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DFO/FSRS Inshore Ecosystem Project Data Synthesis Workshop

19-20 March 2007
Holiday Inn Harbourview
Dartmouth, Nova Scotia

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August 2007

Projet MPO-FSRS sur l'écosystème côtier Atelier de synthèse des données

Les 19 et 20 mars 2007
Holiday Inn Harbourview
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août 2007

Canada

Foreword

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

This workshop was not carried out as a formal Department of Fisheries and Oceans (DFO) Science Advisory process; however, it is being documented in the Canadian Science Advisory Secretariat (CSAS) Proceedings series as it presents some topics of interest related to the advisory process.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d’analyses ou d’interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré en tant que reflet des conclusions de la réunion, à moins d’indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l’information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

Le présent atelier n’a pas été tenu dans le cadre officiel du processus des avis scientifiques du ministère des Pêches et des Océans (MPO). Celui-ci est toutefois documenté dans la série des comptes rendus du Secrétariat canadien de consultation scientifique (SCCS), car il couvre certains sujets en lien avec le processus des avis.

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SUMMARY

The DFO/FSRS Inshore Ecosystem Project Data Synthesis Workshop was held on 19-20 March 2007 at the Holiday Inn Harbourview, 101 Wyse Road, Dartmouth, N.S., Canada. The objectives of the workshop were to review the data gathered through the research components of the Inshore Ecosystem Project (IEP), and to discuss these results with respect to Volume I of the draft Inshore Scotian Shelf Ecosystem Overview and Assessment Report (EOAR), and the utility of these data for describing Ecologically and Biologically Significant Areas (EBSAs) and Ecologically Significant Species (ESS).

The results of the main research components of the IEP were discussed in a series of presentations covering the following:

- Analysis of DFO databases and data archiving;
- Monitoring of environmental and oceanographic data;
- Grey seal pup survey;
- At-sea Catch Analysis;
- Fishery-Independent research;
- Video of bottom habitat using URCHIN (Underwater Reconnaissance and Coastal Habitat Inventory); and
- Local Ecological Knowledge (LEK) Survey of inshore commercial fishermen.

Ample time was allowed for discussion, and breakout groups were held during the second afternoon to discuss the results in relation to a series of questions:

- How does this new information compare with our understanding of the inshore ecosystem? Is there anything unexpected?
- What have we learned about the biodiversity of the inshore? Are there recognizable gradients?
- Can this data help identify areas that are ecologically or biologically significant or degraded? How?
- Can this data help identify Ecologically Significant Species? How?
- Is this kind of data collection useful for monitoring the inshore?
- Research needs?
- Lessons learned?

The primary conclusion of the workshop was that the data from the various project components provide a valuable baseline spanning the geographic breadth of the inshore Scotian Shelf. A variety of sampling methodologies, including underwater video, aerial photography, baited traps, gillnets, and water sampling, were used to describe the Nova Scotia Current (NSC) and the distribution of seaweeds, pelagic sea birds, invasive tunicates, fish, and invertebrates.

The identification of inshore-offshore and alongshore (east-west) gradients, and Ecologically and Biologically Significant Areas, was a focus of the preliminary analysis. Although the data analysis from the project is still in its early stages, the only trends along the coast identified were in the physical oceanography. The Conductivity and Temperature at Depth (CTD) profiles showed the influence of the Nova Scotia Current and an increase in salinity, and a decrease in stratification, from east to west. The initial analysis suggests that the community composition and biodiversity are similar along the Atlantic coast of Nova Scotia, as many of the species that were captured by beach seine and trap were ubiquitous.

Inshore-offshore gradients were apparent in the CTD profiles and FSRS recruitment trap and gillnet results from the Fishery-Independent Survey. The preliminary analysis suggests three potential depth zones (coastal fringe, mid-depths, and offshore) that may be useful in planning and implementation of integrated management and future research. Preliminary analysis also suggests that exposure to open ocean is an important habitat characteristic that may influence diversity and community composition along the Atlantic coast.

It was concluded that the analysis of the new data collected was too preliminary to identify EBSAs or ESS. However, the Science Expert Opinion (SEO) and LEK Surveys will provide a list of candidate EBSAs, which could be evaluated with data from Fisheries and Oceans Canada (DFO) databases, the Canadian Wildlife Services (CWS) bird colony survey, and the new data collected through the IEP.

This workshop provided an opportunity to review the data collected, discuss further data analysis, and explore multidisciplinary collaboration. The discussions highlighted the importance of further research on the inshore ecosystem, as well as the need for long-term monitoring. The DFO/FSRS Inshore Ecosystem Project was an important first step towards a multidisciplinary research program to study the inshore Scotian Shelf ecosystem.

RÉSUMÉ

L'atelier de synthèse des données recueillies dans le cadre du Projet MPO-FSRS sur l'écosystème côtier (PEC) a eu lieu les 19 et 20 mars 2007 à l'hôtel Holiday Inn Harbourview, situé au 101 Wyse Road, à Dartmouth (Nouvelle-Écosse), au Canada. L'atelier visait à examiner les données recueillies dans le cadre des volets de recherche du PEC, à en discuter par rapport au volume I de l'ébauche du Rapport d'examen et d'évaluation de l'écosystème (REEE) côtier du plateau néo-écossais et à établir leur utilité pour ce qui est de décrire des zones d'importance écologique et biologique (ZIEB) et des espèces d'importance écologique (EIE).

Les résultats des principaux volets de recherche du PEC ont été discutés lors d'une série d'exposés portant sur les sujets suivants :

- Analyse des bases de données du MPO et archivage des données,
- Surveillance des données environnementales et océanographiques,
- Relevé des nouveau-nés du phoque gris,
- Analyse des prises en mer,
- Recherche indépendante de la pêche,
- Vidéo URCHIN (Underwater Reconnaissance and Coastal Habitat Inventory) de l'habitat benthique, et
- Enquête sur le savoir écologique local des pêcheurs commerciaux côtiers.

On a fait largement place à la discussion et tenu des séances en petits groupes l'après-midi de la deuxième journée de l'atelier pour débattre des résultats en répondant à une série de questions :

- Où s'inscrivent les nouvelles données dans notre compréhension de l'écosystème côtier? Avons-nous appris quelque chose d'inattendu?
- Qu'avons-nous appris au sujet de la biodiversité de l'écosystème côtier? Des gradients sont-ils apparents?
- Ces données permettent-elles d'identifier des zones d'importance écologique ou biologique ou des zones dégradées? Comment?
- Ces données permettent-elles d'identifier des espèces d'importance écologique? Comment?
- Ces données sont-elles utiles à la surveillance de la zone côtière?
- Quels sont les besoins de recherche?
- Quelles sont les leçons tirées?

Il ressort principalement de l'atelier que les données recueillies dans le cadre des divers volets du PEC constituent une solide assise portant sur la totalité des eaux côtières du plateau néo-écossais. Une gamme de méthodes, comme la vidéo sous-marine, la photographie aérienne, des casiers appâtés, des filets maillants, ainsi que l'échantillonnage de l'eau, ont permis d'obtenir des données qui ont servi à décrire le courant de la Nouvelle-Écosse et la distribution des algues, des oiseaux marins pélagiques, des tuniciers envahissants, des poissons et des invertébrés.

L'analyse préliminaire des données était axée sur l'identification de gradients côtiers (est-ouest) et côtiers-extracôtiers et de zones d'importance écologique et biologique. Cette analyse en est à ses premières étapes, et les seules tendances dégagées le long de la côte concernent l'océanographie physique. Les profils de conductivité et de température selon la profondeur (CTP) révèlent l'influence du courant de la Nouvelle-Écosse et dénotent une augmentation de la salinité, ainsi qu'une réduction de la stratification d'est en ouest. Les résultats de l'analyse

préliminaire donnent à penser que la composition et la biodiversité des communautés sont semblables tout le long de la côte atlantique de la Nouvelle-Écosse, car de nombreuses espèces capturées à la senne de plage et au casier étaient très répandues.

Des gradients côtiers-extracôtiers étaient apparents dans les profils CTP, ainsi que dans les résultats du relevé indépendant de la pêche réalisé aux filets maillants et aux casiers d'échantillonnage des recrues par la FSRS. L'analyse préliminaire permet de croire à l'existence de trois zones de profondeur possibles (frange côtière, zone de profondeur intermédiaire et zone extracôtière) qui peuvent être utiles pour la planification et la mise en œuvre de la gestion intégrée ainsi que pour la recherche future. Elle donne également à penser que l'exposition à la haute mer constitue une caractéristique importante de l'habitat, qui peut avoir un effet sur la diversité et la composition des communautés le long de la côte atlantique.

On a conclu que l'analyse des données récemment recueillies n'était pas assez avancée pour pouvoir cerner des ZIEB ou des EIE. Toutefois, l'avis scientifique et les enquêtes sur le savoir écologique local permettront de dresser une liste de ZIEB éventuelles, qui pourraient être évaluées en fonction de données tirées des bases de données de Pêches et Océans Canada (MPO), des relevés des colonies d'oiseaux du Service canadien de la faune (SCF) et des nouvelles données recueillies dans le cadre du PEC.

L'atelier a été une occasion d'examiner les données recueillies, de discuter de leur analyse plus poussée et d'explorer les possibilités de collaboration multidisciplinaire. Les discussions ont mis en lumière l'importance d'autres recherches sur l'écosystème côtier, ainsi que la nécessité d'observations à long terme. Le Projet sur l'écosystème côtier MPO-FSRS est une première étape importante vers un programme de recherche multidisciplinaire sur l'écosystème côtier du plateau néo-écossais.

INTRODUCTION

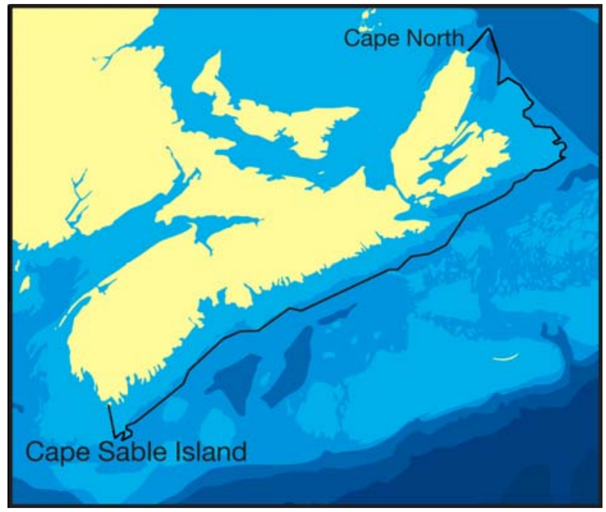

Figure 1. Map of Nova Scotia, Canada, showing the 50 fathom line (100 m) and the 12 mile offshore line.

The Inshore Ecosystem Research Project is a joint project between Fisheries and Oceans Canada (DFO) and the Fishermen and Scientists Research Society (FSRS), funded through Phase 1 of the Oceans Action Plan (OAP). DFO is developing an ecosystem approach to oceans management, which includes the creation of Ecosystem Overview and Assessment Reports (EOARs), in support of integrated management, the development of ecosystem objectives, and the identification of EBSAs (DFO 2004), Ecologically Significant Species and Community Properties (DFO 2006a), degraded areas, and degraded species (DFO 2007). Five large ocean management areas (DFO 2007) have been identified in Canada, including the eastern Scotian Shelf, which has had a pilot integrated management initiative since 1998. The Inshore Ecosystem Project (IEP) is focused on waters within the 12 nautical mile limit of the Scotian Shelf, from Cape Sable to Cape North, Nova Scotia.

The objectives of the project are to draft Volume 1 of the Inshore Scotian Shelf EOAR and to identify potential EBSAs. Although inshore areas are recognized as nursery and feeding areas for many marine species, we have insufficient scientific data to meaningfully contribute to either integrated management of the inshore or to definitions of EBSAs. In order to address this lack of information, the Inshore Ecosystem Project was designed to both collate and synthesize existing information and data and to collect new baseline data in support of integrated management. The Inshore Ecosystem Project consisted of eight research initiatives that will contribute to the Inshore Scotian Shelf EOAR:

1. Workshop on inshore ecosystems and significant areas of the Scotian Shelf (DFO 2006b);
2. Analysis of DFO databases and data archiving;
3. Monitoring of environmental and oceanographic data;
4. Grey seal pup survey;
5. At-sea catch analysis;
6. Fishery-independent research;
7. Video of bottom habitat using URCHIN (Underwater Reconnaissance and Coastal Habitat Inventory); and
8. Local Ecological Knowledge (LEK) Survey of commercial fishermen.

The objectives of this two-day workshop were to present, discuss, and begin the synthesis of the results of these eight project components, especially in relation to how they improve our understanding of the inshore ecosystem, and whether we can use these data to identify EBSAs. The first day and a half consisted of presentations of project results, followed by an opportunity for participants to discuss these results in more detail in breakout groups. This report provides a summary of the presentations, the group discussions, and the wrap-up discussion, which included invited commentary by Dr. John Roff and Shannon McCormick (Acadia University), and preliminary conclusions.

Several participants have agreed to provide copies of their presentations for public access and these have been posted on the Centre for Marine Biodiversity website http://www.marinebiodiversity.ca/en/home.html.

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DFO, 2004. Identification of Ecologically and Biologically Significant Areas. DFO Can. Sci. Advis. Sec. Ecosystem Status Rep. 2004/006.

DFO, 2006a. Identification of Ecologically and Biologically Significant Species and Community Properties. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/041.

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SECTION 1 – PRESENTATIONS

Ecologically Significant Areas of the Inshore Scotian Shelf: A Compilation of Scientific Expert Opinion

Penny Doherty and Tracy Horsman
Oceans and Coastal Management Division, Fisheries and Oceans Canada, Bedford Institute of Oceanography

In order to support 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 by DFO (2004), experiential knowledge must be included in the process of identifying EBSAs. Thus, the intent of this study was to gather scientific expert opinion to contribute to the identification of EBSAs on the Scotian Shelf.

At the DFO/FSRS Workshop on Inshore Ecosystems and Significant Areas of the Scotian Shelf (DFO 2006), participants were asked to identify areas of particularly high ecological significance based on the EBSA criteria (uniqueness, aggregation, fitness consequences, naturalness, resilience), delineate the approximate boundaries of each area on a map, and provide justification for selecting each area (see Doherty and Horsman 2007 for methodologies). Following the workshop, interviews were conducted with various experts identified during the workshop to gather more information about proposed EBSAs.

The boundaries of areas of particularly high ecological significance identified by scientific experts were digitized, and all comments and records relevant to each proposed EBSA were stored in a Geographic Information System (GIS). Final boundaries of proposed EBSAs based on scientific expert opinion were determined by examining actual boundaries drawn by workshop participants or experts interviewed and any associated descriptive text provided.

In the inshore Scotian Shelf, 47 areas of high ecological significance were identified (Figure 1). Of these proposed EBSAs, four areas were identified by a minimum of five experts. These areas were Lobster Bay (#3 in Figure 1), Cape Sable Island area (#4), Bird Islands area (#41) and St. Paul's Island area (#47).

The identification of proposed EBSAs was based most often on aggregation (44/47) either alone or in combination with other criteria, although identification based on fitness consequences in combination with other criteria was also common (37/47). Uniqueness (26/47) was the primary criterion chosen the least when identifying proposed inshore EBSAs.

Forty-seven percent (22/47) of the proposed inshore EBSAs were identified by the three primary criteria, 36 percent (17/47) of the proposed EBSAs met two of the primary criteria (Uniqueness/Aggregation - 2, Aggregation/Fitness Consequences - 15), and 15 percent (7/47) met only one of the primary criteria (Uniqueness - 2, Aggregation - 5).

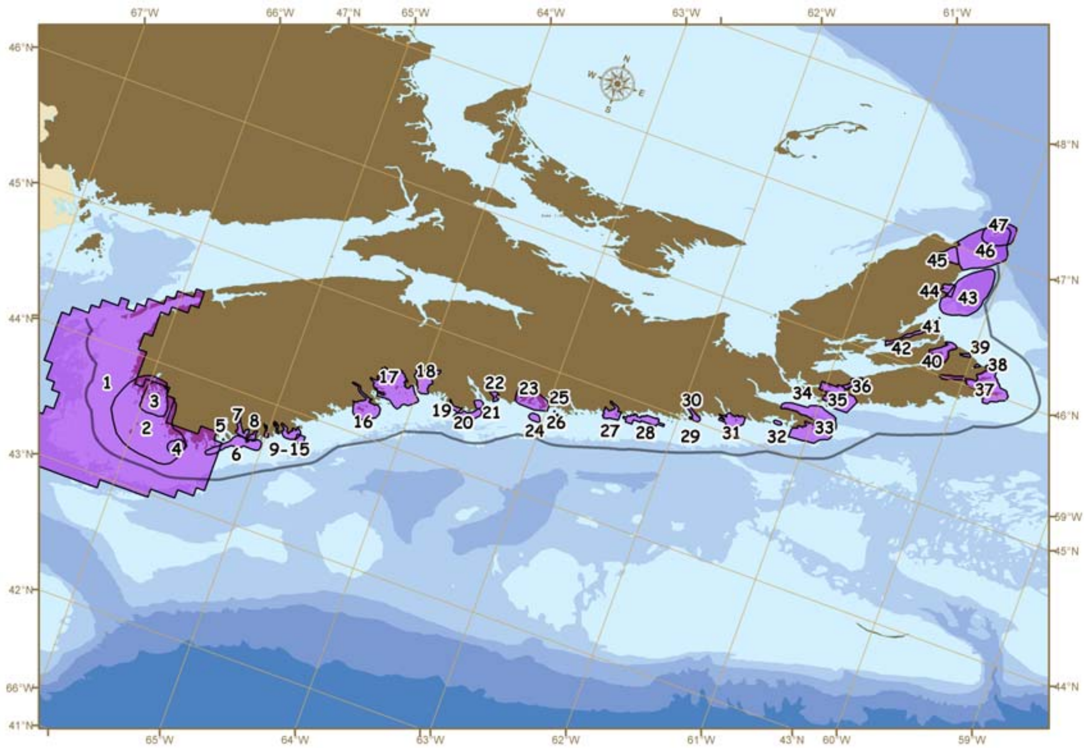

Figure 1. Proposed inshore Ecologically and Biologically Significant Areas of the Scotian Shelf based on scientific expert opinion.

Sixteen inshore areas (34 percent) met all five EBSA criteria although some of the areas were ranked low for certain criteria.

Inshore areas were identified as proposed EBSAs for various reasons. Approximately 30 percent of the areas were identified as highly productive, many of which were associated with macrophyte beds, primarily eelgrass or kelp. Eleven of the 47 inshore areas were described as having eelgrass beds.

About 47 percent of the inshore areas were identified as proposed EBSAs, in part, due to the presence of birds (Important Bird Areas, important wintering/spring areas or colonies of breeding or molting birds). Six inshore areas were identified, in part, because of the presence of endangered birds (piping plover, harlequin duck or roseate tern).

Two other inshore areas were identified, in part, because of the presence of species at risk: the La Have River and islands area for the endangered Atlantic wolfish, and the Sydney River-Sydney Harbour area for the yellow lampmussel, a species of special concern.

About 23 percent of the proposed EBSAs were identified, in part, because of spawning (e.g., herring, cod) or for the potential for species (i.e., lobster) to reproduce in the area.

It is important to note that the proposed EBSAs do not represent a final list of EBSAs for the inshore Scotian Shelf. The information gathered during the workshop and subsequent interviews with other key experts is only one component in the process of identifying EBSAs. The aforementioned information based on science expert knowledge, together with other sources of data, including biophysical data and fishermen's knowledge, will be used to identify EBSAs on the Scotian Shelf. In addition to assisting in identifying proposed EBSAs, the information collected during this study may also be used for other planning and decision-making processes for oceans management.

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DFO, 2004. Identification of Ecologically and Biologically Significant Areas. DFO Can. Sci. Advis. Sec. Ecosystem Status Rep. 2004/006.

DFO, 2006. DFO/FSRS Workshop on Inshore Ecosystems and Significant Areas of the Scotian Shelf, January 16-19, 2006. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2006/002.

Doherty, P., and T. Horsman. 2007. Ecologically and Biologically Significant Areas of the Scotian Shelf and Environs: A Compilation of Scientific Expert Opinion. DFO, Oceans and Coastal Management Division, Maritimes Region, Dartmouth, Nova Scotia. [Draft].

Discussion

Q: I was involved with the workshop and I feel that there are problems with the data and its quality. Some of it was factual and some of it was hearsay. This has to be taken into consideration before any work on EBSAs can be done.
A: I agree. The EBSA areas are not finalized. The results that are given are only those of scientific expert opinion. Alida Bundy is doing data analysis that will contribute to the final EBSA boundaries and traditional ecological knowledge (TEK) will also be taken into account. Some EBSAs that have been mentioned may not make it.

Q: What are the boundaries for the project?
A: The boundaries are from Cape North to Cape Sable Island. We did include EBSAs that were identified outside the study areas but overlapped with areas inside the study area. There has been similar work done on the offshore of the eastern Scotian Shelf.

Comment: With the Local Ecological Knowledge Surveys, if information is given outside of the given areas, it is still collected and processed.

Comment: It is important to look at larger areas for management purposes.

Comment: Value added needs to be done with these data. Scientific knowledge has to be sorted from opinion with science. We have to see if there are any overlaps with local knowledge and the scientific knowledge.
A: All of this information will be taken into account to form the EBSAs.

Conservation of Nova Scotia's Bays: Are We Just coasting? Defining Coastal Zone Representative Bay Types

Michelle Greenlaw, Shannon O'Connor, and John Roff
Acadia University

Selection of candidate sites for designation as Marine Protected Areas (MPAs) in coastal waters still involves many arbitrary choices. Analysis of candidate sites, according to a combination of geophysical and ecological criteria, can lead to the recognition of representative bay types, and potentially reduce the arbitrariness of these decisions. In coastal areas, estuaries have long been classified according to their geophysical properties. Bays are at least as diverse in character, yet existing classifications depend largely upon descriptions of the benthic communities themselves, and take little advantage of existing hydrographic and digital information. We are developing a classification of coastal marine bays, based on GIS analysis of existing digital hydrographic, and associated, data.

Analysis for relationships between morphological factors will determine which factors will suit a predictive nearshore classification. Preliminary results show that bays appear to fall into recognizable categories, or representative types, based on these simple morphometric characteristics. These categories (recognized in Multidimensional Scaling (MDS) plots) can predict: the distribution of fine substrates, the backshore type, and, potentially, the array and distribution of biological communities present. Morphological factors were derived from publicly available government and non-government organizations. Of special significance, are novel calculations of exposure (referenced to wind direction frequencies and durations), which appear to predict the distribution of fine substrates within bays and the creation of a seamless digital elevation model representing the nearshore.

Biogeographic Patterns of Juvenile Fish

To calibrate the relationship between bays of defined geophysical characteristics and biological communities, an extensive survey of the juvenile fish along the Atlantic coast of Nova Scotia was completed. The goal of this project was to determine where juvenile fish are located in the coastal zone, and see whether their distributions can be predicted from topographic and geomorphological features. The primary questions we are addressing include:

1. Are there biogeographic differences in the distribution of juvenile fish?
2. Do fish communities differ across bays?
3. Do the fish assemblages respond to habitat types?

Very few species demonstrate any biogeographic patterns, with most distributed across the entire study area. As well, no significant trends have been found to date between the fish assemblages and bay types. The response of species richness and overall abundance to bay level physiographic features, including bay shape, shoreline development, and exposure, is undetermined. However, species-accumulation curves reveal an interesting characteristic of bay size. Despite larger bays having additional space and habitat types, small bays were found to contain a greater species number. Significant associations were found between the fish assemblages and some of the abiotic characteristics occurring at the site level (i.e., substrate type, depth, etc.). Species number was found to increase as substrate particle size decreased, with mud sites containing the greatest species diversity. This is likely a result of these habitats having substantial vegetation cover that shelter fish from predators.

Discussion

Q: Mud having lots of species is odd. Did some species escape in rockier areas?
A: The chance for fish to escape was less in pebble-cobble sites; however, it was definitely an issue in areas with boulders.

Q: High and low tide sampling?
A: Sampling only occurred during the three hours on either side of low tide, when lowtide corresponded with dawn and dusk.

Q: Compare benthic complexity?
A: No, this has not been done yet.

Q: Why not Principal Component Analysis (PCA) or Canonical Correspondence Analysis (CCA)?
A: A PCA has been performed on the environmental data and produces similar results as seen in the multidimentional scaling ordination plots. CCA is a similar technique to multidimensional scaling that is used for comparing biological data to environmental factors. Although CCA uses a measure of similarity, it does not deal with rare species, as well as the Bray-Curtis similarity calculation used in MDS.

Comment: Intertidal vegetation may have an effect and you are not looking at it.
A: It's hard to get data. We are trying to get vegetation data.

Q: One or multiple sites per bay?
A: In larger bays there were multiple sites sampled. The small bays only contained one site.

Q: Variation in multiple sites?
A: There wasn't a lot of variation in the sites, even though we attempted to sample all the major substrates in a bay.

Q: Instead of counts why not biomass?
A: Not huge jumps.

Q: Time issue between years? Alewifes differ?
A: This should not have been a sampling issue as the same procedure and timing was used both years.

Q: Blueback herring?
A: Tried to look for oddities.

Q: Juvenile pollock?
A: Not many. Four or five individuals found in the second year at the Eastern Shore sites.

Remote Sensing of Macrophytes of the Atlantic Coastal Zone

Glyn Sharp, Robert Semple, and Megan Veinot
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Ascophyllum nodosum, a brown floating algae (rockweed), is the dominant vegetative cover in the intertidal zone of Atlantic Canada. It is also the primary resource for an artesian harvesting industry, exceeding 30,000 landed tons per year. The need to assess the abundance and distribution of this resource has stimulated the mapping of large portions of the coastal zone for algal cover.

There are available highly refined remote sensing techniques including satellite imagery and multispectral airborne instrumentation. However, there are monetary and technical limitations to the day to day use of these methods. More practical are the use of 1:10,000 air photos flown for forestry surveys by the provincial department of Natural Resources.

To provide management of the rockweed resource, the shoreline has been divided into over 200 subsectors. Each subsector has an estimate of harvestable standing crop and annual allowable harvest. The base information is an analysis of digitized air photos involving outlining of each rockweed bed and calculation of bed area. Ground-truthing is based on transects perpendicular to the shore and sampling of the biomass at regular intervals. The average values for biomass are applied to rockweed bed areas for each sector (Figure 1). This information is not only useful for rockweed management, but is also a good quantification of a habitat type that is dominant in the intertidal area of most of the coastal zone.

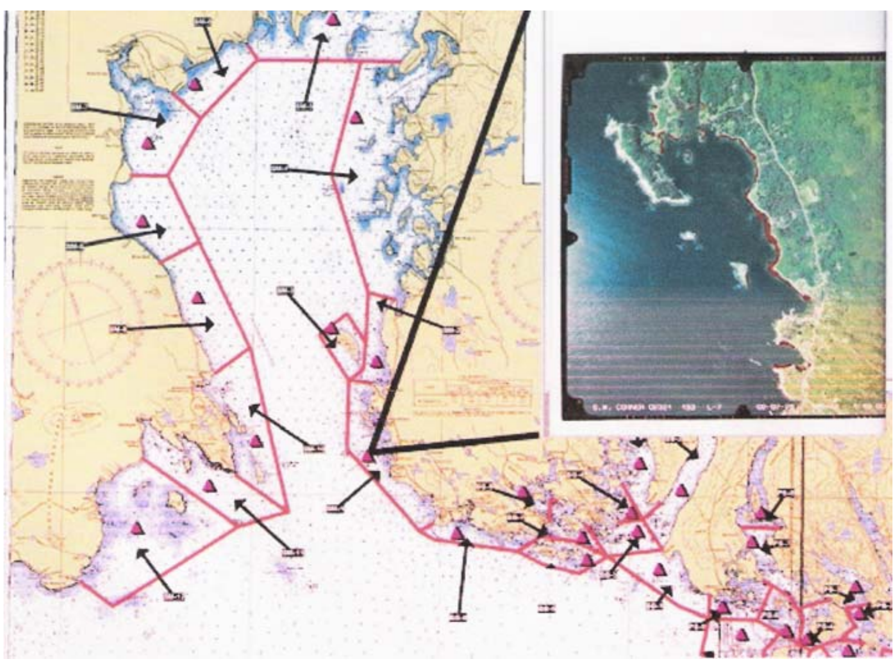

Figure 1. Sectors for rockweed management in St. Margarets Bay insert interpreted air photo.

This same method can be used retrospectively to quantify changes in habitat. The *Zostera marina* (eelgrass) beds of southwestern, southern, and eastern Nova Scotia have had dramatic reductions in cover over the past 15 years. The die off of cover has been extensive and relatively rapid. However, we have not been monitoring this habitat on a regular basis and, therefore, must look for historic or anecdotal information. Air photos again are a useful database, because there have been five series of colour photos series over the past 50 years and three over the time of the loss of eelgrass cover. Analysis of these images in selected sites of southwestern Nova Scotia has quantified changes of 44 percent to 68 percent in a 10-year period. (Figure 2)

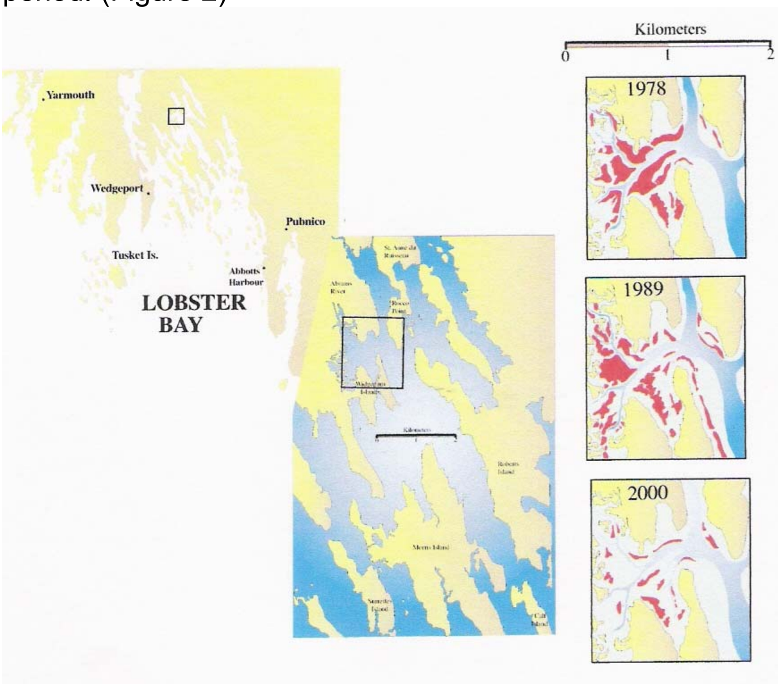

Figure 2. Three series of air photos interpreted for Zostera marina, eelgrass cover, from the Surretes/Morris Island area.

It is recommended that all air photo series that provide information on the habitats of the coastal zone be digitized and analyzed. This data should be on a publicly available data library for a range of management and research uses.

Discussion

Q: Can you differentiate *Ascophyllum* and *Fucus*?
A: No.

Q: Do you know the extent of *Fucus*?
A: Good coverage in some areas.

Q: Why is *Zostera* declining?
A: I don't know. It is likely not wasting disease. Some people think it's due to green crab, but I don't think it is likely.

Comment: There are new remotely operated vehicles (ROVs) for aerial surveys.

Q: Can you differentiate species from an aerial survey?
A: Not very well. *Fucoids*, reds, and kelps can be distinguished. The species of *Fucoids* can't be distinguished though.

Q: Anything replacing the *Zostera*?
A: Mud mostly, some *Zostera* recovery being seen.

Q: Eelgrass declines seen historically?
A: Wasting disease in the (19)40s.

Retrospective Analysis of DFO Databases for the Inshore Scotian Shelf

Jim Simon
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The two primary objectives in this analysis were to describe the distribution and abundance trends of species in the inshore area from Cape Sable to Cape North, and to explore differences between the inshore and offshore areas of the Scotian Shelf. Databases examined were the DFO summer research survey, industry surveys, and commercial landings. The DFO observer database was initially examined but the amount of inshore data was minimal.

The inshore region was defined as the area from the shoreline to the 50 fathom line, or 12 mile limit, whichever was furthest from land. The offshore area for each Northwest Atlantic Fisheries Organization (NAFO) subdivision was the remainder of the Scotian Shelf. Commercial landings from the Bay of Fundy were excluded from this analysis.

Positional (latitude, longitude) data has been available from commercial fisheries since 1990. In some fisheries, greater than 50 percent of landings had positions that were unknown in the early 1990s, but this percentage has been reduced to less that ten percent recently. This improvement has occurred in 4Vn, 4W, and 4X. In 4Vs, which has only a small inshore area, there has been little change in the percentage of landings without positional data. No positional data is available from some fisheries at all, such as the inshore lobster fishery. Knowledge of management decisions is necessary to help in understanding the temporal declines in catches in some areas, i.e., the closure of the cod and haddock fisheries in 4VsW in the 1990s.

Initially a large number of species, gears, and areas were examined. This analysis focused on fisheries that extended into both the inshore and offshore. Species examined were cod, haddock, pollock, herring, winter flounder, snow, rock, and Jonah crabs, as well as scallop, sea urchin, sea cucumber, alewife and shad. Gears examined were gillnets, longline, handline, otter trawl, traps, and drags. Due to time limitations, only a subset of the information was presented.

The number of species caught in traditional fisheries has not changed substantially since 1990, but the total number of species caught has increased from 60 to 68 over this time period. This may reflect the increase in the number of species exploited due, in part, to the developing fisheries on the Scotian Shelf.

The summer research vessel (RV) survey has been conducted on the Scotian Shelf since 1970. The survey does not sample the inshore (less than 50 fm) region except in the strata north of Yarmouth into the Bay of Fundy and off Sydney. Prior to 1995, the number of species, primarily fish, reported annually has slowly increased from less than 60 to 80. Since 1995, the number of species identified annually on the survey has ranged from 90 to 180, reflecting an increased emphasis on the identifying all species caught in the net. Prior to 1999, invertebrate species were not consistently identified on the survey.

Three industry surveys conducted since 1995 (4X Individual Transferable Quota (ITQ), 4VsW Sentinel, 4Vn Sentinel) were examined. The ITQ survey uses otter trawl gear with rockhopper footgear. Thirty-one out of 187 stations are located in the inshore area, primarily in the Bay of Fundy and German Bank areas. The 4Vn and 4VsW Sentinel Surveys use longline gear, with coverage that extends into both the inshore and offshore. The total mean weight per tow for these two surveys has shown similar declines in the inshore and offshore.

The distribution and abundance trends for a selection of species were presented for all data sources. The 2006 distribution of cod catches from the commercial landings by gear was presented for the entire Scotian Shelf. The temporal changes in the percentage of cod caught in the inshore were presented for only the longline fishery in 4X. The percentage of cod in this area has been less than 20 percent of the total catch since 1996, with little change over the series. The mean number per tow of cod from the summer RV survey was presented for 4VW and 4X. In 4X, there has been little change in the catch rate over time compared to 4VW. In 4VW, the catch rate peaked in the early 1980s, collapsed to very low levels in the late 1990s, and has remained low since. The ITQ survey catch rate has declined in both the inshore and the offshore since 1996, except for a peak in 2000 and 2001 in the offshore. The two Sentinel surveys exhibited declines in the catch rate of cod, in both the inshore and offshore. It was noted that cod are distributed throughout the inshore areas not sampled by the RV survey.

A similar analysis was presented for haddock. The ITQ survey indicated that catch rates were highest in the inshore from 1996-2000, but have been higher in the offshore since then. There were very few haddock in the inshore area of either Sentinel Survey.

The distribution of herring from commercial fisheries showed little overlap in area between gears. The catch rate series on the Scotian Shelf from the RV survey indicates that herring were uncommon until the mid-1980s, and have increased exponentially since then, extending over a wide area. The ITQ survey indicated that although herring were found throughout 4X abundance was highest inshore.

Commercial landing of snow, Jonah, and rock crab were presented. Snow crab was found primarily on the eastern Scotian Shelf with some landings near the inshore line in 4X. Both the industry and RV surveys showed similar distributions. The distribution of Jonah crab from the RV survey indicates they are wide spread in 4W and 4X. The commercial fishery is concentrated in isolated areas of 4X and near Halifax in 4W. Rock crabs were caught by the RV survey primarily in the Bay of Fundy, Browns, Middle and Sable Island banks, while the commercial fishery was restricted to Sydney Bight and the Passamoquoddy area of the Bay of Fundy.

Finally, the distribution of two anadromous species, alewife, and shad were examined. Both species are caught commercially in freshwater rivers that flow into the Bay of Fundy and southwest Nova Scotia, and no point locations are available in the database. The RV survey indicates that they are both caught primarily in the Bay of Fundy and the nearshore area of 4X. The distribution of both species is similar in the ITQ survey.

In conclusion, each of the various data sources examined have their biases, and to improve our understanding of the inshore area and its relationship with the offshore, we need to fully analyze all data sources to have as complete a picture as possible of this area.

Discussion

Q: Few haddock reported inshore because of no fish or no fishing?
A: Not saying there is no fish, just no fishing.

Q: Do some species show similarities inside or outside? Differences?
A: Nothing to show cause and effect. Some track inshore quite well.

Q: Same fish moving to different areas?
A: Could be related to different year classes going through the gear.

Spatial Scales of Variability in Nova Scotia Sea Temperatures
Aaron Retzlaff[1] and Brian Petrie[2]
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This data analysis project was an attempt to define scales by which temperatures varied with relation to distance and depth. It was hoped that this would allow for more efficient utilization of resources, in that temperature loggers could be placed a known distance and depth from one another, and could be expected to be representative of temperature fluctuations in a given area. The area was defined as that wherein temperatures from one logger were 70.7 percent correlated to measurements of another logger. This methodology was reproduced in separate areas that would represent the entire coast of Nova Scotia (except Lobster Fishing Area (LFA) 28, which was too data depauperate). The project used data collected by FSRS temperature loggers that was available in the Coastal Time Series (CTS) database. Only loggers that were relatively static in depth were used, to avoid variability caused by shifting depth loggers.

Plots of temperature versus time for each logger showed visually that the loggers were correlated with one another. The seasonal trend in temperature was thought to be capable of having an effect on the relative correlations of the loggers, and so, linear regression of temperature versus time were performed for each logger and correlations of the resulting residuals were used alongside raw data. Logger correlation was again evident in temperature versus time plots.

Symmetrical correlation matrices, as well as absolute depth difference and absolute distance difference matrices, were produced. Depth differences were largely small scale while distance matrices were not. The production of the distance matrices required “corner turning” as earth surface distances did not account for land masses between any two points (i.e., points in LFA 34 that were below Cape Sable Island compared with those in Lobster Bay).

A multiple linear regression was performed in each coastal subsection which had the general formula:

Temperature Correlation ~ Distance + Depth + Constant

This methodology allowed for assessment of what distance resulted in a 70.7 percent correlation, excluding the effect of depth and vice versa. In several cases, depth was not a significant variable in the regression, even with a loose alpha ($p = 0.15$), and so often it was excluded in favour of a distance defined model. This was likely because of a lack of variability in depth in many of the areas. For example, the LFA 27 dataset had a maximum of 18 m dispersion in temperature logger placement.

LFAs 27, 33, and 34 were analyzed separately, while LFAs 29-32 were amalgamated. This was done because individually LFAs 29-32 had very few static temperature loggers, but when combined had plentiful data for the same time period, and so could represent alongshore temperature variability.

It was found that there was a much more obvious linear relationship between logger correlation and distance than logger correlation and depth. In LFA 27, there seemed to be a tendency towards larger distance scales of variability than those seen in LFAs 29-32. Depth scales were very variable and often interpretation of them was unwarranted. It is possible that with a larger range of depths sampled, a more linear trend would be seen; however, this would not be useful in the context of this project, as deeper water measurements are not required by FSRS in many areas (LFA 34 is an exception).

Regressions of temperature correlation versus depth difference were found to often have many outliers and residual normality was typically not seen. As well, even at the minimum observed spatial distances there was often not 70.7 percent correlation between loggers, and this led to negative spatial scales that are uninterpretable.

In an attempt to reconcile this, unexplained variability in the form of standard deviation was used to describe expected degrees Celcius differences in temperature variation between loggers. This resulted in plots of unexplained temperature variance versus distance and depth. This approach did not rely on a threshold limit of 70.7 percent, but instead could interpret the maximum amount of correlation as an expected degrees Celcius difference in temperature between any two loggers. Generally, if the standard deviation of any two loggers represents their variability, and correlation represents the temperature variability of one logger that is explained by the other, then the unexplained variability between the two loggers is the degree difference that one might expect to see between them. From plots using this methodology, one can determine how far apart any two loggers should be if one were expecting a certain degrees difference in temperature regime between them. This approach is more easily interpretable than is a threshold approach, but still requires verification.

Discussion

Q: The wind drives the temperature, and in LFA 27, the coastline changes drastically. Does that affect the temperature?
A: Yes, the LFAs need to be split up more to look for residuals.

Q: Was the data collected averaged over the whole year?
A: No, the data used was only from the lobster season.

Q: Which data are you using? Is it just the FSRS data?
A: Not all FSRS data can be used. Only data between 1999-2003, where all the loggers were at the same depths, have been examined.

Q: Were there differences between the years?
A: Yes, the logger distances varied between 150 and 250 km based on the raw data.

Q: Do we need to give everyone temperature gauges then?
A: It depends on the degree of variations you are willing to accept. If a 2° Celcius difference between loggers is okay, then you will need loggers every 80 km. It all depends on the LFA and the scale of the survey.

Q: What would be the acceptable variability?
A: Way less than that.

Q: There are five years of data and by comparing each year to the other, why not see how much variation can be produced?
A: Firstly, the data needs to be examined for reliability.

Q: Can you determine whether the data you are examining is from the first stop and then just lagged as it flows from the Gulf?
A: No, only distance and depth were examined.

At-Sea Analysis of Commercial Catch in the Inshore of the Scotian Shelf: Preliminary Analysis

Nell den Heyer
Fishermen and Scientists Research Society

Understanding the distribution and abundance of species is fundamental to ecology, but in marine environments, basic data on distribution and abundance can be difficult to acquire. The most substantial source of information on the distribution and abundance of marine species is from commercial fisheries, but catch statistics provide data only on landings of fish and invertebrate species. Commercial fishing gear also captures non-target species. The distribution and abundance of bycatch contributes to fishermen's understanding of the ecology of the marine environment. Similarly, the at-sea analysis of all species caught during commercial fishing could provide valuable data on the distribution and relative abundance of a whole spectrum of species. Here, I present preliminary results of a pilot study collecting detailed morphological data on all species captured during commercial fisheries in the inshore waters of the Scotian Shelf.

Data Collection

The geographical scope of the project is the inshore area of the Scotian Shelf, from Cape North to Cape Sable Island. To ensure data collection in the entire study area, FSRS fisheries technicians, situated in the Sydney area, Halifax, and Barrington were asked to coordinate sampling with local inshore fishermen. The FSRS technicians completed sampling on 41 lobster fishing trips and 1 longline trip that was part of the 4VsW Commercial Index Survey. On each trip, data on the trip, gear, set, catch, and individual morphologies were collected. The fishing gear used was described in detail to better account for the catchability of different species. For example, data on the lobster traps included total length, wire spacing, the number of kitchens, parlours, and bait spikes, and the number, type and size of escape vents.

Biological data was collected by species at the catch and individual level. Species identification was done at-sea with the guides provided. If something could not be identified samples were frozen or pictures were taken for later identification. When seas allowed, individual and total kept and discarded weights were measured. The total weight of the catch was calculated by summing the kept and discarded weight by species. The weight of individuals that were used as bait or for personal use were recorded as kept. Any catch that was thrown back or taken for identification by the FSRS technicians was recorded as discarded. In concordance with the Industry Survey Database (ISDB) methodologies, either total length or fork length was measured in centimeters with a fish board. Lobster carapace length and crab carapace width were measured in millimeters. Maximum shell height was measured for whelks and whelk shells inhabited by hermit crabs. Maximum test diameter was measured for urchins and brittle stars. Maximum diameter, end of arm to end of arm was measured for starfish.

Data Management

We adapted the ISDB forms currently used by fishery observers. The 4VsW Sentinel Manual provides detail on these forms for the longline trip. For the lobster sampling, the ISDB forms and manual were adapted to produce the Ecosystem Research from Lobster Traps Manual. Recording the data on the ISDB observer forms went very well for the longline trip. However, there were many problems trying to record the same data from lobster traps, as each trap generated a separate catch and detailed morphology sheet. To reduce the amount of paper handled at-sea, the FSRS fisheries technicians developed a multitasking datasheet. This sheet allowed a technician to record data from a number of lobster traps on one datasheet. For the first four lobster trips, the FSRS fisheries technicians transferred the data from the multitasking data sheet to the ISDB datasheets, which were sent for key punching and editing. The transfer of data from the multitasking datasheet to the ISDB forms was error prone and time consuming. For all other at-sea sampling on lobster boats, Microsoft Excel worksheets were used for data entry of the vessel, gear, set, and catch (multitasking data sheet) information, and script was written to upload the Excel files to the DFO's Oracle database.

Results

On one longline trip with 1,200 baited hooks, 12 species of fish and invertebrates, representing four phyla, and including sea potatos (*Boltenia sp.*) and widgeon clams (*Pitar morrhuana*). Ninety percent of catch by weight was cod (*Gadus morhua*). The most common non-target species caught were cusk (*Brosme brosme*), pollock (*Pollachius virens*), and longhorn sculpin (*Myoxocephalus octodecemspinosus*).

In total, 2,554 lobster traps were sampled. Forty-eight percent of the traps sampled were in Zone 1, Cape Breton (LFA 27, 29, and 30), 33 percent in Zone 2, Eastern Shore (LFA 31 and 32), and 20 percent in Zone 3, South Shore (LFA 33). While there was a lot of variability in the configuration of traps, there was no difference between the zones. However, the season of sampling, bait, and depth differed between zones.

Forty-four species from nine phyla were caught in the commercial lobster traps sampled. Most traps caught one or two species, but some had as many as six different species. Lobster was the most common species caught by number and weight. Of the 20 most common non-target species, six were decapods, three echinoderms, three molluscs, six fish, and two algae. Notably, 23 percent of the traps sampled captured rock crab (*Cancer irroratus*), ten percent Jonah crab (*Cancer borealis*), seven percent shorthorn sculpin (*Myoxocephalus scorpius*), seven percent sea urchins (*Strongylocentrotus sp.*), and one percent caught cod (*Gadus morhua)*.

While there was some spatial variability in the species composition of decapods, echinoderms, molluscs, and fish caught, most species were found along the entire coastline. The data collected may be used to look at the distribution of species of interest. For example, the number of sea urchins caught peaked around St. Margarets Bay, and all 22 cod that were caught were east of St. Margarets Bay. Data on the length and weight of the individuals captured is also available.

Conclusions

Further analysis could compare the catch of commercial and non-commercial species with depth, and between different Lobster Fishing Areas (LFAs). The data could also be used to investigate relationships between trap design and bait and the catch of both commercial and non-commercial species. More than 20 percent of the lobster traps sampled caught decapods other than lobster. Echinoderms and molluscs were also caught in high numbers. At-sea sampling could provide valuable information on the distribution and size and length of these species. Lobster traps also catch other commercially valuable species such as cod. Monitoring of bycatch of commercially valuable species could contribute to the management of other commercial fisheries. Finally, the collection of biological data from commercial fishing platforms could be a cost effective monitoring strategy. There may be other inshore fisheries that might be valuable sampling platforms because they catch a range of species or species of interest.

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Discussion

Q: How do you catch a clam on a longline?
A: Things like whelks stuck onto the bait of the longlines. Not sure about the clams though.

Q: Why were there gaps in the data along the coast?
A: There was not much sampling done in those areas, mainly due to rough weather. The sampling was done opportunistically.

Q: Was there an effect of having lobsters in the trap on what else was caught?
A: We haven't looked at that yet. It would be nice to see the effect of what is caught with respect to the amount of time into the fishing season.
Comment: This is something we do want to look at.

Q: Was there any sampling in May?
A: There was at least one trip in May in LFA 34 (right on the border of LFA 33?). Seasonality may have a big effect on the data since we will be comparing January to June.

Q: What are the differences in species diversity within and between zones? Could variations/similarities be related to seasonality?
A: It was surprising to see a high diversity of species around Halifax, but basically the zones were similar with only slight variability.

Comment: The sampling was uneven, with more samples in Zone 1 and Zone 2 than Zone 3.

Q: Could you suggest EBSAs based on this work?
A: No.

Fishery-Independent Research – Survey Design

Alida Bundy
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This presentation gives an overview of the Fishery-Independent Survey of the inshore ecosystem of Nova Scotia, from Cape Sable to Cape North. The Fishery-Independent Survey is one of three initiatives to collect new data in the Inshore Ecosystem Project. Its objectives are to:

1. Develop base-line data for the inshore out to 12 miles/100 metres;
2. Identify and map the distribution of plants, benthic invertebrates, and fish along the coast of Nova Scotia out to 100 metres;
3. Explore latitudinal and inshore/offshore differences;
4. Capture marine biodiversity and habitat association; and
5. Identify potential EBSAs.

A working group developed the survey design to encompass the geographical range of the project area. The region was stratified into three geographical areas, Cape Breton (Zone 1), Eastern Shore (Zone 2), and Southern Shore (Zone 3), which correspond to the NAFO Divisions 4Vn, 4VsW, and 4X, traditionally used for the management of groundfish. Within Zones 1 and 2, three sites were selected for sampling, and in Zone 3, four sites were selected, making a total of ten sampling sites. The number of sites selected was a trade-off between sampling coverage and resources and time for the sampling work. Four sites were selected on the South Shore because it offered a larger number of potential sites, and one site was sampled in the summer and fall.

The criteria for site selection were accessibility, current and prior research (e.g., the coastal transect study by Moore and Miller (1983), the St. Margarets Bay research from the late 1960s), the size of bay, and the presence of sampling by the research team from Acadia University. Each site included the bay, the headlands, and, if present, the estuary (to high tide level). There was some concern about omitting the northern tip of Cape Breton, but it was justified on the basis that St. Anne's Bay has been well covered by Dr. Tim Lambert's trawl survey with the RV *Navicula*. The sample sites cover the main Atlantic coast of Nova Scotia, and sites north of Sydney towards Cape North may have greater influence from the Gulf of St. Lawrence.

Our objective was to sample as much of the ecosystem as possible, within time and resources. At each site, we used six types of sampling gear:

- FSRS lobster recruitment traps (ventless traps baited with mackerel);
- Multi-panel bottom set gillnets (200 ft, eight panels (25 ft), mesh size = 1, 1.5, 2, 2.5, 3, 4, 5, 6 inches);
- Beach seine (25 m; cod end mesh=6.3mm);
- Conductivity and Temperature at Depth (CTD) with Fluorometer (Chl a profile);
- Water sampling (for nutrient analysis: silicate, phosphate, nitrate, nitrite, and ammonia); and
- Bongo nets (220 μm and 76 μm) – vertical tows.

Two sampling designs were developed for each site:

1. Transect sampling from chartered fishing vessel – Transect Sampling; and
2. Close shore sampling from DFO *Boston Whaler* and land – Coastal Sampling.

1. Transect Sampling

The transects ran from 10 m out to 100 m depth, or to the 12 nautical mile line (whichever came first). Each line was split into three depth strata (10-30 m, 30-50 m, and 50-100 m), and two stations were randomly selected within each strata (each transect depth strata was divided by nautical mile and each mile numbered, then randomly chosen). At each station, three lobster recruitment traps and one multi-panel bottom set gillnet were set for 24 hours on Day 1, sampled the following day, set again, then sampled and retrieved on Day 3. For each species caught, total number and total weight were recorded, and detailed sampling was conducted for some species where the following were recorded: individual length, individual weight, sex, maturity, stomachs, and gut fullness. In addition, at one station in each depth strata (the first station randomly chosen) we took a CTD profile, a vertical zooplankton tow, and water samples. Between stations, ten-minute seabird surveys were conducted based on Canadian Wildlife Service (CWS) protocols and incidental sightings of marine mammals were noted.

2. Coastal Sampling

At each bay, five sampling sites were selected to represent a range of habitat types from mud to cobble. Sites were initially identified from Canadian Hydrographic Service (CHS) charts and

Google Earth, but ground-truthing sometimes resulted in a change of location. At each site, the objective was to conduct two beach seine tows, over a length of 50 m each. In practice, tows were sometimes shorter, and in some locations only one tow was possible. The time and tidal state were recorded, together with the dimensions of the tow (length, distance offshore, depth offshore), Global Positioning System (GPS) coordinates, water temperature, oxygen (O_2), water samples for nutrient analysis, and a photograph taken. Lobster recruitment traps were set adjacent to the seine site at 5 m and 10 m. At one station on each side of the bay, a CTD profile and a vertical zooplankton tow and water samples were taken.

For each species caught, total number and total weight were recorded and detailed sampling was conducted for some species where the following were recorded: individual length, individual weight, sex, and maturity. Large samples of small fish and invertebrates to weigh in the field (less than 1 g) were brought back to lab for analysis.

The following presentations present preliminary analysis of this new data collection.

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Underwater Reconnaissance and Coastal Habitat Inventory (URCHIN) Survey of the Inshore Scotian Shelf: Work in Progress

Nell den Heyer
Fishermen and Scientists Research Society

The objective of this research is to determine the distribution of fish, invertebrates, and marine plants in the inshore, in relation to habitat and bottom type using underwater video. This data will help define species distribution and habitat associations in the inshore Scotian Shelf.

Methods

Six bays were surveyed using URCHIN (Strong and Lawton 2004). These bays were chosen as focal areas for fisheries-independent sampling and the mapping of local ecological knowledge of commercial fishermen. For the URCHIN survey, representative stations within each bay were chosen based on bottom type and exposure. The combinations of bottom type and exposure sampled varied between bays, due to time constraints and the habitat availability. URCHIN is a drift camera system. Sets were chosen to maximize the depth gradient while drifting at an appropriate speed. An exposure score for each set was calculated based on the angle of exposure to the open ocean and a fetch of greater than 8 km (Moore and Miller 1983). Position information from the National Marine Electronics Association (NMEA) data was logged every 2 seconds, but distance was calculated by subsampling (every 30 or 60 seconds) to minimize the error that results from the detection limit of the Global Positioning System (GPS) (ddmm.mmm) at the very low drift speeds.

Software (Strong and Lawton 2004) was used to continuously log bottom type and record events on the boat. The Wentworth scale was used to describe sediment type as mud, sand, gravel, cobble, boulder, or ledge. A macroalga class was used when the bottom was obscured by macrophytes. Mixed habitat was indicated by alternating between classes. Comments were used extensively to identify macrophytes, fish, crabs and other invertebrates, to family or species. Post analysis of video was used to confirm fish and invertebrate identification and log additional class data on structures such as sand ripples and ridges, benthic organisms such as scallops, sea urchins and sand dollars, and pelagic organisms such as comb jellies and jellyfish. In addition, biogenenic structures such as depressions, holes, tracks, and egg masses were identified. Where possible, individuals were counted. For schooling fish, the abundance was estimated, and for benthic invertebrates that were at high abundance over prolonged periods of time, the beginning and end of the bed was identified and densities were scored. The percent of macrophyte cover were also estimated.

Results
In total, we completed 55 sets or drift tows and recorded 26.5 hours of video of 27.8 km of bottom. While URCHIN is equipped with lights for use in deeper waters, backscatter compromised the quality of the video. The maximum depth of the survey was 48.2 m. Most sites are highly exposed. Thirty-seven percent of the bottom type surveyed was sand, 13 percent was mud, 13 percent boulder, 13 percent macroalga, 9 percent cobble, 8 percent ledge, and 6 percent gravel. More than seven species of fish and at least 23 invertebrate species were recorded. We also saw pieces of traps, wood, and a large number of moonsnail egg masses.

A full analysis of this data has not been done as we are still formatting the class data. A preliminary analysis of the individual fish and invertebrates (Event data) seen in Port La Tour shows more cunner (*Tautigolabrus adspersus*), pollock (*Phollachius virens*), sea potatos (*Boltenia sp.*), sponges (*Haliclona oculata*), and horse mussels (*Modiolus modiolus*) in deeper, more exposed hard bottom areas, and more lobster (*Homarus americanus*), moonsnails (*Lunatia heros*), and crabs (various) in sandy, shallow, sheltered sites. Also notable, we observed tentimes more moonsnail egg masses than moonsnails.

Conclusions
There is more work to be done with this data. We need to analyze the class data (structures, benthos, and pelagics) and calculate density based on distance of good quality video. This data will allow us to answer questions about habitat and community associations within, and across, bays. Specifically, are there particular benthic communities associated with bottom type, shoreline type, and exposure? Can we use these associations to scale-up to the whole bay? Are there differences among bays in species composition, habitats, and habitat associations?

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Discussion

Q: There were many rock crabs caught in the traps but few were observed using URCHIN. Where were they?
A: It is difficult to see rock crabs, particularly on complex bottoms. They need to move to be visible.

Q: What time of day were the surveys done?
A: They were all done between 8:00 am and 6:00 pm, with the majority of the videos done between 10:00 am and 2:00 pm (i.e., midday surveys), although more individuals may be observed at night.

Comment: Rock crabs and lobster move around more at dusk, so many were probably missed.

Q: Why was no sampling done at night?
A: The lights create too much backscatter.

Q: Could you see the camera from the boat? Were the engines cut or idled while filming?
A: In shallow water, you could see the camera from the boat. The engines were in idle while the boat drifted.

Q: Did you notice any animals avoiding the camera?
A: It is possible that animals were moving away from the camera (fish were observed with the sounder but were above the view of the camera). Interestingly, a large school of small fish was observed following the camera.

Comment: Both rock crabs and moonsnails burrow into the sediment, so they may have been missed that way.

Comment: The lobster recruitment traps sample by day and night, while the video is only a day survey. It may be interesting to compare the two methods.

Comment: Urchins were so abundant in some areas; they were part of the background and better represented in the class data.

CTD Observations Taken During the Inshore Ecosystem Project

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As part of the Inshore Ecosystem Project conducted during the summer and fall of 2006, Conductivity and Temperature at Depth profiles were taken at five stations along each of ten inshore-offshore sections spaced along the coast of Nova Scotia from Cape Breton to Cape Sable (Sections 1-10).

Most profiles were sampled with a Seabird model 19 CTD equipped with a Chelsea Minitracka fluorometer. Water samples were taken and filtered for chlorophyll on days when they could be returned to Bedford Institute of Oceanography the same day that they were collected. These samples were used to calibrate the fluorometer. Chlorophyll is an important food source for nekton. In order to characterize the food availability at each station, chlorophyll was integrated over the whole profile to give the total chlorophyll per square meter of bottom (INTCHL). Care must be taken in interpreting chlorophyll data, especially data spread over several months. The reason for this is that phytoplankton abundance is known to be very patchy with the major production of the year taking place during a period of very rapid growth in spring, known as the spring bloom. This bloom lasts for only a week or two, and the timing can vary by over a month from year to year. Factors affecting the timing of the bloom include sunlight, wind, temperature and rainfall/runoff. Nearly all sections showed significant increases in INTCHL toward the seaward end of the lines usually at the fourth station. Part of the explanation for this lies in the fact that the offshore stations are deeper, and, thus, offers more water column for growing plants.

Since stratification is important in regulating nutrient supply to the surface layer and in holding the almost neutrally buoyant phytoplankton in the high light surface layer, the density difference (DD) between the top and bottom of the CTD profile was calculated and plotted. An increase in stratification in the offshore direction was generally seen. This is partially due to the inability of wind mixing to mix the water column all the way to the bottom.

Other parameters calculated to characterize the inshore-offshore gradients include the maximum and minimum temperatures in the water column. These will also give information on stratification and the presence of Gulf of St. Lawrence outflow water. This water is the supply for the Nova Scotia Current (NSC) and its presence is usually indicated by very cold water at the surface or mid-depth very near the coast. The NSC flows from east to west.

Finally, sea surface salinity (SSS) was plotted since it is a good indicator of fresh water runoff, which occurs in most bays. Salinity, along with temperature, are the two factors affecting stratification. SSS generally showed a slow increase in the offshore direction, as would be expected.

When looking for long-shore gradients, data from the most offshore stations were plotted, since data from the shallow inner stations had little correlation from one end of the province to the other. This data clearly showed that SSS increased from east to west. It also showed that the DD decreased from east to west. This should increase the nutrient supply in the west, which should also increase the food supply. The INTCHL does not show a clear pattern, which is not surprising given the difference in the timing of the sampling and the time scales for phytoplankton growth. The NSC is known to affect nearshore stratification, but this study, which has the most dense along-shore sampling to date, shows clearly that it is the major factor. This is the major outcome from this study. Clearly more effort needs to be made to study factors affecting the strength of the NSC. There is an annual cruise in the Gulf to predict ice cover and this, along with numerical models for the Gulf and Shelf, could be used to predict variations in the NSC.

Data from Station 2, 15 nm off Halifax Harbour and part of Atlantic Zone Monitoring Program (AZMP) sampling, is shown to demonstrate the strong seasonal signal in CTD data from this area. The only station in this study to be sampled more than once is St. Margarets Bay. This data also shows a strong seasonal signal. Any future program should take this into account and possibly integrate with the AZMP sampling.

Discussion

Q: Does the AZMP have limitations as to where they can do CTD's regarding depth?
A: They are currently done on the Hudson, so they are unable to get profiles of anything shallower than 50 fm.

Q: Does the inshore have less chlorophyll because it is shallower?
A: Yes, because the offshore has more water to grow the phytoplankton.

Nutrients, MEQ, EOARs and EBSAs

Phil Yeats
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Descriptions of nutrient distributions in inshore waters that would be useful for EOARs have generally been based on rather large ecosystem dynamics projects or long-term ecosystem monitoring projects. For the Atlantic coast of Nova Scotia, we have studies of at least two years duration for Bedford Basin, Ship Harbour, Whitehead Harbour, St. Margarets Bay, Woods Harbour, Sambro and Mahone Bay. Data from these studies can be used to assess winter nutrient concentrations, nutrient ratios, timing and extent of nutrient depletion, extent of eutrophication; all useful indicators of ecosystem health. Winter nutrient concentrations give a measure of the nutrient supply for the spring phytoplankton bloom and also an opportunity to investigate interannual trends. Deep water nutrient concentration increases in summer and fall are a measure of eutrophication, an important factor for ocean management and assessment of the robustness of potential EBSAs.

Knowledge of nutrient dynamics generated by these larger projects has been used to develop a traffic light Marine Environmental Quality (MEQ) framework for the assessment of the nutrient health of inshore waters that makes use of smaller datasets. The framework is based on two premises: 1) maximum nutrient concentrations seen in inshore waters will be determined by wintertime surface concentrations in the adjacent coastal waters, and 2) uptake and regeneration of nitrogen and phosphorus will be determined by the Redfield ratio. Potential environmental management thresholds are based on expected natural background concentrations based on these premises, and the Canadian Council of Ministers of the Environment (CCME) marine water quality guideline for oxygen. Data collected in the Inshore Ecosystem Project, as well as other data in the BioChem database, have been assessed using this framework and green, yellow and red areas identified as shown on these two maps (Figures 1 and 2). The surface distribution map is used to identify areas with additional inputs of nutrients. It shows mostly background (green) concentrations with a few isolated occurrences of yellow and red. The exception is Sydney Harbour where there is a high density of yellow and red, presumably reflecting input of nutrients in sewage discharged to the harbour. The second map shows concentrations in bottom waters in fall. Red areas on this map are indicative of eutrophic conditions that could result from additional inputs (e.g., Sydney Harbour), or a natural tendency for eutrophication because of reduced circulation behind sills.

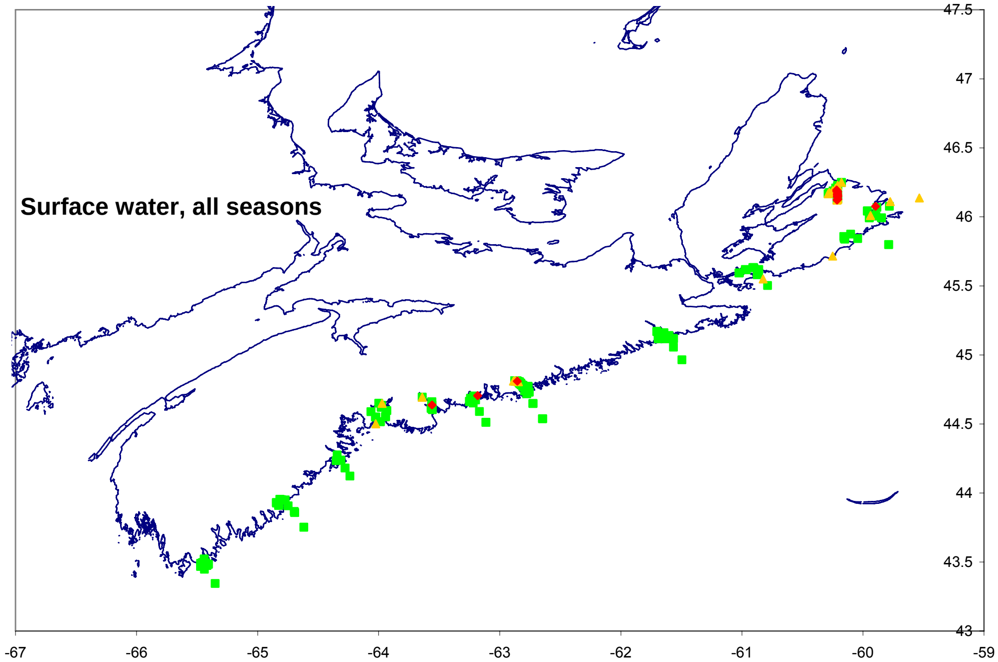

Figure 1. Surface water, all season.

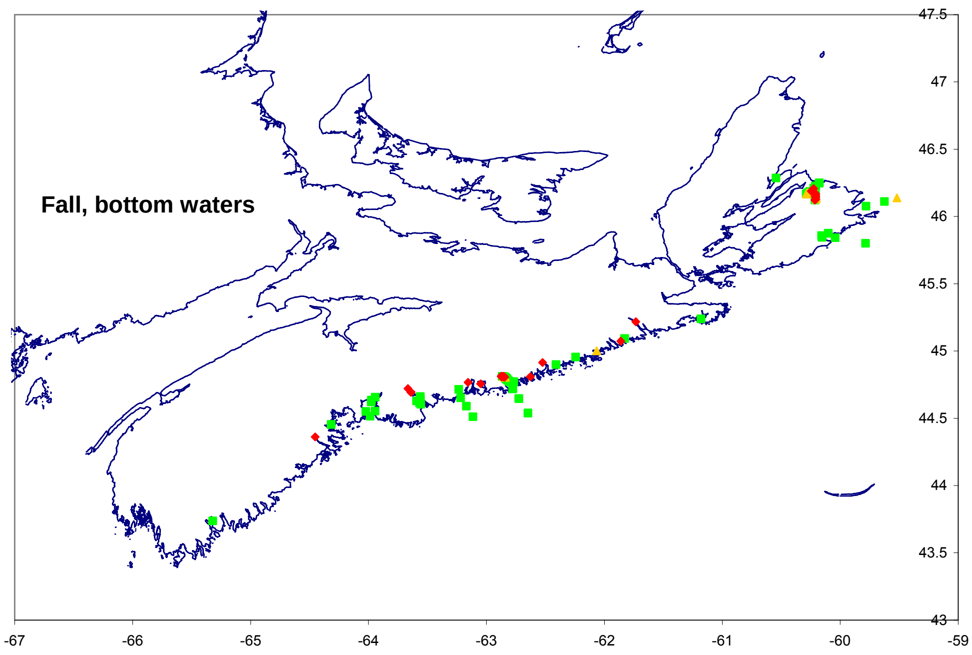

Figure 2. Fall, bottom waters.

Discussion

Q: With this red light definition, how often do you expect to find red locations?

A: Harbours with sills will probably have them. Management will have to determine what this means. Lower oxygen levels to limit biological action may be natural. Not sure how management will deal with it.

Comment: Maybe if an EBSA has eutrophication it should be a stronger candidate?

Zooplankton Community Structure in Ten Nova Scotia Bays

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The objective of this study was to see if, and how, zooplankton community structure varies among bays along the Nova Scotia coast.

Zooplankton were collected at up to five stations per bay along transects running out of each of the ten bays sampled during the inshore survey of summer 2006. Bongo nets fitted with 70 or 200 μm mesh were towed vertically from the bottom to the surface. Only results of the 200 μm mesh tows are reported here. Samples were counted using the AZMP protocol, and the data were analyzed using PRIMER 5, a software package that compares community composition among samples.

When all stations were included in the PRIMER 5 analysis, they did not group geographically (into different bays) or according to sampling month, although there was partial grouping by depth. There were samples taken in St. Margarets Bay in July, September, October and November, and when just these data were included in the PRIMER 5 analysis, the stations separated more according to sampling month than to depth, with the copepod *Acartia* being the most abundant genus in July and the copepod genera *Centropages* and/or *Oithona* becoming more important in September-November. This suggested that differences in the timing of sampling along the coast might have confounded our observations of community structure and suggested that stations should be grouped according to sampling month in the PRIMER 5 analyses. When this was done, stations in bays to the west of, and including, St. Margarets Bay, which were sampled in July, showed no clear geographic separation, although the most easterly bay (St. Margarets Bay) separated from the most westerly bay (Port La Tour) and there was also partitioning of the stations by depth. When stations in Chezzetcook and bays farther east, which were sampled in August/September, were included in the analysis they showed no clear geographic separation and grouped better according to depth.

Community compositions at stations from the three most easterly bays (Mira Bay, Gabarus Bay, and St. Peters Bay) were compared with those from three most westerly bays (La Have, Port Mouton, and Port La Tour), and in this analysis there was distinct separation between the eastern and western groups of stations. This separation also corresponded to the difference in sampling months (July versus August/September) however, so that it was unclear whether geography or sampling month was more important. Partial separation by depth was also evident in this comparison.

On average, over all stations copepods accounted for less than 75 percent of the zooplankton, with the next most abundant categories (cladocerans, appendicularians, and jellyfish) together accounting for another 14 percent. Comparison of the ten most abundant taxa, averaged over all stations for a given bay, showed that while some taxa (e.g., *Oithona spp*.) were found everywhere, others had more restricted distributions. Thus, the copepod *Calanus finmarchicus* was only found at the three farthest west bays. *C. finmarchicus* is an offshore shelf species, which migrates to deep waters in summer. Its abundance in the western bays in July might have been due to greater advection of offshore water into these bays compared with those in the east, or because they were sampled in July when *C. finmarchicus* would have been more abundant offshore than it would have been in August/September. The copepod *Acartia spp*. was only abundant in St. Margarets Bay in July, but its overall abundance was skewed by the results from one station, at which it was exceptionally abundant. The copepod *Temora spp*. was abundant at bays to the east of, and including, St. Margarets Bay. Its abundance in the eastern bays in August/September might have been due to a greater contribution of Nova Scotia Current water in these bays, relative to those in the west; *Temora* is very abundant in the Gulf of St. Lawrence, the outflow from which contributes significantly to the Nova Scotia Current. Alternatively, however, the relative abundance of *Temora spp*. in the eastern bays might be reflecting its annual cycle; the abundance of this genus varies with temperature and is maximal in September/October.

In this study, zooplankton community structure varied with depth, with time of year in a given bay (St. Margarets Bay), and geographically (among bays). We could not, however, determine if the observed geographic differences were due to differences in the timing of sampling in different regions, or to differences in the influences of different water masses (e.g., offshore versus Nova Scotia Current). Further analysis (e.g., of hydrographic data and zooplankton time series data at the fixed time series station outside Halifax Harbour (HL2)) might assist in making this determination.

Discussion

Q: Did you compare the new data to the old St. Margarets Bay data?
A: Two days was not enough to check it out.

Q: Is there a way we could use fishermen to get the samples?
A: I'm not sure.

Q: What is the best time to sample?
A: We'd like to have this done in the same month.

Q: Can it be done in the spring?
A: Yes.

Q: How was the depth integrated?
A: Bottom to surface.

Q: What about the distance from the shore?
A: Haven't analyzed, from 5 m to 100 m in depth.

Q: Was there any crustacean larvae observed?
A: Possibly, I don't remember. It did not make up a large population and wasn't among the ten most abundant.

Fishery-Independent Research – Preliminary Results Fish and Invertebrates

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Between the months of July and November, each of the ten sampling sites (Table 1) were sampled once, and St. Margarets Bay was sampled again in the fall by both the inshore sampling team (September and November) and the transect sampling (see Fishery-Independent Research Survey Design, Alida Bundy, for details of the sampling design and method).

Table 1: Sample sites and sampling details.

			Transects		Inshore	
Zone	Site	Month	Traps	Gillnets	Traps (# of stations)	Beach Seine (# of sets)
1	Mira Bay	August	Y	Y	2	5
1	Gabarus Bay	September	Y	N	2	2
1	St. Peters	August	Y	Y	5	5
2	Country Harbour	August	Y	Y	5	5
2	Ship Harbour	August	Y	Y	5	5
2	Chezzetcook	August	Y	Y	2	5
3	St. Margarets Bay	July	Y	Y	5	5
3	La Have	July	Y	Y	5	4
3	Port Mouton	July	Y	Y	5	5
3	Port La Tour	July	Y	N	5	4
3	St. Margarets Bay	October	Y	N	N	N
3	St. Margarets Bay	September	N	N	5	5
3	St. Margarets Bay	November	N	N	5	5

At least 99 species were caught in the survey. The beach seine caught the greatest diversity of species (60) and the inshore lobster traps the least (22). The total catch and the catch per trap in weight by the traps were greater than the catch by the beach seine or gillnet. However, the beach seine caught the largest number of species.

Table 2: Summary and comparison of catch results for the four survey gears.

Trip Type	Gear	Weight (Kg)	Number	Average weight of individual	Weight per trap or net	Number per trap or net	Number of species
Charter	Trap	1,945	14,129	0.138	4.9	36	36
	Gillnet	210	1,196	0.176	2.3	0.5	41
Inshore	Trap	1,458	7,378	0.198	5.6	28	22
	Seine	85	50,616	0.002	0.85	506	60
Total		**3,698**	**73,319**				**99**

Beach Seine Results

Sixty species were caught across the ten sites, but herring (*Clupea harengus*) and Atlantic silversides (*Menidia menidia*) dominated the beach seine catch by both weight and numerically. Species composition varied within sites and between sites. No species were found at all sites, but sand shrimp (*Crangon sps.*), green crab (*Carcinus maenas*), and the threespine stickleback (*Gasterosteus aculeatus aculeatus*) were caught in nine of the ten sites. These species were not in high abundance, in contrast to pelagic species such as herring, Atlantic silversides, and northern sand lance (*Ammodytes dubius*), which were common and abundant at most of the ten sites. It was suggested, that as with the results presented by Shannon O'Connor (see Greenlaw et al. this volume), it is likely that the catch varies more with habitat type than with the site.

Inshore Lobster Traps

The inshore lobster traps were very effective at catching decapods, and, in particular, lobster (*Homarus americanus)* and rock crab (*Cancer irroratus*), which were caught at all sites, and accounted for 90 percent of the catch by weight and 75 percent in numbers. Other decapods caught were green crabs, Jonah crabs (*Cancer borealis*), and hermit crabs (*Paguridae*). The other 17 species accounted for less than one percent of the catch.

Transect Lobster Traps

In contrast to the inshore lobster traps, the transect traps caught a more diverse catch of 36 species. This reflects the greater depth range covered by the transect, along which these traps were set (10-100 m). The top four species in the catch by weight were rock crab, snow crab (*Chionoecetes opilio*), lobster, and toad crab (*Hyas sps.*); and by number were rock crab, snow crab, wave whelk (*Buccinum undatum*), and toad crab. These species were abundant and caught at all sites. Cod (*Gadus morhua*), longhorn sculpin (*Myoxocephalus octodecemspinosus*), and shorthorn sculpin (M*yoxocephalus scorpius*) were less numerous, but caught at nine of the ten sites. Visually, there are no clear latitudinal patterns in species composition across the sites but there is a clear gradient from the inshore to the offshore: lobsters and rock crab are within 10-30 m depth zone; rock crab, whelks, and fish in mid-depths (30-50 m); and toad crab and snow crab in deeper water (50-100 m). This pattern was consistent with the exception of the two most southerly sites, Port Mouton and Port La Tour, where very few, or no, snow crab and toad crab were caught. The Port La Tour to Port Mouton area thus likely marks the southerly extent of their distribution. At these sites, fish were caught at the deeper sets. Sea urchins and lobsters were generally caught in the shallow zone, whereas brittle stars (*Ophiuroidea*), purple starfish (*Asterias vulgaris*), and whelks (*Buccinum sp.*) were caught in the 30-50 m depth zone.

Gillnets

When interpreting the results of the gillnet sampling, two caveats must be borne in mind: (1) variation in the way that the gillnets were set, and (2) the nets were set at randomly chosen stations within each depth zone, and thus were variable in their suitability as fish habitat. As a result, catches were variable and low overall. Given these caveats, the data from the gillnet sampling offers some insights into fish distribution. Over 40 species were caught, and unlike the other gears, no single species was dominant. Ninety percent of the catch by numbers was made up of ten species: rock crab, red fish (*Sebastes sps*), cunner (*Tautogolabrus adspersus)*, herring, cod, longhorn sculpin, shorthorn sculpin, sea raven (*Hemitripterus americanus)*, sea lilies (*Crinoidea*), and pollock (*Pollachius virens*). There is no consistent pattern from west to east, but there was a detectable gradient from the inshore to the offshore. The distribution of crabs matched the trap data: rock crabs were caught in depths of 10-30 m; toad crab 50-100 m. Some fish were distributed across all depth zones (cod, shorthorn sculpin, longhorn sculpin, pollock, silver hake, and herring), cunner, sea raven, and alewife (*Alosa pseudoharengus*), while winter flounder (*Pseudopleuronectes americanus*) were only caught in the 10-30 m depth zone. Mackerel were not caught in the deepest zone, whereas redfish were mainly caught in the deepest zone. Few invertebrates were caught, but sea lilies were only found in deep water.

Common Patterns Across Sampling Gears?

When the total catch of each of the gear is compared across the sites, it is evident that there is no one site that is clearly more productive than the others (Table 3). Similarly, there is no one site with high species diversity (total number of species) common to all gears, although for the inshore and transect lobster traps, St. Margarets Bay had the highest species diversity. Note that the gillnets had higher catch rates and species diversity in La Have, indicating that La Have may be an area of greater abundance of some fish species. Some caution should be exercised in interpreting these results since the sites were sampled in different months (see Table 1).

Table 3. Comparison of sites with the highest catch rates and species diversity across the four survey gears.

Gear	Site with highest catch rate	Site with greatest number of species
Beach Seine	Country Harbour	Port Mouton
Inshore Lobster Traps	Mira Bay	St. Margarets Bay
Transect Lobster Traps	Gabarus Bay	St. Margarets Bay
Transect Gillnets	La Have	La Have, Mira Bay, St. Peters

Preliminary Conclusions

Each of the gears used in the survey gives a different perspective on the inshore, in terms of species caught, diversity of species caught, and their abundance. Nets catch a greater diversity of species than the traps, while the traps catch a greater biomass than the nets. The ten sites appear similar with respect to the trap data, but there are differences in the beach seine and gillnet data that require further analysis to tease out. There are likely greater within bay differences than between bay differences in the beach seine data. There are clear inshore-offshore gradients evident from both trap and gillnet gear. Next steps include using multivariate analysis methods to explore similarities/differences among sites, and to link differences to environmental and other variables.

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Discussion

Q: In terms of fishery-independent and at-sea surveys, can the results of the different surveys be compared (for economic reasons)?
A: It hasn't been done yet, but it is a good idea. It would also be nice to come up with a more efficient sampling design.

Q: Has the data been normalized with respect to bottom and habitat types?
A: Not yet, but this is planned for future analysis. Marine plants were recorded when they came across them, so it would be nice to examine the data with respect to their presence.

Q: There appears to be no single areas or hot spots important to a single species or biodiversity. Would it be possible to say each station is representative of 100 km of coast?
A: This is a fair comment. Site by site comparisons have not been done on the species level; however, some species were replicated over different gear types.

Q: How does this information relate to the EBSAs process? Is it too preliminary?
A: It is too preliminary at the moment. When we have completed our data analysis, we will be in a better position to comment on the implications of the fishery-independent sampling for identification of EBSAs. In the end, we will say what has been found or not found.

Comment: There is too much data for only Alida Bundy to analyze, so others are welcome to help. Also, the data should be used, and not just kept in a database.

Q: At the planning meeting, it was mentioned that the gillnets were going to be different sized mesh. Was this the case?
A: Yes, there were eight different mesh sizes ranging from 8 inch to 1 inch.

Inshore Ecosystem Research Project – Seabirds

Carina Gjerdrum
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Data on the distribution and abundance of marine birds in Atlantic Canada are required in order to identify and minimize the impacts of human activities at-sea on birds. However, data for the inshore Scotian Shelf are patchy, and very few surveys have been conducted since 1980. As part of the Inshore Ecosystem Project, baseline information on the distribution and abundance of fish, invertebrates, and marine birds was collected along transects at ten locations on the Scotian Shelf in the summer of 2006. I report here on the results of the seabird surveys.

Methods
Seabird sightings were recorded by trained seabird observers following a standardized protocol (Environment Canada 2006). Surveys were conducted while looking forward from the bridge, scanning ahead to a 90 degree angle from either the port or starboard side, limiting observations to a transect band 300 m wide from the side of the platform. A series of ten-minute observation surveys were conducted, regardless if birds were present or not. Observations were not conducted when visibility was poor (i.e., when the entire width of the 300 m transect is not visible due to rain or fog). Binoculars were used to confirm the species identification, and other details such as age, moult, or fish-carrying. Flying birds were not recorded continuously throughout the ten-minute period, as this would overestimate bird density. Instead, they were counted using instantaneous counts, or "snapshots", at regular intervals throughout the observation period. The number of snapshots conducted depends on the speed of the platform.

Results
Between 10 July and 17 October, 98 surveys were completed along 11 transects from Port La Tour to Mira Bay. St. Margarets Bay was surveyed twice (10 July and 17 October). All surveys were conducted during gear-setting activities in order to minimize the attraction of birds to the vessel.

We counted a total of 279 birds within 300 m of the vessel in all surveys combined, which represented 14 different species. The herring hull (*Larus argentatus*) was the most common species encountered (32 percent), followed by the great black-backed gull (*L. marinus*) (19 percent). These are the two most numerous species breeding on the coastline of the Scotian Shelf. The greater shearwater (*Puffinus gravis*), a species which breeds in the southern Atlantic, made up 15 percent of the birds counted. The double-crested cormorant (*Phalacrocorax auritus*) and northern gannet (*Sula bassanus*) accounted for 9 percent and 8 percent of the species observed, respectively. Although the double-crested cormorant is breeding in the study area during this time period, the northern gannet breeds further north off the coast of Newfoundland and in the Gulf of St. Lawrence. The northern gannets observed on our surveys were all juveniles; these are non-breeding individuals that are not tied to breeding colonies and which move to southern wintering grounds earlier than adults (Brown 1986). The black guillemot (*Cephhus grille*), which breeds at a number of sites in Nova Scotia, was the only alcid species observed (6 percent). Other species observed in small numbers include common loon (*Gavia immer*), sooty shearwater (*Puffinus griseus*), Wilson's storm-petrel (*Oceanites oceanicus*), common eider (*Somateria mollissima*), red and red-necked phalarope (*Phalaropus* *fulicaria* and *P. lobatus*), black-legged kittiwake (Rissa tridactyla), and common tern (*Sterna hirundo*).

Regional and Temporal Variation

We found some evidence that birds were more abundant at the most southern (Port La Tour) and northern (Mira Bay) transect locations. This variation may be related to the transects' proximity to the Bay of Fundy in the south and Cabot Strait/Laurentian Channel in the north - highly productive and dynamic habitats relative to the shelf. We found no evidence, however, of any systematic variation in species diversity or composition across regions or across sampling dates.

Historical Context

Seabirds at Sea Database. Pelagic seabird surveys have been conducted throughout Atlantic Canada since the 1960s, under the program PIROP (*Programme Integré de Recherche sur les Oiseaux Pélagiques;* Brown et al. 1975; Brown 1986; Lock 1994), but very little data have been collected since 1992. Although survey methods varied throughout this time period (all birds were counted during surveys before 1984, while only those that occurred within 300 m of the vessel were counted after 1986), we can use the historical information to compare general trends in species abundance and composition with the results obtained from the recent inshore surveys.

In the inshore study area, 636 surveys were conducted between July and October from 1969 and 1990. Over 12,000 birds were recorded, representing 39 species and 11 families. Gulls and terns were the most common birds encountered, followed by shearwaters and storm-petrels. The results from our summer 2006 inshore surveys are consistent with the historical data in terms of species composition. We found some evidence that bird abundance (average number of birds sighted) was greater in the most northerly portion of the inshore area, consistent with recent survey results. Historical surveys also indicate higher species diversity in the north. Species typical of Newfoundland occur more often in this region compared with the rest of the Scotian Shelf (for example, black-legged kittiwakes and alcids) for reasons probably related to the breeding habitat and the physical and biological oceanography of the area. The data from the recent inshore surveys did not reflect this same regional trend in species diversity.

Atlantic Region Seabird Colony Database. The colony database is another source of information that can contribute to our understanding of the inshore ecosystem. More than 380,000 individuals of 14 species are estimated to breed on coastal islands or isolated mainland sites on the Atlantic coast between Cape North and Cape Sable Island. The commonest species by number of colonies are herring gull, great black-backed gull, terns (*Sterna spp.),* and cormorants (*Phalacrocorax spp.),* which are distributed along the entire coastline. Common eider colonies are more concentrated along the eastern shore and southwest coast. Not unexpectedly, these species are also the most common in terms of population size with the exception of the Leach's storm-petrel (*Oceanodroma leucorhoa*), which constitutes the most numerous species breeding on the Scotian Shelf coast (over 200,000 individuals), but is found at only a few colony locations. Although colonies are ubiquitous along the coast, most are small (fewer than 1000 individuals).

The colony database can also contribute information on the areas that are important to species at risk. There are currently six avian species at risk, listed under the Species at Risk Act (SARA), which are found in the nearshore area of the Scotian Shelf. Two are listed as "Endangered": roseate tern (*Sterna dougllii*) 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*). Roseate terns have several breeding sites in the inshore area, but significant numbers are concentrated at just a few sites such as the Brothers, Country, and Quoddy Islands.

Future Data Needs

Although surveys such as the ones conducted this past summer are essential for gathering current information on the inshore environment, they will need to be repeated over multiple seasons and over multiple years given the highly mobile nature of the birds. It is difficult to describe the full extent of the avian community based on single surveys. The pelagic and colony databases maintained at Canadian Wildlife Service (CWS) can provide context for the recent surveys, as they contain information spanning 30 years or more. It should be noted, however, that very little pelagic seabird data has been collected since the early 1990s, and almost no data exist for the southern extent of the study area and very nearshore environment. CWS has recently developed a Pelagic Monitoring Program for Atlantic Canada with the objective of mapping the relative abundance and distribution of birds throughout the region. Although much effort will be focused on the offshore, this program will also contribute new data for the inshore, including the study area of the Inshore Ecosystem Project.

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Discussion

Q: Was anything you observed surprising to you?
A: No, we did not observe any birds that we did not expect to find.

Q: There was a focus on pelagic birds, but why was there no shore monitoring?
A: Shore monitoring was not in the scope of the project, although some areas (i.e., headlands) are used for monitoring sea bird migrations. For example, counts from shore are done annually by volunteers during the Christmas Bird Count in December.

Q: What is special about Country Island and Bon Portage Island that make them good for bird colonies?
A: Both Bon Portage Island and Country Island are offshore, away from heavy human disturbance and free of mammalian predators. Therefore, the islands are safe for the burrowing birds (i.e., storm petrels). Country Island is treeless, providing the right nesting habitat for the terns. Both must also be in the vicinity of good foraging grounds.

Q: Why do you not see higher bird abundance in the northern surveys, as seen in the historical data?
A: The current data are a "one-shot" sample and may, therefore, not adequately reflect the abundance in the area. More samples may show a similar trend.

Comment: Bon Portage seems to work as a stop-over before birds head to the mainland.
A: It is more relevant to song birds.

Q: Is there seasonal variation within the historical and current data? Do you see different species at different times of year?
A: Our surveys were done in the summer and comparisons with the historical data were confined to the same season. We found that species composition within this season are similar between the historical and current data. However, because these birds are migratory, we see shifts in the species using the inshore from season to season.

Comment: Many of the EBSAs identified through the SEO process are based on bird data and it would be interesting to compare the empirical bird data with these SEO EBSAs.

Comment: The seabird communities appeared to be similar up and down the coast, but it is necessary to be weary of gaps. Just because there is nothing there, means that it has yet to be surveyed, so we don't know what is there.

Q: What about piping plovers?
A: Yes, there are good data on piping plovers – we know where they nest and how successful they are. I am not sure how these data will contribute to the inshore EBSA designations.

Pilot General and Targeted Surveillance Program for Tunicates in Nova Scotia

Jean-Marc Nicolas
Ecosystem Research Division, Fisheries and Oceans Canada, Bedford Institute of Oceanography

Tunicates, also known as ascidians or "sea squirts", are a type of Aquatic Invasive Species (AIS), which pose a serious threat to the marine ecosystem in Atlantic Canada, as well as the shellfish harvesting and aquaculture industries. Once established in a new habitat, it is very difficult and expensive to control tunicates, especially in a bay with aquaculture and boating operations (fishing and recreation), which can further increase tunicate numbers by providing attachment structures in the water column, and spread their distribution through inadvertent transportation. The solitary tunicate *Ciona intestinalis*, present in Nova Scotia, but whose origin is unknown, is now a prominent fouling species causing significant problems for the mussel aquaculture industry since 1997, by overgrowing mussels, reducing yields, and increasing costs of harvesting and processing mussels. On the South Shore of Nova Scotia and on Isle Madame, *C. intestinalis* or "vase tunicate" has been found on several mussel farms as heavy foulants in increasing numbers. More recently, it was also found in the Montague River, Brudennel River, and St. Mary's Bay in Prince Edward Island, where it compounds the problem that the mussel industry is already experiencing with other tunicate species, the clubbed tunicate *(Styela clava)*, the violet tunicate (*Botrylloides violaceus)* and the golden star tunicate *(Botryllus schlosseri*). The latter two tunicates form colonies and are thus considered as a greater challenge for the shellfish industry to deal with. They are also found in Nova Scotia. Another colonial tunicate, *Didemnum sp*., recently found on Georges Bank but also present in coastal waters on the east coast of the United States and on the west coast of both the United States and Canada, has drawn attention since it spreads rapidly and fouls marine habitats and man-made structures. It also overgrows benthic organisms, including scallops, mussels and oysters, and as such threatens aquaculture, fishing, and other coastal and offshore activities.

Following the Canadian Action Plan to Address the Threat of Aquatic Invasive Species, approved in September 2004 by the Canadian Council of Fisheries and Aquaculture Ministers (CCFAM), funding became available in July 2005 for an AIS Program. The goal of the program is to conduct targeted research and provide strategic science advice to help reduce the introduction and spread of AIS through prevention, early detection, and rapid response mechanisms. One of the two AIS projects conducted at the Bedford Institute of Oceanography is part of the Case Study of Tunicates in Maritime Canada.

In the case of the vase tunicate (*C. intestinalis*), information provided through a mussel grower questionnaire survey (Nova Scotia Department of Agriculture and Fisheries) has given a sketchy knowledge of their distribution in Nova Scotia. Local population explosions have been reported in southern Nova Scotia, around Lunenburg/Mahone Bay, and in southern Cape Breton. These hot spots are separated by hundreds of kilometers, and several mussel farms located in between these hot spots have reported no tunicates.

A survey program was implemented in 2006 to determine the extent of the distribution of tunicates around the coast of Nova Scotia. Specially designed collectors were deployed at over 60 geo-referenced stations selected for their proximity to a risk factor (ports, marinas, aquaculture leases, and processing plants). A first set of collectors was deployed at the end of May. These were retrieved and preserved in August, and a second set of collectors was deployed which was retrieved in October and November. A third set was left in place from May to October/November. At each deployment/retrieval, temperature, salinity, conductivity, and oxygen concentrations were recorded.

Of the five tunicate species monitored in this study, *Styela clava* and *Didemnum sp*. were not identified at any of the stations at any sampling time. The remaining three species, *Ciona intestinalis*, *Botryllus schlosseri,* and *Botrylloides violaceus* displayed patchy distributions. The golden star tunicate (*Botryllus schlosseri*) had the widest distribution range and was present at almost 70 percent of the sampling stations. In contrast, the violet tunicate (*Botrylloides violaceus*) was only present at less than 20 percent of the stations, and the vase tunicate (*Ciona intestinalis*) was identified at 38 percent of the stations. In general, the densest colonization of collectors was found during the second deployment (late summer, early fall). Our results also confirm the existence of areas of infestations of *C. intestinalis* and *B. schlosseri*. Furthermore, this study is the first report of the presence of *C. intestinalis* in two areas: Sydney Harbour and Meteghan-Digby.

Acknowledgements

Benedikte Vercaemer, Dawn Sephton, Jean-Marc Nicolas, Stephanie Howes, Andrea Locke, Thomas Landry, Andrew Bagnall, and Jason Mullen.

Discussion

Comment: For such a broad-scale survey, you may wish to contact various educational institutes to do some field work for you.

A: We initially wanted to go to the media but this requires Ottawa's approval, which we have been waiting on for several months.

Q: What is the life history of these tunicates? How long is the larval stage? How do they spread?
A: The larval stage is from 1 to 1 ½ day for *Ciona* and they are transported by vectors. They are hermaphroditic and the larvae are positively buoyant due to a mucus film. If there is no current, they just settle back down on to the adults. They typically live two years.

Q: Why do some areas have a higher density than other areas? These areas appear to correlate with anoxic areas?
A: These animals are very tolerant and can withstand near-anoxic conditions for hours. However, they did not look at conditions of where they were found.
Comment: The areas have high nutrients and low oxygen, allowing for a high abundance of tunicates.

Q: While snorkeling in five metres of water, I saw a goldenstar tunicate encroaching on an eelgrass bed. Are there any diving groups keeping an eye for these species?
A: Not at the moment, but there will be more effort placed this year in community outreach and to try to get people to report sightings. They would like to speak to dive clubs, but so far, the only divers to report are those around aquaculture sites.

Q: Is there any evidence of die-offs?
A: Severe winters are main factors for die-offs, but they do not seem to be enough to slow down the colonization process, since the young still recruit and grow the next year.

Q: Are there any ways to mitigate the effects of the tunicates?
A: In Prince Edward Island, the mussel and oyster growers have developed equipment that pulls their lines in and sprays them with vinegar although it is still unclear why vinegar works. There has also been some work on a high-pressure system to treat mussel lines.

Q: Are any native tunicates being displaced?
A: These tunicates have been around for 100-200 years, but it has only been in the past few (7-8) years that the conditions have been right for a population explosion. It is unclear whether the organism(s) that used to control them has been lost, or if it is other factors contributing to the population boom. New Zealand had a similar problem, but it seems to be clearing up on its own.

Q: Since they are filter feeders, do they eat anything, like waste from the mussel cages?
A: It is primarily a handling problem for the mussel farms since even at a high level of fouling, the mussel meat yield is unaffected. An area in Chester Basin even stopped mussel farming for a year to see if there would be a decrease in tunicates, but there was no difference.

Comment: Mussels eat big plankton while tunicates eat picoplankton.

Q: In terms of outreach, is something being seen that is not being reported? Is there something the fishermen can do?
A: Tunicates do better in sheltered, dark environments. There can be a significant larval settling from one week to another, and they require something stationary for approximately seven weeks to settle on and grow enough to be able to identify; therefore, fishing gear would not likely show much growth.

Comment: We can help with outreach and tell others about the invasive tunicates.

Mapping Eelgrass with Side Scan and Video

Herb Vandermeulen
Ecosystem Research Division, Fisheries and Oceans Canada, Bedford Institute of Oceanography

Aerial mapping methods (airphoto, CASI, satellite sensors) typically cannot penetrate turbid coastal waters past depths of about 5 m below chart datum. Important deepwater macrophyte habitats are not routinely “seen” by these methods, even though marine plants can grow at 10 m or more. Costly and intensive ground-truthing and image analysis can help to rectify this situation, but the question then becomes a matter of time and cost compared to other mapping methods.

This talk will cover cost effective acoustic and video methods for mapping eelgrass to sub-metre precision.

Discussion

Q: Based on just video, how easy is it to quantify with increased speed of tow?
A: We developed a three-point abundance scale for our sea cucumber and Ulva surveys, which was easily resolvable at a tow speed of about two knots. You need to use side scan for smaller scale. Greater speed may be more difficult to quantify, it depends on the question being asked.

Q: How difficult is it to tell side scan interpretation without video?
A: We keep the gain setting on the instrument fixed at eight decibels, so we have a consistent reference point. Mud versus hard bottoms show up clearly. Sand has increased reflectivity and can be confused with eelgrass. You need the video to ground-truth.

Q: What are the depth limitations?
A: We’ve had it working in less than a meter with a 30 m max. More expensive equipment, such as a product called Yellowfin, can reach depths of 50 m.

Nova Scotian Shore Grey Seal Pup Survey

Damian Lidgard
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Introduction

The population size of grey seals on Sable Island has shown an exponential rate of increase since 1962, when surveys began. Although a recent aerial survey (2004) suggests that this rate of increase may have declined, there has been a growing interest in the possibility of breeding colonies developing along the Nova Scotian shore due to the limitations of space and food at Sable Island. A verbal questionnaire was designed to collect information from fishermen on the location and size of breeding colonies along the Nova Scotian shore. These data were used to design an aerial survey to provide a more accurate assessment of pup production in this region.

Methods

A verbal questionnaire was designed to collect information from fishermen on the location and size of grey seal breeding sites along the Nova Scotian shore. The following questions were asked:

- Where have you seen grey seal pups?

- When did you see them?
- How many did you see (less than 10, 10-100 or more than100)?
- What type of habitat where they seen on?
- Are there sites where you use to see pups but no longer do?

Based on the results of the questionnaire, a helicopter survey was conducted along the coastline between Brier Island (44° 16' 00" N - 66° 21' 57" W) and Cape North (46° 53' 04" N - 60° 30' 21" W). All of the sites identified by the questionnaire as potential grey seal breeding sites were surveyed.

Results
Between January 2005 and October 2006, 149 fishermen were interviewed either by phone (83) or in person (66). The data collected from the questionnaire provided a reasonable coverage of the Nova Scotian shore from Cape North to Yarmouth. According to the questionnaire, the largest grey seal breeding colonies were located at Noddy Island, Cape Sable, and the inshore islands off Ecum Secum and Scatarie Island (Figure 1). The aerial survey was conducted over four days, 11, 28, 30, and 31 January 2007. The survey identified five breeding colonies: Noddy Island, Flat Island, White Island, Bowen's Ledge, and Hay Island. The minimum estimate of pup production was 2,923 with 87 percent of pups born at Hay Island.

Conclusion
There was a poor correlation between the results of the questionnaire and those of the aerial survey; many of the sites identified as breeding sites by the questionnaire were found not to have pups or adults during the aerial survey. This is likely due to fishermen giving details on adults sighted rather than pups, and providing data on sightings outside of the breeding period. The aerial survey identified five breeding colonies, the largest being at Hay Island, Cape Breton. However, many potential breeding sites were observed. These data will be used as a baseline for future surveys to document the changes in the size of the breeding population along the Nova Scotian shore.

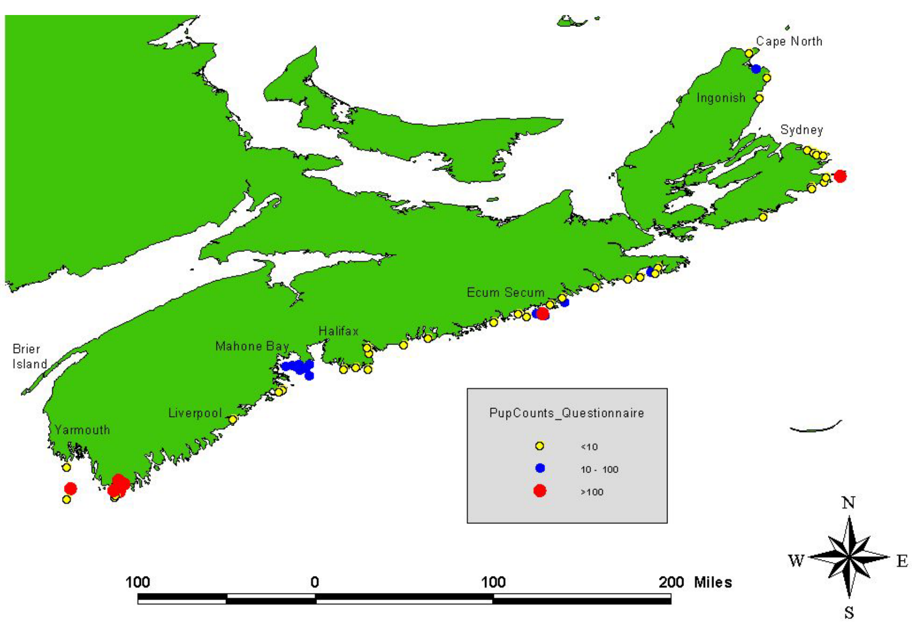

Figure 1. A map of the Nova Scotian shore showing the location and size of grey seal breeding colonies identified from the questionnaire.

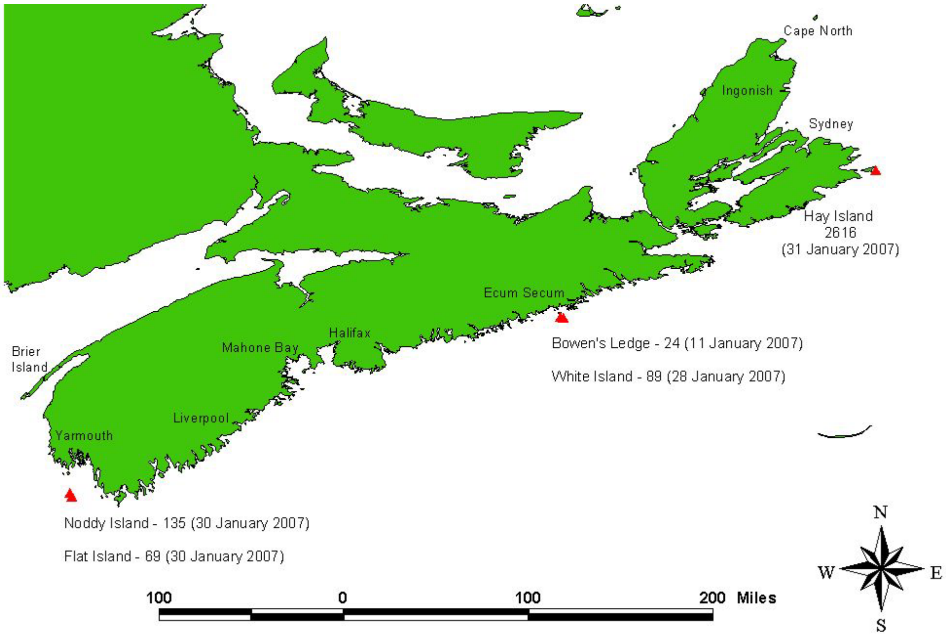

Figure 2. A map of the Nova Scotian shore showing the location and size of grey seal breeding colonies identified from the aerial survey.

Acknowledgements

Jim McMillan, Don Bowen, Fishermen and Scientists Research Society, and commercial fishermen.

Discussion

Q: What is the pup production on Sable Island?
A: An aerial survey was conducted in January 2007, and the results of that survey will be known later this year. However, based on recent counts and population growth approximately 46,000 pups are likely to have been born in 2007.

Q: How do you know that the seals are an overflow from Sable Island?
A: Fisheries and Oceans Canada has conducted a series of branding programs on Sable Island since the 1960s. In recent years, several branded adults have been observed breeding at sites along the Nova Scotian shore.

Q: In previous surveys, have they seen the same colonies?
A: Yes, some of the breeding colonies have been established for some time, for example, Bowen's Ledge and Hay Island. Overflow from Sable Island might be contributing to the pup production at these colonies.

Q: Do these colonies get harvested? That could have an effect.
A: Noddy Island had at least 65 pups taken this year, White Island had 20 pups taken, and approximately 20 were taken on Hay Island. Harvesting pups at smaller colonies (i.e., several hundred pups) is likely to have an effect on the population growth rate but several factors, e.g., pre-wearing mortality, rate of immigration from other colonies, makes it difficult to estimate the extent of the effect.

Local Ecological Knowledge (LEK) Survey

Alida Bundy
Population Ecology Division, Fisheries and Oceans Canada, Bedford Institute of Oceanography

One part of the DFO/FSRS Inshore Ecosystem Project that is on-going is the LEK Survey of commercial fishermen. The objectives of this component of the project is to map fishermen's local knowledge of the distribution, seasonal changes in abundance, and life history and habitat associations of fish, invertebrates, birds, mammals, and macrophytes based on fishing histories and practices in the inshore ecosystem. Fishermen are also being asked to identify ecologically and biologically significant areas. These maps will complement the Fisheries-Independent Survey and At-sea Catch Analysis components of the project. This LEK component of the project will further our understanding of the inshore ecosystem with the additional information that fishermen accrue during their daily observations at-sea, across different season and over the course of years. Thus, in addition to the snapshot that we have obtained from the field projects, the LEK Survey will add longitudinal data, that is, changes that have been observed by fishermen over time.

A rigorous two-tiered approach developed by Davis and Wagner (2003) was used for the LEK Survey. The objective of this approach is to first identify who, among the fishermen in each area, are considered to be the very knowledgeable about the ecology of their area (a local expert). This was achieved through the Tier I telephone survey that asked commercial inshore fishermen to identify up to three fishermen particularly knowledgeable about the ecology of their fishing grounds. The second tier (Tier II) is an open-ended face-to-face interview with the peer-identified experts.

The LEK Survey was conducted in the ten areas sampled in the Fishery-Independent Survey, plus Cape North in northern Cape Breton (Table 1). The survey was stratified by area, and within each area, a random sample was drawn from the total number of licence holders fishing inshore species (e.g., lobster, herring, mackerel, clam, marine plants). The random sample was equivalent to 20 percent of the licence holders in each area, and was checked to ensure that it was broadly representative of the different fisheries in the area. The Tier I telephone survey has four parts and takes approximately 20 minutes to complete.

The Tier I phone calls are complete for all areas except Port Mouton, and the list of experts have been developed. The experts named in the Tier I surveys were ranked by the number of times that they had been nominated, and whether they were named first, second, or third. A minimum criteria was used whereby an expert had to be nominated at least two times.

Due to time constraints, Isle Madame/St. Peters and Port Mouton will not be included in the Tier II surveys at this stage.

Table 1. The nine areas of the Tier I phone surveys, the fishing (licensing) districts and number of fishermen with licences from fisheries that are predominantly inshore for each area. The minimum sample size of 20 percent of the licence holders and the number of surveys completed is reported. The Tier 1 surveys were not completed in Port Mouton at this stage.

Area	District	Licence holders	Number of interviews required	Completed
North Cape Breton	1	149	21	27
Gabarus and Mira Bay	7	256	51	49
Isle Madame/St. Peters Bay	8/9	70	14	19
Country Harbour	16/17	75	15	17
Chezzetcook and Ship Harbour	20	230	46	46
St. Margarets Bay	23/25	149	30	30
La Have River	27	94	19	22
Port Mouton (not completed)	28	206	41	12
Port La Tour	31	314	63	55
Totals		**1,543**	**308**	**277**

The second part of the LEK Survey, Tier II, consists of face-to-face interviews with six of the identified experts in each area. These Tier II interviews take between two and seven hours and are often completed in two sittings. This work is ongoing and should be completed by 31 March 2007. There are ten sections to the interview – see presentation for details. During these interviews, the fishermen are asked to draw on photocopies of nautical charts to indicate information such as spawning areas, nursery areas, migration routes, areas of high abundance, and areas of significance. This data is then mapped digitally, and will form part of the final report. All fishermen who have participated in the project will receive a copy of the final report.

The information from the LEK Survey will feed into the EOAR and into the definition of preliminary EBSAs.

Acknowledgements

Nell den Heyer, Patty King, Penny Doherty, Denise McCullough, Shannon McCormick, Janelle Kennedy, Patricia Gonzalez, Jennifer Doucette, Dawn Robia, Rebecca Goreham, Caroline Cameron, Alain D’Entremont, Sandy Lahey, Christine MacKenzie, and commercial fishermen.

Discussion

Q: How difficult was it to find participants to cooperate and take the survey?
A: It depended on the area. Some areas have 50 percent refusal rates, while others were at 15 percent. FSRS technicians had an easier time phoning because they have local connections.

Q: How confident are you that you are getting the best areas? Perhaps they wouldn’t be willing to share their favourite fishing spots.
A: I’d be lying if I said I was completely confident in all our information; however, most fishermen were pleased with the study and were willing to participate.

Q: Were most fishermen still fishing or retired?
A: Most were older fishermen. I haven’t looked, in detail, whether they were still actively fishing.

Comment: Fishermen are more forthcoming when dealing confidentially with DFO Science. Also, females get more cooperation.

Comment: All data from fishermen is confidential and some interviews were taped. Tapes will be destroyed in two years.

Comment: This is a great effort by Alida Bundy. Maybe providing the information back to the fishermen with anonymity would be a good idea, so that others can verify what is true and what is not.

Comment: Once the report is written each participant will receive a copy.

Comment: They'll also receive a hat.

SECTION 2 – PLENARY

Summary of Plenary Discussion Resulting from Breakout Group Discussion

Participants were split into three groups and asked to discuss the following questions:

1. How does this new information compare with our understanding of the inshore ecosystem? Is there anything unexpected?
2. What have we learned about the biodiversity of the inshore? Are there recognizable gradients?
3. Can this data help identify areas that are ecologically or biologically significant or degraded? How?
4. Can this data help identify Ecologically Significant Species? How?
5. Is this kind of data collection useful for monitoring the inshore?
6. Research needs?
7. Lessons learned?
8. Other discussion points?

The breakout groups were followed by a plenary panel discussion where one member of each group reported back to the plenary. Each question was discussed in turn by the panel members, followed by a general discussion. This discussion (Appendix 3) is summarized below.

<u>Question 1. How does this new information compare with our understanding of the inshore ecosystem? Is there anything unexpected?</u>

Based on the information and analyses presented at the meeting, all the groups agreed that this information compared well with what is known about the inshore Scotian Shelf, such as species gradients from the northeast to the southwest, but that this was the first time that it had been put together for the whole area. Younger participants, however, learned more about the inshore ecosystem, such as the influence of the Nova Scotia Current, which was nicely demonstrated in Ed Horne's presentation (Horne, this volume). It was expected that ocean hydrography would affect the community structure along the coast, but the seasonality was hard to distinguish from this effect. However, the analysis is still in its early phase and it will be interesting to explore the data for patterns in species distribution in relation to habitat type and exposure of the different sites.

Having said this, there were unexpected results from the Inshore Ecosystem Project, such as the results that sea lilies (*Crinoidea*) only occurred at stations in the deepest strata (50-100 m) of the fisheries-independent transect survey. Shannon O'Connor's conclusion (Greenlaw et al. this volume) from her beach seine survey of juvenile fish, that small bays have higher diversity than large bays, is also new. It will be interesting to see if the IEP results confirm this finding. Some were surprised at the presence of snow crab so far south, and others were surprised that so few pollock were caught in the survey, although pollock are known to spend their first one to two years inshore. Other than bird breeding colonies, there did not appear to be any hot spots of species diversity of numbers.

<u>Question 2. What have we learned about the biodiversity of the inshore? Are there recognizable gradients?</u>

There is an obvious shallow to deep (inshore/offshore) gradient in physical parameters (e.g., temperature, salinity, chlorophyll) and in species composition, but further analysis is required to explore the alongshore gradients for marine plants, invertebrates, fish, and birds. Habitat type was important with respect to species diversity, and data should be analyzed with respect to habitat, including features such as exposure, bottom type, and physical processes such as tides. Furthermore, the data should be examined with regard to the home ranges of species (e.g., inhabitants, migrants, exotics) found in the inshore, and incorporate this into the score of biodiversity importance at the species level. For example, if you remove the exotic species, how does this affect our interpretation of biodiversity?

The question of seasonality was raised in response to this question and the last. Sampling began in July on the South Shore and ended in Cape Breton in early September, thus sampling occurred at different times across the sites. This does raise issues of comparability. For example, the catchability of lobster is related to molting and changes during the summer. When comparing catches from one site to another, the time of sampling needs to be taken into consideration.

<u>Question 3. Can this data help identify areas that are ecologically or biologically significant or degraded? How?</u>

The groups agreed that the analysis presented did not provide a basis for identifying EBSAs. No area stood out as having a higher abundance of species, or greater diversity, or as particularly unique. It was noted however, that the project collected data as baseline information for longer-term work. It is a snapshot in time, and may be useful in identifying areas as potential EBSAs for further research. However, other data such as the physical oceanography data and data on larval retention and juvenile habitats may also be used to identify significant areas (e.g., seal pupping areas). Also, areas with increased production (e.g., Lobster Bay) may represent significant areas. Although a goal of the project was to sample the entire ecosystem, there were gaps in the data collection (e.g., the infauna, forage fish), which may have an affect on defining EBSAs or degraded areas.

The term "degraded" is a temporal reference, which led to much discussion including the need for historical data (as a baseline), and the value of identifying reference sites throughout the area (e.g., west of Shelburne, east of Cape Breton) and recognizing general patterns for analysis.

Water chemistry suggests natural stress in some areas (e.g., sensitive areas that should be identified). Degradation of water chemistry suggests that some places are stressed but not necessarily through anthropogenic sources. It may be preferable to use a term like "Areas of

Sensitivity" (e.g., Ship Harbour and eutrophication). The nutrient MEQ framework presented by Phil Yeats (Yeats, this volume) is potentially useful for identifying both naturally sensitive areas and degraded areas. The identification of degraded areas may possibly help to determine significant areas.

Question 4. Can this data help identify Ecologically Significant Species? How?

There was considerable debate concerning this question and two of the three groups did not think that we could identify Ecologically Significant Species. Much of the discussion centered on what ESS are, and there was no unanimity within or between groups. Loosely, ESS are species with a particular tropho-dynamic role, or species that structure the ecosystem. There is a DFO initiative to identify ESS in Canada's five Large Ocean Management Areas, and a CSAS document is available (http://www.dfo-mpo.gc.ca/csas/Csas/status/2006/SAR-AS2006_041_E.pdf). Key trophic roles include forage fish, highly influential predators, and nutrient importing/exporting species.

The new data collected during the Inshore Ecosystem Project does show the ubiquitous distribution of a number of abundant species such as rock crab, herring, and eelgrass that might be considered ecologically significant due to their tropho-dynamic role (rock crab, herring) or their structural role (eelgrass). There may also be data on keystone species whose loss would result in a catastrophic change to the system. The project did not explore the ecological role or function of a particular species and, thus, definitive statements about ESS cannot be made on the basis of the project's findings alone. Additional information is required, such as their structural or trophic roles. The results from this project can be used to direct future research, such as modeling or empirical research, into the role of potentially ESS, and to explore the impacts of their loss. It was also noted that due to the scale and seasonality of the project, some things that were not well sampled in this survey may be significant and will be missed.

Rock crab were suggested as a potential ESS because of their role both as prey for lobster and as a predator. They were abundant and found at all sites. Furthermore, rock crabs contain an enzyme used by lobsters for reproduction (information from Carl MacDonald); therefore, they could be considered an important species. Invasive species may be ecologically significant due to the displacement of native species (e.g., green crabs, *Codium*).

Overall it was agreed that further research is required to identify ESS.

Question 5. Is this kind of data collection useful for monitoring the inshore?

This question evoked resounding agreement among the three groups: the project was considered a good start, providing useful baseline information for a variety of purposes. For example, the survey identified a number of exotic species, which could be used to monitor long-term changes. A suggestion was made that the data be used to identify primary indicators for specific components of the ecosystem.

The following caveats were noted: the scope of the project is limited by, (a) the sampling gears used, and (b) the lack of seasonal sampling. It may be best to try out some other sampling methods such as drop nets, hoop nets, or smaller baited traps. A clearly stated purpose would focus the sampling on particular components.

Question 6. Research needs?

A number of research needs were identified by the groups.

Further Analysis of the Data Collected

- Need to link species distribution with substrate type (this is in the process of being analyzed).
- Further analysis of the present data should consider the depth and coastal/midshore/offshore gradients. When does the inshore become the offshore?
- Could break down the data not just on depth, but also on water mass that may be identified from the CTD data that suggested a break around about Station 4.
- Exposure is important and should be brought into the analysis of the present data – may be able to collaborate with the researchers from Acadia University (Shannon O'Connor, Michelle Greenlaw, and John Roff).

Future Research

- Some of the key issues to answer are catchability and availability of species, and why they change with the time of year.
- Areas which appear pristine (i.e., water quality and no indication of stress), have a value as reference points for assessing the impacts of human activity in more populated areas (e.g., Halifax Harbour, Lunenburg); creating a possible human impact gradient.
- Linking and collaborating with other institutes and research groups to enhance capacity for research, and to identify when research could be done by other groups.
- There is little or no information on suspended particulate organic matter (POM) and its availability as food for coastal organisms.
- Substrate type needs to be ground-truthed with bottom grabs.
- Develop low-impact sampling methods, especially important for protected areas that may limit the type of sampling permitted.
- Information regarding nutrients, suspended particles, and their size range should also be examined.
- There should be a focus on predator-prey studies (e.g., crustaceans).
- From the initial surveys, small areas should be identified for intense research over the long-term. A discussion of the possibility of long-term research along the coast may involve a multi-platform for many aspects of ecosystem research, including working with fishermen.
- This information is necessary for determining protected areas and reserves. Further identification of habitat types is required to determine their importance. Faunal identification is also important for habitat studies. It is also important to identify important spawning sites for species along the coast. It may be preferable to have fewer stations but more seasonal data, and to check whether the bays are acting as retention areas for benthic larvae. Also, it may be beneficial to revisit some of the stations to see if there is any annual change in the ecosystem. Long-term monitoring to look for annual changes.
- Research focused on key species that we think are Ecologically Significant Species.
- To what degree do we need to understand the role of a species, before we can move on to studying the distribution of key species? How do you identify significant species? This research was driven by Ocean Action Plan (OAP) funding for EBSAs; should OAP be defining our research focus in the future?

Question 7. Lessons learned?

The importance of a standardized protocol along the coast was emphasized, particularly with respect to timing. The sampling design should have considered seasons, or at least dissociated season and area, so that not all the sampling was done in the same area at the same time of year (e.g., south shore in July, eastern shore in August, etc.). However, it was noted that the project was conducted with a limited budget that did not allow for repeat sampling at all the sites. One site (St. Margarets Bay) was sampled three times by the inshore sampling team and twice by the transect team to try and capture seasonable variability, at least in one site.

For future research, it would be wise to revisit gear types and consider alternative sampling methods. One suggestion was the use of small research trawls that would reduce soak time, and reduce the time spent on each trip. Furthermore, more intensive sampling in fewer places might be considered.

Question 8. Other discussion points?

It was agreed that there is a lot of value in this project and that it provides a very good reference point for future research. It was suggested that it was unique and that for the first time people were focused solely on the inshore ecosystem. Then the pragmatic issues of how this type of work can be continued and the need to communicate with others in addition to DFO Science were raised. The FSRS is interested in continuing to do ecosystem research in the inshore and fostering stewardship, and linking up with community based groups may provide further opportunities. Informing the public is important and there are specific programs or funding that could partner in this kind of work (e.g., Atlantic Coastal Action Program (ACAP)).

The use of this data for designating Marine Protected Areas was raised and there are clear connections. John Roff and Shannon O’Connor (Roff and O’Connor, this volume) elaborated on this in their presentation that followed this discussion session.

Again the physical oceanographic data for the inshore (Horne, this volume) was highlighted as valuable information for defining the inshore, and for separating nearshore from offshore. Furthermore, stratifying the data analysis to nearshore (10-15 m from shore), midshore, and offshore may help identify longitudinal further gradients, and significant areas may appear with further analysis.

SECTION 3 – CONCLUSIONS

Workshop Conclusions: External Perspective on Data Synthesis

John Roff and Shannon O’Connor
Acadia University

For the conclusion of the Inshore Ecosystem Project Data Synthesis Workshop, we were asked to provide an external perspective on the presentations, lessons learned, and the overall project. We present here our comments on the workshop as a whole, and the future objectives or plans for the project as it moves into Phase 2.

The majority of the workshop objectives were accomplished, as the preliminary results for each component of the project were presented, reviewed, and discussed. However, the synthesis of the results is still very preliminary, and no concrete plans for how to continue this process have been formalized. The comparison between new data and our previous understanding of the nearshore was largely confirmatory, with many findings following previously understood patterns. A comprehensive exploration of these biodiversity gradients requires further calibration between the physical factors and the biological communities. Most participants agreed that at this stage, data collection and analysis is too premature to be able to identify EBSAs. Yet, the project has progressed enough to pinpoint degraded areas in the inshore ecosystem. The data amassed through this research will provide a valuable baseline for any future studies and monitoring in the area. As well, there is substantial potential in this work to expand into community based monitoring programs.

This first phase of the Inshore Ecosystem Project has functioned as a “look-see” regarding the inshore environment, with an emphasis on the EBSA agenda. The research has aided in determining the distribution of marine plants, invertebrates, fish, and other organisms. It has also provided baseline data on the biotic communities, nutrients, and chemical characteristics in the inshore. However, these data are presently very patchy and scattered across the study area. We are still in the data acquisition and exploration stage; as such, no integration of the different project components has been made. In addition, there is still confusion surrounding the rationale for sampling; the reasons for choosing specific species and techniques were unclear.

The current emphasis is on “What do we know?” and “What have we got?” In Phase 1, we have been able to amalgamate inventories of the ecosystem structures at the species level, as well as some information on the habitat and ecosystem levels. Only a limited interpretation of the habitat processes (e.g., nutrients, temperature, and salinity), and no interpretation of the biological processes at the ecosystem level, has occurred. There are still components of the biodiversity spectrum that have not been accounted for.

To determine which other components should be added in the next steps, a clear idea of where the project should go needs to first be outlined. The first goal should focus on synthesising and interpreting the data further, as well as integrating all the components of the study. An assessment of the needs for the inshore ecosystem, and for what gaps in understanding this data can, and should, fill needs to be addressed. A clear grasp of how this work fits into the ecosystem-based management agenda, and what conservation and/or management opportunities can come from this information should be outlined. In other words, to focus future work, clearly defined goals and objectives need to be stated and fundamental questions outlined.

An important consideration in the whole process would be to determine how this project fits into the larger context of conservation and management of the inshore ecosystem. This work needs to be incorporated into the existing protected areas and management programs presently occurring in the inshore, as well as specify the role of each component in the overall agenda of ecosystem-based management. The conservation of distinctive areas in this ecosystem are clearly covered in the DFO mandate for EBSAs; however, representative habitats, or those habitats that make up the majority of ecosystems, are largely ignored. This research can provide valuable information for the identification and description of representative habitats. Perhaps under the mandate of ecosystem-based management, the Inshore Ecosystem Project can inform conservation and management practices for representative habitats. In general, an overall framework and plan for the Inshore Coastal Zone is needed to direct further research and inclusive marine conservation efforts in the area.

Workshop Conclusions: The Editors

Alida Bundy
Population Ecology Division, Fisheries and Oceans Canada, Bedford Institute of Oceanography

This workshop provided the first opportunity to explore and discuss the data and preliminary results produced by the DFO/FSRS Inshore Ecosystem Project. Data from the various project components provide a valuable baseline spanning the geographic breadth of the inshore Scotian Shelf. It can be enhanced by further sampling and used as reference for future studies.

The analysis and synthesis of these results is still in its early stages, but already we can see some patterns emerging in the data and between the project components. In general, the data are consistent with what is already known about the inshore. The CTD data emphasize the role of the Nova Scotia Current in the inshore, and demonstrate cool water temperatures and the increase in salinity, and decrease in stratification from east to west. There is no apparent cline in species richness or productivity (catch rate) from east to west, though this might be expected given the results from the CTD analysis. The preliminary analyses of the biotic data indicate no systematic alongshore variation for zooplankton, invertebrates, fish, or seabirds. Although the data suggest that Port La Tour is less species rich than the other sites, this may be an artefact of sampling. There are a few exceptions: the southerly limit of snow crab and toad crab occurs around the Port Mouton - Port La Tour area, and sea lilies and the black-spotted stickleback occurred in catches only to the east of Chezzetcook.

We are more likely to see patterns in species distribution in relation to habitat type, exposure and other physical and biological environmental data during the next phase of the data analysis. For example, preliminary analysis of fish and invertebrate communities identified by the survey URCHIN survey for Port La Tour showed differences between high and low exposure sites. Differences in abundance and species composition with exposure within bays were also evident in the preliminary analysis of the beach seine catch and the multivariate analysis of the beach seine data from the Acadia study (Greenlaw et al. this volume). When looking at biodiversity, we will explore different measures of biodiversity and relate it to sampling effort.

The CTD, FSRS recruitment trap and gillnet results from the Fishery-Independent Survey indicate inshore-offshore trends in water properties and biota. Increasing depth, integrated chlorophyll, stratification, and salinity is accompanied by changes in species composition. Taken together, these data suggest that there are three zones within the 12 mile limit, to be confirmed by further analysis: the coastal fringe (0-10/15 m); mid-depths (10/15-30/40 m) and offshore (40 m plus). Identification of depth zones, and their associated habitats and biota, would help structure integrated management and future research on the ecology of the inshore Scotian Shelf.

As many species are ubiquitous, these results suggest consistency in community composition and diversity along the inshore Scotian Shelf at the broad scale. At this early stage, the results emphasise the representativeness of the areas sampled rather than any unique or distinct qualities. As noted by Roff and McCormick (this volume), conserving representative areas is also important, and the results of the Inshore Ecosystem Project can inform conservation and management practices for representative habitats. Further data analysis and synthesis may identify potential EBSAs, particularly when the results of the LEK Survey, the SEO exercise, and empirical data are considered together. None of the bays studied stand out as degraded. The nutrient MEQ framework is potentially useful for identifying both naturally sensitive areas and degraded areas. The project can help us discriminate ecological significant species, but further research to identify Ecologically Significant Species and their functional role in the ecosystem is required.

The IEP contributed to the monitoring of pelagic sea birds and invasive tunicates along the coastline, and supported a thorough data analysis to optimize the monitoring of bottom water temperatures using the FSRS Recruitment Project temperature minilogs. Historical distributions of marine macrophytes were analyzed with aerial photography, and potential technological improvements to collect data on macrophytes at depths that cannot be assessed by aerial photography were explored. The DFO-FSRS collaboration on the Inshore Ecosystem Project included an informal LEK Survey that was used to design the aerial survey of new grey seal pupping areas along the coast of Nova Scotia and an on-going two tiered survey of commercial fishermen to map local ecological knowledge.

This is just the beginning of this analysis and there is great scope for further work. Here we have focused mainly on the results of the individual project components. In addition to completing the analysis of these components, next steps include integrating the results across components such as the At-sea Catch Analysis, the DFO database and the Fishery-Independent Survey, comparisons with historical data, and comparisons of fishery-independent results with results from URCHIN. When the LEK Survey is complete, we will have three types of knowledge about the inshore Scotian Shelf: local expert knowledge, science expert opinion, and empirical data. How do they compare? The LEK studies will add an historical dimension, which, together with the retrospective analysis of DFO databases and other previous research, may increase our understanding of the inshore ecosystem of the Scotian Shelf. The DFO/FSRS Inshore Ecosystem Project has provided a rich data set for furthering our understanding of species distributions and use of the inshore. It has identified data gaps that will provide a focus for future research. It is complemented by the research conducted by John Roff and his students at Acadia, and there is much to be gained from looking at these data sets together.

It was clear during breakout groups and plenary discussions that this type of research is considered critical, but there has been no consistent funding of research and monitoring of this scope in the inshore. The DFO/FSRS IEP has been a productive pilot study for an on-going multidisciplinary study of the inshore ecosystem. While DFO funding and resources are mandatory for future work, we should also continue the collaboration with the FSRS and consider further community involvement through outreach and monitoring programs.

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* Note: All area codes are 902 unless otherwise indicated.

Appendix 2. Agenda

DFO/FSRS INSHORE ECOSYSTEM PROJECT
DATA SYNTHESIS WORKSHOP

Date: March 19 & 20, 2007

Location: Holiday Inn Harbourview, 101 Wyse Road, Dartmouth, Nova Scotia

Objective: To summarize the data gathered through the project components of the Inshore Ecosystem Project and discuss what the data can tell us, especially in relation to EBSAs, and how it fits into the EOAR.

Time	**Topic**	**Speaker**
March 19, 2007		
9:00 – 9:10	Opening Remarks/Workshop Objectives	Patty King and Alida Bundy
9:10 – 9:30	Overview of DFO/FSRS Inshore Ecosystem Project Components	Alida Bundy
9:30 - 10:00	Results of EBSA Mapping Exercise from January 2006 Workshop	Penny Doherty
10:00 - 10:20	Coffee Break	
10:20 – 12:00	Conservation of Nova Scotia's Bays: Are We Just Coasting?	Shannon O'Connor/Michelle Greenlaw
	Retrospective Analysis of Aerial Photographs and Remote Sensing Data	Glyn Sharp
	Retrospective Analysis of Existing Research Survey- and Observer-catch data, Catch Statistics, and Previous Inshore Survey Results	Jim Simon
12:00 - 1:00	Lunch	
1:00 – 3:00	FSRS Oceanographic Monitoring, Database Development and Analysis	Aaron Retzlaff
	At-sea Catch Analysis	Nell den Heyer
	Overview of Fisheries-Independent Sampling	Alida Bundy
	URCHIN	Nell den Heyer
	CTD Sampling	Ed Horne
3:00 – 3:20	Coffee Break	
3:20 – 4:20	Nutrients	Phil Yeats
	Zooplankton	Erica Head
4:20 – 4:30	Wrap-Up Day One	

Time	**Topic**	**Speaker**
March 20, 2007		
9:00 – 10:40	Fish and Invertebrates	Alida Bundy
	Marine Bird Monitoring	Carina Gjerdrum
	Invasive Species	Jean-Marc Nicolas
10:40 – 11:00	Coffee Break	
11:00 – 12:00	Mapping Eelgrass with Side Scan and Video	Herb Vandermeulen
	Grey Seal Pupping Areas	Damian Lidgard
	Update on LEK Survey	Alida Bundy
12:00 – 1:00	Lunch	
1:00 – 2:00	Breakout Groups • How does this new information compare with our understanding of the inshore ecosystem? Is there anything unexpected? • What have we learned about the biodiversity of the inshore? Are there recognizable gradients? • Can this data help identify areas that are ecologically or biologically significant or degraded? How? • Can this data help identify Ecologically Significant Species? How? • Is this kind of data collection useful for monitoring the inshore? • Research needs? • Lessons learned?	
2:00 – 3:00	Plenary – Present and Discuss Results of Breakout Groups	
3:00 – 3:20	Coffee Break	
3:20 – 4:30	Plenary continued	
4:30 – 5:00	Conclusions and Wrap Up	

Appendix 3. Discussion - Plenary Session

The group leaders reported back on the discussions within their groups. The group leaders were: Group 1 – Gareth Harding, Group 2 – Angelica Silva, and Group 3 – Rod Bradford.

Question 1: How does this new information compare with our understanding of the inshore ecosystem? Is there anything unexpected?

Group 1: Group 1 concluded that the information was primarily confirmatory, and it was expected that hydrography would affect the community structure along the coast. Differences between the north and northeast gradients were also expected. Seasonality was difficult to distinguish with Cape Breton, etc. It was also unexpected that small bays had more diversity than larger bays. Also, although pollock are known to be found inshore, it was unexpected that they were not being caught in the survey. Overall, the big picture is largely confirmatory.

Group 2: From Group 2, 70-80 percent of the people agreed that there was new information in this project. The younger people, who did not have prior knowledge on all the components of the project, learned a lot and were particularly interested in the influence and degradation of the Nova Scotia Current. However, Junior Risser and Jim Simon said that the information would be well understood by experts. This group felt that this was the first time all the information that was gathered during the IEP was put together and assessed.

Group 3: There were no observable or recognizable hot spots with the exception of the bird breeding colonies. What can be said with the analysis given to date? The degree of exposure in sites is relative to the physical properties. It was also unexpected to find sea lilies. The rest was similar to what was previously thought.

Additional Discussion
Angelica Silva: There was an expectation to see differences in north and offshore areas and those gradients were not evident along the coast. However, evidence of diversity in small bays was expected.

Alain d'Entremont: It was unexpected to see differences within the same bay, but these differences may be explained by physical processes.

Question 2: What have we learned about the biodiversity of the inshore? Are there recognizable gradients?

Group 1: There was an obvious shallow to deep gradient of diversity along the coast, but any alongshore gradient still needs interpretation.

Group 2: Group 2 agreed that small gradients do exist, but further analysis of physical gradients (e.g., bird gradient and north-south gradient) may reveal more. The physical characteristics of various habitats must also be examined.

Group 3: Group 3 identified the same gradients as Group 1. Gradients relative to the degree of exposure of sites, bottom type, and physical processes should also be considered. The data should be re-evaluated with regards to the home ranges of local habitats found in the inshore, and incorporate that into the score of biodiversity importance at the species level. Also, Carl MacDonald mentioned that there are changes in catchability of lobster due to molt, which is related to seasonality; therefore, the study period should be re-examined.

Additional Discussion
Gareth Harding: The habitat type was important with respect to habitat diversity and, therefore, data should be analyzed with respect to habitat.

Alida Bundy: It is early in the analysis, so it is hard to say. There is also a need for a specific definition of biodiversity.

<u>Question 3: Can this data help identify areas that are ecologically or biologically significant or degraded? How?</u>

Group 1: This group came to a similar conclusion as other groups. It is difficult to say from the present data whether there were significant areas. The physical oceanography data and data on larval retention and juvenile habitats may also be used to identify significant areas (e.g., seal pupping areas). Also, areas with increased production (e.g., Lobster Bay) may also signify significant areas; however, this also creates the problem of seasonality and interpretation.

Group 2: Group 2's answer was "NO" to identifying significant areas from the presented data. They felt that there was a lack of significant information and that the limited sources of data and the selective gear may have an affect on determining these types of areas. The current information, however, should be considered a baseline for future research. The identification of degraded areas may possibly help to determine significant areas.

Group 3: There is no evidence for ecologically or biologically significant areas from the information presented. The term "degraded" is a temporal reference, which led to much discussion, including the value of identifying reference sites (e.g., west of Shelburne, east of Cape Breton) by recognizing patterns of east-west, and using those for analysis.

Additional Discussion
Phil Yeats: Degradation of water chemistry suggests that some places are stressed but not necessarily through anthropogenic sources. It may be preferable to use a term like "Areas of Sensitivity" (e.g., Ship Harbour and eutrophication).

Alida Bundy: With regards to concern over data representing a snapshot of only a year or a season, the data should be used as a baseline for EBSAs due to its variability. Although a lot of sampling has already been done, it only compares a bit to what still needs to be done. Phil Yeat's (red, yellow and green) zones are very useful.

<u>Question 4: Can this data help identify Ecologically Significant Species? How?</u>

Group 1: Yes. There were an abundance of species that could be considered "significant" (e.g., herring, *Calanus*, eelgrass – i.e., those abundant in the food web). Also, invasive species may be ecologically significant due to the displacement of native species (e.g., green crabs, *Codium*).

Group 2: A unanimous "NO" to this question. None of the data points to a particular species. Everyone had a different definition of Ecologically Significant Species.

Group 3: No, this question was beyond the scope of the project. Although there was some debate regarding this question, it did not last longer than two minutes.

Additional Discussion
Angelica Silva: Alain d'Entremont said that all species are significant, so it is difficult to choose. We agreed that we could not pick one since they all play a role.

Alida Bundy: Herb Vandermeulen was saying that there are approximately twelve key species with ubiquity of distribution, and which were highly abundant (e.g., rock crab, eelgrass, herring, *Calanus*).

Patty King: Does species being present and abundant make them significant? What defines significance?

Alida Bundy: A significant species would be a keystone species.

Tim Lambert: Keystone species are important to the whole ecosystem. If one is lost, there would be a catastrophic change to the system – the system would crash. Most of what is in this survey does not seem to match this definition, since there is always another species willing to fill the void. Future modeling may show impacts of lost species.

Junior Risser: The only thing out of the ordinary was rock crabs being found further offshore. It is important to know where they are since rock crabs are the main food source for lobsters; therefore, it gives hope to the lobster fishery.

Gareth Harding: If you were to remove herring and mackerel from the ocean, would you get a shift in the ocean food web?

Tim Lambert: The lack of capelin was linked to the demise of the cod, suggesting that capelin may be a key species. It should be noted that if you move anything by a certain degree, it will change everything.

Jim Simon: I don't think this data can identify Ecologically signiFicant Species.

Rob Bradford: There is an issue of scale here.

Patty King: I agree with Jim's point.

Alida Bundy: These surveys can help show species that make up a significant portion of the environment. Eelgrass is considered to be a structural species.

Seasonal occurrences of species compared to year long residents require the scale of the question to be examined.

Herb Vandermeulen: The functional aspect of the survey will be seen later following further analysis. Therefore, everyone is right so let's move on.

Junior Risser: Rock crabs contain an enzyme used by lobsters for reproduction (as described by Carl MacDonald); therefore, they are an important species.

<u>Question 5: Is this kind of data collection useful for monitoring the inshore?</u>

Group 1: Yes, but each gear type is limited and, therefore, it may be best to try drop nets, hoop nets, smaller baited traps or even extend sampling over several seasons. Still, it is a good first start.

Group 2: The whole group agreed that monitoring of inshore areas is useful. Although there is a need for better equipment, the survey is useful in identifying primary indicators.

Group 3: Yes, and the survey provided particularly useful baseline information for monitoring a variety of issues to be later examined. The survey identified a prevalence of more exotic species; so can it be used to monitor long-term changes?

Additional Discussion
Bob Miller: The survey would be better if there was a focused question – but overall agreed tentatively with answers. He suggested that the question should be basic and scientific.

<u>Question 6: Research needs?</u>

Group 1: This information is necessary for determining protected areas and reserves. Further identification of habitat types are required to determine their importance. Faunal identification is also important for habitat studies. It is also important to identify important spawning sites for species along the coast. It may be preferable to have fewer stations but more seasonal data, and to check whether the bays are acting as retention areas for benthic larvae. Also, it may be beneficial to revisit some of the stations to see if there is any annual change in the ecosystem.

Group 2: This group would like to see a link with other institutions, and identify when research could be done by other groups. There is a need to link distribution of species with substrate, which may still be in the process of being analyzed. Also, there is a need to develop further low impact sampling areas, since certain areas may be set up for protection which could limit the possibility of sampling. Information regarding nutrients, suspended particles, and their size range should also be examined. Inshore/midshore/offshore gradients may still be shown with further analysis. Indicator species should also be identified in future research. As well, the substrate should be ground-truthed using bottom grabs. There should be a focus on identifying predator-prey interactions (e.g., crustaceans). From the initial surveys, small areas should be identified for intense research over the long-term. A discussion of the possibility of long-term research along the coast may involve a multi-platform for many aspects of research.

Group 3: Group 3 would like to get back to issues of catchability, availability, and why they change with the time of year. The group suggested that from here on in, areas which appear pristine (i.e., water quality and no indication of stress), have a value as reference points to the effect of human activity in populated areas (e.g., Halifax Harbour, Lunenburg), creating a possible human impact gradient.

Additional Discussion
Tim Lambert: One of the many variables to examine is exposure, and it may be useful to collaborate with Shannon O'Connor and Michelle Greenlaw.

Phil Yeats: The continuity from inshore to offshore – was there a gradient? When does the inshore become the offshore?

Patty King: To what degree do we need to better understand the role of each species and habitat before further sampling can occur? How do you go about studying the role of species? This project was in response to OAP and EOAR; therefore, should OAP be defining our research focus in the future?

Alida Bundy: Cannot answer on the spot.

Alida Bundy: There are open topics that everyone can identify specific research questions.

Damian Lidgard: Has there ever been any monitoring of cetaceans?

Alida Bundy: They were recorded opportunistically but did not fit into the database.

Nell den Heyer: The data goes into a whale sightings database. During surveys, seals were everywhere, and porpoises were seen in many of the areas.

Patty King: There was concern regarding the seals interfering with the gillnets but the seals did not seem to bother the nets.

Alida Bundy: The seals did not pose much of a problem.

Question 7: Lessons learned?

Group 1: This workshop gave insights into the logistics of running a project of this size with little money. One comment; coastal sampling should have been staggered so that not all the sampling was done in the same area at the same time of year (e.g., South Shore in July, Eastern Shore in August, etc.).

Group 2: The surveys gave baseline scientific information although there are issues of logistics, and sampling methods were not conducted in the same manner along the coast. Therefore, the results require careful interpretation.

Group 3: The sampling needs to be more efficient and effective – i.e., better gear choice like smaller research trawls and reducing soak times. Also, it may be useful to have trips less than two days long, and sample fewer places more intensely.

Question 8: Other discussion points?

Group 1: The group wondered how the data could be used to designate Marine Protected Areas?

Group 2: They agreed that there is a lot of value in this project, and it provides a very good reference point for future definitive research. It is unique that for the first time people are focusing on a comprehensive survey of the inshore ecosystem along the entire coast. There is a need to communicate with others – the FSRS is very good at bringing information to communities. Overall, this workshop was practical and allowed issues to be discussed with fishermen as well (e.g., put temperature loggers into traps, new species in traps). It was suggested that fishermen could collect information on specific species, if time permits.

Group 3: How does the inshore differ from the initial surveyed ecosystems?
There is a potential value to connecting with various community groups that may result in stewardships or at least inform the public as to what is present and important in their areas. Other partnerships were suggested, such as Environment Canada, ACAP, and perhaps other groups that might be interested in monitoring of endangered species.

Additional Discussion
Brent Law: The definition of inshore compared to the description of the physical oceanography (Edward Horne's description) may give a better starting point to separate nearshore from offshore. Also, if the data were broken down further to really nearshore (10-15 m from shore), then nearshore/midshore/offshore, further gradients and significant areas may appear. The data is there, it just needs some teasing out.