, and wildlife in the area was reviewed to understand how the Project may impact the surrounding area and steps that can be taken to limit impacts and mitigations. Some studies focused on the interaction in the development area and the community of Nain involved:

- Study of soil and ground conditions

- Consultation with the community
- Archaeology studies
- Reviewing scientific papers along with Inuit knowledge-based sources (Indigenous Knowledge).
- And transportation routes (increased road access will need to be one of the main focus for the development area).

In the Labrador Shelf offshore area project the proponent was unable to produce the properly translated documents to the Innu communities in Labrador. In a meeting with 10 people from Natuashish the proponent had to offer an apology to the community for not having the translated documents. These communities then had to engage with the project without proper education on what the future plan was (Labrador Shelf Offshore Area Sea -Final Report 5.0 Potential Environmental Effects And Planning Implications From Exploration And Production Activities, N.D.). The proponent for the Offshore wind development in Newfoundland and Labrador has still not provided any translated documents. **They did say in section 6.1 "that In addition, the Committee will include a summary of its Report in plain language and available in English, French, Mi'kmaw, Innu-aimun and Inuktitut." This summary has still not been provided and the final date for comments is arriving very soon, November 26th, 2022.**

Another concern brought to the proponents attention for the Labrador Shelf Offshore Area Sea was about the Innus nations several communal-commercial licenses for groundfish, mackerel, capelin, shrimp, and halibut. Atlantic salmon are also a very important species culturally to them (Labrador Shelf Offshore Area Strategic Environmental Assessment Update, 2021). In the Draft Terms of Reference there is a mention of the Indigenous Participation Plan in terms of Public, fisheries and stakeholder participation plan (Regional Assessment Of Offshore Wind Development In Newfoundland And Labrador And Nova Scotia Appendix A Draft Terms Of Reference, N.D.) If the proponent for the regional assessment of Offshore wind development sticks to the plan to consult Indigneous groups on fishing rights that would be positive.

In the Proponent's evaluation for Offshore Wind Development, it looks at how the draft agreement is eyeing multiple areas surrounding the development such as costs, reports and records, participation of government departments and agencies, and indigenous groups. The proponents for Offshore Wind Development have greater reports and drafts, though for Nain's Wind Development being in early stages, reports and drafts will have to be looked at carefully before land use activities start.

10.4 Recommendations

Indigenous groups have knowledge that can be isolated from any discussion on projects that are under development. Indigenous knowledge is an important component of understanding existing conditions which can create potential effects of both positive and negative outcomes and measures of mitigation that regional assessments can provide a collaborative approach to Indigenous knowledge and scientific information to reduce future impact assessments on lands that are untouched by human developments.

Yet, in the terms of reference for the Offshore Wind Development for NL and NS, *transportation* expansion is not discussed properly, even though Newfoundland has greater transportation routes than Northern Labrador. To identify and evaluate information and knowledge on greater transportation

routes, land use will have to be looked at before transporting large equipment onshore for the development of wind turbines. Construction of expanding roads will increase noise pollution along with spills of oil and gas if not looked at properly.

In the Terms of Reference for the Regional offshore wind development there needs to be a few things looked at before moving forward. In section 6.1 where they state “that In addition, the Committee will include a summary of its Report in plain language and available in English, French, Mi'kmaw, Innu-aimun and Inuktitut.(Draft Agreement To Conduct A Regional Assessment Of Offshore Wind Development In Newfoundland And Labrador, N.D.)”

Providing the documents in languages such as French Mi'kmaw, Innu-aimun and Inuktitut is good but it is not enough to have these communities properly educated in the future plans of the proponent. Each document should be translated and be available in the beginning of the comment period as well as before the consultations begin with these communities. In the Terms of Reference in section A1.6 they speak about the plans for developing the Public, Fisheries and Stakeholder Participation plan and the Indegenous Participation Plan but they do not go into enough detail to know what exactly that entails. (Regional Assessment Of Offshore Wind Development In Newfoundland And Labrador And Nova Scotia Appendix A Draft Terms Of Reference, N.D.) For future documents and plans it would be better for the Indigenous communities and the public to know what to expect from these types of plans. One suggestion that was made during another assessment was that if the Indigenous communities like the Innu in this situation, that a member of the local indigenous communities should be a part of the Fishers Committee to be consulted in their fishery rights.

10.5 About the Authors

My name is Peter Dicker, I am an Inuit student at the Grenfell Campus located in Corner Brook, NL. I am in my fourth year under the major Environment & Sustainability with a minor in Geography. Through my four years of studying at the Grenfell Campus, I have learned about physical geography, geographic information systems (G.I.S), economics, and waste management. I have worked as a conservation officer over three summers in Nain, Nunatsiavut. My experience in the workforce was patrolling wildlife by truck and boat, collecting data from fish (char) sampling and assisting archeology in gathering data for study and research. My interests would be to continue expanding my learning at Grenfell Campus and in the workforce related to my major.

My name is Madison Dicks, a Metis student studying at Grenfell Campus, Memorial University of Newfoundland. I am a fifth year student working towards my Bachelors of Environment and Sustainability, majoring in Environmental Studies with a minor in Social and Cultural Studies. I am currently working for Environment and Climate Change Canada, with the Open Science and Communications team of the Science Management deviation. Through this student job I have learned about how inaccessible scientific information is to the public and how that can hinder non-governmental organizations and the public's engagement with assessments. I was born and raised in Newfoundland and it is where my parents own a hotel/adventure tourism business which involves visitors or working from away staying with us. These offshore wind mills would have an effect on the tourism industry of Newfoundland and I would like to see that effect be a positive one.

10.6 References

Draft Agreement To Conduct A Regional Assessment Of Offshore Wind Development In Newfoundland And Labrador. (n.d.). Retrieved from https://iaac-aeic.gc.ca/050/documents/p83514/145234E.pdf

innu.ca. (2022). Retrieved November 14, 2022, from Innu.ca website: https://www.innu.ca/

Labrador Shelf Offshore Area Sea -Final Report 5.0 Potential Environmental Effects And Planning Implications From Exploration And Production Activities. (n.d.). Retrieved from https://www.cnlopb.ca/wp-content/uploads/sealab/slrest.pdf

Labrador Shelf Offshore Area Strategic Environmental Assessment Update. (2021). Retrieved from https://www.cnlopb.ca/wp-content/uploads/sealab/lssumeng-1.pdf

Nain Wind Micro-Grid Project Environmental Registration Document, November 2021. file:///C:/Users/emers/Downloads/NWMG-English_Summary%20(1).pdf

REGIONAL ASSESSMENT OF OFFSHORE WIND DEVELOPMENT IN NEWFOUNDLAND AND LABRADOR AND NOVA SCOTIA APPENDIX A Draft Terms of Reference. (n.d.). Retrieved from https://iaac-aeic.gc.ca/050/documents/p83514/145236E.pdf