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Maritimes Region

Proceedings of a Maritimes Workshop to Scope the Assessment of Human Impacts in the Coastal Zone of Eastern Nova Scotia: Application of the Maritimes Region Ecosystem Approach to Management Framework

26-28 November 2012
Dartmouth, Nova Scotia

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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 workshop to scope the assessment of human impacts in the coastal zone of Eastern Nova Scotia: application of the Maritimes Region Ecosystem Approach to Management (EAM) framework was held on 26-28 November 2012. Participants included representatives from Science, Ecosystems Management, Policy and Economics, Aquaculture Management and Resource Management from Fisheries and Oceans Canada (DFO) as well as representatives from the fishing industry, aboriginal communities, non-governmental organizations, academics and the province of Nova Scotia. The results of this meeting will be used to inform the next stage of this area-based assessment process.

Compte rendu d'un atelier de la région des Maritimes pour déterminer la portée de l'Évaluation de l'impact des activités humaines sur la zone côtière de l'est de la Nouvelle-Écosse : mise en application du cadre de l'approche écosystémique à la gestion de la région des Maritimes; du 26 au 28 novembre 2012.

SOMMAIRE

Un atelier régional a eu lieu du 26 au 28 novembre 2012 afin de déterminer la portée de l'évaluation de l'impact des activités humaines sur la zone côtière de l'est de la Nouvelle-Écosse et la mise en application du cadre de l'approche écosystémique à la gestion de la région des Maritimes. Parmi les participants, on comptait notamment des représentants du Secteur des sciences, de Gestion des écosystèmes, de Politiques et économie, de Gestion des pêches et de l'aquaculture et de Gestion des ressources de Pêches et Océans Canada (MPO) ainsi que des représentants de l'industrie de la pêche, des collectivités autochtones, d'organisations non gouvernementales, des milieux universitaires et de la province de la Nouvelle-Écosse. Les résultats de cet atelier serviront à guider les prochaines étapes de ce processus d'évaluation régional.

INTRODUCTION

The Chair of the meeting, T. Worcester, welcomed participants and thanked them for attending this Maritimes Regional workshop to scope the assessment of human impacts in the coastal zone of Eastern Nova Scotia and apply the Maritimes Region Ecosystem Approach to Management (EAM) Framework. Participants introduced themselves (Appendix 1), and the Terms of Reference for the meeting (Appendix 2) and Agenda (Appendix 3) were reviewed. Participants were invited to engage fully in the discussion and contribute their knowledge and expertise to the review.

This meeting is intended to be the first stage of a multi-stage process. The intent of the overall process is to define a spatially-based operational approach to assess coastal activities using an EAM Framework that was developed for the Maritimes Region. The focus at this stage is on Eastern Nova Scotia (ENS). While ENS is not the most data rich area, it is not the most data poor area either. There is an active and vocal community in this area that can provide valuable community knowledge. There are new coastal development proposals that would likely benefit from a more structured and consistent approach to assessment. During this process, the usefulness and role of various mapping and modeling tools that may have the potential to help assess cumulative impacts, including habitat degradation, eutrophication, organic loading, and interactions with wild fish/invertebrate populations will be reviewed. Non-model based approaches (conceptual models) will also be used. While this is a science process, and the current EAM framework focusses on ecological strategies and processes, the importance of the human dimension of EAM was acknowledged and the role of social and economic information/pressures were considered. This process is expected to support and enhance the provision of DFO Science advice for regional decisions concerning managed activities in the coastal zone, such as tidal power, coastal development, aquaculture, and capture fisheries. At the end of this multi-stage process, there will be an evaluation of the usefulness of this type of approach. Also, while the focus of this project is the Maritimes Region (ENS), the issues and challenges discussed are similar to those being addressed by other regions. It is hoped that these discussions will help inform similar discussions at a national level.

This meeting was organized as a DFO science workshop, rather than as a Science Advisory Meeting, so no Science Advisory Report (SAR) was produced. The product of the meeting was this proceedings. Research Documents may be developed for review at future meetings.

PRESENTATIONS

ECOSYSTEM APPROACH TO MANAGEMENT FRAMEWORK

Presenter: K. Curran
Rapporteur: T. Floyd and T. Worcester

Presentation Highlights

The ecosystem approach (what it is and why it's needed) was described, and a working definition of an "ecosystem approach" and "integrated management" was provided. The ecosystem approach at DFO is an evolving process that was developed through a series of workshops:

- Dunsmuir I (Jamieson and O'Boyle 2001) – holistic approach:
  - Large Ocean Management Areas (LOMAs)
  - Ecosystem Overview and Assessment Process
- Dunsmuir II (workshop held in Montreal on 20-21 November 2007) – introduced the idea of an incremental approach:
  - Simplification of the approach – reduced scale
  - Incremental (bottom-up)

The Maritimes EAM Framework focuses on activities within DFO's purview but gives consideration to other activities as well. Looking forward, there is a renewed national direction regarding an ecosystem approach. DFO will continue to think globally (e.g., holistic - bioregions), while acting locally (e.g., incremental - sectors/sub-units). DFO will continue to undertake science and develop tools to assist with the assessment of human-ecosystem interactions (e.g., Pathways of Effects [PoEs], Ecological Risk Assessments, etc.). The regional EAM framework can be viewed as a common assessment framework to guide DFO Maritimes in how it manages marine ecosystems and the human activities in a consistent and transparent manner across management sectors.

Discussion

Although there was a familiarity with applying similar frameworks to fisheries (e.g., groundfish and herring), there was confusion about why and how this will be applied to aquaculture, given that aquaculture licensing is a provincially managed activity. Also, the tactics were not seen as reflecting existing aquaculture mitigation. It was explained that activities under "DFO purview" is meant to encompass those things controlled by DFO (e.g., fisheries) as well as other activities that DFO provides advice on, influences, or provides information on (e.g., aquaculture). Further to that, the list of tactics was not meant to be exhaustive and additional tactics and attributes, applicable to various activities, would be further populated during this meeting.

The application of the EAM Framework was seen as being limited to marine systems. To be a true EAM approach, it was felt that it should consider the freshwater environment, especially when diadromous species are seen as having significant value. It was clarified that the application of the framework has been limited to marine activities in the past and it has not been tested in the freshwater environment yet, but the intent is to expand to include the entire ecosystem.

Given that activities falling under the responsibility of municipalities (e.g., sewage treatment) can impact ecosystems, municipal buy-in will be important. The objective will be to try and start simple and make sure all necessary parties are aware of the initiative and engage them as

required. It is important to understand that it is not the objective of this process to comment on how other government institutions operate and manage but to ensure their issues and management measure are captured and integrated into the framework where necessary, while addressing information gaps and uncertainties where possible. Accountability, transparency and consistency are important for the general public as well as for government. There is a need to document the decision-making process, including the associated scientific information, models and uncertainties.

It was suggested that strategies, pressures and attributes should be related to the particular human activities under consideration. One of the objectives of this process is for the invited experts to highlight, document and evaluate any gaps. Although the focus has been limited to date, it is expected that the framework will be broadened over time and all relevant information will be considered.

ECOLOGICAL CLASSIFICATIONS

Presenter: M. Greenlaw
Rapporteur: T. Floyd and T. Worcester

Presentation Highlights

Three levels of a hierarchical subtidal ecological classification, integrating oceanographic, geological and geomorphic data were presented. It was recommended that the area of assessment focus on region 11 of the mid-level of the classification. Unit 11 is broken into two classes at the lowest level of the classification, units 11a and 11b. There are similar oceanographic characteristics to the proposed area of assessment along the Atlantic coast, but the topography and surficial sediment patterns are unique. The proposed area is unique regionally in that exposed bedrock with patches of sediment (perhaps the most exposed bedrock in the region), forms a complex topography of nearshore islands with varying degrees of shelter. This bedrock is exposed at or near the seafloor. Several lithologies may be present, but are grouped together at this scale. This topography consists of irregular terrain with rocky outcrops with veneers of softer sediment. Softer sediments could be mobilized by currents if present. Exposed outcrops may be rare, as the bedrock is commonly covered with a veneer of softer sediment with thicker sediment in troughs and pockets and large areas of smooth sea floor between bedrock highs. Most exposed bedrock would be in shallower water, with a distinct transition happening around 120 m of depth to mud. The percentage of surficial sediments is expected to increase with depth.

Epifauna is likely to be present in areas where only a thin veneer of soft sediment exists. The outer limit of the assessment area extends to about 140m depth. Other characteristics that may affect the distribution and abundance of species present have not been included in the classification. These include currents, nutrients, turbidity, sediment inputs, and sea surface temperature.

With respect to general oceanographic conditions, temperature is similar along the Atlantic coast but changes around Cape Sable. Benthic salinity is lower than nearshore regions to the south west and the outer Bay of Fundy. Benthic salinity variability is slightly higher than to the south west and is generally higher in the nearshore.

The inlet types in the proposed area of assessment were primarily complex pelagic bays (predicted to be biodiverse but not productive, with a general variety of species) with a few estuaries. Sheet Harbour is the deepest inlet in the area of assessment, and the comparatively shallow water depths and topography characterizing longer inlets without the underlying

exposed bedrock of the St. Mary's River estuary forms a distinct break between Unit 11a and 12a.

Some Ecologically and Biologically Significant Areas (EBSAs) have been identified in the area using qualitative ecological significance ranking (ranking 1-5), including the Eastern Shore Islands Wildlife Management Area and Taylor Head-Sheet Harbour Area (Doherty and Horsman 2007, Gromack et al. 2010)

Some other classification approaches that have been used to characterize the area include Davis and Brown's districts of the coastal zone and the Significant Habitats of the Atlantic Coast (SHACI) initiative. These approaches did not describe what they based their breaks on, but they line up well with the proposed area of assessment.

Discussion

The outer boundary of the subtidal classification is generally 100 m, except in the Bay of Fundy. The nearshore breaks are at about 50 m. These breaks are based on the extent of the Research Vessel (RV) survey but take into account a number of different factors.

The sea surface temperatures and salinity are based on modeled averages over an irregular grid with spacing between 10 km and 500 m. It was recognized that nearshore point sources of water are problematic for modeling. There is satellite data now available that could be used at a useful resolution given that freshwater plumes can be observed.

The inlet classification is based on physical characteristics but has not been validated with biological data given that data is very sparse. There may not actually be one data point for each inlet. Ecological importance is, therefore, based on predicted values. The EBSAs are a DFO product and did incorporate biological data and expert opinion.

Substrate classification information is in the process of being published and the inlet classification is published. The ranking of ecological significance is not a DFO product but it is published in a journal article. EBSA information is from a separate peer reviewed process.

Observations that the bottom turns to soft sediment at about 75 fathoms (140 m) in depth confirms the model prediction of this feature.

The boundary of assessment was discussed and clarification of the nearshore/offshore split was provided. Basically, the split is based on depth with some consideration of oceanographic factors and is somewhat problematic on the eastern shore because there is no clear break. The break could also reflect whether primarily benthic versus pelagic activities, pressures, or attributes are being evaluated. Essentially, the scope of the activities could dictate the scale of the assessment area.

There is a separate intertidal classification that could be integrated in the overall assessment as it matched up very well with the assessment area.

Given that most impacts will likely be felt perpendicular to the shoreline (e.g., will go downhill), it would be good to capture vertical structure. Therefore, it may make more sense to go outwards (11b) rather than along the shore.

Other sources of information or characteristics for consideration include currents, given that wind driven offshore flushing rates are important biological drivers in the area and are fundamentally different than forces that are driving the Bay of Fundy ecosystem. Acidification is important from a freshwater perspective and might influence the estuarine environment. In general, freshwater systems along the Eastern Shore are very acidified (St. Mary's Rivers has better pH), and significant efforts are underway to restore buffering capacity in the West River

Sheet Harbour. Therefore, it may be worth discussing the effects of acidification and integrating water quality data into the assessment

With respect to stratification, it was included in the principal component analysis but was not as good as temperature and salinity from a modeling perspective given that the modeled data is not uniform enough to be useful. It was noted that there may be sufficient salinity and temperature data from satellites and that more up-to-date information is available (e.g., temperature, chlorophyll)

Generally, there was support for using Area 11a and b as the assessment area.

AVAILABLE SOURCES OF INFORMATION RELATED TO COASTAL ACTIVITIES AND PRESSURES

Presenter: D. Shervill
Rapporteur: T. Floyd and T. Worcester

Presentation Highlights

Types of Human-Use Activities Considered

- Fisheries
- Shipping
- Aquaculture
- Shellfish classification areas and sanitary sites
- Effluent discharge, mineral processing, dredge disposal
- Historic gold districts
- Areas of conservation value

Fishing Effort and Landings

- Composite map for fixed bottom contact gear. Total number of gear sets between 2005 – 2009. Used DFO MARFIS and ZIF databases. Does not include lobster.
- Separate maps for scallop effort and landings
- Composite for groundfish (2006-2010)
- Lobster effort: logbooks mapped by statistical district (2008-2011).
- Lobster total catch weight in pounds (2008-2011)
- Lobster catch weight per trap haul (2008-2011). Could also look at days fished per km^2 traps hauled, and catch weight per km^2

Shipping Data

- One year of Aquatic Invasive Species (AIS) data. Ships over 300 gross tonnage. Bulk of traffic into Sheet Harbour with some traffic in some other inlets.
- Vessel densities
- Can also graph interpret vessel speed (peak at 10-17 knots)
- Can separate into just tanker traffic. Tanker speeds are a little higher (13-16). 35-45 fathoms.
- Light Detection and Ranging (LIDAR) reflectance data and multibeam from Canadian Hydrographic Service (CHS).

Aquaculture Sites

- NS aquaculture sites. Licenses and contains information related to species (salmon versus mussels) but unable to tell easily which ones are active. Limited public information on production, feed rates, or organic enrichment.

Shellfish Sanitation Program

- Environment Canada information. Classification related to safety of consuming harvested shellfish (Fecal coliform levels). Chemical indicators are not tracked. Based on repeated water quality samples (5 times every 3 years, or minimum once per year).
- Point and non-point source pollution. Non-point sources include agricultural, marinas, wharves, golf courses. Point sources include sewage treatment plants.

Effluent Discharge, Mineral Processing and Dredge Disposal

- Mostly focused on Sheet Harbour. Some dredge disposal (very small area). No quantification of inputs. Data related to pollution source treatment type and discharge limits.
- Sampling of dredge disposal site in 2008. Environment Canada. Substrate type, contaminant levels (e.g., lead).

Historic Gold Districts

- Size of dot related to amounts produced.
- Amount of tailings (mercury and arsenic).

Other Potential Types of Activities and Sources of Information

- Food, Social and Ceremonial (FSC) fisheries
- Land-use mapping: industrial, agricultural, residential, undeveloped
- Recreational and tourism use
- Coastal property valuations
- Renewable energy potential
- Oil spill data
- Invasive species
- Recreational salmon (historic) and commercial eel fishing
- Fishery officer local knowledge

There are a variety of methods for reporting effort, but the appropriate method will depend on the objective.

The Southern Upland (SU) Atlantic Salmon population has been evaluated as endangered by Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and there is information for this population including: juvenile abundance electrofishing data, historical commercial fishing weir locations, historical recreational fishing data (location of scheduled rivers and angling data), various tagging programs and historic index river information.

There is also data on the location of eel fishing areas, as well as information on the drainage basins in Halifax and Guysborough counties that have authorized Gaspareaux fisheries and where recent logbook reports have indicated a fishery is active.

Discussion

It is important to note that there is a groundfish moratorium in place on the Eastern Scotian Shelf and this seriously hampers the availability of data.

Lobster is only a 2 month season here along the Eastern Shore, so catch per unit effort (CPUE) may be a better comparative indicator of the fishery than total tonnage.

Clarification was made that detailed aquaculture information is available to DFO management and science for analysis, but it is not made publically available except as summary type information (for business security purposes).

The US requires fecal coliform sampling every year to approve for their markets, so it is possible to identify the sewage outfalls through this sampling.

There is a current interest from the World organization for Animal Health (OIE) in linkages between shellfish harvesting and virus transmission and some areas have closed off due to concerns. Some test areas have been established to collect information for modeling. There has been discussion of the zone of influence of a disease point source (like a sewage plant) to be defined as 3 (to 4 for Maritimes) orders of magnitudes of dilution for viruses. The veterinary community would have this information.

Shellfish sanitation is run by 3 departments. Canadian Food Inspection Agency (CFIA) runs it, Environment Canada is a partner and DFO enforces it. DFO monitors algal blooms but CFIA does not always ask for it. There is not a direct correlation between algal monitoring and actual risk given that there are a lot of false positives, so it may not be a useful indicator. Ship Harbour is an approved shellfish area.

There are data analysis complications with FSC fisheries because it is difficult to distinguish between reported FSC catch and other catch as it is not included in DFO's MARFIS database.

Consideration needs to be given on how to use the fisheries information, particularly with respect to presence versus absence and historical versus current data. It is critical to get a handle on the data and not to over-interpret it.

The datasets presented are meant to be representative and not the full extent of what's available.

There have been significant changes in this area over the past 15 years. There have been major groundfish population declines in an area that used to support a significant groundfish fishery. Snow crab and lobster populations and fisheries are increasing, and there have been changes in water temperature. If these changes continue, it will be important to consider indicators that can account for ecosystem change, although there is concern about the government's ability to track complex indicators given reductions in the science budgets.

There is an extensive dataset on the freshwater sites around the gold mines given concern over whether consumption advisories were required for recreational angling.

Marine plant fisheries are not represented in the information provided, and this information warrants discussion on how to include it within the process. For example, there is an estimated 50,000 tonnes of *Fucus* sp. along the Eastern Shore, and aerial photographs are available. There may also be kelp maps available.

Invasive species are important for aquaculture evaluations, not as a source of invasive species, but as a substrate for colonization and a recipient of negative consequences of invasive species. Examples of invasive species that should be evaluated include green crabs and *Codium* sp.

Until recently, the St. Mary's River was an index river for Southern Upland Atlantic Salmon and annual adult return and smolt escapement data is available for that river.

Residential use information should be considered, especially given that most residents have wells and septic fields.

It available, measures of ocean debris/ocean garbage may be a useful indicator. The International Coastal Cleanup database may have data on shoreline cleanups, and Clean Nova Scotia may also have some information, but it should be at a useful scale.

Arsenic and lead contamination were raised as issues several times as a human consumption concern. There are some one-off projects looking at contaminants in the coastal zone but nothing comprehensive. The Federal contaminated sites program may have some information.

If available, the location of unexploded ordinances, marine disposal at sea sites, and associated fishery closures may warrant inclusion.

There may be mussel watch data available as well.

An attempt should be made to find data on contaminant levels in the coastal environment (e.g., Doug Loring- technical reports) and whether DFO supported this sampling. There may be sampling sites on the Eastern Shore (e.g., Goldboro).

STRESSORS AND PRESSURES DISCUSSION

There are AIS vectors associated with recreational boating that may require a more focused analysis that is separate from AIS vectors associated with larger vessel traffic analysis (e.g., ballast water discharge). There are also risks of spills related to boating.

Federally listed species-at-risk, COSEWIC assessed species, and provincially listed species should all be included in the assessment.

Residential information should be considered as a pressure on the environment.

Commercial and industrial pressures, such as the proposed mines on the eastern shore and commercial activities within Sheet Harbour, should be considered

Acidification has also led to contaminant inputs into the marine environment, and this forms a significant part of water quality degradation. There are pH classifications available from DFO (P. Amiro).

Offshore current patterns are important in the area and should be integrated into the analysis.

SHACI used local knowledge and Fisheries Officer information and should be used for this analysis.

The assessment should incorporate point and non-point source pollution.

PACIFIC REGION ECOLOGICAL RISK ASSESSMENT FRAMEWORK (ERAF)

Presenter: Miriam O
Rapporteur: T. Floyd and T. Worcester

The Pacific Region did not have conservation objectives when they began this process, but they needed to develop something for Marine Protected Areas (MPAs) and LOMA planning purposes. They did not have a lot of data, but they did have some information to evaluate. A modular framework was developed with scoping activities, Valued Ecosystem Components [VECs], PoEs, and screening of VECs using conservation objectives and specific criteria (Level 1- qualitative risk assessment, Level 2 semi-quantitative risk assessment, and level 3 – quantitative risk assessment). Their process with the 3 levels of assessment lead to the identification of three types of indicators: risk-based indicators (vulnerability), "stressor" indicators (indicators to monitor pressures, like fishing effort), and "state of the ecosystem" indicators. Their main goal included being as transparent and reproducible as possible in their evaluation so that stakeholders can clearly understand how decisions are made. Most of the quantitative data was related to the stressors and commercial datasets.

The Pacific Region integrated uncertainty into the analysis based on work by Therriault and Herborg (2008) and Therriault et al. (2011), but they are now trying to incorporate uncertainty into the actual ranking rather than assessing it independently.

Overall, the Pacific Region took a reductionist approach. They selected risk-based indicators (e.g., number of active chimneys at Endeavour Hydrothermal vent MPA), indicators of stressors (e.g., fishing effort), and indicators of the state of the ecosystem (e.g., phytoplankton/ zooplankton). The intent is to prioritize, but they will also be providing a full list of indicators related to stressors and the state of the ecosystem.

Discussion

Pacific Region needed a way to prioritize and focus efforts with the goal of developing a realistic monitoring plan that will capture impacts on the VECs. The intent was to identify the features or attributes in the ecosystem that are at higher risk and what the drivers are in the system, both human induced and natural.

Pacific Region wanted to distinguish between monitoring something that is vulnerable versus monitoring of a stress. Consideration was given to how closely linked the state of the ecosystem indicators were to the stressors and whether one could observe changes in the ecosystem indicators as a result of management actions, recognizing that some indicators are driven by larger scale processes. This is a key difference with the Maritimes Region EAM Framework.

Pacific Region only did level 1 assessment for Pacific North Coast Integrated Management Area (PNCIMA) (400 cells to evaluate), in order to filter out the lower risk attributes, and there is no intention of doing a level 2 assessment. Although there were many stressors in the ecosystem, they only looked at 17 VECs (attributes).

For the MPAs, the level 1 analysis was skipped. A level 2 analysis was done of the various activities, and the most important stressors were fishing and scientific research. Overall, the ERAF provides a process for decision making that is as transparent and reproducible as possible so that stakeholders can clearly understand how decisions are made.

SUMMARY OF DAY ONE

K. Curran gave a brief overview of the "Ecosystem Approach", a short history of DFO's national approach to EAM, and the Maritimes Region's framework for EAM, recognizing that there are some differences in how an Ecosystem Approach is being applied across the country and some changes in its application over time. The Maritimes Regional framework, as represented in the Appendix to the Terms of Reference for this meeting, represents a common suite of objectives and strategies that have been incorporated into integrated fisheries management plans, have been used to guide science activities within the region, and are now being applied to a coastal cumulative effects assessment process.

There were some questions about how this approach will be applied to things beyond DFO purview (and what exactly is meant by DFO purview). It was suggested that DFO will need to focus on things that DFO has influence on. However, discussion often returned to the influence of shore-based activities (like sewage treatment, mining, residential land-use, industrial activity) that are beyond DFO control or even influence (in some cases). DFO was also asked about the future application of the framework to the freshwater environment. It was suggested that this process will have made a step forward if it can address the intertidal and estuarine environments adequately.

M. Greenlaw then presenter her subtidal classification (region 11) as a means of defining the initial geographic scope of this assessment. The area investigated is approximately Ship Harbour to St. Mary's River, though St. Mary's has more in common with Area 12 to the north (softer sediments). For this particular region, it appears to be the sediment characteristics that define the break with adjacent regions, with a high prevalence of exposed rock and primarily complex primary bays with high diversity but lower productivity. Modeled information seems to provide a good picture of the area (given data limitations). While some gaps have been identified, so far there are no major inconsistencies with the common understanding of the area. There was some discussion of how far from the coast to go – whether to approximate 50m or closer to 100/140m depth. It was suggested that further discussion was required after a decision was made on the activities that would be assessed. In addition to the geographic scale of the assessment area, M. Greenlaw also identified some work describing the ecological significance of this area (in terms of biodiversity and productivity), as well as mentioning the identification of two Ecologically and Biologically Sensitive Areas (EBSAs) (Sheet Harbour, St. Mary's River bay).

While the data used may be sufficient for identifying breaks, additional biophysical information may be required for conducting the effects assessment. It was noted that current information will be needed to help assess movement of contaminants or particles. Also, there is more detailed temperature information available from satellites (can see the freshwater plumes). Information on pH classification of river systems (relevant for impacts of acidification and contaminant inputs to the marine environment) is also available.

D. Shervill gave a presentation on the information currently available to identify human activities in this area. This included: fisheries effort and landings (groundfish, scallop, lobster), shipping information, aquaculture sites, shellfish classification, effluent discharge, mineral processing, and dredge disposal, and historic gold districts. T. Floyd showed some maps of the historical salmon weirs and eel fisheries.

There was some discussion about information available on sewage outfalls and some guidance on the proposed zone of influence related to viruses for these. There were questions about whether algal blooms are tracked (though given the potential for false positives, this may not be useful). There is likely additional data for the gold mines and work done for the Environmental Assessment of the Goldboro site. There were questions raised about the information available

of FSC fisheries. It was noted that care is needed in characterizing the fisheries in this area, as there have been large environmental changes over the past 15 years with the collapse of the groundfish fishery and the increase in lobster and snow crab. It was noted that there is information on marine plants (1250 hectares with a standing stock of 50,000 wet tonnes in ENS), though it is not clear what harvesting is occurring within the area. This was identified as a gap, as was information on invasive species. Additional discussion on how to deal with residential land-use is needed, with the intent of highlighting specific concerns or issues related to effects on the marine environment. Also, there were questions about whether there is information on marine debris from shoreline cleanups, mussel watch data, unexploded ordinances, marine disposal sites. However, given the need to prioritize, it was suggested that these might go into an inventory of activities and things to be aware of, but may not be the focus of this assessment. Two activities that were identified as being potentially worthwhile carrying forward in the assessment were recreational boating (as a vector for invasive species, source of pollution, noise, etc.), as well as riverine or land-based sources of pollution.

There were some questions related to the attributes that would be evaluated, such as the list of species at risk, invasive species, and marine plants present in the area.

Finally, there was a short presentation from Miriam O on the Pacific Region ERAF approach being used to help identify priority conservation objectives for PNCIMA and some MPAs. There are some similarities between this approach and the Maritimes Region approach (identification of human activities and stressors, use to Pathways of Effects to evaluate impacts to VECs (which are similar to attributes). However, there are also some differences. For example, the Pacific Region does not have conservation objectives (the ERAF process was helping to identify these), while the Maritimes Region has fairly clearly defined objectives and strategies. The Pacific Region process uses three levels of assessment: level 1 screening, level 2 semi-quantitative risk assessment, and level 3 quantitative risk assessment, leading to identification of three types of indicators: risk-based indicators (vulnerability), “stressor” indicators (indicators to monitor pressures, like fishing effort), and “state of the ecosystem” indicators. So far, PNCIMA is only using a level 1 screening (400 cells to evaluate). MPAs will undergo a level 2 assessment, but only fisheries and scientific research are being evaluated). The main goal is to be as transparent and reproducible as possible in the evaluation so that stakeholders can clearly understand how decisions are made. The working paper provides some useful guidance on selecting/prioritizing valued ecosystem components (species, habitats, and communities).

Discussion

Although there are linkages between this area-based assessment and similar processes in the DFO Gulf Region (Gulf of St. Lawrence Integrated Management [GOSLIM]), various regions are tackling EAM a little differently based upon national guidelines and approaches. The NS Province put in a lot of effort into providing information on its relevant policies and legislation into the Gulf Region process, and it is important to use this information. Given that DFO Habitat Managers will now be responsible for all of NS, including areas previously managed by Gulf Region, a common framework will be important. Habitat Management is engaged in Gulf processes and, as stressors are identified through this process, the work from the Gulf can be used to align mitigation. The Canadian Water Network out of UNB is taking a larger role in planning and monitoring in Gulf Region estuaries and in conducting freshwater studies. However, this resource is not available for the Maritimes Region assessment.

Eel fishing activities include elvers and adult eels; this should be captured in the assessment.

It would make sense to separate finfish from shellfish aquaculture and use these terms throughout the document (e.g., not just salmon and mussels being farmed).

Consider adding fish passage and sedimentation as a contributing factor related to land-based activities/coastal development. Also, add shoreline alteration as a potential stressor under coastal development.

Fish plants are a major source of nutrients to coastal zone.

There is interest in liquefied natural gas (LNG) infrastructure development just outside the study area, but the industrial activities category should capture related effects.

Renewable energy could be considered as a potential activity.

This process will try and assess how the DFO Habitat Management Program risk assessment criteria (and other decision frameworks) fit into the selection of attributes.

Attributes and tactics are not meant to be an exhaustive list. Possible additions and deletions will be discussed.

It was asked whether it is possible to take “natural” pressures into account (changing temperature, storms etc.). The response was that Fisheries Management has attempted to include these when setting thresholds and reference points (e.g., precautionary approach).

There is an existing Halibut fishery in the area that should be included as a human use.

Add bird species to the list of species-at-risk. Consider the role of COSEWIC species as ‘special species.’

REVIEW OF KEY PRESSURES AND IMPACTED ATTRIBUTES FROM SELECTED ACTIVITIES: AQUACULTURE

Presenter: F. Page
Rapporteur: T. Floyd and T. Worcester

Presentation Highlights

Aquaculture potentially interacts with other human activities and ecosystem components. Lots of objectives for aquaculture have been identified through a variety of initiatives (e.g., National Aquaculture Strategic Action Plan Initiative [NASAPI]).

Existing tactics for reducing environmental impacts include: siting, operating license, bay management, integrated pest management plans, Standard operating procedures (SOPs), environmental monitoring, disease monitoring, and net cleaning.

PoEs have been used by DFO Habitat and Aquaculture Management to explain and understand that range of potential stressors, pressures, and effects associated with aquaculture and the environment.

Sulphides levels are typically used to evaluate aquaculture (with regulatory thresholds), but it is important to consider that this is a soft sediment indicator and may not be useful for the hard bottom of this area.

DEPOMOD results can be compared to lobster habitat to estimate how much of the available lobster habitat is overlapping with the zone of influence of aquaculture sites. Currently thresholds have not been established, but these could be developed.

There are dilution models that can be used to define zones of influence, which can be validated with drifters.

The extent of release of pathogens can also be estimated from biological transport and dispersal models. Zones can be estimated based on one tidal cycle.

It is important to understand what the trade-offs are between using simple approaches, where DFO might need to be more risk averse, with more complex approaches that allow for greater flexibility.

Questions that need to be considered when moving forward include: How much information is really needed? How much overlap is acceptable, and what are the metrics for acceptability? Will simple estimates and a precautionary approach results in a sufficient cost-benefit balance?

Discussion

There is a long history in Scotland of aquaculture siting issues. It was asked what lessons have been learned about density of siting there. The response was that Scotland is moving towards bigger sites that are farther apart, as this makes it easier to manage disease interactions. Scotland also had to deal with disease issues related to Infectious Salmon Anemia (ISA) and, similar to NB, they are also using a Bay Management approach to manage this issue.

When DFO has a strategy like, "manage area disturbed", the spatial configuration of those areas needs to be considered and not just the total area.

It is important to monitor the effect of decisions in a meaningful way. There are annual monitoring programs for aquaculture, but they do not tend to monitor far-field effects, and there has not been much feedback on overall impact/cumulative impact. It would be nice to see a management approach that sets ecological reference points and evaluates success against the reference points (objectives). Industry performance has been evaluated in a series of technical reports in this area, and 95% of the sites are within compliance (sulfides).

Fish health is monitored by CFIA, the company, and provincial vets, so they know the disease status on the sites. Regulatory options are in place to control/limit the spread of disease. SOP exist for noise, light, escapee recovery, etc.

While the geo-spatial approach was appreciated, some felt it was contrary to the PoE approach that lists ecosystem attributes. PoEs describe the potential for impact.

The concept of scale was felt to be important, and there was concern about using the word "ecosystem" to apply to a localized impact. Ecosystem effects relate more to far field effects, so it is important to ensure the measurements available are actually related to the "ecosystem". One of the issues with looking at larger ecosystem scales is related to the way in which questions and directions come from management. From the current management perspectives, the intent is to manage an area of influence around the site, which in effect sets the scale or scope.

It would be useful if more informative on site activity or production capacity (and actual production) was public, rather than just location of sites. For example, if there is an important river for salmon management in close proximity to a proposed license, it would be useful to know the potential farm production levels as it is difficult to evaluate potential impacts without it. Production statistics are available from the province of NS by region for the previous year but not for a specific farm given that site specific production is commercially confidential. Government managers and scientists do know the stocking levels for farms, and this information it is taken into account with respect to production plans and modeling. It is possible to talk about averages given that most sites stock around 500,000 fish. Introductions and Transfers permits, issued by DFO, include numbers of fish moved onto a site. It is also possible to calculate estimates of stocking density by simply multiplying number of cages by 20-30,000 fish. Also, if you speak to the operator of the site, they will often tell you.

Existing monitoring tools are measuring indicators (e.g., benthic sulphide concentrations) of predicted ecosystem change (e.g., benthic diversity) and these predictions still require scientific analysis and verification. Knowledge is created by making predictions and then evaluating the results on biological or ecological endpoints. For example, sulfides are measured for cost reasons, and benthic diversity is the key variable of interest, but it is unclear how this is linked to marine birds or fish communities. It is essential that indicators and predicted effects can be linked back to causes.

Underwater video-taping along benthic transects is conducted and helps to support the linkages between indicators and ecological endpoints.

With change to the Fisheries Act, DFO will be challenged to look at broader impacts to fisheries productivity. Changes to fisheries resulting from aquaculture would be very difficult to assess given the relatively small scale of the farm compared to a bay-wide or regional scale. In the great lakes, growth rate changes in native fish populations due to aquaculture are being measured, and these changes are seen as positive from a productivity perspective. The Unites States often takes a more complicated baseline monitoring program to assess changes to ecosystems. In Canada, this approach is not used and "error bars" with respect to fisheries population levels are large, making it very difficult to pick up on a change to the fishery from an activity.

The PoEs are not explicit about the ecological endpoints or indicators; they are just to the level of "change to nutrient levels." There is an opportunity to look at the overlap of the generic PoEs at specific sites.

The zone of influence for something like genetic impacts or changes in community structure related to escapes (i.e., release of live animals) could be hundreds of kilometers. The possibility of changing baselines needs to be considered given that ongoing reductions in population size might impact reference points. The analysis may be similar to modeling of disease impacts in that the whole migration length is assessed. In order to understand the potential impacts, factors related to how an escapee would spread, such as source and potential zone of influence (migration rather than dilution) need to be considered, and then a risk assessment can be applied to the VECs.

Overall, the intertidal habitat picture is not well understood in the area. The amount of information that is needed to understand AIS impacts within existing ecological variability is significant and currently lacking in most areas. The knowledge related to AIS spread, vectors and life histories is good and there is a decent understanding of dispersion modeling. There is reasonable understanding of initial introductions in terms of vectors and planktonic spread, but overall the spread is not well understood. Exercises on green crab dispersal involve the use of buoy data and surveys, but the predictions do not work well. For example, DFO does not have a good understanding of why there are some places where they do not occur, but efforts are underway to try and reconcile these spatial scales.

There are some simple measures, such as temperature, that are not expensive or difficult to collect that will allow linking of offshore and inshore areas. That is where the current research is focusing in order to capture the nearshore variability.

PoEs were designed to address 4 ecosystem components: fish health, fish habitat, water quality and fish populations/communities. They were recently used as an easy way to communicate how government assesses the impacts of aquaculture in the review of the Jordan Bay sites. They were included as background documents on the Canadian Environmental Assessment Registry (CEAR) website. There have been recent changes to the CEAR website and the document may not be available at this time.

There is currently a Newfoundland Region CSAS process planned for January that will focus on indicators on hard bottom. However, salmon sites tend to be in the lower energy environment and are usually sited in more depositional areas. Consideration should be given to other indicators, and they should be evaluated to determine whether they are equivalent to sulfide indicators.

Consideration should be given to adding oyster culture as a separate activity, given it has specific issues related to impacts on waterfowl. Waterfowl also perch on suspended structures causing water quality issues. Some shellfish aquaculture farms may actually enhance feeding areas for waterfowl.

It is suggest that the terminology “finfish” and “shellfish” culture be used throughout the assessment.

INCORPORATING EAM INTO FISHERIES MANAGEMENT

Presenter: S. Quigley
Rapporteur: T. Floyd and T. Worcester

Presentation Highlights

Gaps in the application of the EAM framework within Fisheries Management have been: identifying appreciable pressures and associated attributes; establishing reference points, pressures and attributes; and developing monitoring and evaluation frameworks.

Step 1 (List Activities) is relatively easy, as fisheries managers only consider fisheries (commercial, recreational and FSC).

In Step 2 (Prioritize Key Pressures), there are 3 key strategies of relevance for fisheries:

- Keep fishing mortality moderate (catch and bycatch)
- Control unintended incidental mortality for all species
- Manage area disturbed of habitat

These three and a few others are used for lobster. They have been elaborated upon as:

- Keep lobster fishing mortality moderate
- Keep fish mortality moderate for bycatch species and other harvested species
- Allow sufficient escapement from exploitation for spawning
- Control unintended incidental mortality of North Atlantic right whale
- Control unintended incidental mortality of other species
- Manage area disturbed of bottom habitat
- Limit introduction of pollutants
- Limit introduction of debris

Under Step 3 (Define Management Units and Attributes), practical management units for measuring and regulating the associated pressures must be defined for each strategy. The nature of the pressure determines how the management unit is defined. This is relatively easy for fisheries, as it is usually the stock. Attributes can include: abundance/biomass, size structure, productivity and recruitment, spatial occupancy, and coldwater corals.

For Step 4 (Determine Way to Measure and Monitor Pressures), the measures are: fishing mortality, discards (proxy for mortality), and presence or absence in the coral closure (dense coral areas). Monitoring incorporates landings and use as bait, CPUE, at-sea observer data, SARA logs, and coordinates from logbooks. There are no management units for measuring and

monitoring debris and pollutants. There are tactics related to managing general impacts to the bottom.

Step 5 is to Determine Ways to Measure and Monitor Attributes. For lobster, the focus is on biomass (legal size), size structure, productivity, and recruitment. Monitoring is done through landings (proxy for biomass), as well as secondary indicators:

- Abundance/biomass of commercial sizes
- Production (recruitment, reproduction)
- Demography (size structure, sex ratio)
- Fishing pressure (effort, exploitation)
- Environment (factors potentially affecting catchability, e.g., temperature…etc.)

For other species, biomass is being monitored through landings and observer records.

Step 6 is to Establish Operational Reference Points for Pressures. For lobster, fishing mortality is at or below the 90th percentile of exploitation rate estimates for defined period (1985-2009 proposed). The proportion of females is also a potential reference point. For corals, the threshold is no impact to coldwater coral areas.

Step 6 is to Identify a Suitable Suite of Tactics to Implement Strategies. Possible tactics include:

- Limited entry, prescribed access areas, trap limits, minimal legal size, window in trap, seasons, escape vents, and biodegradable panels (to keep fishing mortality moderate)
- Minimum size (e.g., for Jonah crab)
- Escape vents and biodegradable panels
- Release and v-notching of berried females (e.g., for lobster)
- Avoidance and gear-setting techniques for right whales
- Coral closures
- Weighted traps and proper handling
- Wharf disposal of fuel and garbage

Plan Enhancement is supposed to pick up on gaps in the framework. This is the opportunity to discuss risks and mitigation measures, identify research priorities and timelines (e.g., effects of climate change), and to determine whether there are attributes with no strategies or tactics with no attributes. There is currently an identified gap related to bycatch, which could be addressed through increased observer coverage. There is also an identified gap related to sensitive benthic areas in the inshore, including reference points for these. Activities to address this gap currently include development of maps of fishing footprint and EBSA identification.

Discussion

It is not clear what the linkage is between impacts to coldwater corals and inshore lobster. There is a need to make the strategy related to this more specific.

It was asked whether it would be possible to convert the measure of an area of influence into a measure of mortality. If so, if 10% of a lobster ground was impacted, and this was considered mortality, it was unclear how this would impact the objectives. Also, if there were multiple contributors to the mortality, it was unclear how trade-offs would be considered or apportioned and whether a higher priority would be given to traditional activities versus emerging activities.

It was noted that discard mortality was mentioned but not non-catch mortality (like in other gears). DFO will be coming out with a bycatch policy soon, which includes ship strikes and

entanglement, but it will not include things you do not see. The PA framework does address this, but it is not being addressed within individual plans to the full extent possible.

Aquaculture Management deals with introductions and transfers of fish, but these considerations are not integrated into lobster fishery planning very often. DFO is trying to address this in some fisheries (for example, large pelagic vessels). Movement of lobster vessels and bait would be a risk. For example, bait can be brought in from the Pacific Ocean. There has been a fishery where this has been addressed explicitly.

A green crab fishery has just opened on the south shore and there are now licenses for this fishery. Green crab are great bait for lobster, but only if they are live. They can only be fished along the south shore, but it is unclear whether they will be transferred to other areas. If so, associated impacts to the environment should be considered.

The Introductions and Transfers process is being evaluated nationally, and some gaps are being identified. Movement of wild capture species and invasive species are starting to be considered. There will be a new national code.

Fishing impacts on marine birds are starting to be considered, and there is a currently a closure to protect seabirds in the groundfish fishery.

The lobster fishery was not presented as a PoE. If PoES are not founded on direct observations and knowledge, then they are essentially motherhood statements. For example, debris could act as habitat for lobster, so it may not be negative for that species, but it may be negative for other species.

The focus is on the fishing process and the goal is to try and manage the pressure that fishing exerts on the ecosystem. For the lobster fishery, the focus is looking at the impact of fishing on the benthic habitat, and the impact other activities have on lobster habitat are currently assessed through different processes (e.g., environmental assessments). Kelp beds are critical for lobster dynamics, and if an impact is related to something that is related to the fishery, then it would be the job of DFO Habitat Management to protect that aspect. For kelp beds, the majority of the impact is environment. It is worth noting that the lobster fishery has limited impact compared to natural variability.

Given that there is so much trap data related to the lobster fishery, it was asked whether depth, temperature, substrate, and salinity data have been explored to determine preferred habitat for lobster. The response was that lobster fishery environmental data is limited and spatially precise, so the most relevant data would likely come from specific studies. For example, there is precise geospatial and temperature information for juvenile trap surveys conducted in partnership with the Fishermen Scientist Research Society (FSRS).

Changes in lobster behavior were discussed. For example, lobsters are now being caught in numbers and sizes where they were not before. This is seen at a smaller scale on the Eastern Shore, but within a narrower range.

Information on the lobster fishery is limited compared to other fisheries, and it is low resolution data (e.g., 10 minute squares in some areas). Although the information from the lobster fishery is limited, it is probably quite accurate compared to what information is provided from other fisheries (e.g., quota fisheries).

Given that life-history stages are separated into various habitats, mortality may not be the only relevant indicator, and recruitment would also be a useful indicator. The question of scale is not trivial given that life-history is spatially explicit.

Primary indicators are related to mortality, and secondary indicators are essentially indicators in waiting. As data collection and models evolve, they can be better incorporated into overall stock assessment models (e.g., spawning biomass, recruitment).

Secondary indicators, such as production (recruitment, reproduction), demography (size structure, sex ratio), fishing pressure (effort, exploitation) and environment (factors potentially affecting catchability), need to be considered because monitoring these may indicate that an effect has occurred and the actions being undertaken are having an impact on these indicators. If there is no change, then secondary indicators can help to explain why.

Even if a local change can be detected, it is unclear what that means at a population scale given that every square kilometer may not be equivalent. Scaling is definitely an important factor to consider in this assessment. Also, if an area is a known spawning area, it may have more value than other habitat. By assuming the worst case scenario, a rough indication of whether the loss will have an impact on the overall stock can be determined by plugging habitat loss into the stock status model.

The lobster bycatch in Scallop Fishing Area 29 was investigated in relation to the overall fishery and was seen as a very low impact on the overall stock. Monitoring would then provide the validity of the model. It is important to remember that not all habitats are as important as others. Issues of relevant scale are included in discussion for the new Habitat policy. Smaller scale impacts will not be lost.

There is room in the framework for a habitat-related indicator (as a proxy for mortality).

PRIORITIZATION OF ACTIVITIES/STRATEGIES/PRESSURES

Discussion

It was recommended that all substantial pressures should be included in this framework, focusing on things that are controlled by DFO (e.g., fisheries) but including other pressures where possible.

It was recommended that the focus should be on a few attributes (but more pressures).

It was recommended that an initial triage could be used to identify the important pressures.

It was noted that the Eastern Shore is not as complicated as other areas of Nova Scotia (e.g., Bay of Fundy), so it may be a good place to start applying the EAM Framework more completely. For example, there is limited forestry and one mine that is trying to start up, but there is interest in further economic diversification. Overall, it was seen as a good place to focus.

It was suggested that the usefulness of VECs is in helping to prioritize. When there is a need to prioritize, it was suggested that VECs can be used to help with this since they can capture impacts from new and emerging pressures. However, it was noted that this would be a reverse approach to that currently proposed in the framework.

It was noted that this initiative would eventually have to discuss reference points, but not at this meeting.

Intertidal Zone

A comparison of the coastline classification (area 14) with the boundaries of subtidal zone 11 shows the same watersheds captured but slightly different boundaries. The major inputs into the coastal classification were substrates, terrestrial geology, exposure (shoreline direction), and tidal characteristics, but overall it is more substrate, geology and topography based. No

temperature or salinity data were used. In general, the area has a complex topography, is fairly rocky, and has lots of surface area.

It is important to highlight that this area has a lot island with beaches, and "Bay of Islands" may be under consideration for provincial park designation.

When considering freshwater inputs, the size of watersheds and land-use by watershed should be taken into account. Seasonal variability and inlet characteristics also need to be considered.

It is possible to attain high resolution satellite photography for the whole coastline, and this could be used as a measure of biodiversity/habitat. The cost is per kilometer of shoreline, and it estimated that cost would be about $1000 for a 3x3 km area. A cove of a bay would cost about $500.

Productivity

Lobster could be used as a measure of population productivity, and kelp, sea grass, or phytoplankton could be used as a measure of primary productivity.

Biodiversity

The presence, absence or spatial extent of invasive species, such as green crabs, tunicates (half dozen species), could be integrated into measures of community structure.

It was unclear what indicators could be applied for salmon (e.g., salmon returns, genetics). One of the next steps will be to figure this out and apply lessons learned in other areas and processes. Given that decisions have to be made, DFO will need to make sure that the right people are involved in the planning for this.

One suggestion was to use habitat diversity (at a finer scale) as a proxy for species diversity and then overlay human uses on top of that. The percent of impacted habitat versus the percent of available habitat could be described and thresholds could be applied. This would require more consideration and evaluation.

It was suggested that predicted versus observed species richness or community composition could be used in this process, but further work is required to understand whether there is sufficient data. Use of the data collected for the Coastal Ecosystem Overview and Assessment Report was recommended.

Habitat

The EBSAs that have been identified in the area of assessment include the Taylor Head-Sheet Harbour area, the Eastern Shore Islands Wildlife Management Area, Tobacco Island and the St. Mary's River and watershed (just outside the area of assessment).

Water quality and sediment quality were recommended as important metrics to monitor.

It was recommended that important reproductive and rearing areas for important species should be identified (e.g., seabird rookery).

It was recommended that noise and light be excluded from this assessment.

SUMMARY OF DAY TWO

The inventory of activities that was discussed on the first day was reviewed and some more activities were added (e.g., fish plants, renewable energy, etc.).

F. Page gave an overview of aquaculture in relation to the EAM framework, including some policy and regulatory context; use of the science-based PoEs to identify key pressures; mapping of these pressures to our EAM framework (which seems to work well); description of existing tactics that can be used to mitigate/control key pressures; identification of key attributes; approaches for monitoring these attributes (and some challenges for this particular environment); and a description of the existing sulphide-based reference points. He then spent some time talking about a range of geospatial assessment approaches, from more complex oceanographic modeling to more simple "zones of influence" approaches, which can be used to assess impacts of aquaculture, including habitat impacts, dispersion of pathogens, and possibly impacts to populations (using migration rather than dilution criteria). He described the trade-offs in using simple versus complex (data dependent approaches) when it comes to a precautionary approach (more uncertainty should lead to greater risk aversion). He challenged us with a questions list, which included: how much information do we really need? what is our risk tolerance?

There was a discussion about lessons learned in other places (tending to move to larger sites, further apart: Bay Management approach), the need for feedback on the effectiveness of our tactics (where knowledge is created by making predictions and then evaluating the results on biological or ecological endpoints), and the scale of impact that should be investigated (what is a localized versus ecosystem impact; suggestion that the management requirement will set the scale). Some clarity was provided on the use of site production information for assessment purposes as well as other types of site monitoring data that is available (benthic video, sulfides, etc.). There was discussion of whether there were lessons learned from the invasive species risk assessment work that might be useful, and is was noted that predictions for intertidal zones/inlets are not as good as for the offshore. It was clear that higher resolution information is needed to better characterize the variability in things like temperature and salinity in order to improve the models.

S. Quigley described work that was been done in the Region on incorporating EAM into Fisheries Management, using the lobster IFMP as an example. She went through the steps in the EAM framework, including identifying key fisheries pressures (fishing mortality, incidental mortality, area disturbed, pollutants and debris), defining impacted management units and attributes (such as abundance/biomass, size structure, productivity, recruitment, corals), measuring and monitoring pressures and attributes, describing the current operational reference points and the tactics that are used to implement the strategies. She also identified some of the gaps in terms of ongoing development of reference points (both for population-based attributes and sensitive benthic areas) and monitoring and evaluation frameworks. It was clear that the strength of the fisheries management approach is having a plan (i.e. IFMP) that can be evaluated and updated as new information becomes available. The IFMPs are works in progress, where tactics to address key pressures are agreed to and implemented without having all the answers. Improving understanding of the relationships between tactics, pressures and attributes then become part of the research recommendations.

The location of coral areas was questioned as a relevant attribute for the study area, but there was uncertainty in the location of these.

There was a question about non-catch mortality, and it was suggested that it would not be considered as "bycatch" in the upcoming bycatch policy, but that is addressed in the PA approach.

There was a question about the role of fisheries in spread of invasive species, with a particular concern about use of live bait (which might be addressed in the new Introductions and Transfers code).

The role of debris in the creation of habitat was also discussed, but the consensus was that it should not be considered habitat creation.

With respect to the distinction between impacts of a fishery and impacts on a fishery, questions were asked about how impacts to lobster habitat fit in and what data is available on lobster habitat (e.g., temperature and depth from the FSRS). There was a general discussion on the quality and resolution of lobster fishery data and the fact that the data are getting better. There was discussion on how to compare impacts to lobster habitat (access to habitat/loss of habitat/changes to habitat) with direct mortality. Whether it would be useful to attempt to convert habitat impact to population impact, or whether these should be kept as separate metrics, was also discussed. It was clear that much work would be needed to make the conversion, so it was expected that they would be kept separate in the short-term.

T. Worcester gave a presentation on the initial stages of application of the framework to coastal development activities, using the POEs as a starting point to identify relevant pressures, mapping these against our framework. Although there are some differences in terminology used in the POEs, this seemed to work relatively well.

Preliminary work was done to identify impacted attributes. It was clear that there is still a lot of work required with respect to the identification of ways to measure and monitor the pressures and attributes, although there is a lot of experience within Habitat Management that can be used in developing an appropriate list of management tactics (including identification of the responsible authority given that DFO is not responsible for many of these activities). It was not mentioned in the presentation, but, like contaminants, there will be reference points for some of the pressures identified.

There was some discussion about vessel transportation and it was agreed that, rather than focusing on recreational boating, vessel activity would be separated into small and large boats, and the focus of the assessment would be on impacts from smaller vessels making use of this region. Some information sources were identified that might assist with this, such as a boating survey. A pressure was added related to the introduction/spread of disease/pathogens in ballast water, and this led to some discussion about whether to group activities (given common pathways) versus keeping them separate if they are spatially distinct. This may be dealt with on a case by case basis. Also, it was noted that invasive species should be listed as a pressure rather than an attribute. Attribute still need to be defined and might include some measure of species richness.

Next, there was discussion around prioritization of activities, pressures, and attributes, with a few suggestions for how to go about this. Since there are perhaps fewer pressures in this area compared to other areas of Nova Scotia, it was recommended that all substantial pressures/activities and things that DFO has direct control over be included. The focus should be on a few ecosystem attributes (at least 1-2 from each objective) for which pressures have been identified, such as:

- lobster productivity (abundance/SSB/recruitment);
- primary productivity (macrophytes as well as phytoplankton);
- special species (species at risk);
- another biodiversity related attribute (e.g., species richness);
- special places (EBSA, sensitive benthic areas, reproductive areas for special species);

- water quality (still need more discussion on this);
- sediment quality (still need more discussion on this); and
- habitat structure.

M. Greenlaw's coastline classification (based on expert opinion using information primarily on substrate, geology, and topography, and knowledge of ecology) was discussed. It was concluded that the area of assessment closely overlaps with the Area 14 of the subtidal classification, as it includes generally the same watersheds. It was noted that this area has a lot surface area in the form of headlands/islands and beaches. Again, the importance of the freshwater inputs in this system was reiterated, as well as the fact that freshwater input provides seasonal variability. It was suggested that available information on the size of watersheds, land-use by watershed, and inlet characteristics be used where available. The availability of high resolution satellite photography was also noted.

There was a request that efforts be made to avoid duplication and make use of information provided by the province of NS for previous initiatives (e.g., policy gap analysis). It was noted that the Canadian Water Network has taken a lead role in the Gulf (and, thus, they have gone in a slightly different direction).

Discussion

The EAM approach was seen as a positive and useful planning approach, but concerns were raised about using the Eastern Shore as the first test area given that the results may have implications for ongoing environmental reviews and associated decision making processes. It was noted that this is not the first time the EAM approach has been applied in Maritimes Region, and pilot studies were conducted for Georges Bank and the Saint John River Watershed. It was also noted that controversy can often lead to progress.

It was raised that Sheet Harbour now falls under the authority of Halifax Port Authority, and there will likely be increased vessel traffic and shipping.

The use of the term "transmission" for invasive species was questioned, and it was suggested that a consistent terms, such as "transfer" or "primary/secondary introduction", be used. It was suggested that the term "unintended" transfer is too narrow given that there are issues related intentional transfer of invasive species as well.

Questions were raised about whether a list of "special species" would be devised and whether the word "special species" could be replaced with "species of interest".

It was noted that the table presented by T. Worcester was missing some linkages, but they would be addressed.

It was suggested that component mortality may be a metric to measure given that it is related to population structure and substructure, but it is not well understood as of yet and requires further discussion before inclusion.

INDICATORS

Presenter: A. Bundy
Rapporteur: T. Floyd and T. Worcester

Presentation Highlights

An indicator is an indirect measure of something that cannot be measured directly. There are many different kinds of indicators: biotic, abiotic, economic, social, governance, simple, complex, driver, pressure, state, impact, and response.

Indicators serve four basic functions: simplification, quantification, standardization and communication (UNEP 2003). They summarize complex and often disparate sets of data and, thereby, simplify information. They should be based on comparable scientific observations or statistical measures. They should provide a clear message that can be communicated to, and used by, decision makers and the general public.

Complexity cannot be captured with one indicator and multiple indicators are generally needed to describe something.

The ICES Working Group on Ecosystem Effects of Fisheries has selection criteria that might be useful to use. These criterions should be considered in the selection of indicators. There is no standard rule on how many criteria should be met. Some criteria are more difficult to assess, such as sensitivity (how much an indicator would change if the community/attribute changed), responsiveness (nature or response, time indicator takes to respond to change, signal to noise ratio), and specificity. Indicators can have different responses at different levels of activity and can have linear or non-linear responses. Some indicators take a long time to respond.

Increases or decreases in the indicator can be a mix of responses to different pressures. Some work has been done to demonstrate the differential partitioning of response to such things as environment or fishing pressure.

One of the big advantages of the indicator approach is that they are easy tools to use in stakeholder communication.

Discussion

Basically, there would be a set of indicators for this ecosystem. If a directional trend is noted, then there is some indication that the ecosystem is changing; however, there is still a need to understand the reason for the change.

Aquaculture management has moved towards performance based indicators and away from state of the ecosystem type indicators.

With respect to sorting out cause and effect relationships, there was discussion of whether there are ongoing deliberations about the benefit of using control areas versus places where management occurs. It was suggested that this might happen in an ideal world, and although places like the experimental lakes area exist for similar comparisons in the freshwater environment, similar study areas do not exist for the marine environment. Instead, comparisons can be done of systems with different management regimes. This may be a recommendation for the coastal planning process.

It was noted that these indicators and criteria are developed for marine systems, where the main pressure is fishing (clearly identified), and that it may be a significant hurdle to develop these for planning in coastal environments where multiple activities are occurring under various jurisdictions. Although this may be true, it may not necessarily be as difficult as people think

given that there is an existing process that can be used. A. Bundy's work has been focused on higher trophic levels but there is also work being done on lower trophic levels.

There was some discussion of how to apply indicators in a spatial assessment approach, whether they can be measured within zones to identify patchiness, and whether others are already doing this. It was suggested that it may depend on what the goal is.

There was discussion about testing indicators and whether an indicator should continue to be monitored when it plateaus out and is no longer useful to describe current conditions. It is important to know the sensitivity of the indicator and understand and communicate its limitations. It was suggested that three indicators may not be required if they all respond in the same way. Given an option, it is best to pick the simplest or the easiest to understand.

It was noted that another suite of calculated indicators that may not be biologically based, such as the indicators used by M. Greenlaw, may be very simple and easy to calculate or derive (e.g., inlet stratification) and may serve the purpose of this exercise.

INFORMATION SOURCES AVAILABLE FOR THE EASTERN SHORE

Presenter: T. Floyd
Rapporteur: T. Worcester

Presentation Highlights

T. Floyd made use of various ecological overview reports including McCullough et al. (2005) and the draft "Inshore of the Scotian Shelf Ecosystem Overview Report: Status and Trends" to identify information sources for the Eastern Shore. Human use information was presented on the first day. Southern Upland Atlantic salmon information includes electrofishing data, commercial fishing, historical recreational fishing, tagging information, escapement and smolt estimates. Eel fishing areas are available. Available lobster data includes: distribution and abundance of lobster settlers (settlement), FSRS data, and larval work in Canso. There is limited information on potential habitat use, critical or valuable habitat. DFO surveys that come closer inshore include: ITQ, 4VsW sentinel survey, and 4Vn sentinel survey. The FSRS inshore ecosystem project sampled 9-10 sites (Ship Harbour and Country Harbour) along the Atlantic coast using beach seines, lobster traps, and gillnets. There has been SARA sampling in the lobster fishery. Scallop log books are available. Historical herring spawning locations are known. There are herring acoustic surveys from the area. "Special places" information may be obtained from traditional knowledge. There is leatherback turtle tracking information. Canadian Parks and Wilderness Society (CPAWS) conducted five transects in Eastern Shore Islands Wildlife Management Area. There is spatial knowledge from First Nations, traditional fishers, and other resource users (clam beds, macrophytes). Environment Canada has the location of important bird areas (IBAs).

Data gaps include: freshwater quality and watershed information, macrophyte areas (kelp, eelgrass), and the location of important clam beds.

Information has been gathered on the following coastal EBSA:

- Taylor Head-Sheet Harbour area (noted for haddock spawning, recovery area for salmon, haddock nursery area, marine algae, harlequin duck, ISA, colonies, and sea ducks),
- Eastern Shore Islands Wildlife Management Area (noted as a cod spawning area, haddock spawning area, nursery area for hake, herring and others, invertebrate aggregations, seal haul-outs, IBA, colonies, sea birds, harlequin ducks, roseate tern, and marine algae),
- Tabacco Islands (noted as a colony for common eider and double-crested cormorant), and

- St. Mary's River and watershed (noted for its salmon).

Discussion

Weir and commercial fisheries for salmon would be intercepting fish migrating along the coast, not necessarily just Sothern Upland salmon.

Juvenile abundance data would include information on American eel.

Leatherbacks will swim right up into the harbours.

Guysburough Country Regional Development Authority mapping project may be useful, and DFO data were provided for this. J. Grant and P. Cranford have this information as well. This project included places of interest (e.g., historic sites).

The SHACI information is all available in GIS. Only some of it was published.

The Coastal Communities Network did research on the coves, bays and communities along the shore about 5 years ago. There was an inventory for boating, industries, wharves, etc.

Information has been collected for oil spill clean-up.

DFO Habitat Management has referral and compliance monitoring information related to environmental assessments and other project and has put a request to DFO National Headquarters to pull this information out of their database.

There is data on historic salmon fishway counts at Liscomb and East River Sheet Harbour.

There is additional information on watershed delineations including secondary watershed layer and pH classification.

The Gulf Region may also have some shellfish health information.

The Marine Affairs Program at Dalhousie has been working with various Nova Scotia stakeholders on "Coast Base", a searchable database of location specific coastal information. They are working towards geo-referencing the database. There may be other graduate projects that have occurred in the area.

All participants were encouraged to contact DFO with other suggested information sources.

GAPS IN THE FRAMEWORK

It is important to ensure that data availability does not drive the process. The prioritized list of pressures and attributes (to be revised) should be what is driving the need for data, and the only information that is useful will be that information which informs the objective of the exercise. It was note that it was difficult to see where the indicators fit into the framework.

Incorporating social and ecological objectives may help to prioritize what is monitored. The success of the tactics will largely depend on the social objectives.

All participants were encouraged to send other comments on the framework to DFO

NEXT STEPS

It is DFO's intent to consolidate the maps and data analysis, as well as to evaluate priorities. It will be important to ensure that any new tools and processes that are developed are accessible and reproducible so they can be used in other areas as the EAM approach expands.

The risk assessment component of the assessment can also take up significant time, so it may make sense to integrate existing risk assessment methodology. Habitat Management and

Fisheries Management are already doing risk assessments, so it will be important to work together to integrate approaches that are already being used rather than come up with completely different approaches.

Although it is the intend of the national EAM Working Group to develop a national approach over time, it is still figuring out its role, and ongoing regional efforts such as this will help inform and move national efforts forward . The intent is to hold a national workshop in the spring of 2013 to help providing national guidance on EAM.

The Centre of Expertise on Coastal Management in the DFO Gulf Region is currently completing an analysis on all the different risk assessment approaches that are being used within DFO.

Questions were raised about the timeframe to complete the process, how the process will be evaluated, and the expectations of the participants. It was explained that the intent of this meeting was to have a plan for moving forward, to better understand the group's expectations of what DFO should try and accomplish, but not to get bogged down into the overall process and timelines. Participants may be getting hung up on coming up with an assessment that will have all the answers, and everyone may need to temper their expectations, recognize that DFO may not be able to use this assessment to make decisions on controversial ongoing issues. However, it may help ensure that issues are given appropriate attention. The intent is for this to be an ongoing iterative process, with no "final assessment."

It was highlighted that managers and scientists need to take part in advanced planning and recognize the need for baseline data and the availability of funding to collect that data. Harmonizing science with management processes is a key requirement for making best educated guesses even better. A key part of this relates to monitoring results of decisions and learning from the best guesses. That is what the risk assessment process is for, and it will be critical to ensure that meaningful monitoring is incorporated into the process.

It is important to keep track of datasets they may not be useful now but may inform a future component of the framework.

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APPENDICES

APPENDIX 1. LIST OF PARTICIPANTS

Assessment of Cumulative Impacts in the Coastal Zone within an Ecosystem Approach to Management Framework

Maritimes Regional Science Advisory Process

26-28 November 2012

Lewis King Boardroom, BIO
Dartmouth, Nova Scotia

Chair: Tana Worcester

ATTENDEES

Participant	Affiliation
Arnold, Shannon	Ecology Action Centre (EAC)
Baker Stevens, Nellie	Eastern Shore Fisherman's Protective Assn. (ESFPA)
Breau, Monique	Environment Canada / Assessment & Marine Programs-Atlantic
Brilliant, Sean	Canadian Wildlife Federation (CWF)
Buchan, Carla	NS Dept. Fisheries & Aquaculture (NSDFA)
Bundy, Alida	DFO Maritimes / Ocean & Environmental Science
Carr, Jonathan	Atlantic Salmon Federation (ASF)
Claytor, Ross	DFO Maritimes / Population Ecology
Connors, Peter	Eastern Shore Fisherman's Protective Assn. (ESFPA)
Coppaway, Clayton	Confederacy of Mainland Mi'kmaq
Curran, Kristian	DFO Maritimes / Oceans & Coastal Mgmt.
DiBacco, Claudio	DFO Maritimes / Coastal Ecosystem Science
Fanning, Lucia	Dalhousie University / Biology
Floyd, Trevor	DFO Maritimes / Centre for Science Advice
Fuller, Susanna	Ecology Action Centre (EAC)
Giangioppi, Martine	DFO NCR / Oceans Policy & Planning
Grant, Jon	Dalhousie University / Oceanography

Participant	Affiliation
Greenlaw, Michelle	DFO Maritimes / Coastal Ecosystem Science
Hall, Tim	DFO Maritimes / Oceans & Coastal Mgmt.
Hancock, Bruce	Aquaculture Association of NS (AANS)
Hill, Murray	Atlantic Canada Fish Farmers Association (ACFFA)
Levy, Alex	DFO Maritimes / Population Ecology
McGladdery, Sharon	DFO Maritimes / Ecosystems & Oceans Science
McLean, Mark	DFO Maritimes / Habitat Management
McNeely, Joshua	IKANAWTIKET, Maritime Aboriginal Peoples Council (MAPC)
McPhee, Dan	DFO NCR / Ecosystem Science
Meerburg, David	Atlantic Salmon Federation (ASF)
Metaxas, Anna	Dalhousie University / Oceanography
Page, Fred	DFO Maritimes / Coastal Ecosystem Science
Parker, Edward	DFO Maritimes / Habitat Management
Parlee, Kathryn	Environment Canada / Ecosystems & Oceans Health
Pezzack, Doug	DFO Maritimes / Population Ecology
Quigley, Sara	DFO Maritimes / Resource Management
Reynolds, Craig	DFO Maritimes / Aquaculture
Rose-Quinn, Tammy	DFO Maritimes / Aquaculture
Rutherford, Bob	NS Salmon Association
Shervill, Dan	DFO Maritimes / Oceans & Coastal Mgmt.
Simon, Rick	APCFNC Secretariat
Traversy, Karen	Coastal Coalition of Nova Scotia
Ugarte, Raul	Acadian Seaplants Ltd.
Weseloh McKeane, Sean	NS Dept. Fisheries & Aquaculture (NSDFA)

Participant	Affiliation
Wilson, Marielle	DFO Maritimes / Policy & Economics
Worcester, Tana	DFO Maritimes / Centre for Science Advice

APPENDIX 2. TERMS OF REFERENCE

TERMS OF REFERENCE

Assessment of Human Impacts in the Coastal Zone of Eastern Nova Scotia: Application of the Maritimes Region Ecosystem Approach to Management Framework

Regional Peer Review – Maritimes Region

Part 1 – Scoping Workshop: November 26-28, 2012 (Dartmouth, NS)
Part 2 – Framework Review: March 5-7, 2013 (Dartmouth, NS)

Co-chairs: Fred Page and Tana Worcester

Context

The purpose of this process is to begin defining a spatially-based operational approach to assess coastal activities within an Ecosystem Approach to Management (EAM) context in the Maritimes Region using the EAM Framework, which was developed in the Maritimes Region. The focus of this process will be the coastal waters of Eastern Nova Scotia as a test case for feasibility of developing and applying such a model.

The process will consider the usefulness and roles of a variety of mapping and modelling (physical, biological, population dynamics) tools that may have the potential to help assess cumulative impacts, including habitat degradation, eutrophication, organic loading, and interactions with wild fish/invertebrate populations. This science-based process will support an initiative to investigate the human dimension of EAM. Together, these processes are intended to advance the overall EAM approach in the Maritimes Region (Appendix 1).

This process will be used to support and enhance the provision of Fisheries and Oceans Canada (DFO) Science advice for regional decisions concerning managed activities in the coastal zone, such as tidal power, coastal development, aquaculture, and capture fisheries. These issues and challenges are expected to be similar to those being addressed by other regions, and lessons learned in the Maritimes Region are expected to contribute to development of national guidance and tools.

Objectives

Part 1 – Scoping Meeting

- Review DFO conservation objectives and strategies for the Maritimes Region as outlined in the Maritimes EAM Framework (Appendix 1). Identify priorities for further analysis during this process.
- Define the geographic boundaries of the area to be assessed within Eastern Nova Scotia (based on the Maritimes Region coastal classification, if deemed appropriate).
- Select and describe the appropriate ongoing or proposed activities (with a focus on those under DFO purview, e.g., under the Fisheries Act, Oceans Act, Species at Risk Act or Canadian Environmental Assessment Act, but also those outside of DFO purview that might be of relevance to the assessment) for consideration in this analysis.
- For each selected activity, identify the key pressures (including spatial extent and/or relevant management unit) it exerts on the ecosystem using existing pathways of effects models and a risk assessment of impacts.

- For each selected pressure, review the ecosystem attributes that it is expected to impact. Identify priorities for further analysis during this process, including consideration of:
  - Ability to monitor the attribute.
  - Potential implications of ecosystem change (e.g., climate change) on the attribute.
  - Ability of the attribute to accumulate impacts over time (i.e. its potential role in cumulative effects assessment).
- Review sources of information available to assess the effects of selected coastal activities and pressures on selected ecosystem attributes in Eastern Nova Scotia.
- Identify any gaps in the framework that need to be addressed in next meeting.

Part 2 – Review of Framework

- To demonstrate how the Maritimes Region EAM Framework would be applied to an area-based assessment on the Eastern Shore of Nova Scotia, specifically:
  - Review progress made on the steps outlined in Part 1 of this process.
  - Evaluate methods and metrics for assessment and monitoring of key pressures, or a reasonable proxy of them, using the best available information.
  - Evaluate methods and metrics for assessment and monitoring of key attributes, or a reasonable proxy of them, using the best available information.
  - Identify a suitable suite of potential tactics to implement the conservation strategies.
  - Discuss the expected impacts of known data gaps on the results of such an assessment.
  - Discuss further work that would be required to:
  - Identify or develop potential reference points for the pressure or its proxy to control the impact on all relevant ecosystem attributes (where they have not yet been established).
  - Establish attribute thresholds and associated adjustments to the reference points.
  - Evaluate methods for assessing cumulative impacts of an activity (i.e. across all relevant attributes) and cumulative impacts to an attribute (i.e. across all relevant activities).

Expected Products

- CSAS Research Document
- CSAS Proceedings

Participation

- DFO Science
- DFO Ecosystem Management
- DFO Fisheries and Aquaculture Management
- DFO Policy and Economics
- Nova Scotia Provincial Government
- Aboriginal Communities and Organizations
- Academics
- Non-government Organizations
- Fisheries and Aquaculture Industries

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APPENDIX 3. AGENDA

Assessment of Human Impacts in the Coastal Zone of Eastern Nova Scotia: Application of the Maritimes Region Ecosystem Approach to Management Framework. Part 1 – Scoping Workshop

Regional Peer Review – Maritimes Region

November 26-28, 2012

Lewis King Boardroom, BIO
Dartmouth, Nova Scotia

Chairs: Tana Worcester and Fred Page

DRAFT AGENDA

26 November 2012 – Monday

1:00 – 1:15 Introduction

1:15 – 2:00 Overview of EAM Framework

2:00 – 2:45 Delineation of the Study Area (Area of Assessment)

2:45 – 3:00 Break

3:00 – 4:00 Brief Characterization of the Study Area

4:00 – 4:30 Discussion of Activities to be Evaluated in the Assessment
- Aquaculture, Fisheries, Coastal Development, Etc.

4:30 – 5:00 Pacific Region's Ecological Risk Assessment Framework (lessons learned)

27 November 2012 – Tuesday

9:00 – 9:30 Review of Day 1

9:30 – 10:30 Review of Key Pressures and Impacted Attributes from Selected Activities: Aquaculture

10:30 – 10:45 Break

10:45 – 11:30 Review of Key Pressures and Impacted Attributes from Selected Activities: Coastal Development

11:30 – 12:00 Review of Key Pressures and Impacted Attributes from Selected Activities: Fisheries

12:00 – 1:00 Lunch (not provided)

1:30 – 2:30 Review of Other Pressures and Impacted Attributes (including non-human induced pressures on the ecosystem)

2:30 – 2:45 Break

2:45 – 4:00 Preliminary Assessment/Prioritization of Key Interactions for Further Analysis

4:00 – 5:00 Review of Data Sources and Tools Available to Facilitate Further Analysis

28 November 2012 – Wednesday

9:00 – 9:30 Review of Day 2

9:30 – 10:00 Identification of Framework Gaps and Challenges

10:00 – 10:15 Break

10:15 – 11:45 Next Steps

11:45 – 12:00 Closing Remarks