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Proceedings of the Regional Peer Review for Science Guidance on Design Strategies for a Network of Marine Protected Areas in the Newfoundland and Labrador Shelves Bioregion

May 16-18, 2017
St. John's, NL

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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

The Regional Peer Review Process for Science Guidance on Design Strategies for a network of Marine Protected Areas (MPAs) in the Newfoundland and Labrador (NL) Shelves Bioregion was held in St. John's, Newfoundland and Labrador NL May 16-18, 2017. The purpose of this peer review meeting was to provide advice for DFO Oceans Program (NL Region) regarding the establishment of meaningful ecological targets for the NL Shelves Bioregion, based on Strategic Objectives, Conservation Priorities (CPs) and Operational Objectives (OOs) identified by the NL Region Oceans Program. Prior to this meeting, a Steering Committee developed a framework for setting design targets based on the best available scientific advice regarding MPA network design. Based on this framework, a range of ecological targets were generated, to be presented and reviewed by internal and external experts. The ecological targets identified through the Steering Committee and Regional Peer Review Process will be applied to MPA network planning scenarios in Marxan (software selected by the Oceans Program that delivers decision support for MPA network design).

Participants included representatives from Fisheries and Oceans Canada ({DFO} Science, Ecosystem Management, and Fisheries Management Branches), Environment and Climate Change Canada (ECCC), Industry, Department of Fisheries, Forestry and Agrifoods, academia, Indigenous peoples, and environmental non-governmental organizations (ENGOs).

Detailed rapporteur's notes of the discussion that followed each presentation were produced. This Proceedings Report includes abstracts and summaries of meeting discussions, as well as a list of research recommendations. The meeting Terms of Reference, agenda, and list of participants are appended.

INTRODUCTION

As a signatory to the Convention on Biological Diversity (CBD), Canada has committed to protect 10% of coastal and marine areas by 2020 under Aichi Target 11. One program of work that will contribute to Canada's achievement of this commitment is national Marine Protected Area (MPA) network development. Five priority biogeographic units (bioregions) have been prioritized in the context of developing a national MPA network, including the NL Shelves. The primary goal of Canada's MPA network is to provide long-term protection of marine biodiversity, ecosystem function, and special natural features.

The purpose of this peer review meeting was to provide advice for DFO Oceans Program (NL Region) regarding the establishment of meaningful ecological targets for the NL Shelves Bioregion, based on Strategic Objectives, Conservation Priorities (CPs) and Operational Objectives (OOs) identified by the NL Region Oceans Program. Prior to this meeting, a Steering Committee developed a framework for setting design targets based on the best available scientific advice regarding MPA network design. Based on this framework, a range of ecological targets were generated, to be presented and reviewed by internal and external experts. The ecological targets identified through the Steering Committee and Regional Peer Review Process will be applied to MPA network planning scenarios in Marxan (software selected by the Oceans Program that delivers decision support for MPA network design).

The objectives of the Regional Peer Review Process were to review design strategies and associated targets for developing a network of MPAs in the NL Shelves Bioregion. Specifically:

1. Review the proposed framework for setting targets for OOs identified for the NL Shelves Bioregion.
2. Review proposed design strategies and associated targets for each OO identified for the NL Shelves Bioregion.

Participants included representatives from DFO (Science, Ecosystem Management, and Fisheries Management Branches), Environment and Climate Change Canada (ECCC), Industry, Department of Fisheries, Forestry and Agrifoods, academia, Indigenous groups, and environmental non-governmental organizations (ENGOs).

PRESENTATIONS AND DISCUSSION

MPA NETWORK PLANNING PROCESS

Presented by Melissa Abbott, DFO Oceans Program

Abstract

The purpose of this presentation was to provide context on the MPA network planning process. Canada is a signatory to the CBD, including Aichi Target 11, which commits participating nations to protect 10% of coastal and marine areas by 2020. The current Federal Government has added an interim target of 5% coastal and marine protection by 2017. These targets may be achieved in part through MPA network development. DFO's NL Region works with federal partners, the Province of Newfoundland and Labrador, Indigenous groups, and other interested parties in the MPA network planning process.

The Newfoundland and Labrador Shelves Bioregion was one of the five priority Bioregions identified for MPA network development. Others include: the Estuary and Gulf of St. Lawrence, the Scotian Shelf on the east coast, the Western Artic, and the Northern Shelf on the pacific coast.

The MPA network design process was summarized as follows:

1. Data and information gathering: available ecological data, mapped economic uses, Traditional Ecological Knowledge, and existing federal and provincial marine conservation efforts.
2. MPA network design: objectives and CPs established and reviewed (including the current meeting to review regional MPA network targets for the Newfoundland-Labrador Shelf).
3. MPA implementation: designate areas on a site-by-site basis (as resources allow) in the network as needed, using the appropriate regulatory tools and working with industry partners to incorporate their conservation measures.
4. Management and monitoring: manage, monitor, and evaluate the effectiveness of designated sites and the bioregional network.

Marxan decision support software will be used to generate exploratory design scenarios with low, medium, and high targets. Information on conservation targets and cost (i.e. fisheries) will inform the scenarios. Some information (non-fishing economic cost layers for example), will not be included in Marxan. Instead, these layers, and others will be assessed in overlay exercises. The result of network design phase will be a map for a future network of important areas to protect. It will be a decision support tool for the various jurisdictions with mandates and responsibilities related to marine protected areas.

The MPA network planning process is guided by five overarching Strategic Objectives, ten CPs, and sixteen specific OOs based on national guidance, stakeholder identified priorities, and science. Participants of this meeting were asked to review targets and thresholds for ecological features (EFs) of each ecological Operational Objective (i.e. how much or how many of each ecological component/ecological feature should be protected by the MPA network).

Marxan analysis is expected to begin in the summer of 2017, with network scenarios available for discussion by the fall. In the winter of 2018, consultation of the draft network with industry, Indigenous groups, and other stakeholders will begin. Approval and announcement of the MPA network is expected in 2019. It is not the intent to have the entire network plan implemented by 2020; instead it is meant as a long term planning tool. However, the MCT Plan for the NL Region does include an *Oceans Act* MPA for contribution to the 2020 targets.

Discussion

Several participants noted that it is important to include science (internal and external researchers and reviewers) throughout the MPA network planning process. One participant noted specifically that during consultation with stakeholders, scientists will provide a useful contribution to the discussion, specifically on whether suggestions may or may not be conducive to meeting the MPA network's objectives. It was also suggested the inclusion of DFO-Science representatives in stakeholder consultations would increase transparency with stakeholders and foster a more collaborative process. The presenter agreed that an Oceans-Science committee would be important throughout the planning process, however it was not the intent of DFO-Oceans to include Science in every consultation. Meeting participants were assured that changes to the MPA network would be brought back to a joint DFO Science-Oceans committee for review.

It was noted that Marxan represents a scientific and reproducible process for developing scenarios based on conservation objectives, with extensive peer-review of all ecological inputs.

Fisheries information was based on logbook information and standardized nationally. Some participants were concerned that socio-economic inputs were not subject to a robust and transparent review process comparable to the ecological data. However, it was explained that socio-economic data was beyond the scope of this Canadian Science Advisory Secretariat (CSAS) Regional Peer Review meeting.

The presenter clarified that the strategic goals and conservation targets listed in the presentation are not in a ranked order of importance. The high-level strategic goals were drafted nationally in Ottawa, and adapted for each bioregion through a consultations process that included the Science-Oceans steering committee, academia, ENGOs, Industry, and Indigenous groups. The CPs were subject to a similar process.

INTRODUCTION TO MARXAN

Presented by Mardi Gullage, DFO Oceans Program

Abstract

Marxan software is designed to address a minimum set problem (i.e. to obtain conservation objectives at the minimum cost). The algorithm produces a range of solutions to support decision making for MPA network design. One of the main components of this process is the planning units. Due to the vast extent of the NL Shelves Bioregion, the planning units have been applied at a 10 km^2 hexagonal lattice (106,403 planning units in total). Hexagons are spatially explicit and produce reserve designs with lower edge-to-area ratios. This results in higher compactness and better structural connectivity, an important consideration for the MPA network planning process. Marxan scenarios help identify high priority and efficient areas for protection based on the cost vs. ecological value of each planning unit.

Fisheries have the largest cost footprint in this bioregion, and have been selected as the cost layer in the Marxan analysis. Other marine uses (i.e. oil and gas, marine shipping) will be incorporated into MPA planning in later steps through an overlay analysis. Ten years of historical fishing data were collated to produce the fisheries cost layer. Extending the time-series further than ten years would represent foregone fishing effort (instead of current fisheries), and would greatly expand the fisheries footprint. Data quality concerns were also raised for older logbook data, due to the limitations of georeferencing. However, historical fishing grounds will be considered by the MPA network planning process in an overlay analysis on Marxan scenario outputs.

EFs include all inputs to Marxan that are relevant to the MPA network's CPs. EFs may include any measurable parameter of the environment, including biodiversity metrics, presence of species at risk, or important marine habitats. EFs may take any measurable form (percentage, abundance, biomass, area, etc.) and may be represented by either vector or raster data. Each ecological layer has an associated target that specifies how much or how many of those features should be protected to maintain the integrity of the MPA network.

Marxan scenarios are generated based on a simulated annealing algorithm, in which thousands of iterations are generated selecting different protected areas. In addition to the ecological and cost layers, the scenarios include a boundary cost, which encourages the creation of more manageable networks (fewer, larger MPAs) and a species penalty factor, which incurs a cost if a conservation target is not achieved. The costs and benefits of each scenario are calculated and the software delivers several potential network solutions to decision makers, including the "best" solution (i.e. highest conservation value, least cost) and "sum" solution (sites of high selection frequency based on thousands of iterations). Simulations will also test various start

conditions, which will lock-in existing MPAs and closures and lock-out existing features such as drilling platforms.

Discussion

The Marxan software addresses core systemic conservation principles: it is systematic, repeatable and transparent. However, some objectives are not easily measured, such as resilience, connectivity and non-persistent EFs (e.g. ice edge). Therefore, the Marxan scenarios are decision support tools that represent just one step in a multi-step MPA network planning process.

Participants raised concern that ecological data limitations in the northern portion of the bioregion (i.e. Northwest Atlantic Fisheries Organization [NAFO] Division 2G) would bias Marxan to select southern areas as more valuable for conservation efforts. Post-hoc overlay analyses were suggested as a possible solution by representatives from DFO-Oceans. Participants noted that the research vessel (RV) survey data, which is the basis of the Marxan process presented here, is not appropriate for the identification of important coastal areas. The impact of this limitation on features like eelgrass beds was discussed extensively throughout the meeting, and it was agreed very early that an alternate process would be required to plan MPAs in the nearshore.

The cost layer presented here is based on fisheries data from the last 10 years; several participants agreed that historical fishing data may also offer important information as climate and ocean conditions continue to change in the future. DFO-Oceans agreed, confirming that historical fishing data will be incorporated into overlay analyses after the Marxan outputs are developed.

SPATIAL DATA CONSIDERATIONS

Presented by Margaret Warren (DFO-Science)

Abstract

Several data considerations need to be made when determining which data layers will be used in Marxan. A review of different data types, including polygons and rasters, was discussed to show meeting participants what options were available and the implications of target setting on each type. Three different target types were discussed: proportions, total amounts, and total occurrences. Most features identified fall under the proportion based targets, however, certain features, such as capelin spawning beaches, may benefit from non-proportion based targets. Other data considerations were then discussed, such as the use of kriging, quantile classification and species distribution models (SDMs).

Discussion

It was noted that targets set on fish functional groups may only be relevant for the dominant species of some groups. For example, the piscivore functional group is driven by cod, turbot, silver and white hake. Participants recognized that conservation targets defined by the abundance and distribution of these species may be detrimental to non-dominant species, however it was agreed that group targets were appropriate to the scope and goals of the current MPA network planning process.

Among conservation objectives there is large variation in feature sizes. In general, lower proportion targets are assigned to very large features (20-30%), and high targets are assigned to small features (up to 100%) to balance representation. High targets will likely guarantee inclusion of some features in the Marxan scenarios. One participant expressed concern about high targets that guarantee inclusion of some small features, which may create a seed effect that impacts the entire network. The presenter agreed that this may be a concern, and that it should be investigated through sensitivity analysis. It was also noted that this meeting or a subsequent committee may determine whether there are small features in the planning area of ecological value that require guaranteed inclusion in the network. Several participants stressed that it is very difficult to predict how the software will behave; specific scenarios will have to be tested. For example, a small ecological feature may in fact be meeting other targets or the cost layer may prohibit protection of a particular feature. Low, medium, and high range targets will be included in the scenario development to allow some flexibility in the planning process. It was agreed that extensive sensitivity analyses will be required throughout the Marxan process.

For sessile coral species, Marxan targets will be set on the highest kernel density areas (Significant Benthic Areas). However, mobile fish species may require a different approach and Marxan MPA network solutions will be influenced by the input format (i.e. full distribution of a fish functional group vs or the top quantile of biomass). Some participants raised concern that if the full distribution is used, the Marxan algorithm will attempt to include high biomass areas to meet target efficiently, but high costs may push protection into an area of marginal importance. If the top quantile is employed as the input, an area-based target would be more appropriate than a proportional biomass target. One participant suggested that the top quantile of fish biomass may offer a limited seasonal snapshot of the biomass distribution, and the full data set may provide more flexibility to capture species' range throughout the year. It was also noted that the DFO Maritimes process originally included top quantile biomass inputs, but have since decided to run Marxan scenarios on the full distribution as well. This may result in protection of marginal habitat, however experience in the Maritimes regions indicates that it is very difficult to minimize socio-economic impact if only the top fish biomass quantiles are considered for protection. Academic and ENGO representatives pointed out that the meeting should only proceed with this conservation/cost trade-off if there is high confidence that a large area of marginal habitat provides ecological value comparable to the high biomass areas. In order to avoid protection of marginal habitat, and retain the full information in the dataset (i.e. without classifying by quantiles), one participant suggested a hybrid approach, for example retaining only the top 50% of biomass areas. Alternatively, separate targets could be set on the full distribution to increase scenario flexibility and on top quantile biomass areas to ensure that some core habitat is captured by the MPA network.

The DFO multi-species survey is divided into two time series by the 1995 gear change from Engels to Campelen trawls. The two periods have different survey coverage and catchability and therefore cannot be combined. This raised questions for how the data should be incorporated into conservation targets. Gear conversion factors were calculated for some species, but these calculations cannot be applied to the functional groups used in the target setting process because conversion factors are not available for all species. Due to the mesh size, conversion factors are further limited to larger size classes; there is no way to calibrate for juveniles. It is not clear how much juveniles impact the proposed biomass conservation targets. Although inclusion of juveniles would have a large impact on abundance, biomass may not be significantly changed. Participants noted that ecosystem shifts (i.e. dominance of groundfish) occurring at the same time as the gear change introduces further uncertainty into the comparison of Engel and Campelen trawl data. Due to all these sources of uncertainty and lack of continuity between the Engel and Campelen datasets, setting conservation targets on data layers representing each of the different gear time series was supported by many meeting participants.

In both survey time-series there remains significant data gaps in the far offshore and the nearshore. This is of particular concern for the inclusion of features like eelgrass beds and capelin spawning areas. One participant pointed out that eelgrass beds, which do not occupy very much space along the coast relative to 10 km^2 planning units, may get lost in the Marxan process. The presenter offered possible solutions: increase the species penalty factor for missing eelgrass in the final scenarios, or lock-in some planning units to guarantee inclusion of eelgrass beds. It was agreed that information in the coastal zone is insufficient for Marxan, and an alternate approach will be require for coastal ecological features, similar to the post-Marxan overlay analysis planned for non-fishing social-economic costs.

Limited data availability for the northern Labrador Shelf (NAFO Divs. 2GH) was also brought forward as a challenge for generating representative Marxan scenarios. All existing data for 2G was included in the target development process for this meeting, however the multi-species survey has not collected data in that area since 1999. Although the Northern shrimp survey covers NAFO Div. 2G, the sampling protocol does not match the multispecies survey, as all species other than shrimp are not consistently counted or recorded. Participants agreed that differences in survey coverage and timing introduce too much uncertainty to combine northern and southern data sets within the NL Shelves Bioregion. Several participants suggested that the northern areas could be included in the post-Marxan overlay analysis to ensure that 2G data are included in the network, despite potential southern bias in the Marxan scenarios. Many participants also supported a proposal to split the bioregion into north and south, with conservation targets set for each sub-region. Separating targets for the north and south sub-regions may also provide an opportunity to introduce alternative data sources for NAFO Division 2G and other data-poor areas. One participant noted that surveys by the Bedford Institute of Oceanography and Memorial University were conducted in that area in 2012 and 2016, respectively. Fisheries observer data (100% coverage in the Northern shrimp fishery recording all species) may also provide data for MPA planning on the Labrador Shelf.

ECOLOGICAL FEATURES AND TARGET SCORE DEVELOPMENT

Presented by Nadine Wells (DFO-Science)

Abstract

Draft design strategies were developed for OOs under each conservation priority to guide MPA network design in the NL Shelves Bioregion. Design strategies must specify:

1. The types of areas or features to be conserved; and
2. The relative conservation targets for those areas or features.

Design strategies were developed based on a literature review for each species as well as expert opinion with input from the MPA network steering committee. Also, guidance developed by other DFO regions was taken into account and best practices were applied where possible.

The CPs that have been identified include Ecologically and Biologically Significant Areas (EBSAs), representative features, structural features, marine habitats, ecosystem function, and at-risk species. It was determined that targets will not be assigned to EBSAs based on the knowledge that EBSAs would not be expected to benefit equally from implementation of spatial protection measures. Rather, these areas will be used as overlays on the MPA network scenario to determine the proportion of EBSAs that are captured by the original design.

EFs were presented based on the OOs under all other CPs. The scoring system that was devised to allow for the development of target scores for each EF was also presented.

A set of primary factors was used to assess EFs in order to develop target scores: size/distribution, uniqueness, vulnerability, responsibility and current status. Depending on the Conservation Priority, each ecological feature was scored based on applicable primary factors. Size/distribution scores were based on proportional targets whereas scores for uniqueness and vulnerability ranged from 1-5 and were assigned based on spatial extent, literature searches, and/or expert knowledge. Responsibility was based on the importance of the bioregion for particular species of marine birds and also ranged from 1-5. A final target score was generated by taking an average of the scores for uniqueness and vulnerability, plus responsibility for marine birds. At-risk species were assessed for uniqueness and vulnerability, and final target scores were then increased based on their current status.

Target scores were not developed for a number of species that could be considered as EFs under some of the OO categories. The reasons for this varied by feature but were usually related to data availability or relevance to MPA network planning.

Overall target scores were assigned to both individual species and functional groups. For individual species, the final target score was equivalent to the average of its uniqueness, vulnerability, and responsibility scores (where applicable). In the event a species was also evaluated on current status, an adjustment was applied to the final target score (e.g. 0.5 – 1.5 status dependent). At the functional group level, target scores were derived as an average of all target scores for all species within that group. For some functional groups (fish and some marine birds), only dominant species scores were averaged for the overall functional group target score.

With the exception of at-risk species, Marxan targets can be applied at the functional group level. The conservation target used in Marxan for functional groups or at-risk species will be determined by multiplying its overall target score by 10 (e.g. 1.88 x 10 = 18.8% conservation target). In order to provide a range of conservation targets, a low target will be calculated by subtracting 10% from the conservation target and a high score will be calculated by adding 10%. A conservation target can be increased or decreased depending on other factors, such as data quality or relevance to the conservation priority. These factors were considered in the working paper.

Discussion

The presenter noted that non-government scientists were specifically included on the steering committee to provide an important, external perspective to the process.

The steering committee determined that inclusion of the EBSAs in the MPA Network will help meet the commitment to protect unique marine areas. Meeting participants noted severe gaps in the northern areas (NAFO Divisions 2G, 2H, and 2J) and the presenter reiterated that this limitation does not indicate that these areas are not considered important.

Proposed conservation targets for representativity were based on six eco-units identified within the bio-region by DFO-Oceans. Several meeting participants suggested that Ecological Production Units (EPUs), a data layer developed by DFO-Science based on ecosystem function, would be more appropriate for this purpose. The EPUs are the result of research into relevant spatial scales for ecosystem based management. The boundaries of ecosystems are not fixed, as many species are mobile, however the EPUs are consistent areas identified by a food web functional level classification of many data sources. The EPUs include the shelf and shelf break, however areas deeper than 1,000 m were not classified. An important feature of the EPUs is that the classification distinguishes between the northern Labrador and the Newfoundland shelves, an issue that was brought forward as a concern about the eco-units and other data layers. An expert on the EPUs and ecosystem functions research in this bioregion noted that the two layers are based on different methods and different goals. For the purpose of ensuring representativity at the ecosystem function level, it was suggested that EPUs are more appropriate. It was explained to meeting participants that the eco-units were chosen from among five possible classification systems as the most suitable to MPA planning needs and were reviewed by DFO-NL Science. However, at the time when this review was conducted, the EPU research had not been completed, and this classification was not available for consideration and comparison to eco-units or other candidates. Many participants spoke to the value of the EPUs, and the importance that the MPA network planning process remains open to new or updated scientific knowledge about the bioregion. Participants agreed to replace the eco-units with EPUs (i.e. including both layers). In particular there was considerable support for separating the eco-units between 2H and 2J to better represent the differences between the north and south portions of bioregion. A participant explained that the Pacific Northern Shelf Bioregion, which is 1/10 the size of the NL Shelves Bioregion, will include several ecosystem classifications in order to address the fact that a single system is unlikely to reflect all variation in the marine environment.

Conservation targets for ecological function were developed for invertebrates, fish, cetaceans, and marine birds. Capelin spawning areas (beaches and demersal spawning areas) were included as an additional feature under ecological function. The presenter noted that Atlantic salmon were not included, because marine spatial planning for Atlantic salmon presents a significant challenge due to their life history characteristic (anadromous and far ranging during marine life stages). It was suggested that there may be opportunities to include estuaries as coastal conservation features for the protection of Atlantic salmon at a later stage in the MPA network planning. Conservation targets were not developed for pinnipeds and some cetaceans, largely due to a lack of sufficient spatial data, but also because many of these species are highly mobile and information on critical habitat is currently lacking. Conservation targets for marine birds were developed through a collaborative process with experts from Environment and Climate Change Canada. Shorebirds were excluded at this time due to a lack of data coverage for these species in the NL Region (e.g. Piping Plover). Proportional conservation targets were proposed for bathymetric features based on potential contribution to biodiversity (e.g. rugosity). One participant suggested further prioritization of bathymetric features to minimize potential fracturing of the Marxan output. Many participants agreed that bathymetric features would be more appropriately included under the representativity strategic objective, instead of ecological function. Other structural features included under this objective are canyons, steep flanks, areas of high fish diversity, high invertebrate diversity, and high species richness for corals.

Conservation targets for marine habitats were developed for coral functional groups (large gorgonians, small gorgonians, sea pens, black corals) and sponges, Vulnerable Marine Ecosystem indicators (VMEs, including ascidians, crinoids, and bryozoans), and coastal biogenic habitats (eelgrass and kelp beds). The crinoid layer was based on modeling of all crinoid species combined; an expert on corals and other invertebrates from Memorial University cautioned managers that the Arctic stalked crinoids and other deep sea species have very different life histories and it may not be appropriate to combine these taxa. Similar concerns were raised for the ascidian and bryozoan data layers due to uncertainty in species level identification for these taxa. There may be invasive tunicates or bryozoans inadvertently included within conservation efforts. Some participants noted that it’s unlikely that the ascidians will drive the MPA network site selection, however they cautioned against undermining the scientific process by grouping unrelated species. Concern was raised about how modeled input data was reviewed and validated. Many participants agreed that it is important to recognize that publication in the literature may not guarantee that a model is suitable for the purpose of target setting in the MPA network. It was explained by presenters that the MPA network steering committee relied heavily on internal experts and data inputs that had been previously reviewed, through DFO peer review processes or publication in academic literature. It was noted that the committee was very forthcoming with data, acknowledging uncertainties are associated with any model.

One participant disagreed with the decision to set conservation targets on species listed by COSEWIC before legislative recognition under SARA. Specifically, this participant pointed out high spawning stock biomass estimates in recent stock assessments for Unit 1 and 2 Redfish, which are included as at-risk species in the proposed conservation targets. However, the majority of participants supported the inclusion of COSEWIC species, particularly given the political difficulty in protecting commercial species under SARA. The lead researcher on this work indicated that the at-risk species were extensively vetted by the DFO Science steering committee, and no species would be excluded from that list without sufficient new information to support such a change. However, follow up discussions with relevant experts are planned before finalizing conservation targets for all at-risk species.

Several participants suggested using the fishery observer database, particularly the swordfish longline fishery, to gather data on tuna, porbeagle, and other shark species. It was also noted that the 2007-09 shark survey could be used. There was disagreement over the role of spatial conservation for mobile and wide ranging taxa, such as sharks. One participant suggested that the limited knowledge of spatial distribution and highly mobile life history of these species make it difficult to justify spatial protection. However, it was clarified by experts among the participants that spatial conservation measures may or may not be appropriate for some mobile species but this conclusion should not be made without further study of the species in question. All meeting participants agreed that more data on pupping area for shark species would be extremely important to the MPA network planning process.

PRIMARY FACTORS: UNIQUENESS, VULNERABILITY, RESPONSIBILITY, AND CURRENT STATUS

Presented by Christina Pretty and Lauren Gullage (DFO-Science)

Abstract

In order to generate target scores for species within the NL Shelves Bioregion, comprehensive information on the uniqueness, responsibility, vulnerability, and current status were collected. Scores were assessed at the species level and then averaged within functional groups to generate target ranges for use in Marxan analysis.

Uniqueness was ranked on a scale from 1 to 5 and was assessed for three CPs: Marine Habitats, Ecological Functions, and At-risk Species. It was defined spatially, whereby species with broad distribution ranges were considered less unique and were assigned lower scores than species with narrow distribution ranges. Overall, 117 species from 28 functional groups were assigned uniqueness scores, with 60 species receiving scores of 1, 31 species receiving scores of 2, five species receiving scores of 3, 12 species receiving scores of 4, and nine species receiving scores of 5. When averaged, 12 functional groups received scores between 1 and 2, eight received scores between 2 and 3, two received scores between 3 and 4, five received scores between 4 and 5, and one received a score of 5. The most unique functional groups included corals and marine birds, while the least unique were largely comprised of fish and cetaceans. The average uniqueness of the nine at-risk species assessed was 1.89.

A responsibility factor was assessed for marine birds only. It was scored based on the percentage of the global population which were found within the NL Shelves Bioregion. However, in the event the species consisted of discrete populations, only the Atlantic basin

population was considered. Scores for this factor ranged from 1 to 5, with 1 indicating a small proportion of the total population was found within the NL Shelves Bioregion, and 5 indicating the bioregion contained a significant portion of the total population. Of the 34 species arranged into 9 functional groups, ten received a score of 1, 11 received a score of 2, eight received a score of 3, four received a score of 4, and one received a score of 5. At the functional group level, three received a score between 1 and 2, two received a score between 2 and 3, and two received a score between 3 and 4. Only one functional group was determined to have a responsibility score of 4 or above. Including this factor for marine birds led the functional group conservation target to increase for 3 groups and decrease for 5 groups. One of the functional groups remained the same.

The primary factor of vulnerability was assessed for the Ecological Function, Marine Habitats, and At-risk Species CPs. Vulnerability was defined as the degree to which characteristics of a feature (e.g. species' life history) make it vulnerable to natural or anthropogenic disturbances. It was assessed using information on a species' life history characteristics (LHC) and tolerance to perturbation (TP).

LHC were scored from 1 (indicating lower intrinsic vulnerability) to 5 (indicating higher intrinsic vulnerability) based on up to four sub-factors:

- Growth rate
- Age of sexual maturity
- Lifespan or adult annual survival
- Fecundity

The ranges for each sub-factor were divided into five classes per taxonomic group using Jenks natural breaks or rankings by experts and were assigned scores from 1-5. Each sub-factor was scored for each species, and the final LHC score for that species was computed as an average of the sub-factor scores rounded to the nearest whole number.

TP was scored from 1 (high tolerance) to 5 (low tolerance) based on two sub-factors:

- Frequency of occurrence or population estimate
- Population trend

Frequency of occurrence was scored as a function of how often species were observed in the NL Shelves Bioregion. Proportional scales were classified from 1 (high frequency) to 5 (low frequency) within each taxonomic group using Jenks natural breaks. Where frequency of occurrence information did not exist, proxies were used to generate relative comparisons of frequency of occurrence. For marine birds, population estimates were used instead of frequency of occurrence.

Population trends for all species were identified as increasing, stable, or decreasing. The TP score for each species was calculated by combining the frequency of occurrence score and the population trend.

The vulnerability score at the species-level was calculated as the average of the species' LHC and TP scores. For functional groups, the vulnerability score was the average of the vulnerability scores of all species within that functional group. The vulnerability scores for selected species and all functional groups were presented for discussion.

The primary factor of current status was assessed only for species under the At-risk Species Conservation Priority. This included the following:

- Species that are designated as Endangered or Threatened under the *Species at Risk Act* (SARA);
- Species that are assessed as Endangered or Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC);
- Species that are in the Critical or Cautious zone (depleted) under the DFO Precautionary Approach Framework (PAF);
- Species that are considered depleted under NAFO.

For those species, target scores were adjusted by +0.5, +1.0, or +1.5 based on their current status (depleted, threatened, and endangered respectively). For species that had more than one status (e.g. depleted and endangered), the status corresponding to the most significant target adjustment was selected for scoring purposes.

Of the 19 at-risk species, two species had their scores adjusted for being depleted (+0.5), six species for being threatened (+1.0), and 11 species for being endangered (+1.5).

The scores for uniqueness, responsibility, vulnerability, and adjustments based on current status were presented for discussion.

Discussion

Primary Factor: Uniqueness

Many participants expressed concern about grouping taxa across wide score ranges. For example, cetacean uniqueness scores ranged from 1-2.5 for functional groups, although some individual species scored much higher (up to 4 and 5). Questions were raised about whether taking the average of these species scores was appropriate for conservation target setting. The lead researcher for this work indicated that this question will be pursued further. High scoring taxa included North Atlantic Right whale (4), large gorgonians (4), Atlantic spotted dolphins (5) and black corals (5). These taxa are rare (demonstrated by few reported occurrences) and/or non-aggregating (e.g. black corals). It was suggested that Atlantic spotted dolphins were scored high due to their distribution far offshore, beyond survey efforts. An expert on marine mammals suggested that it may be more appropriate to exclude data-poor Atlantic striped and Atlantic spotted dolphins from the MPA process at this time.

Primary Factor: Responsibility

This factor was generated for marine birds and modified from the Canadian responsibility index developed by ECCC. The purpose of this factor was to differentiate between rare species that are expected in the bioregion, and species that are common elsewhere but may be included at low abundance in the bioregion at the edges of their range. It is meant to indicate whether the bioregion hosts a significant portion of a species population, and therefore has a higher responsibility for protecting it. Meeting participants thought that this was a useful factor, and it was recommended that it be investigated for other taxa. Experts present at the meeting indicated that a similar calculation may be possible for cetaceans in the Atlantic. However, data limitations may prohibit the development of a similar score for fish, coral, and sponges at this time.

Primary Factor: Vulnerability

Vulnerability was assessed for all components of the ecosystem function target (fish, marine mammals, and marine birds), marine habitats, and at-risk species, and was based on a literature review of LHC and TP. Some participants questioned the appropriateness of using frequency of occurrence as a measure of TP. Most species are not expected to be evenly distributed in the stratified and seasonal RV survey. For example, grenadier are not expected to be found in the shallow survey strata; as a result, they will always appear to be vulnerable by this type of scoring. It was suggested that a core range be used to calculate frequency of occurrence within appropriate habitat. However, it was also argued that frequency of occurrence represents the environmental envelop. If a species, such as one of the grenadiers, occurs in a restricted range (i.e. the continental slope) that contributes to a form of inherent vulnerability.

There was some disagreement among meeting participants about specific scores. For example Atlantic cod scored 3 out of 5, which some participants felt was high for a highly fecund broadcast spawner that withstood centuries of fishing. However, other participants pointed out that previous work by Cheung et al. (2007), scored Atlantic cod high for vulnerability. This reference was considered during the development of other scores, however few other species overlapped. Additional scores available on Fishbase were considered, but reported global growth rates vary significantly from local growth rates. For cod, the high frequency of occurrence and the stable population trend contributed to its score of 3; this stock's enormous reduction from historic levels was not included in the scoring. Several participants suggested that a comparison to historic levels may more accurately represent vulnerability in a stock that is widespread but low biomass. Researchers on this project noted that current status is considered in a later score component for at-risk species. Random stratified acoustic biomass surveys were suggested by participants to improve estimates for pelagic species, particularly forage fish like capelin.

Conservation targets for offshore biogenic habitats were developed for corals, sponges, and VME indicator species. Population trends for these taxa were identified through literature review and consultation with experts. However, it was recognized by meeting participants that population trends may be misleading for these species. Corals and sponges are very slow growing, and it may not be possible to identify population trends in the time series of the survey. Rarity and the non-aggregative nature of black corals increased the vulnerability score (score of 5), but experts present at the meeting noted that gorgonians (score of 4) are equally fragile and vulnerable to trawl damage. Some participants suggested that this score reflected catchability more than true vulnerability. It was also noted by an external reviewer that trawl data for sponge and coral species should be treated with caution. Once these sessile and delicate species are caught by a trawl, they are permanently removed from the environment (unlike fish species, where it is assumed that the majority are left).

Issues of species identification and separation were raised again for ascidians, crinoids and bryozoans. Participants suggested that the assessment of vulnerability may deliver very different results if *Boltenia ovifera* were separated from other ascidians and if stalked crinoids were separated from other crinoid taxa. Experts present at the meeting noted that confidence in the bryozoan data was low, due to difficulty identifying to species level or distinguishing invasive byozoans from native species. It was also noted that potentially vulnerable stalked bryzoans are present in Newfoundland waters, but little is known about their distribution or life history.

Vulnerability scores for the coastal biogenic habitats of kelp and eelgrass were low overall (2 and 1.5, respectively). An expert suggested that the proposed score was much too low for eelgrass in particular. Eelgrass is broadly distributed in a thin band around the Newfoundland coast, which is lost in the resolution of the planning units. Importantly to this process, eelgrass is not restricted to a couple of large plots that would be easily protected. Rough calculations completed at the meeting demonstrated that the total eelgrass distribution would fit into a few planning units. It was argued if that were true for any other conservation priority, it would score much higher for vulnerability than what was presented for eelgrass. In addition to restricted distribution, eelgrass beds also provide important juvenile fish habitat and carbon cycling, which some participants felt should factor into conservation priority setting. Presenters explained that increasing population trends led to the low vulnerability score for eelgrass, however the documented increase, mostly on the northeast shore, represents moderate gains that remain fragile due to sea ice scour. On the south coast of Newfoundland, however, eelgrass is threatened by invasive species, including green crab. Eelgrass beds are currently the only Ecologically Significant Species officially designated by DFO; the meeting agreed that this status should be incorporated in a separate process to identify conservation areas on the coast where Marxan layers are not appropriate.

Primary Factor: Current Status

Current status was only assessed for at-risk species, although some meeting participants recommended investigating this type of score for other taxa. Current status score adjustments were incorporated into individual species scores before functional group conservation targets were calculated. It was suggested that rescaling the current status and including it under vulnerability for all species would be more appropriate. Some participants were concerned that current status, calculated only for at-risk species, in addition to individual conservation targets for at-risk species, would overvalue these taxa in the Marxan process, to the detriment of overall ecosystem function goals.

PRIMARY FACTOR: SIZE/DISTRIBUTION

Presented by Margaret Warren (DFO-NL Science)

Abstract

Some features, such as eco-units, are large scale, or coarse filter features and do not easily fit into the target setting framework for species groups. Proportion-based targets were used for these based on a formula provided in the Marxan Good Practices Handbook (Ardron 2010). For this approach, larger features will have smaller targets relative to smaller features with larger targets. This prevents the over-representation of large features in the network design. There were discussions on target setting for biodiversity layers for fish, corals, sponges and other invertebrates. Results for the proportion-based targets were also shown and discussed.

Discussion

It was noted by several participants that biodiversity may not indicate health or function of the ecosystem. For example, in a cod dominated system, depletion of cod increases overall biodiversity. A possible solution for this may be to consider richness (rather than biodiversity indices) for all taxa, as evenness may not be important in a healthy ecosystem that is dominated by one or a few key species. Some members supported a proposal to incorporate diversity as an overlay post-hoc, to ensure hotspots were captured by the Marxan process. In the case of a biodiversity layer, one expert noted that there are proxies for biodiversity already included in Marxan (e.g. measures of habitat complexity). The overlay analysis could therefore function as an independent validation that the Marxan simulation outputs match the MPA network planning goals, similar to the proposed overlay of EBSAs. However, many were concerned that proposed overlay analyses remain vague. If, for example, it is found that the Marxan solutions missed biodiversity hotspots, it is unclear how the planning process would proceed. Many participants agreed that the priority given to biodiversity in the strategic goals for the national MPA network planning process warranted inclusion of this data as a primary input in the Marxan simulations. Presenters also explained that Marxan solutions can also be queried for how much of a target is achieved to deliver a measure of validation for this conservation goal. For example, in the Maritimes, a target of 40% was set on the top quintile biodiversity areas; the maximum captured in final network solutions was 26%. These results were helpful for managers looking to understand and interrogate the Marxan solutions to improve the network. A representative from DFO-Maritimes strongly recommended including biodiversity layers in the Marxan process. Following this discussion, the meeting reached consensus that biodiversity layers would be included in Marxan.

Review of several conservation target maps showed that the spatial distribution of biodiversity across taxa and seasons appears to be concentrated on the shelf break. One participant highlighted that this is a feature of the recent Campelen RV survey; analyses of fish biodiversity distribution in the Engel period shows higher diversity on banks. Meeting participants found this discrepancy interesting, but limited understanding of complex ecosystem function made it difficult to draw conclusions on the role of this perceived shift, or identification of a "healthy" biodiversity level. Similarly, areas of high chlorophyll A persistence were proposed as a proxy for high productivity, but these areas were not incorporated into MPA network planning. Participants pointed out that many other layers act as measures of ecosystem productivity (e.g. fish biomass, biodiversity, etc.). Further, highly variable and seasonal chlorophyll A production cannot be protected or managed by an MPA, and therefore some advised that it would be logically inconsistent to include this feature as a conservation target. It was suggested that instead of including productivity as a Marxan layer, it may offer a useful overlay to identify whether data-poor, but potentially productive areas are included in the final MPA network solutions.

PROPOSED CONSERVATION TARGETS

Presented by Nadine Wells (DFO-NL Science)

Abstract

The proposed conservation targets were presented for each ecological feature based on the methodology presented above. Meeting participants were reminded how the target scores and conservation targets were calculated. The results were presented by conservation priority category. For fish functional groups, the low conservation targets (%) ranged from 5.0 (capelin spawning areas) to 22.5 (plankpiscivores). For cetaceans, the range was 6.9 (Mysticetes) to 22.8 (small cetaceans). For marine birds, the range was 8.0 (surface, shallow-diving coastal piscivores) to 21.7 (plunge-diving piscivores). For offshore marine biogenic habitats the range was 7.5 (ascidians) to 40.0 (black corals). The low conservation targets for kelp and eelgrass were 5.0 and 7.5 respectively. For at-risk species (SARA), the range was 12.5 (Harbour Porpoise) to 45.0 (North Atlantic Right Whale). For at-risk species (COSEWIC), the range was 20.0 (American Plaice) to 40.0 (Beluga Whale). For at-risk species (DFO/NAFO), the low conservation targets for Northern Shrimp and Witch Flounder were 10.0 and 15.0, respectively. Several discussion points, for example, how to set targets on Engel vs. Campelen data, were raised at the end of this presentation for consideration.

Discussion

Low, medium, and high conservation targets were presented for all components of ecological function and at-risk species to provide flexible scenarios for Marxan solutions. Participants and presenters pointed out that the specific calculation of these targets was arbitrary, and the proposed method effectively caps all conservation targets at 50%[1] based on the assumption

[1] The medium target was calculated as 10* [feature score]. The low and high targets were calculated relative to the medium target, and [med]-10 and [med]+10, respectively.

that very high targets would be difficult or impossible to achieve within the Marxan simulation. However, experts disagreed with this approach; depending on the feature, it may be appropriate to set a much higher target. For example, in the Great Barrier Reef MPA, key features were given conservation targets of 100%.

REVIEWER REPORTS

Reviewer 1, Alida Bundy (DFO-Maritimes)

Reviewer #1 commended the meeting, saying that the work was well executed and many of the methods are synergistic between the regions. In addition to applying the eco-units and EPUs for representativity, this reviewer proposed dividing the bioregion into two or three areas. In the Maritimes, the bioregion was divided into coast, offshore, and Bay of Fundy. Network design scenarios were developed for all three broad scale regions. This approach was chosen to address the data discrepancies between the shelf and the offshore, and the ecological uniqueness of the Bay of Fundy. It was reiterated that the Marxan process will not adequately address the needs of the coast, which is poorly sampled by the RV survey.

On the topic of the scoring, reviewer #1 questioned the validity of the 5 point and 10-fold multiplication, which limits the MPA network to medium scores of 50 or less. Although it is reasonable to set achievable goals, this could also be achieved by defining scores ecologically, and adjusting from there rather than setting a constraint on targets prematurely. In the DFO-Maritimes' MPA network planning process, some targets were set to 100%.

Averaging species within functional groups was an issue that also came up in the DFO Maritimes' process. Technicians from the Pacific Marine Analysis and Research Association (Pacmara) advised that combining scores is an important compromise for managers, but it's important to use a method that minimizes loss of information. With that in mind, reviewer #1 suggested investigating alternatives to taking the straight mean (e.g. root mean square (RMS)). Participants noted that tests of the RMS approach for functional group scores resulted in higher conservation targets however, they would be open to doing further investigation of this approach given that other changes had been suggested which would affect final scores for some groups (e.g. removing rare cetacean species from functional groups).

The lack of targets for pinnipeds was highlighted by this reviewer. During target development, experts were consulted, who felt it was appropriate to omit pinniped species at this point. Spatial information on seals is limited, and it is not clear that spatial management measures will contribute significantly to seal conservation. At present there is no hunting on whelping patches, which would be the most appropriate habitat type for spatial management. It was suggested that telemetry may be used to identify feeding areas. Similarly, Atlantic Salmon were omitted due to a lack of spatial data during their time at sea. Relevant coastal data may be used to identify important bays; however the role of spatial management is still unclear.

This reviewer commented that invertebrates were largely missing from the process. Although invertebrates have not been recorded throughout the entire time series, there are data available for the last 5-10 years. Reviewer #1 strongly suggested including invertebrate functional groups. It was explained that little has been done with invertebrate functional groups due to some data limitations; sampling in different years since the adoption of the Campelen gear has been inconsistent for invertebrates, and the data requires significant cleaning.

In addition to these points, reviewer #1 also supported the proposal to move structural underwater features from the ecological function goal to representativity. It was also suggested that for species omitted due to insufficient data, post-Marxan overlays should be applied to test whether conservation was achieved for the species in question. Finally, reviewer #1 pointed out that in the Maritimes, as well as NL, the role of overlay analyses is unclear.

Many participants pointed out that the distribution data for capelin spawning areas is insufficient, as an example of the limitations of the Marxan simulations to capture important features of the data-poor coast. It was also noted that significant species, like Arctic Charr and American Lobster, were not discussed and may be appropriate for inclusion in a separate coastal MPA planning process.

Reviewer 2, Susanna Fuller (Ecology Action Centre)

For VME indicator species, reviewer #2 recommended that managers look beyond the distribution models, which have high uncertainty for ascidians, bryozoans, and crinoids. Taxonomic resolution and identification issues were noted as particularly important for these groups. Relatively small changes could improve this issue; for example, reviewer #2 recommended treating B*oltenia ovifera* separately from the other ascidians, and splitting sponges into *Asconema* and geodids. Other participants also advised against using specific distribution models; although an informal review conducted at the meeting indicated that the crinoid model is acceptable for MPA planning, the ability to predict presence of bryozoans and ascidians were near random, or worse. It was noted that uncertainty was not yet incorporated into the target setting process. In the DFO-Gulf MPA network planning process, uncertainty was addressed quantitatively as part of the target development process. Experts cautioned that to apply a similar or comparable method to incorporate uncertainty into the NL Shelves Bioregion MPA planning would require significant, or perhaps prohibitive, effort. Kernel density was suggested as an alternative to SDMs in cases of high model uncertainty.

Investigation of other data sources, such as observer reports, was suggested by reviewer #2 to incorporate species like Leatherback Sea Turtles, Greenland Shark, and tuna into the Marxan process. Although spatial conservation may not be the optimal approach for these highly mobile species, these data could help identify key locations, such as pupping areas and migration corridors, for protection. Reiterating the views of many participants and the first reviewer, a different and separate MPA network planning process was suggested for the coastal zone. Reviewer #2 recommended that this second process should include coastal features like saltmarshes, rockweed, coralline algae, etc., in additional to kelp and eelgrass. The arbitrary conversion from target score to conservation target was also mentioned by reviewer #2. A multiplication of 20, instead of 10, was suggested to match methods developed in the Maritimes.

Regarding the uncertainty around the EBSA overlays, reviewer #2 recognized that the decisions made on this question will set an important precedent and must be very clear. This reviewer also felt that SARA critical habitat or management plans for non-SARA species should be considered. Furthermore, under the CBD Aichi Target 11, protected areas should be integrated into the wider seascape, based on ecological concepts of connectivity. Due to the limited knowledge about, and difficulty studying ecosystem connectivity, this concept has not been incorporated into the MPA network. Reviewer #2 urged managers, scientists, and external participants to maintain flexibility in the process, as it will be crucial that the MPA network adapt to new information as research in this bioregion continues. Finally, the reviewer reminded participants that the NL Shelves Bioregion abuts land claim agreements, and the planning process should incorporate Indigenous perspectives and ecological knowledge. Presenters noted that Indigenous knowledge was part of some data layers (e.g. Community-Based Coastal Resource Inventories [CCRI] data). It was explained that although there is no intention to introduce Indigenous knowledge as an additional layer to Marxan, there is intention to incorporate Indigenous knowledge throughout the MPA network planning process.

Conclusions

Both reviewers suggested that the meeting participants, scientists, and managers reflect upon the methods and scores generated in other regions. Although the meeting agreed that final targets do not have to match exactly across bioregions, it would be reasonable to expect some harmonization across broad target ranges and methods. Stock conditions of mobile species may vary widely by region, and thus the required level of protection may vary widely as well. However, many participants felt that score/target harmonization across areas was most logical for inherently vulnerable sessile species, like corals and sponges. In the Pacific, high Sensitive Benthic Area (SBA) targets are already locked in by the Hecate Strait MPA; although the NL Shelves Bioregion will protect a large area through the Laurentian Channel MPA, the starting conditions are very different. Target setting approaches proposed by reviewers and participants included generating the medium target through a 20-fold, instead of 10-fold multiplication and adjusting to increase the implicit target cap for SBAs and other special features on a case-by-case basis. One reviewer suggested using previous policy (e.g. SBAs) to set coral targets. This was not accepted by the meeting, due to the difference in core goals between the MPA network and other spatial management efforts. Both reviewers felt strongly that eelgrass should be reprioritized, and the MPA network planning process should identify a more appropriate way to incorporate coastal conservation.

PROPOSED CONSERVATION TARGETS (UPDATED)

Presented by Nadine Wells (DFO-NL Science)

Based on comments from meeting participants, a modified proposal for conservation priority score setting was presented on the final day of the meeting. The original multiplication method and full distribution of data was retained for mobile species; however, scores for sessile organisms and stationary features (e.g. capelin spawning areas) were multiplied by a factor of 20 (instead of 10) to generate the conservation target. The impact of feature size was increased to encourage high targets on small polygon features.

Although these changes addressed many of the concerns raised throughout the meeting, some issues remain: the data format for VME indicator species (e.g. raster or vector) could not be determined without consultation of experts on those taxa; the limited and disaggregated data on black coral renders target setting very difficult; and methods for incorporating waterfowl block and colony data are still uncertain. There was extensive discussion of the coastal zone, and consensus that this area would require special consideration. Partitioning the coast and treating it differently would also introduce the possibility to incorporate data that was omitted from Marxan, like the seabird colonies. Experts clarified that the seabird colony polygon data may also provide a useful proxy for generally productive areas, and that the specific buffer parameters could be altered based on existing range and movement data.

Ultimately, it was agreed that the coast would be retained in the Marxan process, due to the importance of quantitative and transparent conservation targets. This was agreed with the understanding that the MPA network steering committee would investigate additional coastal data sources, and that all Marxan results for the coast would be considered preliminary and subject to critical review. Academic studies in the coastal zone were previously compiled by the Canadian Parks and Wilderness Society (CPAWS) and supplemented through extensive expert consultation to identify 10 important areas throughout the province from 146 sampled sites. These areas were suggested for CSAS review and inclusion in the Marxan process for the coast. A key limitation to the identification of conservation areas on the coast in Marxan is the planning unit resolution; a proposal to apply a mixed resolution approach with smaller planning units at the coastline was made, which was supported by meeting participants and external reviewers.

The modified conservation targets also shifted current status into the vulnerability assessment. At-risk status was ranked 1-5: depleted species scored 3, threatened species scored 4, and endangered species score 5. It was noted that species of special concern could be included on this scale as a score of 2. The current status adjustment factor was added to the sum of scores before calculating overall species vulnerability. However, this adjustment resulted in slightly lower scores for at-risk species compared to original method. Many participants were not comfortable with the relatively arbitrary changes. Consensus was reached that the original method would be pursued with some sensitivity analysis recommended in order to better understand the role of a current status adjustment factor in final target setting.

Species penalty factors (SPF) were proposed as a mechanism to adjust for uncertainty within the input data (i.e. set lower penalty factors for missing conservation targets on input features with higher uncertainty). It was discussed that the SPF could be increased for ecologically significant species (i.e. eelgrass beds), and decreased for features or areas that are data-poor such as NAFO Divisions 2GH. SPF could also be adjusted to ensure targets are met for more recent datasets (e.g. Campelen data layers) vs. earlier datasets (e.g. Engel data layers). Finally, SPF could be adjusted for data layers that are based on survey/observational data vs. models. This proposal reflects the methods tested and selected in the Maritimes and Gulf MPA network planning process.

Stationary features were also given an adjustment factor in the modified target proposal; scores were multiplied by a factor of 20 instead of 10. This resulted in much higher scores for all biogenic habitat features, and resulting vulnerability scores for sea pens and black corals were very similar to scores identified in the Maritimes. This modification for the score development was accepted by the meeting, however, many members felt that the conservation target on sponges remained low. The meeting agreed to split sponge functional groups and assigned the steering committee to review functional group level conservation targets for sponges.

For cetaceans, it was demonstrated that omitting non-dominant species from functional group scores drastically reduced overall conservation targets. An expert on marine mammals and the associated data suggested incorporating direct observational data at the same level as the distribution models. Consensus was reached that these targets could be resolved by the steering committee through expert consultation.

The meeting reached consensus that proportional targets (10% minimum) would be set on both the EPUs and eco-units. It was also agreed that the areas >1,000 m unclassified by the original EPU process would be divided into two additional offshore classes, with a north-south boundary between NAFO Divisions 2H and 2J, and that a third EPU would be added for the Laurentian Fan and NAFO Subdivision 3Pn. It was suggested that the coast be treated as an additional eco-unit (or several) with a 10% minimum target for coastal protection, and this proposal was assigned to the steering committee for review as part of the overall consideration recommended for the coastal zone.

The meeting also reached consensus that 10% should be the minimum for all targets, without altering the upper range, similar to the target setting approach adopted in the Pacific and Maritimes regions. Many participants requested a transparent reporting process on whether targets are met or not through the Marxan solutions and subsequent overlay analyses.

FINAL REMARKS

Delivered by the Chair

The intent of the process was to provide scientific guidance on conservation targets, while incorporating some flexibility due to uncertainty of Marxan outputs at this stage. It was clear throughout this meeting that additional science advice (formal or informal) will be required in the next stages. Some design elements must still be considered: viability, repetition, connectivity, etc., and there are many projects built into the Canadian Healthy Oceans network research goals to support managers. Any changes to CPs will require additional science advice to add new layers and sensitivity analyses were strongly recommended.

Due to uncertainty around ecosystem level impacts of climate change, the meeting strongly recommended including adaptive management mechanisms within the MPA network. Within the Maritimes Region, a review period of 10 years was recommended. This meeting suggested a more flexible term of 5-10 years for review of the MPA network, and agreed that the Science steering committee may refine this term based on approaches taken across the other bioregions.

One participant commended participants who have worked to include Indigenous knowledge and perspectives in the EBSA process and other aspects of MPA network planning. However it was also noted that efforts to incorporate Indigenous knowledge should be expanded to actively engage Indigenous groups in both the collection and implementation of their knowledge in MPA network planning.

RESEARCH RECOMMENDATIONS

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

1. Protection of coastal areas

As discussed throughout the three day meeting, participants recommended an additional process (e.g. CSAS Regional Peer Review process or CSAS Science Response process) to ensure adequate representation of the coastal/nearshore in the MPA network. This may include Marxan outputs and other data sources (lobster, herring, rockweed, coralline algae). Several participants emphasized the importance of engaging Indigenous groups during the prioritization and protection of coastal areas. The steering committee was tasked with investigating the utility of setting an additional 10% target within the coastal area, and exploring potential data sources for the coast.

2. Mixed resolution Marxan analysis

The meeting adopted the proposal to test mixed resolution Marxan analysis, generating smaller planning units at the coast. The purpose of this proposal was to facilitate meaningful inclusion of fine scale coastal data in the quantitative and repeatable Marxan simulation process.

3. Responsibility scores

It was agreed that the responsibility score component presented for marine birds was useful for MPA network planning, and the meeting made recommendations that the steering committee investigate this score component for other taxa.

4. Invertebrate functional groups

Further research employing existing datasets was recommended to expand the invertebrate functional groups considered by the MPA network conservation targets.

5. Seabird colonies and foraging buffers

Inclusion of seabird colony data, and associated buffer zones to capture foraging areas were supported by the meeting. However, based on the concerns raised by managers about spatial uncertainty within the estimated foraging zones, it was recommended that these areas be refined through literature review and expert consultation with ECCC.

6. Impacts of climate change

The potential impacts of climate change and associated shifts in species distribution must be considered for the planning, implementation and management of the MPA network. The meeting strongly encouraged research into the potential impacts of anthropogenic climate change on the MPA network.

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APPENDIX I – TERMS OF REFERENCE

SCIENCE GUIDANCE ON DESIGN STRATEGIES FOR A NETWORK OF MARINE PROTECTED AREAS IN THE NEWFOUNDLAND AND LABRADOR SHELVES BIOREGION

Regional Peer Review – Newfoundland and Labrador Region

May 16-18, 2017
St. John's, NL

Chairpersons: Keith Clarke and Robyn Jamieson

Context

Canada has agreed to the CBD Aichi Target 11 which includes the conservation of 10% of coastal and marine areas by 2020. Areas of high biodiversity and those that provide ecosystem services are of particular importance. The NL Shelves has been identified as one of the five priority biogeographic units for MPA network development. The primary goal of Canada's MPA network is to provide long-term protection of marine biodiversity, ecosystem function, and special natural features.

Oceans Program, NL Region, has identified Strategic Objectives, CPs and OOs for the NL Shelves Bioregion. For each of the OOs, information on design strategies or targets is required to determine how much/many of each ecological component to aim to protect.

A Steering Committee has used the best available scientific advice regarding the design strategies for a MPA network in the NL Shelves Bioregion. A framework for setting design targets was developed and used to provide a range of targets which can be used as inputs into Marxan (software selected by the Oceans Program that delivers decision support for reserve system design).

Objectives

The objectives of the Regional Peer Review Process are to review design strategies and associated targets for developing a network of MPAs in the NL Shelves Bioregion. Specifically:

a) Review the proposed framework for setting targets for OOs identified for the NL Shelves Bioregion.

b) Review proposed design strategies and associated targets for each OO identified for the NL Shelves Bioregion.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Expected Participation

- DFO (Science, Ecosystem Management, and Fisheries Management Branches)
- Industry
- Department of Fisheries, Forestry and Agrifoods
- Academia
- Aboriginal communities/organizations
- (ENGOs)

APPENDIX II – AGENDA

Regional Peer Review – Science Guidance on Design Strategies for a network of Marine Protected Areas in the Newfoundland and Labrador Shelves Bioregion

Chair: Keith Clarke and Robyn Jamieson

May 16-18, 2017

Salon A – Delta Hotel
120 New Gower Street, St. John's, NL

Tuesday, May 16, 2017

Time	Topic	Presenter
09:00	Opening remarks and overview of Regional Peer Review Process	*Chair*
-	MPA network Planning Process	*Melissa Abbott*
-	Introduction to Marxan	*Mardi Gullage*
-	Spatial Data Considerations	*Margaret Warren*
12:00	LUNCH	-
13:00	Introduction to Methods: EFs and Target Score Development	*Nadine Wells*
-	Primary Factors: Uniqueness, Vulnerability, Responsibility, Current Status	*Christina Pretty, Lauren Gullage*

Wednesday, May 17, 2017

Time	Topic	Presenter
09:00	Primary Factors: Uniqueness, Vulnerability, Responsibility, Current Status cont'd.	*Christina Pretty, Lauren Gullage*
-	Primary Factors: Size/Distribution	*Margaret Warren*
12:00	LUNCH	-
13:00	Proposed Targets	*Nadine Wells*
-	Reviewer Reports	*Alida Bundy & Suzanna Fuller*

Thursday, May 18, 2017

Time	Topic	Presenter
09:00	Final targets	*Nadine Wells*
-	Drafting of summary bullets for Science Advisory Report	*All*
-	Conclusions and research recommendations	*All*

Time	Topic	Presenter
-	Upgrading of Working Paper	*All*

Notes:

- Health breaks will occur at 10:30 a.m. and 2:30 p.m.
- Lunch (not provided) will normally occur 12:00-1:00 p.m.
- Agenda remains fluid and may change.

APPENDIX III – LIST OF PARTICIPANTS

Name	Affiliation
Derek Butler	Association of Seafood Producers
Elizabeth Young	Canada-Newfoundland and Labrador Offshore Petroleum Board (CNLOPB)
Dave Taylor	Canadian Association of Petroleum Producers (CAPP)
Tanya Edwards	Canadian Parks and Wilderness Society
Erika Parrill	DFO Centre for Science Advice – NL Region
James Meade	DFO Centre for Science Advice – NL Region
Michele Boriel	DFO Communications – NL Region
Marty King	DFO Oceans – Maritimes Region
Maxine Westhead	DFO Oceans – Maritimes Region
Jessica Mitchell	DFO Oceans – National Capital Region
Jennifer Janes	DFO Oceans Program – NL Region
Mardi Gullage	DFO Oceans Program – NL Region
Melissa Abbott	DFO Oceans Program – NL Region
Tony Bowdring	DFO Oceans Program – NL Region
Jason Simms	DFO Resource Management – NL Region
Alida Bundy	DFO Science – Maritimes Region and Meeting Reviewer
Bob Gregory	DFO Science – NL Region
Christina Pretty	DFO Science – NL Region
Corey Morris	DFO Science – NL Region
Danny Ings	DFO Science – NL Region
David Cote	DFO Science – NL Region
Eugene Lee	DFO Science – NL Region
Fred Phalen	DFO Science – NL Region
Geoff Veinott	DFO Science – NL Region
Hannah Murphy	DFO Science – NL Region
Jack Lawson	DFO Science – NL Region
Katherine Skanes	DFO Science – NL Region
Kate Dalley	DFO Science – NL Region
Kent Gilkinson	DFO Science – NL Region
Krista Tucker	DFO Science – NL Region
Lauren Gullage	DFO Science – NL Region
Margaret Warren	DFO Science – NL Region
Mariano Koen-Alonso	DFO Science – NL Region
Mark Simpson	DFO Science – NL Region
Nadine Templeman	DFO Science – NL Region
Nadine Wells	DFO Science – NL Region
Neil Ollerhead	DFO Science – NL Region
Nicolas Le Corre	DFO Science – NL Region
Philip Sargent	DFO Science – NL Region
Pierre Pepin	DFO Science – NL Region
Vonda Wareham	DFO Science – NL Region
Katie Gale	DFO Science – Pacific Region
Susanna Fuller	Ecology Action Centre and Meeting Reviewer
April Hedd	Environment and Climate Change Canada
Dave Fifield	Environment and Climate Change Canada

Name	Affiliation
Karel Allard	Environment and Climate Change Canada
Sabina Wilhelm	Environment and Climate Change Canada
Dwan Street	Fish, Food and Allied Workers Union (FFAW)
Johan Joensen	Fish, Food and Allied Workers Union (FFAW)
Bobbi Rees	Govt. of NL – Dept. of Fisheries and Land Resources
Kris Vascotto	Groundfish Enterprise Allocation Council
Keith Clarke	Meeting Co-Chair
Robyn Jamieson	Meeting Co-Chair
Evan Edinger	Memorial University
Rodolphe Devillers	Memorial University
Patricia Nash	NunatuKavut Community Council
Francine Mercier	Parks Canada
Stephen Rose	Qalipu Mi'kmaq First Nation Band
Emilie Novaczek	Rapporteur
Victoria Neville	Torngat Secretariat
Sigrid Kuehnemund	World Wildlife Fund (WWF)