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Proceedings of the Regional Peer Review of an Assessment to Support Decisions on Authorizing Scientific Surveys with Bottom-Contacting Gears in Protected Areas in the Newfoundland and Labrador Bioregion

Meeting dates: October 5-9, 2020
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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.

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SUMMARY

A Regional Peer Review Process to support decisions on authorizing scientific surveys with bottom-contacting gears in protected areas in the Newfoundland and Labrador (NL) Bioregion was held on October 5-9, 2020, virtually on Microsoft Teams. The purpose was to evaluate potential impacts of bottom-contacting scientific surveys on conservation objectives within protected areas, evaluate the implications of excluding surveys in these areas, and review the benefits of survey activities as well as potential mitigation measures that could reduce or eliminate their impacts.

Participation included representatives from Fisheries and Oceans Canada (DFO) Science, Ecosystem Management, and Resource Management Branches, Government of Newfoundland and Labrador, Indigenous Groups, Industry, Academia, and Non-Governmental Organizations.

This Proceedings Report includes abstracts of presentations and summaries of meeting discussions, as well as a list of research recommendations. The meeting's agenda, Terms of Reference, and list of participants are appended.

PRESENTATIONS

INTRODUCTION / OVERVIEW

R. Rideout

Abstract

Canada has already attained a goal of protecting 10% of its marine and coastal areas and is working toward protecting 25% of the country's oceans by 2025 and 30% by 2030. Closures in the Fisheries and Oceans Canada (DFO) Newfoundland and Labrador (NL) Region are intended to protect sensitive taxa and/or important fish habitat from anthropogenic impacts (e.g., commercial bottom trawling) but bottom contacting gears are also used during DFO research activities. The objective of this meeting is to provide advice as to whether these research activities could potentially hamper the achievement of conservation objectives for these spatial closures, the potential consequences of not allowing research activities within these closures, and to recommend mitigation measures if necessary. This work follows DFO's 2018 National Framework to guide the evaluation of ongoing recurrent scientific surveys within protected areas.

Discussion

A participant sought clarification about which closures were included in the analysis. The presenter explained that all closures within the NL Region, including both DFO and Northwest Atlantic Fisheries Organization (NAFO) closures, that intersect with any surveys with bottom-contacting gear were included, regardless of the closure's purpose (e.g., coral and sponge protection areas, fish protection areas). More detail on how the closures were organized within the analysis is given in later presentations.

A reviewer made note that Significant Benthic Areas (SiBAs) were not included in the analysis, and therefore this exercise focused on the management measures rather than the habitat. They cautioned that boundaries are negotiated and only sometimes relevant to the actual biodiversity of the area. The presenter agreed that yes, the focus of this analysis was within the boundaries of closed areas only. A co-chair expanded on this point, noting that DFO Science only has to fill out Activity Plans for surveys within managed areas, not SiBAs, which is why this process focuses on management boundaries. However, later presentations would briefly touch on some analysis of impacts within SiBAs.

PROTECTED AREAS IN THE NEWFOUNDLAND AND LABRADOR (NL) REGION & BOTTOM-CONTACTING SCIENTIFIC SURVEYS IN THE NL REGION

M. Warren

Abstract

A brief overview of each bottom-contacting scientific survey in the NL Region and the protected areas that they interact with. Four surveys were described, the spring and fall multispecies Research Vessel (RV) surveys, the collaborative post-season snow crab survey, and the unit 2 redfish survey. The bottom-contacting oceanographic survey gear was also described. The protected areas that these surveys overlap with were described including the difference between a Marine Protected Area (MPA) and a Marine Refuge (MR). NAFO Closures were introduced as the RV surveys fall into some of them just outside the boundary of the Exclusive Economic Zone (EEZ).

Discussion

A participant questioned why the Hatton Basin and Northern Shrimp Survey were not included in the list of protected areas and surveys, respectively, and thus not considered in this analysis. The authors noted that the Hatton Basin MR, which overlaps NAFO Division 2G, is co-managed by DFO-Arctic and DFO-NL, but it does not overlap with ongoing recurrent bottom-contacting scientific surveys from DFO-NL Region. DFO Arctic Region will potentially be doing analysis on the Hatton Basin closure and will include the Northern Shrimp Survey with their analysis at that time. Several participants disagreed with this decision, and suggested that full consideration be given to all closures and surveys within the NL Region, including Hatton Basin. These participants noted that the Hatton Basin and Northern Shrimp Survey should be named in the documents from this meeting, and it should be indicated that they will be covered in a separate process by DFO Arctic Region.

Two participants made notes related to the Northern Shrimp Research Foundation (NSRF) and crab surveys; first, that the NSRF covers Shrimp Fishing Area 4 and north, which is outside of the DFO RV survey, and therefore conclusions outside of NAFO Division 2G achieved at this meeting should remain relevant, and second, that the crab survey will be a long-term survey containing a mixture of random and fixed stations.

A participant mentioned that this process did not include the longline survey for the Scotian Shelf Atlantic Halibut survey in NAFO Div. 3NOPs (and the rest of the shelf). The authors responded that this process was focused on impacts from surveys conducted or led by the NL Region, as per the Terms of Reference and including them in the analysis at this point would be challenging. However, these surveys could be mentioned in the meeting documents (e.g., Scientific Advisory Report [SAR], Research Document).

One participant asked why the Lophelia Coral Conservation Area was not included in the analysis. A participant responded that it is a marine refuge within Maritimes Region, therefore outside of the scope of this meeting's Terms of Reference, but that Maritimes Region was listening to this process to learn from and apply similar analyses to their region.

A participant asked a question pertaining to the Division 3O Coral Closure, given that part of the closure lies outside of Canada's Exclusive Economic Zone (EEZ), and whether there would be an attempt to harmonize what is happening outside the EEZ (in regard to surveys) with inside. A participant mentioned a process within NAFO looking at the impacts of Canadian and European Union (EU)-Spanish surveys on closures within NAFO's Regulatory Area (NRA), including the 3O closure. Preliminary analysis was showing no significant effects, but the work was on-going, and until finalized, all nations conducting those surveys had an agreement not to survey within the Vulnerable Marine Ecosystem (VME) closures. They also noted that there was no formal talk of coordinating surveys, as that would be very complicated and involve comparative fishing, etc. Both the DFO and EU-Spanish surveys have similar maximum depths (1,500 m and 1,400 m, respectively) and therefore it is unlikely that either survey within the 3O closure because of its depth.

REVIEW OF SIGNIFICANT ADVERSE IMPACTS DUE TO BOTTOM CONTACT GEAR ON BENTHIC HABITAT

B. Neves

Abstract

Bottom contact gear can have an impact on benthic communities through the direct removal, mechanical damage (e.g., tipping, injuries, susceptibility to predators, health), smothering

(e.g., due to increased sedimentation) of benthic organisms, and smoothing of the seascape. Vulnerable Marine Ecosystems (VMEs) are particularly susceptible to bottom contact gear, primarily on the first pass. Different ways in which corals and sponges can be impacted by bottom gear were presented, including certain biological traits such as method of attachment (sessile, mobile), longevity and growth rates. Ecological functions provided by corals and sponges (e.g., habitat provision) were also highlighted. Significant Adverse Impacts (SAI) are defined by the Food and Agriculture Organization (FAO) as those that "compromise the ecosystem integrity (structure and function), i.e., impairs the ability of populations to replace themselves, degrades the long-term natural productivity of the habitat, or causes significant loss of species richness, habitat or community type on more than a temporary basis". A full assessment of SAI takes six factors into consideration: intensity or severity of the impact, spatial extent of the impact, sensitivity/vulnerability of the ecosystem, ability of an ecosystem to recover, extent to which ecosystem functions may be altered, and timing and duration of the impact. A report from NAFO's Working Group on Ecosystem Science Assessment (WG-ESA) showed that from an analysis of intensity or severity of the impact of commercial fisheries (factor 1), sea pens were considered vulnerable, and sponges and gorgonians considered extremely vulnerable. From the analysis including spatial extent of the impact (factors 2–3) sponge grounds and gorgonian VMEs were rated as low overall risk and sea pens rated as at high risk. These ratings reflect differences in VME indicator distribution, density, and bottom type preferences, for example. SAI analysis on DFO coral and sponge scientific trawl (RV) survey data have not been assessed in the NL Region (within Canada). However, large fractions of the Significant Benthic Areas (SiBAs) in the NL Region have been exposed to commercial fishing activities. In addition, we showed that between 0.3 and 74% of DFO-NL RV survey sets (1995–2019 , NAFO zones 2HJ3KLNOP) fell within a SiBA. We found a high overlap for sea pens in the NE Newfoundland Slope Closure (73.74%), sponges (80.29%) and large gorgonians (67.88%) at Flemish Pass/Eastern Canyon, and small gorgonians (50.74%) at the 3O coral closure (Canadian EEZ). These results show that RV surveys often occur in areas of significant concentrations of corals and/or sponges. In some cases, RV strata fall completely within a protected area, meaning that sets for these strata cannot be relocated to an alternate position outside of the closed area. The fact that high numbers of corals and sponges can be removed in a single trawl set was highlighted. For instance, between 2006–19, 47 sets contained records of >100 sea pens per set, and five of those contained >500 sea pens per set (3O, 3P). The removal of this amount of sea pens could have population-level impacts, as suggested by Kenchington et al. (2011).

Discussion

A participant asked if it would be possible to use known information within an area (e.g., Laurentian Channel MPA) to avoid high concentration areas with only a modest compromise of the stratified random design. The presenter mentioned that this could be discussed in the mitigation presentation, as it is a possibility for areas with a lot of video data. They also clarified that biomass or catch data indicates that the sea pens used to be there, whereas video data shows us the current state.

Another participant reflected that the Significant Benthic Area (SiBA) polygons were delineated using different methods (kriging, species distribution models, etc.). A co-chair acknowledged that this was a common concern and that it would be a good idea to provide the method by which they were defined, or at least give a reference to that information, as the boundaries for all areas had not been ground-truthed. A second participant mentioned that, although the methods were different, they were all valid methods of modelling and analysis. They noted that, without extensive ground-truthing with remotely operated underwater vehicles (ROVs), etc., these boundaries are just general areas where the habitats are expected to be found.

A participant wondered if there was room for consideration of other negative impacts of bottom trawling on ecosystem health (e.g., disruption of biogeochemical cycles, carbon storage, eutrophication, carbon sequestration rates). The presenter acknowledged that section could be improved to look at the whole of ecosystem functioning rather than just the habitat.

COMPARING THE FOOTPRINT OF RESEARCH VESSEL (RV) BOTTOM-TRAWL SURVEYS TO COMMERCIAL FISHING & PROPORTION OF AREAS IMPACTED AND RECURRENCE TIME INTERVAL CALCULATIONS

M. Warren

Abstract

This presentation was broken into two sections, the first describing a comparison of the footprint of RV bottom-trawl surveys to commercial fishing and the second describing the proportion of areas impacted and recurrence time interval calculations. The first section showed some unpublished work completed as a follow-up to a 2018 paper by one of the co-authors (Koen-Alonso et al. 2018) investigating commercial fishing effort in Significant Benthic Areas (SiBAs) on the east coast of Canada. Fishing track lines were created for a single commercial fishing gear and compared to the footprint of tracks from the RV surveys for the same time period. It was found that the commercial fishing footprint was much larger than the RV survey footprint. The second section outlined how the calculations for proportion of impact and recurrence times were done for each of the surveys. These calculations were based on advice from the national framework (DFO 2018).

Discussion

A participant asked for clarification about what exactly makes up the “swept area.” The presenter said they received the swept area as a pers comm from the gear manufacturer, but noted that the same gear type can have different track widths for commercial fishing vessels based on the vessel size and the target species for commercial fishing (whereas the swept area for the DFO RV survey is consistent). The participant wanted to raise their concern that, if the numbers are based on door spread, not everything between the door spread is contacted. The presenter said they would look into the specifics of exactly what was being considered as “bottom contacting.” The participant thought the approach used should be the same for both commercial fleets and the RV survey and should consider how the gear behaves in the water when determining what was “contact.”

Another participant suggested putting the presented values in the table into context using proportions, etc., to provide perspective on the protected area itself. The presenter thought that this context was already in the text, but would ensure it was included in the table.

A participant wondered how the swept area or footprint for the crab pot fleets was measured, particularly around calculation of the actual bottom area impacted by the haul-back. The presenter said they used the recommendation in the national framework document for pots and traps in a string, which is total gear length (km) multiplied by the assumed lateral sweep of the gear (0.1 km).

A participant noted that the assumption in the national framework was based on a 2018 meeting and thought that assuming 10% of the full length of the survey set is an overestimation of the crab trap impact, especially when looking at specific closures where it becomes miniscule in context. The presenter noted that the calculated mean swept area for crab is larger than other gear types being analyzed, but that they relied on the national framework because of a lack of data on the gear and what is actually impacted. However, this issue was potentially addressed

in the Quebec/Gulf Regions' process, and the presenter opened the floor to suggestions for adjustments. A participant mentioned that a research document had come out after the national framework document that re-calculated the swept area to be an area of magnitude smaller. The authors agreed to re-calculate the swept areas based on those revised numbers and present the results tomorrow. One author noted that the minimum recurrence intervals of 5,000–7,000 years were likely to get better (i.e., larger), although this would not change the overall summary statements.

A discussion was held around the values presented (e.g., proportion of impact, recurrence intervals) and how the bottom depth variance within a closure was accounted for, if at all; for example, in cases where a shallow portion of a protected area could be impacted by the RV survey, but not all of that protected area was shallow enough to be surveyed. The presenter acknowledged that the proportion of impact is calculated as a proportion of the entire closure, regardless of the closure's depth range, and the recurrence time is calculated just for the portion that is impacted based on the strata that have sets in them. The participant noted that this method assumes the bottom impact is all equal, whereas we do not actually know the depth distributions for some of the most sensitive taxa. A strata by strata analysis, while laborious, could be proposed as a solution. However, another participant contributed that, if the recurrence time interval is significantly large enough to allow for recovery of an aggregation of corals, then it is large enough to be acceptable in areas where something does not occur.

Another participant asked if consideration had been given to the density of corals. An author responded that every area was treated as being homogeneous for practicality because of the scale of the analysis, although this method was acknowledged as a shortcoming because heterogeneity exists in some of these areas. They also noted that we need to consider the resolution of the data that we have. The presenter noted that these points were discussed in the working paper, but could be further fleshed out.

A discussion was held around the terminology used, specifically "impact" instead of a term that better captures the indirect effects of bottom trawling (e.g., "interaction"). There was general acknowledgement that impacts of bottom-trawling go beyond physical impacts. However, several issues were noted with measuring these indirect (e.g., biogeochemical) effects, including a lack of data at the scale of a research survey (e.g., smaller intensity, single passes) and their context-dependent nature (e.g., type of gear, prevailing currents, how it's fished) that often is not available. National guidance recommends that the recurrence interval should be at least an order of magnitude greater than the time you would think it would take for the feature to recover – this creates a buffer to account for effects that are otherwise difficult to calculate. The need for more clarification in the working paper was noted, as well as the potential for more research.

OVERVIEW & METHODOLOGIES

R. Rideout

Abstract

In general, analyses were intended to explore if the exclusion of science surveys from protected areas would bias the data used by the Department to provide science advice with respect to marine resources in the broader ecosystem context. These analyses were based on existing survey data and the exercise of selectively excluding any data that were collected within the spatial closures. Consideration was given only to the main objective of the closure (e.g., protect sponges and corals, protect sea pens, protect fish habitat) and not to the different pieces of legislation used to establish the various closures (e.g., *Oceans Act* vs. *Fisheries Act*) or

jurisdictional issues (i.e., closures established by NAFO as well as those by Canada were included). Analyses focused on oceanographic data, ecosystem level indicators, and stock-specific trends for demersal fish stocks and shellfish stocks. Generalized additive models comparing the ratio of survey indices with and without data in the spatial closures were used to evaluate the potential for time-varying bias in the data series due to the exclusion of bottom-contacting research surveys from the spatial closures.

Discussion

In response to a question on context, it was clarified by the presenter that this analysis was looking at the impacts on the data that feed into resource assessment processes, not the impact on the assessment process itself nor impacts on outcomes (e.g., management decisions).

A participant sought clarity on how strata were combined where cases of small sample sizes require imputation/inference. The presenter briefly noted that, where possible, merged strata were of the same or similar depth within the same NAFO Division, but this would be addressed in a later presentation.

PHYSICAL OCEANOGRAPHY

F. Cyr

Abstract

A trawl-mounted conductivity-temperature-depth (CTD) instrument is used during the RV surveys. These data are essential to the determination of bottom temperature maps used in the provision of scientific advice. The impact of the removal of sets from the closures on the bottom temperature is analyzed here. Results suggest that overall, the impact is relatively minor for all scenarios, except for NAFO Division 2H where the data are scarcer. Apart of 2H, the largest differences between the reference and any scenario is observed in 3Ps (spring) and is related to the exclusion of data from the Sea Pens closure (-8.7% to +0.6% change), followed by the exclusion of fall data from Fish Habitat closures in 2J (-5.2% to +1.3%) and 3K (-2.8% to +3.7%). Overall, the removal of observations from the closures creates a cold bias in bottom temperature.

Discussion

A participant noted an error where Funk Island Deep Closure and Hawke Channel Closure were reversed in the presentation.

Another participant asked how the data from the RV survey relates to the Atlantic Zone Monitoring Program (AZMP) and Atlantic Zone Off-Shelf Monitoring Program (AZOMP) and whether those programs could supplement the removal of RV survey data. The presenter noted that bottom temperature was calculated from a variety of sources including AZMP, ships, Argo floats, etc., however, the calculation of bottom temperature on the shelf largely relies on data from the RV survey. For this analysis, only RV survey data were removed, while other data (e.g., AZMP, AZOMP) were kept. Data from these programs can fill the gaps, but would require a new sampling strategy that does not contact the bottom and they currently do not have the ship time to do that.

A participant asked whether the mitigation measures discussed in the working paper (e.g., less impactful gear, changing survey design, reducing survey footprint) were considered when looking at the implications on the collection of scientific data. An author responded that no, the analysis did not attempt to mimic any mitigation measures, and a co-chair noted that this

conversation could be continued later during the mitigation presentation. The presenter did state that oceanographic observations do not require bottom contact (e.g., CTD cast stopping 10 m from the bottom would be OK).

ECOSYSTEM ASSESSMENTS

H. Munro

Abstract

Description of trends in fish communities play an important role in the science advice provided within the NL DFO ecosystem assessments. The data used to look at these trends comes from the Spring and Fall RV Multispecies Surveys. The NL Bioregion can be described in terms of four Ecosystem Production Units (EPUs): the Labrador Shelf (2GH), the Newfoundland Shelf (2J3K), the Grand Bank (3LNO), and southern Newfoundland (3Ps). Trends in fish communities are described in terms of these four units, with the Fall survey only covering the 2H and 2J3K, both Spring and Fall covering 3LNO, and only Spring covering 3Ps. Fish trends are summarized by seven fish functional groups, which are defined by general fish size and feeding habits. Three indices are derived from the RV Multispecies Surveys: RV biomass, RV abundance, and RV Biomass/RV Abundance ratio. These indices are estimated based on standard random-stratified design. To look at the impact of removing the Multispecies Surveys from protected areas, scenarios described in general methods were used and employed the log-ratio method with GAM to look for time varying bias.

The standard random-stratified design used in these analyses relies on a minimum of two sets within each stratum in a given year. To account for the loss of sets within the protected areas in the scenarios explored, and to retain the original survey area, some strata were merged to create ‘merged strata’. This method assumes that the sets outside of a protected area within a given strata are representative of the sets within. The merged strata tried to keep similar depth profiles and create compact merged strata.

The retrospective analyses preformed found that there are some examples of large visible trends in some functional groups within some EPUs (e.g., biomass of Medium Benthivores in 2H). Most functional groups showed small discrepancies, but these discrepancies can show bias across time, indicating that the removal of sets can impact our advice on fish trends. Time varying bias was observed across many functional groups, but the variation may not be ecologically important, or large enough to affect our interpretation of fish trends. With both large and small discrepancies if they are not consistent across functional groups within an EPU it may result in distortion of our perception of the fish community structure. The area overlap between the EPU and protected areas may drive some of the variation in effect of removals, with area with low overlap having less impact and higher overlap having a greater impact. Advice from ecosystem assessments focusing on trends in fish trends will likely be affected by the removal of the Spring and Fall RV Survey from protected areas.

Discussion

Clarification was sought by some participants regarding merging strata. It was confirmed that when strata are merged, the area of the strata/trawlable unit is combined, and the same total surface area for the survey is maintained when calculating the stratified mean. Additionally, the “strata merged” column is the number of strata that have been merged to produce the new set of strata (e.g., 3O, 14 strata became 5).

It was noted by the authors that the merged strata were not proposed for the future, as that would require a change in survey design through a separate process. However, if the meeting

advice recommended staying out of closed areas, it would be necessary to look at the existing strata and boundaries, etc., to determine if a redesign was needed and how existing information would be incorporated into the design.

A discussion was held around what would happen to the existing RV survey dataset and strata if the survey were redesigned. A co-chair clarified that these data were only “thrown out” for this particular meeting to compare how the analysis would change if those data were no longer available, but that in reality they would always be part of the time series for stock assessment and ecosystem-level analyses.

In the event that survey activities were removed from closed areas, a participant suggested two ways forward: one, maintain survey area and impute values to the closed areas via strata that overlap and/or merging with neighbouring strata (assuming the mean of the strata applies to the area where information is no longer collected), or two, cut the closed areas out of the survey design and keep the time series consistent by removing all existing data within that closed area from the dataset. The former method would be less likely to impose a bias, and would be preferable to the latter, which would provide a biased picture of what is happening with species that inhabit the areas that are cut out.

A discussion was held around the data in NAFO Div. 2H, particularly the lack of sets in that division. The presenter noted that because there is not a lot of data in Div. 2H, when we remove some of the data, we are more likely to see impacts of removing that data, whereas removing some of the data from areas with more data has less of an impact on the results. A participant mentioned that this point argues for more surveys rather than less. A co-chair mentioned previous analyses for Div. 2H that looks at how the smaller dataset makes it different, and recommended adding an appendix with the number of sets per NAFO Division for additional transparency and context when we say we removed X number of sets. Another participant offered that another driver with the Div. 2H difference is that the closed area takes out entire depth ranges from the survey and will bias it over time, especially with changing water temperatures and associated shifts of fish species into different depths. A co-chair recommended capturing this discussion in the working paper.

A participant asked if the data were based on a mobile gear survey, which was confirmed yes by the presenter. The participant asked if the analysis could be broken down by the relative coverage of the sets in each EPU. A co-chair said that it could be possible to do at the NAFO Division or EPU-level and could capture those absolute numbers in the working paper, including how many sets have already occurred and the number that would have been lost each year. An author clarified that the analysis was done using a set of “core strata” that differ from the strata used for specific stock assessments; these core strata have been consistently used for several years and form the baseline for ecosystem analysis. The core strata do not include some deepwater and inshore strata because they have not been consistently sampled over time, however those non-core strata can be used in specific stock assessments. This clarification would be important to note in the working paper text, as this baseline cannot be confused as the baseline for every analysis due to the different method of strata selection.

A participant wondered how this high level view translates into individual stocks and whether the ecosystem-level conclusions can be extended to the stocks themselves. It was noted by a co-chair that this point would be addressed in a later presentation.

REDFISH SURVEY PRELIMINARY ANALYSIS

M. Warren

Abstract

The Unit 2 redfish stock is co-managed by DFO-Quebec and DFO-NL and so it was decided that it would be better to leave a full stock assessment-type analysis for the actual stock assessment meeting (planned for 2021). Here we presented a preliminary spatial analysis to get an initial look at the potential bias that could occur if survey sets were excluded from the design in the future. Annual rasters of interpolated biomass form the survey catch data were created and the overall proportion of biomass that fell into each protected area was calculated relative to the interpolated biomass from the entire study area. Although variable over time, it would appear that the Laurentian Channel MPA and the St. Anns Bank MPA may have some areas of higher biomass, and if removed from the survey design, could create some bias in the indices used during regular stock assessments. It was recommended that a full analysis be completed using the standard stock assessment methods during the upcoming Unit 2 redfish stock assessment meeting.

Discussion

There was consensus to recommend a full analysis for redfish at the next stock assessment meeting.

A participant asked if the redfish survey had a cod liner, and whether the biomass for the RV survey would be different from the redfish survey if not as much is retained without the liner. Another participant answered that there is no liner used in the codend on the redfish survey, so they would see some smaller individuals move through the net and not be retained. The net has been calibrated to Campelen units, meaning it is a modified Campelen 1800.

The presenter clarified in response to a question that the biomass values in the presentation were just of the two redfish species.

A discussion was held around how two redfish species, *Sebastes mentella* and *S. fasciatus*, were combined for this analysis. One participant noted that the two species are generally found in two different locations: one on the Laurentian Fan and the other in the Laurentian Channel itself. The potential differences in trajectories when looking at the overall biomass index versus looking within a stock was also noted. Another participant acknowledged the time varying bias when both species are combined. The authors responded that this analysis was preliminary, as DFO's redfish species lead was at sea and unable to do deeper analysis, but the intention of this analysis was to ensure that redfish were not missed in the overall discussion. Multiple participants agreed that it will be important to have this area well surveyed and that a full stock assessment for redfish should be completed in 2021.

A participant raised concerns around the bycatch data from the redfish survey, particularly noting very high bycatch numbers for corals, and asked if there is a difference of how things are treated at sea during this survey. Another participant with knowledge of the redfish survey noted that they tend to follow protocols that are provided by DFO and had At-Sea Observer (ASO) trained technicians on board in 2020, although some discrepancies have been dealt with on recent surveys.

A participant asked if the redfish survey overlaps the Lophelia Closure. Another participant answered that it does not.

SNOW CRAB ASSESSMENTS

J. Pantin

Abstract

Biomass estimates of exploitable Snow crab (males >94 mm carapace width) were determined under various scenarios of excluding survey stations within protected areas and compared to the biomass estimates presented in the most recent NL Snow crab Stock Assessment. An analysis to determine if significant time-varying biases exist was executed using exploitable Snow crab data from DFO multispecies trawl surveys and DFO-Industry Collaborative Post-season (CPS) trap surveys. Exclusion of stations within protected areas from multispecies trawl surveys resulted in time-varying biases in Assessment Divisions (ADs) 2HJ, 3K and 3LNO and from CPS trap surveys resulted in time-varying biases in AD 3K. Excluding surveys within the Fish Habitat Closures (Hawke Channel Closure and Funk Island Deep Closure) were shown to impact the exploitable biomass estimates in ADs 2HJ and 3K which are used in the Snow crab stock assessments which provide science advice for management decisions.

Discussion

A participant wanted to re-emphasize a point in the presentation regarding the Hawke Channel and Funk Island Deep Closures, which were not originally intended as habitat closures for cod. Another participant noted that fisheries-related closures tend to focus on demersal or pelagic species, and therefore the impact on habitat (e.g., corals and sponges) is likely to be minimal compared to the benefits of the crab survey.

A participant asked a question regarding Snow crab stock assessments and how measures of recruitment would be impacted by the removal of these closed areas. The presenter noted that they focused only on exploitable biomass for this analysis, although they could potentially also look at pre-recruits, small sized crab, and also look into the future had time allowed. However, the most recent stock assessment showed that the distribution of catches for exploitable biomass and pre-recruits/small crab were generally within the same areas or “hot spots,” so would likely see similar results. A co-chair recommended adding qualitative text referencing previous assessments, etc., around this point in the working paper.

SHRIMP ASSESSMENTS

K. Skanes

Abstract

There are some overlaps between the Marine Refuges (MRs) considered during the meeting and Shrimp Fishing Area (SFA) 5 (Hopedale Saddle overlaps) and SFA 6 (Northeast Avalon Slope, Funk Island Deep and Hawke Channel all overlap). However, it is important to note that the development of MR boundaries had considered fishing activity and the degree of overlap between commercial shrimp fishing and MRs is low. An overview of Northern Shrimp assessments in SFAs 5-6 and their interaction with the Marine Refuges was presented. Fishable sized shrimp (with carapace length of 17 mm or greater) were utilized in the analyses. Baseline estimates, as accepted in previous stock assessments, were compared to the estimates that would have resulted had DFO fall multi-species surveys been excluded from MRs. While there was no evidence of time-varying bias from these analyses, biomass estimates, and precautionary approach reference points utilized in assessments would need to be adjusted should surveys cease within MRs.

Discussion

A participant wanted to ensure that additional context for the Funk Island Deep Closure was captured, as it had been a voluntary closure for one sector until recently, and asked if the

authors had looked at historical catches. The presenter answered that there was very little fishing activity within the closure, with most of the commercial sets hugging the boundaries of the closed area.

DEMERSAL FISH ASSESSMENTS

R. Rideout

Abstract

The previously described standard methodology was applied to a large number of demersal fish stocks to determine if exclusion of RV surveys from the established spatial closures might introduce time-varying biases in the survey data. Both spring and fall survey indices were examined for demersal fish stocks managed by Canada, bilaterally between Canada and France, and those managed by NAFO. For many stocks/time series, the exclusion of data from protected areas did not result in noticeable changes to survey indices, or there was no evidence that the changes caused by excluding data from protected areas resulted in a time-varying bias in the indices. For other stocks, however, excluding data collected from the spatial closures resulted in significant time-varying bias. Such time-varying biases may indicate that the survey indices produced without sampling in the spatial closures do not reflect true population status/dynamics.

Discussion

It was clarified that “beaked redfish” included both *Sebastes mentella* and *S. fasciatus*.

A discussion was held around the impact on species at risk. One participant noted that the “max difference” column in a table made it appear that at-risk species (including COSEWIC-assessed species) were disproportionately impacted by the scenarios. The presenter noted that the max difference only looks at one year and could be noise, but thought that information could potentially be useful in stock assessments, especially if the max difference were to occur during the terminal year of a time series where some assessment models are particularly sensitive to data in that terminal year.

A suggestion was made to add text around the fact that the analysis was completed using existing Marine Refuges (MRs) that are generally in areas where the RV survey does not go (e.g., Northeast Newfoundland Slope, Division 3O Coral Closure), and that future MRs established in areas that are actively surveyed would have a larger impact on the results.

It was noted that there are many places where Vulnerable Marine Ecosystems (VMEs) or Significant Benthic Areas (SiBAs) are larger or occur outside of the boundaries of protected areas, and even within closures, there may be areas of sea pens vs. other areas of corals. A potential research suggestion included breaking down the areas into a higher resolution and running the analysis based on those instead of looking at the closure as a whole. Additionally, it was suggested by a participant that management decisions could vary by SiBA within the same closed area.

Several participants agreed that there was a need to look beyond bias when considering the decision of whether to continue or remove surveys, including age and size structure, growth, maturity, etc., as it is important to understand how these areas play into fish behaviour (e.g., where they are at particular life stages). The presenter referenced discussion in the national framework around this point and noted the need for additional analysis in some situations.

Another participant noted the importance of understanding the different species better, but also ensuring that the closures are achieving their intent. They noted that the closures are not just useful for providing a snapshot of survey biomass, but also other information on life history stages, etc., that is being gathered and understood. The presenter agreed that they should be looking in detail at specific stocks, but also that the authors are trying to answer the bigger picture question of whether the exclusion of surveys could cause problems in terms of the quality of the data for advisory processes generally going forward.

A discussion was held around data richness of the different closed areas and whether a set lost in one area would be more important than a set lost in a second area. The presenter noted that closures were not analyzed individually, so they could not make a statement to that point, but also emphasized that the intention was not to determine relative importance of the closed areas. A co-chair noted that the closures were grouped based on their conservation objectives (COs)/intent to make the advice more succinct and allows managers to make decisions that are more logical – for example, Funk Island Deep and Hawke Channel have similar objectives and therefore could be dealt with by management in the same way. It was noted by another participant that management measures related to the survey would likely be implemented to the entire survey as a whole and not at the level of the individual stocks, even though the impacts are not the same everywhere for a variety of reasons. Another participant noted that these simulations are trying to get at the potential of an effect, albeit retrospectively, and the past may not be the best indicator of the future. They noted that these closed areas occur where some populations are at the extent of their distribution, and given that populations change the most at the boundaries of their distribution, we can expect that there will be change in the future.

A participant asked a question about mean difference in the table, and the presenter clarified that it was the mean of the absolute value of the log ratios. The participant noted that we want indicators of overall variability. Some indices had more interannual variability, partially from removing sets and/or lower sample size, but this issue could be problematic for assessments if extracting the signal from the noise becomes more difficult. The presenter agreed, although noted that dealing with a bias that is large but consistent over time is not new.

A participant wanted to highlight that the area covered by one standard Campelen tow is 0.025 km^2 and that the 2020 fall RV survey would have between only 0–9 sets in each of the closures. They encouraged meeting participants to weigh this information with the potential negative impacts on the assessment and advice for several shellfish and demersal stocks as suggested by the various presentations. A co-chair noted that this thought was prompted by a previous presentation as well, and that it would be a broader conclusion for the entire meeting to be discussed later.

CORALS AND SPONGES

B. Neves & V. Wareham-Hayes

Abstract

This presentation focused on the vulnerability and role of corals and sponges in the context of Sensitive Benthic Areas (SBA) within Canada; also referred to as Vulnerable Marine Ecosystem (VMEs) internationally. Impacts of bottom contact gear on benthic communities is extensive with much scientific evidence on the severity and long-lasting effects on corals and sponges. VMEs are particularly vulnerable to bottom contact trawl gear, primarily on the first pass. Impacts can range from complete removal, crushing, or varying degrees of mechanical damage from abrasion, tipping, or toppling of VME species; areas with high fishing effort have a general ‘smoothing’ of the sea scape through time. Corals and sponges for the most part have a

stationary habit, and rely on currents to deliver food, as a result up-right positioning is important; perpendicular to water flow to maximize feeding. Impacts will depend on species “life-style” - attached or free-living on the sea floor, possess the capacity to move or avoid or reposition if disturbed, and morphological characteristics like size and shape will also determine the risk of impacts by bottom contact gears. Majority of coral and sponge species are sessile, and can’t avoid anthropogenic disturbances. However, there are several species of sea pens that can exhibit limited movement with the capability to slowly withdraw into the sediment (e.g., *Pennatula aculata*, *Protoptilum carpenterii*); note behavioral cures are not well understood. Even with this attribute, bycatch rates of the sea pen *P. aculata* are still some of the highest among sea pens in the Region with up to 880 colonies (1.8 kg) per survey tow, and with biomass recorded up to 10.6 kg. Despite known catchability issues, sea pens are still vulnerable to Campelen gear. Dislodged *Funiculina quandrangularis* colonies took six days to reposition. For *Halipteris willemoesi*, survival rate after dislodgement was 50%, with high levels of predation. Additionally, once a colony is damaged or injured, risk of parasitism increases which can impact overall health of the colony. Based on life history characteristics of corals such as longevity and growth, impacts can be long-lasting taking decades to centuries to recover to original state. Sea pens longevities can range between 10–80 years, while other large gorgonians such as bamboo corals can take 100s of years to recover. Based on piston cores from Baffin Bay, bamboo forests have occupied that area for at least 2,000 years – it was impacted by a DFO Survey trawl in 1999 and shows no evidence of recover decades later. Sponge longevity and growth are less well known. Glass sponges with small scale mechanical damage can recover within one year, however crushed sponges showed no signs of recovery after three years. Resuspension of fine sediments can also impact sponges by interfering with metabolic functions, with increased Suspended Sediment Concentrations leading to sponge ‘coughing’ arrests. Modeling of sediment transport indicates that sponges found as far as 2.6 km from the source plume can be affected; large *Geodia barretti* sponge can cope with single short exposures to elevated sediment concentrations but effects of long-term exposures is less understood.

Corals and sponges play a vital role in deep sea communities, functioning as habitat for other organisms, with diverse array of associations documented. Regionally, *Mycale* (*Mycale*) sponge species have been shown to function as nurseries for bob-tailed Rossia squid – a dominant prey specie in arctic systems – with deposited eggs at varying stages of development indicating repeated use of the sponge as a nursery habitat. Similarly soft corals have been shown to function as nurseries for juvenile basket stars, and juvenile redfish larvae have been shown to have a strong association with sea pens in the Laurentian Channel. Loss or removal of these SBA or VME species means loss of habitat for fish, invertebrates and even microbial communities; loss of corals and sponges means a loss of function in SBAs or VME areas.

Discussion

A participant raised a concern sometimes voiced by harvesters that their reporting of coral and sponge bycatch could be used against them when delineating closed areas. Several authors responded to these concerns, noting that SiBAs and VMEs were identified through scientific processes using mostly RV survey-type data (although information from stakeholders was used to validate those); the closures themselves were delineated using SiBAs/VMEs plus fishing effort in separate processes and have little overlap with fishing areas (i.e., the closures are areas that were not normally fished anyway). It was emphasized that DFO is not looking to protect individual coral and sponges, but rather high concentrations that provide the habitat for the fish that the harvesters are targeting. The participant wanted to note that closures and SiBAs/VMEs are not treated the same and do not have the same management. Authors rebutted that areas of high concentration of corals and sponges are not necessarily confined to

SiBAs/VMEs, but that these unprotected SiBA/VME portions are exposed to fishing and RV surveys, etc. It was suggested by an author to use data from outside the closure to infer within the closure, should the decision be made not to survey within closed areas, but overall to prioritize lower impact gear, which would be discussed in a later presentation.

REVISION TO PROPORTION OF AREAS IMPACTED

M. Warren

Abstract

Updates were provided to information presented during the Proportion of Areas Impacted presentation on Day 1 of the meeting. The crab trap survey swept area was recalculated using new values from a recent publication, which decreased the swept area and increased the recurrence interval. The RV survey impact was re-calculated using the door spread (versus the original wing spread) to be consistent with the commercial fishery and also represent the maximum possible impact; this change increased the RV survey swept area.

Discussion

A participant asked if frequency was accounted for in the calculations (e.g., Unit 2 redfish survey is once every two years). The presenter responded yes; redfish used a frequency value of 0.5 versus 1 for all other surveys.

A discussion was held around the appropriateness of using door spread versus wing spread in the commercial fishery and RV survey calculations. Several participants noted the “bridles” between the wings and the doors on bottom trawls; these bridles come very close to the seabed and often touch; therefore, they can interact with emergent taxa and/or leave physical marks on the seabed. The national guidance used door spread, as do stock assessments in Norway when calculating swept area. (A participant offered to forward a reference to support this comment.) Participants agreed that door spread is the better metric when calculating impact for these reasons.

A participant asked if the commercial groundfish trawl door spread of 275 m accounted for a double or triple trawl. Many participants were not aware of triple trawling, with mostly single trawls and sometimes double trawls, although one participant noted having received data from fisheries observers for triple and twin trawls. Another participant asked how the 275 m was calculated. The presenter noted that it was the mean of otter trawls offshore for yellowtail and Greenland halibut, which varied from 250–300 m, so 275 m was assigned to fishing vessels >100 ft that targeted those species, while smaller vessels and/or different target species had different door spreads. These measurements came from an informal internal survey previously done by a DFO scientist when they were trying to develop tracks and refine their estimation of bottom contact for a different research project. However, some participants felt that these numbers were greatly overestimated. A co-chair suggested that the authors reach out to the previous researcher for sources, etc., and qualify these numbers in the text.

A participant noted that the Laurentian Channel MPA had the highest proportion of area impacted out of all of the closed areas and wondered if this also included impact from the redfish survey. The presenter said no, but that they would check to see if the data (i.e., end coordinates, door spread) were available and would include the updated numbers from that impact in the research document, if not before the end of the meeting. A participant offered a quick estimate of time/speed as a 15 minute tow at 3 knots, however, the presenter noted that they would also need the door spread, as the redfish survey’s modified Campelen gear is

smaller than the door spread value being used for the RV survey. It was agreed to include these calculations in the working paper.

REVIEW OF POTENTIAL MITIGATION MEASURES FOR SCIENTIFIC SURVEYS

M. Koen-Alonso & B. Neves

Abstract

Protected areas have specific conservation objectives, and the impacts of scientific trawl surveys need to be assessed in relation to those objectives. Scientific trawl surveys generate a broad range of information, and the trade-off between their impacts versus benefits have been considered in other presentations during this Canadian Science Advisory Secretariat (CSAS) process. If scientific trawling takes place inside of protected areas that aim to protect corals, sponges, and other benthic communities, then measures such as avoidance when possible, compensation, and mitigation should be considered. For instance, to expand the boundaries of protected areas would be a measure to compensate for trawl survey impacts, while maintaining the current impact level constant. A few mitigation measures were discussed:

1. to reduce the number of sets within closures (i.e., avoidance); although survey design integrity cannot be compromised, which may or may not make this possible,
2. to reduce the length of research tows; although this likely will not yield any additional protection based on a comparison performed by NAFO in which biomass for 15 and 30 minutes tows were not significantly different. This might be the result of coral/sponge patchiness and concentration in specific zones of the seafloor,
3. to consider zoning within protected area-stratum through the selection of zones that would avoid high concentrations (would require high-resolution data),
4. to consider the type of habitat being trawled (e.g., higher risk aversion for gorgonians/sponges versus sea pens),
5. to enhance sampling protocols (maximize information from destructive sampling) with a focus on very large coral/sponge and other VME catches and unsuccessful sets,
6. to include potential buffer zones (e.g., survey set distance),
7. to require regular training of sea-going staff (e.g., familiarization of coral taxa),
8. to consider the adoption of “linney” bags already used in some surveys for the retention of small specimens (e.g., juveniles) and collection of additional data (e.g., size),
9. to use of ship-time for additional collections (e.g., sparse camera work, sediment grab samples).

Discussion

A participant commented that there is risk analysis already within marine protected areas (e.g., evaluation of activity plans) to look at reducing impacts on fish and fish habitat, including corals and sponges. The risk frameworks they use generally follow Avoid, Mitigate, and then Compensation only if there is residual risk, which is different from the approach outlined in this presentation. The presenter agreed that it makes sense to mitigate first and then compensate for what you cannot mitigate.

A participant asked for clarification around how reducing a tow’s time duration would not reduce the impacts to the bottom. The presenter responded that technically there is less impact

because less time is spent on the bottom, but that does not necessarily apply to impact on corals and sponges because of their heterogeneous distribution (e.g., larger clusters with space in between). Previous studies by NAFO found that it takes on average 15–30 minutes of trawl time to find a high density aggregation of corals; therefore, shortening the trawl time from its current 15 minutes to 10 minutes is not likely to make a significant change to the probability of encountering an aggregation. While it is a mitigation measure, the presenter cautioned against putting energy into exploring it further when other methods will prove more effective, as well as the effect reducing trawl time would have on the catchability profile of the gear when conducting the RV survey to inform stock assessments. It was further clarified that this information was in the context of research vessel trawl surveys and not commercial trawls.

A participant commented that they agreed with the mitigation points and suggested, based on past experience with EU-Spanish surveys on the Flemish Cap, that null trawl sets or unsuccessful trawl sets be more carefully examined, as these areas may have a high probability of large coral concentrations (e.g., rocky areas). The presenter agreed that looking at places where we have historically lost gear may be a good indicator of places where these habitats exist but have not yet been identified. An author noted that they have received 40 coral and/or sponge samples from unsuccessful sets over the years from all NAFO Divisions and that they continue to ask for data from unsuccessful sets in addition to noting these sets on maps for future reference.

In response, a participant asked if a process already exists within the RV survey design that excludes areas where historically gear has been damaged or lost. A participant involved in the survey design answered that they do not formally exclude any specific areas, even difficult ones (e.g., shelf edge), and that they do not manually remove sets that fall within an area that is difficult to survey. Another participant recalled discussions where one or two sets have been re-allocated from an area where they always tear up the gear, but that it may not be part of the formal design process. The second participant mentioned that the procedure is to look for bottom, even in difficult areas, for a couple of hours maximum, then move to the alternates (i.e., within two nautical miles) if it cannot be found on an ad hoc basis. Another participant noted that Olex is available to provide a 3D view of the bottom, and if it is very rough, they may skip the set and take the alternate. It was mentioned that Maritimes Region has formalized selection criteria of areas that have been excluded from the survey design for these types of reasons, and that EU-Spanish surveys also take steps during allocation to avoid areas where large catches of sponges have torn up the gear previously. There are hopes that on-going improvements to the geographic information system (GIS) for survey selection will formalize a similar process for NL’s surveys to increase transparency.

A participant raised the option of modifying the survey trawl, for example flying the trawl semi-pelagically. The participant stated that semi-pelagic trawls can reduce the seabed impact and footprint by either leaving the door on the seabed but lifting the rest (“French rigging”) or leaving the trawl on the bottom and lift everything else (e.g., bridles, doors). Another participant mentioned that there is effort within industry to reduce their impact, such as through similar methods of raising the gear off the seabed, and wants to see that context included when talking about commercial activity. An author emphasized the implications of changing the selectivity of the trawl and, even with comparative fishing, would end the trawl survey time series. A participant agreed with that statement and noted that it would mean a loss of baseline data for future monitoring and assessment of MPAs if the time series were to be interrupted.

A participant noted another potential mitigation strategy of increasing the number of alternate stations from its current one alternate per stratum. For example, in strata that partially overlap the closures, the primary station could be within the closure, but at least one or two alternate

stations could be outside it. One participant liked this suggestion, but two participants noted that more alternates would statistically change the design of the survey.

The presenter noted again the implications of changing the survey, including the gear, even if just within closed areas, and mentioned that these consequences are why they have chosen a middle ground when it comes to the list of mitigations. Another reason is the practicality of their implementation versus the practicality of changing the survey design, the level of analysis for which would require massive amounts of time and money. A participant added that even now, DFO is attempting to calibrate new survey vessels coming into service but is looking at the possibility of getting little calibration data for the entire survey; calibrating to new gear and/or methods (e.g., video monitoring) would be feasibly impossible.

A participant commented that some of the options discussed are more compensation than mitigation (e.g., collecting more information on the trawls).

A discussion was held around recurrence intervals and recovery time. One participant commented that some of the recovery intervals were on the scale of glaciation (e.g., 10,000s years) and noted that there will be some areas where relative impact is important but other cases where we may be chasing details. Another participant responded that it is important to consider the recovery time of habitats versus the recovery time of individuals; a recovery time based on the lifespan of individuals and recruitment rate would be making large assumptions, as some of these habitats have been present for at least 2,000 years and we do not know the recovery time for the habitat as a whole. Another participant agreed that caution needs to be exercised; not only are individuals being removed, but the function that the habitat provides is also lost. They noted that the animals that rely on these habitats have much shorter life spans than it would take for the habitat to recover. The presenter acknowledged those concerns, particularly given the lack of information on these habitats, but also agreed with the first participant, noting that the RV survey has relatively localized impact; while RV survey trawls may remove one portion of a larger habitat, the remainder of the habitat can continue to function and may also help with recolonization. The presenter also noted perturbation by natural causes and the need to understand the magnitude of this impact in context with everything else that is happening in the ecosystem (e.g., natural variability). An author agreed that we should acknowledge our lack of understanding of these habitats and species, as that is the reason for the “magnitude difference” criteria that is set out in the national framework.

METHODS / DATA SOURCES FOR MONITORING AND EVALUATING THE EFFICACY OF PROTECTED AREAS

M. Warren & B. Neves

Abstract

The current practices for monitoring of MPAs and MRs in the NL Region were described including the use of data from the annual RV surveys to produce spatial distribution maps and summary statistics for various species of interest in each protected area, as per the Service Level Agreement (SLA) signed between DFO’s Science, Marine Planning and Conservation, and Resource Management and Indigenous Fisheries Branches. Another potential methodology, using OgMap to monitor biomass and abundance trends with RV survey data in the protected areas, was introduced. It was discussed that further investigation into using this type of analysis is needed, but that it was not a suitable method for looking at trends of coral and sponge biomass or abundance.

The second part of this presentation focused on the use of alternative methods to trawling that could provide reliable data for monitoring of protected areas in the NL Region. Deep-sea

research has been increasingly conducted using seafloor imagery technologies. They have multiple advantages in comparison to trawls, including the fact that they: are less invasive (i.e., less destructive), capture the true habitat and fauna behavior, can access a wider range of habitats and depths (i.e., Campelen trawl surveys limited to ~1,500 m), provide more accurate data for certain metrics (e.g., coral abundance, size), can collect data at different spatial resolutions (e.g., downward vs. forward looking cameras), and can have high position accuracy. Many different types of camera systems are currently available, and their choice will depend on the survey objectives and resources available. Remotely Operated Vehicles (ROV) are one of the most advanced systems. They can have multiple cameras, can access complex topography, have high video quality, low or null contact with the seafloor, high position accuracy and precise sampling capabilities (e.g., fauna, sediment, water, plankton, CTD metrics). Other camera systems include drop/tow cameras, baited cameras, benthic sleds adapted with cameras, and benthic "flying" arrays, which can have low contact with the seafloor and are less costly and less complex to deploy than ROVs. In most cases, these systems do not have sampling capabilities, but if deemed necessary, this could be overcome through the sporadic parallel deployment of small, low-footprint bottom-contact gear (e.g., Agassiz trawl). Autonomous Underwater Vehicles (AUV) are another class of complex systems that can be outfitted with cameras, but which often are used for the collection of multibeam sonar and CTD data, at high position accuracies. Many of these camera systems can be costly, but the fact that less invasive equipment is more in line with conservation objectives, and that imagery can be more appropriate to collect data on certain metrics should be considered. Often a large portion of the cost is associated with ship-time to access offshore protected areas. In addition to camera systems, acoustic technologies such as multibeam sonar and side scan sonar are often very useful to produce habitat classification data (e.g., bottom types, benthoscapes) and to map the presence and distribution of reef-forming organisms (e.g., *Lophelia pertusa* coral, sponge reefs), but they do require ground-truthing. Another equipment mentioned for the collection of data that could be used in the monitoring of benthic areas is sediment samplers (e.g., box-cores, grabs), which can complement the data on biodiversity metrics (i.e., mostly macrofauna); however, these equipment are not possible/unlikely to be deployed in hard bottom/complex topography areas. A final method discussed in the presentation was environmental DNA (eDNA). There is growing interest in the use of eDNA to assess biodiversity trends. This method is relatively straightforward, and it will be a good addition to the pool of data types collected as part of a monitoring program. However, identification of benthic taxa at low taxonomic levels (i.e., high resolution) is still in its infancy, which will improve with the development of better DNA libraries. Overall, complementary gear and tools were suggested to be considered in order to better assess changes in benthic diversity, rather than a single system (e.g., cameras, sonar, sediment samplers, eDNA, etc.). Whichever systems are selected, consistency needs to be considered to allow for spatial and temporal comparability. The selection of gear and protocols should be integrated into the ecological monitoring programs, along with a plan and budget for capacitated personnel and ship time.

Discussion

A participant asked if the authors had considered a modeling approach such as zero-inflated models for corals and sponges. The presenter responded that they had discussed using OgMap, but other estimates (e.g., kernel density) would be more appropriate; OgMap is not designed for highly aggregated organisms, and OgMap would still require data inside or nearby the closures. An author added that they are interested in exploring the types of models that can handle zeros and the spatial heterogeneity typical of coral and sponge data, but kernel density is a good starting point. The participant mentioned that kernel density has been used in analyses completed for NAFO. Another participant mentioned the increasing capacity for spatial

analysis within DFO, previous analyses for modelling distributions (e.g., species distribution models), and information sharing with academics on the best methodologies to use.

A participant asked what data was used for the biomass estimate in the Hawke Channel. The presenter clarified that it was generated from biomass values within the closure only and gave a brief, high-level overview of how OgMaps works. The participant asked if the OgMap values were validated or compared against another source (e.g., Kincaid and Rose 2017). The presenter did compare their early results with biomass estimates from stock assessment meetings and found the results to be similar. The participant sought clarification on the goal of this analysis and if it was to estimate population within a protected area as a way to indicate if the protected area is achieving its objective of increasing the biomass of target species. The presenter said yes, but noted that further investigation is needed to compare outside vs. inside the closure, and also to determine whether impacts are because of the closure itself or stock-level trends. The participant referred to the results of Kincaid and Rose (2017) who found that most of the trends were driven by overall stock trends, although there was some effect of the closure. The participant also noted that the analysis as presented still requires trawling inside the protected area. The presenter responded that this analysis was to show that Science's ability to continue monitoring these areas going forward and/or producing these summary statistics/indices depends on the continuation of the time series. An author clarified that OgMap was used because of its ability to "cut out" a closure and commented that the performance (e.g., effectiveness) of closures would require more sophisticated analysis. Another author agreed with this comments and shared the conclusion of the Kincaid and Rose (2017) paper.

A participant noted that, based on the presentation, there are better methods for monitoring taxa within the protected areas than bottom trawling; however, they asked how they could be used to monitor the efficacy of the closures if they do not have baseline data using those techniques. The presenter stated that some studies are looking into conversion (e.g., comparison of trawl data and ROV/drop camera video data within the Laurentian Channel MPA) and developing metrics, but anticipated that these types of questions would be further discussed at an upcoming CSAS meeting specifically on monitoring of closed areas. Another participant agreed that trawls are not the ideal technique for monitoring corals and sponges. They also noted the longer time frames required to determine measurable differences (e.g., 10–20 years vs. 2 years), but that the locations of the closures (i.e., areas that have not been traditionally impacted) means that it is unlikely to see large changes as a result of the closure and therefore we can use the new technologies to get baseline data now. The presenter agreed and stated the importance of using these new technologies to also collect baseline data in areas that have been identified as potential closures down the road.

A participant offered that eDNA could be considered as a complementary technology to provide a more complete picture of the communities that the trawls are sampling while providing context to the protected areas from outside the boundaries. Several people agreed that more thought should be given to including eDNA in the surveys.

A participant noted that the presenter spoke about acoustics for habitat surveys, but not acoustics for fisheries surveys, and proposed that the latter could be considered as an alternate technology for assessing fish populations in closed areas. An author responded that acoustics would not work for flatfish and many other species that are assessed by the survey.

A participant commented that it may be important to look at the purpose of a particular closure (e.g., habitat protection vs. fisheries enhancement), as the purpose will determine the way in which we monitor for effectiveness.

Several participants noted several logistical limitations with the surveys (e.g., time, personnel, cost, ground-truthing of fish acoustic surveys) and concerns over adding additional methods

(e.g., cameras) when it is already challenging to complete the survey as-is and scientists have already been asked to reduce biological sampling requests, etc. The presenter countered that it should not be business as usual in protected areas. An author added that the objectives associated with closed areas are valid objectives and that the perspective around the additional sampling required should change from an “add on” to a “must have.” They noted that conversations need to happen with management to ensure that the appropriate vessel time, resources, etc., are available to achieve this.

A participant suggested that DFO should develop conditions around what a proper or meaningful calibration would look like when determining whether to switch to alternative methods. They suggested looking to a review conducted by the Centre of Independent Experts on scallop surveys in the Northeast US that developed a list of pros and cons comparing dredge surveys to HabCam surveys.

A participant recalled a recent presentation at DFO for a camera technology that could quantify fish in a trawl; however, several other participants noted that this technology would still require a trawl contacting the bottom.

A participant cautioned that the advice from this meeting needs to be realistic, understanding that certain changes can be done now within the scope of the technology we currently have, while other elements (e.g., new, less impactful technology) require large investments in time, resources, capacity, etc. Another participant commented that minimizing the impact of the multispecies surveys while continuing to gather data and still use the time series is different from the question of how to monitor the closed areas for their objectives, to which another participant agreed that the two were getting mixed up. Another participant contributed that the multispecies survey had been used for both up until now, leading to the two questions being intertwined. A co-chair noted that they would attempt to address both questions separately in the SAR.

BENEFITS AND LIMITATIONS OF SURVEYS TO MONITORING PROTECTED AREAS

B. Neves

Abstract

This presentation focused on the benefits and limitations of trawl surveys to monitor protected areas. The spatial and bathymetric coverage of DFO’s scientific trawl surveys in the Newfoundland and Labrador Region is impressive. Data on coral and sponge presence and biomass from these surveys have been successfully useful in the initial reconnaissance of their distribution in this Region, and hence as inputs in species distribution models, density estimations, and the delineation of protected areas themselves. These surveys provide an opportunity to collect large numbers of specimens, which is advantageous in ecological studies. Ecological monitoring of protected areas (MPA and Marine Refuges) will depend on the identification of ecological indicators. A range of indicators have been suggested in the literature and in other CSAS meetings and include metrics such as coral/sponge biomass, abundance and density, size distribution, geospatial indicators (e.g., patch area and density, isolation/proximity of sponge grounds, connectivity between sponge grounds, dispersion of sponge grounds and sea pen fields), taxonomic diversity and richness. While bottom trawls are one of the most effective ways to catch fish and to sample multiple species at once, they are not the most adequate method to monitor protected areas that aim to protect benthic organisms such as corals and sponges. Other than their invasive nature on the seafloor, one of the primary limitations is that trawl catchability is very low or unknown for corals and sponges. Even for fish,

catchability can be affected by many factors and varies both between species and between different sized conspecifics, having the capacity to confound our understanding of predator-prey interactions, relative abundance of different species, and fish size classes. Estimates of the catchability of each size class by species would be required for more accurate trawl sample densities. While trawl biomass data could still be used in a monitoring program (e.g., geospatial indicators), data on abundance and density would be limited by the catchability issue and by the fact that DFO has not been consistently collecting data on these metrics. Data on size has also not been collected (i.e., not part of survey protocols) and smaller colonies/individuals are likely not retained in the standard Campelen trawl cod-end. The use of “linney bags” (small mesh bags attached to the outside portion of the net) was suggested to allow better collection of size data for corals. Data on taxonomic diversity and richness can be collected using trawl samples, but depends on at sea efforts to identify taxa to high taxonomic resolutions (i.e., depends on training). Furthermore, many species are not caught in the trawl surveys, despite their known presence in the area (i.e., detected only from imagery surveys). Alternative methods such as imagery surveys (e.g., videos, photos) were recommended for the collection of data for assessing many of coral/sponge-related indicators. Several of the current knowledge gaps cannot be necessarily assessed using trawl survey samples (e.g., behavior, in situ studies, impacts of oil and gas exploration and aquaculture activities, understanding of their habitat, community structure, associations, etc.). In conclusion, while RV trawl data can be seen as complementary for the monitoring of protected areas, alternative surveys such as seafloor imagery surveys are preferred to collect data on several candidate monitoring indicators for coral and sponge protected areas.

Discussion

A participant asked if attention was being given to broader biodiversity beyond corals, sponges, and fish (e.g., crinoids) within and between the closed areas in the NL Region, similar to work done by NAFO in the NRA. An author noted that a researcher within DFO has been cleaning up the invertebrates data from the RV survey dataset and identifying functional groups to incorporate into ecosystem summaries. They hope that it will be a similar analysis to the work done by NAFO.

An author commented that there are many benefits and limitations to the RV survey when trying to understand the biology and ecology of benthic taxa. Overall, the RV survey is far from ideal, but does provide reliable information at some level.

The presenter noted that there is ongoing collaboration with academics who are using benthic invertebrate samples (not just corals and sponges) from the trawl surveys to inform studies.

REVIEWER REPORTS

Reviewer 1 – Hugues Benoit (DFO Quebec Region)

Reviewer 1 was involved in developing the national framework discussed throughout the meeting, as well as its application in DFO Gulf Region. They thought that the authors in this case applied the framework completely in a clear and objective manner. However, they noted that authors should make explicit the risks of potential damage caused by the surveys by discussing the relationship between recurrence times and recovery times of individual taxa and or habitat features and colonies.

Reviewer 1 appreciated that the authors did not constrain themselves to the national framework, particularly adding in the discussion around potential compensation for survey impacts that, while discussed at the national framework meetings, was not admissible for that process.

This reviewer commented that it is important to clarify the intention of the retrospective analyses (e.g., removing survey sets) as looking at the potential for creating either time-varying biases or an increase in variability in survey indices, rather than focusing on specific results for specific species, in both the Science Advisory Report and the research document. They noted that there are many reasons to believe distribution shifts and abundance changes that have been seen in the past may not be the best indicator of future change, especially under directional change associated with climate change (e.g., temperatures, dissolved oxygen, acidification). Given that species distributions are changing and that these closures overlap with the edges of species distributions, there is a real potential for biasing the signals that we get from our surveys, with ensuing consequences to the advice we can propose for the management of fish resources, recovery of depleted species, and broader ecosystem considerations.

Reviewer 1 commented that they wanted to see survey designs that cover entire populations rather than focusing on stocks, as the latter affects our perspective of what the stock is doing and makes it challenging to identify changes associated with survey methodology versus true changes of abundance.

This reviewer noted that the largest element missing from this analysis was the lack of interregional coordination for the assessments. One example was the halibut longline survey, which was excluded because it is run by DFO Maritimes Region, yet overlaps with the spring and fall RV survey, redfish survey, snow crab survey, and some protected areas. They noted that, by excluding it, the authors underestimated the cumulative impact of surveys in these areas, which would change the results (albeit not the conclusions because the density is quite small), and if/when similar analysis is done by Maritimes Region, it will require re-doing the analysis in NL Region.

A similar missed opportunity involved the lack of a fulsome analysis of the consequences to the redfish survey by removing sets from those areas. Reviewer 1 noted that the authors suggested a joint analysis with Quebec Region; however, that analysis has already been completed for the part of the survey for Unit 1, and they believe that a fairly complete review could have been done for Unit 2 for this meeting, as well. By not doing so, the authors risk never completing this analysis and therefore this information not being available for decision making to the potential consequence of the redfish survey.

When analyzing survey impacts in Section 2.3.1.1, Reviewer 1 commented that the use of only successful survey sets underestimates the impact of the surveys, given that unsuccessful sets are usually invalid because of something that happened while the net was on the bottom (e.g., tears). They noted that, while these tows are not a representative sample, the net did interact with the bottom for a period of time and therefore should be included in the analysis. This inclusion would not change the overall conclusion and likely would not change the specific results by much, but is worth considering in a revision.

Reviewer 1 concluded by saying that they will pass along specific comments on the text so the authors can revise accordingly.

Reviewer 2 – Susanna Fuller (Oceans North)

Reviewer 2 has been involved in these types of conversations with both DFO (regionally and nationally) and NAFO since 2004, and also acknowledged similar discussions happening within academia (e.g., CHONe).

This reviewer commented that, throughout these discussions, there has been a continued focus on the trade-offs between surveys for stock assessments and the impacts on the protected areas. While they do believe that there is a nuanced road forward, they noted inconsistencies in

the arguments that the protected areas are not effective for depleted species yet defending multispecies survey trawls occurring within those areas to assess the trends of those species. They highlighted that the impacts of removing surveys from closed areas and their effectiveness as monitoring tools are two separate discussions and asked that this separation be reflected in the conclusions of the working paper.

Reviewer 2 acknowledged the amount of work that is required to look at the impacts to long term datasets and all of the variables that trawl surveys collect. They stated that this is one of the reasons why NAFO settled on just an agreement to avoid those areas so priority could be given to other issues.

While this reviewer appreciated the various scenarios, they thought that clumping the areas together based on the reason they are protected ignores the nuances of the individual areas. One example given was how the trawls do not survey in deeper areas of NAFO Div. 3LNO, those areas are avoided. They suggested that the discussions on mitigations, including Avoid, have to be included in the text, potentially in advance of the conclusions. Related to this point, this reviewer noted that they would expect different monitoring requirements and protocols based on the type of protected area (e.g., *Fisheries Act* Marine Refuge vs. *Oceans Act* MPA) and asked that the authors include this nuance in the text.

Reviewer 2 mentioned the permitting process required by DFO Maritimes Region for scientific surveys in the Gully MPA as an example of a way to collect more information that is relevant to the MPA while avoiding important areas that may be impacted by the trawl. While scientists involved in stock assessments may not want to be permitted by their own department, it is a good way to bring together stock assessment biologists with those interested in corals and sponges, habitats, and ecosystems to open that conversation.

This reviewer noted that the swept area and recurrence time calculations assume that the trawls are completely independent; however, there is the possibility that trawls may cross each other. Regardless, they noted that the first trawl is the worst in terms of impact and noted that the very large amounts of corals and sponges being collected by trawl surveys is one of the reasons why the SiBAs were identified.

Reviewer 2 said that they would like to see a mention of biogeochemical processes that are impacted by trawling (e.g., carbon cycle, nitrogen cycle) in the text. This information will be useful in future processes.

This reviewer challenged the authors to think of other non-intrusive methods to collect bottom temperature that could be added to monitoring.

Reviewer 2 asked if the survey strata are the same across all of the areas and if the authors could look into that further.

Reviewer 2 echoed Reviewer 1s comments around the missing halibut longline survey. They asked if proxies have been or will be established between that survey and the trawl survey as the two overlap, particularly in the Div. 3O Coral Closure area.

This reviewer also fully supported including null surveys in the analysis, especially for the purpose of understanding where gear is getting lost and how that overlaps with SiBAs. They gave the example of NAFO, where they do not survey in and therefore have no data for areas where they lose gear, but yet this data is needed to close areas via “forensic ecology” (i.e., based on what has been pulled up in the trawls). They encouraged the authors to dig for more information as to why a set was null or unsuccessful.

Reviewer 2 acknowledged that the redfish survey is an industry-led survey; however, they would like to see more work done on industry-led surveys contributing to protected area monitoring

and management, particularly given that DFO will not have the capacity alone. This work could include more training on the vessels, ensuring that samples are sent in, mitigating how many surveys are happening in a given area from the onset, and looking at alternatives (e.g., acoustics).

This reviewer commented on the process behind identifying the locations of RV survey sets and suggested recommending that sets located in high concentration SiBAs be moved to alternate sites. They reflected on a previous CSAS process for oil and gas exploratory drilling where the ultimate advice was to avoid SiBAs and worried about consistency in the policies of not recommending RV surveys avoid those same areas. This reviewer suggested adding examples of processes from other MPAs or regions (e.g., the Gully, Maritimes Region) to this report in support of the nuanced approach.

Reviewer 2s final comments highlighted that some areas that had the highest concentrations of corals and diversity were not included in the final boundaries of the closures. They suggested that the closures be reviewed periodically to ensure they are as effective as possible.

This reviewer concluded by saying they would provide more specific notes on the text to the authors.

Discussion

The authors acknowledged that excluding unsuccessful sets from the analysis was a gap and that they were considering going back to address that for the final revision of the research document. The authors also acknowledged missing the halibut longline survey and the potential for duplication of effort in the future as a result. They provided additional context as well to the reason behind missing the redfish survey, noting issues with the strata files and interregional discussions after the previous assessment while observing that the redfish expert was not able to attend the meeting to provide more detail.

A participant was asked to speak on an investigation into acoustics for potentially monitoring redfish. The participant noted that it is part of a program out of St. Andrew’s Biological Station (Maritimes Region) to develop indices for some species (pollock, haddock, cod, redfish). The survey still uses a bottom trawl, however, also opportunistically collects acoustic data via a scientific-grade echosounder between stations. They will be using 2020 as a start/index and intend to continue this method in future surveys, and noted that trawl data would be important to validate the acoustic data. Authors mentioned that NL Region had attempted acoustic data collection during the trawl surveys in the past and showed interest in collaborating with those researchers with the intention of complementing, not replacing, the bottom-trawl survey for pelagic species, and noted that they would include some of this information in the relevant section of the working paper.

An author expressed their concerns around next steps assuming that there will not be a lot of additional funding or resources allocated to this work. They noted that the proposals and conclusions to come from this meeting should be realistic and focus on what we can do based on what we currently have. The surveys will need to continue to meet their objectives, but there is now the additional challenge of accounting for both existing and future conservation areas and closures. For this reason, they suggested developing a practical set of guidelines to deal with the current reality and available resources that accounts for areas of high concentrations while still allowing the continuation of the time series. As planning occurs for the future, more resources and funding should be requested if this type of work is to be done properly.

A question was asked whether the impacts of longline surveys have been compared to other surveys in the past, either quantitatively or qualitatively. This question sparked a long discussion during which several participants spoke:

- A participant described the impact of longline surveys as having minimal bottom contact compared to some of the other surveys discussed.
- Another participant referenced a paper from Maritimes Region that quantifies the interaction with longline fishing, to which the halibut survey is similar. Additionally, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has information on the catchability of various Antarctic VME species by longline fishing. This participant cautioned that, if longline surveys are less impactful to the bottom than the RV survey, it would still be worth investigating differences in catchability.
- A third participant disagreed with the first participant, noting papers cited in the national research document (Benoît et al. 2020) that have shown that longline gear is prone to sweeping laterally (when there are fish on the hooks or when affected by currents and ocean storms, etc.), which can take out emergent taxa. The research document also included a table that estimated the swept area impact for the halibut survey, but the table does not account for cumulative effects with other surveys. This participant also noted that catchability of fish to longline gear is quite selective and it would not be a viable option for a multispecies survey-equivalent as there would be no way to calibrate the two.
- Another participant mentioned a 2007 report to World Wildlife Fund (WWF) that found coral bycatch in longline fisheries for Atlantic halibut and Greenland halibut, due in part to the ability to set longline gear in rockier habitats (i.e., where corals occur) than can be trawled, as well as impacts as the gear moves over the bottom during haulback. This participant acknowledged that this report was based on commercial fisheries, not surveys, but concluded that given the same gear, this method is not without impact.
- A co-author acknowledged the impacts of longline gear on corals and sponges, but mentioned that they had looked at an activity plan from the halibut longline survey in the Laurentian Channel and that there had been no catches of any type of coral reported by DFO-certified observers in 56 completed sets.
- Another co-author spoke to work done previously that looked at significant adverse impact (NAFO) and potential significant adverse impact (NL Region) of commercial fisheries. As part of this work, a cumulative biomass of VME or SiBA taxa as a function of fishing effort was calculated and used to identify an average fishing effort per year that is associated with significant impact on some of these VMEs or SiBAs. The co-author hypothesized that analyses would not show significant impact at the scale of the VME or SiBA, but impacts may be significant locally, and suggested mitigations to avoid areas where we know these species are concentrated (e.g., through the identification of zones within closures to avoid those areas).
- The first participant rebutted the third participant, saying that the table in the research document was based on assumptions (e.g., longlines and gill nets have identical assumed lateral sweeps with strung pots and traps) and wondered if work could be done to confirm or re-adjust the numbers in the table.
- A different co-author agreed that the swept area for the longline survey seemed to be overestimated, but they did not have the data or references to confirm. It was agreed that a better swept area estimate would be run and included in the document from this meeting if this information could be collected.

ATLANTIC HALIBUT LONGLINE SURVEY

M. Warren

Abstract

The Atlantic Halibut longline survey only began in 2017 and uses a stratified random survey design. Data from the survey, received from Maritimes Region, was presented to the meeting. In the NL Region, there were no sets within the Div. 3O Coral closure and only twelve sets occurred within the Laurentian Channel MPA.

Discussion

A participant noted that the survey had been asked to stay out of the Laurentian Channel MPA Zones 1a and 1b; this pattern was evident on the map. Another participant asked if this request affected the random stratified survey design. The first participant said that the survey was asked to remove sets in Zone 1a and 1b, not replace them, and that general discussions were had on avoiding high concentrations of sea pens. They said that the number of sets (n = 12) is the number expected after those discussions and based on the activity plans submitted.

A participant cautioned against calling a 100 m lateral sweep a “gross overestimate”. They referred to studies from the southern hemisphere where 100 m was the median estimate of the lateral sweep of these lines. They acknowledged that longlines behave differently from crab pots (e.g., the lines move even when anchored on the bottom), but that longlines can still impact emergent benthic taxa, and that a 100 m lateral sweep was not an unreasonable number based on the best available science.

Another participant suggested looking at the calculations used in the activity plans mentioned previously when estimating bottom contact and impacts of longline gear.

A co-author asked whether it was worthwhile to run this additional analysis and add it to the paper. Several participants said yes, that it would be good to include it for completeness and for future reference. It was acknowledged by several participants that this additional analysis would not affect the overall conclusions of the meeting. Therefore, given time constraints, all agreed that the results of this additional analysis would not be presented at this meeting, but would be included in the final paper.

POTENTIAL PROTOCOL FOR SURVEYS IN CLOSED AREAS

M. Koen-Alonso

Abstract

A potential protocol for surveys in closed areas was presented as an attempt to formalize the discussions of this meeting and to aid in decision-making processes in the future. The protocol aimed to find ways of modifying current survey practices to minimize the impact on different SiBA habitats.

Discussion

The protocol was well received in general. One participant recommended turning it into a visual flow chart.

A participant asked about having fixed stations within MPAs, acknowledging a much more frequent recurrence time while noting that the first pass of a trawl is the most damaging. The presenter responded that there would be a lot of thought and statistical analysis required to

merge a fixed station design with the random stratified design, likely including a full re-design of the survey. They also noted that consistently surveying the same areas may permanently reduce the productivity of those areas as well as affect the use of those areas by the fish species that we are trying to survey. Given the low recurrence time for survey-only areas and assuming that nearby communities could re-colonize impacted areas, this process could be simplified by avoiding high concentration areas where bottom type would likely result in null or unsuccessful sets anyway. Two other participants agreed that a hybrid design would be complicated, but that acknowledging the potential and/or analysis would reduce future criticism.

A participant asked where unsuccessful sets could fit into the protocol. The presenter acknowledged that unsuccessful sets may indicate places where we have high concentrations of VME species and suggested that they could be used to determine areas that we want to explore further with visual surveys and potentially label as no-go areas, especially where these sets have already been discarded from stock assessment indices.

A participant continued the discussion of fixed stations within closures if we are considering adjusting the survey in other ways (e.g., identifying and removing sets from no-go areas). They mentioned that the fixed stations would only be visited a maximum of twice per year (i.e., spring and/or fall) and that they could be useful for gathering information on the behaviour of fish and ecosystem complexities. The presenter said that the idea of fixed stations is not being dismissed, but it would require a level of statistical analysis of the design and its consequences beyond what has been done here. The presented protocol was based on the existing random stratified design of the survey because of the many complexities that would come with re-designing the survey and the consequences of doing so (e.g., behavioural changes of fish if grounds are consistently surveyed and permanently bare vs. a VME-type habitat that was impacted but has been rebuilding). Another participant would still encourage avoiding SiBAs and high concentrations, even with fixed stations. A different participant disagreed with the idea of fixed sets as part of the multispecies survey, including the reasoning that it would likely mean interrupting the time series of the survey. A co-author appreciated the suggestions and noted that the discussions would be captured in the proceedings, but that incorporating fixed stations into the random stratified survey would be statistically complicated and outside the scope of this meeting and would not be a recommendation.

A participant asked if small adjustments to the random stratified survey design would create a new time series. Another participant said no, actions like moving sets nearby would be OK and consistent with the current time series. A co-chair clarified that the purpose of this meeting was to decide whether an adjustment had to be made, and if so, that means more work (i.e., another meeting or process to decide on those adjustments).

A co-author asked if the specifics of the protocol (e.g., to still collect biomass data for unsuccessful sets) would be listed in this document. The presenter noted that the current protocol provides a template of process and considerations, but that they did not get into the details. However, the presenter would like to see enhanced sampling protocols to maximize the collection of information, particularly within SiBAs, and wanted it flagged as something to be developed. A participant found “enhanced sampling protocols” that included length, weight and sex for all species of interest had been mentioned in the Lewis et al. (2014) research document, and they suggested building upon and extending similar protocols to other surveys.

A participant asked why the protocol had been broken down separately for gorgonians and sea pens when the two sections were almost identical. The presenter said they were trying to capture the difference in recovery times between the different habitat types to emphasize the need to treat these areas differently.

A co-chair liked the protocol, but wondered if it fit within the Terms of Reference of the meeting. A co-author noted that a comprehensive protocol would require input from many people not in attendance at this meeting, to which several people agreed. As such, it was decided that this meeting would recommend that a protocol be developed. The protocol presented here could be used to start those further discussions.

FINAL REMARKS

The co-chairs recognized the work done by all parties in preparation for and during this meeting, including the co-authors, reviewers, and everyone who contributed to the discussion.

RESEARCH RECOMMENDATIONS

The meeting reached consensus on 10 research recommendations, listed below in order of discussion (not ranked importance).

PROPORTION OF AREAS IMPACTED

There is interest in additional research into the impacts of bottom-contacting gear outside of physical damage (e.g., geochemical), particularly in the context of a research survey versus commercial activity (i.e., scaling down).

ECOSYSTEM ASSESSMENTS

If it is decided to exclude sets from all or some closed areas, it is recommended that a deeper investigation be taken to determine if data from previous assessments should be kept for future analyses.

It is recommended to investigate alternative ways of sampling that are less destructive such as seafloor imagery, acoustic technologies, and eDNA. However, more research will be needed to determine if these methods can be used to supplement or compensate for data lost from removing trawl sets from protected areas.

UNIT 2 REDFISH

A full analysis of Unit 2 redfish is recommended at the next stock assessment meeting in 2021.

LONGLINE SURVEY

Additional effort is required to find existing data sets and calculate estimates of gear-swept area for longline surveys that are more accurate than suggested in the national framework.

DEMERSAL FISH ASSESSMENTS

Further research is recommended regarding the impacts of removing surveys on understanding population composition. In particular, it is important to consider other elements (e.g., age, size structure, growth, maturity, juvenile associations) in addition to bias. Linked to this point is understanding how fish behave in or use these areas and how excluding these areas might influence the information gathered on these species' structures (e.g., excluding animals of a certain size from stock assessments or certain analytical models will have a large impact).

METHODS / DATA SOURCES FOR MONITORING AND EVALUATING THE EFFICACY OF PROTECTED AREAS

If alternative (not complementary) methods are chosen, a detailed review would be required that examines pros and cons associated with each method, what a meaningful calibration would look like, and whether the data can be quantitatively related or compared to the existing survey data.

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APPENDIX 1: AGENDA

CSAS Regional Peer Review Process:
An assessment to support decisions on authorizing scientific surveys with bottom-contacting gears in protected areas in the NL Bioregion

October 5-9, 2020

Co-Chairs: Nadine Wells and Christina Bourne, DFO Science

While the agenda is flexible, the tentative meeting schedule is as follows:

- 10:00 am - 12:00 pm
- 1:00 pm - 2:30 pm
- 3:00 pm - 4:30 pm

Day 1 - Monday, October 5

Time	Activity	Presenter
10:00	Opening Remarks	Co-Chairs
10:15	Introduction • Overview/Intro • Protected areas in the NL Region • Bottom-contacting scientific surveys in the NL Region	R. Rideout M. Warren M. Warren
ToR Objective #1: An evaluation of the potential significant adverse impacts of bottom-contacting scientific surveys on conservation objectives within protected areas.		
11:00	• Review of Significant Adverse Impacts due to bottom contact gear on benthic habitat • Comparing the footprint of RV bottom-trawl surveys to commercial fishing • Proportion of Areas Impacted and Recurrence Time Interval Calculations	B. Neves V. Wareham-Hayes M. Warren
12:00	LUNCH	
ToR Objective #2: An evaluation of the potential implications for science advice if bottom-contacting scientific surveys are excluded from protected areas.		
1:00	Overview & Methodologies	R. Rideout
1:30	Physical Oceanography	F. Cyr
2:00	Ecosystem Assessments	H. Munro
2:30	HEALTH BREAK	
3:00	Demersal Fish Assessments	R. Rideout

Time	Activity	Presenter
4:00	Redfish survey preliminary analysis	M. Warren

Day 2 - Tuesday, October 6

Time	Activity	Presenter
ToR Objective 2 cont'd		
10:00	Snow Crab Assessments	J. Pantin
10:30	Shrimp Assessments	K. Skanes
11:00	Corals and Sponges	B. Neves V. Wareham-Hayes
ToR Objective #4: A review of potential mitigation measures or actions that could reduce the impact of bottom-contacting scientific surveys in protected areas as per DFO 2018/043 guidance.		
11:30	Review of potential mitigation measures for scientific surveys	B. Neves/ V. Wareham-Hayes/ M. Koen-Alonso
12:00	LUNCH	
AFTERNOON OFF		

Day 3 – Wednesday, October 7

Time	Activity	Presenter
ToR Objective #3: A review of: • the benefits and limitations of bottom-contacting scientific surveys to the monitoring and management of protected areas and each of their corresponding conservation objectives; and • the implications for science advice on the ability to monitor whether protected areas are achieving their conservation objectives if bottom-contacting scientific surveys are excluded from protected areas.		
10:00	Methods/data sources for monitoring and evaluating the efficacy of protected areas	M. Warren/ B. Neves
10:30	Benefits and limitations of surveys to monitoring protected areas	B. Neves

Time	Activity	Presenter
Additional meeting items		
11:00	Reviewer Reports	H. Benoit S. Fuller
12:00	LUNCH	
1:00	Conclusions and Advice	ALL
2:00	Research Recommendations	ALL
2:30	HEALTH BREAK	
3:00	Drafting of Summary Bullets for SAR	ALL

Day 4 – Thursday, October 8

Time	Activity	Presenter
10:00	Drafting of Summary Bullets for SAR cont'd	ALL
12:00	LUNCH	
1:00	Drafting of Summary Bullets for SAR cont'd	ALL
2:30	HEALTH BREAK	
4:00	Upgrading of Working Paper and Next Steps	E. Parrill
4:15	Closing Remarks	Co-Chairs

Day 5 – Friday, October 9

Friday is a placeholder meeting day to allow for additional meeting discussions if they are required.

APPENDIX 2: TERMS OF REFERENCE

AN ASSESSMENT TO SUPPORT DECISIONS ON AUTHORIZING SCIENTIFIC SURVEYS WITH BOTTOM-CONTACTING GEARS IN PROTECTED AREAS IN THE NEWFOUNDLAND AND LABRADOR BIOREGION

Regional Peer Review Process – Newfoundland and Labrador Region

October 5-9, 2020
Virtual Meeting

Co-chairs: Nadine Wells and Christina Bourne, DFO Science

Context

In 2019, the Government of Canada introduced a plan to conserve 25% of Canada's oceans by 2025, and work towards conserving 30% by 2030. This came after Prime Minister Trudeau announced that Canada had surpassed its marine conservation target of protecting 10% of Canada's marine and coastal areas on August 1, 2019. Under Fisheries and Oceans Canada's (DFO) mandate, Canada established Marine Protected Areas (MPAs) under the *Oceans Act* and Marine Refuges (MRs) under the *Fisheries Act,* including three MPAs and five MRs in the Newfoundland and Labrador (NL) Region. In addition to this, the Northwest Atlantic Fisheries Organization (NAFO) has established fisheries closures in the NAFO Regulatory Area, including the nose and tail of the Grand Bank, to protect corals and sponges in an analogous manner to DFO's MPAs and MRs.

In 2019, the Government of Canada adopted new national protection standards for MPAs and MRs. For MPAs, these standards prohibit four industrial activities: oil and gas, mining, dumping, and mobile bottom trawling. For MRs, DFO will use a risk-based approach for prohibiting or limiting activities, which will be assessed on a case-by-case basis. In both types of areas, some activities will be allowed if they are consistent with the conservation objectives of the area. For example, proposed scientific activities will be assessed by regional managers based on the risk posed to the conservation objectives and will require approval of an Activity Plan, which outlines the survey methods and design, potential impacts to the area, and any avoidance and mitigation measures that will be used.

In the NL Region, DFO Science conducts several bottom-contacting surveys that can have an impact on conservation objectives in MPAs and MRs. While most surveys are conducted by DFO Science staff, some are carried out by industry partners. These surveys include the multispecies Research Vessel (RV) survey, which has been a mainstay since the early-1970s, the Collaborative Post-season (CPS) trap survey, conducted for Snow Crab since 2003, and the Unit 2 Redfish survey, conducted biennially since 2000. The multispecies survey provides information on species distribution, biomass, and abundance for various groundfish and invertebrate species, as well as other biological (e.g., growth rates, maturation schedules, diet, etc.) and physical information (e.g., bottom temperature and salinity). The CPS trap survey also provides information on Snow Crab distribution, biomass, catch rates, and size frequency distributions to complement the multispecies survey. The Redfish survey provides information on species distribution, biomass, and size frequency distributions and is the only survey index used in the assessment of the Unit 2 portion of the Units 1 and 2 Redfish stock. Data from all three surveys represent a critical component of DFO's science-based monitoring and advice, including stock, ecosystem, and environmental assessments. Since the multispecies survey also samples within NAFO fisheries closures outside the Canada's exclusive economic zone (EEZ), and considering that most indices integrate information from both domestic and

international waters, the NAFO closures will also be considered for this process as analogous to MRs.

In 2018, DFO Science developed a national framework with an agreed set of assessment criteria that can be applied consistently across Canada to assess the impact of existing and proposed scientific activities on the benthic components of protected and sensitive benthic areas, as well as to assess the time series value of the scientific survey designs and protocols that include sampling in these protected areas (DFO 2018). Following this process, the Gulf Region applied the framework to their own scientific surveys with bottom-contacting gears (Benoit et al. 2020, DFO 2020). DFO Science in the NL Region will carry out a similar process to assess the impacts that scientific surveys with bottom-contacting gears have on protected areas, to examine the implications of excluding surveys in these areas, and to review the benefits of survey activities as well as potential mitigation measures that could reduce or eliminate their impacts. This information will inform future scientific survey activities, as well as provide a basis for the development and assessment of subsequent Activity Plans.

Objectives

1. An evaluation of the potential significant adverse impacts of bottom-contacting scientific surveys on conservation objectives within protected areas.
2. An evaluation of the potential implications for science advice (e.g., on stock assessments, ecosystem assessments, climate studies, long-term monitoring, etc.) if bottom-contacting scientific surveys are excluded from protected areas.
3. A review of:
    - the benefits and limitations of bottom-contacting scientific surveys to the monitoring and management of protected areas and each of their corresponding conservation objectives; and
    - the implications for science advice on the ability to monitor whether protected areas are achieving their conservation objectives if bottom-contacting scientific surveys are excluded from protected areas.
4. A review of potential mitigation measures or actions that could reduce the impact of bottom-contacting scientific surveys in protected areas as per DFO 2018/043 guidance.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Expected Participation

- DFO Science, Ecosystems Management and Fisheries Management Branches
- Province of Newfoundland and Labrador - Department of Fisheries and Land Resources
- Academia
- Indigenous groups
- Industry
- Non-governmental organizations
- Other invited experts

References

Benoit, H.P., Asselin, N.C., Surette, T., and Juillet, C. 2020. An assessment to support decisions on authorizing scientific surveys with bottom-contacting gears in protected areas in the Estuary and Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res Doc. 2020/007. xi + 80 p.

DFO 2018. Framework to support decisions on authorizing scientific surveys with bottom-contacting gears in protected areas with defined benthic conservation objectives. Can. Sci. Adv. Sec. Sci. Adv. Rep. 2018/043.

DFO 2020. Assessment to support decisions on authorizing scientific surveys with bottom-contacting gears in protected areas in the Estuary and Gulf of St. Lawrence. Can. Sci. Adv. Sec. Sci. Resp. 2020/013.

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