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DFO/FSRS Workshop on Inshore Ecosystems and Significant Areas of the Scotian Shelf

Atelier du MPO/FSRS sur les écosystèmes côtiers et les zones importantes du plateau néo-écossais

January 16 – 19, 2006
Bedford Institute of Oceanography

Du 16 au 19 janvier 2006
l'Institut océanographique de Bedford

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Foreword

The purpose of these proceedings is to archive the activities and discussions of the meeting, including research recommendations, uncertainties, and to provide a place to formally archive official minority opinions. As such, interpretations and opinions presented in this report may be factually incorrect or mis-leading, but are included to record as faithfully as possible what transpired at the meeting. No statements are to be taken as reflecting the consensus of the meeting unless they are clearly identified as such. Moreover, additional information and further review may result in a change of decision where tentative agreement had been reached.

Avant-propos

Le présent compte rendu fait état des activités et des discussions qui ont eu lieu à la réunion, notamment en ce qui concerne les recommandations de recherche et les incertitudes; il sert aussi à consigner en bonne et due forme les opinions minoritaires officielles. Les interprétations et opinions qui y sont présentées peuvent être incorrectes sur le plan des faits ou trompeuses, mais elles sont intégrées au document pour que celui-ci reflète le plus fidèlement possible ce qui s’est dit à la réunion. Aucune déclaration ne doit être considérée comme une expression du consensus des participants, sauf s’il est clairement indiqué qu’elle l’est effectivement. En outre, des renseignements supplémentaires et un plus ample examen peuvent avoir pour effet de modifier une décision qui avait fait l'objet d'un accord préliminaire.

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SUMMARY

A *Workshop on Inshore Ecosystems and Significant Areas of the Scotian Shelf* was held at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia on January 16 - 19, 2006. Funded by Phase 1 of the Government of Canada's Oceans Action Plan, this workshop leads new research on the inshore ecosystem of the Scotian Shelf and the identification of ecologically and biologically significant areas (EBSAs) on the Scotian Shelf.

The workshop was hosted by the Department of Fisheries and Oceans (DFO) and the Fishermen and Scientists Research Society and included researchers from various universities, government departments and NGOs. The first two days brought together scientific experts on the inshore areas of the Scotian Shelf (defined in this project as the area inshore of 50 fathoms and/or the 12 nautical mile territorial sea limit, from Cape North to Cape Sable Island). The presentations explored our current knowledge and understandings of the ecology, distribution and abundance of birds, marine and diadromous fish, marine plants, turtles and invertebrates of the inshore areas of the Scotian Shelf. The talks highlighted the patchy distribution of research initiatives in time and space, and the need to compile available information. Discussions included debate over the status of the ecosystem and its components, possible linkages between inshore and offshore ecosystems, and potential for human impacts, including the cumulative effects of land-based activities and climate change. Of particular concern were the impacts of land-based activities, especially in the very nearshore or coastal fringe, and the lack of information on species distribution between diving depth (30 m) and the inshore limit of the DFO research vessel survey (100 m). The proceedings from this part of the workshop will provide the basis for an Ecosystem Overview and Assessment Report (EOAR) for the inshore area of the Scotian Shelf.

The second half of the workshop focused on the identification of EBSAs in the inshore and offshore areas of the Scotian Shelf. EBSAs are areas that are considered to be particularly important or significant with regard to specific ecosystem properties. A recent DFO Ecosystem Status Report identifies three primary criteria for defining EBSAs, uniqueness, aggregation and fitness consequences, and two secondary criteria, resilience and naturalness. Presentations and discussions explored these and other criteria for defining EBSAs. Discussions also explored the management implications of EBSAs and the level of scientific understanding of ecological processes both inshore and offshore. Participants engaged in a mapping exercise to identify possible EBSAs based on the criteria. Thirty-six areas of particularly high ecological significance were identified in the inshore and 27 areas of high ecological significance were identified in the offshore. In addition to identifying applicable criteria, participants also provided rationales for the areas chosen as possible EBSAs, and identified sources of information that would help to define EBSAs on the Scotian Shelf.

RÉSUMÉ

Un *Atelier sur les écosystèmes côtiers et les zones importantes du plateau néo-écossais* a eu lieu à l'Institut océanographique de Bedford, à Dartmouth (Nouvelle-Écosse), du 16 au 19 janvier 2006. Financé dans le cadre de la phase 1 du Plan d'action sur les océans du Gouvernement du Canada, cet atelier avait pour but d'orienter les nouvelles recherches sur les écosystèmes côtiers du plateau néo-écossais et de cerner des zones d'importance écologique et biologique (ZIEB) sur ce plateau.

Ont participé à l'atelier, qui se tenait sous les auspices du Pêches et Océans Canada (MPO) et de la Fishermen and Scientists Research Society, des chercheurs de diverses universités, ministères gouvernementaux et ONG. Les deux premières journées, l'atelier réunissait des experts scientifiques des zones côtières du plateau néo-écossais (définies en l'occurrence comme étant les zones s'étendant entre la côte et une profondeur de 50 brasses ou la limite de 12 milles marins de la mer territoriale, de Cape North à l'île Cape Sable). Les exposés présentés ont exploré notre connaissance actuelle de l'écologie, de la distribution et de l'abondance des oiseaux, poissons de mer, poissons diadromes, plantes marines, tortues et invertébrés des eaux côtières du plateau néo-écossais. Les discussions ont fait ressortir le caractère irrégulier, dans le temps comme dans l'espace, des travaux de recherche, ainsi que la nécessité de réunir toute l'information disponible. Elles ont porté, notamment, sur l'état de l'écosystème et de ses composantes, sur les liens possibles entre les écosystèmes côtiers et ceux du large, et sur les incidences anthropiques possibles, notamment les effets cumulatifs des activités terrestres et du changement climatique. On s'est particulièrement inquiété des incidences des activités terrestres, surtout dans la zone très proche du littoral ou frange côtière, et de l'absence d'information sur la distribution des espèces entre les profondeurs de plongée (30 m) et la limite côtière (100 m) du relevé par navire scientifique du MPO. Le compte rendu de cette partie de l'atelier sera à la base d'un Rapport d'aperçu et d'évaluation de l'écosystème dans les eaux côtières du plateau néo-écossais.

La deuxième moitié de l'atelier a été axée sur l'identification des ZIEB dans les eaux côtières et les eaux du large du plateau néo-écossais. Les ZIEB sont des zones qu'on considère particulièrement importantes eu égard à certaines propriétés particulières de l'écosystème. Un récent Rapport sur l'état de l'écosystème publié par le MPO établit trois principaux critères pour la définition de ZIEB : l'unicité, la concentration et les conséquences sur la valeur adaptative, ainsi que deux critères secondaires, à savoir la résilience et le caractère naturel. Les présentations et discussions ont porté sur ces critères ainsi que sur d'autres critères pouvant servir à définir des ZIEB. On a aussi discuté des incidences de la gestion des ZIEB et du niveau de compréhension scientifique des processus écologiques dans les eaux côtières et dans celle du large. Les participants ont pris part à un exercice d'établissement de cartes visant à identifier d'éventuelles ZIEB d'après les critères établis. Des zones de haute importance écologique ont été cernées. Leur nombre s'élevait à 36 dans les eaux côtières et à 27 dans les eaux du large. En plus d'établir les critères applicables, les participants ont aussi justifié le choix des zones retenues comme éventuelles ZIEB et indiqué les sources d'information qui pourraient aider à définir des ZIEB sur le plateau néo-écossais.

INTRODUCTION

This document summarizes presentations and discussions from the *Workshop on Inshore Ecosystems and Significant Areas of the Scotian Shelf* which was held at the Bedford Institute of Oceanography on January 16 – 19, 2006. The objectives of the workshop were: (i) to explore our knowledge of the biodiversity, structure and function of the inshore Scotian Shelf, (ii) to explore the criteria and metrics for the identification of ecologically and biologically significant areas (EBSAs), and iii) to identify EBSAs based on scientific expert opinion. Invited participants included government, university, and NGO-supported researchers, independent scientists and members of the FSRS Ecosystem Working Group.

This workshop was funded by Phase I of the Government of Canada's Oceans Action Plan, which aims to promote implementation of Canada's Oceans Act, as described by Hall *et al.* (this volume). Rangeley *et al.* continue this theme, stressing the importance of identifying EBSAs and their role in ecosystem-based management. They also point out that EBSAs are necessary, but by themselves are not sufficient for sustainable management of our oceans.

The first two days of the workshop focussed on the inshore Scotian Shelf and began with a description of the DFO/FSRS Inshore Ecosystem Research on the Scotian Shelf project. This was followed by a series of invited presentations on physical and biological linkages, biological interactions, the distribution and abundance of marine species, with a focus on species of conservation concern, and the ecological impacts of anthropogenic activities, including climate change. Building on the discussions following presentations, the break-out groups identified knowledge sources and limitations, and priority areas for future research.

The last two days focussed on EBSAs and began with an overview and theoretical background by Kees Zwanenburg and a discussion of the purpose of EBSAs from an Oceans Management perspective (David Millar). These were followed by a series of invited presentations exploring the criteria and metrics for defining EBSAs, the design and implementation of integrating data from different sources, and other experiences in applying the EBSA criteria. During the scientific expert opinion mapping exercise, participants were asked to identify potential EBSAs in both the inshore and offshore of the Scotian Shelf, based on the national criteria: uniqueness, aggregation, fitness consequences, naturalness and resilience. Participants were also asked to complete a survey to document the rationale and EBSA criteria for the identification of an area as ecologically and biologically significant

The workshop exposed participants to the scope and breadth of research in the inshore and provided an opportunity for researchers to share information and explore opportunities for collaboration and interdisciplinary research. This report is an important first step in the development of the first Ecosystem Overview and Assessment Report for the inshore of the Scotian Shelf and the identification of EBSAs in both the inshore and offshore. We hope that this report will further promote research in the inshore of the Scotian Shelf and help to develop a systematic and inclusive process for the identification of EBSAs.

Several participants have graciously provided copies of their presentations for public access. The presentations have been posted to the Centre for Marine Biodiversity website: http://www.marinebiodiversity.ca/en/other-activities1.html.

SECTION 1 – WELCOME AND INTRODUCTION

Integrated management on the Scotian Shelf: Providing the context for Ecosystem Overview and Assessment Reports

Tim Hall, Dave Duggan and Dave Millar
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The development of Ecosystem Overview and Assessment reports is an important step in the implementation of integrated management in Canada. Integrated management is a new approach to managing our oceans that considers the ecosystem and all of its users comprehensively and involves defining objectives and strategies for the sustainable use and conservation of an entire area. In contrast, traditional 'sector-based' management addresses human activities (e.g., fishing, oil & gas development, shipping) on an individual basis through a patchwork of independent planning processes. Integrated management brings regulatory authorities from all levels of government together with a wide array of ocean stakeholders to work collaboratively. This allows for a more efficient, coordinated, and inclusive management approach and a more thorough consideration of the relationships among different ocean users and between humans and the environment.

On the Scotian Shelf, integrated management has been applied primarily through the Eastern Scotian Shelf Integrated Management (ESSIM) Initiative, which focuses on a 325,000km^2 offshore area between Halifax and the Laurentian Channel. Since its inception in 1998, the ESSIM Initiative has brought together representatives of the full spectrum of ocean interests and regulatory authorities to develop a common vision, shared objectives, and agreed management strategies for the Eastern Scotian Shelf. In February 2005, following extensive consultation with stakeholders and partner agencies, a draft Eastern Scotian Shelf Integrated Ocean Management Plan was released. The draft Plan defines ecological and socio-economic objectives, proposes management strategies and tools, and outlines the model that will be used for engaging stakeholders and decision makers in collaborative planning.

The legislative basis for integrated management in Canada is the 1997 *Oceans Act*, which directs the Minister of Fisheries and Oceans to lead the development of integrated management plans for all Canadian waters. *Canada's Oceans Strategy* and its companion *Policy and Operational Framework for the Implementation of Integrated Management* (released in 2002) provide guidance as to how the *Oceans Act* should be implemented and how integrated management should be applied. One of the main tenets of the *Policy and Operational Framework* is that integrated management should be ecosystem-based. To achieve this, the development and implementation of integrated management plans should be guided by the identification of ecosystem objectives and reference levels. Ecosystem Overview and Assessment Reports— a component of which is the identification of Ecologically and Biologically Significant Area (EBSAs)— are compiled to inform the implementation of ecosystem-based management and support the development of ecosystem objectives. Similar socio-economic assessments are also conducted to guide the establishment of objectives for human use.

Current Ecosystem Overview and Assessment activities on the Scotian Shelf have been largely triggered by the April 2005 release of *Canada's Oceans Action Plan*, which presents a series of activities to be undertaken to further the implementation of *Canada's*

Oceans Strategy. The *Oceans Action Plan* identifies the entire Scotian Shelf, including the inshore, as a priority area for the application of integrated management. One of the key activities required to enable the application of integrated management across the Scotian Shelf is the completion of the Ecosystem Overview and Assessment process for this region. Many components of the Ecosystem Overview and Assessment for the offshore have already been carried out or are near completion— a notable exception being the identification of EBSAs. For the inshore, the development of an Ecosystem Overview and Assessment is just beginning. The preparation of an inshore Ecosystem Overview and Assessment Report and the identification of offshore EBSAs have both been identified as priority activities for the first phase of the *Oceans Action Plan*.

Identifying significant marine areas: New challenges and opportunities

Robert Rangeley, Jennifer Smith and Marty King
World Wildlife Fund Canada

Canada has committed to changing the way our oceans are managed. To carry out ecosystem-based management and achieve our common objectives, we must understand and map the values we are trying to restore and protect – including special, unique and important areas. The identification of EBSAs will make a significant contribution to this information need.

The importance of identifying EBSAs

EBSAs fill an important information need for protection, management and restoration of our marine ecosystem. Identifying them will allow for prioritization of enhanced management, which is of some urgency. But EBSAs will also be part of larger planning processes – zoning and networks of MPAs through Integrated Management – that are a key ingredient in the move to fully implement Ecosystem Based Management and realize our domestic and international commitments to conservation.

Although mapping out a picture of the way biodiversity is distributed in the oceans is part of a new approach, we needn't start from scratch in defining EBSAs. In fact, we're in a very good position to build on a body of knowledge and theory. 'Special areas' on the Scotian Shelf have been identified by Parks Canada, DFO, university researchers and NGOs. With our collaborators, we at WWF-Canada have identified some of the places we think are unique, distinctive and important enough to merit special management attention, and we've shown how these sites fit within a comprehensive conservation framework.

What else is needed to complete the picture?

EBSAs are not the whole picture, nor are they intended to be. There are several key types of information that will be needed to supplement the EBSA approach. These include: a) a classification of the full range of different biological communities or seascapes; b) a picture of the other kinds of 'special' places and values that add to the ecological and economic value of our region and that may not meet the strict definition of an EBSA but merit special management nonetheless; c) an analysis of the interrelationships between candidate EBSAs and the connectivity of EBSAs with their surroundings - we may find that not all EBSAs make sense in isolation; and d) a picture of the human uses taking place in our region. As we move to planning for enhanced management, zoning, or MPA networks, this knowledge will be needed if we are to plan comprehensively and incorporate socioeconomic operating principles, like minimizing cost to and displacement of resource users, into our decision-making.

Where to from here?
We need to be committed to following through on the outcomes of this workshop. The work we do this week [at this workshop] must be more than an academic exercise. There must be commitment to use the information to protect, manage and restore immediately, and to integrate it with other relevant initiatives.

There should also be clarity on the progression of decision-making that flows from identifying EBSAs. Do we understand the decision-making process that is specific to the identification of EBSAs? What are the policy, regulatory and management implications for EBSAs? And what are the details, the timelines, the lines of accountability and the opportunities for moving to the management of areas?

Finally, we need to anticipate change by adapting, remaining flexible and incorporating new information. The EBSA map that eventually results from this workshop will not be a static map. We're discovering astonishing new things about the Scotian Shelf with every research effort, and any picture we paint of the biodiversity of this region will be a work in progress. New information will need to be added as it is acquired.

Done right, EBSAs will be a key part of the marine biodiversity picture, a piece of the information we need to achieve new Oceans objectives. As we move forward let's strive for a balance between rigor and pragmatism – so that the map for areas of enhanced management can be drawn. We need to get on with it as there still remains the challenge of implementing new management around EBSAs and testing their contribution to a healthier ocean.

Establishing a baseline: An ecosystem overview and assessment of the inshore Scotian Shelf

Nell den Heyer[1] and Alida Bundy[2]
[1]Fishermen and Scientists Research Society, [2]Department of Fisheries and Oceans, Bedford Institute of Oceanography

Both nationally and regionally, the Department of Fisheries and Oceans (DFO) is undertaking an ecosystem approach to oceans management, including the Eastern Scotian Shelf Integrated Management (ESSIM) initiative, and the development of methods for the identification of Ecologically and Biologically Significant Areas (EBSAs). Recently the geographic scope of Integrated Management planning under the Oceans Action Plan has been extended to include inshore waters of the Scotian Shelf.

Inshore areas are critical nursery and feeding areas for many marine species but we have insufficient scientific data to meaningfully contribute to either Integrated Management of the inshore or definitions of EBSAs. The DFO/FSRS Inshore Ecosystem Research on the Scotian Shelf project, funded under Phase 1 of the Oceans Action Plan, aims to fill this data gap to the extent possible. We are bringing together existing data and knowledge from a range of sources, including a local ecological knowledge of commercial fishermen and new data on the use of the inshore by marine and diadromous fish, marine mammals, invertebrates, and marine plants. These data are essential for the successful implementation of Integrated Management.

The Inshore Ecosystem Research Project is a joint project between the Fishermen and Scientists Research Society (FSRS) and DFO, which we hope will grow to include other researchers and members of the fishing industry. This project relies heavily upon the participation of inshore fishermen for both the local ecological knowledge survey and the collection of new data. FSRS fishermen members have been involved in the design of the project and will be critical to the successful completion of the project.

The geographical scope of the proposed project is the inshore area of the Scotian Shelf (Fig. 1.1), from Cape North to Cape Sable Island. For the purposes of this project, the inshore is defined as the current inshore limit of the DFO Research Vessel Trawl Survey, less than 50 fathoms depth or less than 12 nautical miles offshore. We note however that these limits neither reflect the functional role of this ocean area in the structuring and population dynamics of diadromous or marine species, nor the distribution of species, habitats and ecological processes. Therefore, we consider these limits as a guide only, and are considering more ecologically and biologically relevant boundaries.

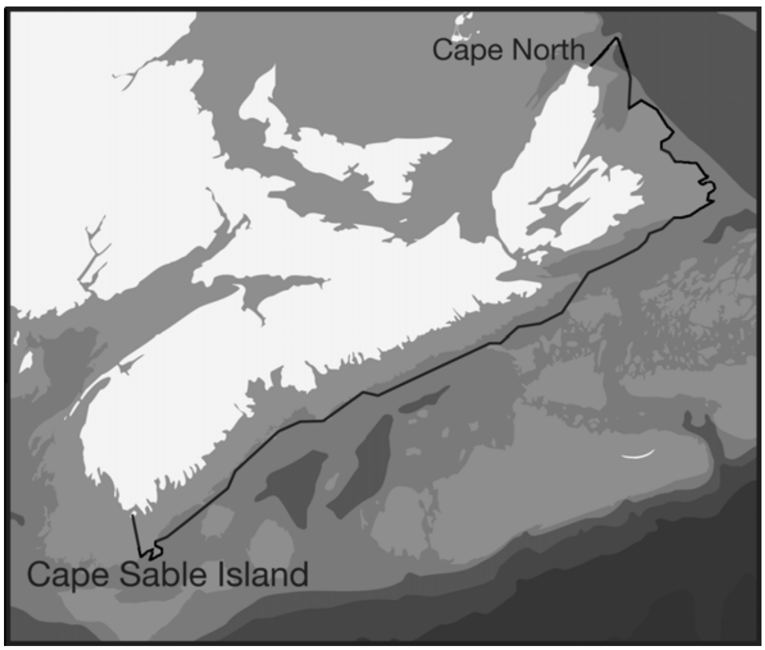

Figure 1.1. Map of Nova Scotia, Canada, showing the 50 fathom line (100m) and the 12 mile offshore line.

This project will begin with baseline research on the distribution and relative abundance of marine and diadromous fish, marine mammals, invertebrates and marine plants by surveying existing scientific literature and data; conducting a local ecological knowledge survey; and by conducting at-sea catch analysis during commercial fishing activities. The second year of the project will also involve fisheries-independent research to describe the distribution of species along the Atlantic coast of Nova Scotia out to 50 fathoms. This will provide a degree of ground-truthing for the baseline information and provide more detailed data to identify geographic gradients, habitat and species associations, and candidate EBSAs. By April 2007, we will have completed a draft Ecosystem Overview and Assessment Report (EOAR) for the Inshore of the Scotian Shelf, which will contribute to the development of a strategic research plan in support of Phase 2 of the Oceans Action Plan.

Discussion

Questions focused on clarifying the intent and extent of these research and management programs. It was noted that threats are not being considered in the guidelines for the identification of Ecologically and Biologically Significant Areas. We were told that this has been a concern in other EBSA initiatives. There was also concern that EBSAs would be static and not reflect changes in the ecosystem. Further discussion of concerns about EBSAs (the criteria for their identification, methods for their identification and the use of EBSAs) were identified as the focus of the last two days of the workshop.

SECTION 2 – PHYSICAL AND BIOLOGICAL LINKAGES

Coastal areas are characterized by highly spatially variable physical environments. Exposure to wind and currents, inflows of freshwater, and the bedrock and sediment will be reflected in the productivity and diversity of associated communities. The presentations in this session link the physical and chemical characteristics with the primary productivity of the Atlantic coast of Nova Scotia.

The inshore Scotian Shelf: The physical environment

Gary Bugden
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The physical environment of the Nearshore Scotian Shelf (NSS) encompasses the surficial geology of the sea floor, the movement of the water on various time scales and the temperature, salinity and other properties of the water column.

When drawing lines on a map to delineate different areas it would be sensible to remember that it is the physical environment which, to a large extent, determines the nature of ecosystems. Concepts such as upstream/downstream, which are determined by water circulation, are also important when examining the linkages between ecosystems. It would also be prudent to remember that human time scales are not the same as ecosystem time scales. Sea level rise and climatological shifts in temperature and salinity occur on much longer time scales than we as human beings are used to dealing with. Yet ecosystems respond at these time scales and there are some examples available in the literature of avian migration patterns which don't make much sense at present, but correspond to shoreline configurations from thousands of years ago.

The surficial geology of the NSS is much simpler than that of the Bay of Fundy, for example, where the collision of ancient continents has left a confusion of different geological provinces. In contrast, the NSS is, to a large extent, one geological province, although the degree of bedrock exposure and other factors such as sediment supply provide a lot of variety in coastal morphology. This diversity of substrates presumably extends out beneath the water. The geology of the NSS may appear more complicated than that of the offshore simply because it is readily available for visual inspection. Several shoreline classification schemes already exist and there is a lot more information awaiting compilation.

The motion of the waters of the NSS ranges from the rapid variations caused by surface waves through the twice-daily changes of the tides to the seasonal and longer scale variations of the general circulation pattern. The general circulation is dominated by the NE to SW flowing Nova Scotia Current which consists primarily of outflow from the Gulf of St. Lawrence. Several numerical circulation models of the NSS exist, covering various portions of the area of interest. They all duplicate the general features of the circulation and its seasonal variations. Many of the inlets and embayments along the coast have also been individually modelled for various reasons. The tides are relatively uniform along the Atlantic Coast of Nova Scotia. They are predominately semi-diurnal (twice-daily) and range between 1m and 2m. The time of high water along the coast varies by a few hours. The NSS is situated between the more complicated tidal regime of the Southern Gulf of St. Lawrence where smaller, diurnal (daily) tides dominate and the famously large semi-diurnal tides of the Bay of Fundy. In the summer, the prevailing winds are from the SW. In winter, the winds are stronger and more from the W and NW. This is reflected in the wave climate, with significant wave heights ranging from slightly less than 0.8m in August to nearly 1.3m in February. Compared to other areas, the wave climate is relatively benign and uniform because the prevailing winds are not directly onshore and the coast is relatively straight. However, hurricanes passing offshore at rare intervals result in extreme wave heights estimated at 20m with 50 year return period.

This large range of tidal mixing mentioned above has implications for the temperature-salinity cycles near the two ends of the NSS. At the NE end, where freshwater discharge from the Gulf of St. Lawrence stratifies the water column and limits vertical mixing, the annual cycle in temperature is large. The water is very warm in summer and very cold in winter. At the SW, or Bay of Fundy end, where vigorous tidal mixing means that a given surface heat flux is spread over a larger volume of water, the annual cycle is moderated. The waters do not warm up as much in summer, nor do they cool as much in winter. Along the middle portion of the NSS wind-driven coastal upwelling is an important process. If a wind blows along the coast from the SW, the rotation of the earth will cause the surface waters to move offshore. This results in the shoreward transport and upwelling of deeper waters which are generally cooler and saltier. During the summer, when the wind blows predominately from the SW, this can lead to rapid and extreme changes in surface water temperatures near the coast. Conversely, a wind blowing from the NE will cause the onshore transport of warmer, fresher surface water. This upwelling and downwelling has important implications for the supply of nutrients to the surface layer. To a great extent, the characteristics of the waters which fill the numerous inlets and embayments along the coast are controlled by shelf processes such as coastal upwelling.

Compared to many other locations, there is a lot of temperature, salinity and current data available for the NSS. There is also a substantial amount of information describing the surficial geology. Much of this data has not been arranged in a form suitable to assist the delineation of Ecologically and Biologically Significant Areas. To this extent, the physical environment might be better described as uncompiled rather than under-studied.

Inshore primary production on the Atlantic Coast of Nova Scotia

Trevor Platt and Carla Caverhill
Department of Fisheries and Oceans, Bedford Institute of Oceanography

The data concerned are from the 1960s and 1970s, from Bedford Basin and St. Margaret's Bay. They are very complete, and provided the basis for our present approach to oceanic primary production. What data are available for inshore primary production on the Atlantic Coast of Nova Scotia? We have both *in situ* primary production and photosynthesis-irradiance datasets for at least a complete year in Bedford Basin and St. Margaret's Bay. Also, detailed studies have been done in Bedford Basin at least three times, with an emphasis on the Spring Bloom, and we have a 70-day continuous dataset in Bedford Basin. The temporal and spatial variability of primary production has been a focus of these studies. Community structure is another focus. There is a large body of data in the public domain (in the form of data reports) and there are at least 30 publications.

The principal environmental factors that affect inshore primary production are: surface irradiance, wind direction and intensity, topography of the inlet, and community structure and biomass of phytoplankton. Surface irradiance can be depressed by coastal fog, and this in turn reduces primary production. Intense wind will break down stratification of the water column and entrain nutrients from below the mixed-layer depth into the surface water, thus increasing primary production. The direction of the wind also plays a role through Ekman transport – bringing either nutrient-rich deep water inshore or warmer surface water, depending on the direction of the wind. If the wind is very intense, the inlet is flushed and whatever community structure has built up is replaced with offshore water. The topography of the inlet is also important. Deep basins with a high sill have more protection from offshore forcing than inlets with a less-pronounced sill.

A comparison of St. Margaret's Bay and Bedford Basin shows that the annual cycle of primary production varies between the two inlets. St. Margaret's Bay has a later, more pronounced Spring Bloom while Bedford Basin has high production in the spring, summer, and fall. Nutrient fluctuations in 1967 were similar in the two inlets – except during spring bloom – suggesting that for most of the year nutrient levels are controlled more by water movements on the shelf than by the biological processes within the inlets. These dynamics are shifted in the spring when the biological forcing dominates.

We have many measurements of biomass and *in situ* primary production. We have also studied in great detail the photosynthesis response of the biomass and its seasonal variation. This work forms the basis for a theory of primary production that is in use around the world. The photosynthesis response is represented by the parameters $\square^B$ (the initial slope of the curve) and P_m^B (the specific productivity at saturating light, also known as the assimilation number). Variation in these parameters reflects changes in the phytoplankton community structure and gives us insight into why primary production changes from time to time and from place to place. The phytoplankton community structure has a normal seasonal succession, but on the exposed coast a procession of storms has the effect of perturbing this orderly seasonal succession. The effect of physical forcing on the short-term dynamics of primary production may not show up in *in situ* productivity measurements – but the Photosynthetic-Irradiance (PI) parameters show these effects. The PI parameters can also be used to estimate primary production.

Nova Scotia has many inlets parallel to each other along the coast and joined to the continental shelf. Do these inlets have a life of their own or are they a projection of life on the shelf? Observations show that they experience the same perturbations as the shelf, but they do have autonomy, especially in the spring when the biological forces are strong. In each inlet there is a seasonal cycle to unfold, but the effect of the weather on the shelf interferes. The trophic status of these inlets varies greatly with time. One study of the f-ratio (ratio of nitrate-based production to total production) in Bedford Basin shows the f-ratio varies from eutrophic values to oligotrophic values over the space of a few weeks from start to finish of Spring Bloom.

In summary, we have a good understanding of the links between physics and biology in the inshore. Further research is recommended on the optical properties of inshore water, and on community succession and photosynthetic response with a focus on flushing times of the inlets.

Nutrients as indicators of inshore MEQ?

Philip A. Yeats
Department of Fisheries and Oceans, Bedford Institute of Oceanography

Chemical studies have an important place in the development of descriptions and understanding of the bio-physical environment with nutrients and toxic chemicals (heavy metals, PAHs and other organic compounds) both having impacts on ecosystem functioning. Relevant chemical investigations will include studies of transport, distribution and fate of these chemicals. Inputs (natural and anthropogenic inputs to streams and atmosphere, direct discharges to coastal waters and exchanges with the offshore) are all important. Measurements of the distributions of both toxic chemicals and biologically beneficial ones are important measures of the 'state of the environment'. Knowledge of the environmental fate, i.e. the geochemical and biological processes that alter the distributions is critical for development of MEQ indicators and thresholds based on these distributions.

We have developed a substantial knowledge base for the distribution of priority contaminants in sediments, water and biota, as well as scientifically defensible thresholds for environmental management. The thresholds include ones based on assessment of the extent of disturbance from natural conditions as well as ones based on potential toxicity to marine organisms or human health effects. For priority metals in sediments we have data for 15 harbours but for organics only 2, PAHs and PCBs in Halifax and Sydney Harbours. The picture is similar for water column data; we have metal data from 21 harbours, but PAHs, PCBs and tributyltin from only Halifax and Sydney Harbours. The data for biota are more limited with some data for both mussels and lobster digestive glands for only 7 harbours along the Nova Scotia Atlantic coast.

Nutrients are important indicators of environmental quality but indicators and thresholds based on nutrients are less well developed. Knowledge relevant to MEQ can be developed from ecological studies, assessments of seasonal nutrient cycles and nutrient distributions in N:P space. Ecological studies develop knowledge of nutrient dynamics and biological interactions – i.e. the understanding of the ecology that is required to develop MEQ indicators and thresholds. They provide a good assessment for a specific location but are time and labour intensive. Seasonal cycles of nutrient distributions give a somewhat less labour intensive assessment of the environment that yields several measures that could be MEQ indicators including concentrations during winter and the extent of depletion of nutrients during spring and summer. We currently have in our database, seasonal cycle results that are at least two years long for 8 harbours as well as the open coastal AZMP station 2 site.

The third method (distributions in N:P space) is much less developed but has potential for making assessments based on archived data or minimal field measurements. The method is based on a description of nitrate, ammonia and phosphate concentrations and N:P ratios and requires the development of thresholds that could be used to identify concentrations that would represent 'normal' inshore conditions, those that indicate exceptional concentrations that may or may not be harmful, and those that are actually harmful. The concept shows promise but actual determination of scientifically defensible thresholds has yet to be accomplished. The potential value for MEQ assessments is substantial, the BioChem database contains thousands of nutrient measurements from the Atlantic coast of Nova Scotia for areas where we have neither ecological studies nor complete seasonal nutrient cycles.

Discussion

The physical oceanography of bays is dominated by shelf-wide processes. All major inlets respond to shelf forces (in unison). Some inlets have been classified and well described. Mahone Bay or St Margaret's Bay would respond to a larger extent because they are more open, but even Ship Harbour which is very protected responds to shelf forcing such as upwelling. Some bays have been well described in terms of bathymetry (volume, presence/absence of sills), freshwater inflow, and tidal range.

There was a discussion about the contribution of the shelf, land-based and aquaculture nutrient sources in bays. The data presented suggested that shelf processes dominate, although there were no data from nearshore or fringe areas. For example, in St. Margarets Bay where stations were 5 km offshore and at the mouth of the Bay, while in Bedford Basin samples are taken from the middle of the basin. In Halifax Harbour, spring blooms are now contributing less to the annual primary production, possibly indicating an impact of sewage in Halifax Harbour. Further discussions highlighted the potential of macro-algal and epiflora uptake of nutrients masking increases in land-based or aquaculture nutrient loading. If changes in the intertidal communities reflect changes in nutrient loading and these communities may be indicators of eutrophication. Research in Long Island was cited as showing detectable biotic response to nutrient loading, but no effect on nutrient concentrations.

There was also a discussion about the processes that could be affecting the relative concentrations of nitrogen (N) and phosphorus (P) in coastal waters. Residual P in coastal waters may result from preferred biological uptake of N or denitrification. Finally the importance of the physical structure of bays, such as the presence of a sill, can influence nutrient retention and primary productivity. As an aside, there may be impacts of aquaculture such as the displacement of the wild mussel with the edible mussel in Ship Harbour.

The use of the word pristine to describe the Atlantic Coast was contentious. The discussion highlighted the need to consider watershed and cumulative land-based activities in the context of the soil and geology of the area.

SECTION 3 – BIOLOGICAL INTERACTIONS AND BIODIVERSITY

This session describes the distribution of some of the habitat forming species and community assemblages and temporal changes in species abundance, food webs and ecological processes in the inshore of the Scotian Shelf.

Kelp, sea urchins, and wave exposure: Their contributions to diversity of near shore habitats

Robert Miller
Department of Fisheries and Oceans, Bedford Institute of Oceanography

The near-shore bottom along 4900 km of coast line from Cape Sable Island to northern Cape Breton was mapped as rock or sand/mud bottom. 140 dive transects evenly spaced along the rocky shore were surveyed to a depth of 15 m or to where the bottom changed to mud/sand. Transects were classified by five categories of wave exposure based on angle of sight to the open sea and length of fetch within bays. Observations on bottom type, depth, distance from shore, occurrence of 8 types of macroalgae, and occurrence of sea urchins were made at 2100 stations on these transects. Transect length and maximum depth increased with wave exposure.

Macrophytes add considerable third dimension structure and production to rocky bottom habitat. Individual plants can reach several meters in length and a biomass between 4 and 10 kg/m^2 is common. Wave surge moves these plants rapidly over the surface of the rocks controlling what can live on the substrate. In the absence of sea urchin grazing, annual subtidal macroalgal production equals phytoplankton production out to the 90 m depth contour. This area is not much smaller than the area to the 50 fathom/12 mile contour considered for study by this workshop. With the addition of production from intertidal algae and eel and marsh grasses about one-half the total plant production in the study area would be provided by attached plants located shallower than 15 m.

Sea urchin grazing can reduce the subtidal macrophytes to small refuges as seen in the 1970s, and disease can virtually eliminate sea urchins in macroalgal depths. Disease eliminated the urchins from Cape Sable Island to Torbay, Guysborough Co. in the early 1980s and again from Cape Sable Island to about Pt. Michaud, Cape Breton Co. in the late 1990s. Recovery is only beginning from the last mass mortality.

The accompanying figures (Fig. 3.1) show the relationship of depth (vertical axis), wave exposure (increasing from left to right in each figure), and sea urchin grazing on macroalgal abundance. Each dot is an occurrence at one of the 2100 stations observed. Note in the top two figures that *Laminaria digitata* was present in exposure categories 3-5 with urchin grazing but exposures 2-5 without grazing. In the middle figures *Saccorhiza sp*. is present in only exposures 3 and 5 with sea urchins, but in 2, 3, 4, and 5 and to greater depth without grazing. *Chondrus crispus*, a shallow water species, is present at all five exposures without urchins, but limited to exposure 5 with urchins. Therefore, all of macrophytes, sea urchin, and sea urchin disease play important roles in providing structure and production in the inshore waters of Nova Scotia’s outer coast.

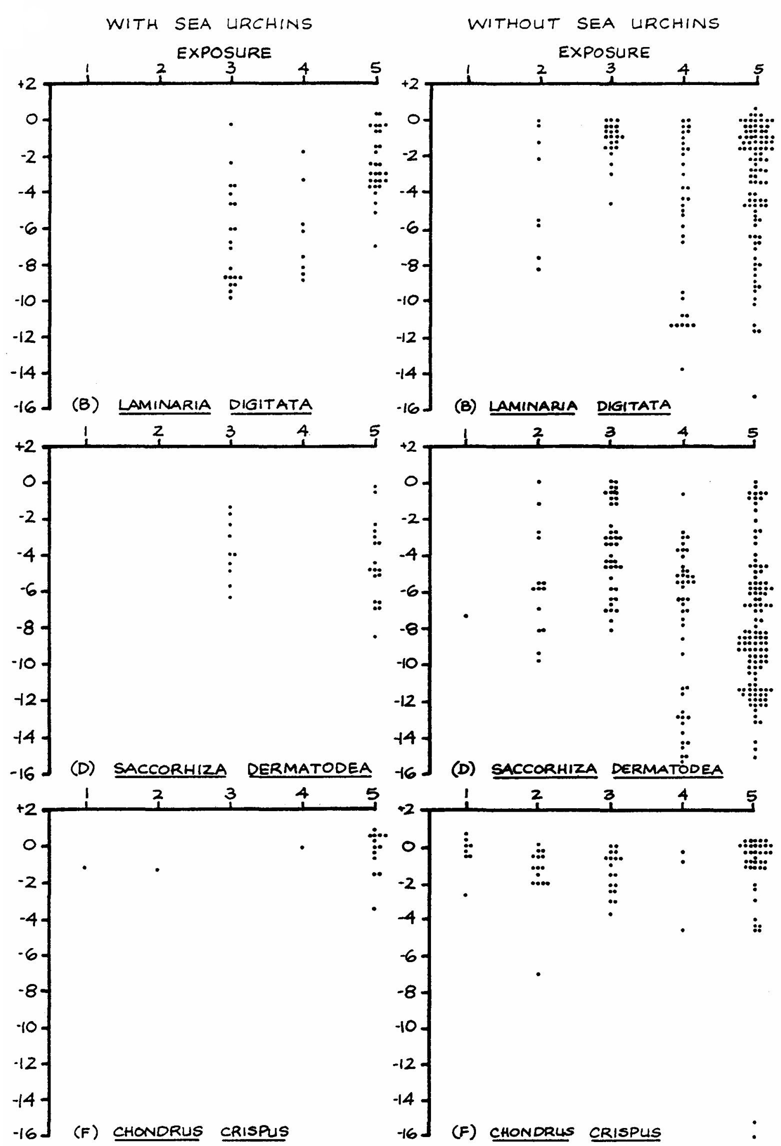

Figure 3.1. Occurrence of algal groups by exposure index and depth in areas with and without sea urchins (Taken from Figure 4, Moore and Miller 1983).

Reference

Moore, D.S., and R. J. Miller. 1983. Recovery of macroalgae following widespread sea urchin mortality with a description of the nearshore hard-bottom habitat on the Atlantic coast of Nova Scotia. Can. Tech. rep. Fish. Aquat. Sci. 1230: vii +94p.

Quantifying the rapid decline of eelgrass beds on the Eastern Shore of Nova Scotia: 1992 *vs*. 2002

Annelise Chapman and Jennifer Smith
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In several large tidal inlets on the eastern shore of Nova Scotia, eelgrass (*Zostera marina*) occurs in extensive beds, both intertidally and subtidally. Throughout the 20th century eelgrass was used commercially in the region, but mass mortalities have been documented repeatedly in the past. During the 1990s, eelgrass beds on the Eastern Shore of Nova Scotia were dense and extensive, but anecdotal evidence indicated a rapid and massive decline of populations between 1999 and 2002.

The goal of our study was to quantify this decline by measuring the distribution changes of intertidal eelgrass populations in four large tidal inlets in eastern Nova Scotia. We compared existing aerial photographs, published by the province of Nova Scotia in 1992 and taken at low tide, with new aerial images taken during this study in 2002. Through a process of (i) image registration to a topographical grid, (ii) colour signature selection of eelgrass, manually adjusted and (iii) quantification of grid cells occupied by eelgrass signatures, we were able to calculate the total intertidal area occupied by *Zostera marina* in four inlets (Cole Harbour, Chezzetcook, Petpeswick and Musquodoboit Harbour) in 1992 and in 2002. We ground-truthed the 2002 eelgrass signatures identified from aerial photographs by visiting 103 GPS registered stations in three of the inlets by canoe, identifying sediment types and benthic vegetation. This allowed us to distinguish eelgrass beds from other benthic vegetation, such as green algal mats.

The average decline of intertidal *Zostera marina* beds in the four inlets was 79.5 % ± 20.8 % (SD), with Petpeswick having the greatest loss (96%) and Cole Harbour the smallest (49%). We did not find any consistent pattern of *Zostera* disappearance, i.e. neither sediment type, exposure, location within the inlet or population features explained the decline of some beds and persistence of others. We also did not find symptoms of the wasting disease, which, in the past, devastated eelgrass populations across North Atlantic coasts.

We conclude that aerial photography is an extremely powerful tool to map the distribution of intertidal *Zostera marina* on scales of 10s of kilometres, but should not be used to draw conclusions about population parameters at smaller scales, such as surface cover, shoot density and shoot length.

The changing face of shallow vegetated communities in eastern Canada: A multiscale investigation of the green menace *Codium fragile* ssp. *Tomentosoides*

Patrick Gagnon
Hyperspectral Data International (HDI) and Dalhousie University

Over the past two decades, several species have been introduced to inshore ecosystems of eastern Canada. One of those, the green alga *Codium fragile* ssp. *tomentosoides*, was first reported along the coast of Nova Scotia by the end of the 1980s. Qualified as one of the most invasive species worldwide, *C. fragile* has since received considerable attention by local scientists interested in understanding how it may affect the integrity (structure and function) of the dominant communities, and most notably kelp beds which provide habitat, food and shelter to a variety of invertebrate and fish species.

In this presentation I **1)** provide a historical overview of the introduction and spread of *C. fragile* along the east coast of North America, **2)** summarize our current knowledge of ecological and biological aspects of *C. fragile* that make it a successful invader along the coast of Nova Scotia, **3)** present key results from ongoing surveys showing that *C. fragile* can disrupt natural cycles of alternation between kelp beds and urchin barrens and lead to atypical community climaxes, **4)** highlight the need to move from local to coastal scale studies to understand the direction and rate of spread of *C. fragile* along Canada's eastern coast, **5)** propose a framework that combines the use of (hyperspectral) remote sensing and GIS technologies to characterize the extent of *C. fragile* and of key algal assemblages (e.g., kelp) over large spatial (km) and temporal (years) scales, and **6)** identify the main limitations to this framework, which include the scarcity of adequate bathymetry for shallow coastal waters in support of benthic habitat classification.

I suggest that we, members of distinct realms (e.g., academia, public and private sectors) with different expertise and resources, should assemble to recognize operational gaps and establish joint programs for the systematic mapping and management of shallow coastal communities and resources in eastern Canada. This is most likely to be a critical step in the sound definition of inshore ecologically and biologically significant areas (EBSA).

***Ascophyllum nodosum* (rockweed): An integral part of habitat architecture in the intertidal of Atlantic Canada**

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Ascophyllum nodosum (rockweed) a floating brown alga is the dominant biological component of the intertidal habitat on the sheltered to semiexposed coastlines of Atlantic Canada.

The higher amplitude of tides (6 - 9m) in the Bay of Fundy along with low shoreline slopes result in much larger beds of *Ascophyllum* than on the rest of the Atlantic coastline with tidal amplitudes of 1.5 to 2 m. While Ascophyllum exists in a range of wave exposure, in the most extreme wave exposure *Fucus spp*. replaces *Ascophyllum* due to its ability to reproduce continually over the summer versus the single short pulse of reproduction from *Ascophyllum*.

The complexity of the *Ascophyllum* bed is a function of plant structure, starting from the smallest unit, an epiphyte on a shoot, to a shoot, to a group shoots on a common holdfast (e.g. a clump). At the landscape level the density and distribution of clumps within a bed. As the total length of the clump of shoots increases the biomass and habitat complexity becomes more distal.

As a result of all these levels of complexity *Ascophyllum* clump has a range of niches that contribute to biodiversity and high abundance of invertebrates from crustaceans to worms. The 55 taxa of invertebrates found in the canopy of *Ascophyllum* range from those that are simply "passing through" transients at high tide to sessile species that occupy the habitat year round. Some species such as the blue mussel use the plant as an initial settlement substrate and move on to more stable habitat. Animals such as crab move into the habitat to forage during the rising and high tide.

The abundance of meso invertebrates in the canopy can vary greatly between *Ascophyllum* beds at the same time of year. Wave exposure and canopy structure can contribute to this variability. Field experiments manipulating plant density and underlying substrate suggest the adjacent habitat has a strong influence on what groups dominate early immigration to *Ascophyllum* clumps.

Vertebrate species use the *Ascophyllum* habitat both as a forage and shelter.
Water fowl including several species of ducks and geese forage in the high tide canopy of *Ascophyllum*. There is a critical period when eider ducklings cannot dive to feed on the same benthic invertebrates as the adult birds. During this time the canopy invertebrates that are very accessible are an important food source. There have been a range of 31 fish species reported from intertidal rockweed at high tide. Some such as juvenile winter flounder and sculpins are eating amphipods and isopods among the 100 prey species available in this habitat. The schooling behaviour of juvenile pollock changes from tight schools to a more dispersed distribution in the *Ascophyllum* canopy making them less vulnerable to bird predators.

In the nearshore *Ascophyllum* provides a significant part of the macrophyte productivity particularly when other macrophytes such as kelp species have been overgrazed by sea urchins. The most obvious sign of this contribution to nearshore production is the windrows of storm cast *Ascophyllum* apparent after storm action. In southern New Brunswick of a standing crop of 157,000 t, 47,000 t are naturally detached and broken down within the ecosystem each year.

Ascophyllum nodosum is also a commercially valuable species and has been harvested for over 45 years in Nova Scotia. Landings using artisanal methods have reached 45,000 tons annually from a resource base of 350,000 to 450,000. This harvest is area managed with quotas based on ecosystem targets to lower the risks to the system and the value of this resource as a habitat.

Structure, process and biodiversity
John Roff
Acadia University

In attempting to recognize and define Significant Areas of the coastal zone, EBSAs should not be the only agenda item. A comprehensive framework is required to recognize ALL ecosystem components, and classify them so that EBSAs are non-arbitrarily defined. The components of such a framework would include:

1. Classification of 'Functional Units' - Ecosystems' (Representative Areas)
2. Location and characterization of EBSAs (Distinctive Areas)
3. Analysis of distribution of the elements of marine biodiversity within the coastal zone.
4. Analysis of coastal zone impacts / disturbances: regimes and frequencies
5. Development of indices of impacts
6. Development of a management / conservation / utilization – strategy

Classification by taxonomic groups can inform us about: biogeography, community type, water quality; juvenile and larval fish assemblages may be the most informative group.

Classification by community and habitat type should yield an inventory of Repeat Coastal Units and Representative Areas. Such classification is important for the objectives of ESSIM and the establishment of Coastal Management Areas. Among other questions, we should ask:

- How do these units represent the major elements of marine biodiversity?
- How are coastal processes related to structures?

Unfortunately, the EBSA agenda ignores Representative Areas (comprising the great majority of coastal habitats), and the fundamental elements of marine biodiversity.

I review the fundamental elements of marine biodiversity, and my present research program. I show that high benthic species diversity (one of the components of biodiversity that should be recognized in EBSAs) can be accounted for by environmental variables.

Discussion

The talks in this session covered biogeography, invasive species and local impacts on the macrophytes and associated communities that were identified with a variety of techniques including SCUBA, traditional sampling and remote sensing. It was noted that the broad patterns of urchin fronts and kelp die-backs were better understood than the recent localized eel grass die-backs. Urchins are the main consumers of kelp, producing wide scale removals, although snails and a Bryozoan can also cause some damage to kelp, for example, in Mahone Bay. These talks presented maps of distribution, which are useful, but it was noted that what we need for management is predictive ability and an understanding of ecological process.

There was a discussion on the identification of EBSAs and how this would be used for oceans management. It was suggested that EBSAs may not be prescriptive, but rather a classification system based on large-scale biogeography, and that specific management plans would be based on research into process/mechanisms in specific areas. The need for better definition of EBSAs, avoiding the ”my favourite species” trap and the arbitrariness of available data, as well as the definition of management objectives was highlighted and tabled for discussion later in the workshop.

SECTION 4 – LIFE HISTORY, HABITAT USE AND POPULATION STRUCTURE

Inshore habitat can be important to many species for various life history stages. Mapping habitat use, as migratory routes, spawning areas, rearing areas and foraging areas, and exploring the importance of habitat in the context of population dynamics will identify habitat that is critical or necessary. Understanding how and when habitat is used is also fundamental to predicting impacts from human activity. The presentations in the next two sessions focus on habitat use of invertebrates, fish, marine mammals and birds in the inshore areas of the Scotian Shelf.

Geographic distribution and habitats of some inshore decapod crustaceans on the Atlantic coast of Nova Scotia

John Tremblay
Department of Fisheries and Oceans, Bedford Institute of Oceanography

This presentation reviews the distribution of some inshore decapods – the Brachyura or true crabs, the Anomura (Hermit & lithodid crabs, squat lobsters) and the Astacidea or true lobsters. Of 17 species in these groups that are known to occur inside of 12 nautical miles of the Atlantic coast of Nova Scotia, we have little or no information on 8 species. This level of knowledge is probably "rich" compared to many epibenthic taxa that are non-commercial. Data sources for distribution include trawl surveys (but these are mainly beyond 12 nautical miles) and data from commercial traps.

Broad gradients in species composition related to temperature and depth are evident in these taxa. The invasive green crab predominates in the warmer shallow waters of sheltered bays while snow crab are found mainly where bottom temperatures are less than 3-5 °C year-round. Places where these cold conditions exist within 12 miles of the coast include parts of eastern Cape Breton and Chedabucto Bay. Jonah crab are found in warmer bottom waters, only on the western half of the Scotian Shelf.

While we have a broad outline of the life history of inshore decapods and know something about the range of temperatures they are found in, we know much less about details (e.g., migrations, seasonality of growth, spatial and habitat linkages). An understanding of population structure is absent or limited. As far as population ecology and habitats, as might be expected we know most about the lobster and this is reviewed in the presentation. A key point is that some inshore areas can be considered as brood areas for lobster in that mature females are known to move inshore in summer to take advantage of warmer temperatures to accelerate egg development. Detailed seasonal use by lobsters of habitat in individual bays is generally not known.

Demersal communities of inshore Sydney Bight

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The 4Vn inshore survey was initiated in 1991 and ran until 2003. The original goal of the survey was to confirm literature (1930s) reports and anecdotal information of cod spawning in the western Sydney Bight area of NAFO statistical subdivision 4Vn, and further to search for possible cod nursery areas. A small 50 foot flounder trawl with a small mesh liner was selected to collect adult and juvenile fish, and bongo nets and a Mininess plankon sampler were used to gather fish eggs and larvae. Initially, trawl and plankton surveys were conducted in the spring and autumn, but first the plankton, and then the spring trawl survey was discontinued due to lack of resources.

Fish were identified, weighed and counted and when time permitted length frequencies collected. Detailed information was collected for individual cod: these data comprised length, weight, otolith (age), sex, maturity, and stomach contents. In addition, invertebrates were identified, weighed and counted. A CTD cast was made at each station and surface temperature recorded.

In 1991 and 1992, cod in spawning (‘ripe and running’) condition were taken in western Sydney Bight in early May and cod eggs were identified in plankton samples taken in late April and through May. In September of all years, young-of-the-year cod were captured in the vicinity of the Bird Islands in south-western Sydney Bight. In general fish and invertebrate species were distributed according to depth, bottom type and season. There was a movement of fish species that was both ontogenetic and seasonal: young fish inhabit shallow waters but move to deeper as they age, and all ages tended to move offshore to deeper water during the winter months. It was determined that the Bird Island area was a nursery area for not only cod, but probably other groundfish species as well.

In early trawl surveys, snow crab were rare but gradually increased in number until the late 90s after which their abundance decreased to zero by 2003. A decrease in the 4Vn cod stock (4Vn sentinel survey) coincided with the build up of the snow crab population and the subsequent decrease coincided with increasing catches due to an expansion of the snow crab fishery. Lobsters occurred infrequently in the trawl catch; however, at one location near the Bird Islands, large numbers of this shellfish were always taken. Interestingly, lobsters were caught here only in the autumn months and not during late spring and early summer indicating a probable overwintering area.

Diadromous fishes of the Atlantic coastal Nova Scotia

R.G. Bradford
Department of Fisheries and Oceans, Bedford Institute of Oceanography

Diadromous fishes migrate between salt and freshwater. Those which spawn in freshwater and spend a portion of their lives at sea are diadromous, of which there are 10 species which occur within Atlantic Coastal Nova Scotia. Fishes which spend most of their lives in freshwater and spawn at sea are referred to as catadromous of which only one species occurs in the area.

Diversity of freshwater aquatic habitat, variable estuary morphology and ocean forcing, as well as among-species variability in life-stage specific habitat requirements, in combination, contribute to substantive variability in both population richness and absolute population size among and between species. No single drainage supports all of the 10 federally managed species, although many rivers support several species. Several species are considered to be rare, occurring in only one or a few locations. At least two species have been assessed as ‘at risk’; two additional species are under assessment. Important commercial and/or recreational harvest fisheries occur for several of these species, including at least one of the species which has been assessed as at risk, and the two currently under assessment.

The inshore area has particular significance for diadromous fishes, as the interface between freshwater and marine habitat, as staging areas to fulfill life-history imperatives, as migratory corridors, as feeding areas. Operational definitions of ‘inshore’ and ‘coastal’ -areas of less than 50m depth, inside the 12 mile limit – do not necessarily convey either the functional role of this ocean area in their structuring and population dynamics or the diversity of habitats and oceanographic processes occurring therein.

The Province of Nova Scotia possesses hundreds of primary river drainages and associated estuaries owing to complex physiography. Supporting habitat for diadromous species within both the freshwater and estuarial/near shore realms is accordingly diverse in character, productivity, water quality and availability. Ocean forcing imparts additive complexity to the near shore area and its use as supporting habitat for diadromous species. Water circulation and mixing can be expected to vary among estuaries as a function of their position relative to important coastal currents, and to predictable gradients in tidal forcing in addition to physiographic factors such as river discharge and estuary morphology.

Individual river drainages represent the unit of management for most of the anadromous species, that is most ‘runs’ are assumed to represent reproductively discrete populations. Obligate freshwater residency times vary from a few hours to several years among species. Estuarial and marine dependency, as the inverses to freshwater residency, is therefore equally variable among species. The marine phase of diadromous fishes, specifically their distribution, seasonal occurrences and habitat requirements are not well studied.

Fish near shore

Robert Miller
Department of Fisheries and Oceans, Bedford Institute of Oceanography

Fish, decapods, small benthos, and near-bottom plankton were sampled over 15 months in a sheltered inlet near Peggys Cove. Juvenile and adult fish collected in trammel nets and fish post-larvae collected in plankton nets were reported on here (Figure 4.1).

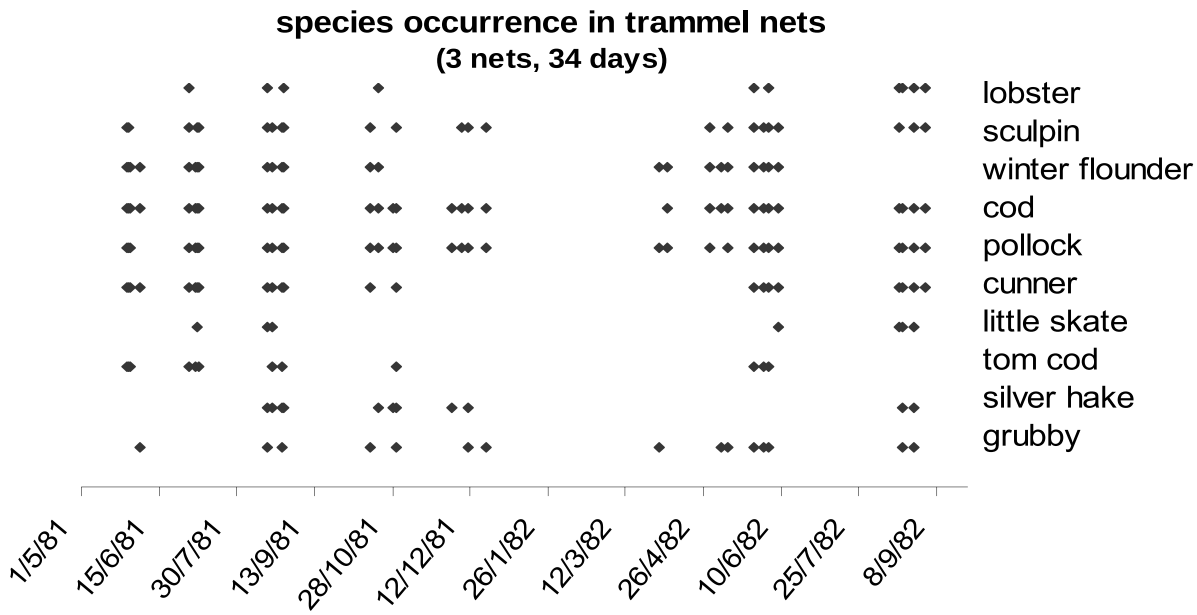

Figure 4.1. Temporal changes in species occurrence in trammel nets in Coyle Cove, Nova Scotia.

Among the abundant species taken in trammel nets, pollock, cod, three species of large sculpins, and a small sculpin were taken year around. Cunner, tomcod and little skate were not taken from December through May and silver hake were taken only in the autumn. Cod and winter flounder catches were greater among kelp than over bottom without macrophytes. Pollock was equally abundant in both habitats. Two young cohorts plus a group of larger cohorts could be identified.

Rock gunnel and cunner were by far the most abundant fish species in plankton net hauls. Cunner peaked at 5/m^3 in August. Cod, pollock, grubby (a small sculpin), winter flounder, lump fish, and sea snail (*Liparis*) were taken occasionally. During 5 months of sampling in one year 58% of the fish were taken in one month.

In summary, this shallow and sheltered embayment had abundant year-around residents and seasonal visitors. It was clearly a nursery area for pollock, cunner, and silver hake. Post-larval abundance showed a strong seasonal peak in August. The area's use by the fish community would be unfairly represented by one or two sampling dates in a year.

Coastal fish populations of Nova Scotia

Don Clark
Department of Fisheries and Oceans, St. Andrews Biological Station
Summary by Jim Simon, Department of Fisheries and Oceans, Bedford Institute of Oceanography

This presentation focused on the distribution of fish in the inshore area of the Scotian Shelf. The spatial and temporal changes in distribution, abundance, spawning areas, migratory routes and nursery areas of various fish species within this area were contrasted with the offshore area. Because there is no comprehensive inshore survey, these questions were examined using various data sources, each of which have their own biases and limitations.

The DFO summer RV trawl survey has been conducted annually since 1970 on the Scotian Shelf and the Bay of Fundy. Coverage of the Scotia Shelf has been excellent except in the nearshore area (<50 fms). In the Bay of Fundy and off Cape Breton coverage extended closer to shore(20 fms) due to suitable bottom. Generally, relative changes in fish abundance in the inshore can not be detected by this survey.

To partially address the problem of poor inshore coverage a number of industry/science surveys were initiated. In NAFO Division 4X, a trawl survey has been conducted by industry since 1996 using rockhopper trawl gear. This gear is generally more effective in catching fish lying closer to the bottom. Although there are no inshore stations between St. Margarets Bay and Shelburne coverage was good in the remainder of the NAFO Division 4X inshore area. This survey indicates that age 0 and 1 cod were most abundant inshore with the highest catches off Cape Sable. Winter flounder were only found in depths < 50 fms, but very few were caught in St. Margarets Bay. Spiny dogfish were most likely caught in the Bay of Fundy and the mid-depths of the Scotia Shelf.

In NAFO Division 4VsW, a longline Sentinel Survey has been conducted since 1995. Given the gear used, catches are restricted to the species can be caught by the hook and line, and that would be taken with the size of hooks used. In addition, biological sampling has been relatively limited. Inshore coverage by this survey has been excellent. Cod are the dominate inshore species and catches are higher here than the offshore. Other species caught inshore by this survey are primarily near Halifax and off Chedabucto Bay.

Geo-referenced commercial fisheries catch data has been available since 1991 for otter trawls and since 1996 for longline gear. In NAFO Division 4VW, closures of the directed cod and haddock fisheries have reduced recent effort to near zero. In NAFO Divsision 4X, haddock and halibut are the primary species caught inshore by longline gear. Although there has been relatively little effort by otter trawlers, inshore catches were primarily cod and winter flounder. Prior to 1991, landings by all fisheries were recorded at a much coarser scale, ie country or NAFO unit. Although these landings were not geo-referenced, all information points toward the existence of extensive inshore fisheries. Thousands of tonnes of pollock were caught by gillnets and traps. Until the early 1990's , inshore catches of cod in NAFO Division 4Xmo remained dominant. A haddock handline fishery was active around Cape Sable until recently and herring were abundant in the winter off Chedabucto Bay.

A number of species are summer migrants to the Scotian Shelf and adjacent inshore areas. Mackerel are caught in traps all along the coast, while tuna show up on the Scotian Shelf, including coastal areas feeding on the mackerel and herring. Recently a hook and line fishery on spiny dogfish began in the Bay of Fundy.

Other data sources examined were the icthyoplankton surveys (Scotian Shelf Ictyoplankton Program, Larval Herring Program) conducted on the Scotian Shelf and the Bay of Fundy. These suggest, for example, that cod spawn in coastal Nova Scotia in the fall.

A number of tagging studies have been conducted on various species to help determine stock structure and migration patterns. For example young pollock tagged in traps along the coast remain in the area for one year and then migrate offshore in subsequent years.

An examination of the historical literature revealed some references to inshore fish distribution and spawning behaviour, but there have been no large scale continuing studies in the inshore. For example, studies in St. Margaret Bay indicated that small cod and white hake prefer eelgrass and have higher survivorship there. Small cod (3-10cm) were caught in many locations by beach seines around Nova Scotia. All along the coast spawning herring were noted.

In conclusion, there is relatively limited information fish distribution and abundance in the inshore. There is little annual inshore monitoring and the gears used at present do not adequately survey the area. What limited information there is indicates that there are less fish inshore than in the past. Despite these limitations, historical landings and survey data suggest that four areas of the inshore may be important. Around Cape Sable catches are more diverse than other areas, cod spawning has been noted, and juvenile fish are abundant. Near Halifax, there have been productive fisheries and cod and herring spawning. Similarly, Sydney Bight and the mouth of Chedabucto Bay have higher abundance and diversity of fish.

Distribution of leatherback sea turtles in Canadian waters

Michael C. James, Scott A. Sherrill-Mix and Ransom A. Myers
Dalhousie University

From 1998-2005, we collected geo-referenced records of leatherback turtles, *Dermochelys coriacea*, from a volunteer network of commercial fishers and tour boat operators in Atlantic Canada. These data provide new insight into the spatial and temporal distribution of leatherbacks in temperate northwest Atlantic waters. Patterns in sightings data were consistent with the results of concurrent satellite telemetry studies, revealing a broad distribution of leatherbacks on the Scotian Shelf throughout the foraging season. Our results suggest inter-annual variation in leatherback abundance in Canadian waters. Weekly mean area sea surface temperature had a significant effect on the number of leatherback sightings reported, independent of day of year. Most turtles were reported inshore from the continental shelf break, however, fisheries observer data indicates that leatherbacks also regularly occur in waters on and beyond the continental slope. Our findings suggest that the northernmost portion of the leatherback's range in the western Atlantic (waters above 38°N), and Canadian coastal waters in particular, provide important foraging habitat for this species. Conservation efforts must be broadened to address threats to leatherbacks in these areas.

Patterns of marine bird use over the inshore portion of the Scotian Shelf

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The Canadian Wildlife Service maintains databases on the distribution and abundance of breeding and non-breeding marine birds in the Atlantic region. Marine birds, comprising petrels, cormorants, gannets, gulls, terns, auks, phalaropes, seaducks and geese, loons, and herons, are ubiquitous over the inshore portion of the Scotian Shelf at all times of year. During the summer months, virtually the entire Scotian Shelf coastline is covered in marine bird colonies at which breed several hundred thousand individuals of 14 species. Colonies are usually on coastal islands or occasionally on isolated mainland sites. The commonest species by number of colonies are Great Black-backed Gull (*Larus marinus*), Herring Gull (*L. argentatus*), terns (*Sterna* spp.), cormorants (*Phalacrocorax* spp.), and Common Eider (*Somateria mollissima*). These species are, not unexpectedly, the commonest by population size with the exception of the Leach's Storm-Petrel (*Oceanodroma leucorhoa*), which constitutes the commonest species breeding on the Scotian Shelf coast by population size (over 200,000 individuals), but is found at only a few colony locations. The Cabot Strait coastline of Cape Breton differs from the rest of the Scotian Shelf area in having fewer islands and more cliff habitat. For these and other reasons probably related to biological oceanography, colonies are more spread out and breeding species are more typical of Newfoundland (e.g., Black-legged Kittiwake, *Rissa tridactyla*; alcids). Many marine birds breeding on the Scotian Shelf coastline would be expected to make use of the entire inshore zone out to the 50 fathom isobath or 12 mile limit. Some species are shoreline or coastal feeders (e.g., terns, eiders), and for these, numbers diminish rapidly with distance from shore. At the other extreme, Leach's Storm-Petrels are pelagic feeders and typically forage out to the shelf edge. The breeding season on the Scotian Shelf coast is about May-August inclusive, however, birds arrive at colonies before this and some, such as the Leach's Storm-Petrel, remain through October.

In addition to breeding birds, the Scotian Shelf is used as refuge and feeding habitat over the spring, summer, and fall months by migrant species from the south Atlantic and Antarctic (e.g., shearwaters, *Puffinus* spp. and Wilson's Storm-Petrel, *Oceanites oceanites*), by immature, pre-breeding northern hemisphere species from the North Atlantic (e.g., Northern Fulmar, *Fulmarus glacialis*), and by staging and moulting waterfowl (e.g., Common Eider). With the exception of waterfowl, most of these species tend to be pelagic and typically feed in areas of upwelling and high productivity over the offshore shelf and shelf-edge. Many Common Eiders use the southwestern portion of coastal Scotian Shelf to moult in the fall. In the spring and fall, both inshore and offshore areas of the Scotian Shelf are used as a corridor and feeding area for transient species migrating north in the spring and south in the fall (e.g., Northern Gannet, *Morus bassanus*; Red Phalarope, *Phalaropus fulicarius*; scoters, *Melanitta* spp.; Red-throated Loon, *Gavia stellata*). Total numbers of migrant and transient individuals of these species using the area of interest are unknown but could reach millions over the entire period of use.

In the winter months, local breeding marine birds disperse to coastal, inshore or pelagic realms and some typically move south off the eastern seaboard of the US. These are replaced by similar species breeding to the north which use Scotian Shelf waters as a winter refuge and feeding area. In addition, inland breeding birds (e.g., Black Duck, *Anas rubripes*; Canada Goose, *Branta Canadensis*; Common Loon, *Gavia immer*) move to the coast to feed. Of note here is the large numbers of Black Ducks that use the coastal areas around Halifax and Musquodoboit Harbour. These species are joined by large numbers of marine birds from Newfoundland, Arctic Canada, Greenland and northern Europe, which migrate south from breeding areas to over-winter. These notably include Common Murre, *Uria aalge*; Thick-billed Murre, *Uria lomvia*; Dovekie, *Alle alle*; Black-legged Kittiwake, and Northern Fulmar. Although some like the fulmar and kittiwake are pelagic in habit at this time of year, and would not typically enter the inshore portion of the Scotian Shelf, others like the murres and Dovekie would do so on a regular basis, sometimes in large numbers (i.e., 100,000s).

Marine birds in the Scotian Shelf area use a wide variety of marine species as food sources. Marine bird predators range from surface pickers, through plunge divers to pursuit divers, and some feed on benthic prey. Typical prey species selected tend to be small-medium size and highly nutritious such as oily fish (e.g., herring, capelin, mackerel, Myctophids), squid, and plankton such as copepods and krill. Waterfowl such as eiders and scoters prey on shellfish such as mussels, and can be a nuisance at aquaculture sites. Inland waterfowl such as Black Ducks and Canada Geese feed in shallow water on vegetation such as eelgrass, and also take invertebrates.

Research, evaluation and monitoring of coastal birds and their habitats

Al Hanson
Canadian Wildlife Service, Sackville, NB

In this presentation I provide an overview of the important habitats and bird species. Seaducks are an important group in the inshore and associated coastal islands. Research on Common Eider through banding programs and surveys has identified important breeding and moulting sites as well as promoting understanding of population structure and demographics. Seaduck aerial surveys conducted throughout the year monitor populations and identify important areas. Eelgrass is an important habitat for migratory birds such as Canada Goose, Atlantic Brant, and American Black Duck. Concern over the observed decline in eelgrass distribution and abundance in some localities in NS is shared by fisheries and waterfowl managers. A Bay of Fundy Ecology Program (BoFEP) Eelgrass Working Group (www.bofep.org) was established to facilitate information sharing and the development of joint research.

The Maritime Shorebird Survey is a volunteer-based monitoring program for shorebirds that was initiated in 1974. Many shorebird species nest in the Canadian arctic and use habitats in our region during late summer for staging, and fall and spring during migration. There are nine shorebird species that have experienced regional and continental declines: Red Knot, Least Sandpiper, Short-billed Dowitcher, Dunlin, Spotted Sandpiper, Lesser Yellowlegs, Sanderling, Purple Sandpiper, and Willet. Habitat for these bird species is important and ranges from intertidal mudflat, sandy beach to rocky shore. Surveys of gull, tern and Great Blue Heron colonies are conducted by the Canadian Wildlife Service.

Salt marshes and associated wildlife populations such as Nelson's Sharp-tailed Sparrows and Willet have been identified as priorities for restoration and conservation in northeastern North America. To better understand habitat requirements of salt marsh birds, breeding bird and habitat surveys were conducted on 161 salt marshes in the Canadian Maritime Provinces. The density of Nelson's Sharp-tailed Sparrows was positively influenced by marsh area, with salt marshes less than 5 ha having a much lower density compared to marshes larger in size. Currently the proportion of salt marshes 5.0 ha or greater is only 54, 45, and 31 % of the total number in Bay of Fundy, Atlantic and Gulf of St. Lawrence regions, respectively. Southwestern Nova Scotia is regionally very important for Willets.

The Maritime Wetland Inventory has mapped coastal habitat and plans are underway to develop a Canadian Wetland Inventory which will incorporate newer remote sensing technologies. Federal, provincial and non-government agencies have identified and purchased important bird areas in coastal NS.

Marine mammal distribution along the Atlantic coast of Nova Scotia

Tonya Wimmer
Marine Animal Response Society

Marine mammals are one of the top predators in the marine environment and are a prominent component of marine ecosystems. In Nova Scotia, there are over 20 pinniped and cetacean species that are regular visitors to our waters including several species at risk such as the blue, northern bottlenose and North Atlantic right whales.

Marine mammal distribution and occurrence has not been looked at on a large scale (spatial or temporal) in the Maritimes. The most detailed information occurs for species and areas that are the focus of dedicated research programs (e.g., right whales in the Bay of Fundy, northern bottlenose whales in the Sable Gully). Marine mammals occur in all coastal and offshore areas including some rivers. Many species are year-round inhabitants (e.g., minke, harbour porpoise, and grey and harbour seals) while others are seasonal visitors (e.g., migrating baleen whales and harp and hooded seals). For many of these species we have very limited data on their spatial and temporal distribution.

Besides direct research on specific species, information regarding the distribution of marine mammals can be obtained from several other data sources. The main issue with these data sources is that many have not been compiled (the North Atlantic right whale consortium currently maintains the largest database of marine mammal sightings). The primary sources for information on marine mammal distribution are: opportunistic sightings, whale watches, strandings, direct research, anecdotal reports and traditional ecological knowledge (TEK).

Opportunistic sightings have been collected while people are conducting research on specific species (such as during right whale or harbour porpoise surveys) or during other activities such as fishing and seismic surveys. Anecdotal reports and TEK include vessel logs, community member sightings, etc.

While the data that have been compiled highlight some potentially highly used areas, it is critical to understand that these data are temporally and spatially biased. In Maritime waters, most of the research and activities occur in the summer months and in specific areas (Bay of Fundy, Sable Gully, slope waters, etc.). Thus, when plotted, the data suggest that these areas and times of years are where and when marine mammals occur in our waters (or conversely that they are not there at other times or in the other locations). This is not the case. From stranding reports, limited activities (such as late fall seismic surveys), and community reports we know that large and small marine mammals are sighted in inshore and offshore Maritime waters throughout the year.

The compilation of all available data sources will help to clarify when and where marine mammals occur and highlight areas that need to be examined in more detail. This will include collecting data from all opportunistic surveys, anecdotal reports from fishers and community members, strandings and any other relevant sources. The development of a Maritime-wide marine animal sightings network will also help us to determine the extent of marine mammal distribution (particularly in the winter and for species at risk) and the identification of important habitats.

Discussion

Discussion focused on exploring bias of various surveys, sightings of mammals and turtles, and fishing gears. For example, DFO and sentinel surveys are concentrated in specific time periods, the gears often size- and species-selective and the data on non-target species, such as invertebrates, is not always reliable. Despite the biases, Chedabucto Bay was identified as a hotspot for invertebrate biodiversity, because the strong depth gradient. Given that some of the data in the inshore is quite old, it was suggested that the 36-year offshore survey offshore be used as a reference for the intermittent inshore surveys.

There was a discussion about the distinction between preferred and critical habitat. There were also several discussions about trophic interactions and changes in the abundance and distribution of species. There were also specific questions about turtle physiology, diving and feeding behaviour, and diel movement patterns.

There was another extensive discussion on the eel grass die-back, focusing on whether the die was recurring and the impacts on shore birds. There was a decline in 1930 which was due to blight. There is no evidence of blight in the recent die off although the fungus is still there naturally and stress due to high temperature, high salinity or both can lead to an outbreak. David Garbary's (St. Francis Xavier University) work on destabilization of eel grass caused by the activities of the invasive green crabs was cited as one explanation of the eel grass die-back. Other causes discussed included increased siltation resulting from increased sediment loading from land-based activities such as coastal development and forestry. Quantitative retrospective analysis of eel grass die-backs is difficult because the aerial photographs available were not ground-truthed at the time.

The impact of the fishery on the sea and shore birds was the subject of some discussion. There is only one example in the Bay of Fundy, Machias-Seal Island, where the absence of herring resulted in a decrease in a bird colony, but for the most part birds, particularly the diving birds, are adaptive feeders and resilient to the declines in fish stocks. However, surface feeders are usually more sensitive, for example kittiwakes in Newfoundland. It was noted, that if anything, efforts to better manage waste from fishery and urban areas, has had a negative impact on the birds that took advantage of discards, bait and landfills. The rebound in eagle and falcon populations may also have an effect on shore birds. While the larger colonies are tolerant to reduced reproductive success resulting from predation, smaller or new colonies could be eliminated.

SECTION 5 – SPECIES OF CONSERVATION CONCERN

Identifying the distribution and habitat use of species of conservation concern in the inshore area of the Scotian Shelf will be part of the EOAR and is essential for management. The Species at Risk Act (SARA) was created to protect wildlife species at risk of extinction. The Act prohibits the killing, harming, harassing, capturing or taking of species at risk, and the destruction of critical habitat. We begin this session with an introduction to the requirements of a species recovery plan and follow-up with presentations on a few of the species (species groups) that are of concern, focusing on habitat use in the inshore area of the Scotian Shelf.

The Species at Risk Act and DFO

Lei Harris
Fisheries and Oceans Canada, St. Andrews Biological Station

The purpose of Canada's Species at Risk Act (SARA) is to prevent wildlife from becoming extinct in Canada, to secure the recovery of extirpated, endangered or threatened species, and to manage special concern species to prevent them from becoming further at risk. The Act covers all wildlife species listed as being at risk and their critical habitats. The Act was entered into force on June 5, 2003, except for the prohibitions which came into force on June 1, 2004. Environment Canada is the federal department that has overall leadership on the Act. It is also responsible for wildlife and migratory birds. Fisheries and Oceans is responsible for aquatic species (marine and freshwater) and Parks Canada agency is responsible for species in national parks and national historic sites

The fundamental structure of SARA involves three stages: assessment, response, and recovery. Species assessments are science-based and are undertaken by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Within 9 months of receiving the recommendation from COSEWIC, the Canadian government must decide on one of the following options: accept the assessment and add the species to schedule 1 of SARA, decide not to add the species to schedule 1, or to refer the matter back to COSEWIC. Schedule 1 is the list of species to which SARA applies. The currently listed species under DFO Maritimes' jurisdiction include leatherback turtle, north Atlantic right whale, Atlantic whitefish, inner Bay of Fundy Atlantic salmon, Lake Utopia dwarf smelt, blue whale, harbour porpoise, northern wolffish, spotted wolffish and Atlantic wolffish. The number of species under DFO's jurisdiction being assessed is increasing and uneven: 15 are scheduled for 2006, 3 for 2007 and 8 are in development. It is difficult to predict the species that will be assessed since emergency assessments and unsolicited reports may be submitted at any time.

The SARA listing process requires much input from several sectors in DFO. DFO consults with the public through website surveys, meetings with stakeholders in their communities, and workbooks. There are increasing expectations for information and analysis in advance of a listing decision. DFO is asked to provide recovery targets and timeframes under different scenarios, the level of allowable harm that would be permitted, and socio-economic analyses. Most of the regional effort is being put toward SARA listing. Often this work can not be completed in the 9-month period. This has led to a 2 sets of listing timelines, depending on the species. For species where the listing would affect few people (minimal socio-economic impact) the 9-month listing timeline is still used. For those where many people would be affected (substantial socio-economic impact), such as commercially fished species, an 18-month listing timeline is followed. In 2006, COSEWIC may assess more than 10 Atlantic species with commercial fisheries interactions (directed or by catch).

After Legal listing automatic prohibitions come into force to protect the species. SARA states that for any listed extirpated, threatened or endangered species on Schedule 1 of SARA, no person shall: kill, harm, harass, capture or take an individual, possess, collect, buy, sell or trade an individual or any part or derivative of one or damage or destroy the residence of an individual. However, under section 73 of the Act the Minister may authorize a person to engage in an activity affecting a listed wildlife species if three pre-conditions are met. The first is that all reasonable alternatives have been considered and the best solution has been adopted, the second is that all feasible measure will be taken to minimize the impact on the species, and the third is that the activity will not jeopardize the survival or recovery of the species. The three activities which qualify are scientific research relating to conservation of the species, work that would benefit a listed species, and any incidental effect while carrying out the activity

The recovery planning requirements for listed species depends on the species' designation. For extirpated, endangered and threatened a recovery strategy and an action plan are required. For those listed as special concern a management plan is required. In the recovery strategy population objectives, threats, strategies to address threats, critical habitat, to extent possible timelines for action are identified. This is an inclusive process of development or consultation with those who may be affected. DFO science is expected to provide a definition of critical habitat, or schedule studies to allow its determination, monitor populations, evaluate whether or not a species is recovering toward target (detecting trends requires much more monitoring effort than most non-scientists realize). This work is expensive; little of it is currently underway. SARA does not explicitly require this work, but rather requires that we evaluate our progress to date (every 5 or 10 years).

Avian Species at Risk in the nearshore area of the Scotian Shelf

Andrew Boyne and Julie McKnight
Canadian Wildlife Service, Environment Canada

The *Species at Risk Act* (SARA) was introduced and deemed to have passed all stages as Bill C-5, in the House of Commons on October 9th, 2002. The purposes of the *Species at Risk Act* are to prevent wildlife species from becoming extirpated or extinct; to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity; and to manage species of special concern in order to prevent them from becoming at risk. It covers all wildlife species at risk nationally, their critical habitats and applies to all lands in Canada. SARA, as well as complementary provincial and territorial legislation as provided for under the Accord for the Protection of Species at Risk, will protect species everywhere in Canada.

There are currently six avian species at risk, listed under SARA, that are found in the nearshore area of the Scotian Shelf. Two are listed as Endangered, Roseate Tern (*Sterna dougallii)* and Piping Plover (*Charadrius melodus melodus*); and four are listed as Species of Special Concern, "Ipswich" Sparrow (*Passerculus sandwichensis princeps*), Harlequin Duck (*Histrionicus histrionicus*), Barrow's Goldeneye (*Bucephala islandica*), and Ivory Gull (*Pagophila eburnea)*.

Recovery Strategies are being developed for the two Endangered Species and Management Plans are being developed for the four Species of Special Concern. Some of the threats to these species, such as habitat loss and disturbance, are similar across species while others, such as logging are species-specific and not related to the nearshore area of the Scotian Shelf.

Roseate Terns, Piping Plovers and “Ipswich” Sparrows nest along the coast of the nearshore area of the Scotian Shelf while Ivory Gulls, Harlequin Ducks and Barrow’s Goldeneye are only found in this area during the winter. Species like Barrow’s Goldeneye and Ivory Gull are quite dispersed during the period of time they are in the area, while other species like Roseate Terns and Harlequin Ducks are found clumped together at breeding colonies and wintering areas, respectively. More details on the threats, recovery actions, and status of these six species are provided in the presentation.

Marine fish Species at Risk in the inshore Scotian Shelf

Lei E Harris
St. Andrews Biological Station, Fisheries and Oceans Canada

In the Scotia-Fundy region, northern wolffish, spotted wolffish, Atlantic wolffish, cod, cusk, winter skate, white hake, and thorny skate have been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or are scheduled to be assessed. Any of these species designated at risk will be considered for listing under Canada’s Species at Risk Act. The composition of this list is expanding and is dependent largely on the order in which species are assessed. Cod will not be discussed further since they are included in the presentation on marine commercially important fish species. The northern wolffish and spotted wolffish have a more northern and offshore distribution and so they will not be discussed further.

The data sources examined include the 1985-1986 exploratory trawl survey that was conducted in the inshore of southern Nova Scotia. The Individual Transferable Quota (ITQ) industry survey has been conducted every July since 1995. This is a bottom trawl survey that samples NAFO Division 4X, including inshore strata where possible. The NAFO Division 4VsW sentinel survey, which is a long line survey, has been conducted every fall since 1995. It includes 3 inshore strata. Commercial fishing data were also analysed however these data were limited. Only recent data are geo-referenced and even then, only in some fisheries.

The Atlantic wolffish, which is fairly common on the Scotian Shelf, is listed as special concern. It is a sedentary and solitary species found widely distributed on the Scotian Shelf. It has a preference for rocky bottom and seaweed beds. It is considered a deep water species but is also found close to shore, in waters from 1 to 550 m. The mature fish migrate inshore in spring where they spawn amid rocks and seaweed in shoal waters (1-15 m). Their benthic larval stage is spent near the spawning grounds. Juvenile fish remain offshore. Based on survey data wolffish were found off Cape Sable Island in NAFO Division 4X. In NAFO Division 4VsW they are found all along the eastern short with an aggregation off Canso.

Cusk were designated as threatened by COSEWIC in 2003. Cusk are sedentary and solitary. They prefer rocky bottom and have been observed hiding in crevices. They are considered a deepwater species but are found in all depths in our surveys. In both survey and fishing data, cusk are caught mostly offshore though some have been caught closer to shore off Cape Sable Island and Halifax.

The Eastern Scotian Shelf population of winter skate was designated as threatened and the Georges Bank-Western Scotian Shelf- Bay of Fundy population was designated as special concern in 2005. Winter skate is a shallow water species found primarily on banks in waters less than 100 m. They prefer sand or gravel bottom. A winter inshore migration has been observed in the Bay of Fundy. Winter skate distribution in the inshore of Nova Scotia is widespread, with an aggregation found off of Canso.

Thorny skate are scheduled for assessment by COSEWIC in May 2007. This is a benthic species found at intermediate depths, most commonly between 36-108 m. Thorny skate prefer sandy, sandy silt, and clay bottom. They are more common offshore but have been caught inshore in our surveys, with an aggregations found off Canso and Halifax.

White hake are scheduled for assessment by COSEWIC in May 2007. White hake is most commonly found at depths between 200-1000 m. Mature white hake prefer soft bottom. The young of the year (~5-15 cm) are found inshore at depths <1m, move offshore as they grow. They have been observed in estuaries associated with eelgrass beds or a substrate of mud or fine-grained sand. In the survey data few white hake are caught in the inshore area. However fishing data from the 1920s indicate that they were fished commercially inshore along the entire coast of Nova Scotia.

This information presented on inshore habitat usage by marine fishes at risk or potentially at risk is limited by the data available. The inshore is not well sampled, and for some areas (such as Lockeport to Halifax) no survey data were available. In most areas only one survey gear type was used, and in only one season. The absence in the inshore of the species considered may be due to the ecology of the species, a reduction in range or it may be an artefact of limited data. Three inshore areas in which aggregations of several of theses species were found were noted: the first is off Cape Sable Island, the second is off Halifax going east towards Sheet Harbour, and the third is off Canso.

Discussion

The timeline for recovery strategies were discussed. While some bird species will have management and recovery strategies completed this year, after 7 yrs in development, the only marine species which has a recovery strategy is the North Atlantic right whale, but this strategy is not SARA compliant as it was completed before SARA. A question was also raised concerning strategies for animals that are only in our waters part of the time. Essentially, we can only assess threats and take action while in Canadian waters.

It was acknowledged that it would be helpful to do research on species before they became listed, but that it was difficult to get funding for such research because the system is reactive not proactive. For example, R. Bradford suggested that American Shad warrant more research because all along the Scotian shelf the population abundance is uncertain and they are a conservation concern but not listed.

There was further discussion and cautions about interpreting bias in survey and sightings data. It was also noted that some areas appeared in several talks as areas of high concentrations of fish, bird and mammals species. It was also noted that for fish species of concern, most of the available data are not for the inshore so it makes it difficult to comment authoritatively on the inshore. There was some discussion about focusing the Inshore Ecosystem Research in these areas but it was concluded that the transect design was a good approach as it would provide data to compare areas and identify EBSAs.

SECTION 6 – ANTHROPOGENIC IMPACTS

Inshore areas are intensely used and stressed through a variety of small and large scale anthropogenic activities. To assess ecological impacts, we need to identify human activities, direct and indirect impacts, and the cumulative effects of human activities, all in the context of climate change. The presentations in this session focus on some of the research on the ecosystem impacts of human activities, climate change and invasive species in the inshore areas of the Scotian Shelf.

An overview of environmental issues related to marine aquaculture

B.D. Chang
Fisheries and Oceans Canada, St. Andrews Biological Station
Presented by Tom Sephton, Fisheries and Oceans Canada, Bedford Institute of Oceanography

Aquaculture in the nearshore marine environment of the Maritimes has grown considerably in the last two decades and is dominated by salmon culture in southwestern New Brunswick and mussel culture in Prince Edward Island. The industry in Nova Scotia remains relatively small. Along the coast of Nova Scotia there are currently about 47 licensed finfish farms (mostly salmon and steelhead) and 287 shellfish farms (mussels, oysters, scallops, quahogs, clams).

The presence of the physical structures required to culture animals (cages, nets, longlines, moorings, etc.) have the potential to affect fishing activity, vessel traffic, recreational activities (boating, sea kayaking, diving), wild species (including commercial species and species-at-risk) and aesthetic values. Physical structures may affect local water circulation patterns. They can also provide substrates and refuges for wild species. In finfish culture, prepared feeds are provided, while in shellfish culture, the cultured animals filter plankton from the water. Impacts can occur due to the production of organic matter wastes (uneaten feed, feces), dissolved nutrients, and contaminants (metals on treated nets, metals and drugs in feed). Possible impacts include degradation of benthic habitat (primarily due to deposition of organic wastes) and changes in the algal communities (due to removal of plankton by cultured shellfish and/or eutrophication caused by dissolved nutrients). There may also be beneficial impacts if wild species are attracted to aquaculture sites due to increased availability of food.

So far, there is no clear evidence of major impacts on commercial fisheries due to aquaculture, although some local impacts may have occurred. Fisheries landings in intensive aquaculture areas show no clear trends, in fact landings of some species have increased at the same time that aquaculture has grown. The impacts of the physical structures would be limited to the farm sites themselves, which in Nova Scotia is less than 0.4% of the total sea floor shallower than 30 m. There are some indications that, at least in a few locations in the Maritimes, we may be at or near the carrying capacity for salmon and mussel culture. Anoxic conditions have been found directly under salmon cages at a few farms. Altered benthic communities are generally limited to less than a few 100 m around operations. Some chemical residues have been detected, but generally not at harmful levels. Slightly depressed dissolved oxygen levels have been detected at some salmon farms, but it is not clear if aquaculture is the cause and there has been no major dissolved oxygen depletion detected adjacent to salmon farms. Some increased nutrient levels have been detected in the water column near some salmon farms, but there are no clear indications of increases in phytoplankton blooms, although there are some indications of changes to nearby macrophyte communities.

There may be changes in phytoplankton communities due to the filtering capacity of intensive mussel farming. There are also indications of increased productivity and diversity near some sites, due to the food, hard surfaces and/or refuges provided by aquaculture operations. Actions taken to minimize impacts include: the site allocation process, various marine planning exercises, environmental monitoring, and improvements in husbandry. In addition, research is being done to address various environmental issues related to aquaculture.

Approaches to investigate the impact of chemicals from anthropogenic sources on aquatic biota

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In the context of this presentation, an impact was defined as a change due to a chemical exposure. It is generally expected to be negative when it involves anthropogenic chemicals and is placed in context of a comparison between geographical locations or periods of time. Studies that relate to biological effects and implicate chemicals have to demonstrate a population level effect to be viewed as significant. At the opposite end, in ecotoxicology, the interest is in developing approaches that can be used as early warning signals for potential longer-term effects on higher levels of organisation. The challenge is to make the link between an end point that can be used as a preventive tool, and expected population level effects. As well, to sort out if anthropogenic chemicals rather than other variables such as temperature are implicated in an observed effect, cause-effect relationships are investigated in the lab to help interpret field observations. Later, the chemical data obtained in the field ascertains the interpretation of results. After presenting the range of chemicals, i.e. priority pollutants and emerging chemicals of toxic concern that can be detected in the environment, different approaches taken to rate the quality of a site were discussed.

The analysis of organic and metallic priority pollutants can be done in sediments and water. Results are then compared to sediment or water quality guidelines (SQG or WQG) that derive from the compilation of a large number of field and lab studies that correlate the concentration of chemicals with toxic effects. Results of chemical analyses can then be plotted on maps with a colour coding for each specific chemical that would indicate high potential toxic risk, medium or low risk following a street light convention. This provides a first step in studying potential biological impact in an environment. However, studies performed internationally have raised many questions on SQG. For example, there have been many SQG developed over time. Also, high levels of a contaminant in sediment do not necessarily mean that the chemical will be available for uptake by all organisms; the type of matrix determines the outcome. Chemicals are not present as one entity in the environment, but as complex mixtures and various concentrations of chemicals will display different risks and complicate the rating of sites relative to one another, if and when decisions have to be made for further action. Species variability in sensitivity relative to the SQG is another major unsolved question. Using levels of contaminants to address population level effects represents another challenge.

The presentation gave a brief outline of the multi-disciplinary studies that have taken place in Halifax Harbour involving sediments, water, snails, lobsters and mussels over the past 15-20 years. A few more details were presented on the more recent research involving mussels, with an example of a simple cumulative marker that represented the animals' health. This immune effect reflects the time that mussels will survive out of water. Over many samplings, it ranked mussels' health similarly to the bioaccumulation of abundant priority pollutants, polycyclic aromatic hydrocarbons (PAH), with an inverse relationship. Survival varied with site and sampling time, but the more contaminated animals survived for the shortest period of time.

Using the rating generated by studying the field mussels and discrepancy relative to the rating of some sediment sites, a laboratory approach was developed to examine the availability of PAH from sediments and the potential effects on a benthic amphipod available from the Bay of Fundy. An avoidance/preference response for contaminated/reference sediments demonstrated that animals will in many cases avoid contaminated sediments diluted with reference sediments, until the level of PAH reached the concentrations associated with the SQG. This was observed for five out of seven harbour sites or 70% of the time. The five sites are all located in the central channel of the harbour and also contain numerous other chemicals derived from sewage effluents. The other two are further away and representative of an undetermined geographical area. This biological effect can be viewed as a defence mechanism of the amphipod. Given a choice, amphipods will avoid contaminated sediments and display a preference for reference sediments. This could be easily interpreted as a population level effect, migration to greener pastures, if available. As in the case of other biological effects investigated in mussels, the bioaccumulation of PAH in amphipods represented a tool that enabled the interpretation of the behavioural results.

The authors concluded that chemistry enhances the interpretation of biological effects. It provides a valuable diagnostic tool and can lead to prevention. We drew a comparison to the role of chemistry in medicine. Chemistry is needed to get a diagnosis for a disease and for the treatment of many illnesses.

References are available from the authors.

Impacts of petroleum-related activities on the inshore environment

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In this presentation I provide an overview of potential impacts from petroleum and petroleum-related activities on the inshore environment. Although most petroleum exploration and production activities in the Maritimes Region have been occurring in the offshore environment, there are some activities that may influence the nearshore environment. These include pipelines, servicing of the offshore, seismic exploration and release of petroleum into the environment. Installation of pipelines, such as the Sable offshore gas pipeline that comes ashore at Goldboro, may result in habitat disruption, sediment suspension, obstruction, noise and discharges. Exposed portions of pipeline may act as hard substrate for attachment of marine organisms. Servicing of offshore exploration and production may lead to increased vessel activity in the coastal environment, which in turn may lead to increased infrastructure requirements, increased potential for release of hydrocarbons and other discharges, etc. Prior to 1984, some 2D seismic exploration had been conducted in the Maritimes nearshore environment, including St. Georges Bay, the Bras d'Or Lakes, and the Bay of Fundy. More recently, seismic exploration has been discouraged from entering waters less than 12 nm from shore. Petroleum may enter the nearshore marine environment from a variety of sources, including natural seeps, atmospheric transport, land-based run-off and marine spills. Large-scale accidental oil spills (such as the sinking of the Arrow tanker in Chedabucto Bay in 1970) receive intense media attention and can generate long-term impacts on the coastal environment. However, the ongoing, small-scale, land-based sources of petroleum are likely to have greater overall impact. Environment Canada's Emergency Environment Mapping Service (E-Map), which was created to assist in emergency response, may be a useful source of information on coastal resources. These GIS-based maps identify important coastal features, including species, shoreline types, distinctive physical features, human activities and infrastructure that may be useful information in a spill situation; however, this information may also be useful in the compilation of an Ecosystem Overview and Assessment Report for coastal Nova Scotia.

Sea surface temperature changes and biogeographic ranges of commercial marine species

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We examined the changes in February and August sea surface temperatures (SSTs) projected with greenhouse warming using output from an ensemble of four Atmosphere-Ocean General Circulation Models (AOGCMs) for two levels of global climate warming (2 and 4°C) and climate warming scenarios (A2 and B2). Differences in the magnitude of SST changes between the two scenarios were less than differences among models. In the Scotian Shelf Large Marine Ecosystem the magnitude of warming was substantially greater in winter than summer (Table 6.1).

Table 6.1. Ensemble Zonal Average Increases in SSTs (°C) over the Scotian Shelf Large Marine Ecosystem.

	A2		B2	
Global warming	2 deg	4 deg	2deg	4deg
February	2.2	4.6	2.2	2.7
August	1.5	3.8	1.6	2.6

We used projected SSTs to predict changes in biogeographic distribution of over 30 marine species important to commercial harvests. These include the important copepod prey *Calanus finmarchicus;* various shellfish (*Arctica islandica*, *Callinectes sapidus*, *Cancer irroratus*, *Crassostrea virginica*, *Homarus americanus*, *Mytilus edulis*, *Mya arenaria*, *Mercenaria mercenaria*, *Placopecten magellanicus*, *Stongylocentrotus droebachiensis*, *Loligo pealei*, *Pandalus borealis);* finfish (*Anarhichas lupus*, *Brevoortia tyrannus*, *Clupea harengus*, *Gadus morhu*, *Hippoglossoides platessoides*, *Hippoglossus hippoglossus*, *Melanogrammus aeglefinus*, *Merluccius bilinearis*, *Mallotus villosus*, *Salmo salar);* introduced and invasive species (*Littorina littorea*, *Carcinus maenas*, *Hemigrapsus sanguineus*, *Fucus serratus);* and harvested seaweeds (*Ascophyllum nodosum*, *Fucus vesiculosus*, *Laminaria spp.).* For each species the "thermal niche" or "bioclimate envelope" was determined from its geographical distribution (water depths and range in latitude) with respect to satellite-derived (AVHRR) data on sea surface temperatures.

Many species may experience some loss in the southernmost part of their range, near Cape Hatteras. For instance, SSTs will be limiting for the pelagic larvae of the Atlantic deep-sea scallop (*Placopecten magellanicus*) limiting future harvests in the south. Although we have not addressed impacts on populations, changes in populations should be expected in areas adjacent to extirpated regions. For some species a change in biogeographic range is expected within Canadian waters. This includes the invasive Asian shore crab (*Hemigrapus sanguineus*), presently spreading northward into New England. Assuming that range expansion is primarily temperature limited, warmer winter ocean temperatures predict its expansion along the shore of most of the Canadian Atlantic. As it expands it is likely to prey on native clams and mussels, endangering these harvests. Higher summer ocean water temperatures in the Gulf of St. Lawrence will limit the marine phase of the Atlantic salmon (*Salmo salar*) life cycle, causing further decline in populations.

More information on our research can be found at www.geog.mcgill.ca/climatechange/ and www.wwf.ca.

Discussion

Following the presentations there were a number of questions and comments specific to each. It was noted that we do not know if we are close to carrying capacity for mussel aquaculture, and the impacts of mussel aquaculture on the zooplankton community and the nearby benthic community have not been resolved. Research by Grant and Cranford (DFO, Bedford Institute of Oceanography) on the impacts of bivalve aquaculture in Prince Edward Island was cited as showing an interaction between aquaculture and nutrient loading from agriculture. Concern was also expressed about the effects of aquaculture on the wild Atlantic salmon stocks.

We have data on the concentrations of contaminants along the coast but have only looked at biotic impacts in Halifax Harbour. In addition to the threats of large oil spills there is a large number of smaller oil slicks that can kill as many birds as the Exxon Valdez every year. There was also an extended discussion of the challenges of studying the thermal response of fish to climate change, without authoritative models that predict changes in water temperature at-depth and the changes in ocean currents.

General discussion highlighted a variety of impacts that were not covered by any of the presentations including land-based silt, nutrient loading and the restriction of freshwater flows. It was noted that the work presented did not look specifically at the effects of fishing on the ecosystem or at cumulative effects of stressors. It was also noted that impacts can be area specific and that assessment should occur on a bay by bay basis. A map of impacts on this coast has been completed by DFO.

SECTION 7 – DISCUSSION IN BREAK-OUT GROUPS: RESEARCH CHALLENGES AND OPPORTUNIES, COLLABORATIVE POSSIBILITIES AND DATA SHARING

There were 4 break-out groups of 8 to 10 people that were asked to discuss the workshop findings and address the following questions:

Part I

Which inshore areas are well-studied?
Which areas have received little attention?
What are the main limitations to our knowledge about Scotian Shelf inshore ecosystems?
What do we understand about the spatial variability of Scotian Shelf inshore ecosystems, latitudinally and with distance from the shore?
What do we understand about the temporal variability of Scotian Shelf inshore ecosystems, both annual and seasonal?
What can we say with what we know now about
a) The status of Scotian Shelf inshore ecosystems and their components?
b) Potential EBSAs in the inshore Scotian Shelf? Are there areas that could be considered unique, or special? Why?
c) Areas that are representative of a broader geographic area?

Part II

Where should we focus our research priorities?
What are the challenges to furthering research in the inshore area?
Is this an opportunity for wider collaboration?
Are there data sources that you know of that require recovery?

Discussion

All the discussion groups identified a need for more research in the inshore. There have been pockets of research in the inshore in response to specific issues such as oil spills or development, but there has been no systematic survey of this area.

Several areas were identified as having significant research projects in the past:

- Halifax Harbour – Chemistry, water quality, primary productivity and nutrients (this sampling is on-going).
- St. Margaret's Bay - Chemistry, water quality, primary productivity and nutrients – 1970s – check dates
- Sydney Bight – Fish and invertebrates, water temperatures - dates
- Mahone Bay – Macrophyte mapping - dates
- Lunenburg Bay – oceanography information via Dalhousie University – dates

Many of these research initiatives are completed and several groups were concerned that much of the information in the inshore was old and only focused on small areas. Halifax Harbour is the area with the most consistent monitoring. A couple of the groups highlighted that it would be difficult to bring the data together from this range of studies because it was collected on different temporal and spatial scales.

Taking a different approach, one group commented that there are no areas that are well studied, but that the Eastern Shore, possibly with the exception for Country Harbour and Goldboro, stood out as an area that was not well studied. To some extent all groups supported this argument by recognizing that ecosystem processes and functions, and temporal variability (seasonal and longer term) are not well understood. Three of the groups noted that the impact of nutrients exported from land-based activities requires further study. One group suggested that we need a better understanding of benthic ecology and another suggested that there was a need for research on primary production (phytoplankton and macrophytes) and the energy flow through the food web.

There also was no clear sense on connectivity between the coastal areas and the inshore. A couple of groups noted that we really do not even fully understand how fish populations use the inshore. On another level, it was also noted that there is very little communication or connectivity in the human dimension: between people who hold information, between different government and non-government agencies or between different stakeholders in the inshore.

There is not a lot of variation in water chemistry between the headlands and the 50 fathom depth, but there is variation in the bays and estuaries. One group suggested that there are three broad areas: Cape Breton, Eastern Shore and Southern Shore. Another group highlighted the potential significance of three zones of high productivity (Cape Island, Sydney Bight, and Chedubucto Bay) caused by water going around corners causing more upwelling. Another group identified some of these (Chedabucto Bay, St Margaret's Bay and Cape Sable Island) as areas of high diversity because they were identified in several of the presentations, but it was difficult to assess whether these area are of particular ecological and biological significance.

The break-out groups also discussed the definition and identification of potential EBSAs. One group pointed out that EBSAs could be defined as higher productivity areas, representative areas, pristine areas or threatened areas such as where the last remaining cod or herring spawning areas exists. Birds were suggested to be indicators of environmental health, and saltmarshes were identified as a significant habitat. In general, there was concern that the identification of EBSAs would be biased by where there have been research projects and it was suggested that local ecological knowledge could help fill in some of the research gaps. A germane question is whether we are looking to conserve the ecosystem as it is today, or return to a former state?
Most groups concluded that there is a need for regular monitoring, identifying and accessing data from different sources, analysis of that data, taking into account the time and spatial scales, and more funding to support new research.

SECTION 8 – INTRODUCTION TO EBSA CRITERIA

Introduction to EBSA criteria
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The overall objective of the EBSA process is to identify or call attention to areas of particularly high ecological or biological significance in that these areas require “a greater than usual degree of risk aversion in management of [human] activities in such areas” (DFO 2004). If such areas were perturbed severely, the ecological consequences (in space, in time, or outward through the food-web) would be greater than an equal perturbation of most other areas or species, although the nature of those consequences could differ greatly among specific cases” (DFO 2004).

It is recognized that all areas are significant to some extent, therefore in order to distinguish EBSAs from all other areas, we as humans must impose a relative valuation scheme. We have chosen to do so by classifying areas relative to a set of criteria. The list of evaluative criteria explicitly excluded economic value or potential for harm from human activities and tried to choose criteria that would focus on importance to the integrity of the ecosystem.

A recent compilation of EBSA evaluation / classification criteria (Table 8.1) proposed by researchers around the world allows for a ranking of the criteria based on the number of publication in which each is promoted.

Table 8.1. Summary of criteria developed for identifying candidate sites for MPAs from Dearden and Tolpeko 2005.

Source	Biogeographic representation	Habitat representation / heterogeneity	High diversity (habitat, sp.)	Genetic diversity	Degree/ Nature of Threats	Productivity	Spawning/ Breeding grounds	Size/ shape/ connectivity	Export functions	Viability	Disturbance	Management/ Feasibility	Aggregations	Vulnerable habitats	Vulnerable life stages	Species or populations of special concern	Exploitable species	Ecosystem linkages	Ecological services for humans	Naturalness	Uniqueness/ Rare habitats	Rare/ endemic species	Scientific value	Critical habitat	Comprehen-siveness	Site integrity	Int'l/ nat'l importance
Gubbay, 2003		✓	✓		✓				✓		✓	✓									✓	✓				✓	
IMO, 2001	✓	✓	✓			✓	✓							✓				✓		✓	✓	✓	✓	✓		✓	
IUCN, 1996	✓	✓	✓					✓				✓	✓			✓		✓	✓	✓	✓			✓		✓	✓
Kelleher, 1999	✓	✓		✓			✓									✓		✓		✓	✓	✓				✓	
Salm & Clark, 2000	✓	✓	✓			✓								✓				✓		✓	✓					✓	
Roberts, *et al.*, 2003a	✓	✓			✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								
Hockey & Branch, 1997	✓		✓						✓					✓	✓	✓	✓									✓	
Gladstone *et al.*, 2003	✓	✓					✓								✓												
Mills & Carleton, 1998	✓				✓																						
OSPAR Commission, 2003	✓	✓	✓		✓		✓	✓				✓		✓	✓	✓				✓							
Conner *et al.*, 200			✓		✓			✓							✓	✓				✓	✓	✓					✓
McLeod *et al.*, 2005; Johnston *et al.*, 2000		✓														✓					✓				✓		✓
UNEP, 1994		✓					✓								✓	✓		✓			✓	✓	✓				
DFO, 2005																				✓	✓						
Levings & Jamieson, 1999		✓	✓			✓	✓		✓	✓		✓		✓						✓	✓	✓		✓			
Parks Canada, 2003	✓	✓											✓			✓							✓	✓	✓		
ANZECC, 1998	✓	✓		✓		✓								✓	✓			✓		✓	✓	✓			✓		✓
Environment Australia, 2003	✓	✓	✓		✓		✓	✓									✓			✓							
NSW, 2000	✓	✓		✓		✓	✓							✓	✓	✓			✓	✓	✓	✓			✓		✓
Brody, 1998	✓	✓	✓		✓	✓		✓								✓				✓	✓	✓		✓		✓	
Total	**14**	**16**	**10**	**3**	**6**	**6**	**8**	**6**	**4**	**2**	**2**	**5**	**3**	**8**	**8**	**11**	**3**	**7**	**3**	**12**	**13**	**9**	**3**	**5**	**4**	**7**	**5**

Such a ranking results in the following rank order of criteria:
1. Habitat representation (heterogeneity)
2. Biogeographic representation
3. Uniqueness (rare habitat)
4. Naturalness
5. Species or population of special concern
6. High diversity
7. Rare or endemic species
8. Vulnerable habitats, life stages, spawning / breeding grounds.
9. Ecosystem linkages / site integrity
10. Threats, productivity, size / shape/ connectivity
11. Critical habitat, management feasibility
12. Export functions / comprehensiveness
13. Genetic diversity, aggregations, exploitable species, ecological services to humans, scientific values
14. Viability, disturbance

In DFO's Ecosystem Status Report 2004/006 (DFO 2004), 5 EBSA criteria are identified, namely; Uniqueness, Aggregation, and Fitness Consequences as primary criteria, and Naturalness and Resilience as secondary criteria. Comparing the definition of the international criteria with those proposed in DFO's Ecosystem Status Report (DFO 2004), finds that these 5 criteria encompass all of the international criteria except:

- Habitat representation (inverse of uniqueness)
- Biogeographic representation (only national and global)
- Ecosystem linkages (including export)
- Viability (including comprehensiveness) – for MPAs only?
- Ecological services to humans (objective dependent)
- Scientific value
- Management feasibility (important)

Some of these additional criteria (particularly representation and linkages) may need to be considered in evaluating any geographic area. The concept of relative threat (through human impacts) was initially rejected as a criterion; however it makes sense to consider this at least as a modifying criterion (that is, all things being equal the area under the most threat will require the most immediate attention).

The process of identifying EBSAs then becomes evaluation of each area / species / feature / or process against each of the criteria finally chosen and to assign it value from low to high. The degree of resolution between a low and a high ranking will depend on the information available. The overall objective is to develop relative valuations of areas that can be used to direct risk-averse management plans and actions. Essentially we are trying to develop Marine Biological Valuation Maps (Derous et al. Submitted).

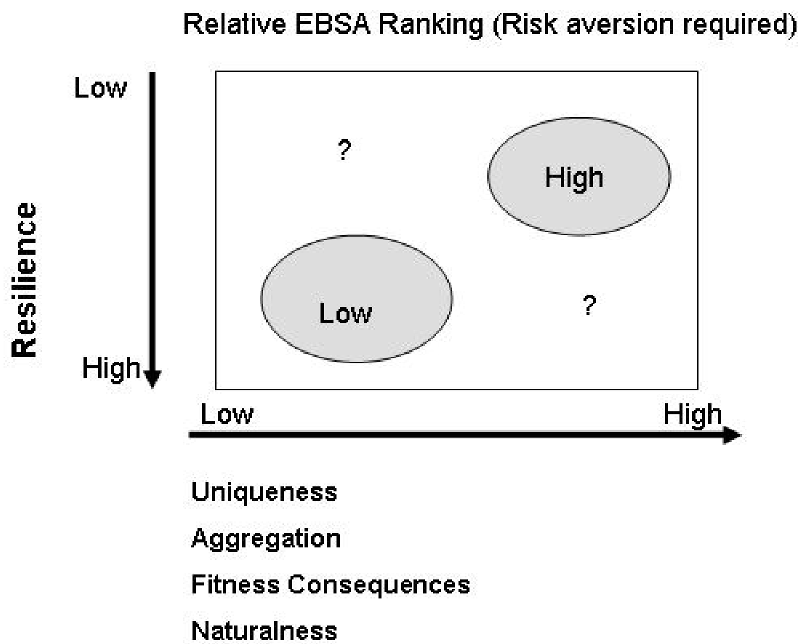

Figure 8.1. EBSA dimensions.

We envision at least two approaches to this overall process. The first is by seeking the opinion of those knowledgeable about the areas in question and asking them, based on their expertise to evaluate areas of interest and rank them relative to one another. The second is by gathering and / or interrogating objective observational data, developing or adopting a method that allows us objectively to evaluate and rank each area of interest relative to each other. The two are not mutually exclusive but each has merits and drawbacks.

The expert opinion method draws on the knowledge of those who “know” an area and this may make for easier “buy-in” by the local community if risk-averse management strategies have an impact on human activities. This method also takes advantage of integrated or emergent properties of experiential knowledge. However, expert knowledge and memories are fallible and may not be reproducible. In addition, few experts have the depth of knowledge required to compare areas at all levels of biological and physical organization. Boundaries based solely on expert opinions may not stand up in a court of law if disputes arise.

The more analytical approach of collecting and interrogating scientifically defensible observational data for each area of interest means that all assumptions used in evaluation (against criteria) are explicit and methods used are reproducible. Such an approach may be more convincing in some instances and such boundaries may carry more weight in a court of law in case of disputes. The drawback for this approach is that not all requisite data are available and collection of the remainder is very expensive. Furthermore it is not really clear what “all data” would mean. In addition there are a plethora of scientific uncertainties that remain (particularly related to ecological interactions).

It appears that an effective approach is to use a combination of both. That is to use expert (in this case expert scientific) opinion to identify initial EBSA boundaries based on experiential knowledge of areas of interest and then to follow this up by using the analytical approach both as a means of corroborating (or disputing) these valuations, and to give some guidance in areas not valuated by the experts.

EBSAs fit into the overall approaches to sustainable use, conservation, and management. Since there appear to be three general approaches to developing management plans:

1. Features based – identify features of the ecosystem that require protection and build a management plan.
2. Threat based – identify human impacts and threats and develop plans to do the activity with the least impact.
3. Tools based – identify a management tool i.e., MPA and apply it to protect multiple ecosystem features.

EBSAs then are the places where features are located, they are the areas that have the highest priority for mitigating threats and they provide the rationale for applying multi-attribute management tools.

- Are the Canadian criteria sufficient and do they have a defensible rationale?
- Are all the criteria operational – that is can we conceive of a metric for each species / feature / process against each of the criteria?

It appears that the Canadian criteria encompass most of the criteria (with some exceptions as noted above) considered by the international community and metrics can be conceived for all criteria even though the information required to develop these metrics is lacking for in many instances:

- What about scale, predictability and persistence in time?
- Does spatial and temporal scale matter in the identification of EBSAs?
- If so, why and how?

It is recognized that EBSAs will be identified within a very dynamic natural system (in the case of the Scotian Shelf) and that many features of interest cover and act over a wide range of geographic and temporal scales. It is likely that boundaries will be “nested” and that temporal consideration will be important in some instances.

- Ranking areas based on a single criterion is relatively simple (if information is available). But what about ranking with multiple criteria, how do we balance ecological and biological “weight” with human wants weight? (This is not a methods question).

Relative rankings of areas of interest with regard to EBSA valuation criteria will require decisions on relative values of ecosystem components and processes. To a large extent these are not strictly scientific questions (although science can help to examine the consequences of various valuations) but will require input from stakeholders.

- Do we have a working understanding of the ecology of the offshore Scotian Shelf?
- There is a real need to know more about connectivity. How strongly is any one area linked to another (physically / biologically)?

Our current understanding of the ecological functioning of the Scotian Shelf remains incomplete. It will be particularly challenging to consider criteria such as connectedness between areas of interest since our understanding of these connections remains rudimentary.

- What about the distribution of all the components?

Improved knowledge of “all taxa biodiversity” is a major gap in our understanding of biological diversity in Canada. This will require significant investments of time and money. The consequences of not improving our understanding of “all taxa biodiversity” is that decisions of ecological and or biological importance of any given area will continue to be made from only a small subset of the requisite information. John Roff considered that this is a major current gap in the process of identifying EBSAs.

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Why identify ecologically and biologically significant areas?

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Identifying Ecologically and Biologically Significant Areas (EBSAs) is not a general strategy for protecting all habitats and marine communities that have some ecological function. Rather, it is a tool for calling attention to areas that have particularly high Ecological or Biological Significance. The intention is to highlight these areas so that their significance can be considered by decision-makers as they work towards the achievement of ecosystem objectives. The identification of EBSAs has the potential to contribute to a wide range of planning and decision making processes, including, for example, environmental impact assessments, spatial risk assessments, plans and proposals for ocean activities and infrastructure, or any other planning or management process that includes a spatial component. This information will be useful not only to government, but also to ocean users and other stakeholders. For example, a company wishing to develop a new cable, pipeline, or offshore power installation could use EBSA information to identify and avoid areas that might be perturbed by such developments and thereby prevent environmental conflicts.

There are no preset rules regarding how activities in or around EBSAs should be managed, and it should not be assumed that EBSAs will necessarily be subject to blanket closures or general prohibitions. The management of EBSAs should not be approached in isolation, but rather should be a component of the broader integrated management process and should reflect ecosystem objectives. DFO guidance states only that a greater-than-usual degree of risk aversion should be applied when managing activities in EBSAs. In other words, activities that carry a high level of environmental risk are less likely to be tolerated in EBSAs than in most other areas. In defining high-risk activities in this context, it is important to consider that each EBSA may have a unique set of characteristics that make it significant, and therefore an activity that would present a high risk in one area may be relatively benign in another. Management decisions regarding activities in EBSAs should take this into account and be specific to the characteristics of the area and the nature of the activity in question. In many cases, existing activities may be unaffected by the identification of an area as an EBSA, or only minor modifications may be required, while in other cases more extensive management interventions may be appropriate.

EBSAs and Marine Protected Areas
The federal government's 2005 *Marine Protected Areas Strategy* reaffirms Canada's commitment to establishing a comprehensive network of marine protected areas (MPAs). This strategy applies not only to DFO's *Oceans Act* Marine Protected Areas, but also to Parks Canada's National Marine Conservation Areas, Environment Canada's Marine Wildlife Areas and Migratory Bird Sanctuaries, and various other protected area designations, which are intended collectively to constitute a marine protected areas system. The criteria used to identify EBSAs overlap with many of the criteria for the selection of MPAs, and therefore the outcomes of the EBSA process will provide a useful information source for MPA planning; however, the identification of EBSAs is not primarily intended to serve as a selection mechanism for MPA candidate sites. While the ecological criteria for both may overlap, they are not identical, and they may not always be applied at the same scale. Furthermore, planning MPAs requires not only an assessment of the ecological attributes of potential candidates, but also an analysis of human activities in and current threats to these areas, as well as a review of the objectives and requirements of the MPA system as a whole. Therefore, while it is likely that many MPAs will be established around areas that would classify as EBSAs, it should not be assumed that all EBSAs will be appropriate MPA candidates, or that all MPA candidates will necessarily be EBSAs.

Discussion

Although not a conclusion of the workshop, J. Roff expressed the view that the proposed EBSA process is workable, but that it:

1) Is not systematic
2) does not complete the task
3) is missing representativeness
4) does not include connectivity and ecological processes
5) is missing a coherent link to management
6) confounds criteria such as fitness consequences and aggregation
7) is biased towards fisheries management, and
8) fails to distinguish between ecosystem services and natural capital

The motives for the identification of EBSAs were questioned. There was particular concern that the identification of significant areas could be interpreted as giving carte blanche to areas not identified as EBSAs? There was also concern that the identification of EBSAs woul hide the things that we do not know. It was suggested that the process should explicitly identify areas for which information is lacking or sparse. It was also recommended that once the EBSAs are identified, and the areas of no information (non-EBSAs?) are identified, the approach should be to require potential users of non-EBSA areas to show that their activities would not harm the area rather than the reverse which is now the case.

The exercise of identifying EBSAs was thought to be a good way to gather all of our information on areas of interest into a single place and into a common format. The importance of understanding the metadata that accompanies all of these observations was stressed. We need to know how all of the information that we use was collected and what the limitations of these data are.

Social implications of EBSAs need to be considered; however this will require more knowledge of the management measures that are envisioned for an area.

There were a number of additional considerations raised during discussion sessions:

- Seasonality should be considered in the design of EBSAs since some features are only present at particular locations during specific time periods. Some of these already exist as seasonal fishery closures and other seasonally closed areas. It may be that these can be incorporated in the EBSAs.

- Some components occur only in the pelagic realm and are highly mobile (e.g. tuna, sharks and whales among others). Could we envision mobile pelagic EBSAs? Although these can be conceptualized, management of human activities within such areas (if this is necessary) may be a significant challenge.

- The purpose of identifying EBSAs is to focus on the ecological and biological significance of areas, and to identify Ecosystem Objectives. However by virtue of identifying such objectives it is recognized that these may become areas where management of human activities is required. It was also recognized that management of EBSAs in the inshore would involve many more layers of government and community involvement than those in the offshore. It would be necessary to either utilize existing governance structures designed for inshore management or to establish new ones that accomplish that task.

- It was considered that management of EBSAs to meet specific ecosystem objectives must be risk averse.

SECTION 9 – EBSA INFORMATION RELEVANCE AND DATABASE CONDISERATIONS

Using metadata standards to achieve interoperability

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Broad scale environmental and biodiversity research initiatives, such as defining Ecologically and Biologically Significant Areas (EBSAs), would be greatly facilitated if all of the available information on distribution and abundance of organisms, oceanographic data and information on habitat and bottom types were to be gathered into or made accessible through a single source. Is this truly a realistic expectation? Even though, DFO's scientific data are considered a public resource and subject to full and open access within two years of being acquired, what about the evolving relationship between technology and the legal right to, or public expectation of privacy in the collection and sharing of data as well as the ever growing need for data security? Despite these concerns, the Centre for Marine Biodiversity (CMB : http://www.marinebiodiversity.ca/) believes that the answer is yes. Data usage arrangements, such as promoted by CMB provide practical advice and guidance on how to achieve these goals. CMB together with the Bedford Institute of Oceanography (BIO) has so far published 18 scientific data collections onto the Internet using the Ocean Biogeographic Information System (OBIS: http://www.iobis.org). Under this arrangement OBIS end-users agree to formally acknowledge the use of contributor's data, just like they would any other publication as well as recognize the limitations of the data they are using and provide the portal managers with a full citation for publications resulting from the data obtained from the portal.

This ability to consistently and reliably use data from different and remote systems is called interoperability and results from community wide acceptance of data standards. A very important element of interoperability is metadata (e.g. information about the data) standards for discovery, authority and access. Under this scheme, Discovery portals manage information provided by original data providers and allow end-users to search that information for data collections particular to their needs. Discovery portals can also provide access links to actual data. The Global Change Master Directory (GCMD: http://gcmd.nasa.gov) is one such portal, currently providing discovery metadata on over 16,000 data collections. Authority services on the other hand allow for names (species, locations, etc.) to be unambiguously defined by providing the original source or authority for a given name. A standardized naming system such as the Integrated Taxonomic Information System (ITIS: http://www.itis.usda.gov/) would tell you that Atlantic Cod was first formally identified and named *Gadus morhua* by Linnaeus in 1758. ITIS currently contains information on over 392,000 biological names and should be used wherever possible when dealing with scientific names. And finally, access is the actual means for getting data to the end-user. With public systems such as OBIS, end-users are given access to standardized quality controlled results from a wide variety of project database(s). OBIS currently provides access to over 9,000,000 location records on 60,000 species from 92 sources worldwide. In addition to formal metadata standards based systems, the CMB approach also makes use of what are called quasi standard data products such as spreadsheet ready text files and geographic information system (GIS) ready shape files. The text files appear as simple point data whereas the shape files give point as well as complex line and area features. Portal users are generally given the opportunity to use interactive mapping tools such as DFO's ACON (A Contouring Program) to preview the data collection, find the desired subset (e.g. species, area, time) and then download the data to their personal computer in the desired form. The scientist or technician then loads the data into their preferred analytical software.

Not working with reusable systems such as these will result in much duplication of effort and individual frustration. It is only by routine publishing of standards based biological data and metadata that individual scientists will be able to effectively operate joint project agreements and participate in large scale international projects.

Discussion

There were a number of additional considerations raised during discussion sessions:

- It was emphasized that this project would adopt a unified approach to both inshore and offshore data management and data standards and that these standards would be consistent with international standards. There are currently a number of international projects which will provide templates for this project (i.e. NaGISA: Natural Geography in Nearshore areas, and Japanese word for beach).

- The project may require a significant amount of data rescue particularly for the inshore component where a lot of data are known to be held in paper and other non-electronic formats.

Habitat template approach to defining EBSAs

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Definition of ecologically and biologically significant areas necessitates recognition of important biologic and oceanographic patterns and processes on the Scotian Shelf. The significance of different areas on the shelf is different for the general public, fishermen, scientists, and economists, and is a function of the utility of these areas to these groups. An area of interest has a value for an advocate of its significance – it could bring profit (e.g. fishing areas with high catches), provide valued ecosystem services (food webs), or be aesthetically pleasing (for recreational divers). Because of the multitude of users and disparities of values, the significance is not easily quantifiable. The commonly used Delphic approach is not objective in defining 'vulnerable', 'representative', 'unique' etc. areas. Making zoning decisions based on the known distributions of important species is also problematic, because the larger the number of species of recognized importance, the wider the coverage of the significant areas. For example, the plot of 13 sensitive species on the Scotian Shelf shows that together their distributions cover most of the region, making definition of significant areas meaningless.

One of the approaches to defining ecologically and biologically significant areas is to accept the intrinsic value of nature, and characterize seabed habitats and species assemblages by their vulnerability to anthropogenic impacts in a quantitative manner. Such an approach would remove subjectivity in picking 'valuable' species and would provide ranking of seabed areas on the basis of natural properties rather than human-imposed values. It is reasonable to assume that the species most vulnerable to human activities are those long lived, slow growing, slow to reproduce, and relatively rare. These traits can be predicted from habitat properties. Similarly, the most vulnerable habitats are those which are naturally stable and are susceptible to human disturbance. Definition of such areas was carried out through detailed mapping and characterization of seafloor environments based on the current understanding of biological, geological and oceanographic patterns and processes on the Scotian Shelf. Species' and habitat traits were defined by two major forces, which are the natural disturbance and productivity of the benthic environment. The logic of this approach predicts that the most vulnerable habitats and communities are located in the areas of low natural disturbance, limited by scope for growth. Habitats and communities adapted to natural disturbance, such as shallow sandy banks, will be at a lower risk of adverse impacts than stable deep-water habitats. A productivity map is used to show which areas may have populations with fast recovery rates from fishing impacts and areas in which populations may not recover at all. The habitat template map (interaction of disturbance and productivity axes) acts as a guide for defining ecologically and biologically significant areas by providing a logical and quantitative framework.

Discussion

There were a number of additional considerations raised during discussion sessions:

- It was suggested that these analyses could be extended to inshore areas however it was pointed out that the requisite data are too patchy and extending the model to the inshore would be very difficult. As an example it was indicated that for the west coast, the bottom characteristics were mainly driven by ice-scour.

- It was suggested that the model could be extended to the pelagic realm but again it was indicated that the relatively complex nature of the pelagic realm may preclude this.

- It was considered that human disturbance should be included in the model of habitat classification and it was indicated that there is currently an attempt underway to map human activities. It was noted that this refers only to mechanical disturbances and that expanding this to chemical disturbances would require a reparamaterization of the model.

- Currently the communities that are predicted to occur at particular bottom types are limited with regard to taxonomic scope. What would be the impact of expanding this scope, would different patterns emerge?

SECTION 10 – METRICS FOR EBSA CRITERIA, DATA INTEGRATION, VISUALISATION AND INTERPRETATION

EBSAs: Concepts and metrics

John Roff
Acadia University

The opening remarks from the first talk are recalled.
In attempting to recognize and define Significant Areas of the coastal zone, EBSAs should not be the only agenda item. This may be where we conceptually start a management and conservation agenda, but delineation of EBSAs does not complete the task. Concentrating on an EBSA agenda, driven by a 'Delphic' process essentially ignores the whole Marine Biodiversity Spectrum, and does not meet DFO responsibilities under the *Oceans Act* and the *Oceans Action Plan*.

A critique of the EBSA agenda is offered with observations, including the following:

1. It recognizes only a small part of the Biodiversity Spectrum.
2. It does not recognize the fundamental DFO concept of ecosystem-based management.
3. This is a 'Natural History' and 'Delphic' process not a scientific one.
4. The process is driven predominantly by fisheries management concepts and marine mammals, and contains redundant or ill defined concepts.
5. It is arbitrary in its selection of ecologically and biologically significant units.

Metrics for EBSAs are evaluated in terms of data sources, and strengths and limitations of the concept. There are many types of EBSAs and explicit recognition of these types will aid in defining management purposes. It will be shown how size of EBSAs can also be established, once their purpose is defined.

The elements of the Biodiversity Spectrum are recalled and I show how the EBSA agenda captures only a very small proportion of it. Modified EBSA criteria can be applied across the Biodiversity Spectrum to achieve a less arbitrary planning process and address defined management purposes, which should complement the ongoing ESSIM process.

Discussion

There were a number of additional considerations raised during discussion sessions:

- It was considered that it is urgent to initiate the integrated management process. However questions were raised over the manner in which it has been initiated. As an example it was claimed that the Gully was chosen relatively arbitrarily and that it was based on a limited consideration of overall biological diversity.

- It was strongly suggested that the scales of ecological processes should determine the scale of EBSAs. There was support for this but it was also suggested that this needs to be combined with selection based on the location of important biophysical features. It was suggested that the size of EBSAs should be more or less self-determined based on the extent of the processes or features under consideration.

- It was emphasized that the EBSA process needs to be clear about research and knowledge gaps as well as the existing data that inform the EBSA definition process currently. The degree to which information is missing in areas that are being considered as EBSAs should be explicitly taken into consideration during the decision making process and in subsequent decisions regarding the types of human activities that should be allowable or excluded from these areas.

- It was suggested that instead of approaching the definition of EBSAs by compiling all of the knowledge we have about a particular area, it may be effective to first compile information about the nature and extent of the human activities that occur in the areas under consideration and use these to determine appropriate management strategies. Although this is somewhat counter to the spirit of the EBSA definition process (which was originally to exclude any consideration of actual or potential human impacts) it is desirable that the compilation of current and potential human activities for an area should be considered concurrently with the compilation of the non-anthropogenic data. These data will be essential to estimating the degree of naturalness for an area and will provide at least a preliminary indication of the sorts of management issues that may arise.

- It was pointed out that there exist a host of other approaches that might achieve the overall objectives of EBSAs. One such approach is to consider all areas closed until such time that proponents of any particular activity can provide sufficiently convincing evidence for the sustainability of that activity within the overall ecosystem management objectives established.

- There were concerns raised that EBSAs appeared to be considered without due consideration for how they fit into an overall management framework. Although it was pointed out that EBSAs are only one part of an overall integrated plan that will take into consideration such issues as connectivity and representativeness these plans were not presented at the workshop. Participants considered that the discussion of such plans is essential to understanding how EBSAs will function as part of an overall integrated plan.

The Bras d'Or EBSA experience

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The Bras d'Or EBSA process was carried out as part of a larger project to complete both an Ecosystem Overview and Assessment Report (EOAR) and to identify EBSAs within the Bras d'Or Lakes ecosystem. The EOAR draft was completed based primarily on research and literature completed by or in association with federal and provincial government staff. This information provided a solid basis upon which to present EBSAs. The EOAR began with the evaluation of the physical and chemical oceanographic characters and the morphological features of the Lakes. This preliminary evaluation showed that the finest spatial resolution for which there was relatively equal coverage of study on the Lakes was at a fairly large "bay scale" (e.g., East Bay, Whycocomagh Bay, St. Andrew’s Channel) and not at the finer inlet scale (e.g., Baddeck Bay, Denas Pond). The “bay scale” was related to the oceanographic and bathymetric information available and tentative boundaries were created on which to evaluate for EBSAs. This approach is based on the assumption that physical and chemical oceanography drive the presence of biological communities in the marine environment, and are modified by physical habitat features.

As the EOAR was being drafted, narrative that would support identification of EBSAs was collected based on the 10 “bay scale” areas previously identified, and which covered 100% of the area of the Bras d’Or Lakes. Narrative was collected under 18 different “theme headings” that represented species, structure, and processes of the ecosystem. Then a means of quantifying the narrative was developed by identifying a range of scores for the five dimensions of evaluation identified in the national EBSA guidance document. The range of scores (Table 10.1) reflects the weighting suggested in the national document.

Table 10.1

Uniqueness 0-5	Aggregation 0-5	Fitness Consequences 0-5	Resilience 0-3	Naturalness 0-3	Total Score Per Feature Heading
0-3 Local 4 Regional 5 National	0-3 Local 4 Regional 5 National	0 does not affect pop. using Bras d’Or 5 dramatically affects pop. using Bras d’Or	0 Resilient 3 Sensitive	0 impacted 3 natural	0-21

Each narrative theme heading was then scored based on the collected narrative for each “bay scale” area on each of the five dimensions. Scores for all 18 theme headings for each of the 10 “bay scale” areas were then tallied to provide a ranking of areas in terms of ecological and biological significance to the Bras d’Or Lakes Ecosystem. This scoring system highlights information gaps both by theme heading and geographic location, providing some guidance on what study may be needed to better manage the system. Creating a narrative by theme heading and location also allows for discussion on the relative importance of individual characteristics, and modification of scores as appropriate.

The whole project was then reviewed through a Regional Advisory Process (RAP), and changes are currently being made to the EOAR to include grey literature and traditional ecological knowledge (TEK). The draft scoring process that was developed is being evaluated for strengths and weaknesses, in order to determine if it is appropriate and / or should be modified.

Discussion

There were a number of additional considerations raised during discussion sessions:

- Participants expressed some concern that the scores used to differentiate the proposed EBSAs did not indicate a lot of contrast between areas. It was suggested that a different group of experts looking at these same data might have come up with different relative scores. This was acknowledged and it was concluded that this is one of the attributes of using expert opinions to determine EBSAs. A broader base of experts would be desirable.

Open source tools for geospatial tasks
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Dalhousie University

Free and Open Source software are computing tools whose source code is available and that are distributed under licensing agreements that do not restrict their modification or redistribution. Many variants of the popular GNU General Public License (GPL) exist but all share one common theme: software is best developed in an open and free fashion. Such tools, which include the Linux operating system, have gained popularity over the last ten years and provide a powerful, reliable and versatile computing environment.

Analysis of geospatial data requires a framework that facilitates the creation, manipulation and visualisation of information defined in a spatial reference system. A Geographic Information System (GIS) provides such capabilities in an integated environment but the different capabilities of a GIS are also available individually, either through software development libraries or through various software products. In this talk, Open Source softwares that can be used to perform geospatial tasks are presented and are shown to represent viable alternatives to some popular proprietary software products.

Break-out group discussion

Questions

- *Do we have a working understanding of the ecology of the offshore Scotian Shelf?*
- *What about the distribution of all the components?*
- *There is a real need to know more about connectivity. How strongly is any one area linked to another (physically / biologically)?*
- *How will EBSAs interact with Objectives Based Management?*
- *Can we maintain this façade of independence between science advice and management "negotiations" regarding special areas (EBSAs and others)?*
- *Insert your favourite question here.*

There were two large break-out groups. The main points from these discussions are summarized below:

- Participants questioned the motives of identifying and delineating EBSAs. There is no clear indication of what EBSAs will or will not be used for. In the absence of clear objectives it is difficult to know what types of features or processes would be more important than others. It is also difficult to engage participants whose activities may be affected by the definition of EBSAs but who have valuable and necessary expertise and knowledge.

- If the objective of the EBSA exercise is to afford protection to particular areas of importance it might be better to start with protecting the whole shelf area and then evaluating the suitability of all human activities for any particular area. Since there are many areas for which there is little or no information (this is particularly true if we consider that our understanding of biological diversity is taxonomically limited, and our understanding of ecological processes is at best rudimentary. Some participants expressed the opinion that we are not in a position to define EBSAs because our knowledge base is incomplete in these area.

- One group explored the value of protecting representative areas based on geography and biogeography, noting that to some extent EBSAs identified by any criteria would capture some representativity.

- It was also noted that naturalness is an important criteria, because it would be a more effective management strategy to protect the more pristine sites than degraded sites.

- An argument was made for monitoring, both in protected and not protected areas to assess change over time and the effectiveness of management strategies. Further there was a call to identify targets for, and indicators of, ecosystem integrity.

- Information gaps should set research priorities.

- It was emphasized that a lack of information for any particular area should carry significant weight in determining its overall EBSAness score as opposed to providing a license to conduct any activity.

- Participants considered that this would be a costly process, particularly if the intention was to address the knowledge gaps that exist for the area. Participants also questioned whether or not there would be the vision and resources to carry out such a program.

- It was considered important to compile a list of human activities for any areas to be evaluated in the EBSA process.

- The pelagic realm is not being considered in this exercise and it should be.

- The participants indicated that there exists a lot of scientific expertise that was not represented at this workshop and that should be consulted.

- The participants indicated that the data driven approach to identifying EBSAs must use caution in incorporating information and ensure that all data sources are verified. (This is the objective of the group working on data standards as reported by Branton et al.).

SECTION 11 – IDENTIFICATION OF ECOLOGICALLY AND BIOLOGICALLY SIGNIFICANT AREAS OF THE SCOTIAN SHELF: GATHERING SCIENTIFIC EXPERT OPINION

Results of EBSA identification exercises

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In order to support the integrated, ecosystem-based management of Canada's oceans, Fisheries and Oceans Canada (DFO) is undertaking programs to identify ecologically and biologically significant areas (EBSAs) in a number of regions, including the Scotian Shelf. As outlined in DFO's Ecosystem Status Report 2004/006 (Identification of EBSAs), identifying EBSAs is not a general strategy for protecting all habitats and marine communities that have some ecological significance. Rather it is a tool for drawing attention to an area that has particularly high ecological or biological significance, to facilitate provision of a greater-than-usual degree of risk aversion in management of activities in the area.

As outlined in the Ecosystem Status Report, experiential knowledge must be included in the process of identifying EBSAs. Thus, this session of the workshop focused on gathering scientific expert opinion. The assumption is that science expert opinion is based on a life's work rather than any particular project or set of data, and therefore is not readily accessible from the literature. In working groups focusing on either inshore or offshore areas of the Scotian Shelf, participants were asked to identify areas of particularly high ecological and/or biological significance based on the EBSA criteria (uniqueness, aggregation, fitness consequences, naturalness, resilience), delineate the approximate boundary of each area on a map, and provide justification for selecting each area (see Appendix 3 for methodologies). Thus areas identified as potential EBSAs should meet the EBSA criteria to a higher degree than other similar areas or areas with similar characteristics.

Participants identified 36 areas of particularly high ecological significance that met EBSA criteria within the inshore study area[1] (Table 11.1, Figure 11.1) and one area that warranted further investigation (Table 11.2). In the offshore, 27 areas of high ecological significance (Table 11.3, Figure 11.2) and 5 areas requiring further investigation were identified (Table 11.4). Note that participants were initially separated into 3 inshore and 2 offshore workings groups, thus some of the areas presented in Tables 11.1-11.4 may overlap. If the boundary of an area identified by one group was completely encompassed by another area identified by a different group and rationales were similar, the site and rationales for identifying that area as an EBSA are presented together. However, if two areas had only partially overlapping boundaries, they are presented separately.

It is important to note that areas listed in Tables 11.1 and 11.3 do not represent a final list of EBSAs on the Scotian Shelf. The information gathered during the workshop will be

[1] Brier Island/West Port, Annapolis Basin, Whycocomagh Bay and Denys Basin were also identified as potential EBSAs but are not discussed here because they are not located within the study area. No primary criteria were identified for Terence Bay but it is included here to adequately reflect workshop results.

supplemented with that from other key experts who were not present at the workshop, to produce a final map of EBSAs based on science expert knowledge. This, together with other sources of information, including scientific data (see Sections 8-10) and local ecological knowledge, will be used to identify EBSAs on the Scotian Shelf.

For both inshore and offshore areas the identification of possible EBSAs was based most often on aggregation (33/36 and 24/27, respectively) in combination with other criteria, although identification based on uniqueness was a close second for the offshore (22/27) (Table 11.5). A few areas were identified based solely on uniqueness (3/63) or aggregation (8/63). Fitness consequences were not chosen as the sole criterion for any area, suggesting that fitness consequences are linked to uniqueness and aggregations. Fitness consequences were also the least likely primary criteria to be chosen, although in the inshore it was selected to describe more than half the potential EBSAs (24/36).

Nineteen percent (7/36) of the inshore areas and 52% (14/27) of the offshore areas were identified by two primary criteria, and 56% (20/36) of the inshore areas identified as possible EBSAs met all three of the primary criteria, compared to only 26% (7/27) for the offshore areas (Table 11.6). The secondary criteria of naturalness and resilience were also selected more often in the inshore than the offshore. Perhaps these secondary criteria were deemed to be more relevant in the inshore because of a greater perceived range for these criteria.

No single criteria or combination of criteria described all the areas identified as potential EBSAs. The more detailed information available in the narratives associated with the areas identified as potential EBSAs would provide a better basis for research and conservation. Further analysis of these narratives to identify themes or key features of potential EBSAs may help to define EBSA criteria.

In several cases, participants knew that certain areas on the Scotian Shelf were ecologically significant but did not have the expertise to provide appropriate rationales for identifying that area as an EBSA or for delineating its boundary. Thus, many participants emphasized the importance of consulting with other experts after the workshop to determine if other sites need to be identified as EBSAs or have their boundaries refined. Additionally, participants noted that working groups were instructed to identify EBSAs in either the offshore or inshore area but that there is a further need to address the interactions between these areas (e.g., animals moving between offshore and inshore areas).

Participants expressed concern about areas that had not been identified as EBSAs because they did not want it to be assumed that those areas were unimportant and did not require consideration. It was noted that areas not identified as potential EBSAs may be areas for which 1) we have information for but are not considered important based on EBSA criteria, 2) we have information for but do not know the importance of the area, or 3) we have little information. It is important to recognize why areas have not been identified as EBSAs.

There was a lot of discussion about whether EBSAs should be identified based on historical and potential future ecological significance. There are currently habitats that no longer support species which were once present but which may be significant to population or species recovery. For example, there are many rivers along the Atlantic coast of Nova Scotia that once supported salmon populations. Without considering the historical context and the potential importance of these areas to population or species recovery the ecological and biological significance may not be apparent. Historical ecological and biological significance are important factors to be considered in the identification of EBSAs.

Table 11.1. Potential inshore EBSAs identified by participants. Checks or high (H), medium (M) and low (L), indicate which of the 5 criteria, uniqueness (U), aggregation (A), fitness consequences (FC), resilience (R) and naturalness (N), were chosen.

#	Site name / location	Rationale for selecting area as a potential EBSA	Criteria				
			U	A	FC	R	N
1	Chebogue Point to Cape Sable, out to 12 nm limit. Includes Lobster Bay & Seal Island	Important upwelling area, productive area. Biological aggregation, diversity of birds & fish, lobster abundance & life cycle. Varied bathymetry structurally. Unique topography. Mud bottom with high abundance & aggregation of lobster. Unusual for lobster bottom. Wolffish population; multiple groundfish species; macrophyte beds (rockweed & kelp). Roseate Terns [endangered], Brandt Geese, Oyster Catcher, Piping Plover [endangered]. Mud bottom easily disturbed.	H	H	H	H	H
2	Off Cape Sable Island to Outer Island	Area of high productivity, important migration route. Cod, lobster, macrophytes, scallops. Storm Petrels, Sand Pipers, Brandt Geese, Piping Plover (endangered). Outer Island is an important bird island.		√	√		
3	South Cape Sable Island	Eelgrass beds: productive & sensitive. Access to deeper water. Canada geese migration	L	M	L	H	M
4	Kejimkujik Adjunct / Port Jolie / Port L'Hebert	Large array of salt marsh /eelgrass areas, bird habitats, etc. Provincial Park & Federal Park with undeveloped shorelines. Productive offshore area. Common Eider moulting site in fall. Port Jolie & Port L'Hebert have productive eelgrass beds & are migratory bird sanctuaries for Canada Geese & a mix of waterfowl. They are intertidal through to sub-tidal with good open water access. Piping Plover [endangered] & Harlequin Duck [endangered].	L	H	M	H	M
5	Area off Port Mouton	Herring spawning area in fall of the year. Whales, marine birds, fish, invertebrates feed on herring & eggs.		√	√		
6	Petite Rivière Estuary / nearshore	Freshwater to nearshore including areas (some) distance away that literature suggests anadromous Atlantic whitefish may migrate during life cycle. Likely relatively nearshore. Based solely on potential as a significant area for the future recovery of the endangered Atlantic whitefish now only found within the Petit Rivière watershed. Thus supports all biological functions of the complete population giving high uniqueness, aggregation & fitness.	H	H	H		
7	LaHave River & Watershed / Green Bay / Mosher Bay / LaHave Islands	Anadromous species (e.g., salmon); productive shallow shelf habitat; eelgrass bed in Green Bay.	H	H	H	M	

Table 11.1. Potential inshore EBSAs identified by participants con't

#	Site name / location	Rationale for selecting area as a potential EBSA	Criteria				
			U	A	FC	R	N
8	Lunenburg Blue Rocks; Islands	Puffins, seals. Appears to be an area of high productivity.		√			
9	Mahone Bay	The islands at the mouth of the Bay have quite extensive kelp beds (e.g., East Ironbound, Little Duck Island & Flat Island) that are still very healthy & dense (not invaded yet by Codium & Membranipora). Rafuse Island & the northwestern tip of Big Tancook have shallow, extensive eelgrass beds. Area with macrophyte beds; highly productive. Pearl Island is an important bird island. Sea bird nesting colonies & coastal waterfowl use is quite significant. Former (possibly current) Roseate Tern [endangered] nesting. Nesting & rearing of many bird species. Unique high density of island habitats representing a diversity of island types. Shoals associated with many islands & sand beaches that could be considered sensitive habitats. Shoals have apparent but undocumented importance in productivity & presence of small fish which makes them a feeding, rearing, reproduction area for birds, but also may have significance for those fish species as well.	M	M-H	M	M	M-L
10	St. Margaret's Bay	Bluefin tuna come into the Bay; very big mackerel fishing area; highly productive area. Shrimp. Physical features representative of general shelf. High flushing rate.	√	√			
11	Cranberry Cove (north of Peggy's Cove)	Ad hoc information from local divers' comments on the diversity of the sub-littoral community.		√			√
12	Terence Bay*	Area is a coastal adjunct to large expanse of crown land - somewhat unimpacted watershed.					√
13	Cole Harbour Estuary	High productivity area, estuary. Eelgrass prominent. Blue crabs keep appearing in this area. Migratory birds.	√	√	√		
14	Rainbow Haven to East Jeddore Harbour (30 km stretch)	Diverse mix of saltmarsh, eelgrass, sandflats, barrier islands; inshore productive habitat.	M	H	H	L	L
15	Chezzetcook Inlet, Petpeswick Inlet, Musquodoboit Harbour area	Large areas of salt marshes, eelgrass beds. Bird Areas. Bird migration. Overwintering area for Black Ducks. Common Eider breeding habitat.	√	√	√		√

Table 11.1. Potential inshore EBSAs identified by participants con't

#	Site name / location	Rationale for selecting area as a potential EBSA	Criteria				
			U	A	FC	R	N
16	Yankee Bank (off of Musquodoboit Harbour; 30 metre depth)	Herring & cod spawning area in autumn. Whale & marine birds feed on herring as do many other marine species such as flounder.		√	√		
17	Taylor Head Provincial Park & Eastern Shore Islands	Area encompasses an array of coastal islands & protected nearshore waters that provide habitat to an array of seabirds (breeding, feeding, rearing). Taylor Head Provincial Park provides opportunities for relatively unimpacted nearshore marine adjunct.		√	√		√
18	Sheet Harbour/West River	Salmon (potential recovery area of salmon population). Reasonable size estuary. Lobster fishery.	M	M	M	H	L
19	St. Mary's River	Important salmon watershed	H	M	M	H	L
20	Country Harbour Islands	Harbour with several treed & grassy islands. Country Island is one of only two significant Roseate Tern [endangered] colonies. The area is a feeding area for Roseate Terns. Common & Arctic Terns also nest on the Island as well as a large number of Leach's Storm Petrels (100,000+ individuals).	√	√	√		
21	Canso / Chedabucto	Area of high productivity. Cod, wolffish, lobster, snow crab, cod spawning (historical). Extensive ascophylum bed in the area.	√	√			
22	Janvrin Islands	Presence of a very extensive rockweed (*Ascophylum nodosum*) bed that extends approx. 1 km along the south side of the island from low intertidal down to approx. 30 feet deep. Pure bed (100% cover). It is highly productive, monospecific rockweed bed.	√	√	√	√	√
23	Mouth of Bras d'Or Lakes (includes St. Peters Bay, Bay of Rocks, Red Point)	Area of high productivity. Mackerel, lobster & herring all available in area. Diverse benthic habitat. Possibly habitat for white hake.		√			
24	St. Peter's Inlet area (with islands)	Unique collection of islands. Mix of exposures & salinity. Deep water eelgrass beds, scattered.	M				M

Table 11.1. Potential inshore EBSAs identified by participants con't

#	Site name / location	Rationale for selecting area as a potential EBSA	Criteria				
			U	A	FC	R	N
25	Scatarie Island through Myra Bay into Myra Gut through Morien Bay seaward to Flint Island	Highly productive area. Movement/aggregation of species in this area. Myra Gut has got interesting salinity regime. Eelgrass, oyster. Important Bird Area (Greater Cormorant, Bicknell's Thrush). Grey seal pupping area. The bay behind the barrier beach in Port Morien has a large eelgrass bed.	H	H	M	H	M
26	Northern Head / South Head, Glace Bay (prominent, rocky cliffs, 15-30 m in height)	This is a breeding area for cliff-nesting seabirds including Black-legged Kittiwakes & Great Cormorants. 6.7% of the North American population of the Great Cormorant nests in this area. This is only one of the perhaps 45 locations in Nova Scotia where Kittiwakes nest. Harlequin Ducks [endangered] are found in the winter time off the heads. Important Bird Area.		√			
27	Big Glace Bay	Eelgrass behind a barrier island. Important Bird Area (Canada Geese).	L	H	H	H	M
28	Lingan Bay	Eelgrass behind a barrier island. Canada Geese.	L	H	H	H	M
29	Sydney River / Harbour Watershed	Spawning/breeding/feeding area for multiple species. High diversity of fish species. Very big freshwater streams entering the area (smelt runs, gaspereau runs). Seals. Yellow lampmussels upriver [Species of Special Concern].	H			H	
30	Great Bras d'Or Channel	Inflow of salt water for the Bras d'Or system. Gradient of salinity along its length. Transportation corridor for species moving in & out of Bras d'Or Lakes.	H	M			M
31	Bird Islands area Cape Smokey to Cape Dauphin, out to 6-8nm offshore	Important Bird Area. Very important breeding area for colonial seabirds. Regionally unique; species composition more similar to Newfoundland than Nova Scotia (auks, kittiwakes). This is the largest colony of Great Cormorants in North America. Area also important for juvenile fish, which likely provides ready food source for resident seabirds. Nursery area for cod & probably other species; newly settling cod (young-of-the-year) each September. Lobster overwintering area. Site also important for whale species. Only shelf area in the whole Sydney Bight that was shallow & a large area. Migration/spawning/feeding grounds.	H	H	H	M	M
32	Ingonish Bay	Whales breeding & feeding in the area.		√			

Table 11.1. Potential inshore EBSAs identified by participants con't

#	Site name / location	Rationale for selecting area as a potential EBSA	Criteria				
			U	A	FC	R	N
33	Western Sydney Bight	Cod spawning late April to end of May. Area considered unique because 4Vn cod spawn there.	√	√	√	√	√
34	Aspy Bay	Marine mammals feeding in the area. Blue whales.		√			
35	Channel between Cape North & St. Paul Island	Migration route used by cod, herring, mackerel, marine mammals & possibly white hake.	H	H	H	√	√
36	St. Paul Island	Large, offshore wooded island. Bird colony not surveyed but suspected to be a very large Leach's Storm Petrel colony. Island also home to 1% of Canadian population of Bicknell's Thrush, a landbird, which nests there.	√	√	√		

*No primary criteria were identified for this area but it is included here for completeness.

Table 11.2. Inshore areas that require further research

Site name	Rationale for selecting area for further investigation
Shelburne-Yarmouth	Area of convergence/upwelling & lower temperature, high chlorophyll c. Region of high diversity of plankton larvae so it may indicate a benthic recruitment zone. Marine Conservation Biology Institute identified this area as an area of significance (their criteria are reported elsewhere). Further research is needed to delineate potential EBSAs within the area.

Table 11. 3: Potential offshore EBSAs identified by participants. Checks or high (H), medium (M) and low (L), indicate which of the 5 criteria, uniqueness (U), aggregation (A), fitness consequences (FC), resilience (R) and naturalness (N), were chosen.

#	Site name/location	Rationale for selecting area as a potential EBSA	Criteria				
			U	A	FC	R	N
1	Rock Garden, Jordan Basin, west of Fundian moraine	Complex bottom; recent surveys show unique habitat, unique bedrock outcrop, and unique and diverse benthic community (e.g., corals, anemones, benthic invertebrates) in some areas. Dense aggregations of krill.	√	√		√	√
2	German Bank	Moraine, parallel ridges, rough topography. Scallop broodstock area, herring spawning, groundfish aggregation, deep water lobster spawning area.		√	√		
3	Southwest Nova Scotia & frontal area from Browns Bank· Extends from Cape Sable to Digby neck, out to approx. 75m isobath. Terminates in frontal zone.*	Inshore upwelling, tidally energetic area surrounding Yarmouth. Extended productivity due to tidal upwelling. Very rich lobster grounds, major lobster fishery. Abundant whales. Porpoises along front. Settling stage lobster along frontal zone. Important haddock nursery grounds. Herring nursery near Lurcher Shoal. High fishing species diversity. Gadoid nursery ground. Phalaropes staging area.	√	√		√	√
4	Fundian Moraine (Browns Bank) An area on the north flank of Browns Bank that is centered on the Fundian Moraine. A linear prominent ridge of boulders. Bouldery transgressed moraine 100km x 2km x 20/30m high. Includes zone to north and south of moraine.	Unique geology. Highly productive. High aggregation of scallops. Hand line for fish on the moraine itself. Groundfish, scallops, marine mammals, seabirds. Major haddock and cod spawning area (seasonal closure). Strong currents, local turbulence.	√	√			
5	Browns Bank & edge slope (100-175m)	Cod & haddock spawning; gadoid nurseries; lobster protected area; scallops aggregated; natural refugia on the north side.		√	√		
6	Northern edge of Georges Bank (a)	Herring spawning area.	√				
7	Northern edge of Georges Bank (b)	Tubeworm habitat – may be unique. Area is biologically active but tubeworm cited as being unique, at least regionally (otherwise unknown). Interesting geologic features. Herring spawning area.	√	√			

Table 11.3. Potential offshore EBSAs identified by participants con't

#	Site name/location	Rationale for selecting area as a potential EBSA	Criteria				
			U	A	FC	R	N
8	Top of Georges Bank, Canadian portion of Georges above 100m depth	Highly productive – primary spawning and nursery grounds for cod and haddock, spawning and settling area for scallops, spawning and summer residence for deep water lobster.	√	√			
9	Scotian Slope/Shelf break, Scotian Slope from 200-3000m from Fundian Channel into the Laurentian Channel.	This area shows high fish diversity both demersal, mesopelagic and large pelagic fishes. Primary residence for mesopelagic fishes. Primary migratory route for large pelagics fishes (e.g., sharks, swordfish, tuna). Migratory route for leatherback turtles, including concentrations of salps (leatherback turtles feed on salps). High diversity of squid, overwintering area for a number of shelf fish species. Seabird feeding/overwintering area, halibut overwintering area, lobster overwintering (especially the western end). Whale migration route. Greenland sharks. Includes areas of unique geology (iceberg furroughs, pits, complex/irregular bottom). Inhabited by corals, whales, porbeagle shark, tuna, swordfish. The canyons, including the Gully, are particularly important areas (corals and unique fish assemblages).	√	√	√		√
10	Northeast Channel, Rocky area near mouth of channel, strip in between the banks; 300m to 1000m and potentially below (unresearched). Includes deep sea coral closure, monkfish holes (3), Rommey's Peak.	High productivity; many juvenile redfish around corals; monkfish holes; Hell Hole (aggregation of large pelagics).	√				
11	Roseway Basin, North of Browns & Baccaro Banks; as defined by the 200m isobath	Key feeding area for migrating right whales (June-November). Feeding on copepods (*Calanus* sp.). Very important in regards to fitness – this is a critically endangered population. Other whale species observed there – possibly were whaled there (fin, blue). Highly productive area off Cape Sable Island. High concentrations of juvenile redfish. Persistent upwelling feature. High level of surface chlorophyll year round.	√	√	√	√	√

Table 11.3. Potential offshore EBSAs identified by participants con't

#	Site name/location	Rationale for selecting area as a potential EBSA	Criteria				
			U	A	FC	R	N
12	Top of LaHave Bank (≤80m)	Covered in boulders/gravel with a lot of attached life; minimal amount of trawling; self-protected? Could be important spawning area.	√	√			
13	Bottom Emerald & LaHave Basin Pockmarks	Fields of pockmarks that likely have chemosynthetic cold seep communities. Unique oasis of life on bottom of pockmarks fed by venting hydrocarbon gas. Krill and overwintering Calanus on LaHave Basin.	√	√			
14	Emerald Basin Area deeper than 150m to southeast top of Sambro Bank.	Primary residence & spawning ground of silver hake. Overwintering ground of basking sharks (primary) (November-June) & porbeagle sharks. Residence for whales and dolphins. Summer residence of tuna & swordfish (June to October). Important overwintering area for Calanus (July-March) which is a springtime source to the western Scotian Shelf. Important aggregation for krill – highest biomass on the shelf. High species richness.	√	√	√		
15	Emerald Basin/Sambro Bank/The Patch North Emerald Basin-the Patch Just south of the northern part of Emerald Basin; approx. 180-120m.	Only known monospecific population of the sponge, *Vazella pourtalesi* (Class Hexactinellida, Family Porsillidae), on Scotian Shelf and perhaps anywhere. Sessile species, permanently aggregated. Entire life cycle spent in this one area (fitness consequences); long lived; slow growing. Globally unique; 100% of known population. Not resilient to fishing disturbance. Has been heavily fished but some areas still intact (in terms of naturalness). Provides habitat for other species. Sponges on till bottom and on bottom of Emerald Basin.	√	√		√	√
16	Emerald, Western, Sable Island (EWS) Banks Complex Contained by approx. 80m contour to the north and approx. 200-400m contour to the south.	Important spawning area for gadoids & other fish. Highest diversity of fish larvae observed here. High aggregations of haddock, etc. Important overwintering area in the slope waters. Juvenile fish area (nursery). Haddock, cod, monkfish, yellowtail, skate, flounder. Contains 4W Haddock Box Nursery Area which is defined by location of fishery closure area. This area was closed to groundfish otter trawl in 1987 & closed to all groundfish fishing in 1993.	√	√	√		√
17	The Bull Pen/The Owl	Highly productive with large number of fish species; both southern and northern species. Highly diverse area with mix of cold and warm water. Possible white hake spawning area.		√			

Table 11.3. Potential offshore EBSAs identified by participants con't

#	Site name/location	Rationale for selecting area as a potential EBSA	Criteria				
			U	A	FC	R	N
18	Sable Hot Box Northwest of Sable Island, on Northern Spur	Unexpected hard gravel/bouldery seabed. Haddock, sea cucumbers, skate purses, possible mussel beds.	√	√			
19	Deep holes of Canso area*	Topographically diverse and serves as a deep water reserve for lobster. Largest lobsters along the Eastern Shore and may serve as larval supply downstream.	√	√			√
20	Sable Island and surrounding area to a depth of approx. 20m	Area with high concentrations of juvenile fish, particularly haddock (young-of-year and age 1).		√			
21	Gully, Shortland and Haldimand Canyons Area including all three canyons, the Gully MPA and trough, and the deeper waters between (out to 1000-1500m depth).	The Gully is a unique geological feature with unique current patterns. It is a highly productive area. It is an area of cold-water coral diversity and the most important habitat for endangered northern bottlenose whales on the Scotian Shelf. It is a foraging area for seals (especially the trough) and marine mammals, and an area of high fish species diversity. Shortland and Haldimand Canyons are important for endangered bottlenose whales; they move between the canyons, likely along deeper contours (800-1200m). These canyons are habitat for deep sea corals (including large gorgonian corals), concentrations of other whales including endangered blue whales & sperm whales, and concentrations of prey of whale species.	√	√	√	√	
22	The Noodles (includes Louisburg Hole)	Shrimp aggregation. Possible snow crab retention.		√			
23	Eastern Shoal (on Banquereau Bank)	Unique geology. Further justification because of gyres in the area and planktonic significance. Aggregations of surf clams, sand lance, scallops, quahogs.	√	√			
24	Stone Fence & Laurentian Channel environs Edge of Laurentian Channel/Banquereau Bank (150-300m)	Redfish fishery, lots of fish, only known living *Lophelia* reef in the region. Area heavily fished; high energy area; coral reef slow to recover.	√	√		√	√

Table 11.3. Potential offshore EBSAs identified by participants con't

#	Site name/location	Rationale for selecting area as a potential EBSA	Criteria				
			U	A	FC	R	N
25	Laurentian Channel Slope Continuation of Scotian Slope from Banquereau Bank to St. Paul's Island between 175m & 400m contours (within 4Vs4Vn)	High fish diversity for demersal, pelagic & mesopelagic fishes. Unique migration corridor for white hake, cod, redfish, flatfish, Greenland shark. Portion of mating area for porbeagle sharks (summer-fall). Primary overwintering area for cod & white hake. Important overwintering area for Calanus which supplies the entire Scotian Shelf. Important aggregation area for krill. Important migration route from Scotian Shelf to Gulf of St. Lawrence & back.	√	√	√		√
26	Laurentian Channel & Slope (4Vs & 4Vn)	Overwintering area for 4Vs cod, Calanus, white hake, Dover sole, turbot (Greenland halibut), redfish & Greenland shark. Important migration route via Cabot Strait to Gulf.	√	√	√		
27	Laurentian Fan cold seep community Eastern Valley of Laurentian Fan *Not shown in Figure 2*	Large dense chemosynthetic communities of vesicomyid & thyasind clams, gastropods, galatheid crabs. New family of polychaetes. Unique to region, found on crests of gravel waves. Specialized tissue with carbon fixing, sulfide oxidizing bacteria.	√				√

*encompasses both inshore and offshore components

Table 11.4. Offshore areas that require further research

Site name/location	Rationale for selecting area for further investigation
Jordan Basin	Although the Rock Garden (Table 1) was identified as a potential EBSA, there may be other areas of ecological significance in the same geographic region that warrant further investigation.
Scotian Gulf	Modelling has suggested there is little natural disturbance in this deep channel, implying that any communities there might be especially susceptible to human impacts. Little is known about this area.
Roseway Bank (<100m, mostly boulders)	May be good habitat for fish due to the rough bottom (untrawlable). In the areas (approx. 1/3) of the bank that are trawled there are good catch rates of groundfish including juvenile fish.
Misaine Bank Convoluted area north of Banquereau Bank. It is a mixture of extreme depths.	A geologically distinct area. Tectonically active. Largely unknown but representative of interesting area. Unsure of biological criteria. Aggregations of crab and shrimp. Shrimp preferred area. Snow crab range limit. Large lobster in holes in proximity to Canso.
Banquereau dolphins & porpoises Louisburg line between stations 627. AZMP cruises.	Frequent sightings of dolphins and porpoises. Indicates an area deserving more investigation (e.g., data, surveys)

*area encompasses both inshore and offshore components

Table 11.5. Criteria chosen by participants to identify EBSAs

Criterion	Inshore	Offshore
Primary Criteria		
Uniqueness	25	22
Aggregation	33	24
Fitness Consequences	24	9
Secondary Criteria		
Resilience	16	6
Naturalness	20	10

Table 11. 6. Number of primary criteria chosen by participants to identify EBSAs*

Number of Primary Criteria	Inshore	Offshore
1	8	6
2	7	14
3	20	7

*The identification of one inshore area was not based on primary criteria.

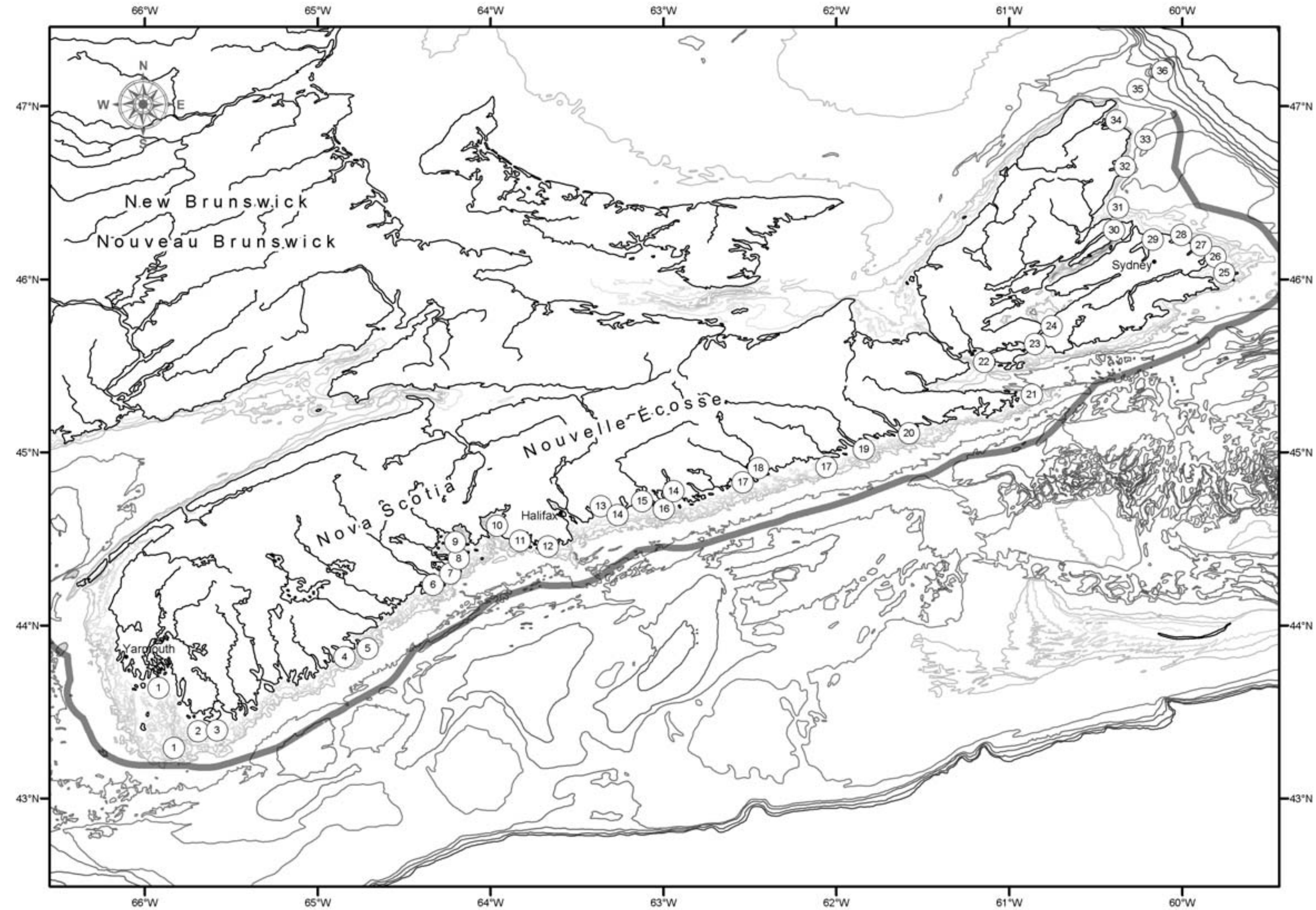

Figure 11.1. Approximate locations of inshore EBSAs on the Scotian Shelf identified by workshop participants.

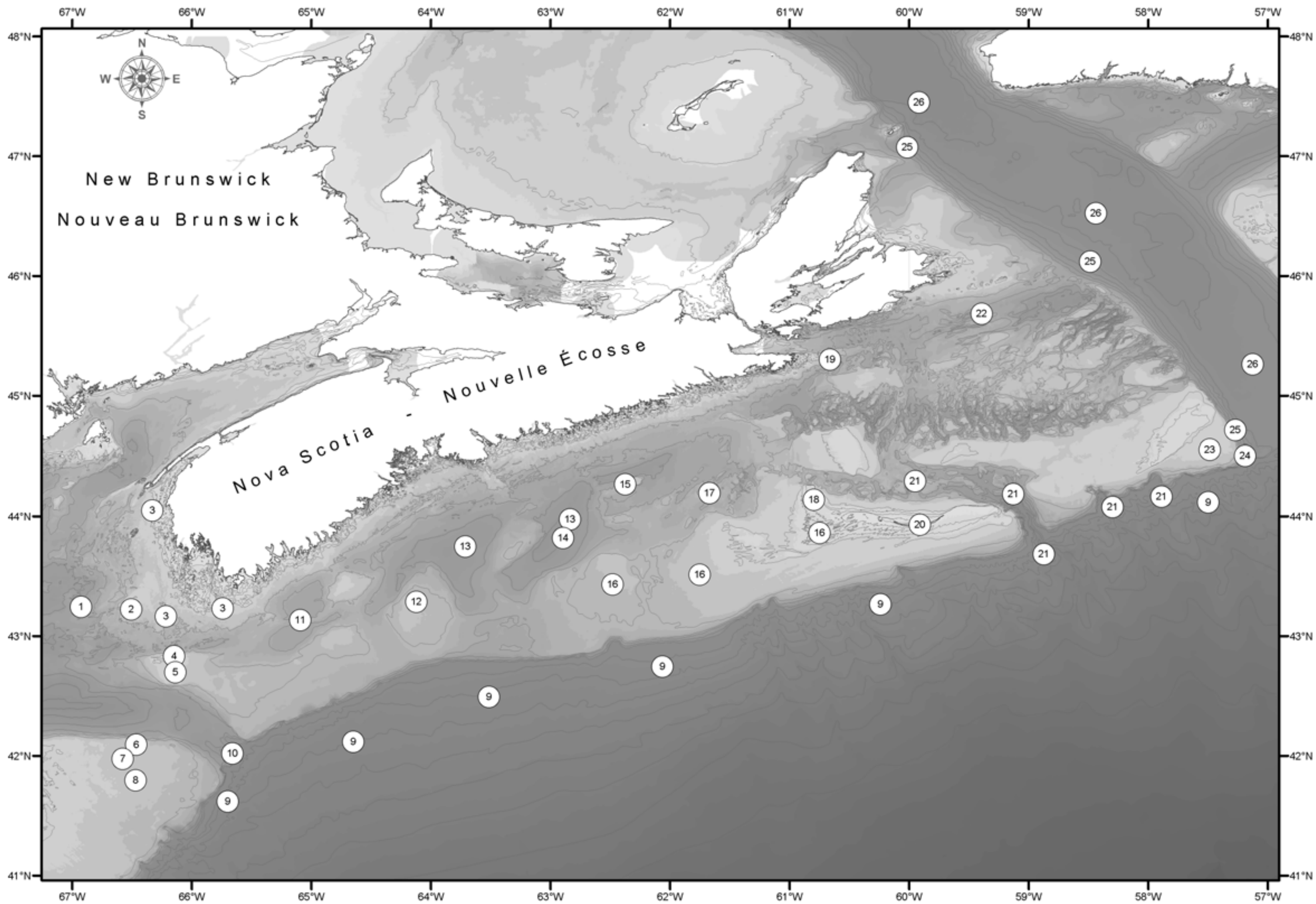

Figure 11.2. Approximate locations of offshore EBSAs on the Scotian Shelf identified by workshop participants.

SECTION 12 – CONCLUSIONS

There were approximately 80 participants at the *Workshop on Inshore Ecosystems and Significant Areas of the Scotian Shelf*. Invited participants included independent scientists and researchers from various government departments, universities and NGOs. The collective expertise provided a valuable assessment of scientific knowledge of the biodiversity, structure and function of the inshore ecosystem of the Scotian Shelf, and exploration of the criteria and data available for the identification of Ecologically and Biologically Significant Areas (EBSAs) on the Scotian Shelf.

During the first two days, participants were asked to assess our current knowledge and understandings of the ecology of the inshore, and the distribution and abundance of birds, mammals, marine and diadromous fish, marine plants, turtles and invertebrates of the inshore Scotian Shelf. The presentations brought together a wide variety of data and acknowledged temporal, spatial, and often species and size biases in the available data. Unlike the offshore Scotian Shelf, where there have been over 35 years of standardized research surveys for groundfish (notably only a small part of the ecosystem), there has been no consistent approach to studying the inshore ecosystem on a coast-wide scale. With the exception of the Bedford Basin, in which there is long-term monitoring, projects in the inshore have been of limited duration and spatial scope.

Some areas, such as Halifax Harbour, St. Margaret's Bay, Lunenburg Bay, Lobster Bay and Sydney Bight, have been subject to ecosystem-focused research at some point in the last 40 years. Other areas along the eastern shore of both mainland Nova Scotia and Cape Breton have received little or no ecosystem-focused research. Furthermore, a data gap exists along the entire coast between diving depth and the shallowest depth of the DFO research vessel survey. While, oceanographic data such as temperature, salinity and primary production are available on a coast-wide scale, landings from commercial fisheries are the only data on the distribution and abundance of fish and invertebrates at this scale.

While we have a good understanding of the links between physics and biology in the inshore, there is concern that land-based activities and their impacts, particularly in the very nearshore or coastal fringe, have not been adequately studied. There have been very few ecological studies that have aimed to understand the structure and function of the inshore ecosystem at the scale of the Scotian Shelf. Those that exist have largely focused on particular interactions, such as kelp/sea urchin interactions, the impacts of invasive species, the decline of eelgrass and the ecology of rockweed communities. We have some knowledge of species distribution and abundance, but primarily for those species of commercial value, such as lobster or crab. The coastline of Nova Scotia is also important to migratory and non-migratory birds and the distribution and habitat association of these species have been relatively well studied.

The workshop highlighted the complexity of the inshore area, both in terms of the physical and biological features, and also with respect to management and regulation. There are a suite of federal and provincial government departments, non-government institutions and stakeholder groups that have research capacity and a vested interest in the inshore. Many activities impact the inshore, including fishing, aquaculture, coastal development, forestry in the watersheds, oil and gas, shipping and tourism. The inshore is also home to marine and avian species protected by the Species at Risk Act and other legislation.

Several themes or research needs emerged throughout the workshop, including the need for:

1) a compilation of biological, ecological and physical research on the inshore,
2) greater collaboration between the various government departments, university-seated researchers and community groups,
3) interdisciplinary research,
4) an investment in research, and
5) a commitment to monitoring, including sightings of marine mammals and turtles.

The second half of the workshop focused on the identification of EBSAs in both the inshore and offshore areas of the Scotian Shelf. Discussion focused on the concern, and in some cases confusion, about the definition of EBSAs and potential management implications of identifying areas as ecologically and biologically significant and consequently identifying other areas as not significant. Many participants felt that it was important to clarify the specific management objectives for EBSAs. Indeed some felt that this was a prerequisite to ensuring the success of this project.

Other aspects of this discussion focused on the relationship between marine protected areas and EBSAs, the value of protecting representative areas and biodiversity, which is encompassed by aggregation in the national guidance document. The criteria as presently defined encompass the range of criteria identified by the international community (Zwanenburg this document) with the exception of the degree of connectedness between EBSAs and the degree to which EBSAs are representative of ecological and biological areas in the region.

Particular metrics were identified for some criteria while it was concluded that information gaps exist for other criteria (particularly those related to fitness consequences). Participants also indicated that were significant gaps in our understanding of taxonomic diversity and of ecological processes for many areas, and that identification of EBSAs based on current information would of necessity remain preliminary. The workshop emphasized that data gaps for areas under consideration should increase the degree to which risk-averse management is indicated.

Effective data management and adherence to strict data and metadata standards was seen as essential to the rational and effective identification process. Presentations indicated that there are significant efforts that are currently aimed at making biophysical data for the Scotian Shelf readily available for incorporation into GIS based analytical frameworks and that these data are being edited to adhere to internationally accepted metadata standards.

Participants engaged in a mapping exercise to identify possible EBSAs and explore the rationale for selecting those areas. Thirty-six potential EBSAs were identified in the inshore and twenty-seven in the offshore. The identification of these areas represents a preliminary attempt to identify EBSAs on the Scotian Shelf based on scientific expert opinion. An analytical approach will also be undertaken to further identify and define potential locations of EBSAs, both as a means of corroborating (or disputing) scientific expert valuations, and to give some guidance in areas not valuated by the experts. Where data or research is not adequate, local ecological knowledge may help to identify EBSAs. In addition to the EBSAs, several areas of particular interest that require more research were identified. The rationale for site identification which accompanies the areas identified may help direct future research, inform management and provide insight into the metrics to describe EBSAs.

The EBSA discussions and mapping exercises identified the need for:
1) assessing the connectivity between inshore and offshore areas,

2) considering historical ecological and biological significance in the identification of EBSAs,
3) participation of experts from all relevant areas of research, and
4) considering the reasons why certain areas may not have been identified as EBSAs, specifically if there is relatively little known about these areas.

The workshop was an important first step in the development of the first Ecosystem Overview and Assessment Report for the inshore of the Scotian Shelf and the identification of EBSAs in both the inshore and offshore. For the inshore, we have identified the scope of our ecological knowledge and specific research needs. The current approach for identifying EBSAs, combining both local and scientific expert opinion and a rigorous information based approach, is likely to yield usable and reliable results. We hope that the proceedings from this workshop will further promote research in the inshore of the Scotian Shelf and help to develop a systematic, transparent and inclusive process for the identification of EBSAs.

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Appendix 2. Agenda

DFO-FSRS Workshop on Inshore Ecosystems and Significant Areas of the Scotian Shelf

January 16th– January 19th 2006
The Auditorium
Bedford Institute of Oceanography,
1 Challenger Drive, Dartmouth, NS.

Monday, 16th of January

8:30 - 8:45	Welcome *Alida Bundy, Bedford Institute of Oceanography (BIO), Kees Zwanenburg, BIO, and Patty King, Fishermen and Scientists Research Society*
8:45 - 9:00	Oceans Action Plan, Integrated Management and Science Input *Dave Duggan, BIO, and Tim Hall, BIO*
9:00 - 10:00	Identifying significant marine areas: new challenges and opportunities, *Robert Rangeley, World Wildlife Fund*
10:00 - 10:15	Break

Part 1. Inshore Ecosystems of the Scotian Shelf

10:15 - 10:45	Establishing a baseline: ecosystem overview and assessment of the inshore Scotian Shelf *Nell den Heyer, FSRS, and Alida Bundy, BIO*

Physical and Biological Linkages, 10:45 – 12:00
Convenor: *Alida Bundy, BIO*

10:50 - 11:10	The Inshore Scotian Shelf: Dominant Physical Oceanographic Processes and Significant Studies, *Gary Bugden, BIO*
11:10 - 11:30	Inshore Primary Production on Atlantic Coast of Nova Scotia, *Trevor Platt and Carla Caverhill, BIO*
11:30 - 11:50	Nutrients as indicators of inshore MEQ? *Phil Yeats, BIO*
11:50 - 12:00	Discussion
12:00 - 1:00	Lunch – provided

Biological Interactions and Biodiversity, 1:00 – 3:10
Convenor: *Herb Vandermuelen, BIO*

1:05 - 1:25	Sea weeds, sea urchins, and waves, *Bob Miller, BIO*
1:25 - 1:45	Quantifying the rapid decline of eelgrass beds on the Eastern Shore of Nova Scotia: 1992 *vs* 2002, *Annelise S. Chapman, Dalhousie*
1:45 - 2:05	The changing face of shallow vegetated communities in Eastern Canada: A multiscale investigation using conventional and state-of-the-art technologies, *Pat Gagnon, Dalhousie*
2:05 - 2:25	*Ascophyllum nodosum* (rockweed): an integral part of habitat architecture in the inter tidal of Atlantic Canada, *Glyn Sharp, BIO*
2:25 - 2:55	Structure, process and biodiversity, *John Roff, Acadia*
2:55 - 3:10	Discussion
3:10 - 3:30	Coffee Break

Life History, Habitat Use and Population Structure: Invertebrates & Fish, 3:30 - 5:25
Convenor: *Heath Stone, St. Andrews Biological Station (SABS)*

3:35 - 3:55	Geographic distribution and habitats of some inshore decapod crustaceans on the Atlantic coast of Nova Scotia, *John Tremblay, BIO*
3:55 - 4:15	The demersal community of inshore Sydney Bight, Cape Breton, *Tim Lambert, BIO*
4:15 - 4:35	Linking the freshwater and marine realms of diadromous fishes, *Rod Bradford, BIO*
4:35 - 4:50	Fish near shore, *Bob Miller, BIO*
4:50 - 5:10	Finfish in inshore Nova Scotia, *Don S. Clark, SABS*
5:10 - 5:25	Discussion

Tuesday, 17th of January

Life History, Habitat Use and Population Structure continued: Marine mammals, Birds, Turtles, 8:30 -10:10
Convenor: *Peter Hurly, BIO*

8:35 - 8:55	Marine turtles on the Scotian Shelf, *Mike James, Dalhousie*
8:55 - 9:15	Patterns of marine bird use over the inshore portion of the Scotian Shelf, *John W. Chardine, Canadian Wildlife Service (CWS), and Andrew W. Boyne, CWS*
9:15 - 9:35	Patterns of coastal bird use over the inshore portion of the Scotian Shelf., *Al Hanson, EC*
9:35 - 9:55	Marine mammal distribution along the Atlantic coast of Nova Scotia, *Tonya Wimmer, Marine Animal Response Society*
9:55 - 10:10	Discussion
10:10 - 10:30	Break

Species of Conservation Concern, 10:30 – 12:00
Convenor: *Rod Bradford, BIO*

10:35 - 10:55	Science needs for implementation of the Species at Risk Act, *Lei Harris, SABS*
10.55 - 11:15	Avian Species at Risk in the inshore areas of the Scotian Shelf, *Andrew Boyne, CWS, and Julia McKnight, CWS*
11:15 - 11:35	Distribution of marine fish species at risk in the inshore areas of the Scotian Shelf, *Lei Harris, SABS*
11:35 - 12:00	Discussion

12:00 - 1:00	Lunch – provided

Anthropogenic Impacts, 1:00 – 3:00
Convenor: *Tana Worcester, BIO*

1:05 - 1:25	An overview of environmental issues related to marine aquaculture, *Blythe Chang, SABS*
1:25 - 1:45	Approaches to investigate the impact of chemicals from anthropogenic sources, *Jocelyne Hellou, BIO, and Phil Yeats, BIO*
1:45 - 2:05	Impacts of Petroleum-Related Activities on the Inshore Environment, *Tana Worcester, BIO*
2:05 - 2:25	Climate change and thermal sensitivity of commercial marine species, *Gail Chmura, McGill*
2:25 - 2:45	History of multiple human impacts in estuarine and coastal ecosystems, *Heike Lotze, Dalhousie*
2:45 - 3:00	Discussion

3:00 - 3:20	Break

Discussion in Break-Out Groups: Research Challenges and Opportunities, Collaborative Possibilities and Data Sharing,
3:20 – 5:30
Convenor: *Alida Bundy, BIO*

3:20 - 4:45	Break-out Group Discussions (Please see questions in the handout)
4:55 - 5:30	Regroup and Report Back

Part II: Ecologically and Biologically Significant Areas (EBSAs) on the Scotian Shelf

Wednesday, 18th of January

Introduction to EBSA Criteria, 8:30 – 10:00
Convenor: *Kees Zwanenburg, BIO*

This session will focus on our understanding of the criteria used to define EBSAs. Emphasis will be on both the array of criteria required to achieve stated objectives and a thorough unpacking of each criterion. Initial emphasis will be on criteria as outlined in Identification of Ecologically and Biologically Significant Areas, Ecosystem Status Report 2004/006.

8:30 - 9:00	Introduction, *Kees Zwanenburg, BIO*
9:00 - 9:30	Why Identify Ecologically and Biologically Significant Areas? *Dave Millar, BIO*
9:30 - 10:00	Discussion
10:00 - 10:20	Break

EBSA Information Relevance and Database Considerations, 10:20 – 12:00
Convenor: *Kees Zwanenburg, BIO*

Here we will evaluate available information for the Scotian Shelf and determine what is relevant to the identification of EBSAs. We have available an array of information with a wide range of spatial and temporal scales. We will evaluate which of these data sources is most relevant to developing metrics of EBSA criteria and how best to make these available to the analytical methods to be employed.

10:30 - 11:00	Interoperability and Metadata, *Bob Branton, BIO, and Tara McIntyre, BIO*
11:00 - 11:30	Benthic Habitat Classification, *Vlad Kostylev, NRCAN*
11:30 - 12:00	Discussion
12:00 - 1:00	Lunch – provided

Mapping Exercise 1: Identification of EBSAs by working groups, 1:00 – 5:00
Convenor: *Penny Doherty, BIO*

In this session, we will identify EBSAs on the Scotian Shelf using scientific expert opinion via a Delphic approach. Working groups will focus on either inshore or offshore regions on the Scotian Shelf. Groups will identify areas that they know to be of ecological and/or biological significance based on EBSA criteria. Approximate boundaries of these areas will be drawn on charts provided, and participants will record their rationales for selecting each area.

1:00 - 1:30	Explanation of EBSA Mapping Exercise 1, *Penny Doherty, BIO*
1:30 - 3:00	Identification of EBSAs, *working group session*

3:00 - 3:20 Break

3:20 - 4:30 Identification of EBSAs cont'd, *working group session*
4:30 - 5:00 Regroup and Report Back

Thursday, 19th of January

Metrics for EBSA Criteria, Data Integration, Visualisation and Interpretation, 8:30 - 12:00
Convenor: *Kees Zwanenburg, BIO*

In this session we will (a) focus on developing specific metrics for each of the EBSA criteria outlined above and (b) explore methods (mainly GIS based) of integrating the information developed for each criterion above. While some of the proposed metrics are readily amenable to the development of metrics (e.g. aggregation of particular species groups), there are others that are more problematic (e.g. life-history consequences). The spatio-temporal distribution of individual metrics will be explored. One of the central issues of this session will be the relative weighting of criterion metrics and how data integrity (variation in spatial and temporal scales of observation) factors into this process. Development of thematic layers (GIS) will be emphasized.

8:30 - 9:00 Introduction, *Kees Zwanenburg, BIO*
9:00 - 9:30 EBSAs Concepts and Metrics, *John Roff, Acadia*
9:30 - 10:00 Discussion

10:00 - 10:20 Break

10:20 - 10:50 EBSAs – A case study from the Bras D'Or Lakes, *Maxine Westhead, BIO, and Mike Parker, East Coast Aquatics Inc.*
10:50 - 11:20 Open Source Tools for Geospatial Tasks, *Daniel Ricard, Dalhousie*
11:20 - 12:00 Discussion

12:00 - 1:00 Lunch – provided

EBSA Mapping Exercise 2: Refining EBSA Boundaries, 1:00 – 4:00
Convenor: *Penny Doherty, BIO*

In this session we will review the results of the previous day's EBSA identification mapping exercises. All the EBSAs identified on the previous day will be superimposed into one map with areas shaded in accordance with the degree of overlap. Working groups will then review and refine the boundaries of the EBSAs to a finer scale..

1:00 - 2:00 Explanation of EBSA Mapping Exercise 2, *Penny Doherty, BIO*
2:00 - 3:00 Refining EBSA boundaries, *working group session*

3:00 - 3:20 Break

3:15 - 4:00 Refining EBSA boundaries cont'd, *working group session*

Wrap-up, Next Steps for EBSAs and Overall Next Steps, 4:00 – 5:00
Convenors: *Alida Bundy, BIO and Kees Zwanenburg, BIO*

Appendix 3. Gathering Scientific Expert Opinion for Identification of Ecologically and Biologically Significant Areas of the Scotian Shelf, Participants' Workbook

Workshop on Inshore Ecosystems and Significant Areas of the Scotian Shelf

Gathering Scientific Expert Opinion for Identification of Ecologically and Biologically Significant Areas on the Scotian Shelf

January 18 and 19, 2006

Participants' Workbook

Gathering Scientific Expert Opinion for Identification of Ecologically and Biologically Significant Areas on the Scotian Shelf

January 18 and 19, 2006

Background Information

In order to support the integrated, ecosystem-based management of Canada's oceans, Fisheries and Oceans Canada is undertaking programs to identify ecologically and biologically significant areas (EBSAs) in a number of regions, including the Scotian Shelf. Identifying EBSAs is not a general strategy for protecting all habitats and marine communities that have some ecological significance. Rather it is a tool for drawing attention to an area that has **particularly high ecological or biological significance**, to facilitate provision of a greater-than-usual degree of risk aversion in management of activities in the area.

To identify an area as "significant" is to conclude that if the area or species were disturbed severely, the ecological consequences (in space, time, or outward in the foodweb) would be greater than an equal perturbation of most other areas or species. Although societal values and potential threats play a role in determining the management measures that may be applied to EBSAs, **threats and values ARE NOT considerations** in the identification of EBSAs.

As outlined in the Ecosystem Status Report 2004/006 (Identification of EBSAs), experiential knowledge must be included in the process of identifying EBSAs. This session of the workshop is designed to gather scientific expert opinion which is based on a life's work rather than any particular project or set of data, thus is not found in scientific publications. The information gathered in this session will be combined with other sources of information, including scientific data and local ecological knowledge, to identify EBSAs on the Scotian Shelf.

Mapping Exercise 1: Identify EBSAs
January 18, 2006
1:00 – 4:30pm

Purpose

The purpose of Exercise 1 is to **identify areas of particularly high ecological and biological significance** on the Scotian Shelf. For this exercise, participants will be divided into working groups of mixed expertise, which will focus on either nearshore or offshore regions. The goals for each group are:

1) to identify areas that meet each of the EBSA criteria independently,
2) to draw approximate boundaries of these areas on a chart, and
3) to record rationales for choosing each area.

Methods

1) As a group, identify areas that meet at least one of the primary EBSA criteria (uniqueness, aggregation, fitness consequences) **to a higher degree** than other similar areas (or areas with similar characteristics). Fill in the EBSA Criteria Matrix, indicating the areas that also meet either of the secondary criteria (resilience, naturalness). General comments are sufficient for filling in the Matrix (e.g., unique cod spawning area).

2) Locate and draw boundaries of each area identified in the Matrix on a chart.
    a. First, draw outlines around the cells on the chart that encompass the entire boundary of the area of ecological and/or biological significance. Identify each area with a number.

    b. On mylar sheets superimposed on the charts, draw approximate boundaries of each area, if possible. Identify each area with a number. Ensure that the number of each area is the same as the number of the corresponding area in a).

Note: To ensure that the group considers areas of particularly high ecological and biological significance and to prevent the group from selecting the entire Scotian Shelf, **no more than 40% of the nearshore or offshore region can be identified as areas of ecological and/or biological significance.**

3) For each area identified on the chart, complete a Site Selection Form with as much detail as possible, providing the rationale for selecting the areas as an area of particularly high ecological and biological significance. Ensure that the number of the site is written at the top of the form and that it corresponds to the site identified on the chart, and that the cell numbers that encompass the area on the chart are written on the top of the form.

Note: Following Exercise 1, all the working groups' selections will be superimposed into one map with areas shaded in accordance with the degree of overlap. Exercise 2 (January 19, 2006) will focus on refining the boundaries of the identified areas to a finer scale.

Questions for Consideration

1) Are there areas you consider to be of particularly high ecological and biological significance that were not identified in this exercise because they did not meet the EBSA criteria? If yes, which areas and why do you consider them to be ecologically and biologically significant?

2) Would you recommend any additions/modifications to the EBSA criteria? If yes, please explain.

3) For general areas where you have not identified areas of particularly high ecological and biological significance, please record your rationale (i.e., lack of data in that area or the area is not considered of high significance according to criteria). If lack of data, what information is needed?

4) If areas were selected that together comprised more than 40% of the offshore or nearshore area, how did you decide which areas would be included and which would be left out?

Mapping Exercise 2: Review and Refine EBSAs
January 19, 2006
1:00 – 4:00pm

Purpose

The purpose of Exercise 2 is to review and refine the boundaries of the areas of high ecological and biological significance identified in Exercise 1. For this exercise, participants will be divided into working groups by geographic region on the Scotian Shelf, with members having differing expertise. The goals for each group are:

1) to review the results of Exercise 1,
2) to refine the boundaries of areas identified in Exercise 1,
3) to produce a new chart with finer scale boundaries of significant areas,
4) to provide additional information on the Site Selection Form, and
5) to identify areas of particularly high ecological and biological significance not selected in Exercise 1.

Methods

1) Review and discuss the areas identified in your geographic region, noting the degree of overlap.

2) Review the Site Selection Forms for each area and discuss the rationale used for identifying the area as ecologically and/or biologically significant. Comment on any information that you feel is incorrect or lacking, noting any additional information that should be included (e.g., additional reasons why the area should be considered ecologically and biologically significant) or reasons why the area should not be considered as ecologically and/or biologically significant.

3) Draw an approximate boundary around each area on the chart provided.
    a. Elaborate on any comments/rationale regarding the positioning of the boundary for each area.
    b. If you are not comfortable drawing approximate boundaries of an area, discuss the reasons why (e.g., the group doesn't feel it has enough expertise to define the boundaries of the area, there is not enough data available to help define the boundary, etc.). If the reason includes a lack of data, provide details as to which data are required.

4) Discuss any additional areas of particularly high ecological and biological significance within your geographic region that are not identified on the chart.

5) For each newly identified area,
    a. draw outlines around the cells on the chart that encompass the entire boundary of the area,
    b. draw its approximate boundaries on the chart, and
    c. complete a new Site Selection Form with as much detail as possible, providing the rationale for selecting the area as an area of high ecological and biological significance.

Ensure that the number of the site is written at the top of the form and that it corresponds to the site identified on the chart.

Note: After the workshop, the boundaries of areas of particularly high ecological or biological significance identified by experts will be digitized, and all comments and records relevant to each identified EBSA will be stored in a GIS.