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Canadian Science Advisory Secretariat (CSAS)

Proceedings Series 2023/012

Maritimes Region

Proceedings of the Regional Advisory Meeting on the Review of Musquash Monitoring Plan and Assessment Framework

May 11–12, 2021
Virtual Meeting

Chairperson: Tana Worcester
Editor: Rabindra Singh

Fisheries and Oceans Canada
Maritimes Region
PO Box 1006, 1 Challenger Drive
Dartmouth, Nova Scotia B2Y 4A2

May 2023

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

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ISSN 1701-1280
ISBN 978-0-660-48310-8 Cat. No. Fs70-4/2023-012E-PDF

Correct citation for this publication:

DFO. 2023. Proceedings of the Regional Advisory Meeting on the Review of Musquash Monitoring Plan and Assessment Framework; May 11-12, 2021. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2023/012.

Aussi disponible en français :

MPO. 2023. Compte rendu de la réunion sur les avis scientifiques régional sur l'Examen du Plan de surveillance de l'estuaire de la Musquash et du Cadre d'évaluation ; du 11 au 12 mai 2021. Secr. can. des avis. sci. du MPO. Compte rendu 2023/012.

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SUMMARY

The Musquash Estuary Marine Protected Area (MPA) Ecosystem Monitoring Plan (2014–2019) was developed to guide monitoring of biodiversity, productivity, and habitats, as well as human activities and pressures that may impact the conservation objectives established for the MPA. The aim of this meeting was to review progress on monitoring the Musquash MPA and provide advice on how to move forward efficiently with future monitoring activities. Data relevant to the ecosystem and anthropogenic indicators for the Musquash MPA were reviewed to assess coverage to date, utility for monitoring change, and to interpret any trends revealed by recent survey and sampling programs. Central to this review was an evaluation of the efficacy and feasibility of existing data streams to inform the selected indicators. This review was also intended to capture and document progress towards a comprehensive baseline by which change can be assessed. Participants at this meeting included experts from governments, academia, Indigenous communities / organizations, and non-governmental organizations. Based on the discussions at the meeting, a Science Advisory Report was prepared that provides advice on improvements that could be made to the Musquash monitoring program, as well as whether modifications should be made to the current monitoring protocols.

INTRODUCTION

The Musquash Estuary Marine Protected Area (MPA) Ecosystem Monitoring Plan (2014–2019) was developed to guide monitoring of biodiversity, productivity and habitats, as well as human activities and pressures that may impact the conservation objectives established for the MPA (OCMD 2015). The Monitoring Plan outlines indicators and associated data streams that are available to inform managers and stakeholders about the performance and effectiveness of the MPA in meeting its conservation objectives.

After five years of implementation, there is an opportunity to review the Monitoring Plan, revisit the ecosystem and anthropogenic indicators it identifies, examine the utility of available datasets, and interpret any trends revealed by recent survey and sampling programs. Central to this review is an evaluation of the efficacy and feasibility of existing data streams to inform the selected indicators. The review is also intended to capture and document progress towards a comprehensive baseline by which change can be assessed. As one of the first MPAs in Canada, a peer review of the monitoring and assessment underway at Musquash is expected to provide lessons and important perspectives for the development of monitoring programs at other coastal MPAs, and ultimately, for Canada's bioregional MPA networks.

OBJECTIVES

The primary objective of this meeting is to review progress and provide advice on how to move forward efficiently with monitoring for the Musquash MPA. To accomplish this:

- indicators will be compared against data with respect to availability, sampling frequency, and spatial coverage;
- datasets for each indicator will be evaluated to access whether they are sufficient to establish a baseline for monitoring change;
- based on observed variability, revisions to the spatial and temporal coverage of monitoring will be reviewed to provide guidance for improving sampling efficacy and efficiency;
- data sets, indicators, and monitoring activities that are best positioned to inform management MPA effectiveness will be identified;
- additional information required to evaluate how well the MPA is meeting its conservation objectives will be outlined and prioritized.

See Appendix A for the Terms of Reference. Participants in this meeting included, DFO Science, DFO Ecosystem Management, Environment and Climate Change Canada (ECCC), Province of New Brunswick, Aboriginal communities / organizations, non-government organizations, and academics (see Appendix B for list of participants). This virtual meeting was held from May 11 to May 12, 2021 using Microsoft Teams (MS Teams) (see Appendix C for the Agenda).

DAY 1: TUESDAY, MAY 11

Rapporteurs: U. Goggin, E. Stuart, B. Bone and C. Schram

The meeting started with the Chair, T. Worcester, welcoming everyone. It has been 8 years since the last Musquash CSAS, so this is a good opportunity to look back on what has been done over the past 8 years and to look forward on what we would like to accomplish in the next few years. The Chair then went over the Canadian Science Advisory Secretariat (CSAS) peer review process and the use of the Scientific Advice for Government Effectiveness (SAGE)

Principles and Guidelines. Since the meeting was using Microsoft Teams (MS Teams) as the platform, tips on the effective use of MS Teams were provided. After a roundtable of introductions from the participants, the Chair reviewed the Terms of Reference (Appendix A) and the Agenda (Appendix B) for the two-day meeting.

MUSQUASH MPA: INTRODUCTION AND MANAGEMENT

E. Stuart gave an overview of the Musquash Estuary MPA, including its location in the Bay of Fundy and its contribution to Canada's conservation targets. The presentation included a description of the different habitats in the MPA and its ecological importance, particularly noting the important role of estuaries and salt marshes. The designation process and the importance of community involvement and interest in establishing the MPA were described. The MPA's conservation objectives, the different zones, the regulations, and the prohibitions along with the management, including the role of the MPA advisory committee were presented.

A brief discussion followed the presentation. There were some differences noted between Musquash and Basin Head, another coastal MPA in the Atlantic. The objectives for the Musquash MPA are much broader than the Basin Head MPA, which was established to protect a particular species. Musquash is the largest intact salt marsh remaining in the Bay of Fundy, and the surrounding land-based conservation partnerships (i.e., Nature Conservancy of Canada) enhance the protection of the area. Given all these factors, it was suggested that Musquash could act as an important reference site for other estuaries in the Bay of Fundy, especially regarding climate change.

CURRENT STATE OF MONITORING

A. Cooper provided an overview of the 12 monitoring indicators and the objectives of the meeting. Definitions for some of the terms that were used throughout the meeting were provided. The data sources used for the analysis, as well as their spatial and seasonal/temporal coverage, were described.

Discussion centered about how to characterize deviations from the baseline and how deviation from baseline is not always a trigger for management. There are different ways to calculate and measure change. For example, in determining environmental impacts from paper/pulp mills and mines, the crossing of a threshold change of 20% triggers management. The suggestion was made that when a data series is available, consideration should be given to the use of a running average to compare against. Some species may be more sensitive or vulnerable than others to change, which might be another criterion to add to the definition of indicator species.

Monitoring indicators in general are variables that can be quantified, whereas the Musquash indicators are more like aspirational goals of things we would like to monitor. Since monitoring should measure change over time and the long-term monitoring indicators are not yet defined, it is difficult to determine the baseline. There is need to determine what long-term monitoring is and what are the quantifiable indicators. Musquash monitoring indicators need to evaluated against change outside the MPA. This will provide a broader sense of what is happening and help to determine if the trends are unique to the estuary or if they are happening more broadly. The scale of the impact will inform the management action.

Monitoring indicators in Musquash is very difficult, particularly given the sensitivity of zone 1. This and other factors play a role in data gaps and in being able to get the holistic baseline that is needed. The pressures and threats indicators are directed at the areas where management actions could have an effect, but there could be more of a focus on areas that can be actively managed. The monitoring is slowly building enough information to know where to focus

monitoring and research, and, as more information is collected, it is hoped to be able refine the indicators even more.

For Musquash monitoring, there has been an inventory and characterization of the ecosystems. This has been followed by initial identification of data gaps and investigation of the temporal bias in sampling conducted so far. This is equivalent to a site profile. There is a need to find standardized protocols that answer the questions for the indicators that will be monitored. For monitoring to be comparable, sampling outside and inside the MPA must have similar protocols, and coordination will be crucial at the regional level and with monitoring at other MPAs. Using Musquash MPA as a reference site from which to compare trends with other sites, or compare to impacted areas outside an MPA, or other areas within a network, would be something to work towards.

Baseline monitoring is really the characterization of a site. It is a data collection exercise, and we are at the point now where we can identify those specific things that we want to monitor long-term. There is a need to figure how to prioritize the indicators given the resources and partners involved in the monitoring. Characterization, background, and baseline will have to be followed by further analysis and articulation of how the ecosystem functions within the MPA. This require additional effort and resources.

PRODUCTIVITY AND BIODIVERSITY INDICATORS

A. Cooper next presented on the productivity and biodiversity indicators. The productivity indicators included the total biomass, abundance, and spatial distribution of key species in each trophic level. The biodiversity indicators included number of species per trophic level within each habitat type, and the number of species at risk within the MPA (by each habitat if required). The presentation covered in detail the datasets that were included in the working paper that may contribute to characterizing baseline conditions and which may be built upon for a long-term monitoring plan. These included data on nearshore fish communities from Ipsen (2013), bird observations from Birds Canada (2013–2017+), and benthic infaunal sampling (2010–2017). Discussion followed the presentation.

It was suggested that the e-Bird database might be a useful source of observations; however, most of the Birds Canada observations are not on marine birds, which is problematic considering the MPA is a more of a marine environment. There are also different measures of species diversity (e.g., the Shannon index), but they have parametric requirements (like assuming that sampling is complete). The problem with long-term baseline, where different people are collecting the information over long periods of time, is that collections may not be done in the same way. Non-parametric multivariate types of analyses would be very appropriate for this type of assessment provided the data are collected over the long term and data collection is done in the same manner.

It was suggested that larger datasets of commercially or recreationally important species that could serves as baseline are not available at the scale of the MPA. There is also concern around using traditional or more destructive sampling methods, as might be the case for commercial or recreational species. There is need to explore alternative, non-destructive sampling methods, such as sampling of eDNA. There are many different variables that need to be considered, including persistence in the environment, as well as comparison between different areas and across the gear types that are used to verify species presence.

While there are possible cross-program linkages with the vulnerability framework, there is need to look at recovery potential factors to inform impacts from stressors other than oil spills (which is what the current vulnerability framework is designed to address). It might be possible to infer impacts from stressors, such as metal contaminants, but this would be harder to do with fishing.

Monitoring the important habitat for some of the species-at-risk present in Musquash could be another way of getting at monitoring and protecting their habitat. If there was a way to determine whether habitats in Musquash are suitable habitats for species-at-risk, (e.g., cod), then this could lead to the identification of important habitat to monitor. It would be beneficial to situate Musquash in the bioregional conservation network, and, thus, understanding both what is happening in Musquash and how this contributes to the network is critical.

HABITAT INDICATORS

The presentation next moved on the habitat indicators including: the total area and location of each habitat type within the estuary and the proportion and frequency that is disturbed or lost, the hydrodynamic and sediment regime, and temperature and salinity within the estuary.

The habitat types were obtained from Singh et al. (2000) and also Greenlaw et al. (2014), with a few differences. The nomenclature from Greenlaw et al. (2014) is a bit more consistent with other Bay of Fundy studies, so these were used in the working paper. Greenlaw et al. (20014) produced static maps, which have not been updated since. The authors suggested that it is possible to coordinate with Planning for Integrated Environmental Response, or other programs, to facilitate collection of data over time.

In terms of the hydrodynamic and sediment regime within the estuary (e.g., sediment infilling), studies has shown a sedimentation rate of 0.5 cm/yr in Musquash, but coverage was sparse (only 3 stations). Samples collected using bottom grab for benthic infauna sampling may be useful for sedimentation monitoring. In the Bay of Fundy area, an accumulation rate of 0.1–0.5 cm/yr of fine sediments is normal. The question than becomes where to sample without having to sample the entire area and maybe introduce a threshold indicator as opposed to baseline that is used to assess sedimentation. Sediment deposition is known to influence the benthic infaunal composition.

For the MPA characterization, the first step is a habitat map, and the next really valuable thing is a model of water movements. This has the potential of transforming the understanding of the ecosystem and should be a priority.

There can be a 1.5–2.0 degree difference in water temperature from the influence of tides, so there will be some variability in the data. Eastern Charlotte Waterways (ECW) has CTD data, and it would be great to link this data up with the Ocean Protection Plan baseline monitoring because CTDs are being deployed in the Musquash area. The ECW data, however, have not be analyzed.

In terms of nutrient concentrations, ECW water quality data are now not only being collected in the spring, summer, and fall, but also after every two rainfall events. The new ecosystems stressor program from 2016 is looking at the nutrient loading from freshwaters sources primarily from Nova Scotia (NS). It gives nutrient estimates of outflows from rivers around NS, and this will be expanded to the Maritimes Region with a potential to be relevant to the Musquash MPA.

In terms of monitoring habitat types, some habitats are more static and there is limited need for regular monitoring, but other habitat types are more sensitive to human influences and disturbances. They are more susceptible to changes, so they need more focus. It is important to consider how to monitor changes in habitat types and to think about what should be the focus.

DAY 2: WEDNESDAY, MAY 12

Rapporteurs: U. Goggin, E. Stuart, B. Bone and C. Schram

After the introduction of new participants, the Chair, T. Worcester, presented a summary of Day 1 including the themes that were covered. The monitoring framework has evolved over time, and will continue to be updated throughout this CSAS process, making it more specific and attainable. It should be focused more on key species, targeting vulnerabilities, and finding efficiencies. The Working Paper is a good synthesis of the history of monitoring. A key objective of this meeting is to make sure there is a good characterization of the monitoring work done to date. Another key objective is to determine how to move forward in developing a work plan for the monitoring of the MPA.

PRESSURES AND THREATS INDICATORS

The next presentation by A. Cooper covered the pressures and threats indicators. These included the Catch Per Unit Effort (CPUE) for the commercial and recreational fisheries, the bycatch number per impacted species, the number of non-indigenous species in the MPA (within each habitat type, if applicable) relative to non-indigenous species in the region, the degree of human-induced perturbation or loss, and the contaminant concentrations within the estuary.

The CPUE for the commercial and recreational fisheries and the bycatch data were not sufficient to be analyzed for trends. There were only 3 instances where scallop landings were reported to be collected from within the MPA (one each in 2008, 2009, and 2013). It is not clear what the absence of scalloping in the MPA implies in relation to species presence or abundance.

It was suggested that the pressure indicator (if data existed) should be either effort, or catch, because CPUE gives a very poor measure of biomass and it is not a useful variable for long-term monitoring. It would be worth monitoring fishing pressure wherever the pressure might affect the MPA . It is worth noting, however, that the extent of fish migration is species-specific, making monitoring of fishing wherever it might have an impact impractical. Monitoring effort or catch across some arbitrary area outside the MPA may not be useful.

The amount of fishing within the MPA by fisheries, which have georeferenced data in MARFIS, is negligible. If fishing pressure within the MPA is to be monitored, it will need a different form of data collection. This may be easier said than done since it may require the imposition of new reporting requirements. The suggestion was made to consider documenting fishing within the MPA (recreational and commercial) using the techniques more often applied to recreational fisheries. For example, a proportion of trips are monitored by the use of port interviews at the wharf. Interviews are conducted with any fisherman willing to provide information, such as location of fishing activity and how much fish was caught. This may be the best that can be done under the special circumstances of Musquash MPA.

There might be merit in deploying somebody with binoculars and a camera to the lighthouse at intervals to record the presence (or more often, absence) of fishing activity in Zone 3 during random samples of time. This may take place either in place of, or as a check on, interviews in fishing communities along the coast, seeking information on who works inside the MPA line, how often, and what they fish there. DFO Conservation and Protection officers do patrols in the area, and there might be an opportunity for them to report presence/absence fishing activity as part of their regular duties.

In terms of Non-Indigenous Species (NIS), the Aquatic Invasive Species (AIS) surveys were completed within the MPA for tunicates, green crabs and other invasive species. Green crabs

have been observed in the MPA since the 1950s. Tunicates were not found at the time of monitoring. This was likely due to the unfavorable conditions at the old monitoring site near Five Fathom Hole with high freshwater influence. It is anticipated that tunicates would be recorded in more recently collected data. It was recommended that these new data be included in the Working Paper.

It was noted that climate anomalies (warm years) can lead to establishment of NIS, which can then survive in normal or even cold years. There is not a good program to investigate this currently. The anomalies will affect what is considered as baselines and should be discussed at a later time. It was recommended that there be continued monitoring efforts and, that in trying to understand changes in AIS distribution/abundance in the MPA, consideration should be given to regional temperature and salinity fluctuations/anomalies.

Since the AIS program covers a larger geographic area, comparisons could be made using species distribution modeling to see how the MPA compares to other areas. These regional data sources should be referenced in the Working Paper. It was also noted that that a new invasive crab species has been found in Southwest Nova Scotia (SWNS) in a recently finished rapid assessment, but it was absent from Southwest New Brunswick (SWNB). Subsequent rapid assessments could include Musquash MPA. In terms of sampling frequency, it was recommended that consideration be given to seasonal surveys (best between late spring and late fall).

For human induced perturbation, the focus was on marine debris monitoring conducted in the MPA. The amount of marine debris has been steadily declining (likely due to blocking off certain areas and by increased recreational presence which discourages dumping). There was a suggestion that only debris where the known source is marine be called marine debris (e.g., those picked up in Gooseberry Cove). Other debris from likely inland sources (e.g., at Black Beach), should be grouped separately. In the end, it is most important that the waste/debris that interacts with the marine environment be identified as such.

The recommendations from the Working Paper and from the discussion were to continue the sampling protocol, attempt to calculate/measure sampling effort (to complete cleanup, time allotted, area covered), and to add weight estimates to certain items (currently, one nail is given the same ‘score’ as a car engine), review the debris categories and maybe look at debris above and below high tides. It is important to maintain a time series so trends over time could be tracked. Consistency over time would also be required.

Metals and bacterial contaminants have been monitored in the MPA over several sampling years. Samples for microbiological contamination were compared against Canadian Shellfish Sanitation Program thresholds, and some samples were found to exceed thresholds when sampling occurred during wet times (i.e., after heavy rainfall events).

Recommendations from Working Paper and discussion are to continue the sampling program with added samples in Zone 1. Such additional sampling will allow for assessment of correlations between salinity and densities. There is need to consider newer science such as assessing for *Enterococci* vs faecal coliforms because feacal coliforms can be more sensitive to changes in salinity. There is need for more data to determine variability and trends. This requires baseline monitoring using appropriate methodology. Consideration should be given to comparing data from the MPA to other estuarine locations in the Bay of Fundy. It was further suggested that having a good hydrodynamic model would help determine point sources, and thought should be given to reviewing the thresholds. For example, it is not clear if the Canadian Shellfish Sanitation Program standard thresholds are relevant to the conservation objectives for the MPA. The microbiological health of MPA (from a human health perspective) are related to the socio-economic objectives for the MPA. The best practice is to consider both ecosystem and

human well-being values. The latter can include indigenous use and ecosystem services. Perhaps the relevance of bacterial monitoring has more to do with human well-being values related to the conservation objectives.

GENERAL DISCUSSIONS

Some participants wondered about the possibility of having a Musquash MPA database so that data could be easily accessed on the species richness and abundance of certain species. This would allow easier tracking of trends and getting more information on the characterization of the estuary. In terms of representing some of the data in Working Paper, it was suggested to explore ways to include more of the information, such as size classes and species (i.e., present more of the data), and show more of the summary of that data to give more information on the accumulation of the data. While the gillnet sampling may provide more useful data, it is a destructive sampling method and other forms of sampling may have to be explored.

Consideration should be given as to whether there should be continued use of an indicator long enough to see trends versus improving the indicator for future use (e.g., with the debris database, if a change is made in the categories, the value of the previous years may be lost). There might be interest in forming smaller working groups to work through some of the details. This would be a way to get some idea of the structure of a framework, what is working, and what to proceed with. This should be the focus going forward. By doing this, there can be more discussions and opportunities to learn from each other.

The Global Program of Action Coalition (GPAC) monitoring protocol was suggested as a possible source of comprehensive information on monitoring tidal wetlands and could potentially be adopted for use in Musquash. The idea of scalability and consistency in monitoring approaches across scales, taxa, and habitats in Musquash could provide a great baseline function within a broader landscape context. If monitoring is consistent, then there would be a lot of benefits, and it could be easier for other groups involved in monitoring to adopt similar approaches and contribute to the effort.

In terms of efficiency and effectiveness, the definition of baseline may need to be refined so that geographical areas of focus could be found. These would be areas of the MPAs where change is likely to occur. In terms of monitoring for which there may be a management action, these will help to narrow the focus of the monitoring program. For monitoring for invertebrate and fish, eDNA is good option, and passive acoustic monitoring for fish or invertebrates and could be explored as non-invasive methods of sampling. A suggestion was made to perform a power analysis before pursuing any one path since a lot more data is needed for multivariate analysis. There is need to cover aspects of efficiency and effectiveness in the Science Advisory Report (SAR) along with some recommendations on these aspects.

Discussion followed on the use of bottom-contacting gear and the implications of using them in MPAs for monitoring. The recommendation is to always consider the use of non-destructive methods.

The point was made that more time should be spent on characterizing the changing environmental conditions (i.e., the abiotic conditions) to be able to situate Musquash within the broader region and investigate how abiotic, and some biotic, variables would be influenced by the changing environment. One suggestion would be to have environmental data loggers inside the MPA (e.g., those offered through the AIS program) with help from other groups. This is something that is being considered. The other consideration here is the possible use of sea-surface temperature anomalies from satellite data, in and around Musquash, to highlight differences in baseline from late 1990 to 2010. There is high variability between years, and capturing this could be important in explaining some of the trends and patterns.

While the Working Paper indicates that there were no tunicates collected to date in the Musquash MPA, there is need to revise some of the text to better reflect that not all available data were used in this particular analysis.

Climate change and sea level rise, and the human responses to these changes, could exacerbate certain pressures (e.g., coastal squeeze) and result in further loss of saltmarsh through emphasis on protecting infrastructure. Monitoring of environmental condition would be important to capture ecological changes caused by climate change. The causes of change (over time) that are detectable would then have to be determined. The challenge is to distinguish between variables that are regularly measured for the purpose of MPA monitoring from variables that may later be needed to contextualize what is being seen in the long-term monitoring data.

There was general support for the suggestion of a science advisory group for Musquash. This group could discuss what research is being proposed and what should be completed to meet the science needs for the MPA management. The point was also made that funding is needed for long-term monitoring, and the case has to be made to secure funding in order to allow for consistent long-term sampling and monitoring.

DISCUSSIONS ON THE SAR

Suggestions were made on the content of the SAR. The SAR should include a summary of the Working Paper and describe the present status of the indicators, where meaningful results have been determined, instead of trying to come to consensus on what the next steps would be. The focus in the report should be on the indicators that were established in the monitoring plan, and the progress to date on these indicators. However, mention could be made of any new indicators that are in development but not yet included in the analysis of the monitoring program.

Participants were invited to provide written comments on the Working Paper, which will be revised and shared with meeting participants. It was suggested that there would be a meeting to go through the final text of summary bullets and discussions; however, instead of a meeting, the draft SAR was distributed by email and participants provided with an opportunity to provide feedback secretarially.

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APPENDIX A: TERMS OF REFERENCE

Review of Musquash Monitoring Plan and Assessment Framework

Regional Peer Review – Maritimes Region

May 11–12, 2021
Virtual Meeting
Chairperson: T. Worcester

Context

The Musquash Estuary MPA Ecosystem Monitoring Plan (2014–2019) was developed to guide monitoring of biodiversity, productivity and habitats, as well as human activities and pressures that may impact the conservation objectives established for the MPA (OCMD 2015). The Monitoring Plan outlines indicators and associated data streams that are available to inform managers and stakeholders about the performance and effectiveness of the MPA in meeting its conservation objectives.

After five years of implementation, there is an opportunity to review the Monitoring Plan, revisit the ecosystem and anthropogenic indicators it identifies, examine the utility of available datasets, and interpret any trends revealed by recent survey and sampling programs. Central to this review is an evaluation of the efficacy and feasibility of existing data streams to inform the selected indicators. The review is also intended to capture and document progress towards a comprehensive baseline by which change can be assessed. As one of the first MPAs in Canada, a peer review of the monitoring and assessment underway at Musquash is expected to provide lessons and important perspectives for the development of monitoring programs at other coastal MPAs, and ultimately, for Canada's bioregional MPA networks.

Objectives

The primary objective of this meeting is to review progress and provide advice on how to move forward efficiently with monitoring for the Musquash MPA. To accomplish this:

- indicators will be compared against data with respect to availability, sampling frequency, and spatial coverage;
- datasets for each indicator will be evaluated to access whether they are sufficient to establish a baseline for monitoring change;
- based on observed variability, revisions to the spatial and temporal coverage of monitoring will be reviewed to provide guidance for improving sampling efficacy and efficiency;
- data sets, indicators, and monitoring activities that are best positioned to inform management MPA effectiveness will be identified;
- additional information required to evaluate how well the MPA is meeting its conservation objectives will be outlined and prioritized.

Expected Publications

- Proceedings
- Research Document
- Science Advisory Report

Expected Participation

- Fisheries and Oceans Canada (DFO)

- Canadian Wildlife Service (CWS)
- Province of New Brunswick
- Conservation Council of New Brunswick
- Eastern Charlotte Waterways
- Universities
- First Nations and Aboriginal organizations
- Fishing industry
- Other invited experts
- Musquash MPA Advisory Committee

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APPENDIX B: LIST OF PARTICIPANTS

Participants at the Gully Monitoring Review Meeting, May 11–12, 2021. Y = present, a dash (-) indicates absence.

Name	Affiliation	Day 1	Day 2
Abbott, Matthew	Conservation Council of NB	-	Y
Allan, Pamela	DFO NHQ /MPC	Y	-
Allard, Karel	Environment Canada / CWS	-	Y
Beardy, Krista	University of New Brunswick	Y	Y
Blanchard, Marc	DFO Maritimes Science / CESD	Y	
Bone, Bryden	DFO Maritimes / MPC	Y	Y
Cooper, Andrew	DFO Maritimes Science / CESD	Y	Y
Courtenay, Simon	University of Waterloo	Y	Y
Curry, Colin	Wolastoqey Nation in New Brunswick	Y	Y
D'Aloia, Cassidy	University of New Brunswick	Y	Y
Dibacco, Claudio	DFO Maritimes Science / AIS	Y	Y
Edmonston, Elizabeth	DFO NHQ / MPC	Y	Y
Faille, Geneviève	Quebec Science	Y	-
Fanning, Lucia	Dalhousie University (retired)	Y	Y
Goggin, Una	DFO Maritimes Science / CSA	Y	Y
Hamer, Adrian	DFO Maritimes Science / SABS	Y	Y
Harvey, Cara	DFO Maritimes Science / SABS	Y	Y
Hatt, Terry	NBDAAF	Y	Y
Heaslip, Susan	DFO Maritimes Science / CESD	Y	Y
Ipsen, Erinn	DFO Quebec Science	Y	Y
Jones, Owen	DFO Maritimes Science / SABS	Y	Y
Joseph, Venitia	DFO Gulf Science / Basin Head	Y	Y
Kenchington, Trevor	DFO Maritimes Science	Y	Y
Kinkade, Chris	NOAA / NERRS	Y	Y
Lander, Terralynn	DFO Maritimes Science / SABS	Y	Y
Long, Rachel	DFO Maritimes Science / SABS	Y	Y
MacNab, Paul	DFO Maritimes / MPC	Y	Y
Merritt, Vicky	DFO Maritimes Science / SABS	Y	Y
Méthé, Denise	DFO Gulf Science	Y	Y
O'Laughlin, Casey	DFO Maritimes Science / SABS	Y	Y
Page, Fred	DFO Maritimes Science / CESD	-	Y
Robinson, Brian	DFO Maritimes Science / COOGER lab	Y	Y
Saunders, Sarah	World Wildlife Federation	Y	Y
Schram, Catherine	DFO Maritimes / MPC	Y	Y
Singh, Rabindra	DFO Maritimes Science / CSA	Y	Y
Stanley, Ryan	DFO Maritimes Science / CESD	Y	Y
Stewart, Madelyn	DFO Gulf / MPC	Y	Y
Stuart, Erica	DFO Maritimes / MPC	Y	Y
Theriault, Marie-Helen	DFO Gulf / MPC	Y	Y
White, Jennifer	Nature Conservancy of Canada	Y	-

Name	Affiliation	Day 1	Day 2
Worcester, Tana	DFO Maritimes Science	Y	Y
Mawer, Kalen	Eastern Charlotte Waterways	Y	-

APPENDIX C: AGENDA

MUSQUASH MPA MONITORING REVIEW

11–12 May, 2021
Virtual Meeting (MS Teams)

Day 1: Tuesday, May 11, 2021

Time	Topic	Leads
10:00–10:10	Introduction	Chair, T. Worcester
10:10–10:40	Musquash MPA – Introduction & Management	Marine Planning and Conservation (DFO)
10:40–12:00	Part 1 Current state of monitoring, operational terms and definitions, objectives, data sources	A. Cooper
	Reviewers comments and Discussion	Reviewers
12:00–1:00	**Lunch**	
1:00–2:30	Part 2 Assessment of Baseline – Productivity and Biodiversity	A. Cooper (with input from data providers)
	Reviewers comments and Discussion	Reviewers
2:30–4:00	Part 3 Assessment of Baseline – Habitat	A. Cooper (with input from data providers)
	Reviewers comments and Discussion	Reviewers

Day 2: Wednesday, May 12, 2021

Time	Topic	Leads
10:00–10:10	Review of day 1, agenda for day 2	Chair, T. Worcester
10:10–11:30	Part 4 Assessment of Baseline – Pressures and Threats	A. Cooper (with input from data providers)
	Reviewers comments and Discussion	Reviewers
11:30–12:00	Summary and improved strategies	A. Cooper
	Discussion	Everyone
12:00–1:00	**Lunch**	
1:00–4:00	Review of draft Science Advisory Report	Everyone
	Research Recommendations and Wrap up	