Annex 1 – Atlantic Salmon

**Response from Gulf Science Salmon SMEs:**


Summary

- There are 55 rivers thought to have Atlantic salmon in the Nova Scotia rivers draining into the Gulf of St. Lawrence.
- The Margaree River has had a stock assessment conducted annually since 1987, and it has remained above the Limit Reference Point (LRP) in each year of the series. Stock status is not available for other rivers of Salmon Fishing Area 18 although active recreational fisheries occur in all rivers of Salmon Fishing Area 18. Catch per unit effort in salmon rivers in Gulf Nova Scotia remain below long-term averages, including Margaree River.
- Evidence to suggest that the Cabot Strait may be an important migratory corridor for salmon smolts from Gulf NS and PEI rivers.
- Repeat spawner adult salmon have been detected using the Cabot Strait to enter the Gulf of St. Lawrence and return to their respective rivers.
- Unclear how Offshore Wind development may affect salmon migration or the specific routes they use for migration.


## Overview of Atlantic Salmon in SFA 18

Within the Gulf of St. Lawrence area identified by the IAAC wind project evaluation, there are an estimated 55 Atlantic salmon rivers (Figure 1; Daigle 2023). The Gulf Nova Scotia (GNS) rivers are collectively referred to as Salmon Fishing Area (SFA) 18. Within SFA 18 population status is only available for the Margaree River (Cape Breton) which has a population estimate above the Limit Reference Point (LRP), and it has been for every year since 1987 (DFO, 2023). Catch per unit effort from the recreational Atlantic salmon fishery in other rivers in SFA 18 remain below long term average, including the Margaree River. Daigle 2023 cites habitat shifting and alteration, extreme temperatures and droughts as principal threats, all of which are related to climate change.


Figure 1: Potential Atlantic salmon rivers in Gulf Nova Scotia (SFA 18), figure modified from Daigle 2023.

## Atlantic Salmon Migration in Study Area

There is a knowledge gap in understanding the importance of the Cabot Strait to migrating salmon. An acoustic receiver line was first established across the entire width of Cabot Strait in 2012, enabling the detection of fish tagged with acoustic transmitters. Chaput et al. 2019 conducted a study tagging smolts in northern New Brunswick Rivers (Miramichi and Restigouche rivers; n = 2,862), and they detected 2 tagged smolts that used the Cabot Strait corridor. Based on two acoustic tracking projects conducted in northeast Prince Edward Island (PEI) and the Margaree River (Cape Breton, NS), smolt migration through the Cabot Strait may be more common for smolts derived from nearby rivers (Figure 2: Scott Roloson, Unpublished Data). From the PEI study, 7/106 post-smolt were detected on the Cabot Strait array, several were subsequently detected on the Strait of Belle Isle array, meaning they did not pass through the Cabot Strait, but used it as a migratory corridor in their northward migration to the Strait of Belle Isle. The relatively high detection rate, compared to other rivers of the Gulf (Chaput et al., 2019), suggests there may be region specific migratory corridors. With the proximity of SFA 18 rivers to the Cabot Strait it is plausible that salmon migrating from there may also be using the Cabot Strait as a migratory corridor. Unfortunately, there are no other data sources, to our knowledge, of tagged smolt since the Cabot Strait receiver array was deployed in 2012. With regards to adult salmon returning to the Gulf, limitations of acoustic tag size and battery life dictate that there is a dearth of information on return migration of first time spawning salmon. However, repeat spawner salmon migrating from the Labrador Sea have been detected using the Cabot Strait to enter the Gulf of St. Lawrence on the return to their home rivers (J. Daniels, ASF, pers. comm). These data suggest that the Cabot Strait could be an important migratory corridor for salmon returning to all rivers throughout the Gulf of St. Lawrence.

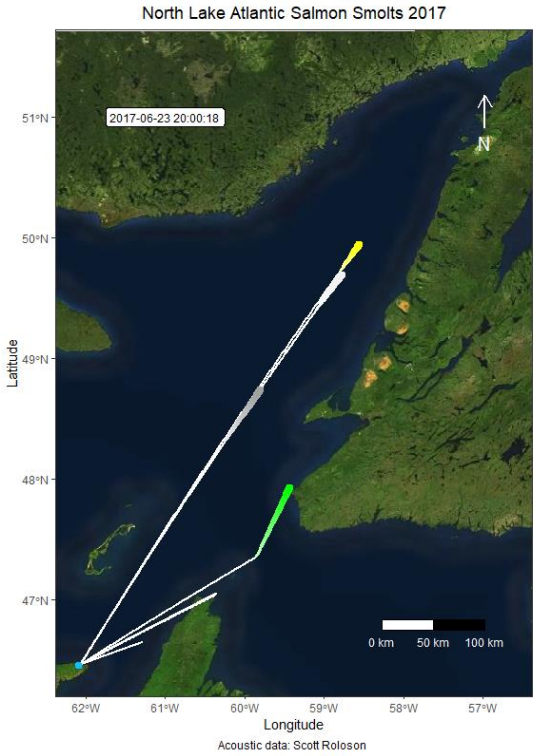


Figure 2: Atlantic salmon detection data illustrating detections of acoustic tagged smolts from North Lake Creek, PEI. Exact locations of fish estimated based upon timing of detections at entry into Gulf, Cabot Strait and Strait of Belle Isle.

References

Chaput, G., Carr, J., Daniels, J., Tinker, S., Jonsen, I., and Whoriskey, F. Atlantic salmon (*Salmo salar*) smolt and early post-smolt migration and survival inferred from multi-year and multi-stock acoustic telemetry studies in the Gulf of St. Lawrence, northwest Atlantic. ICES Journal of Marine Science. 76: 1107–1121.

Daigle, A. 2023. Information on Atlantic Salmon (*Salmo salar*) from Salmon Fishing Area 18 (Gulf Nova Scotia) of relevance to the development of a 2nd COSEWIC status report. DFO Can. Sci. Advis. Sec. Res. Doc. 2023/007. iv +44 p.

DFO. 2023. Update of stock status indicators of Atlantic Salmon (*Salmo salar*) in DFO Gulf Region Salmon Fishing Areas 15 - 18 for 2022. DFO Can. Sci. Advis. Sec. Sci. Resp. 2023/035.

**Information provided by the following subject matter experts**: Scott Roloson; Michael Coffin; and Cindy Breau

Annex 2 – Chlorophyll-a

**Response from Gulf Science Chlorophyll-a SMEs:**

The State of the Atlantic Ocean report: **Bernier, R.Y., Jamieson, R.E., and Moore, A.M. (eds.) 2018. State of the Atlantic Ocean Synthesis Report. Can. Tech. Rep. Fish. Aquat. Sci. 3167: iii + 149 p.** contains information on Chlorophyll. An updated version of the State of the Atlantic Ocean report (2018-2021) is currently being published and should be available in coming weeks.

There are also many sources of chlorophyll information are available on the Atlantic Zone Monitoring Program website: Atlantic Zone Monitoring Program (AZMP) (dfo-mpo.gc.ca). This includes information for 2022 which will not be included in the updated State of the Atlantic Ocean report.

- For example, https://publications.gc.ca/collections/collection_2023/mpo-dfo/Fs97-18-357-eng.pdf.

Other publication also have information requested on Chlorophyll:

- Modeling publication with some information on timing of blooms and primary production https://doi.org/10.3389/fmars.2021.732269
- As well as a publication with future projections https://publications.gc.ca/collections/collection_2020/mpo-dfo/Fs97-18-334-eng.pdf

**Consulted Gulf Science SME**: Joel Chassé

**Gulf SME proposed Science SMEs on Chlorophyll at IML**: Marjolaine Blais and Diane Lavoie

After discussions with Maritimes Region MSP Science it was realized that requests for Chlorophyll information was requested for the entire RA area by Maritimes region therefore most of this information will come from that request.

Annex 3 – Climate Change

**Response from Gulf Science:**

A great summary document for this topic is the "State of The Atlantic Ocean" report. A more recent version of this document is soon to be published. **Bernier, R.Y., Jamieson, R.E., Kelly, N.E., Lafleur, C., and Moore, A.M. (eds.) 2023. State of the Atlantic Ocean Synthesis Report. Can. Tech. Rep. Fish. Aquat. Sci. 3544: v + 219 p. (in publication).**

There are also many information resources available on the Atlantic Zone Monitoring Program website: Atlantic Zone Monitoring Program (AZMP) (dfo-mpo.gc.ca). This includes information for 2022 which will not be included in the updated State of the Atlantic Ocean report.

**Consulted Science Section Heads**: Rémi Sonier; Nicolas Rolland; and Fabiola Akaishi

Annex 4 – Coral and Sponges

**Question/request:** Known information and data / information gaps, and vulnerabilities regarding coral and sponge presence and absence within the region, including noted areas of higher density such as Significant Benthic Areas, or rare / unique species such as *Vazella pourtalesi*. (if available).

**Response:**

***Using this template, please provide brief summaries in tabular or bullet format. Responses should only apply to the Gulf section (North shore of Nova Scotia) of the 'Study Area' outlined in the figure above. Responses should include the following considerations, but are intended to be brief and drawing upon/pointing to existing data and published reports:***

- **Overview of current knowledge:** A brief summary of coral and sponge presence and absence within the region, including noted areas of higher density such as Significant Benthic Areas, or rare / unique species such as *Vazella pourtalesi*. Please also include any pertinent references to CSAS reports, DFO technical reports, and/or primary publications, including hyperlinks to available data and/or reports published on-line.

Sources of sponge distribution information:

- There is a field guide with some distribution information that can be used to say which sponges were collected in the area. **Dinn, C. 2020. Sponges of the Gulf of St. Lawrence: Field and Laboratory Guide. Can. Manuscr. Rep. Fish. Aquat. Sci. 3198: vi + 118 p.**
    - **Caveats:** It is only based on some collections in 2018 (and the ROPOS 2017 collections). So it's not a complete resource of species distributions.
    - Sponges are collected each year in trawl surveys, but identifications are difficult in the field, even with a guide. So records of species distributions from trawl surveys are not always accurate to the species level.
- Portions of the Cape Breton Trough area were surveyed with ROPOS (an underwater Remotely Operated Vehicle, ROV) in 2017 (report in preparation).
    - Polymastidae sponges were probably the most common sponges counted in the ROV transects in the CBT. All members of the genus *Polymastia* are considered to be Vulnerable Marine Ecosystem (VME) representative taxa which includes groups of animals that form ecosystems that are easily disturbed, slow to recover, or may never recover from damage such as trawling (ICES 2020). *Mycale (Mycale) lingua* is also a VME representative taxon that was seen in the CBT area. Prior to being re-combined into a separate genus in 2020, *Plicatellopsis bowerbanki* was considered to be within the genus *Phakellia* (Dinn et al. 2020), and *Phakellia* spp. is also considered a VME representative taxon
    - Here is a list of species seen and also collected nearby from the CBT ROPOS report (in preparation):

| Body Type | Possible Taxa |
|---|---|
| Massive | *Mycale (Mycale) lingua* (Bowerbank, 1866), *Tedania (Tedania)* c.f. *suctoria* |

| | |
|---|---|
| | Schmidt, 1870, *Iophon* sp. (Bowerbank, 1858) |
| Vase | *Plicatellopsis bowerbanki* Vosmaer, 1885), *Mycale (Mycale) lorea* Dinn, Ott, Marmen, Steeves, Côté, Hayes, Nozères, Everett, Powell & Chu, 2023 |
| Sphere with Projections | *Polymastia* spp., *Sphaerotylus capitatus* (Vosmaer, 1885) |
| Sphere without projections | *Tentorium semisuberites* (Schmidt, 1870),*Tethya* spp., *Polymastia* spp. |
| Stalked, Erect | *Cladocroce spatula* (Lundbeck, 1902), *Plicatellopsis bowerbanki* Vosmaer, 1885) |
| Encrusting | *Aplysilla* c.f. *sulfurea* Schulze, 1878, *Hymedesmia* (*Hymedesmia*) cf. *paupertas* (Bowerbank, 1866) |
| Other Forms | Unknown "*Protosuberites*", Suberitida unknown 1 |

In the sGSL, the only glass sponge observed to date is Asconema *foliatum*. *A. foliatum* is also listed by ICES as a deep-sea sponge aggregation Vulnerable Marine Ecosystem (VME) indicator species. *Vazella pourtalesi* the species found on the Nova Scotia shelf has not yet been observed in the Gulf.

During the Southern Gulf Survey of 2013 a glass sponge was coded as *Asconema foliatum*, however, there is no way to confirm the identification as there were no photos or samples collected (location indicated on attached map).

**Caveats**:

- For past survey records, there is no way to confirm species identifications as there were no photos or samples collected.
- *Asconema* was not available to code in the survey before 2011, therefore if observed would have been coded as "Sponge Unidentified" (species code 8600) prior to 2011.
- Much of the area is not trawlable (complex, non-flat benthic habitat) so there is limited information available. Limited trawl coverage of higher relief areas (boulder-rich and bedrock outcrop areas) could lead to biased records of sponges which often anchor on hard surfaces.
- Not much coverage by other survey methods, such as underwater ROVs.
- Due to current survey methods it is difficult to determine true species distributions.

In terms of corals, sea pens and small soft corals are most common in the Gulf of St. Lawrence. Distribution information can be found in Kenchington et al. (2010).

- Although not directly related to corals and sponges, there is also dense anemone fields in the CBT area (mentioned briefly in **Faille, G., Méthé, D., Thériault, M., Thorne, M., Roy, V., Chiasson, M., Benjamin, R., and Rangeley, R. 2019. Cruise Report for the 2017 Fisheries and Oceans Canada and Oceana Canada Mission using the ROPOS in the Gulf of St. Lawrence. Can. Manuscr. Rep. Fish. Aquat. Sci. 3171: v + 22 p.**) the CBT ROPOS report (in preparation) will have more info on this.

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

Most coral and sponge data have been obtained through annual multispecies surveys which are not the most ideal for surveying corals and sponges.

  - Sponge absence is not exactly possible to confirm. There is a catchability problem tied to a trawlable-area bias problem. The trawls are also generally limited to soft bottom habitats. Trawls used in regional surveys also have rock hopper gear which often precludes organisms attached to hard substrates. Soft bodied sponges also tend to disintegrate in trawls. As such, the absence of sponges in a trawl should not be considered a true absence.
  - Sponge presence is fine to report on. However, data presented as weight caught or kg/tow should be taken with a grain of salt due to the catchability problem with the trawls. To obtain accurate sponge catch weight numbers you need to use more destructive methods (beam trawls for example) which collect more of the benthos.

It should be noted that species IDs for the gulf may not be up to date in the Multispecies Survey database. Identification of some species are still being conducted.

- **Known vulnerabilities / impacts of climate change:** Brief summary of known vulnerabilities or potential impacts to species (e.g. aggregation areas) associated with climate change.

- **List any accompanying geo-spatial data / maps:** Provide hyperlinks or include as separate attachments, mapping data on spatial or temporal trends, or predictive

modelling that would indicate a higher potential for interaction of coral and sponge with any planned offshore wind development.

Mapping information can be found in the listed important references below

- **List important / references:** Please also include any pertinent references to CSAS reports, DFO technical reports, and/or primary publications, including hyperlinks to available data and/or reports published on-line.


- Dinn, C. 2020. Sponges of the Gulf of St. Lawrence: Field and Laboratory Guide. Can. Manuscr. Rep. Fish. Aquat. Sci. 3198: vi + 118 p.
- DINN, C., LEYS, S.P., ROUSSEL, M., and MÉTHÉ, D. 2020. Geographic range extensions of stalked, flabelliform sponges (Porifera) from eastern Canada with a new combination of a species of *Plicatellopsis* in the North Atlantic. Zootaxa 4755(2): 301–321. doi:10.11646/zootaxa.4755.2.6.
- Faille, G., Méthé, D., Thériault, M., Thorne, M., Roy, V., Chiasson, M., Benjamin, R., and Rangeley, R. 2019. Cruise Report for the 2017 Fisheries and Oceans Canada and Oceana Canada Mission using the ROPOS in the Gulf of St. Lawrence. Can. Manuscr. Rep. Fish. Aquat. Sci. 3171: v + 22 p.
- ICES. 2020. ICES / NAFO JOINT WORKING GROUP ON DEEP-WATER ECOLOGY (WGDEC). 2(62): 188. doi:https://doi.org/10.17895/ices.pub.7503.
- Kenchington, E., Lirette, C., Cogswell, A., Archambault, D., Archambault, P., Benoit, H., Bernier, D., Brodie, B., Fuller, S., Gilkinson, K., Lévesque, M., Power, D., Siferd, T., Treble, M., and Wareham, V. 2010. Delineating Coral and Sponge Concentrations in the Biogeographic Regions of the East Coast of Canada Using Spatial Analyses. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/041. vi + 202 pp



**SME:** Curtis Dinn, Marine Conservation Section, Science.

Annex 5 – Important Areas from Savenkoff *et al.* 2007

**Request to Science Subject Matter Experts (SME):**

"The research document 2007/015[2] and its associated spatial data layers have been identified by MPC as information that could be shared with IAAC since it contains location of key sensitive receptors deserving greater than usual risk aversion in our region. Prior to submitting this information to IAAC, the MPC would like to ensure that it is the best available and most up to date.

The Marine Protection and Conservation (MPC) sector is **asking Science what would be the preferred method (Science Response or other reports/analysis) to validate the Res Doc 2007/015** important areas and location of key sensitive receptors. Below is the information to be confirmed:

1. Are the important areas and their significance (i.e., high scores) listed in Table 1 still relevant today? If not, are there areas or descriptions that should be change from Table 1 because of major changes in species range, or importance of the area?

2. Are there new important areas that should be considered? For example, would the marine mammals important area also cover the NARW potential important areas?

**This request by MPC Gulf is independent from the CSAS requested by Maritimes Region** entitled "State of knowledge on the environmental impacts of offshore wind energy technologies in Canada and determination of new Pathways of Effects". The CSAS is asked to review gaps in knowledge and the need for additional pathways of effects for DFO's regulatory role when comes the time for an actual project for offshore wind energy. It is likely that some or most of the data layers required for the MPC request will also help prepare Science Gulf Region for the multi-regional CSAS request. More details on the CSAS request and its status can be read in DMApps (Request ID: 1007)."

**Science Advice provided to Marin Conservation and Conservation**:

This message is in response to your request from May 2023 for a science advice regarding the validation of the information contained in the Research document 2007/015 to be used in the Regional Assessment to assess possible effects of the OWD for the Nova Scotia's Study Area. Science management has discussed this request and determined that an email would suffice to provide our advice on the validity of the important areas identified in the previously mentioned document.

On August 1st, I have met with the section heads for the Crustaceans group (Fabiola Akaishi) and the Marine Fish and Mammals group (Nicolas Rolland) to review the Table 1 of the request along with the provided figures. On that, we would like to mention that we really appreciated how the request was structured and presented to us, with key elements, clear questions, and supporting material. We recognize that there were some back-and-fort between your team and Tanya to end up with such product and we want to thank everyone for their contribution.

For clarity, here are the questions from the request and our answers. I have also copied items from Table 1 and added comments where relevant to provide more details supporting our answers to the two questions. Other items in the table are still relevant.

1. Are the important areas and their significance (i.e., high scores) listed in Table 1 still relevant today? **YES**

2. Are there new important areas that should be considered? **Not for the portion of the Study Area (SA) within the sGSL. For important areas for NARW East of Cape Breton, please check with the lead science sector in NCR for that species.**

Fig #8; Important area #11: very limited overlapping with the SA, no concerns

Fig #9; Important area #11: very limited overlapping with the SA, no concerns

Fig #10; Important areas #8-9: please validate information with leading team for marine mammals in NCR, especially for the portion of the SA East of Cape Breton.

In a nutshell, we are confident that the information provided in the Research Document 2007/015 still map out an accurate portrait of important areas for most of the species found in the sGSL. Even 16 years later, overall distributions and aggregations of those species remain similar, as well as the fitness consequences previously identified per area. For benthic invertebrates, species found in the SA within the sGSL are abundant and widely distributed, with no particular area critical for their fitness. Anthropogenic activities could have impacts locally but nothing that would impact a stock, even for the commercially important lobster and snow crab. Unfortunately, several demersal and pelagic fish stocks are at very low abundance levels so caution is warranted when assessing anthropogenic activities that might be disruptive to them. Redfish (*Sebastes marinus* and *S. mentella*) population has displayed a significant increase since the 2006 exercise but in the context of this request, there is no need to add anything since the SA does not overlap with the bulk of the species' distribution/aggregation (Laurentian Channel).

**Subject Matter Experts consulted:** Amélie Rondeau, Fabiola Akaishi and Nicolas Rolland