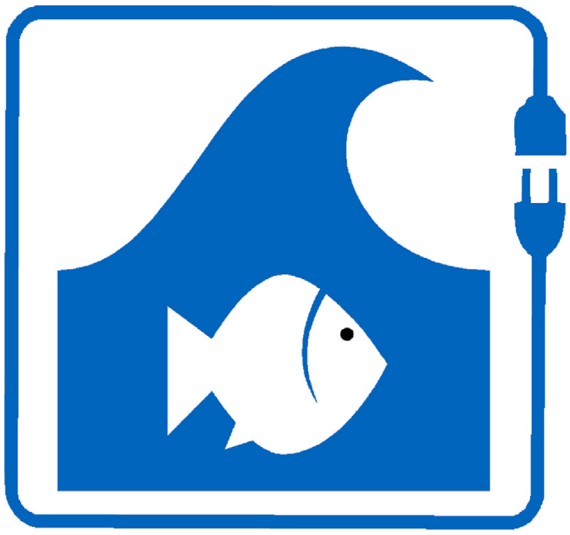
Creating ~ sharing ~ using knowledge about the Bay of Fundy

8th Bay of Fundy Science Workshop



Abstracts

"Resource Development and its Implications in the Bay of Fundy and Gulf of Maine"

May 26 ~ 29, 2009
Acadia University
Wolfville, NS

ACADIA CENTRE FOR ESTUARINE RESEARCH

INDEX of AUTHORS

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Overview of a Talking Circle on Conservation.

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From a BoFEP Management Committee retreat held in the summer of 2006, came the idea of bringing two cultures (Native and non-Native) together using the word "conservation". This would be seen as an opportunity to interact and share dialogue in order to explore the existing relationship as well as a future potential relationship between the two. The format chosen would be an informal "talking circle" consisting of equal numbers from each culture. Such an event took place on February 26, 2009. Support for the "circle" included CCNB (Conservation Council of New Brunswick), BoFEP (Bay of Fundy Ecosystems Partnership), The Southern Gulf of St. Lawrence Coalition, Saint Thomas University Native Studies and the Passamaquoddy First Nation. Since the "circle" lacked the discipline of a "workshop" and because the use of story telling would consume any time allotment one day could possibly provide; the event needed to be viewed as a beginning to dialogue and not an end product. Discussion would often slide away from the main topic of "conservation", not to change the focus of the meeting but to expose the different approaches to the same subject and the reasons for these differences. For before we can understand each other; before we can agree to any approach to any subject we need to overcome these differences. Though we speak the same words; we may hear different things! A video and a report will summarize the event; however, the true follow-up to the "circle" must include getting individuals together to address specifics pertinent to their own agendas which may be done by region or subject. Only in this way can the door between the cultures be kept open to let meaningful dialogue to take place. It is not enough to "assume" we understand each other, knowing there are inherent problems in communication.
[Paper Session *I1*]

Effects of Nutrient Availability, Snail Abundance and Shorebird Predation on an Intertidal Mudflat Community

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Bay of Fundy intertidal mudflats are important staging areas for more than one million Semipalmated Sandpipers (*Calidris pusilla*), which feed primarily on the amphipod *Corophium volutator* to fuel their annual migration to South America. Diatoms are an essential food source for *C. volutator*, polychaetes, copepods and nematodes. Eastern mud snails (*Ilyanassa obsoleta*) migrate into intertidal zones in the spring where they compete for diatoms and interfere with other invertebrates. To investigate trophic interactions in this system, we conducted a manipulative experiment examining the individual and combined effects of Semipalmated Sandpiper predation, changes in primary production and presence and abundance of mud snails on community structure. Fertilizer addition was used to stimulate primary production, while bird and mud snail exclosures and enclosures controlled predation. Semipalmated Sandpipers reduced densities of adult, but not juvenile *C. volutator*, while mud snails of low, medium and high densities had a negative effect on both, acting primarily as interference competitors. Although mud snails were more detrimental to juveniles, there appeared to be an additive effect of sandpipers and mud snails on adults. Fertilizer had a negative effect on *C. volutator*, likely due to aggregations of mud snails in fertilized sites. While nematodes and copepods were unaffected by Semipalmated Sandpipers, medium and high mud snail densities significantly reduced their abundance, likely due to interference competition and possibly consumption. Results indicate that community structure is controlled by both top-down and

bottom-up factors. A community-ecological approach is required to fully understand interactions between *C. volutator* and migrating shorebirds.
[Paper Session E6 , Student-Gu]

Habitat Mapping for Species at Risk in the Bay of Fundy

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The Bay of Fundy is home to a variety of species at risk ranging from invertebrates to birds to marine mammals. Definition of essential habitat is important in managing the distribution and abundance of those species. Due to stresses of development, resource extraction, shipping, fishing, etc., areas where various species can feed and reproduce are also at risk. Habitat mapping and prediction are powerful approaches for defining essential life history areas and mapping potential habitat for species at risk. Many data are available for the distribution of various species in the Bay of Fundy. We attempted to define ecogeographic variables based on bathymetry, substrate type, and circulation for the entire Bay. Remote sensing was used to quantify further habitat layers based on turbidity, salinity, and temperature. The variables were used with Biomapper, a type of factor analysis to produce habitat suitability maps for several species. This approach will yield important tools for DFO to manage habitat in the region. The success of this approach relative to species type and habitat variables is discussed in light of ongoing research in this area.
[Paper Session C6]

Managing Tidal Change

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Different approaches to coastal management were studied around three estuaries with some of the highest tidal ranges in the world; the Bay of Fundy in Canada (world's highest); the Severn Estuary in UK (Europe's highest); and the Penzhinskaya Guba in Siberia (Russia's highest).
The research invetigated three areas of resource management:

1. *Land use management in response to flood risk and tidal surge;*
2. *Opportunities for renewable energy using tidal power;*
3. *Public awareness and marketing the tide for tourism.*

The three estuaries share dynamic tides but extreme differences in culture, population and wilderness. Communities have evolved near estuaries for resources, trade and leisure – but need to co-exist with the rich natural environment if development is to be sustainable. The contrast between resource utilisation around the Severn Estuary with over 3 million people, compared to the Bay of Fundy with less than 1% and Penzhinskaya with less than 0.1% of that population, posed useful questions for how we seek sustainable development. The potential for conflict between man and nature is high around developed estuaries such as the Severn Estuary. With vastly different population levels and degrees of development, the study explored the evolution of the three estuaries and current management issues.
[Poster L3]

Tracing the Exposure of Snails to Anthropogenic Organic Compounds

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Numerous anthropogenic organic chemicals are introduced in the environment and are associated with different sources of contamination. The marine environment acts as a sink for many pollutants, where directly discharged and atmospherically transported lipophilic compounds will end up depositing in sediments. Polycyclic aromatic hydrocarbons (PAH) are ubiquitous contaminants referred to as priority pollutants because their uptake has been associated with toxicity in many vertebrate and invertebrate species. For that reason, their fates and effects are of major international interest. Because PAH are reactive molecules, their structure can change in the presence of abiotic parameters such as ultra violet light, sunlight, temperature, other chemicals that act as catalysts or pH. As well, PAH can be biotransformed by numerous organisms including bacteria, fungi, finfish and some molluscs. Our study focused on an abundant component in PAH mixtures, pyrene and 1-hydroxypyrene, a derivative of the former, both environmentally relevant in terms of uptake by animals. A chemical approach was developed for the extraction, fractionation, quantification and identification of the bioaccumulation and biotransformation products produced by snails including one abundant in the Bay of Fundy, *Ilyanassa obsoleta*. Laboratory experiments compared fate relative to dose, uptake over time, as well as through feeding, sediment and seawater exposure. Results were compared to animals collected in the field.
[Poster N5, Student-G]

Currents in Minas Basin, Nova Scotia, Canada

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The Bay of Fundy tides produce tidal heights reaching approximately 12 metres in Minas Basin. These extreme tidal heights are known to generate high currents in Minas Channel. Oceans Ltd used both moored upward looking and vessel mounted downward looking ADCP's to measure the currents for Minas Basin Pulp and Power Co. to help identify appropriate sites for placing marine current turbines to harness the tidal energy. The currents were found to be aligned with the channel and reached speeds in excess of 5 m/s at some locations. The currents were mainly due to the semidiurnal tidal constituent M_2 (semidiurnal lunar constituent) and S_2 (semidiurnal solar constituent). Since the magnitude of M_2 was approximately 8 times larger than S_2, the currents were high during neap tides as well as during spring tides. The current decreased only slightly with depth. The current measurements demonstrated the potential for a significant amount of power to be generated from Minas Basin.
[Paper Session A5]

Taking Stock of Current Conservation Levels on the Scotian Shelf and Bay of Fundy

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WWF-Canada, in partnership with the Department of Fisheries and Oceans, The Canadian Parks and Wilderness Society (CPAWS) and the Ecology Action Centre recently undertook a gap analysis to determine how well the current collection of federal closures, marine protected areas and other measures serve to meet ESSIM objectives. Comparing these management measures with various habitat types, we are provided with a snapshot of existing conservation levels for each seabed feature as well as the region as a whole.
[Poster L1]

WWF-Canada's Information Products in the Scotian Shelf and Gulf of Maine

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WWF-Canada has identified the need for several information products in support of the Scotian Shelf and Bay of Fundy MPA network planning process. The first of these products is the seabed feature classification. Developed with marine geologist Gordon Fader, this classification defines and delineates major seabed features in the Northwest Atlantic. Drawing on a range of data sources including scientific research, multibeam mapping and sediment samples, a GIS product was developed which will serve as a proxy for habitat types during the MPA design process. The second product focuses solely on the Bay of Fundy and Gulf of Maine. Our aim is to compile geographic information from various sources in an effort to present areas of high conservation value. This product will serve to educate others about these unique areas and will be developed into a GIS database and presented as an atlas of Marine Areas of High Conservation Value.
[Paper Session D3]

Proposal for a Half-day Hands-on Geomatics Capacity Building Workshop

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Through a collaboration of COINAtlantic, Southern Gulf of St. Lawrence Coalition on Sustainability, CoastalCURA and the Atlantic Ecosystem Partnership, materials have been developed for training in support of capacity building. A ½ day workshop would be convened in association with the BoFEP conference to bring together 10-15 interested people who would like to become familiar with the use of geomatics for coastal and ocean planning and management and research. The hands-on workshop will aim to provide a general introduction to geomatics and introduce some useful tools including GoogleEarth and the COINAtlantic search Utility. Participants are expected to be familiar with the internet and general use of either MS Explorer or Mozilla FireFox. They will come away with a better understanding of the general application of geomatics to accessing and using available environmental information. They will also be provided the opportunity to access and work with some of the available on-line information on their desktops. A computer lab at the University would be required to carry out this training and registration would have to be limited to the number of computers in the lab.
[Mini-workshop]

Integrating Environmentally Sustainable Grassland into the Acadian Landscape

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Grassland constitutes a form of agricultural land use with a long history in the Acadian landscape surrounding the Bay of Fundy. Management has been changing over time and the intensity of land use for hay production and livestock keeping can greatly influence the ecosystem function of grassland. The potential for grassland management to reduce the flow of nitrate into the aquatic environment has been explored in a plot experiment and in a field experiment near Truro since 2004. Results of these two experiments are being discussed with a focus on the relation between management-induced plant diversity and soil nitrate leaching. The experiments have demonstrated the functional order of the diversity-function-relation in grassland. Implications for the environmental sustainability of grassland management and the integration of grassland into the Acadian Landscape are being discussed.
[Paper Session G6]

Macro-Tidal Salt Marsh Ecosystem Response to Culvert Expansion

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This paper examines the vegetative, sedimentary, nekton and hydrologic conditions pre-restoration and the initial three years post-restoration at a partially restricted macro-tidal salt marsh site. Replacement of the culvert increased tidal flow from 5 ha to 43 ha. This was instrumental in altering the geomorphology of the site, facilitating the creation of new salt marsh pannes, expansion of existing pannes in the mid and high marsh zones and expansion of the tidal creek network by incorporating relict agricultural ditches. In addition, the increase in area flooded resulted in a significant increase in nekton use, fulfilling the mandate of a federal habitat compensation program to increase and improve the overall availability and accessibility of fish habitat. The restoration of a more natural hydrological regime also resulted in the die-off of freshwater and terrestrial vegetation along the upland edge of the marsh. Two years post-restoration, *Salicornia europea* (glasswort) and *Atriplex glabriuscula* (marsh orache) were observed growing in these dieback areas. Similar changes in the vegetation community structure were not observed at the reference site however, the latter did contain higher species richness. This study represents the first comprehensive, quantitative analysis of ecological response to culvert replacement in a hyper-tidal ecosystem. These data will contribute to the development of long term data sets of pre- and post-restoration, and reference marsh conditions to determine if a marsh is proceeding as expected and to help with models that are aimed at predicting the response of marshes to tidal restoration at the upper end of the tidal spectrum.
[Paper Session B3]

The Checkered Status of Bay of Fundy Striped Bass

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Striped bass, *Morone saxatilis*, formerly spawned in five Canadian rivers, the St. Lawrence (Québec) the Miramichi (New Brunswick), the Shubenacadie (Nova Scotia), Annapolis (Nova Scotia) and the Saint John (New Brunswick). Currently, only two of these populations are known to produce new individuals annually, the Miramichi and the Shubenacadie. Within the Bay of Fundy, it is uncertain if spawning any longer occurs in the Saint John and Annapolis rivers with the result that Bay of Fundy striped bass have recently been designated as threatened by the Committee on the Status of Endangered Wildlife in Canada. This presentation provides a summary of activities aiming to resolve the present status of the Saint John, Shubenacadie, and Annapolis populations, to assess current abundance and habitat requirements of the Shubenacadie population and to identify threats arising from human activities to either survival or recovery.
[Paper Session F2]

Groundline profiles on the Bay of Fundy Lobster Gear as a Threat to North Atlantic Right Whales.

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Conservation of North Atlantic right whales (*Eubalaena glacialis*) requires mortalities caused by human activities to be significantly reduced. Entanglement in fishing gear is considered an important cause of mortality and one that is underestimated. In order to reduce this risk, we must know where the whales are, where the gear is and the probability of lethal outcome if an encounter between the two occurs. All three of these needs are currently being researched. An important component of this concerns the groundline, a rope used to attach traps (e.g. crab, lobster) in a series (trawl). A common assumption is that groundlines form arches in the water column and are a threat to whales. Many fishermen have challenged this interpretation. This research measured the elevations of groundlines in the Bay of Fundy and evaluated several factors that could influence their elevations. Sensors were attached to nineteen groundlines on seven different lobster trawls that were being actively fished in the Bay of Fundy and elevations were recorded for at least two days. Results suggest that groundlines are within 3 m of the bottom most of the time, but groundlines of poorly set trawls may reach as high as 7 m. Although many factors did not influence elevations (e.g. water depth), some did (e.g. current velocity) and it was concluded that as a result of these influencing factors, fishermen in the Bay of Fundy can help ensure that their groundlines remain low, reducing the risk to right whales.
[Paper Session F5]

Population Characteristics, Movement and Angling of the Striped Bass (*Morone saxatilis*) Summer Aggregation in Minas Basin, Nova Scotia.

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The status and composition of striped bass stocks within the Bay of Fundy is currently debated and ultimately not well understood. With native stocks presently designated by COSEWIC as threatened or reproductively extinct, combined with increasing recreational fishing pressure, and development of in stream tidal power pilot projects to begin by 2009, the striped bass stocks of the Bay of Fundy may continue to be troubled. This study was designed to obtain baseline population data on length, weight, age, and stock origin from the summer bass aggregation in Minas Basin prior to turbine installation. In total 574 angled bass were measured, weighed, and scale and tissue samples taken between May-October, 2008. Mean FL was 40.5cm, with a corresponding weight-length relationship of Log(Wt) = 3.30Log(FL)-

5.58. Aging results indicated that the mean age was 4.3y, with 75% of bass being 2-4y. Recaptures accounted for 23.2% of the 529 bass tagged; of which 92% were reported from the site of initial tagging. Across all sampling locations a mean of 7.08 anglers were present per tide, and overall rates of fishing effort were 0.34 fish/rod/hr, and 0.006 retainable size fish/rod/hr. Ongoing analysis of mtochondrial DNA is expected to provide insight into relative stock contributions within the summer aggregation. This project will continue during 2009 where objectives will include: 1) testing acoustic telemetry equipment within Minas Basin, 2) investigation of bass movements in response to tidal stage and lunar cycle using acoustic telemetry, and 3) continued collection of baseline population data.
[Paper Session F1, Student-G]

The Greencover Project: Riparian Zone Restoration for Improvement of Water Quality in an Agricultural Landscape

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This project is part of the Nova Scotia Eastern Habitat Joint Venture's Kings Agricultural Wetland and Biodiversity Conservation Initiative, and one of a number of recent initiatives being supported in part by Agriculture and Agri-Food Canada's Greencover Program to address water quality issues in agricultural landscapes. The project is located within the upper reaches of the Cornwallis River, which flows into the Minas Basin of the Bay of Fundy, and is being carried out by a multi-stakeholder group composed of farmers, local citizens, wildlife resource managers and both federal and university research scientists, students and technicians. The primary objective of the project is to determine the effectiveness of a variety of Beneficial Management Practices (BMPs) aimed at reducing the impact of agricultural activities on water quality. The project design and preliminary results of the first two years of the project will be presented.
[Paper Session G5]

Abundance of Ribbed Mussels (*Geukensia demissa*) in Salt Marshes Located in Contrasting Tidal Regimes: Northumberland Strait *vs* Upper Bay of Fundy.

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A positive interaction has been documented between saltwater cord grass (*Spartina alterniflora*) and ribbed mussels (*Geukensia demissa*) in salt marshes of southern New England; however, the abundance and role of ribbed mussels in salt marsh communities of Atlantic Canada have not been studied. The tidal regime in Atlantic Canada is more varied then more southerly regions, and the extreme tides and associated suspended sediment in the Bay of Fundy diminish the ability of animals to filter feed. Two salt marshes (Cape Jourimain in the Northumberland Strait and John Lusby in the Bay of Fundy) located in two different tidal regimes (microtides/clear water and macrotides/turbid water, respectively) were sampled to determine community differences and density of ribbed mussels. Ribbed mussels only inhabited the Cape Jourimain salt marsh. PRIMER analysis (using presences/absences) detected significant differences in community structure between the two salt marshes ($p=0.01$), with the difference being due to the abundances of common salt marsh grass species and the presence/absence of marine invertebrate species, namely ribbed mussels and the gastropods *Littorina saxatilis* and *Melampus* sp. Future studies will examine the ecological role of *G. demissa* in salt marshes of Atlantic Canada.
[Poster J4, Student-U]

COINAtlantic: An Initiative of the ACZISC to Facilitate and Promote the Application of Available On-Line Information to Coastalshed Management

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The Coastal and Ocean Information Network Atlantic (COINAtlantic) is one of the most recent initiatives of the Atlantic Coastal Zone Information Steering Committee (ACZISC). This initiative is made up of a blend of both "people" and "technology". The core of the people network are those departments, agencies and organizations that make up the ACZISC. They have a direct interest in accessing and applying available information to coastalshed management. The presentation will provide a definition of "coastalshed" as the geographic area made up of Canada's oceans, estuaries, inland seas, and their adjacent sub-watersheds. This is a very useful concept that highlights the environmental and socio-economic linkages between the land, coastal zone and open ocean. It also draws attention to the large variety of information that is generally required for effective coastalshed management. Thus, it is presented here as an essential concept for identifying the information requirements to be addressed by a COIN. Through the work of COINAtlantic participants, and funding from GeoConnections, an on-line utility has been implemented that allows users to search, find and map information from various sources on any internet browser. The presentation will provide a brief history and background of COINAtlantic and provide a short demonstration of the utility.
[Paper Session D2]

The Atlantic Coastal Zone Information Steering Committee's Role as an Incubator and a Champion

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The Atlantic Coastal Zone Information Steering Committee (ACZISC) was established in 1992 under the auspices of a former agency of the Council of Maritime Premiers (now the Council of Atlantic Premiers). The ACZISC is working to foster cooperation in integrated coastal and ocean management, coastal mapping and geomatics in Atlantic Canada. The success and longevity of the Committee is, in large part, due to the engaged membership who represent the majority of the major coastal stakeholder groups: ten federal departments, the four Atlantic Provinces, the private sector, academia and NGOs. A small and deliberately neutral Secretariat is based at Dalhousie University. The ACZISC has no 'authority' per se. but it can exert considerable influence by virtue of its membership. The Committee has been described as an exemplar of "horizontality" by the Treasury Board of Canada Secretariat. One of the unique features of the ACZISC has been its ability, to incubate, facilitate and champion some important regional projects and programmes, the focus of this paper. All of the projects and programmes described are dependent on interagency collaboration.
[Paper Session D1]

Georges Bank Moratorium Review

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Georges Bank represents an important ocean area to Canada from a broad social, economic and environmental perspective. The area is under exploration moratorium until 2012 and as part of that moratorium, the federal and provincial ministers are required to initiate a review by January, 2010, and determine by June 2010 whether there will be a full public review. Since the Panel decision in 1999 and the Governments acceptance of the recommendation to extend the existing moratorium there have been changes in petroleum exploration including: new seismic methods and technologies, risk and mitigation strategies including the potential for re-injection of produced water and enhanced disposal of muds and cuttings. An evidence based decision making process will require extensive information on the state of eco-system science knowledge applied to environmental screens of potential petroleum activities and potential mitigation methodologies. An updated geoscience understanding of resource potential and information of the impact of the offshore oil and gas sector in Nova Scotia over the past 10-12 years is also critical for conducting a clear socio-economic analysis of the implications of extending or ending the moratorium. This paper will explore the various projects underway or set to be underway in Nova Scotia that will assist the Governments of Canada and Nova Scotia in making a decision on whether to proceed to a Public Review of the Moratorium in 2010.
[Paper Session H1]

Use of a GIS for Decision Support in Coastal Zone Management in the Southwestern New Brunswick Portion of the Bay of Fundy

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The southwestern New Brunswick portion of the Bay of Fundy is the location of considerable human activity in its marine waters despite a relatively low human population. Traditionally, fisheries have been the dominant activity in marine waters. Commercial shipping has also been of importance since the earliest days of European settlement. More recently, salmon aquaculture and marine recreational activities have become important and interest is growing to develop tidal power generation capacity. The area is also used by endangered species, such as the northern right whale and wild Atlantic salmon. As a result, proposals for new activities are increasingly coming into conflict with existing activities and uses of the Bay. In order to help in the decision-making process, we have used a GIS to map existing knowledge on the various activities and uses of the bay. In our preliminary analyses, we have depended on published materials in scientific journals, books, and technical reports. GIS has enabled us to overlay geo-referenced information to determine where overlaps occur, and where the potential for locating new activities will cause the least negative interaction and potential for conflict. We can also use oceanographic data and models to estimate the transport and dispersal of materials and which areas are technically best suited for certain activities, such as tidal power or offshore aquaculture. The presentation will highlight some of our applications and experiences with taking this approach to Decision Support.
[Paper Session D5]

Restoration of Ecosystem Services in Salt Marshes

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Some would maintain that conservation and restoration activities are justified on ethical grounds alone, but economic limitations can force choices amongst restoration activities and demonstrating economic value can be critical to government support of restoration activities. A commonly used approach is to assess ecosystem services provided through restoration. Daly (1997) defined ecosystem services as "the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life." Although tidal salt marshes were included in the valuation of global ecosystem services by Costanza et al. (1997) and later reviews, the lists of services vary and none have addressed all the ecosystem services that can be attributed to tidal salt marshes. This presentation reviews the ecosystem services attributed to salt marshes and suggests additional services that have been overlooked. It then describes a "restoration performance index" (RPI) that can be used to calculate benefits of a restoration project based upon the value of ecosystem services. The RPI can employ any number of indicators to assess restoration success. It calculates the proportion to which the indicator has been restored, as compared to one or more reference marshes. By multiplying this proportion times the value of ecosystem services per unit area of reference marsh, the RPI can be used to calculate annual monetary benefits accrued from a restoration project.
[Paper Session B6]

Effect of the Mud Snail (*Ilyanassa obsoleta*) on Vital Rates and Behaviour of the Amphipod, *Corophium volutator*.

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The two dominant invertebrates on mudflats in the upper Bay of Fundy, *Ilyanassa obsoleta* and *Corophium volutator*, are negatively correlated. This may be related to exploitation competition, interference competition and/or predation. We examined the effect of snail density (0, 5, 50 ind./m^2) on survival, growth and movement of juvenile and adult *C. volutator*, and on fecundity of adults in laboratory experiments (with simulated tides). Based on results analyzed to date, survival of juveniles decreased significantly with increasing snail density, whereas survival of adults was minimally affected. During behavioural observations, we discovered that snails did prey on *C. volutator*. The probability of a snail attacking an encountered amphipod was variable (partly dependent on the snail's hunger level); however, probability of capture after attack was consistently high (~85%). Snails did not appear to affect movement patterns, such as immigration into or emigration away from an area, when amphipods were given a choice of areas with and without snails. Other observations indicated that: (1) upon immersion, swimming frequency of amphipods was initially low but increased steadily until a plateau was reached 3-4 h into the high tide period. (2) Upon emersion, crawling frequency of amphipods was initially high, but declined steadily during the low tide period. In future studies, apparent effects of snails on swimming and crawling frequencies need to take into account mortality of amphipods. Mud snails have long been thought to feed primarily on detritus, carrion and biofilm. However, our results indicate that they are at least opportunistic predators.
[Paper Session E5, Student-G]

The Changing Sands of Biodiversity in the Minas Basin (Bay of Fundy, Canada)

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The holocene history of the Minas Basin has been incredibly dynamic. Within the last 7000 years, the Minas Basin has transformed from a river to an estuary, and within the last 4000 years has developed into a megatidal estuary with 15m tides that move 14 billion tonnes of seawater twice daily. This highly productive ecosystem has historically been rich in mudflats and salt marshes but within the last 300 years, 98% of the original 40,000 acres of salt marsh has been 'reclaimed' for farming and more recently, sediment flow has been compromised by causeways and beach stabilization programmes. Attempts to catalogue the biodiversity of the basin began in the 1920s, peaked in the 1970s, and collectively report 440 species of animals. The primary source of historic data for our study is an extensive survey of intertidal life based on 900 samples covering 40 km of coastline (Gratto, 1977-78). Our goal is to re-sample key locations (e.g., Evangeline Beach) following the 1977 transects. Preliminary analysis suggests substantial change has occurred in this 30 year period. For example, equivalent sampling effort (1977, 2008) in the mid-intertidal zone found that density of infauna doubled (from 17,800 to 40,767 individuals/ m^2). While the number of species remained unchanged, 4 of the 12 species found in 2008 were not recorded from that site in 1977. In 1977, three species made up 62% of the mid-intertidal infauna (*Eteone longa*, *Pygospio elegans* and *Streblospio benedicti*). In contrast, samples from 2008 were dominated by *Chaetozone setosa*, representing 53% of individuals sampled, an increase from only 6% in 1977. These data suggest that the Minas Basin is currently undergoing major transitions in its mudflat communities. Understanding these transitions is key to understanding the basin itself as the mudflats, now that most of the salt marshes have been lost, are major sources of productivity in this dynamic ecosystem.

[Poster J6, Student-U]

The Effect of *Ilyanassa obsoleta* on the Vertical Distribution of *Corophium volutator* in Mudflat Ecosystems of the Bay of Fundy

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The amphipod, *Corophium volutator*, is the most abundant macroinvertebrate on mudflats of the upper Bay of Fundy, and a vital prey item for migrating Semipalmated Sandpipers (*Calidris pusilla*). To fully understand mudflat community dynamics, and factors affecting prey availability for shorebirds, knowledge of interactions between mudflat organisms which affect *C. volutator* abundance is essential. Negative interactions have been documented between the eastern mudsnail (*Ilyanassa obsoleta*) and *C. volutator*. This may be a result of exploitative and interference competition between the two species. However, it is unknown whether the presence of *I. obsoleta* influences the vertical distribution of *C. volutator* within the sediment. In the presence of mudsnails, *C. volutator* may burrow deeper to minimize disturbance by snails. If this occurs, availability of prey for foraging sandpipers would be greatly reduced. We examined the vertical distribution of *C. volutator* in the presence of mudsnails at varying densities during summer 2008. Field work was conducted at two mudflats in the upper Bay of Fundy. Sediment samples were collected monthly from a series of snail enclosures and exclosures. Upon collection, sediment cores were immediately separated into distinct vertical layers**.** *C. volutator* present in each horizontal layer were counted and sized. Preliminary results indicate substantial negative effects of snails on *C. volutator* density, as well as a slight vertical depression of *C. volutator* at high snail densities. This

study will contribute to our understanding of interactions between *I. obsoleta* and *C. volutator*, and clarify the effects of mud snails on prey availability for Semipalmated Sandpipers.
[Paper Session E4, Student-U]

Bay of Fundy Species-at-Risk Mapping Tool: A Compilation of Aquatic Species-at-Risk Distribution Data for the Purpose of Predicting Suitable Habitat

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The Bay of Fundy (BoF) constitutes a dynamic habitat for many migratory and resident species-at-risk. Such species are now receiving increased attention, with the coming into affect of the Species at Risk Act (SARA) in 2003. However, there exists a significant knowledge gap in terms of habitat use, distribution, and the biodiversity of the BoF. We produced distribution plots of ten species listed on Schedule 1 and found to occur in the BoF and surrounding watershed. With a focus on Atlantic wolffish (*Anarhichas lupus*), we then utilized the distribution plot to produce a Habitat Suitability Map utilizing Biomapper software. We found that areas of high suitability for Atlantic wolffish were consistent with the distribution of coarse sediment texture. The results of this predictive modelling study may be used to advise issues of sustainable development as it pertains to Atlantic wolffish. However, issues of limited ecogeographical coverage, particularly in coastal areas, renders this method appropriate only for defining areas of suitable habitat, and inappropriate for designating areas of unsuitable habitat.
[Paper Session C7]

Establishing Aquaculture Research Objectives for Southwestern New Brunswick: Bringing Local Fisheries and Scientific Knowledge Together

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Current New Brunswick legislation provides for a public voice in the marine aquaculture site allocation process. However, the capture fishers of the provinces Southwestern waters are still seeking acknowledgement that the government is listening to their concerns. Even with an aquaculture policy in place halting further site development, the industry continues to expand in the region through policy loopholes and government sponsorship of industry initiatives such as beach allocations and species-specific research. To demonstrate they are listening, in the fall of 2008 the province called for the development of a Fisheries-Aquaculture Working Group. This paper will be follow the processes of how the working group develops and establishes research goals that will combine the resource concerns of both the Traditional Fishers Coalition and the New Brunswick Salmon Growers Association of Southwestern New Brunswick.
[Paper Session F8]

FERN (Fundy Energy Research Network): Facilitating Cooperation in Fundy Tidal Power Research

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The return of interest in Fundy tidal power for the fourth time in the last century demands an integrated research programme comparable with those of the 1930s and 1970s. But times have changed. Governments are no longer the principal proponents of tidal power developments, although the two provincial governments (New Brunswick and Nova Scotia) have encouraged private sector interests to pursue renewable energy options from the Bay of Fundy. Primary focus is on kinetic energy conversion devices, and a demonstration and test site is planned for completion in 2010 in Minas Passage, but potential energy options are also being considered. The tendency of private sector proponents to narrow the scope of environmental studies and to resist sharing of information with competitors, combined with the absence of federal government sponsorship, could lead to inadequate assessment of the long range and long term effects of commercial energy development. The Fundy Energy Research Network (FERN) is being created to promote collaboration and integration of research and monitoring activities conducted by proponents, universities and government agencies. This presentation will outline its research objectives and challenges.
[Paper Session A11]

The Minas Basin Lobster Stock, Its Fishery and the Movements of Tagged Lobsters

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The Minas Basin lobster stock supports a well defined fishery that operates in the Minas Basin during spring- summer (May 1 – July 31) and fall (mid Oct – end December). Although the lobster fishery in this region is open during winter a fishery is not possible because of ice cover. The fishery is exploited by approximately 14 fishers from ports on the north (Parrsboro) and south sides (Delhaven) of Minas Basin and ports on the Nova Scotia shore of the Bay of Fundy (Halls Harbour). Fishing effort is limited by the large tides of Minas Basin that cause lobster buoys to submerge except around high water and low water slack; a period of about 2-4 hours in each case. During 2008 we sampled the lobsters taken from fisher's traps in three areas; Minas Channel, central Minas Basin and off Halls Harbour. Trap haul daily yields were high in both in the spring-summer and fall and averaged about 400-500 kg per trap. Lobsters sampled from fishers traps ranged from 60 – 130 mm CL and the proportion of shorts:markets was about 1:2. The sex ratio in the catch was approximately 1:1 and there was a good representation of berried females. We tagged and released about 2600 lobsters. During the spring-summer fishery tagged lobster were all shorts (>82.5 mm CL). In the fall we fished before the season opened and were able to tag both shorts and market lobsters (<82.5mm CL). We will report on the tag returns from fishers. To date, most have been from inside Minas Basin. However, one of our tagged lobsters from off Halls Harbour was recaptured in Digby Gut during late fall suggesting these lobsters move considerable distances. This study was undertaken as part of a board examination of the fishery resources in Minas Basin and the impacts that may occur from tidal power development in the inner Bay of Fundy.
[Poster M3]

Social Network Analysis of Water Management Regime in the Annapolis and Cornwallis River Watersheds: A Tool for Comparative Analysis of Watershed Management Regimes

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Water is an increasingly valuable resource throughout the world. This is true even in water rich countries such as Canada, both because our own per capita consumption is on the rise and because water-poor

countries demonstrate stronger interest over time in accessing water from abundant sources. At smaller scales, as the diversity and volume of uses continue to grow, we can anticipate increasing levels of competition both for the water itself and for the right to allocate and distribute it. The goal of this research was to quantify and illustrate the relationships among actors engaged in water management in the Annapolis and Cornwallis River basins in Nova Scotia. This exercise was undertaken to understand, broadly, water use in the region, and whether and how different consumers and providers align themselves politically in order to influence allocation patterns. Social network analysis is the measurement tool used to meet these research objectives. Representatives of public agencies (federal, provincial, municipal), non-profit organizations, and business and industry were interviewed in order to both complete a census of the actors in watershed, and to measure the existing and strength of ties among them. The results of this research will be presented, and its implications for policy, planning, and management discussed.
[Paper Session G3]

The Mercury Flux of an East Coast Marine Embayment

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The Bay of Fundy is a large tidally energetic embayment in the Gulf of Maine of **1.38×10^{10} km^2** . River water, seawater marine sediment and plankton samples were collected in the spring of 2001 and the summer of 2002 with the intent of creating a mercury budget for the region. Seasonal atmospheric precipitation of mercury was obtained from the National Atmospheric Deposition Program and calculated from the seasonal rainfall averages to be **104 kg THg/y** (**4.4 kg MeHg/y**). River water sources of mercury were calculated from the nine largest rivers emptying into the bay at 185.3 kg THg/y (9.39 kg MeHg/y). Oceanic transport was calculated from a transect of five stations sampled at standard depths to be 612 kg THg/y (186 kg MeHg/y), 711 kg THg/y (201 kg MeHg/y) and 1179 kg THg/y (358 kg MeHg/y) for residual surface, residual deep flow and tidal flux, respectively. This oceanic inflow would be balanced daily by an equivalent outflow. It is calculated that 60 kg THg/y (0.38 kg MeHg/y) are deposited within the deep sedimentation basin in the lower bay off northeastern Grand Manan and that 22.1 Kg THg/y (0.1 kg MeHg/y) are carried into the Gulf of Maine with fine particulates. Planktonic organisms represent an additional flux into and out of the bay of 22.1 kg THg (10 kg MeHg/y). There is therefore a net accumulation of mercury in the sediments of thebay derived largely from riverine input. The anthropogenic input is predominantly atmospheric within this region and represents less than **3.7%** of the total flux.
[Poster N2]

Monitoring Long-term Change in Infaunal Diversity, Abundance and Distribution in Minas Basin Mudflats.

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The Minas Basin, with some of the highest tides in the world (15m), is characterized by extensive mudflats which comprise 1/3 the total area of the basin during low tide. Extensive sampling in the Southern Bight of the Minas Basin occurred in 1977-1978 (Gratto) with 900 samples collected over 40km

of coastline. Polychaetes represented approximately half of the species identified in these samples. Key areas (e.g. Kingsport and Avonport) were re-sampled in July 2007, with replicate samples from low to high tide zones. Species richness and abundance data from 2007 will be compared with the Gratto 1978 study and longterm trends in infauna communities will be examined. This system is highly dynamic so there is a need for new baseline information in these areas. A study in 1995 (Shepherd et al.) revealed a 12% increase in silt and clay at Kingsport since the late 1970's. Since species presence and abundance in mudflats depends primarily on sediment grain size, organic content, and water content, changes in species richness and abundance at Kingsport are likely. With renewed interest in tidal power development in the Bay of Fundy, changes in sediment distribution from altered tides and currents are a possibility. Depending on the magnitude of the proposed tidal power project, there may be associated changes in the distribution of infauna in the intertidal zone of the Minas Basin. Long-term monitoring of the system before and after the tidal power development will be crucial to understanding environmental effects. Preliminary analysis of Kingsport samples are presented here. Avonport species identification and a detailed sediment analysis of both Avonport and Kingsport will take place summer 2009.
[Poster J5, Student-G]

Within-mudflat Variation in Density, Demography and Movement of the Amphipod *Corophium volutator* on the Mudflat of Pecks Cove, Upper Bay of Fundy.

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Variation in life cycle of the amphipod *Corophium volutator* between mudflats has been well described, but within-mudflat variation in demography and movement remains largely unstudied. We performed a year-long survey of density, demographic variables and movement patterns of *C. volutator* on the intertidal mudflat of Pecks Cove in the upper Bay of Fundy, Canada, using hierarchical sampling, mark-recapture trials and stationary plankton nets. Distribution of *C. volutator* showed significant positive spatial autocorrelation at lags ranging from 0.5 to 200 m suggesting small and medium scale patchiness, and non-significant autocorrelation, indicating random distribution, at lags of 200 to 2000 m. As well, temporal patterns showed that early-summer increases in amphipod density were faster close to shore compared to far from shore. Proportion of adults, sex ratio, proportion of ovigerous females and proportion intersex did not show this temporal pattern in distance from shore, but rather were mostly location-time specific, corresponding to the small-scale variation detected in the autocorrelation analysis. Emigration, immigration and density of swimmers also showed small-scale spatial and temporal variation, although amphipods consistently swam along-shore (towards the south of the mudflat), likely reflecting tidal currents. Correlation between the different variables suggests that formation of large-scale patterns in distribution of *C. volutator* on a mudflat results from movement patterns rather than variation in demographic parameters.
[Paper Session E7, Student-G]

Diel and Semi-lunar Cycles in the Swimming Activity of the Amphipod *Corophium* volutator in the Upper Bay of Fundy.

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Although movement of individuals has important consequences on population dynamics and various ecological interactions, it is often difficult to quantify fully. We investigated the temporal variation in the number of the amphipod *Corophium volutator* swimming in the water column during periods of

immersion over the intertidal mudflat of Pecks Cove in the upper Bay of Fundy, in spring-summer 2006. Swimming is an important mode of dispersal, since the number of swimming amphipods can peak at over 30,000 individuals within a 20-cm-diameter, stationary plankton net over a period of immersion of ~4 h. Amphipods swim throughout spring-summer, but abundance in the water column is less in May than in the other months. As well, amphipods swim during the day and night, but the number swimming shows periodicity in relation to diel time of high tide, with peaks when high tides occur around 1:45 am. Finally, the number of amphipods swimming shows periodicity in relation to lunar cycles, with peaks around the time of new moon and full moon. We developed a statistical model describing the swimming activity of *C. volutator* based on month, diel time of high tide, and day of the lunar calendar. The model accurately predicts the timing of peaks, but does not predict well the amplitude of the highest peaks. Overall, the model gives a very good approximation of the number of swimmers (61 % of the variation is explained) and provides a strong basis for future modeling of spatial population dynamics of *C. volutator*.
[Poster J2, Student-G]

Striped Bass (*Morone saxatilis*) Eggs and Larvae in the Stewiacke/Shubenacadie River Estuary 1997 to 2008.

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Plankton net tows conducted over past 10 years close to the confluence of the Stewiacke and Shubenacadie Rivers yielded insight of both the timing of spawning in May-June, and the recovery of the spawning population following a high recruitment year in 1999. In 2008, as part of the Alton Natural Gas project, more detailed sampling quantified the density of eggs and larvae in the water column with respect to tide and time of year. High density of freshly spawned eggs (>50 eggs/m^3 water filtered) was recorded May 30, June 1, 2, 5, 9 and 11th. The highest egg density recorded was 1562 eggs/m^3 on June 1 on the Stewiacke River (0.6ppt salinity, 14.2 ^oC). Typically, egg density in the water column was low at high tide, then increased progressively through the ebb tide. Eggs were present right through the ebb tide until the next bore arrived. Larval stages were caught between June 5 and June 27. High densities of larvae occurred June 16 (154/ m^3 water filtered) and again on June 20 and 24 (119 – 240/ m^3 water filtered). The aim is to better understand how survival and growth of early life-history stages are affected by the complex interaction between tide, rainfall and temperature.
[Paper Session F3]

The Seabed of Minas Passage and its Relationship to Tidal Power Development

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It has been suggested that working in the Minas Passage region of the Bay of Fundy is like functioning in a region that experiences two hurricanes a day. This results from the extreme tides and their associated high current velocities that funnel through the Passage which connects the Bay of Fundy proper in the west to Minas Basin at the head of the Bay. After failure of the 1980s round of tidal power development that envisioned the construction of massive barrages across areas of the inner Bay of Fundy, EPRI, the Electric Power Research Institute of California reevaluated Atlantic Canada for the development of in-stream tidal power. They concluded that the Minas Passage region contained the “mother load” of global tidal power potential. This conclusion prompted the Nova Scotia Provincial Government to seek proposals for the development of a tidal power demonstration facility that included testing the commercial potential of three tidal power turbines and associated infrastructure. The Provincial Response to the Strategic Environmental Assessment (SEA) supported the creation of a demonstration facility for tidal in-

stream energy conversion (TISEC) devices, pending environmental approvals. Minas Basin Pulp and Power Company Limited of Hantsport, Nova Scotia, was successful in its bid to develop the overall demonstration facility including the placement of their chosen turbine technology along with two other device providers. Over the past year considerable research has been conducted in Minas Passage using a variety of high-resolution seabed mapping systems and oceanographic instrumentation. Previous research on the Passage was minimal due to the lack of high-resolution technology and the operating limitations imposed by the severe environmental conditions in these waters. Considerable speculation and anecdotal evidence suggested that the survival of bottom mounted turbines would be at risk from large rocks moving above the seabed and sunken water-logged, neutrally to negatively buoyant trees and/or sediment ladened ice blocks that move along the seabed. Results of the marine surveys have shown that the seabed is a mature scoured depression in which most of the fine-grained sediments have been excavated to the bedrock surface by erosion over many thousands of years. Boulder strewn bedrock crops out on the seabed and consists of red and grey sediments of the Parrsboro Formation in deeper areas and North Mountain Basalt forming a flat segmented ridge that projects west from Black Rock. In areas where sediments occur, they are thin and gravel covered glaciomarine stiff muds. Till is rare in the region, and in areas outside scoured depressions, glaciomarine sediment is the dominant surficial material. Gravel waves occur closer to shore and appear to be varying their orientation. Slumped sediments have been found on the edge of the shoreline platform and are cut into glaciomarine sediments. Examination of approximately 600 bottom photographs shows no debris such as rope, logs, and wood on the seabed. The bedload sediment transport zone extends only a few decimeters above the seabed and larger boulders and bedrock are encrusted with delicate marine growth that attest to minimal bedload transport and lower current velocities at the benthic boundary layer. The analysis of high-resolution sidescan sonograms and extensive bottom photography show no evidence for seabed impact by moving ice or debris. This presentation will show high-resolution imagery of the seabed of Minas Passage and Minas Channel as the basis for an understanding of sediment distribution and dynamics, stratigraphy, and geological history: essential elements for the siting of in-stream tidal power infrastructure.
[Plenary Presentation 1]

Understanding Influence: Lessons from Canada's and Nova Scotia's 1999 Georges Bank Moratorium Decision

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This presentation provides a retrospective analysis of the four-year decision-making process leading to the 1999 ocean policy decision to extend the Canada-imposed moratorium on petroleum exploration and drilling on Georges Bank until 2012. It provides the background to the policy problem, describes the existing policy context, decision-making process, subsequent policy outcome and potential opportunities for policy actors to exert influence over the decision-making process. The analysis focuses on the relationship and behaviour of policy actors involved in the process, based on their understanding of the principal areas of concern and preferred outcome, as influenced by their underlying core values and stated objectives. Stakeholders engaged in the current efforts to revisit the moratorium decision can benefit from this analysis as the research findings suggest that policy actors with shared values can enhance their potential to influence the policy outcome by coalescing into subgroups of advocacy coalitions. The potential composition of such coalitions may prove surprising to some, with members possessing varying levels of authority, mandate or capabilities within the network.
[Paper Session H2]

Youth Engagement in Local Conservation Issues in Bay of Fundy and Gulf of Maine Communities, Nova Scotia, Canada

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Canada is the second largest and one of the most prosperous nations on earth. We are stewards of an estimated 20% of the world's last great wilderness; in short, we are responsible for safeguarding some of the most critical remaining ecosystems that support all life on earth. It is on OUR WATCH that decisions will be made about whether our wild land and seas will disappear, or whether we will protect it for generations to come. The education program of CPAWS in Nova Scotia works to provide accessible and easy to understand information about conservation and to open doors for anyone to get involved in protecting our wild lands and waters. If Nova Scotians send a clear message to governments and industries that they expect action, these institutions tend to respond. Where there is clear public support for new protected areas, we have seen results. It is critical to "mainstream" the issue of protecting Canada's wilderness, and therefore increase attention to this issue by decision makers over the next decade. By partnering with Democracy 250 (D250) and Gulf of Maine Institute (GOMI) youth teams around Nova Scotia, CPAWS has been presenting opportunities for youth to speak their minds and share their visions for a sustainable future of their design. The message we have heard has been clear, concise, and in unison: youth are clearly concerned of the Nova Scotia they are about to inherit.
[Paper Session I3]

From the Headwaters to the Sea, Implementing a Watershed Approach in Southern Maine

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Coastal watersheds in southern Maine connect coastal and inland communities where diverse land use practices and land conservation strategies create a complex mosaic of policies affecting water quality and quantity. This presentation shares lessons learned from a project designed to improve land use decision making and overcome barriers to implementing a watershed approach. The watershed approach mirrors the principles and practices of community-based ecosystem management. This project integrated Collaborative Learning and land use planning tools developed by the Ecosystem Based Management Network to connect the practice of ecosystem management to municipal land use decision-making. Desire to incorporate water quality and habitat protection into economic development strategies motivated the town of Sanford, Maine to examine existing resource conditions, and Comprehensive Plan priorities. In addition, Sanford's five watersheds drain to significant coastal areas including two National Estuarine Research Reserves, one National Wildlife Refuge and the area included in a National Estuary Partnership. This project used the Collaborative Learning approach to guide stakeholder engagement and use of geospatial tools and Community Viz technology to develop a Conservation Plan that considered the value of headwater streams, aquifers and riparian buffers for water quality and quantity protection. Watershed values were considered along with habitat, recreation and land productivity values. This presentation addresses challenges and successes associated with the application of land use technology tools to improve decision making at the watershed scale, including stakeholder engagement, techniques to enhance public participation, developing priorities for watershed management and linking land conservation goals with water quality protection goals.
[Paper Session G1]

Macrozooplankton Ecology of the Lurcher Shoal Area (15 nm South of Brier Island)

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There is a 27 year time series of autumn Icthyoplankton surveys of the Bay of Fundy and parts of the Gulf of Maine. We can look at this as an annual census of the main players in the macrozooplankton community. Copepods from eight stations in the Lurcher Shoal area have been identified and counted. These results are compared here with previously determined order of magnitude estimates of major invertebrate taxa; many of which are copepod predators, taken from the same survey samples. Temperature and salinity monthly averages from Station Prince 5 are also used to determine the timing of major changes physical changes in the water column.
[Paper Session F6]

Contemporary Diagnosis of an Intracellular Parasite of Cod: Application for Investigating the Life History of *Loma morhua*

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Farming Atlantic cod in Canada is of particular interest because of consumer interest in the product and the market profit associated with cod. Emergence of the intracellular fungal parasite, *Loma morhua*, at cod aquaculture sites poses a significant threat to the developing industry. Moreover, the pathogen is of international concern and is expected to become a limiting factor for cod aquaculture in Iceland and Norway. *Loma morhua* infections are characterized by mortalities and reduced growth rates in juveniles and adults. To date, the life cycle of *L. morhua* has yet to be elucidated and epidemiological investigations have failed to identify route(s) of infections. A Polymerase Chain Reaction PCR-based method that takes advantage of the variable ITS region of rDNA has been developed for specific diagnosis of *L. morhua* in infected host tissue. Results from empirical assessment of this assay indicates that the specific rDNA primer sites are highly conserved among geographic isolates from Atlantic Canada, Iceland, and Denmark. The determination of presence/absence and quantification of level of infection will be facilitated by employing quantitative real-time PCR (qPCR). The qPCR diagnostic assay will represent an excellent tool for identifying route(s) of transmission and identifying organisms at cage sites that contribute to the epidemiology of infection. Moreover, the qPCR assay will be utilized to compare Atlantic cod families to assess resistance/susceptibility to *L. morhua* infection. The evaluation of family regarding resistance/susceptibility to infection will be used as a criterion for the selection of cod broodstock.
[Paper Session F7 , Student-G]

Food Habits and Foraging Behaviour of Semipalmated Sandpipers (*Calidris pusilla*) During Migratory Stopover in the Upper Bay of Fundy, New Brunswick

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We investigated the feeding ecology of Semipalmated Sandpipers (SESA) during their fall migratory stopover in the upper Bay of Fundy in 2006 and 2007. We set out to test whether SESA diet at important stopover sites was restricted to the traditional prey, the amphipod *Corophium volutator*, or whether alternate prey were consumed. We also tested whether diet composition was consistent among the sexes

and among birds roosting at different sites. Alternative foods include biofilm (a thin benthic layer of microalgae and associated mucopolysaccharides), polychaetes, and other meiofauna such as ostracods and copepods. Diet composition was assessed using stable isotope analysis of SESA blood plasma. To investigate links between SESA foraging behaviour and relative abundance of prey, we videotaped foraging birds and collected mudflat core samples for invertebrate prey in areas where birds were feeding. Using videotapes, we later observed different foraging behaviours and quantified proportion of time spent in each. Isotopic mixing models suggested a high intake of biofilm in 2006, but very little in 2007. However, behavioural observations indicate that SESA did not target biofilm as a food source; in 2006 a strong relationship was found between a novel foraging behaviour, "slurping", and abundance of ostracods. In 2007, slurping disappeared, but evidence of dietary segregation among roosting sites was observed. Dietary segregation among sexes was not substantial in 2006 but was more pronounced in 2007, though biological significance of these differences cannot be determined with certainty. Foraging behaviour and diet in this region appears more flexible than previously thought.
[Paper Session E1, Student-G *(supervisor presenting)***]**

Nova Scotia's Sustainable Coastal Development Strategy: What, When, How and What's Next?

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This presentation will provide an overview and analysis of Nova Scotia's process to develop a Sustainable Coastal Development Strategy from the perspective of the many community and environmental groups that have been actively involved in coastal issues over the last decade. The talk will review some key events that shaped public interest and concern around coastal management in Nova Scotia, including the White Point Expert Panel Review which recommended the province develop a coastal management policy as soon as possible. The Nova Scotia provincial government commitment to developing a sustainable coastal development strategy by 2010 and its efforts to date will also discussed.
The focus will be on how local and provincial groups work together on coastal issues and in the process have built themselves into a vigorous and active coalition. This is part of ongoing efforts by the EAC to document and understand the role of civil society in environmental change. The presentation will end with some conclusions about how community groups, scientists, government, and the general public can work together towards the creation and implementation of a sustainable coastal development strategy for Nova Scotia.
[Paper Session D6]

Conservation Monitoring of a World Heritage Site

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The Joggins Fossil Cliffs, located in Chignecto Bay (a northern arm of the Bay of Fundy), is Canada's newest site inscribed on the UNSECO World Heritage List. The inscription was based on the outstanding universal value of the cliffs' geology and fossil content to promoting a deeper understanding of the life and times of the Pennsylvanian Period (Upper Carboniferous). With the addition of Joggins to the World Heritage List and the opening of the Joggins Fossil Centre, increased tourism in the region is expected. Since the Centre has opened in April, 2008 there have been approximately 30,000 visitors to the area, about three times more than previous years. Effects of this increased tourist activity will need to be closely monitored to ensure that the integrity of the property is not compromised. The newly formed Joggins Fossil Institute (JFI) has worked in conjunction with community groups and government agencies

in order ensure that the value of these cliffs is lasting and appreciated. The JFI will create a monitoring program which will be used for reporting purposes on the conservation status of the property to UNESCO. The program will include a proposed six indicators, ranging from presence of litter to percent coverage of flora and fauna and will be observed bi-yearly through collecting, surveillance, and monitored plots. UNESCO has noted that the most significant potential impact on the property is the removal of resources (specifically fossils), therefore management plans will need to address this through educational signage and beach monitoring.
[Poster L2]

Status and Trends of Eelgrass in Eastern Canada

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Although eelgrass (*Zostera marina*) has been widely recognized as an important component of coastal ecosystems in eastern Canada, regional surveys to monitor changes in eelgrass distribution and abundance do not yet exist. Important areas for eelgrass in eastern Canada include the outer Bay of Fundy, Atlantic Coast of Nova Scotia, Island of Newfoundland, Gulf of St. Lawrence, St. Lawrence River Estuary, and James Bay. I will present an overview of current information on status and trends of eelgrass and efforts to develop cost effective monitoring programs based on a recent *Northeastern Eelgrass Workshop* in Portland Maine, and a *DFO - RAP Workshop* in Moncton NB. The trends, issues and monitoring programs for eelgrass differ dramatically throughout eastern Canada. Several areas in Nova Scotia and New Brunswick have documented declines in the extent and distribution of eelgrass related to invasive species and eutrophication. On the island of Newfoundland, eelgrass appears to be stable but the European Green Crab has recently arrived. Eelgrass appears to be stable or increasing in the Gulf of St. Lawrence and St. Lawrence River Estuary in Quebec. In James Bay Quebec localized declines of eelgrass beds potentially due to hydro-electric development have been reported.
[Paper Session E9]

Sixteen Years of Contaminant Monitoring in the Gulf of Maine and Bay of Fundy by Canada and the United States; 1993 to 2006.

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Contaminant monitoring of blue mussel tissues has been conducted since 1993 by the Gulfwatch Program for the Gulf of Maine Council. The Council was established in 1989 by the premiers of Nova Scotia and

New Brunswick and the Governors of Maine, New Hampshire and Massachusetts to jointly oversee the health of the Gulf of Maine ecosystem and thereby the sustainable use of its resources. To accomplish this a network of stations was established to get a comprehensive coverage of the entire region. Many of these locations have been sampled repeatedly to distinguish any trends in the contaminant levels. It has been found that in general the level of contamination mirrored the human population density such that polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), organochlorine pesticides (OC) and many heavy metals were most concentrated in blue mussel tissues in the southwestern gulf. Local "hotspots", however, where found for individual contaminants at various locations around the gulf. There is also evidence for a decline in PCBs and pesticides such as DDT over the span of the program. The picture is very much complicated when examined location by location. However silver, mercury, PCBs and DDTs are declining at the most contaminated localities such as at the Sandwich, Massachusetts, site. It is hoped that in the near future the program will be expanded to place more emphasis on the suite of emerging contaminant concerns, such as other industrial compounds and pharmaceutical drugs.
[Poster N3]

Bioaccumulation of Methylmercury in the Food Web of the Bay of Fundy, Gulf of Maine

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Mercury enters the East Coast marine environment from many sources, most notably from long-range atmospheric transport, land runoff or river discharge, oceanic currents and migrating organisms. As a priority toxic substance mercury, and especially its methylated form, are of concern due to its persistence, high toxicity, known bioaccumulation and biomagnification and suspected effects on the genetic, developmental and reproduction of aquatic organisms. Despite infamous pollution events of previous decades, such as occurred in Minimata Bay, Japan, where people were poisoned by consuming mercury in shellfish, little is known comprehensively about the fate of mercury in coastal marine ecosystems. There is evidence in the Maritimes that our loon, which spends its life as a juvenile in coastal marine waters and subsequently overwinters there as adults, has body mercury burdens well above inland populations.
In the present study total mercury and methylmercury were measured in the Bay of Fundy in the following environmental and ecosystem compartments: a). river water; b). seawater c). sediments; d). planktonic organisms fractionated into seven logarithmic size categories from phytoplankton and flagellates (25 to 65um) to macrozooplankton (2 to 4mm); e). pelagic organisms size fractionated from ichthyoplankton and crustaceans (4 to 8mm) to small fish and shrimp (16 to 32mm); f). macrophytes; g). benthic macrofauna such as mussels, lobsters and flatfish; demersal fish such as cod & haddock; h). pelagic fishes such as herring, mackerel and tuna and j). marine mammals. Our results support the hypothesis that methylmercury is bioaccumulated in the marine food chain. Methylmercury levels consistently increase exponentially from phytoplankton (25µm; 0.05 ± 0.03ng/gWet) to zooplankton (500µm; 0.51 ± 0.04 ng/gWet) to macrozooplankton (2.0mm; 1.9 ± 0.11 ng/gWet) to krill (8.0mm; 5.7 ± 0.76 ng/gWet) to pelagic fish (herring; 40.2 ± 25.2 ng/gWet) to large pelagic fish (Bluefin tuna; 712 ± 140 ng/gWet). This represents a biomagnification of 10^4 from phytoplankton to tuna or a bioconcentration of 10^7 from unfiltered seawater to tuna.
[Poster N1]

The Atlantic Mud Piddock (*Barnea truncata* : Family Pholadidae) a Relict Warm-water Species in the Minas Basin

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The Atlantic Mud-Piddock (*Barnea truncata*), found only in Minas Basin waters, shows an amphi-Atlantic distribution which cannot be accounted for through any single dispersive mechanism. Overall distribution is in intertidal habitats from Senegal to South Africa and Brazil to Massachusetts, where substrate allows, with a single disjunct population in a restricted formation in the intertidal of the Minas Basin. This candidate COSEWIC species is constrained to a total area of distribution of < 0.6 square kilometers and is only found in a one, restricted substrate within the basin. It may be subject to disruption, not only by land-use practices affecting estuarine water quality but potential tidal- power technologies.
[Paper Session A9]

Presence, Fates and Effects of Some Organic Contaminants: the Case of a Minas Basin Beach

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It is important to have a set of criteria in order to assess the quality of an environment. The concept of weight of evidence approach requires an investigator to gather data in a manner that could be clearly connected to, and with a strong enough background to support or refute a research hypothesis. Assessing can in some cases be viewed as making a judgment call, and requires a certain level of comparison to an ideal along with a polluted environment so as to place the results in as much of a realistic context as possible. Sediments and animals from Hantsport beach were collected at low tide and transported to the Bedford Institute of Oceanography for use in experiments. Exposures were conducted on mud shrimp and mud snails, *Corophium volutator* and *Ilyamassa olbsoleta*, to examine the bioavailability and effects of organic contaminants spiked in sediments or present as a complex mixture in field sediments. The presence of ubiquitous organic contaminants, polycyclic aromatic hydrocarbons, was determined in field collected sediments and animals, as well as after exposure over a period of two, four or up to ten days of uptake or of depuration. The animals were examined for weight, lipid content, avoidance/preference behavior, as well as body burden of detectable contaminants. The ability of the microbial community to degrade a natural product was also compared. This series of results permitted to characterize the relative state of the tested sediments, along with some potential causes associated with the quality of the sediments.
[Paper Session E11]

Tidal Energy Development: Developing a Conceptual Framework for the Integration of Environmental and Socio-economic Impact Information for Management Decisions, with Particular Reference to the Lobster Fishery in the Upper Bay of Fundy

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Nova Scotia is moving ahead to develop the tidal energy resources of the Bay of Fundy using a new technology called tidal in-stream energy conversion (TISEC). As there has bee no previous experience with TISEC operation in the Bay of Fundy, there is no foundation on which to evaluate impacts or to develop indicators for monitoring and assessment. What is currently understood of TISEC socio-economic and environmental impacts is based largely on impact predictions. The study proposed a conceptual framework based on concepts from NRC (1990) to develop an effects monitoring program, collect appropriate impacts and research data and integrate data into the EIA decision process. An approach was suggested to identify and prioritize potential TISEC project interactions with environment and socio-economic components over the project lifecycle. Potential effects of TISEC development and operation on the lobster population and fishery were selected for indicator development. Management questions and an adaption of a Pressure-State-Impact-Response model were used to identify indicators and indices to monitor potential changes in lobster populations. Recommendations emphasize the importance of a long term monitoring program to assess development impacts over the project lifecycle, the need for incremental TISEC development with approval to proceed to the next phase based on evidence that no significant adverse impacts have occurred, and careful assessment of capacity to directly extrapolate short term monitoring results to a commercial scale development. Implementation of the recommendations made by this study, the OEER (2008) and NSDOE (2008) reports is considered essential in addressing public and community concerns relating to implications of TISEC development to the Bay of Fundy ecosystem and the lobster fishery.
[Poster M4]

Reviewing Climate Change Impacts on Coastal Habitats, Marine Invasive Species, and Water Quality in the Gulf of Maine

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As our understanding of the impacts of climate change grows, so does our need for location- and context-specific implications. The Gulf of Maine region is no exception, so efforts are underway to identify existing resources and knowledge gaps in order to assist conservation and restoration efforts, as well as policy and decision making, with integrating climate change impact considerations. Three papers recently developed by the Climate Change Network of the Gulf of Maine Council on the Marine Environment address the impacts of climate change on coastal habitats, marine invasive species, and fresh water supplies in the gulf's watershed. Findings indicate that although much work remains to be done, there is a great deal of relevant information already available. The papers describe what is known and identify gaps, while tables summarize specific impacts of the major changes (temperature, precipitation, wind, sea-level rise, etc.) on different habitats, species, and water bodies. It is hoped that by raising the profile of existing work and gaps, the relevant information will be more widely utilized and new research will be better focussed on the region's needs.
[Paper Session D9)

Tracking the Use and Influence of Marine Environmental Information – Applying Methodologies from an Intergovernmental Agency Case Study

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Numerous significant, multi-stakeholder situations regarding marine environments and related policy decisions could be informed by authoritative scientific information. Such scientific information is often available, much of which is grey literature published by governmental and non-governmental organizations. Recently, publication and dissemination of scientific information have undergone significant change, largely due to the widespread diffusion of digital technologies and Web access. This poster outlines a composite metric of citations which aims to provide a more holistic understanding of the influence of grey literature published in print and digital formats. It draws on a review of the arguments for webometrics – the study of web-based citations – and an analysis of citation data for an international intergovernmental advisory group on marine concerns, collected from Web of Science as well as from Google and Google Scholar. The analysis of citations arising from periodicals, monographs, and web-based documents provides informative insights into how shifting publishing practices are changing the ways researchers are citing scientific information. The poster describes methodologies to improve understanding of the influence of such literature in an information economy characterized by rapid communication and over abundant sources. The influence of the environmental information published about the Bay of Fundy can be evaluated using the methodologies employed in this case study, a process that will highlight methods for increasing understanding of the influence of Bay of Fundy environmental information.
[Poster K4]

Assessment of Tidal Current Energy in the Minas Passage, Bay of Fundy

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The Bay of Fundy has the world's highest tides. In particular, the Minas Basin has tides with a range of over 12m. The Minas Passage, which connects Minas Basin to the Bay of Fundy, has mean tidal currents of over 3m/s making it a promising location for tidal turbines. In this talk we examine the potential power that could be extracted from Minas Passage and the effect that extracting the power would have on the surrounding tides. A mathematical model is used to predict the effect of turbine drag on the flow through the Minas Passage and the tidal amplitude in the Minas Basin. The theory is compared to two-dimensional, finite-element numerical simulations of the Bay of Fundy-Gulf of Maine system. Together, they suggest that a maximum of 7 GW of power can be extracted by turbines. The simulations also show that any power extraction in Minas Passage pushes the Gulf of Maine-Bay of Fundy system closer to resonance with the forcing tides resulting in increased tidal amplitudes throughout the Gulf of Maine. While extraction of the maximum power will result in significant changes, over 2.5 GW of power can be extracted with less than a 5% change in the tidal amplitude at any location. Finally, we examine how isolated turbines and turbine fences might be best located in the Minas Passage by examining the fluid dynamics of flow past a turbine.
[Paper Session A4]

Winter Ice, Sediment, Marsh Health and Tidal Turbines

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Winter ice develops routinely in Fundy's upper reaches. The relation between winter ice and estuarine sediment budgets and the health of coastal marshes is poorly understood as is the risk of ice for future turbines. Ice affects marshes vertically and laterally. Marshes are inundated at perigean spring tides, maximally 100 hours per year. Ice cakes with as much as 25% sediment (by weight) may become

stranded on top of the marsh. Sediment variation within ice or spatially in the estuary is unknown. Research elsewhere suggested that winter ice contributes significantly to tidal marsh accretion. Erosion of tidal marshes by winter ice occurs mostly laterally along the banks of tidal creeks. However, the creation of vertical ice walls along tidal creeks also has a stabilizing effect. The balance between these two processes is not quantified. As much as 60-85% of original tidal marshlands in the Greater Bay of Fundy have been locked away behind dykes, a process that affected the storage capacity of the estuary, increasing tidal range and decreasing nutrient supply. Winter ice is also a risk factor for tidal turbines. Ice cakes with as little as 10% incorporated sediment no longer float and may become a serious hazard for underwater objects. Significant amounts of ice were observed in Minas Channel near the pilot site (Black Rock) from a low altitude aircraft and from satellite photography on the day of maximum winter ice (March 1) in 2007. It would behoove decision makers to pay serious attention to this subject.
[Paper Session A10]

Distribution and Morphology of Horse Mussel Beds in the Bay of Fundy Identified Using Multibeam Sonar

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The presence of horse mussel (*Modiolus modiolus*) reefs in the Bay of Fundy has been known for the last decade since their discovery using sidescan sonar and high resolution seismic systems. The reefs are long, thin, and parallel structures covered with epifauna. Since 2006, the Geological Survey of Canada, in cooperation with the Canadian Hydrographic Service and the University of New Brunswick, acquired 12,465 square kilometres of multibeam sonar coverage in the bay. We have identified and outlined mussel beds by visually inspecting the multibeam bathymetry and backscatter strength maps. Horse mussel beds are expressed as elongated and elevated ridges with backscatter strength different from the surrounding seabed. Approximately 1500 mussel beds were mapped and measured. The beds are located in 40 - 100 m water depths with a median depth of 76 m. The beds ranged in length from 32 m to 2 km with median length of 185 m and were on average several meters high. The shape of the beds was more irregular and less linear in areas of multidirectional tidal current. The total area of the horse mussel beds in the bay is approximately 700 ha. Distribution maps and morphological data could be used to design and implement protection measures for this important ecosystem component of the Bay of Fundy.
[Paper Session A8]

Coastal CURA – Community Involvement in Coastal Management

Melissa **Landry** on behalf of the Coastal CURA team
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The Coastal CURA is a long-term project that is building knowledge and capacity across the Maritime Provinces, to support community involvement in managing our coasts and oceans. It is a partnership that brings together First Nations communities, fishery-related organizations and university participants. A key goal of the Coastal CURA is to build local-level capacity to analyze policy options, articulate alternatives and explore alternative management structures, such as integrated management that facilitates linkages between community and government. In this way, we are exploring what works and what does not in community-focused management of fisheries and other coastal resources. Thus our work includes (a) comparative research to monitor and assess a set of coastal management initiatives in the 4 key areas of the Maritimes where our community partners are located, (b) capacity building in media techniques, community GIS and mapping, (c) policy research, such as studies of how different provincial management strategies affect local fisheries, and (d) “reflection research”, to understand varying models

of integrated management, and thereby to create a vision for community-centred integrated management. This paper reports on our progress to date, including specific research outputs and insights from our partners. The lessons we have collectively learned and are sharing in this paper demonstrate ways that communities can work together with academics and government toward a "sustainable and prosperous future in ocean and coastal management".
[Paper Session D7]

Clam Management in the Bay of Fundy: Comparing Nova Scotia and New Brunswick

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This poster examines the traditional and sustainable harvest of soft-shell clams that has been carried out along the rich and abundant shores of the Bay of Fundy by small-scale clam harvesters, both Aboriginal and non, for thousands of years. Only in relatively recent times has the harvest of clams and its environment undergone tremendous change, resulting in the commercial and recreational fishery that we see today. We address the similarities in challenges being faced by clam harvesters on both sides of the Bay – from habitat destruction and contamination to a need for shellfish restocking. In Nova Scotia, the privatization of 1,682 ha of beach in St. Mary's Bay has taken away a traditional harvest area and placed it in the hands of a private leaseholder for 10 years. Our poster identifies the common goals for the fishery that are held by, and unite, harvesters from Nova Scotia and New Brunswick: a) the restoration of the ecological health of the clam resource; b) enhanced local capacity in clam fishery management; c) effective strategies in product marketing, including eco-labeling; d) supportive collaborations between clam harvesters and other organizations and agencies. In keeping with the latter of these goals, harvesters have aligned themselves with local ACAP community organizations: Eastern Charlotte Waterways (NB) and the Clean Annapolis River Project (NS). These collaborations are providing clam harvesters with the resources and capacity needed to reach their goals of community focused clam fishery management.
[Poster M1]

Nocturnal Habits of Semipalmated Sandpipers (*Calidris pusilla*) and *Corophium volutator* on Bay of Fundy mudflats.

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Essentially all research conducted on Semipalmated Sandpipers and *Corophium volutator* in the Bay of Fundy has been diurnal. Although sandpipers do feed at night, virtually nothing is known about their foraging behaviour or the night-time distribution and availability of their prey *C. volutator*. Based on studies of related species, feeding behaviour and prey selection may well differ between day and night, with tactile foraging becoming more important after dark. Perhaps related to this, *C. volutator* in Europe show differences in their distribution in the sediment at night, with more being found on the surface. During the summer of 2008, we investigated how sandpiper and *C. volutator* behaviour differs from day to night. Specifically, we looked at the vertical distribution of *C. volutator* at night, and the mechanism(s) by which sandpipers forage for them nocturnally. We predicted that Semipalmated Sandpipers would switch from visual to tactile foraging by night due to reduced vision. Moreover, we predicted that the vertical distribution of *C. volutator* would change from day to night due to changes in temperature. Preliminary observations of foraging sandpipers support these predictions. Daytime feeding consisted primarily of pecking, while at night birds maintained contact between their bill and the substrate for longer periods. We also observed different flocking behaviour at night, with birds foraging much further from shore than during the day. These observations will be coupled with data on vertical distribution of C.

volutator to identify links between nocturnal foraging behaviour and prey availability. Results will provide a more complete picture of habitat use and foraging by sandpipers in the upper Bay of Fundy.
[Paper Session E2, Student-U]

The Gulf of Maine Council on the Marine Environment: An Investigation of the Use of Its Grey Literature Publications

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Although many governmental and intergovernmental organizations publish vast quantities of grey literature, the diffusion and impact of this literature are rarely studied. Our study of the output of the Gulf of Maine Council on the Marine Environment (GOMC) begins to fill this gap. In the twenty years since GOMC was created, it has generated a large and diverse body of publications. Among the array of over 300 publications produced directly by the Council, or in collaboration with other organizations, are action plans, annual reports, technical reports, conference proceedings, background documents, newsletters, newspapers, magazines, fact sheets, brochures, maps, and a comprehensive website. Published in print and digital formats (now primarily in digital formats available on the Council's website), GOMC provides a complex publishing history for investigation. To determine the influence of GOMC publications, citation data for GOMCs major reports was drawn from Web of Science, Google, and Google Scholar. This data demonstrates that the grey literature output of GOMC was cited over lengthy periods, but grey literature tends to be cited primarily by other grey literature. Although open access and powerful search engines are improving access, a reliance on grey literature as the primary means of publication continues to pose hurdles for influencing scientific research, public policy, and public opinion. The impact of this literature can be muted because of the limitations of its dissemination and perceptions of its quality. Based on these findings, this poster will outline steps to overcome the dissemination and perception hurdles.
[Poster K2]

From Science to Policy and Decision Making: Investigating the Use and Influence of Marine Environmental Grey Literature

Bertrum H. **MacDonald**,[1] Peter G. Wells,[2] Ruth E. Cordes,[3] Gregory R.G. Hutton,[1] Julie Woods,[1] and Suzuette Soomai[4]

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Publication is currently an extensive phenomenon because it is easily achieved with widely accessible digital technologies. Annually, thousands of publications are generated worldwide often as grey literature. However, distribution and access to these publications can be problematic, even in the presence of open access systems, the Internet, and powerful search engines. Are the extensive resources (upwards of $1 million per title) devoted to the production of such publications justified? This question is particularly

significant in environmental contexts where decisions affecting the fate and future of terrestrial and marine-based ecosystems could and should be informed by currently available scientific information. This poster outlines the framework and objectives of a research project being pursued by the authors. Using three major case studies of governmental organizations focused on marine environmental protection, the project is investigating several questions including: what is the influence of scientific grey literature? In policy decision-making contexts are research reports published as grey literature perceived differently than research published as papers in scientific journals (even when grey literature may undergo similar quality checks as journal papers)? And, how should publications be designed for effective discovery and ultimately for impact? Through use of a suite of research methodologies (citation analysis, content analysis of public policy documents, interviews of key informants in public sector management, and surveys) comprehensive understanding of information and knowledge diffusion and use in public sector settings is being developed. This research is of importance to many environmental organizations that communicate with audiences through grey literature.
[Poster K3]

Examining Encounter Rates of the Nudibranch, *Onchidoris bilamellata* (L.) in Relation to Mosimann Random motion and Search Theory Models.

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Onchidoris bilamellata is a simultaneous hermaphrodite found in low densities on Indian Point in Passamaquoddy Bay. It is hypothesized that encounter rates will be non-random during mid-breeding season when population density is highest. When densities are low due to immaturity or senescence at the beginning and end of the breeding season, encounter rates are expected to be random. Preliminary results support the hypotheses. Non-random encounter rates suggest mate-seeking techniques, such as trail following, are being employed.
[Paper Session E8, Student-U]

Potential Adverse Effects of Mining Near the Bay of Fundy

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There is an increasing demand for extraction of mineral resources near the shores of the Bay of Fundy. The risk of adverse effects of mining on the Bay of Fundy is enhanced by: (1) a lack of coastal development and protection policy and (2) inadequate attention paid to the long-term environmental impacts of the proposed developments in the municipal, provincial, and federal regulations. Three examples of the proposed mining projects discussed in this article support the need for more strict environmental regulations which will assist in sustaining the well being of the Bay of Fundy and the residents along its shores. The first example is the proposed Whites Point Quarry for mining basalt. The project was not approved because of potential adverse effect on the marine life and well being of the community. The second example is the proposed extension of the Miller's Creek gypsum mine near the Minas Basin, which has not been approved yet. This mine will create cumulative and unmitigable impacts of the pollution from ANFO (used in blasting) on the local aquifer and the Minas Basin. The third example describes the potential environmental effects of dumping the saline water into the Shubernacadie Estuary from the process of solution mining of the proposed salt caverns. The proposed project has failed to address both the environmental and the economical aspects. We believe that development of mineral

resources near the ocean is appropriate if it will bring value-added and environmentally neutral consequences to the area.
[Paper Session H3]

Understanding Ecosystem Changes in the Gulf of Maine Marine Environment Through Climate Change Indicators

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Ecosystem and resource management has become quite complex since managers have identified the need to incorporate climate change information into their decision-making processes. To aid in understanding the potential impacts on Gulf of Maine ecosystems, the Ecosystem Indicator Partnership (ESIP) of the Gulf of Maine Council on the Marine Environment is developing a set of climate change indicators.
Proper indicator evaluation using a pressure state response model is revealing what aspects of the Gulf of Maine are sensitive to climate change and therefore which indicators should continue to be monitored. These results feed into the greater ESIP effort to provide baseline data and information about ecosystem conditions against which future changes can be compared and provide consistent, scientifically-sound, credible information that can be used to strengthen environmental policy and guide management decisions with environmental and social implications. This work builds upon a previous effort by the Gulf of Maine Council's Climate Change Task Force (http://www.gulfofmaine.org/council/publications/cross-border-indicators-of-climate-change.pdf). Approximately a dozen environmental indicators for which phenological historical data were available, including air temperature, precipitation, sea surface temperature, and sea level rise, were chosen and analysed. In general, the indicator findings were consistent with observed changes in temperature and precipitation over the same period and with what one would expect from a warming climate. Because they demonstrated that the Gulf of Maine region is sensitive to climate change in many ways, these indicators should continue to be monitored and their sensitivity taken into account by ecosystem and resource managers in the future.
[Paper Session C3)

Learning to Crawl before Learning to Walk - Macro- & Meso-tidal Wetland Restoration (Compensation) in Atlantic Canada.

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In Nova Scotia (NS), an estimated 62% in provincial area of saltwater wetlands, and as much as 80% for the Bay of Fundy, has been lost or significantly degraded over the past 400 years. In 2005, the first two salt marsh restoration compensation projects were undertaken at Cheverie Creek and Walton River (Bay of Fundy). A third tidal barrier removal project took place in 2006 and restoration activities are currently underway at two additional sites; bringing the total number of projects in the province to five. This poster will highlight the research activities, partnerships, and legislative measures leading to the success of these projects. The GPAC Regional Monitoring Program is being used as part of each project to monitor

hydrology, soils & sediment, vegetation, fish, birds and invertebrates. Each restoration site is paired with a natural salt marsh and a minimum of one year pre-restoration and five years of post-restoration monitoring is conducted. The results from the pre- and first year of post-restoration monitoring for the two Bay of Fundy restoration sites will be looked at in detail to illustrate some of the lessons learned regarding the ecological condition of NS salt marshes and the response to restoration efforts.
[Poster J1]

Mercury Fate and Biogeochemistry in Coastal Wetlands on the Minas Basin, Bay of Fundy

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While much is known about mercury distribution and speciation dynamics in freshwater wetlands very little is known about these processes in coastal wetlands and the capacity for bioaccumulation. To address these issues, sediment cores were collected from 4 coastal wetland sites (Wolfville, Hantsport, Kingsport, and Windsor) and one intertidal mudflat (Kingsport) on the Minas Basin, Nova Scotia, Canada. All samples were separated into mineral and vegetation and were analyzed for mercury speciation. The Minas Basin (on the Bay of Fundy) experiences among the highest tides in the world with tidal amplitudes often in excess of 12-13 meters. In order to determine the effect of tide on mercury release from the coastal wetlands mercury flux was measured at the Kingsport site over a period of 3 days using a Teflon flux chamber technique with Tekran gaseous mercury analysis. Total mercury concentrations in intertidal mudflat cores were low (0.45 – 35.77 ng g^{-1}) and minimal methyl mercury (MeHg) was present at depths < 6cm (mean = 2.7 pg g^{-1}; std. dev. = 1.0 pg g^{-1}). Coastal wetland sediments were also low in total mercury but ~90 times higher in methyl mercury when compared to unvegetated intertidal sediment. Windsor coastal wetland was notably higher in methyl mercury (ranging from 142-715 pg g^{-1} in Windsor and 14 – 269 pg g^{-1} at all other sites). A measured positive enrichment factor for total mercury (mean 1.5; std. dev. = 1.9; n= 68) and for MeHg (mean = 3.6; std. dev. = 4.8; n = 66) was observed between mineral sediment and below-ground biomass. Mercury volatilization was observed to be 3-4 times higher (0 - 7.5 ng/m2/h) at Kingsport coastal wetland than other reported flux measurements in Nova Scotia in areas of forest soil and glacial and granite till. While no direct relationship was observed between mercury flux and tidal height, ratios of flux to solar radiation does provide evidence that tidal inundation and gas release does facilitate mercury release from sediments during peak flux times.
[Paper Session E10]

Preliminary Implementation of a Hydrologic Flood Model to Simulate Overtopping of a Dyke in the Bay of Fundy

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The risk of flooding in response to tidal surge is great for low-lying coastal zones. A rising sea level is associated with higher than average tides, from which current tide barriers are not sufficient for protection. Using ArcGIS 9.2, a GIS-based approach was adopted to analyze the impacts of flooding caused by surging tides for two marshes in the Windsor area: Newport (NS27) and Tregothic (NS68).
This project aims to quantify (1) the per-zone volumetric capacity using a detailed digital elevation model (DEM); (2) the rate of water input during overtopping events; and (3) the corresponding time taken to fill

each zone. Results demonstrate that Tregothic Marsh is highly vulnerable to tidal surge flooding, and the marsh body can be rapidly inundated under all scenarios considered.
[Poster L4, Student-U]

Comparison of Vertical and Temporal Variations in Hydrodynamics on a Macro-Tidal Salt Marsh and Mudflat in the Minas Basin, Nova Scotia, Canada

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The purpose of this research is to examine the vertical and temporal variations in flow velocity and turbulence under vegetated and non-vegetated conditions in a high macro-tidal salt marsh environment. High-resolution velocity profiles were collected within the vegetated canopy with a vertically mobile Acoustic Doppler Velocimeter, while an Acoustic Doppler Current Profiler was used to characterize and analyze tidal flow over the adjacent mudflat surface. Data were collected in both zones simultaneously over five individual tidal cycles in the Minas Basin. Turbulence intensity, total turbulent kinetic energy, 2D and 3D shear stresses were calculated along with resolved horizontal velocities, showing significant change across individual tides. As expected, velocities measured on the vegetated marsh surface were significantly lower (1-4 $cm \cdot s^{-1}$) than those measured on the bare mudflat (5-14 $cm \cdot s^{-1}$). Flow velocity and turbulence were effectively reduced within the canopy, compared with faster and more turbulent flow measured above the canopy, known as skimming flow. Flow within the canopy did show some variation, corresponding with vertical changes in biomass. These results can be applied in future salt marsh restoration and management efforts.
[Paper Session B1, Student-U]

Sea-Level Rise and Salt Marsh Restoration in the Bay of Fundy, Canada

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Over the next century and beyond, societies will face significant increases in temperature and sea-level, which pose a threat to coastal communities. To protect these communities, sustainable adaptation strategies are needed. Recent events, like Hurricane Katrina in the U.S., illustrate how vulnerable and under-prepared many coastal regions are for natural disasters. The purpose of this paper is to explore the ability of Bay of Fundy marshes to self-adapt to changes in sea-level, their function as a buffer to coastal processes, and their cost-effectiveness relative to traditional, static, man-made defences. The viability of salt marsh restoration around the Bay is considered using a marsh in Musquash, NB as a case study. This 19 ha marsh was restored in early 2005 and data collected so far suggest that the restoration is a success. The marsh is being completely flooded with salt water at spring high tide. The drainage network is continuing to evolve and expand and is draining the marsh effectively after flooding. Sediments are arriving at the marsh in the water column and settling out; they are also arriving contained in ice blocks.
The amount of sediment arriving is sufficient to allow the marsh to grow vertically at a rate which keeps pace with the current rate of relative sea level rise. The density of halophytic plants is increasing. Our data indicate that the restored marsh will continue to develop into a fully functional salt marsh and that within a decade or two it will be difficult to tell, without digging, that a dyked, agricultural field once existed in the location.
[Paper Session B5]

Consultation as a Preventative Measure in the Atlantic Canadian Fisheries

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Consultation in which fishers and government officials are involved is crucial and indispensible. The government has identified, both in the Oceans Action Plan and the Oceans act, their willingness to participate in integrated management. According to the United Nations Law of the Sea Agreement which has been both signed and ratified by the Canadian Government, conflict management and consultation at every level is required for integrated management to succeed. Consultation not only resolves conflicts, but can act as a preventative measure. It is the exploratory procedure prior to consultation which makes the process more effective and constructive because it provides structure. For example, to identify 'interest based' conflicts as a frequently occurring dispute where natural resources are of concern, precautionary measures can be taken such as "focusing on the interest rather than positions, to look for objective criteria, developing integrative solutions that address the needs of all parties, searching for ways to expand options or resources and developing trade-offs to satisfy interests of different strengths" (Moore, 1996, p.61). 'Data Conflicts' are often another source of dispute in the fisheries. 'Data Conflict' is defined as the "lack of information, misinformation, different views on what is relevant, different interpretations of data and different assessment procedures" (Moore, 1996, p.60). Reasons for disputes in the fisheries could be identified and explored and precautionary frameworks established prior to consultations, which ultimately makes it easier to arrive at a mutually beneficial result.

Christopher Moore (1996). The Mediation Process Practical Strategies for Resolving Conflict. Jossen-Bass: San Francisco, CA.

[Paper Session D10, Student-G]

Multibeam Bathymetry and LiDAR Surveys of the Bay of Fundy, Canada – Progress to November 2008

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The Bay of Fundy has the largest recorded tides in the world, with a maximum range of about 17 metres. Tidal current velocities that exceed 4.5 m s^{-1} are currently being studied to determine the potential for in-stream tidal electrical power generation. In 2006, the Geological Survey of Canada, in conjunction with the Canadian Hydrographic Service and several universities, commenced a program to map the seabed of the Bay of Fundy on the east coast of Canada. About 12,500 km^2 of multibeam bathymetry have been collected in the bay. Sub-bottom profiler data were collected simultaneously to provide information on the character and thickness of the sediments on the sea floor. Large intertidal areas were surveyed using airborne Light Detection and Ranging (LiDAR), providing an opportunity to generate a continuous map of the marine, intertidal and terrestrial areas. Information from geophysical surveys, seafloor samples, photographs and video transects is being integrated to produce surficial geology and benthic habitat maps. Some key findings of the project are:

- Large glacial landforms may provide suitable habitats for fish and shellfish.
- Strong tidal currents are reworking sediments.
- Migration of large sand waves is observed in repetitive multibeam bathymetry surveys.

- Deep tidal-scour channels are present in several areas.
- The distribution and morphology of extensive horse mussel reefs have been mapped.

[Paper Session A2]

A Disappearing Act? Monitoring Eelgrass (*Zostera marina*) Decline in Kejimkujik National Park, Nova Scotia, Canada

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Eelgrass (*Zostera marina*), considered a keystone habitat in Atlantic Canada, has been experiencing continued decline in many parts of this region. Long-term monitoring of eelgrass extent and condition was initiated in Kejimkujik National Park in 2007. Comparison of eelgrass coverage based on mapping conducted in 1987 and again in 2007-2008 indicates a loss of approximately 64 ha (~88%). Although the original cause of decline is unknown, our investigations suggest that several factors may be contributing to continued decline. Swim transects of the remaining bed conducted in 2007 followed up by trap surveys in 2008 indicate high densities of juvenile and adult European green crabs (*Carcinus maenas*). Floating mats of dislodged shoots contained a large proportion of shoots with signs of green crab disturbance (shredded bundle sheaths and whole, live plants neatly sliced off at the base). Exclosure experiments are proposed for the summer of 2009 to investigate the impact of green crabs on the eelgrass bed. Eelgrass condition surveys detected several plants partially covered with the invasive golden star tunicate (*Botryllus schlosseri*). Otherwise, epiphyte coverage was considered low and eelgrass wasting disease was not detected. Water quality analyses conducted in 2008 indicate that salinity and water clarity are strongly controlled by episodic large precipitation events which result in freshwater inputs rich in CDOM (coloured dissolved organic matter) from surrounding wetlands. Dissolved Inorganic Nitrogen (DIN) and phosphate concentrations marginally elevated above nearby open ocean concentrations were occasionally observed in the lagoon between May and September 2008, but were not high enough to be considered a threat to eelgrass health.

[Poster J7, Student-G]

What's the State of the Soft-Shell Clam (*Mya arenaria)*? Results from Coastal Ecosystem Monitoring at the Kejimkujik Seaside.

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Ecosystem monitoring in national parks has the dual benefits of providing managers with the information they need to maintain ecological integrity (EI) while providing the scientific community with reference conditions from relatively pristine areas for the assessment and restoration of more impacted ecosystems in the region such as the Bay of Fundy. Research began in 2007 to enhance the coastal ecosystem monitoring program at the Kejimkujik Seaside. This small park protects representative coastal habitat in a region experiencing increasing development pressure and where coastal sensitivity to sea-level rise is considered high. One of the indicators selected for protocol development and field implementation was the status of soft-shell clam (*Mya arenaria*). Recreational clam harvesting ceased in the park in 1998. Population surveys conducted in 1985, 1990, 1994, and 1996, and a growth study conduct in 1995

provide a historical record. In 2008 the clam bed was surveyed again, providing rare data from a site that has not been recently harvested. The 2008 data suggest the population structure skewed towards large size classes (>50 mm) that is expected in an unharvested population, but also indicates 3-5 years of successive low recruitment. Determining whether this is a natural cyclical phenomenon, a result of predation, or another as yet unidentified factor, requires further investigation. Population studies of the European green crab (*Carcinus maenas*) conducted in 2007-2008 indicate high crab densities which may be impacting soft-shell clam numbers, particularly small size classes. Green crab exclusion studies and/or trial green crab removals are being planned for 2009.
(Paper Session C4, Student-G)

Bay of Fundy Ecosystem Partnership (BoFEP) – Creating and Using Knowledge on the Bay of Fundy Coastal Ecosystem.

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The Bay of Fundy is a biologically productive and diverse coastal ecosystem, rich in renewable living resources, non-renewable mineral resources, and energy. In recent decades, various people and groups have been concerned about effects of various pressures, alone and combined, on the bay's biota, habitats and ecosystems. Some species, habitats and fisheries resources continue to be at risk, e.g. migrating shorebirds, North Atlantic right whales, salt marshes and eelgrass beds, wild Atlantic salmon. Identifying and documenting issues, seeking solutions, and sustaining a healthy, high quality, functioning ecosystem requires the involvement of scientists, resource managers, governments at all levels, business interests, including resource users, and coastal residents. Bay of Fundy Ecosystem Partnership (BoFEP) was established in 1997 to foster such cooperative efforts. It comprises individuals and groups committed to creating and using knowledge about the Bay of Fundy coastal ecosystem and its watersheds, and promoting environmental protection and conservation, sustainable resource use and integrated coastal management. BoFEP sponsors a public, biennial science workshop to review results of new research, promote group's activities, and discuss new initiatives on current issues. As of 2009, BoFEP has 11 active working groups (see www.bofep.org) working on specific topics and research areas, and promoting communication and cooperation. BoFEP publications, searchable through the Fundy Information Collaboratory, are available on the web; they include Proceedings of workshops (7 since 1996), forums, and the 29 Fundy Issues fact sheets. The web site also provides information about BoFEP, committees and working groups, Fundy news, and hotlinks to other information sources.
[Poster K5]

Bay of Fundy Near-shore Biodiversity: Now part of the 'Big Picture'

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NaGISA *(The Japanese word nagisa, refers to the narrow coastal zone where the land meets the sea)* is a world-wide collaborative effort (http://www.coml.org/projects/natural-geography-shore-areas-nagisa) aimed at inventorying and monitoring coastal biodiversity. Started in 2002, there are now regional centers

in Japan, USA, Italy, Venezuela, Kenya, and since 2007 at the Huntsman Marine Science Centre (HMSC) in St. Andrews, NB (http://www.nagisa.coml.org/region/ao/atlantic). As one of the first Census of Marine Life (CoML) field projects, NaGISA has an ambassadorial role linking CoML goals and local interests, encouraging international cooperation and capacity building in coastal monitoring and research. Inventorying and monitoring biodiversity are crucial tasks for identifying and clarifying activities that impact ecosystems. NaGISA provides baseline data for long-term monitoring, and information needed to answer fundamental questions concerning changes in biodiversity with latitude and longitude. Implementation is through a simple, cost efficient, low-tech sampling protocol adopted by many research groups and countries, with the intent of promoting local community involvement. Based on a series of 30m transects from the high inter-tidal zone to a depth of 10m, the target habitats are rocky shore and soft bottom sea-grass communities, chosen for their global distribution, community complexity and poor state of current knowledge. Data is being incorporated in the Census` Ocean Biogeography Information System (OBIS), an online global atlas for accessing, modeling and mapping marine biological data. NaGISA activities include three partnership sites within the Bay of Fundy, with data from two successive years submitted for global analyses for presentation in October 2010 as part of the CoML "Decade of Discovery" public release.
[Paper Session C5]

Detecting Dissolved Organic Matter Using Airborne Laser Fluorescence in the Annapolis Watershed, Nova Scotia, Canada

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The Applied Geomatics Research Group (AGRG) in Middleton, Nova Scotia, has received an Atlantic Innovation Fund (AIF) grant for a project entitled "Environmental Assessment and Management of Watershed Quality" over a five year period. The project will assess the water quality throughout the Annapolis Valley, as well as other areas in the Maritimes. Part of the assessment process will involve determining the amounts of dissolved organic matter (DOM) produced from agricultural and septic runoff and decaying organic materials in the water using a new airborne Remote Sensing technique called Laser Induced Fluorescence Light Detection and Ranging (LIF LiDAR). The results collected in August 2008 by the AGRG using the Fluorescence LiDAR System (FLS), operated by LDI[3] out of Ottawa, will be compared to simultaneous water grab samples taken to determine the potential sensitivity and accuracy of this new and previously untested system. The current configuration of the FLS results in geometric positional errors of up to tens of meters for any given laser return and this issue will need to be resolved prior to comparison with the traditional grab sample data. The FLS system has the potential to be a valuable tool for broad watershed health assessments to determine areas with high DOM in the system which can adversely affect the health of aquatic systems by creating hypoxic or anoxic environments. Other applications of the FLS system are for mapping areas contaminated by hydrocarbons and to infer water clarity as it is influenced by light absorption and scattering.
[Poster N6, Student-G]

Response of *Ilyanassa obsoleta* to the Presence of Chemicals Including Chlorothalonyl, Endosulfan, Hexazinone and Pyrene

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The habitat of Eastern mud snails covers a diverse range of conditions. In the Bay of Fundy, these gastropods can be seen at low tide as well as at high tide on the surface of, or buried in sediments, located on a rock or hard substrate, near a stream or marsh grass, and often with amphipods residing in proximity. The literature describes their maintenance in exposure tanks while being fed lettuce, spinach, shrimp and other fish products. In the field, they graze on small particles such as detritus, bacteria and phytoplankton. Their size range and density varies with the time of year, temperature and location of a beach. These molluscs are also abundant near urbanised locations, where they can be exposed to agricultural runoff from fields treated with biocides. These gastropods constitute an important lower link of the food chain contributing to the diet of crabs, fish and birds. Our study focused on the avoidance/preference response of these snails relative to the presence and dose of chemicals. The attraction to various marine food items and specific natural products was tested and to the presence of freshwater, pesticides or harbour derived organic contaminants in seawater or sediments. The survival, horizontal and vertical movement of *Ilyanassa obsoleta*, as well as distress, *i.e.* flipping onto their shell with the foot and siphon extended, or retraction where the soft tissue is hiding within the shell was investigated. Examples of the results will highlight the knowledge gained about the stress response or tolerance of these invertebrates to exposure conditions.
[Poster N4, Student-U]

Effects of Density of the Amphipod *Corophium volutator* on Sediment Properties

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The mudflats in the upper Bay of Fundy are home to high densities of the tube-dwelling amphipod *Corophium volutator*. Based on past observations, crashes and recoveries of *Corophium* populations correlated with changes in sediment properties. Distributions of benthic invertebrates are known to be influenced by sediment properties; however, the reverse, modification of sediment properties by invertebrates, is less well studied. We examined the effect of density of *Corophium* (0, 1000, 5000 and 20000 ind. per m^2) on sediment properties, such as chlorophyll *a* concentration, organic content, water content, penetrability and temperature, in a field experiment. Cages (15 cm diameter, with 250 μm mesh) were deployed on a mudflat, filled with sieved mud (to remove all macro-invertebrates), allocated an amphipod density, and sampled regularly over 28 days in July-August. We also monitored *Corophium* density (varied between 1500 to 70 000 ind. per m^2) and sediment properties in control, undisturbed plots. Chlorophyll *a* and organic content decreased with increasing *Corophium* density, and the pattern was consistent over time. However, there appeared to be no relationship between *Corophium* density and water content. Penetrability was similar across cage treatments, increased slightly over time, and was consistently higher than in the undisturbed, natural plots. Sediment temperature showed little variation over time and across treatments. We still need to process samples for particle size distribution and erodibility. Based on results to date, *Corophium* may alter some sediment properties, depending on their density.
[Poster J3, Student-U]

Options for Managing Nova Scotia's Water Resources at a Watershed-Scale

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There is emerging evidence (groundwater contamination, loss of aquatic species at risk, degraded aquatic ecosystem functions, water supply shortages) that existing approaches to water management may be insufficient to address current and future challenges. In Nova Scotia, there is a growing consensus that effective management of the province's various watersheds will require a more coordinated and collaborative approach than is currently in place. The government of Nova Scotia is currently in the process of developing a provincial Water Strategy, which will serve to provide a framework for the management of water resources. During the winter of 2009, a consultation and planning exercise was undertaken with key groups and sectors having an interest in water management, including municipalities, forestry, agriculture and non-governmental organizations. The purpose of this process was to identify mechanisms for management of Nova Scotia's water resources at a watershed scale. The outcomes of this process will be reported, including: possible models for watershed management in Nova Scotia; stakeholders and sectors and that require involvement in these approaches; and the steps necessary to move from the current system to the desired scenario.
[Paper Session G2]

Catastrophic Expansion of Tidal Range in the Bay of Fundy

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Tidal models for the Bay of Fundy, Canada show that tidal amplification began in the early Holocene, and that by c. 5000 ^{14}C yr BP range was almost 80 % of the present range. Empirical data consisting of 146 sea-level index points and other observations appear to contradict model results. Aggregated relative sea-level data for Chignecto Bay and Minas Basin show that rapid tidal expansion began a mere c. 3400 ^{14}C yr BP. Segregation of the data into two geographically separate sets — Chignecto Bay and Minas Basin — reveals that evidence for rapid late-Holocene tidal expansion is confined to Minas Basin alone. We argue that a sand and gravel spit formerly extended across Minas Basin from Parrsboro to Cape Blomidon, and that the rapid breakdown of this barrier resulted in near-instantaneous tidal expansion. The barrier was subsequently destroyed by growth of the 170 m-deep Minas Passage Scour Trench. We discuss the evidence supporting the barrier's existence, and also some of the implications.
[Paper Session A6]

The Influence of Vegetation on Sedimentary Processes in a Macro-tidal Salt Marsh

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Salt marsh systems are ultimately dependant on the accumulation of sediment for survival. Previous research has shown that vegetation plays the dominate role in controlling sediment dynamics within the marsh zone. Within a macro-tidal environment such as the Bay of Fundy where vegetation may only

occupy a small portion of the water column, knowledge of salt marsh sediment dynamics is still evolving. The purpose of this research was to investigate whether vegetation causes increased rates of sedimentation within the vegetative canopy. This research took place on the macro-tidal Elderkin salt marsh near Windsor, Nova Scotia. Three 1 m^2 plots were established on the study site, one on the mudflat and two in the low marsh vegetation. One vegetated plot was trimmed and maintained throughout the entire study period to represent an area of lower roughness within the vegetative canopy. Each plot contained three rising stage bottles at two different elevations above the bed to measure the suspended sediment concentration, and three co-located sediment traps to measure the amount of sediment deposited over ten individual tidal cycles. It was hypothesized that the highest degree of sedimentation would be observed at the sediment traps within the vegetation canopy. However, results indicate that relatively higher amounts of sediment were deposited within the sheared plots and on the mudflat as opposed to within the vegetated plots. Additional analysis is being conducted to investigate the relative influence of meteorological and hydrological conditions as well as grain size characteristics on sedimentation.

[Paper Session B2, Student-U]

The Kings County Lake Monitoring Program, Nova Scotia

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The Kings County Lake Monitoring Program is an example of an innovative approach, by a municipal government, to watershed management that links lake water quality science to land use planning. Volunteers and Municipal staff have collected lake water samples since 1997 and have compiled an extensive database on lake water quality. From May to October, dedicated volunteers set out once a month to collect water samples, record water temperatures and take water transparency readings using a Secchi Disk. Water samples are sent to a laboratory for detailed analysis including Total Phosphorus and Chlorophyll a data. A total of 11 lakes are monitored. The majority of these lakes are located in the Gaspereau River watershed that drains into the Bay of Fundy. The information collected is analyzed in order to observe trends and see if associated land use controls are working. The lake monitoring program demonstrates the importance of moving beyond scientific analysis to practical land use policies that impact where and how shorelines are developed. After twelve years of monitoring, however, Kings County's experiences illustrate both the benefits and challenges to maintaining the relevance the initiative in a municipal government context. Lessons learned include the importance of volunteer participation, the clear communication of results and the maintenance of political interest. Ongoing challenges include inconsistent laboratory testing, the weak enforcement of land use controls and a need to strengthen the linkages between lake science and land use planning.

[Paper Session G4]

Use of Scientific Information in Decision Making for Effective Marine/Coastal Resource and/or Environmental Management

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Scientific information on the marine environment has been produced over the years by international advisory agencies. In spite of the availability of information it is uncertain whether it is being efficiently utilized by members of the wider community of researchers and policy makers. This is evident in the continuing declining trends in the global state of the marine environment and fisheries and impacts a wide range of stakeholders. The primary question being asked in this graduate study is whether the information

provided by selected international organisations (grey literature) is being used or considered by senior managers and other decision makers, resulting in better resource and environmental protection decisions. The study seeks to understand the following: how scientific communication occurs in public policy decision-making with regard to what is to be studied and who determines this; information pathways and uses in policy-making settings; and nature of policy directives. The study incorporates a methodology that looks at the impact of grey literature on environmental subjects using citation searching, content analysis, and surveys. The study will also consider adaptations/alternative methodologies for specific geographical regions, such as the Caribbean, which may result in the development of new ways of measuring the influence of grey marine management literature in the digital age. The objectives of this study and expected results can assist the Bay of Fundy Partnership in promoting its vision of facilitating effective communication and timely sharing of information amongst its partners.
[Poster K1, Student-G]

Safeguarding the Bay of Fundy: Opportunities for Marine Conservation

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The Bay of Fundy is at risk from pollution, climate change, growing industrial development and harmful fishing practices. Without protection, the rich ecosystems and incredible diversity of life in the Bay of Fundy will not be sustained. The Canadian Parks and Wilderness Society - Nova Scotia chapter (CPAWS-NS) has been working with government, industry, academics and community members to identify key conservation opportunities around the Bay to ensure that ecologically significant areas are protected. CPAWS-NS has two conservation campaigns underway in the Bay of Fundy: 1.Advancing the establishment of a Parks Canada National Marine Conservation Area (NMCA) in the Digby Neck and Islands region of the Bay of Fundy. An NMCA would provide legal protection from industrial activities that could impact marine life in the area while being compatible with, and beneficial to, existing local fishing and tourism industries and 2. Campaigning for the protection of rare horse mussel (Mo*diolus modiolus*) reefs which are the largest known to exist worldwide and perform a number of crucial ecological roles in the Bay. Although the reefs are threatened by human activities, such as bottom-trawling and dredging, no protection measures have yet been implemented to ensure that these globally significant features on the Bay of Fundy seafloor are maintained. Protecting these two areas are critical steps that must be taken in order to maintain the ecological integrity of the Bay, and the traditional livelihoods of local communities.
[Paper Session I2]

Hard Bottom Sublittoral Benthic Communities in Northern Minas Passage, Bay of Fundy

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A baseline seabed video and photographic survey for a tidal energy demonstration project located on the northern side of Minas Passage, Bay of Fundy, Nova Scotia, Canada, has shown for the first time physical conditions and biological communities which occur in the high current, predominantly hard bottom, subtidal environment (10 – 55 m below mean low water). Over 600 photographic and video images were collected at 245 stations in August and September 2008 and February 2009, showing invertebrate communities on major substrate types including outcrops of sedimentary (sandstone, siltstone, mudstone) bedrock; plateaus of volcanic bedrock (basalt); and intervening moderately sorted cobble to small and large boulder bottoms (6 cm to 1 m or more in diameter) derived from major bedrock types. On bedrock and boulder surfaces exposed to the strongest currents, taxa having low profiles (e.g. encrusting sponges

such as the bread crumb sponge, *Halichondria panicea*) as well as the blood star *Henricia sanguinolenta* were common and characteristic, and small surface-attached tube-building organisms, probably amphipods and polychaetes, occurred occasionally, forming a patchy cover. On vertical and sloping surfaces, and in crevices and irregularities on rock surfaces, more extensive growth of surface-attached tube building organisms, barnacles, encrusting sponges, and small red sea anemones (tentatively identified as Red Stomphia, *Stomphia coccinea*) occurred, in places completely covering surfaces. Occasional species included the colonial bryozoan *Flustra foliacea* and hermit crabs (*Pagurus* sp). No commercial species of invertebrate, were observed although the substrate, particularly the extensive areas of cobble, pebbles and granules, would otherwise likely be suitable for sea scallops. Animals from several rock samples taken in the survey included the small surface-dwelling, tube-building amphipod *Jassa falcata*, hydroids (e.g. *Eudendrium arbusculum),* and the attached bivalves *Anomia* spp., polynoid polychaetes, and the barnacle *Semibalanus balanoides* (whose occurrence was unusually deep for the species) and various other commonly occurring Bay of Fundy species. Most of the organisms identified in the study were particle or detritus feeders, with the exception of the sea anemone which feeds on zooplankton, and hermit crabs which are omnivorous. In the boundary layer on the gravel bottom, bedload movement of granules, pebbles and cobbles has scoured near-bottom surfaces and limited development of attached benthic organisms to 20 cm or more above the seabed. Unlike the nearby Minas Basin, waters at the site have low suspended sediment levels which would not interfere with particle/ suspension feeding. The high turbulence could distribute food particles throughout the water column as a food source for bottom dwelling suspension and detritus feeders.
[Paper Session A7]

Using Multi-Species Electronic Tagging and Tracking Technology to Better Understand Animal Behaviour and Ocean Physics

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Large scale Global (Ocean Tracking Network [OTN]) and regional (Tagging of Pacific Pelagics [TOPP], Tag-A-Giant [TAG] and the Pacific Ocean Shelf Tracking [POST]) projects are now allowing researchers to examine migrations of marine animals on a large scale. Pop-off archival satellite tags, satellite linked tags, and acoustic tags deployed on animals now provide researchers with new detailed information on ocean basin scale migrations and connectivity between populations. The OTN will produce data on animal movement and physical oceanography from all 14 ocean regions. These data will be permanently housed at Dalhousie University and openly accessible to the public. Data from tagged marine animals will be combined with oceanographic measurements from sensors sampling on coordinated schedules allowing researchers to model data on a global scale. Regional projects that tend to be more species specific, such as the TAG program, have now demonstrated how complex the stock structure may be for highly migratory species such as Atlantic bluefin tuna. This information is now being recognized as fundamental to the proper design of fisheries management regimes. The cutting edge of tagging technology is now being beta tested by researchers in the OTN. Large animals such as Atlantic sturgeon and grey seals will soon be tagged with archival tags that store data (including light curves for calculation of geolocation) which are either relayed to satellites or collected by re-capturing tagged animals. Researcher will also recover the data from the acoustic tags that send signals to arrays of passive receivers when a fish is within range. By also tagging with “Business Card” (BC) tags (a miniaturized receiver coupled with a coded pulse transmitter) we obtain time, depth and location stamped data along with records of inter- and intra-specific animal interactions. A computer model has been developed to enable

the interpretation of 3-D measurements of parameters related to animal/environment interactions. These variables include feeding and reproductive behaviour of the animals, measurements of local physical oceanography and bathymetric data. This methodology will provide fundamental information for 1) quantifying the impacts of in-stream tidal power infrastructure in the Bay of Fundy 2) detecting animal movement, migration and the behaviour of many commercially important and iconic species including Atlantic sturgeon, Atlantic salmon, striped bass, American herring, Atlantic cod and American eels. Such an experiment coupled with the extensive infrastructure provided by the OTN will produce information on local scale behaviours in critical areas, as well as information on large scale movements and migrations.
[Plenary Presentation 2]

Ecosystem Indicators and Tools in the Gulf of Maine

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The Gulf of Maine Council on the Marine Environment (GOMC) is a U.S.-Canadian partnership of government and non-government organizations focused on the health, environmental quality and productivity of the Gulf of Maine. In 2006, the GOMC identified priority indicators to monitor ecosystem health in the Gulf of Maine, including the Bay of Fundy. The Ecosystem Indicator Partnership (ESIP) led activities in six indicator theme areas (coastal development, climate change, contaminants, eutrophication, aquatic habitats, and fisheries and aquaculture). Subcommittees were established for each theme area, and currently more than 100 volunteers from local, state and federal governments, along with academics and partners from non-government organizations participate in one or more of these subcommittees. Based on a consensus-based process, the subcommittees selected priority indicators for each of the theme areas. Following the indicator selection process, ESIP developed an Indicator Reporting Tool (www.gulfofmaine.org/esip) to provide an easily accessible site for data on the priority indicators. The Tool allows users to visually assess data and use a graphing function to view status and trends at specific sites or for specific time periods. Data are automatically updated on a regular basis, providing the user with access to the most current data available. By providing this compilation of information in an easily accessible format, along with developing more detailed indicator fact sheets, ESIP is accomplishing one of the priority goals of the partnership: assisting users in locating and utilizing information on priority indicators in the transboundary Gulf of Maine and Bay of Fundy Region.
[Paper Session C2]

An Overview: Parks Canada's National Marine Conservation Area Program

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The presentation provides a national perspective on Parks Canada's National Marine Conservation Area (NMCA) program. It highlights the federal context, objectives, legislation, policies and the planning process. It also addresses the current status of various initiatives across the country and ends with a focus on Atlantic Canada. The NMCA program is part of the Federal Marine Protected Areas Strategy under the Oceans Action Plan which serves as the framework to sustainably develop and manage Canada's oceans.
(Plenary Presentation 3)

Insight into the Glacial History of the Bay of Fundy Revealed Through Sea Floor Mapping Using Multibeam Sonar

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In 2006, the Geological Survey of Canada, in cooperation with the Canadian Hydrographic Service and the University of New Brunswick, instituted a broad-scale regional mapping program to map the entire sea floor of the Bay of Fundy. To date, 12,466 square kilometres of multibeam sonar coverage have been acquired. The resulting sea floor map contains a wealth of evidence demonstrating the impact of Pleistocene Epoch glaciation on the Bay of Fundy and holds the promise of yielding one of the most comprehensive depictions of a glacial landsystem ever obtained in a marine setting. Glacial ice flowed from the head of the bay in the northeast to the Gulf of Maine in the southwest. In the southwest, a topographically controlled ice stream existed in the bedrock trough between Brier and Grand Manan islands. Streamlined subglacial landforms (drumlins and megaflutes) are prominent on the flanks of the trough. Prominent lobate ridges, convex to the southwest, are ubiquitous in the central portion of the bay. It is not clear if these ridges are subglacial or ice-front in origin; in any case they appear to mark a complex pattern of ice retreat to the northeast. During retreat, icebergs calved from the floating ice front; iceberg keels incised a dense pattern of scours and pits into the sea floor sediment and this pattern is used to infer paleocurrent patterns. Superimposed on the glacial landsystem features are Holocene Epoch sedimentary bedforms that reflect the modern current regime in the Bay of Fundy.
[Paper Session A1]

Evaluation of Short-term Changes in Rockweed (*Ascophyllum nodosum*) Following Harvesting in Maine

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The rockweed *Ascophyllum nodosum* is a large brown alga characteristic of North Atlantic intertidal zones where it grows to greatest height and mass on wave protected shores. The hold-fasts and three-dimensional canopy of rockweed beds provide habitat for numerous important intertidal invertebrates and fish. Rockweed is harvested for use in cosmetics, processed foods, and fertilizers. For decades, an active rockweed fishery has existed in the Gulf of Maine but a recent expansion of harvesting in Maine has raised public concern and re-stimulated the need to answer basic questions about potential impacts. With funding from Maine Department of Marine Resources, a field experiment was conducted to evaluate the potential effects of harvesting. In July 2008, biomass and community composition on thalli were assessed in control and experimental plots with destructive sampling using 25 cm^2 quadrats in a stratified random sampling design. Immediately after sampling, rockweed was harvested from the experimental plot by Acadia Seaplants Company. Both plots were re-sampled in September after two months of recovery. September biomass was significantly greater in the harvested plot, while the control plot showed no significant change. There was a direct relationship between the number of thalli and weight. Weight of thalli was greater in September. The number of common periwinkles found below the understory on the substrate did not change significantly between samplings. Most epifaunal species decreased in frequency in both harvested and control plots except the bryozoan *Flustrellidra hispida*. Potential effects of rockweed harvest appeared to be nested within changes in epifaunal frequency that may be related to seasonality.
[Poster M2]

Changes ~~I~~in Composition of Rockweed (*Ascophyllum Nodosum*) Beds due to Possible Recent Increase in Sea Temperature in Eastern Canada

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Ascophyllum nodosum (Rockweed) is the main economic resource of the seaweed industry in the Atlantic Provinces of Canada. The annual harvest steadily increased since 1995, reaching an historic peak of 37,000 tonnes in 2008. Due to a high demand for fertilizers and animal feed supplements derived from rockweed, this trend seems likely to continue. The current management plan for the sustainable harvest of the *A. nodosum* resource is considered conservative. The resource has been managed with a precautionary approach since 1995 to protect the integrity of the habitat. Acadian Seaplants Limited (ASL) has been granted approximately 90% of the government-issued licenses to harvest *A. nodosum* resources in the Maritimes. Since 1995, ASL has proactively undertaken extensive annual surveys and research on biomass productivity of this renewable resource to establish acceptable annual exploitation rates.
Historically the rockweed beds of southwestern Nova Scotia (NS) have been almost 99% pure *A. nodosum*, with a minor component of *Fucus vesiculosus* . However, since 2004 a steady increase in *F. vesiculosus*, with a peak of 4.6% of the total biomass in 2008, was recorded. This coincided with one of the mildest winters on record for the Maritimes. This increase in temperature seemed to be also responsible for an unusual recruitment of the blue mussel *Mytilus edulis* in rockweed beds in some areas of southern New Brunswick (NB) in 2006, causing the detachment of up to 30% of the seaweed biomass in some harvesting sectors. Other phenomenon observed in southwestern NS during 2003 and 2004 was extensive ice damage on rockweed beds produced by an early melting of the ice, with losses of up to 90% of the rockweed biomass in some areas.
[Paper Session F10]

A Tale of Two Macro Tidal Estuaries: Differential Morphodynamic Response of the Intertidal Zone to Causeway Construction

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This paper examines the spatial and temporal variability in the intertidal morphodynamic response of two macro tidal estuaries to tidal barrier construction. Contemporary bathymetric surveys of the Petitcodiac River and the Avon River in Canada were compared with historical surveys (1960s and 1860s). Both rivers underwent very rapid sedimentation during construction and rapid infilling downstream of the causeway during the first year after causeway completion. At both sites, there was an unexpected decrease on the order of 90% in intertidal cross sectional area within the first 1-2 km downstream of the causeway as extensive mudflats rapidly developed. Once sufficiently consolidated, these were quickly colonized by *Spartina alterniflora.* The response of the remainder of the intertidal zone in the two systems has differed significantly downstream of the area of initial sedimentation. In the Avon, no significant decreases in cross sectional area were recorded and seasonal cycles of changes in bed elevation exceed differences recorded between years. In the Petitcodiac however channel infilling continues up to 21 km downstream of the causeway. It is hypothesized that the response of the Avon system is mainly attributable to the connecting St. Croix River and associated hydrodynamics, as well as the position of the causeway within the broader estuary. A significant change in the calculated critical

velocity in the Petitcodiac system before and after causeway construction implies that the actual physics of sediment erosion and deposition were altered. These results demonstrate the importance of considering the broader estuary when developing management guidelines.
[Paper Session B4]

Effects of Foraging Semipalmated Sandpipers on the Vertical Distribution of *Corophium volutator*

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Each summer, migrating Semipalmated Sandpipers (*Calidris pusilla*) forage extensively on the amphipod C*orophium volutator* on mudflats in the upper Bay of Fundy. These amphipods create U-shaped burrows extending 1-10 cm into the mud. The extent to which *C. volutator* use these burrows to avoid predation is unknown; predators may cause these amphipods to retreat more deeply into burrows, rendering them inaccessible to birds. To quantify *C. volutator* activity in the presence and absence of sandpipers, we monitored the vertical distribution of amphipods in bird exclosures and adjacent control areas throughout summer 2007. Sediment samples from each study plot were periodically collected and immediately separated into four distinct layers. *C. volutator* from each layer were sized, counted, and adults sexed. Adult *C. volutator* retreated deeper into burrows after sandpipers arrived, while no shift was observed in juveniles. Results were more marked in control plots where sandpipers could forage freely than in exclosures. Surface activity (crawling *C. volutator*) declined sharply in response to bird predation. Thus, absolute density of *C. volutator* does not necessarily provide an accurate measure of prey availability, and behavioural responses of *C. volutator* should be taken into account when evaluating quality of foraging sites for migrating sandpipers.
[Paper Session E3, Student Gu]

Integrating Multibeam Bathymetry and LiDAR Surveys of the Bay of Fundy, using Isle Haute as an Example

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Terrestrial LiDAR was acquired during low tide for many of the coastal areas of the Bay of Fundy with the intention of integrating the multibeam bathymetry in order the construct a seamless digital elevation model. The LiDAR elevation data are referenced to the WGS84 mapping system and the heights transformed to the Canadian Geodetic Vertical Datum of 1928 (CGVD28). The bathymetric data are often referenced to a local chart datum based on an elevation lower than the lowest tide. In order to construct the seamless DEM the differences in the two vertical datum must be reconciled. In order to test this methodology, terrestrial LiDAR data collected by the Applied Geomatics Research Group and multibeam bathymetric data collected by the Geological Survey of Canada, in conjunction with the Canadian Hydrographic Service around Ilse Haute in the Bay of Fundy have been used. The CGVD28 vertical datum was used as the common vertical reference and the bathymetric data were transformed to this datum. The two elevation models (bathymetry and land) were then merged to form a single, seamless model where the zero value approximates mean sea level and negative values denote the bathymetry and positive values denote the land elevations. Even with the large tidal range in the Bay of Fundy a gap exists between the multibeam coverage and the LiDAR coverage. This near shore bathymetry data is

difficult to collect with marine vessels because of navigation safety issues and the cost of multibeam surveys in shallow water due to the narrow survey swath. Bathymetric LiDAR technology may be suitable to fill in this "white ribbon" on the map; however this technology is not readily available in the region. This proof of concept project has demonstrated the need to reconcile differences in vertical datums between datasets in order to perform subsequent analysis. For example, the land water boundary is a transient feature that is constantly changing. Geological evidence from other parts of the Bay indicate sea-level was once much lower during the last glaciation, then rose to a high stand 10s of meters above the current shoreline 12-15 ka after the ice melted and prior to the crust rebounding. Today the crust is subsiding in this region at a rate estimated to be between 15-20 cm per century and global sea level is rising and predicted to accelerate under the projected climate conditions. A seamless DEM allows us to simulate past and future sea-level changes and better understand the morphology and history of the processes that have shaped the landscape.
[Paper Session A3]

Population Characteristics and Movement of Atlantic Sturgeon (*Acipenser oxyrinchus*) which Aggregate in Minas Basin, Bay of Fundy during Summer.

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Atlantic sturgeon have known populations in Bay of Fundy rivers (Saint John, Annapolis) and southern stocks may migrate into the Bay but little is known about the sturgeon aggregation found in Minas Basin during summer. Trawl surveys between 2004 and 2008, and a directed study on sturgeon caught in commercial fish weirs during 2007 and 2008 examined 951 sturgeons; 567 of which were measured and tagged with dart tags, 333 were weighed, and 120 had pectoral spines removed for aging. Mean fork length of annual samples ranged from 129 to 140 cm and significantly differed among years. Ages from 2005 and 2007 samples ranged from 3 to 29 years. Observed length and age determinations suggest the annual aggregation is mostly immature sturgeon. The weight-length relationship for sturgeon captured in 2008 was Log W = 3.23 Log Fl - 8.76 and indicated good condition. Two sturgeon tagged in Five Islands during 2007 and two tagged in 2008 were recaptured in the southern Basin after being at large 1-2 months during respective years. Of seventeen sturgeon recaptured in the Southern Basin in weirs and by trawl in 2008; 1 was originally tagged in 2004, 1during 2005, 6 during 2007, and 9 during 2008. Two multiple recapture estimates (Schnabel, Jolly-Seber) using all tagged sturgeon from 2004-2008, suggest a population of approximately 10,000 sturgeon in the Basin during summer. Each year Atlantic sturgeon appear to enter Minas Basin along its northern shore during May and June. By July and August they are concentrated along the southern shore and depart the Basin by September. We anticipate that distant tag returns and samples collected for mitochondrial DNA analysis will provide us with clues for the origin of the summer aggregation of Atlantic sturgeon.
[Poster M5]

Coastal Ecosystem Health and Integrity – Selecting a Core Set of Indicators for Long-term Monitoring and Reporting

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The need for coordinated longer term coastal monitoring and environmental reporting for this region is briefly discussed, as an introduction to the papers in this session. Coastal ecosystems worldwide and especially in the Northwest Atlantic are under many stresses, natural and anthropocentric. A set of primary indicators is required for periodic environmental reporting, moving from a full suite of measures, often specific to a stressor and used for measuring short term ecosystem or ecological health, to an abbreviated set of indicators, common across stressors, that measures coastal ecological integrity over the long term. Conceptually, the available indicators converge towards a smaller set, as with commonly used economic indicators. This indicator convergence process (ICP) considers commonality, practicality, importance and quantification. That is, it includes: a) identifying the common measures, across stressors; b) identifying measures practical for the longer term; c) identifying key measures that describe ecosystem/ecological integrity; and d) showing how a shorter set could produce quantitative indices of health (status of the system today) and integrity (status of the system over time, relative to an appropriate baseline). Such indicators and indices would be the basis for frequent and publicly visible environmental reporting on coastal waters of the Northwest Atlantic, in this workshop's context, the Gulf of Maine and Bay of Fundy.

[Paper Session C1]

Enhancing the Use and Influence of Bay of Fundy Information - Insights from Recent Studies of the BoFEP Fundy Informatics Working Group

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The Bay of Fundy region is rich in living and non-living resources but it has many resource and environmental issues to consider and manage. Regional policy and decision-makers continually need relevant information to consider options, make informed decisions, and take action to manage resources and risks effectively. The Bay of Fundy is a data and information rich area, with many data banks and thousands of publications produced over the past 150 years. A major BoFEP goal is to make this information more accessible and influential with the whole Fundy community, through the BoFEP website (Percy) and through an on-line "Information Collaboratory" (Toms *et al.*). In a parallel study, several group members (MacDonald, Wells, *et al.*) have been examining the diffusion, use and influence of information produced by two international organizations responsible for giving strategic advice on current issues affecting the ocean. Their research team has utilized a suite of established methodologies (e.g. citation analysis, content analysis), and is embarking on surveys and interviews of key informants, and developing new measures of information influence in the environmental management realm. This presentation describes the above Fundy Informatics WG initiatives; introduces the study of grey literature of the international organizations and its ongoing research (tracking new literature, conducting follow-up with users, paramatizing information production and use interactions - social and scientific); summarizes insights on use and influence of information from the working group; and proposes a guiding framework for informatics (access, use, influence) research for the Bay of Fundy.

[Paper Session D4]

Aquaculture Leases on Closed Beaches: a Roadblock to Sustainable Shellfish Management?

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As part of a larger study of integrated management projects in the Canadian Maritimes (see *www.coastalcura.ca*), an assessment of habitat reconstruction and shellfish reseeding projects in the Annapolis Basin and St. Mary's Bay area through the Annapolis Watershed Resource Committee was conducted. It demonstrated an important roadblock to integrated coastal management in the Canadian Maritimes. This case study examines how federal and provincial regulation in shellfish sanitation, in public health, in aquaculture leases and in depuration have come together to present a serious impediment to improved water quality and long term habitat reconstruction. It also demonstrates that the public participation in integrated coastal management promised in the *Oceans Act* has been slow to develop in the face of other legislative agendas.
[Paper Session F9]

Calling for Integrated Management of Saint John Harbour

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The Canadian port city of Saint John, New Brunswick, has many management challenges, including expanding petrochemical development, international shipping, tidal power, tourism, coastal gentrification, etc.. The harbour is also affected by agricultural and forestry run-off, pulp and paper mills, oil refineries, freighter and cruise ship terminals, harbour dredging and dumping, and raw municipal sewage outflows. In the midst of this remains an important inshore fishery. Mitigating environmental impacts and juggling the multiple uses of the harbour requires effective integrated management institutions. Jurisdictional overlaps are part of the problem, with several federal, provincial and municipal agencies producing fragmentary management efforts. While the 1997 *Oceans Act* promised integrated management and a stronger role for stakeholders, many feel that over ten years have passed without any progress. This paper discusses the concerns of the Fundy North Fishermen's Association, which has been central to the formation of several *ad hoc* committees to address specific management harbour issues. They have undertaken planning and research, including environmental impact assessment, developing monitoring protocols, and evaluating tugboat and shipping damage to fishing gear and lobster stocks. In these activities, Fundy North has experienced frustrations created by the existing consultation process, in which there are unclear channels of responsibility and authority. Analysis by the Coastal CURA team (www.coastalcura.ca) suggests government leadership is needed to establish an integrated planning board to help facilitate harbour planning and operations. This paper argues that new policy initiatives can be guided by the experiences in Saint John harbour and by best practices from elsewhere.
[Paper Session D8]
