Coastal Monitoring

and the

Bay of Fundy

Proceedings of

The Maritime Atlantic Ecozone Science Workshop

Held in St Andrews, New Brunswick

[November 11 - 15, 1997]

Editors:

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FOREWORD

Coastal monitoring, covering many types of habitats and ecosystems, is essential for understanding the changes and trends of Canada's marine environments and processes at the land-sea interface.

The Ecological Monitoring and Assessment Program (EMAN), spearheaded by Environment Canada, has a number of sites, supporting marine and terrestrial monitoring and assessments research projects in Atlantic Canada, one of which is the Quoddy Site established in 1994 at the Huntsman Marine Science Centre in Passamaquoddy Bay, New Brunswick. Recently, the Bay of Fundy Ecosystem Project (BOFEP) was started as an outgrowth of the Fundy Issues Workshop of 1996, and a realization that the Bay of Fundy, as a whole, was undergoing changes that were poorly understood but potentially vital to the Bay's ecological and resource viability and sustainability. Scientists involved in work at the Quoddy EMAN Site joined with those of BOFEP to co-sponsor the present Maritime Atlantic Ecozone Science Workshop held in November 1997.

The Workshop attracted 167 persons, 47 formal presentations, 15 posters, 32 talks about associations and groups, and three and one-half days of discussions. The results are in these proceedings. They cover new science and knowledge on the Atlantic EMAN sites and specific coastal water bodies such as Passamaquoddy Bay and the Bay of Fundy, descriptions of stakeholder activities around the Bay of Fundy, and an inaugural meeting of a revitalized BOFEP.

In our view, the meeting created much optimism for the future of Atlantic coastal environments and their living resources, even at this time of crises with fisheries and uncertainties about the magnitude and effects of global climate change. It showed the continued excellence of Canadian marine science and the commitment of its practitioners. It also showed a genuine desire for many different individuals and stakeholders to work together whenever possible for the common goal of coastal sustainability. Above all, it showed the pivotal role of coastal monitoring and subsequent assessment in understanding the ecological processes and biota of coastal environments and the changes occurring in them. There is a need to institutionalize programs such as EMAN to ensure that long-term monitoring and assessment of Canadian coastal ecosystems continues well into the new millennium.

Michael D.B. Burt and Peter G. Wells

St. Andrews, N.B.
March 1998.

TRIBUTE

We offer these proceedings as a special tribute to Dr. Tom Brydges who has been the guiding light for Environment Canada's Ecological Monitoring and Assessment Network. His enthusiastic support of, and participation in, this workshop are especially appreciated in this, the year of his retirement. Ever since the first site was established at Kejimkujik National Park, Tom has worked passionately to extend the network across all the Provinces and Territories of this vast Country. His networking strategies combined with his elegant use of "grease and glue", are second to none; we recognize and applaud him for his outstanding role as a true leader and visionary in Canadian environmental monitoring and assessment.

ACKNOWLEDGEMENTS

The Workshop was supported by EMAN, HMSC, BOFEP, EC and DFO (St. Andrews). Thanks are due to staff at HMSC for their hospitality and support, and the Biological Station (DFO) for use of conference facilities. Susan Hill is thanked for her careful work in typing the Proceedings. As well, the organizers thank all participants, especially those from community groups and from our neighbour to the south, for their efforts to inform us of their work. Publication and distribution of the proceedings was made possible through the generosity of EMAN (Environment Canada, Burlington) and Environment Canada (Atlantic Region), Dartmouth, N.S.

EXECUTIVE SUMMARY

A workshop "*The Maritime Atlantic Ecozone Science Workshop*" was held in St. Andrews, N.B., in November 1997, co-sponsored by the Ecological Monitoring and Assessment Network (EMAN) and the Bay of Fundy Ecosystem Project (BOFEP) and supported by Environment Canada (EC), the Huntsman Marine Science Centre (HMSC) and the Department of Fisheries and Oceans (DFO). The overall theme was "Coastal Monitoring and the Bay of Fundy" as the host of the meeting was the Quoddy site of the Atlantic EMAN program and BOFEP, both groups interested in marine science and monitoring in the Bay. The expectation of about 100 participants was greatly exceeded as 167 persons attended three and one-half days of talks, posters, and discussions. These proceedings reflect the presentations and exchanges that took place during the meeting.

These were four main foci of the meeting:

(1) Presentations during the first day focussed specifically on work in progress in the Quoddy Region largely through efforts associated with the Quoddy EMAN Site (QES). These included: An overview of the QES activities by Wilfred Pilgrim, along with detailed accounts of a certain phytoplankton by Irena Kaczmarska and her colleagues and water dispersal patterns by Fred Page and his several co-workers at DFO; four papers dealing with different aquaculture impacts in Passamaquoddy Bay by Inka Milewski, Gerhard Pohle, Jennifer Martin and Rob Rangeley, along with their respective colleagues; three papers on invertebrate ecology by Rabrindra Singh, Gerhard Pohle and David Wildish and their co-workers; three papers on seabirds in the region by Tony Diamond and his students Kim Mawhinney and Julie Paquet; one paper dealing with coastal fog on coastal forests by Roger Cox and one paper detailing the migration patterns of songbirds that live in coastal forests by Tracey Dean.

(2) Presentations during the second day included: Descriptions of activities of other maritime EMAN sites by Doug Clay (The Greater Fundy Ecosystem EMAN Site), Cliff Drysdale (Kejimkujik EMAN Site), Tom Clair (Terramon EMAN Site), Hugh O'Neill (Terra Nova EMAN Site), and an overview of the challenges faced in the next millennium by Tom Brydges; a description of critical habitats in the Quoddy Region by Mick Burt on behalf of many colleagues; a water classification system by Jane Tims; a discussion of marine protected areas by Inka Milewski; and a description of the National Biodiversity Information Initiative in Canada by Larry Speers.

(3) Presentations during the third day dealt with work in progress in the Bay of Fundy, *sensu lato*, and included such diverse areas as: An overview of the Fundy Marine Ecosystem Science Project by Graham Daborn and Peter Wells; various physical aspects such as storm surges by Charlie O'Reilly and his colleagues,

modelling tidal flows by David Greenberg and his colleagues, and changes in SPM concentration over a tidal cycle by Kee Muschenheim; detailed accounts of various animal populations by Shawn Robinson and his co-workers, spatial patterns and scale by Rob Rangeley and Peter Lawton, benthic communities by Susannah Fuller, the influence of ice cover by Valerie Partridge, and lobsters by Lew Incze; seaweed by Thiery Chopin; the changes in different sea bird populations by Falk Huettman, Peter Hicklin, and Diana Hamilton respectively; the effect of acoustic harassment devices used by the aquaculture industry on harbour porpoises by Dave Johnston; three papers dealing with contaminants in the Bay of Fundy by Sean Brillant, John Dalziel and Phil Yeats, and Vladov Zitko, respectively; and the effects of opening the gates on the Petitcodiac River by Hugh O'Neill and his co-workers.

(4) The morning of the fourth day was devoted to an in-depth discussion of BOFEP on how to foster and maintain close inter-linkages between the various players interested in the Bay of Fundy and further our monitoring and assessment networking. This involved significant dialogue between the different interested groups including the Acadia Centre for Estuarine Research at Acadia University headed by Graham Daborn, the Clean Annapolis River Project headed by Jon Percy and the Fundy Maine Ecosystem Science Project headed by Peter Wells.

In addition, there were 15 poster papers describing various projects relating to the Bay of Fundy and 32 presentations by different groups each of which has an interest in and which is involved in some way or another with the health of the Bay of Fundy.

The value of this total package is much greater than the sum of the various parts as it identifies and brings together most of the major players involved in the monitoring and assessment of changes in the Bay of Fundy. We hope that these proceedings will further our understanding, and hence contribute to better understanding and future management of our fragile marine environment within the Bay of Fundy in the northern Gulf of Maine.

The next Bay of Fundy Science Workshop, the third one sponsored by BOFEP and FMESP, will be held at Mount Allison University in 1999, courtesy of Dr. Jeff Ollerhead of the Geography Department.

You, the reader, are invited to attend and participate.

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- Bay of Fundy and Gulf of Maine

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INTRODUCTION TO THE

ATLANTIC MARITIME ECOZONE SCIENCE WORKSHOP

GUEST SPEAKERS

John M. Anderson
Tom Sephton
Don Dennison

Welcome from Huntsman Marine Science Centre

John M. Anderson, HMSC Chairman
Huntsman Marine Science Centre, St. Andrews, NB E0G 2X0

Good morning ladies and gentlemen. It is my pleasure to welcome you to this special four-day workshop dealing with maritime **ecosystem** issues. It is being co-sponsored in St. Andrews by the Huntsman Marine Science Centre, the organization which I represent, and the Department of Fisheries and Oceans' Biological Station, in whose Conference Centre we are comfortably ensconced. "Ecosystem" is the key word. It's why we're here.

Seen from space, Canada shows no roads, no political boundaries, no languages, no politics and no people; just vast stretches of land and water, which on closer inspection are not uniform. It turns out that these can be divided into twenty distinct ecosystems called ecozones: 15 terrestrial ecozones and 5 marine ecozones. Two of the marine ecozones are in the east, the Northwest Atlantic Marine Ecozone, and the one we're interested in because it included the Bay of Fundy, the Atlantic Marine Ecozone. There are several Terrestrial Ecozones covering Atlantic Canada, but it's the Atlantic Maritime Ecozone which involves us because it includes the three maritime provinces.

There are, of course, many disciplines, and therefore many persons with differing professional backgrounds, involved in understanding how any ecosystem works, and it is because of this that a national Ecological Monitoring and Assessment Network (EMAN) was established. Its purpose is to link inter-disciplinary activities occurring in the Canadian ecozones. To help give structure and effectiveness to EMAN, Ecological Science Cooperatives (ESCs), sometimes called Nodes, other times Sites, have been formed consisting of scientists sharing a common interest in one or more ecological areas of concern.

The Quoddy Node, or Site, or ESC, was established in 1994 jointly by the Huntsman, the New Brunswick Department of Environment, Fisheries and Oceans Canada, Environment Canada, and a range of other partners. The objective which binds the Quoddy Node people together is **understanding the impacts of human activities on coastal systems** through:(i) monitoring marine biodiversity; (ii) monitoring and assessing impacts of airborne chemical pollutants (with monitoring equipment situated on our upper campus, this is one of Huntsman's specific contributions to the Quoddy Node activities); (iii) investigating long-term changes in the Bay of Fundy; and (iv) evaluating the ecosystem effects of aquaculture and resource harvesting in the Quoddy region.

But EMAN does not have a lock on the concept behind it. Thus, there is the Bay of Fundy Ecosystem Project (BOFEP), and the Fundy Marine Ecosystem Science Project (FMESP) which share much in common with the Quoddy EMAN Site. We'll hear more about the Fundy Marine groups, led by Drs. Daborn and Wells, on Friday.

In the meantime, welcome again, and enjoy your stay in St. Andrews.

Opening Remarks

Tom Sephton, Director
Fisheries and Oceans, Canada, Biological Station, St. Andrews, NB

The St. Andrews Biological Station has a long and distinguished history of involvement in ecological research in the Bay of Fundy which continues to the present day. The depth and breadth of research which has been, and continues to be, conducted at the Station in collaboration with the Huntsman Marine Science Centre, other research institutes and universities provides the foundation for many environmental monitoring programs both in the immediate geographic area and across the continent.

A few highlights include studies such as the effects of pulp mill effluent on the aquatic environment, acid rain, toxic phytoplankton, effects of salmon pen culture on the local environment, effects of escaped farmed salmon on local wild populations, and, most recently, the effects of coastal oceanography on the sustainability of aquaculture development for salmon and mussels. The latter study hopes to provide some insights into the fish-holding and shellfish-carrying capacity of those areas presently being used for aquaculture with the ultimate goal of providing both an administrative and farming management tool for the sustainable development of aquaculture in those areas. This information is timely in light of the review of the provincial salmon aquaculture site evaluation policy which commenced recently.

It is through this natural association with environmental concerns that the Biological Station and its staff are both pleased and proud to be associated with the Quoddy EMAN Site and an active participant in the Maritime Atlantic Ecozone Science Workshop. Throughout the course of this week's Workshop, I hope that everyone will have both the courage and the insight to ask both the difficult questions and to participate actively in the ensuing discussion periods with an open mind. Therefore, on behalf of both the staff and myself, we extend to you a warm welcome to St. Andrews and wish you every success through the course of the Workshop.

Welcome Address

Don Dennison
Deputy Minister, New Brunswick Department of Environment
Box 6000, Fredericton, NB

I'm very pleased to have the opportunity to speak at the outset of this important event and am replacing the Hon. Joan Kingston who is in Regina today meeting with the Federal Minister of the Environment and Provincial colleagues. I'm also pleased to be here today as one who follows closely the issues and concerns affecting the present and the future of this region.

As an avid, and fairly regular, reader of the St Croix Courier I look particularly for Dick Wilbur's "Fisheries File". Last Friday, in his column, Dick asked who is really heeding the environmental warnings of the Conservation Council of New Brunswick, the Eastern Charlotte Waterways Inc., the St Croix Estuary Project or even the Atlantic Salmon Federation. These efforts are heard and heeded not just by politicians but by dedicated professionals within Provincial and Federal Departments who are encouraged by the work and interest of community-based organizations. In the same column, by way of closing, Dick asks the question: "Who is our Environment Minister?" to which I can only respond, somewhat bureaucratically: "It all depends..." For some matters, it is Joan Kingston; for others it is Christine Stewart. The problem is that without better clarification of the roles and responsibilities, how are we, let alone the public, to know who should be held to account? But more about that later.

The recognition of the Quoddy Node (now the Quoddy EMAN Site [QES]) as an official EMAN site is a significant accomplishment, and one in which everyone involved can take well-deserved credit. Many benefits flow from such a designation and I'm sure they will be evident over the next two days as a great deal of new information about environmental quality in our corner of the world is examined in detail.

I find it particularly encouraging to see such a wide range of interests represented among the participants here today. This underscores the fact that in any environmental science endeavour, a multidisciplinary forum is a great help in trying to fit the diverse pieces of the overall picture together. No matter what the technical topic is over the course of your specific discussions, one key point is certain to arise near the end of each session and it's typically introduced by someone asking: "Where do we go from here?"

Taking a peek into the crystal ball is never easy, but when groups of individuals are mapping out an environmental monitoring program, it's rather important that they have a sense of what the future holds. I am very mindful of the fact that there is much on the positive side of the ledger to focus on at this event but, at the same time, I want to sound a cautionary note. The fact is that answering the question: "Where do we go from here?" is likely to prove much more difficult than any of us would have preferred. In fact, as 1997 draws to a close,

there is considerable evidence that the field of environmental monitoring across Canada is in a state of flux. And, from our New Brunswick Provincial perspective, we see distinct clouds on the horizon as a result.

The kind of environmental science we are talking about at this event is obviously something each and everyone of us wants to see continue and grow in New Brunswick for many years to come. But, frankly, I am not as confident as I would like to be that the future will unfold along those lines. Against this background, I believe the QES group can be a very positive influence in addressing the issues involved.

The New Brunswick Department of the Environment brings a particular perspective to any discussion of 'who should be doing what?' in the field of environmental programming; and it flows directly from the concerns we have been expressing for more than three years at the "Harmonization" table with our colleagues from the Federal Government and the Provinces. New Brunswick's view, from the outset, has been that the Federal Government's role regarding the environment should be significantly strengthened in our Province, through harmonization.

This is where I want to come back to Dick Wilbur's question: "Who *is* our Environment Minister?". The fact of the matter is, that in the scurry to respond to environmental challenges and public pressures, legislation has been developed and organizations built without any clear distinctions being drawn about who is responsible for doing what. Two years ago, in an effort to address this problem, an environmental management framework agreement was developed that laid out ***for the first time*** some roles and responsibilities in 11 different areas, including the issue of central importance to the QES, 'Research and Development'.

"Research and Development are the critical underpinnings for environmental management. This schedule recognizes a leadership role for the Federal Government and commits the parties to develop a database of research plans, progress and results. This schedule proposes the establishment of a National Environmental Science Forum for the purpose of setting jointly agreed-on priorities for environmental research and development. The Forum will also review trends in environmental research and development and will adjust priorities accordingly".

This schedule and entire framework were rejected largely at the urging of those who were afraid that it was all an effort to hand over Federal responsibilities to the Provinces. Last week, Environment Ministers were supposed to meet to initial a much more modest package, an accord and three sub-agreements, which haven't even addressed the crucial questions of science and eco-system monitoring. More pressing considerations, the run-up to the Kyoto Conference, caused the Federal Minister to cancel the meeting. Meanwhile, as we know, budgetary decisions march on; the cuts to Environment Canada's budget are somewhere between 30 and 40% and all of you know that these are not across-the-board cuts. Certain areas, the most critical to this forum, are being cut even deeper.

All of this cries out for two things:

1. A better definition of who is responsible for what; and
2. A rational combined effort at making the best of what we have to work with.

That is really all that harmonization is about and I sincerely hope it can get back on track.

In advancing this file, New Brunswick has been stressing at every opportunity that the experience, expertise, and clear 'pre-eminence' of the Federal authority in the field of environmental science is crucial to effective environmental programming at the Provincial level. One reason we take this position, of course, is that in our view New Brunswick has not been the focus of sufficient attention over the years by Federal environmental monitoring programs. The creation of the Quoddy EMAN Site, for example, is certainly good news. But, I think most would also agree it comes rather 'late in the game', from the New Brunswick point of view, particularly when you look simultaneously at the major investment in monitoring which the Federal Government has made within Nova Scotia over the last quarter century.

The establishment of the Quoddy EMAN Site also comes at a time when we are receiving unsettling news from Ottawa and Dartmouth about further general constraints on Federal environmental monitoring activity. Our firm view is that the scientific effort within Environment Canada is absolutely the last area where long-term budget reductions should be considered; yet, when asked to demonstrate how such cuts would impact on New Brunswick, we find ourselves in an odd situation. Since the level of Federal effort in environmental monitoring within New Brunswick has been 'so low' for 'so long', further restraints may not appear to be as statistically significant here as elsewhere.

This past summer, the Atmospheric Environment Service of Environment Canada began offering a public information service in southern New Brunswick on smog forecasting. It was a pilot project which received a generally good response from a variety of stakeholders and local news media outlets. At the same time, however, it should be pointed out that Federal support for the Provincial air qualify monitoring system, which made that project possible, has been on a declining track for years. Furthermore, that system is focused on only one section of the Province. The northern and eastern parts of New Brunswick are essentially unserved by the Federal Government in terms of air quality monitoring; recent information we have received suggests that further constraints on our existing NAPS Station System may also be in the cards.

These are just some examples of the questions we have about the future strength of Federal scientific efforts within New Brunswick, but I also want to highlight this as a national issue.

This week, environmental and energy Ministers are meeting in Regina to work on three critical environmental problems: Climate change; acid rain; and smog. There will be a significant amount of scientific information on the table at that discussion, much of it originating with the Federal authority or coordinated by Ottawa in conjunction with the Provinces.

Monitoring, coordinating, reviewing, and interpreting that kind of scientific information is, in my opinion, the single most important role which any agency of Federal Government can play in the environmental field. It's a role which taxpayers in all parts of Canada have been comfortable with for decades and it's a responsibility which Ottawa has carried with considerable distinction, and wide-spread recognition, within the scientific community. Some Provinces in Canada may believe themselves to be capable of taking on that role from the Federal Government as part of the 'Harmonization' exercise. I would seriously question whether that is actually viable in any jurisdiction; I can assure you it is not the case in New Brunswick. To the contrary, we see environmental monitoring, research, and the coordination of setting National Standards as the key contribution which can, and should, be made by the Federal Authority.

New Brunswick is committed to supporting those efforts to the best of our ability, and within our own program and resource limitations. But, we also recognize that the scientific challenge ahead can only get more technically complex in future years. It seems that as we steadily learn more about our environment, the unanswered questions which remain become even more challenging. With this in mind, Canada needs to build on its strengths and the Federal Government is clearly best suited for this critically important task.

In the months ahead, I can see the Quoddy EMAN Site playing a very useful role in developing a 'holistic approach' to the provision of scientific information on the assessment of our environment in New Brunswick. I would urge you to continue building partnerships wherever possible and working to identify areas for future concentration through a 'harmonized' approach. But I would also suggest an additional role for everyone associated with this group and that, quite frankly, falls under the broad definition of 'lobbying' Ottawa. In every way possible, I believe we should continue to make the case both internally and externally, that the environmental science and monitoring role of the Federal Government has never been more important to our Province, and to our Country, than it is now; and it is destined to become even more critical in the years ahead.

Let me cite just one, but very timely example. The National Acid Rain Strategy, which is before Ministers today in Regina, sounds a very ominous warning note: "The most pressing requirement is to maintain an adequate level of monitoring". It goes on: "Without rejuvenation of monitoring programs, the 1997 acidifying emissions assessment report will be the last assessment of aquatic impacts of its kind". Perhaps by finding new ways to get this message across, the Quoddy EMAN Site can contribute in a very concrete way to ensuring there will be many future meetings like this in the years ahead which can only serve to benefit the environment we all share.

SESSION ONE

THE QUODDY EMAN SITE

Wednesday, November 12, 1997

Session Chairmen:

W. Pilgrim

R.M. Cox

The Quoddy EMAN Site

W. Pilgrim
New Brunswick Department of Environment, P.O.Box 6000, Fredericton, NB

Historically, the Ecological and Assessment Network (EMAN) was developed as a multi-agency, Canadian science network. It is led by Environment Canada but consists of various partners: NGOs, other government departments, First Nations, and universities. EMAN started in 1994 and national workshops were held across the country.

The specific goals of the Quoddy EMAN Site in St Andrews, managed by the Huntsman Marine Science Centre (HMSC), are to:

- Monitor and assess coastal and atmospheric issues;
- contribute to sustaining the viability of the Quoddy Region's natural resources;
- form partnerships with other organizations in addressing various issues.

Traditionally, Provincial and Federal Government Departments have worked independently with little cooperation between similar-line departments. This segregation has resulted in overlap of jurisdiction, duplication of effort, and a general lack of coordination. It was to overcome this that EMAN was formed. EMAN advocates partnerships even between government departments. Has EMAN been successful in the last four years? Is it working as proposed in 1994? Are we cooperating and forming partnerships outside our respective agencies and disciplines?

Nationally: 85 sites have been established and are linked through the activities of the Coordinating Office and the Annual Meeting.

Regionally: The Atlantic Region was the first in Canada to establish a site (at Kejimkujik National Park) and the Atlantic Region has a Regional Steering Committee with a representative from each site.

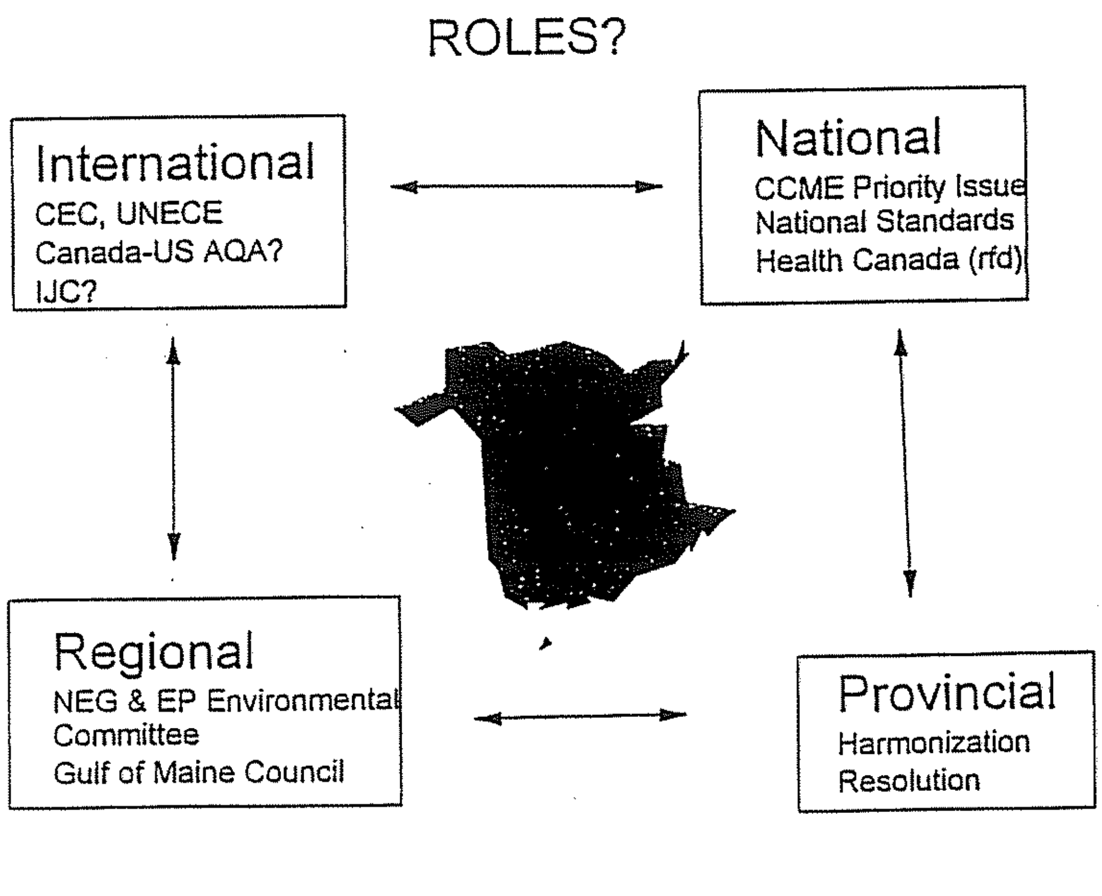
Locally: There is both a Management Committee which meets three or four times/year and an Advisory Board consisting largely of stakeholders.

The Quoddy EMAN Site (QES) has developed several partnerships with various organizations. A number of different projects depend on the Atmospheric Master Site on the grounds of the Huntsman Marine Science Centre where the QES is centred. At this site, the following environmental pollutants are monitored on a regular basis:

→ Ground level ozone;
→ Temperature and humidity;
→ Total gaseous mercury;
→ Visibility;
→ Fine particulate airborne material; and
→ Toxic organic compounds.

One of the main issues being addressed at the QES is atmospheric mercury and its effects on the biota of the region. There was a Mercury Resolution, signed by the Governors and Premiers of the New England States and Eastern Canadian Provinces respectfully, in June, 1997. The aims of the Mercury Resolution are: (1) To develop coordinated regional, national, and international efforts; (2) to complete a study of the Mercury Issue in the northeastern States and eastern Provinces; and (3) To provide support for cooperative action between the States and Provinces involved. The roles and inter-linkages are shown in Figure 1 below:

Figure 1



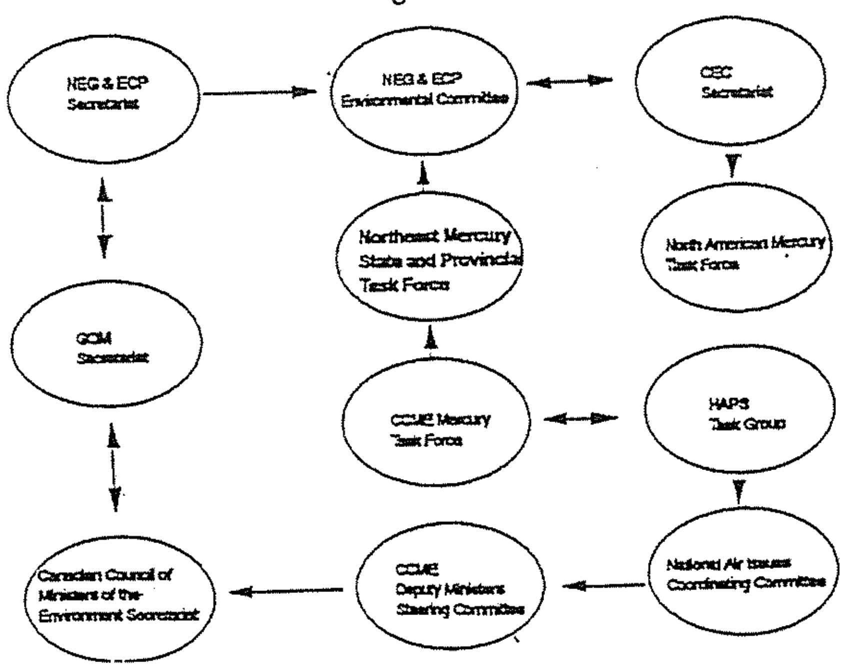
Important inter-linkages

Evidence of mercury impacts in New Brunswick

Provincial sources of atmospheric mercury include coal combustion, the chlor-alkali industry, cement manufacturing, medical waste incineration, dump burning, glass manufacturing, oil refining, wood burning and crematoria. Although New Brunswick sources emit only a small percentage of the regional mercury emissions, the New Brunswick environment, based on very little data, show elevated mercury levels in precipitation, sediments, and biota. Wet mercury deposition in southern New Brunswick is moderately high (8-10 ug/m^2/yr in 1997) compared to background levels of 1-4 ug/m^2/yr. Historic radio-carbon dated sediment profiles show that mercury accumulation has increased in the New Brunswick environment from 2-5 times what it was in 1880. Mercury levels in New Brunswick loons are some of the highest in North America. Mercury levels in bass, pickerel and yellow perch are elevated to the degree that, when consumed in average amounts, the daily allowable mercury intake would be exceeded.

Figure 2 (below) shows a suggested reporting structure for the eastern Canadian Provinces and northeastern States Mercury Task Force.

Figure 2



Suggested Mercury Task Force reporting structure

Figure 3 (below) compares mercury emissions for Canada and the USA as well as for the eastern Provinces and the northeastern States and Figure 4 shows seasonal variation in mercury concentration in precipitation at NADP sites in Atlantic Canada from July, 1996 to October, 1997.

Figure 3

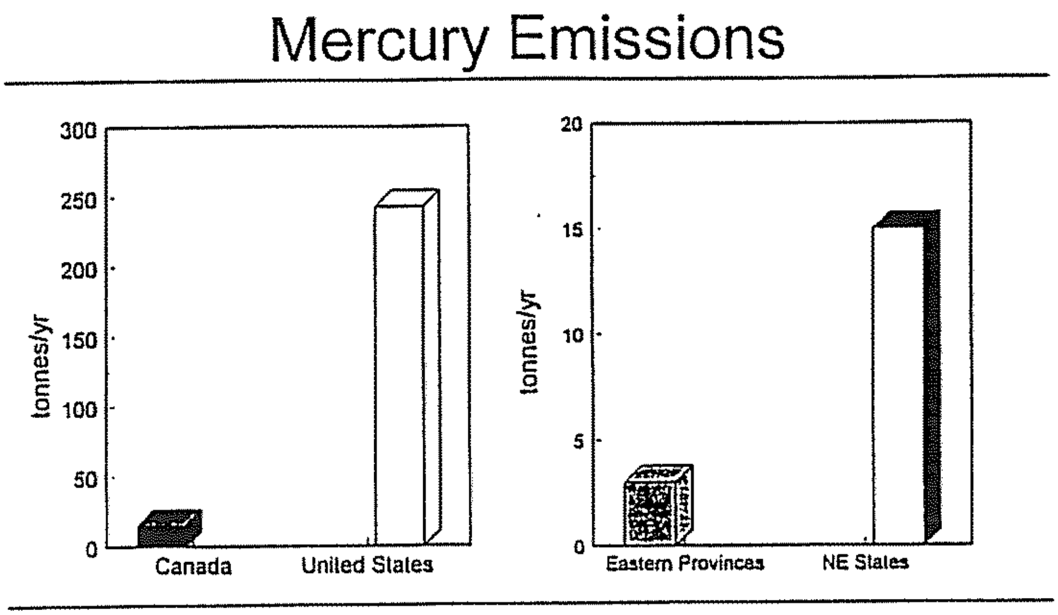
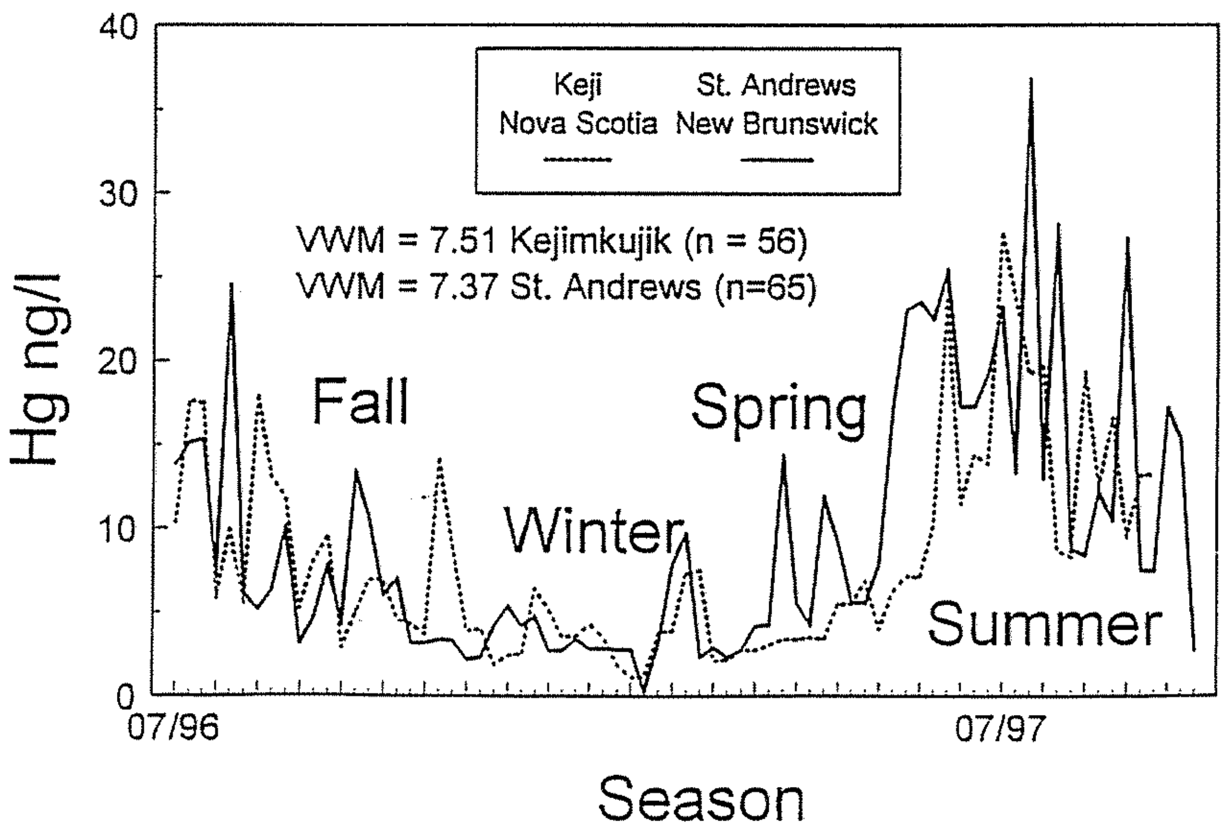


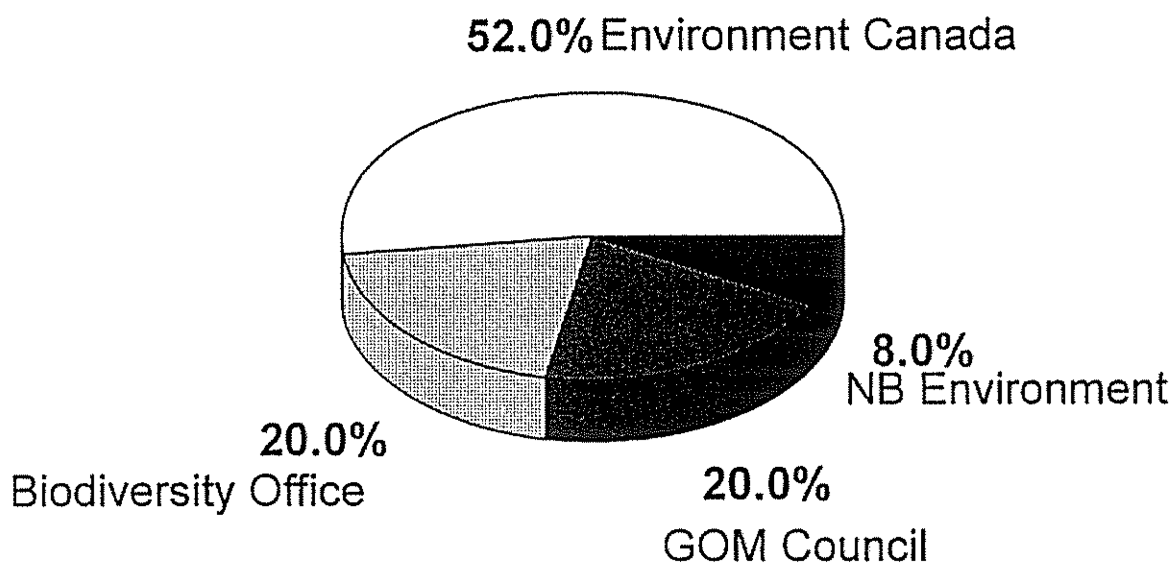
Figure 4



The State of Maine is already addressing the Mercury Issue in that they have: (1) passed legislation with respect to emissions; (2) initiated a Toxics Monitoring Program to determine the extent of the problem; (3) developed an air monitoring network; (4) compiled an inventory of sources; (5) issued fish consumption advisories; (6) initiated extensive lobbying by the commissioner; (7) collaborated with Canada; and (8) called for Federal Legislation.

Resources provided to the Quoddy EMAN Site since 1994 are shown in relation to each other in Figure 5.

Figure 5



Resources provided to the Quoddy EMAN Site since 1994.

In summary:

EMAN sites are focal points for interactions between agencies;

EMAN sites constitute Country-wide linkages; and

EMAN provides a forum for consensus science.

Sporulation of *Chaetoceros furcillatus* in Passamaquoddy Region, New Brunswick, Canada

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Introduction

Many coastal marine phytoplankton include in their life cycle the formation of morphologically distinct, physiologically resting spores. Spores are thought to enhance survival of a population at the end of a bloom when nutrients are low or when other factors inhibit cell growth (e.g. Hollibaugh *et al.*, 1981, Hargraves and French 1983). Rapid changes in nutrient concentration, photoperiod, temperature and salinity are known to induce formation of spores. Heavily silicified resting spores sink and settle to the bottom of shallow waters. These accumulations may form an inoculum for subsequent blooms (Van Iperen *et al.* 1987, Itakura *et al.* 1997). When the spores of different species have different germination timing and requirements, a spore "seed bank" may represent a source of variation in species succession (Pitcher 1986, Itakura *et al.* 1997).

Spore producing genera, particularly *Chaetoceros* and *Thalassiosira* are at their peak of diversity and density in cool coastal regions where the properties of environment fluctuate and seasonal mixing of waters returns cells to the surface. The genus *Chaetoceros* is well represented in the Quoddy Region. We identified thirty eight species of this genus, fourteen of which formed spores. Of these, *Ch. furcillatus* is the most prolific spore former. Earlier workers noted the presence of spores in Passamaquoddy Bay, but to date the spores were neither enumerated nor was their distribution related to the physico-chemical properties of ambient waters. Our goal was to examine the timing and process of sporulation in the local population of *Ch. furcillatus*.

Material and Methods

The study was conducted in the Quoddy Region as defined by Thomas *et al.* (1983; Fig. 1). Samples were collected using van Dorn bottles from discrete depths and vertical and horizontal net hauls. The vegetative cell and spore concentrations and relative abundance were related to temperature, salinity and depth of the sample by using the Pearson correlation method and the coefficients tested with Bonferroni test for probabilities (SYSTAT 5.0, 1990). When appropriate a t-test and Tukey's HSD (pair-wise comparisons) were also applied.

Results and Discussion

Ch. furcillatus resting spores form abundantly, in contrast to many other species. Most spores were produced at the end of a high cell density period for the vegetative population in May and June, but a few spores were always present throughout the whole period. Two morphological types of resting spores were found, the paired (typical) and single-celled (atypical) spores (Fig. 2). Sporulating chains of *Ch. furcillatus* produced normally only one type of spore. The onset of spore formation is evident when the spore-parent cell produces a specialized valve with strong seta, the valves which will hold the spores. Each spore results from two consecutive mitotic divisions so there is a net loss of three progeny cells for each spore. This represents an energetic investment and population loss, presumably outweighed by the adaptive advantage conferred on the species by the ability to produce spores.

Vertical distribution of vegetative cells and spores was different. Vegetative cell concentrations displayed positive correlation with temperature (0.768), and negative correlation with depth (-0.694); cell densities were highest in the upper 12 m of the water column. The spore (both paired and single-celled) concentrations were negatively correlated to temperature (-0.607) and positively correlated to salinity (0.711), generally at deeper and saltier parts of the water column. Thus, spores correlate to the cooler, deeper and saltier waters but the single-celled spores less so than the paired ones.

The relative abundance of paired and single-celled spores was not uniform between the stations. Single-celled spores were more frequent in the southern Stations (1 - 5), while paired spores were more frequent in the northern part of Passamaquoddy Bay and in the Outer Quoddy Region (Stations 7 - 12; Fig. 3). Both spores were least abundant in Station 6, and most abundant in Stations 4 and 9. The spores are correlated to the cooler, more saline and usually deeper parts of the water column at individual stations. However, when considering all stations throughout the Quoddy Region, we observed that the single-celled spores are more abundant in relatively warmer and less saline waters of the southern part of Passamaquoddy Bay, while paired spores are more common in the northern part of the Bay and in the outer Quoddy stations. Thus, differences in spore morphology relate here to different ecology. The southern part of Passamaquoddy Bay remains under the influence of the St. Croix River for a few weeks longer during May and June than the northern part of the Bay (Robinson *et al.* 1996).

Ch. furcillatus shows inter-annual variation in its relative abundance in the Passamaquoddy Bay, exemplified in Station 1, at Brandy Cove (Fig. 4). Annual maxima of relative abundance in 1991, 1994 and 1996 constituted between 35 and 41% of the micro-phytoplankton community. During 1988 -1990 the diatom was either undetected or the annual maximum of abundance did not exceed 10%. A similar trend of increasing relative abundance of this species can be seen in the Outer Quoddy Station at Wolves. At this time, two alternative explanations should be considered. First, an increase in abundance represents a natural cyclicity in population dynamics of the species in this region. However, the increase in cell abundance and duration of species existence coincides well with the growth of fish aquaculture in the Quoddy Region (DFO 1995). Cold water fish culture developed in Atlantic Canada from its infancy in the early 1980's to a $100 M industry in 1994. We thus speculate that factors associated with the commercial phase of fish aquaculture affect the environmental conditions that favour more abundant occurrence of *Ch. furcillatus* in the last few years. Further studies are needed to identify the factors and to substantiate the causal relationship between the recent increase of this diatom and fish aquaculture. It would also be most interesting to study how the change in this species abundance is reflected through the Passamaquoddy food web.

Acknowledgments

The staff of HMSC at St. Andrews, N.B. expertly assisted at sea and in our initial research at their facilities. J. Ehrman helped with statistics, graphics and operation of the SEM. The research was supported by NSERC Research Grant to I. K. and M. Y. Bell and an Undergraduate Summer Research Scholarship to T. P.

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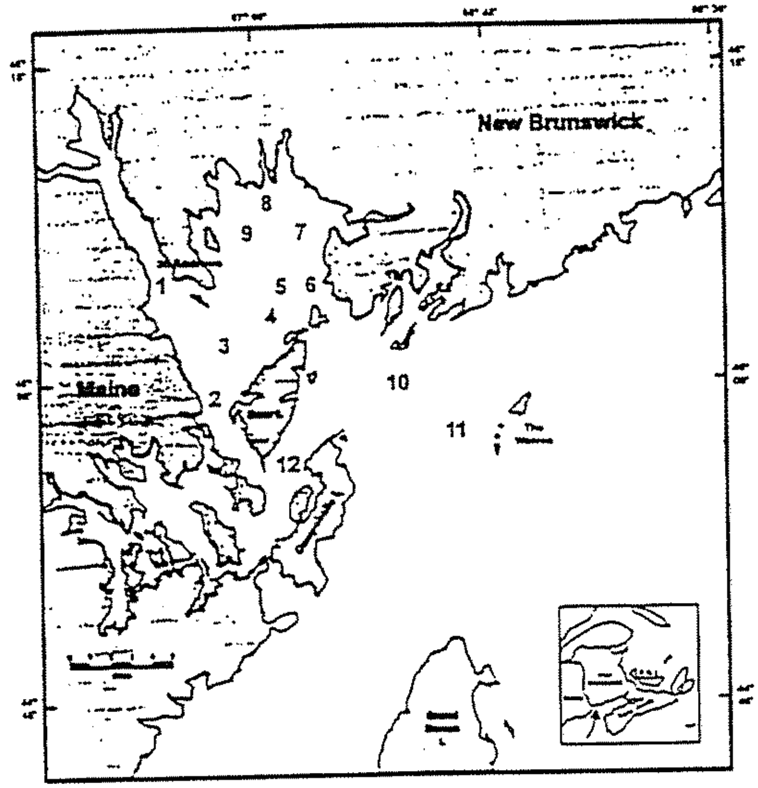
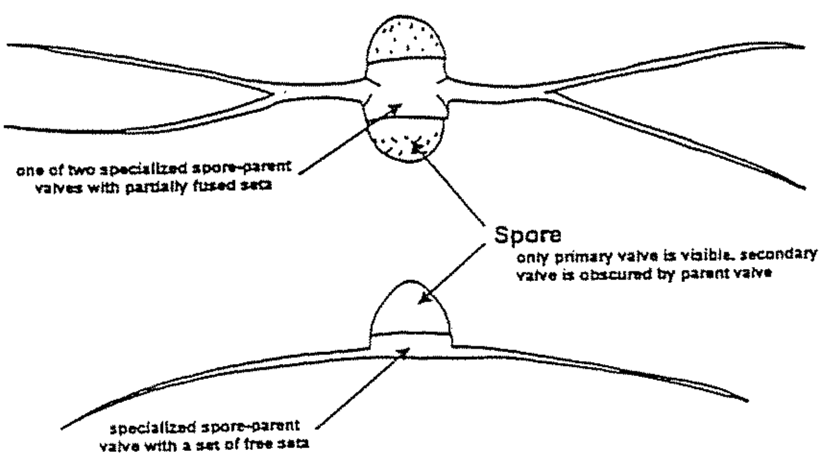
Figure 1



Map of the Passamaquoddy Region showing location of the sampling stations (1-12).

Figure 2

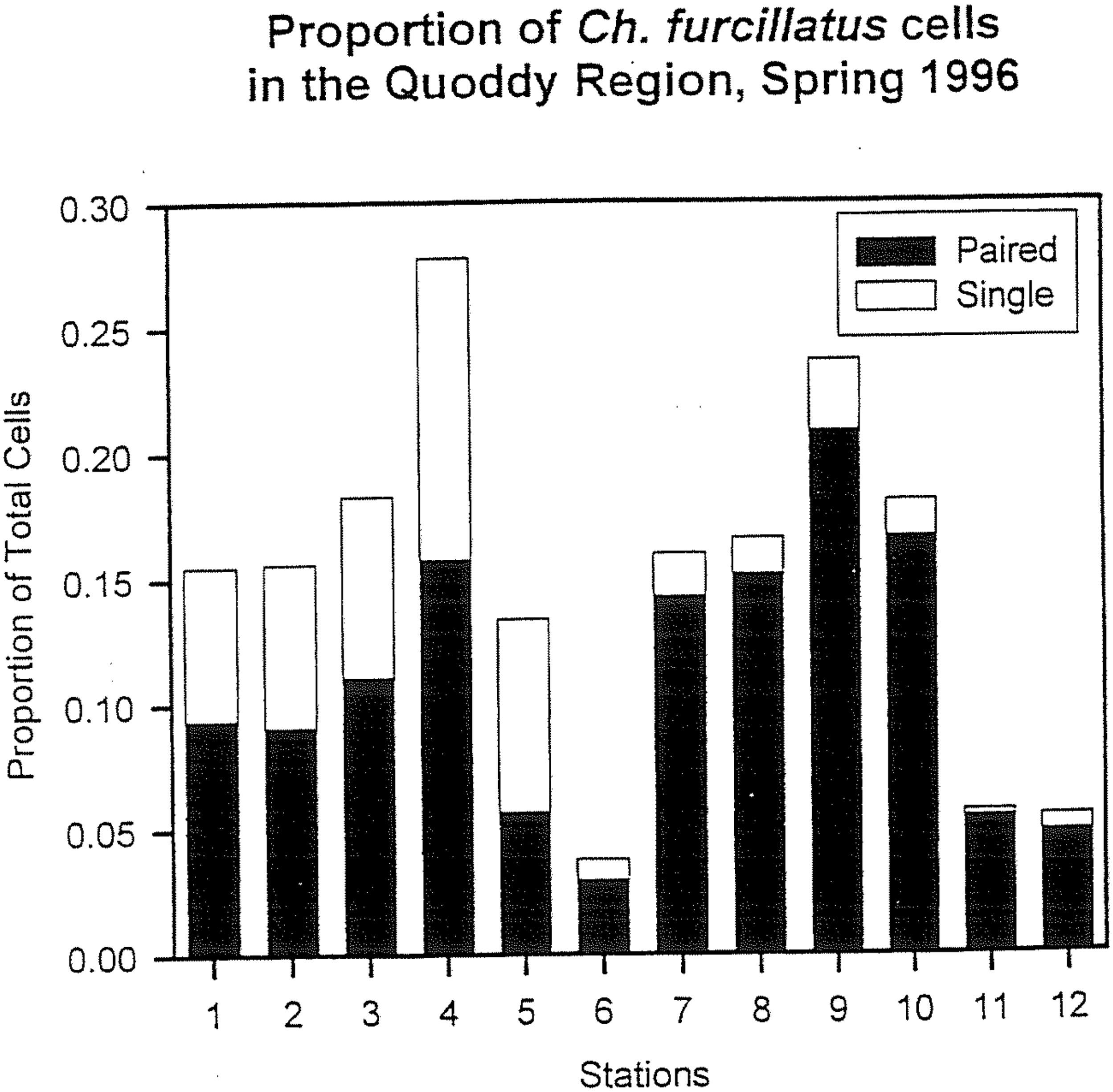
Paired Spores



Single Spore

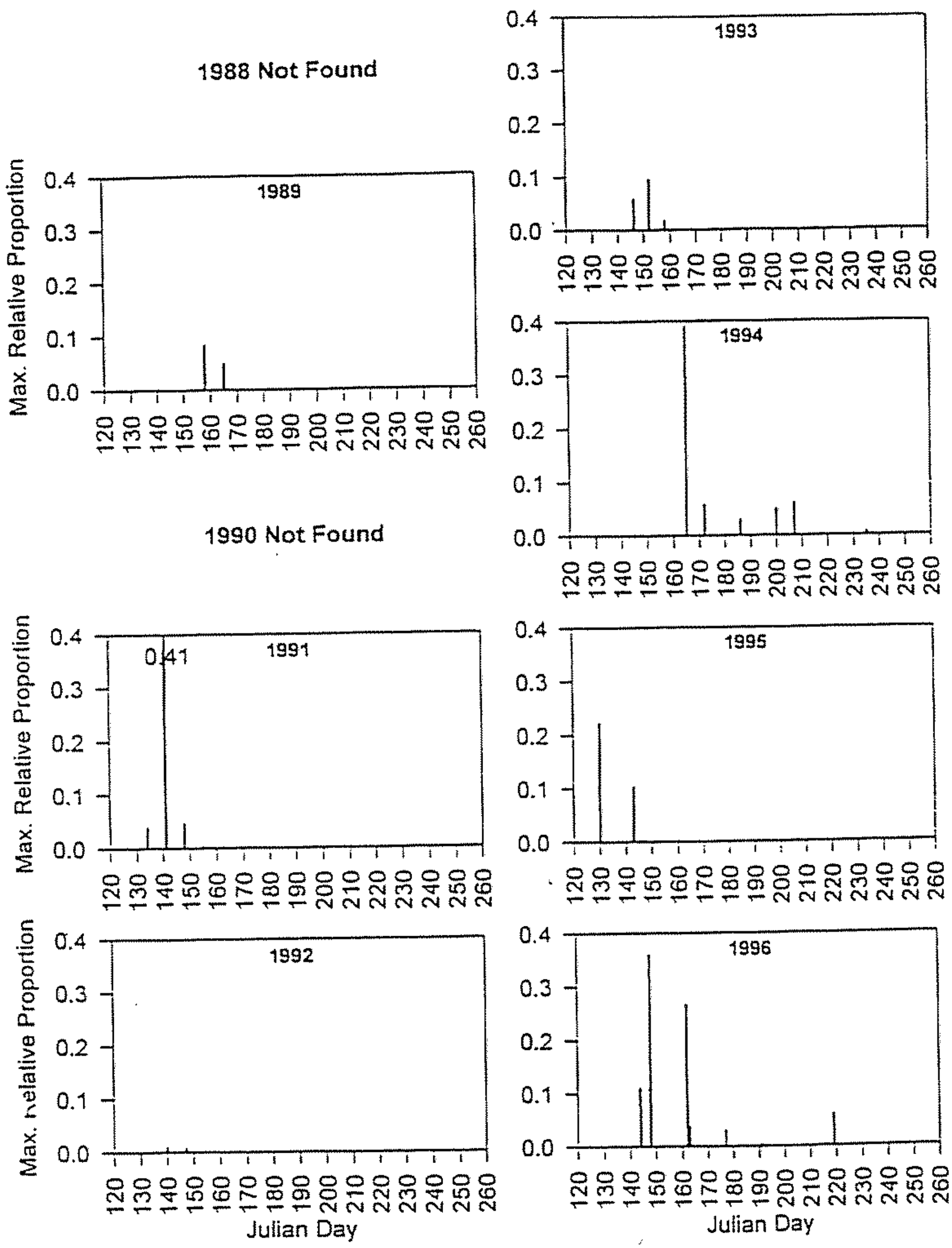
Fig. 2. Diagrammatic representation of the two types of spores.

Figure 3



Proportion of the paired and single-celled spores at each sampling station in spring 1996.

Figure 4



Annual proportions of *Ch. furcillatus* cell densities (including all spores) over the nine-year period at Brandy Cove (St. 1).

A protocol for passive ozone monitoring for forest health assessment

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Abstract

Levels of tropospheric ozone, established as national air quality objectives for the protection of crops and other plants, are now being exceeded over large forested areas, giving rise to the need for an extensive monitoring program to establish ambient levels and to detect related forest health effects. The requirement for an inexpensive monitor that can be used in remote locations prompted the development of the CanOxy Plate™ passive ozone monitor and a monitoring protocol by the air pollution research group of the CFS's Forest Health Network. The monitors underwent initial trials in 1996 and operational trials during 1997 that involved two, 2-3 week mid-summer exposures in the canopy, and at adjacent forest openings at selected ARNEWS sites across Canada, including some in the southern Maritimes Region. In both trials the monitors were also co-located with Ogawa passive ozone samplers at the nearest continuous ozone air quality monitor. This allowed for the production of a field calibration for quality assurance assessment, and comparison of the two passive monitors under field conditions. Rigorous foliage sampling for forest health assessment was a key part of the 1997 trials. Results from 1996 indicate similar performance of the two monitors, both yielding highly significant correlations with accumulated ambient ozone concentrations at the co-located sites (r^2 of 0.97 for the Ogawa and 0.93 for the CanOxy Plate). However, no such relationship was found between these sites and the forest plots often several hundred kilometres away. This may indicate spatial heterogeneity in ozone exposure between the continuous air quality monitoring sites and the forest plots. This information, together with our knowledge that strong gradients of ozone exposure are found within the canopy, underlines the importance of *in situ* monitoring of ozone exposure of Forest Health plots at risk to ozone effects. These results have encouraged the development of a passive ozone monitoring protocol which will also be discussed.

After the gold rush:
The status and future of salmon aquaculture in New Brunswick

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Abstract

This presentation provides a synopsis of a recently published report by the Conservation Council of New Brunswick* which examines New Brunswick's salmon aquaculture industry from its inception and outlines the resulting public policy issues, including environmental impacts, public subsidies, conflicts with traditional fisheries, and constraints on the future development of finfish aquaculture in this region. The report also proposes a policy and regulatory framework that the Conservation Council believes is required to address many of the problems identified in the report.

* After the Gold Rush: The Status and Future of Salmon Aquaculture in New Brunswick. I. Milewski, J. Harvey and B. Buerkle. 1997. Conservation Council of New Brunswick. Fredericton, NB. 61pp.[ISBN 0-9695708-5-6]

Local and regional enrichment effects: An assessment of Lime Kiln Bay and Bliss Harbour

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Abstract

A 3-year study sponsored by the New Brunswick Department of Fisheries and Aquaculture (DFA) on the effects of organic enrichment in Lime Kiln Bay and Bliss Harbour was recently completed at HMSC. The research involved an assessment of the community structure of organisms living on the bottom in the vicinity of aquaculture operations. While a previous study showed little environmental impact beyond cages of relatively recently established operations, the present study documented effects much further away. For the first time, evidence of regional rather that local effects were also documented in Lime Kiln Bay. This area has the greatest density of aquaculture operations in the Bay of Fundy but also receives some additional effluent from other industrial sources further away. The embayment-wide impacts were less severe than in the proximity of cages but continued close monitoring will be essential to determine the nature and extent of alterations over time to help prevent more detrimental conditions. Findings should help NBDFA in its ongoing review of site allocation policy. Presently, another NBDFA-sponsored study has been initiated to document the effects of fallowing, a recommended practice where an area previously used for fish farming is allowed to recover while culture operations move elsewhere. The extent and timing of recovery will be of primary concern in this study. Results should help fish farmers implement fallowing practices.

The participation of Dr. Robert Findlay, University of Miami, is gratefully acknowledged.

Does aquaculture impact harmful algal blooms in the southwest Bay of Fundy?

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Introduction

There has been concern in the last 10-20 years throughout the world that harmful algal blooms are increasing in intensity, frequency, number of species responsible and geographical distribution. Correlations are also being made between increased eutrophication and industrial pollution. The implication of the salmonid aquaculture industry impacts on harmful algal blooms in the southwest Bay of Fundy is of major concern. As a result of the rapidly expanding industry that began in 1980, a phytoplankton monitoring programme was initiated in 1988 in order to: act as an early warning to the industry of potentially harmful algal species; establish baseline data since the most recent records of phytoplankton populations in the area were from Gran and Braarud (1935); determine patterns and trends in algal populations; and study the impacts of aquaculture on the phytoplankton community.

Major industries affected by harmful algal blooms in the Fundy region include bivalves (soft-shell clam, blue mussel and giant sea scallop) and herring. Bivalves filter-feed and when feeding on species such as *Alexandrium fundyense* and *Pseudo-nitzschia pseudodelicatissima*, organisms responsible for producing paralytic shellfish poisoning (PSP) toxins and amnesiac shellfish poisoning (ASP) toxins (or domoic acid), respectively, toxins are stored in their tissues without visibly affecting the bivalves themselves. PSP has a long history in the area. For example, traditionally, it was common for natives in the area to avoid eating shellfish or to prefer eating bark from trees during months that did not have an "r" in their spelling for fear of illness. Toxins are not accumulated in the scallop meats or muscles; therefore not affecting their market value. However, marketing of viscera is not permitted due to toxin accumulation and retention for extended periods. The retention-only records of fish mortalities from marine toxins are from 1976 and 1979 when hundreds of tonnes of herring in weirs in the Grand Manan area died following consumption of PSP toxins accumulated through the food chain.

Presented are results of *Alexandrium fundyense* and *Pseudo-nitzschia pseudodelicatissima* populations since 1988 and resulting shellfish toxicities.

Materials and Methods

Sampling for phytoplankton in the southwest Bay of Fundy has been conducted by Fisheries and Oceans Canada in St. Andrews since 1988. Four sites that continue to be monitored weekly during warmer months and monthly during wintertime are: Brandy Cove, Lime Kiln, Deadmans Harbour and an offshore indicator site located near the Wolves. Additional measurements include: temperature, salinity, chlorophyll *a*, nutrients (nitrates, phosphates, silicates and ammonia), and secci depth.

PSP shellfish toxicity results continue to be done by mouse bioassay according to the AOAC method and are collected and analyzed by the Canadian Food Inspection Agency (AOAC, 1984).

Results and Discussion

Since the programme was initiated, more than 200 algal species have been observed of which 5 are known to cause problems - *A. fundyense* and *P. pseudodlicatissima* (problems with PSP and ASP, respectively, in the Bay of Fundy), *Gyrodinium aureolum* (salmonid mortalities in Scandinavia and the U.K.), *Chaetoceros convolutus* (salmonid mortalities on Canada's west coast) and *Dinophysis* spp. (diarrhetic shellfish toxins in Nova Scotia, Newfoundland and elsewhere in the world.)

Historical shellfish toxicity records indicate that PSP toxins and *A fundyense* have been present in the Bay of Fundy annually for many years; generally during summer months. Most species of algae tend to act as a unit in the area outside Passamaquoddy Bay and behave differently from those within Passamaquoddy Bay. Results from *A. fundyense* populations in Lime Kiln Bay from 1988-97, the sampling site located close to the majority of the aquaculture sites (Fig. 1), show the annual pattern to be an early bloom in late May/early June followed by a more concentrated bloom in July with maximum cell densities observed during most years between July 11-July 21. Highest concentrations since 1988 were observed in 1993.

Figure 1

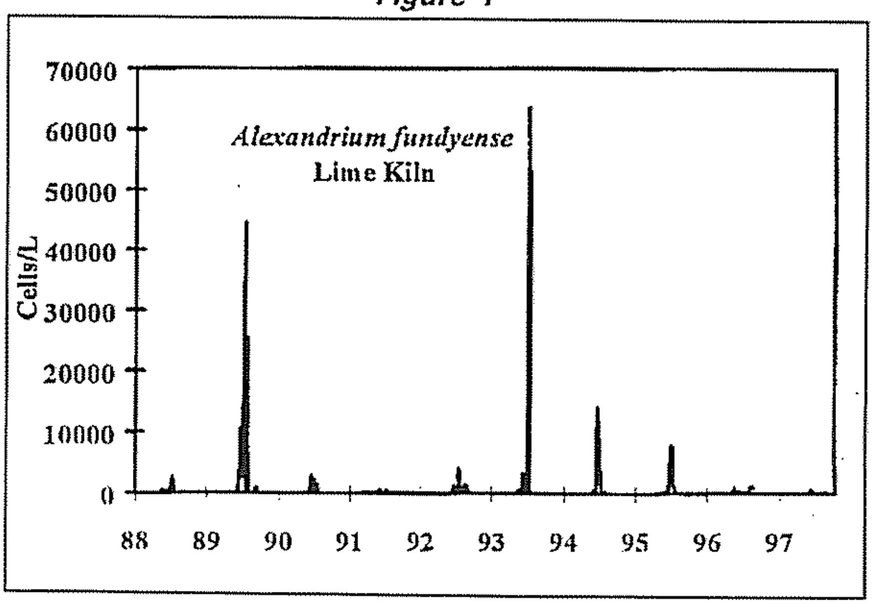
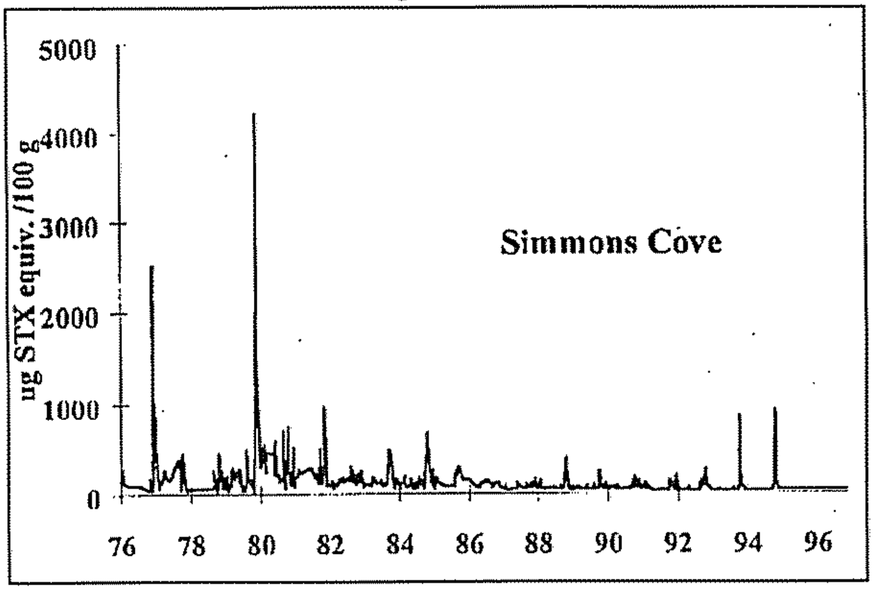


Figure 2

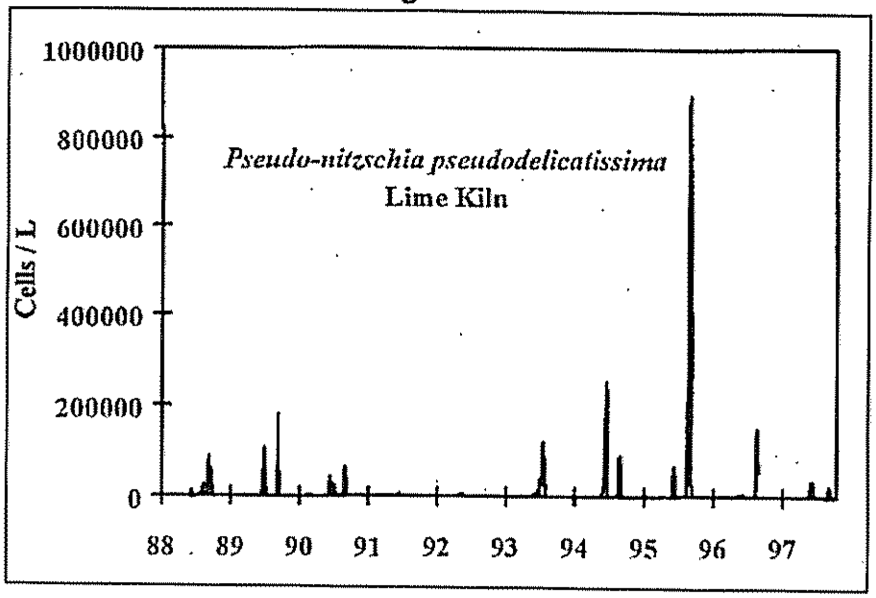


Results since 1976 from PSP toxicity in soft-shell clams (Fig. 2) at Simmons Cove, adjacent to the Lime Kiln water sampling site, indicate a similar annual pattern with shellfish accumulating toxins each year with maximum shellfish toxicity occurring 1-2 weeks following maximum cell density. The highest levels for toxins in soft-shell clams were during 1980 with high values measured also during 1976. Areas within the Bay with longer data sets indicate that highest levels were detected in shellfish in 1944. There also seems to be a pattern that the higher shellfish toxicities may be linked to an 18.6 yr lunar tidal cycle with higher values during the mid 1940's, early 1960's and late 1970's and including 1980. During 1996 and 1997, cell concentrations were very low due in '96 to storms with gale force winds that occurred each time *A. fundyense* cells appeared in the water column dispersing the cells and creating unfavourable bloom conditions. In '97 the reverse occurred where there were extended periods with little or no winds that did not provide conditions for growth and dispersion.

Populations of *P. pseudodelicatissima* in Lime Kiln (Fig. 3) occur each year with the early bloom in May/early June and a larger late bloom in early August. In order for shellfish to accumulate unsafe levels of domoic acid in their tissues, approximately one million cells $\bullet L^{-1}$ are required in the water. The only year that this occurred in the outer Passamaquoddy Bay region was 1995. Inside Passamaquoddy Bay, the only year that shellfish harvesting areas were closed due to domoic acid was 1988.

In summary, our results show that populations of *A. fundyense* and *P. pseudodelicatissima* have not grown in intensity in recent years or since the advent of aquaculture. On the other hand, other species, such as *Chaetoceros furcillatus*, that are not known to cause harm appear to be increasing, but throughout the region, not just in areas where the aquaculture industry is located.

Figure 3



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Variability in the use of rockweed habitats by fishes: implications for detecting environmental impacts

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Abstract

The rocky intertidal zone is a highly productive coastal ecosystem that is extensive in area, particularly in the outer Bay of Fundy. It is dominated by rockweed algae, *Ascophyllum nodosum*, which is a habitat for hundreds of organisms including many fishes. The current estimate of species richness is 31 fishes in total of which 21 occur commonly in the summer months; 17 are present as juveniles. Use of rockweed as a foraging and refuge habitat by juvenile fishes has been demonstrated in previous studies.

Commercial harvesting of rockweed is a potential source of habitat loss for fishes. Impacts may arise through reduction in the amount of habitat and through changes in plant structural complexity. Rockweed harvesting has generated a considerable amount of interest in recent years and has prompted a number of calls for harvesting impact assessments yet how to do this seems not to be appreciated.

The major hurdle in any impact assessment, and particularly for fishes, is the high natural variability in density. In this study I present new estimates of the variability of fish densities in the rocky intertidal zone for the purpose of demonstrating the relationship between variability and conducting a meaningful (i.e. powerful) impact assessment for habitat loss in the rocky intertidal zone. The study focuses on temporal and spatial variability of habitat use for three species, the implications for impact assessments and alternative approaches to conducting low power assessments.

The three species chosen as examples were winter flounder (*Pleuronectes americanus*), pollock (*Pollachius virens*) and Atlantic herring (*Clupea harengus*). Average densities were lowest for flounder (0.03 - 1.4 / 100m^2), higher for pollock (0.03 - 7.6 / 100m^2) and highest for herring (0.01 - 631 / 100m^2). These estimates were highly variable. Sources of variability included seasonal, diel and tidal patterns in the use of intertidal zone habitats. Another source was highly dynamic patterns of distribution. Pollock disperse in rockweed habitats and consequently had the lowest (2.5) coefficient of variation (CV) for our density estimates in that habitat. In contrast, flounder were patchily distributed in rockweed but more evenly distributed on the mud and sand substrate of the open habitats. Herring formed small schools in rockweed habitat and very large schools in open habitats; catches of herring were highly variable with CV's in the 5-6 range. Pollock also schooled in the open habitat and variance (CV=3.5) in catches was higher.

Statistical power analysis was performed on the density data for these species. Analyses were conducted for a range of temporal and spatial scales using a number of catch methods (seine, trap & gill nets and transect surveys). Regardless of the contrasts performed, the general conclusion holds that large sample sizes (n = 200-1300) are required for even a simple impact assessment to attain statistical power in the 0.8 - 0.95 range.

The conclusions from this study are that current methods of assessing fish populations have a low probability of detecting significant changes in abundance, should they occur. This finding is consistent with studies reported in the literature for other systems. Estimates of variation and power analyses must be taken into account in designing powerful impact studies. However, an inescapable consequence of high natural variability in fish densities in the intertidal zone is that lengthy studies (~5-15 years) may be necessary to detect changes. Shorter term research studies on functional relationships and on reducing sources of error will be a valuable complement to future impact assessments.

The feeding ecology of the sea cucumber, *Cucumaria frondosa*, in the Bay of Fundy

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Abstract

The suspension-feeding northern sea cucumber, *Cucumaria frondosa*, is the most abundant dendrochirote holothurian along the northeast coast of North America. A target of a commercial fishery, very little is known about the general biology and feeding ecology of this species. Field observations using time-lapse video indicate that *C. frondosa* displays a definite annual feeding rhythm. Feeding activity, by insertion of individual tentacles into the mouth, occurs in the spring and summer months followed by a period of about 6 months when the tentacles are withdrawn (i.e. no feeding). There is a strong positive correlation between feeding activity and chloropigment concentration of the natural seston (ug L^{-1}) but not with water temperature. Laboratory experiments where seston concentration was manipulated confirmed this relationship between feeding activity and chloropigment concentration. Rates of tentacle insertion (# min^{-1}) and chloropigment concentration in the stomachs of sea cucumbers (ug $individual^{-1}$) increased as the chloropigment concentration of the seston in the experimental tanks increased. Time-lapse video of feeding sea cucumbers in the field indicates that tentacle insertion rate was correlated with chloropigment concentration but not with current speed (cm s^{-1}).

Common eiders and great black-backed gulls in the Gulf of Maine: An overview

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In 1995, we initiated a comprehensive study to examine the post-hatch and brood ecology of the common eider (*Somateria mollissima*) in the Bay of Fundy with specific reference to post-hatch movements, habitat use and behaviour of both adult females and ducklings around the Wolves Archipelago in the Bay of Fundy. Information generated from this colony, particularly recruitment, over the next three years was to be used in conjunction with demographic information collected from breeding colonies located in the Grand Manan Archipelago and Passamaquoddy Bay to provide a minimum estimate of recruitment for the breeding population of common eiders in the Bay of Fundy. However, exceptionally high depredation rates by great black-backed gulls (*Larus marinus*) on eider ducklings precluded the study of brood amalgamation as only 12 of 3000 ducklings produced in this colony fledged; and despite limited gull control measures undertaken in 1997, only 8 ducklings fledged. Furthermore, brood surveys flown in 1995 and 1996 suggest that low duckling production was not only associated with the Wolves Archipelago but was more widespread throughout the Bay of Fundy, despite stable numbers in breeding pairs.

In 1997, in addition to working on the Wolves Archipelago, Canada, we expanded the current study by parallelling this work on Petit Manan/Green Island, a National Wildlife Refuge in the Gulf of Maine, USA, with the support of the U.S.F.W.S. Petit Manan Island has been gull free since 1984 as a result of gull control measures undertaken for tern restoration. Green Island, which is attached to Petit Manan Island at low tide, hosts a population of 800 breeding pairs of common eiders. Despite the fact that 40-65 great black-backed gulls were observed consistently loafing in areas on Green Island throughout the eider breeding season and during peak duckling hatch, duckling mortality rates were considerably lower than on the Wolves Archipelago. On the Wolves Archipelago, 46 ducklings fledged from a breeding colony of 600 breeding pairs in 1997, whereas on Green Island, 185 ducklings fledged in the immediate vicinity of the breeding colony. In addition, broods with radio-tagged ducklings and colour-marked females from Green Island were observed in coastal brood-rearing areas up to 9 km from the breeding colony. Broods of nasal-tagged females and/or radio-tagged ducklings from the Wolves Archipelago were not observed in other coastal brood rearing areas.

Crèching behaviour (the formation of groups of females and ducklings, two or more of which are parentally unrelated) has been suggested to be a strategy adopted by eider in areas with high predation. Crèching behaviour is not observed in eiders where there is little predation pressure. A striking result that came out of our work last summer has been the noticeable absence of crèching behaviour in areas where depredation rates on ducklings are extremely high compared to areas where depredation rates are considerably lower. In all three years on the Wolves Archipelago, eider broods ranged in size from 1-8 ducklings with only one or two tenders. In Petit Manan National Wildlife Refuge, large crèches of up to 75 ducklings and 12-45 tenders were observed consistently. Whether there is a threshold of depredation above which crèching behaviour breaks down will be investigated in the next field season.

The use of seabirds as windows into marine foodwebs

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Abstract

The potential for seabirds with a variety of feeding strategies to serve as indicators of the health and status of components of marine food-webs was outlined, with specific examples from the Bay of Fundy.

A current case-study using ACWERN's study of Arctic Terns, *Sterna paradisaea*, on Machias Seal Island to predict catches of herring in Grand Manan weirs is described in more detail on EMAN's web-site:

http://www.cciw.ca/eman-temp/reports/publications/nm97 tern/intro.html

Development of marine biodiversity monitoring protocols: The EMAN initiative

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Abstract

The conservation of marine biological diversity is an important issue that has received little attention compared to concerns of the terrestrial environment. This occurs despite the fact that the marine environment represents the most extensive habitat on Earth with many organisms that are critical for the functioning of the global ecosystem. Canada, as the country with the longest coastline in the world, has become involved through the mandate of the Ecological Monitoring and Assessment Network (EMAN). A group of scientists, representing government, university and museum sectors and led by Dr. Gerhard Pohle of the Huntsman Marine Science Centre, was charged with developing protocols for the monitoring of marine and estuarine biodiversity. Protocols are important to standardize procedures, so that monitoring is done in a way that allows for data between different localities or time periods to be compared so that results do not reflect differences in methodology used in monitoring. This approach is necessary in order to understand long term processes on a large geographic scale that includes ecosystems, because the health of whole systems is at stake. Over a two-year period, collaborations have resulted in the development of nine protocols that span from the very small to the largest living organisms characteristic of particular habitats, including plankton (D. Deibel, Memorial University & J. Martin, Biological Station), benthos (G. Pohle, Huntsman Marine Science Centre (HMSC) & M. Thomas, University of New Brunswick, (UNB), fish (E. Trippel, St. Andrews Biological Station), parasites (M. Burt, HMSC & B. MacKinnon, (UNB), seaweeds (T. Chopin, UNB), seabirds (A. Diamond, UNB), sea mammals (D. Gaskin, U. Guelph) and sea-ice algae (M. Poulin, Canadian Museum of Nature). These protocols are now available for viewing on the Internet to anyone interested by accessing the EMAN site, http://www.cciw.ca. The next step will be implementation and testing of the protocols by monitoring selected sites within the Bay of Fundy. This work will commence in 1998.

Horse mussel reefs in the Bay of Fundy

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Bivalve reefs are common features of the Continental Shelf benthic environment, at depths which may be greater than 100m. The traditional method of quantitative sampling in the sublittoral involves a small grab, generally of <1m squared and most frequently of $0.1 m^2$, deployed blindly from a research vessel. Because of logistical constraints, primarily of the time required to identify the specimens collected, a sufficient number of grab samples cannot be taken to cover adequately the sampling area. Another problem is that because of the contagious distribution of bivalves at mesoscale levels, grab replication results in very high variance estimates. Traditional grab sampling is also unable to accurately describe the reef shape and area, necessary if accurate estimates of secondary benthic production are sought.

In an attempt to overcome some of these problems we have employed modern surficial geological techniques including sidescan sonar and high resolution seismic reflection systems. Our experience to date with Bedford Institute-designed, 70kHz and Klein dual frequency, 100 and 320 kHz sidescan sonar systems, is presented. Independent confirmation that the bioherms were horse mussel reefs was made visually with video cameras mounted on a ROV, and with actual samples taken with a video grab of $0.5 m^2$ sampling area. This grab was also fitted with a video camera focussed between the open grab jaws and a Nikon still camera mounted on the outside frame.

Our preliminary results show that the bioherms recognized are horse mussel, *Modiolus modiolus*, reefs occurring on megarippled sands in long (kms) thin strips (up to 30m wide). The horse mussel reefs are raised, up to 3m higher than the rest of the seabed, and flow-parallel features run at right angles to the megaripples. The reefs run parallel to the New Brunswick and Nova Scotia coastlines.

Horse mussels are not limited to the bioherms which occur in the geological province described above and termed: *sand with bioherms*. They also occur in two other geological provinces: *gravel/cobble* and *mottled gravel*, but here no bioherms or other raised features are evident. Horse mussels do appear to be absent from the two other geological provinces so far recognized: *sand ribbons* and *sand with comet marks*.

Monitoring bird migration: building a database

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The St. Andrews Banding Station has been collecting data about the movement of songbirds along the St. Croix River since 1989. Financial aid was obtained from the James L. Baillie Memorial Fund to establish the Station; they continued this support in 1997. The St. Andrews Banding Station is a small project with 10 - 14, 12m mist nets used during the April to October field season. Over the eight years of operation 5228 birds of 78 species have been banded and released, even though the nets have not been opened every day.

The Station is now planning to expand its operation to become part of the Migration Monitoring Network that is being set up across Canada. Until recently, Atlantic Canada has been poorly represented in this Network, with no major Bird Observatory or daily banding Station. Now, with the help of the Atlantic Cooperative Wildlife Ecology Research Network (ACWERN), there are two banding stations operating during the fall months in Nova Scotia (Seal Island and Bon Portage Island) and two in New Brunswick (Grand Manan Island and St. Andrews). The major focus is on the offshore islands where birds stop to refuel before making the long flight to the next landfall. As the only mainland site, St. Andrews should provide an interesting contrast.

In order to qualify as a full scale migration monitoring site, a banding station needs to: 1) open its mist nets every day that weather permits; 2) record daily estimated totals of birds in the area; and 3) count birds along a daily census route. At this time the St. Andrews Station is unable to comply with the daily requirements due to a lack of licensed and qualified people available. However, the preliminary work has been done and the foundation is ready to be built upon.

Once individual birds are marked and recognizable, life histories can be built up, movements traced and ages calculated. Results based on birds recaptured at the Station will be presented here as there is not enough data to see any trends in species populations.

A few results from Spring banding

In Spring, the nets are in place by the end of April, well before most of the migrant songbirds start to return from the south. During this time and early May it is not usual to catch more birds with bands from previous years, than unbanded birds; 220 individuals have been recaptured at least one year after banding. Some have returned more than once, accounting for the 292 incidences of recapture recorded. Of those banded, 28 different species have been recaptured, all of which can be classified as local breeders. Of recaptured birds, 84% were banded as adults, and only 15% were banded as hatch-year birds. This is a huge difference and could reflect, among other things, birds returning to reclaim familiar territories and to the high mortality rate of young inexperienced birds during their first migration and winter. Even though there are not many banding days in April, 11.5% of the birds banded during this month have returned at least once. This drops to 6.3% for May, and changes to 7.8% for June and 6.4% for July. After the breeding season, the rate of returning birds declines in August to 2.3% and 1.4% in September.

Table 1 presents the averaged return rate of birds banded at St. Andrews. Are these figures high or low? It would be interesting to compare them to results from other breeding area stations and migration monitoring sites.

Table 1

Average return rate after						
1 yr	2 yrs	3 yrs	4 yrs	5 yrs	6 yrs	7 yrs
4.37	2.25	0.90	0.56	0.14	0.17	0.00

How long do small passerines live? Longevity records for birds recaptured at St. Andrews are listed in Table 2. Well established banding stations in other parts of Canada will probably have records of older birds but interest in these records will only increase as the St. Andrews database expands.

Table 2

Birds Recaptured at HMSC showing known age (yr-mo)			
	age		age
Black-capped Chickadee	8 - 05	Solitary Vireo	4 - 08
Black-&-White Warbler	7 - 09	Black-thr. Green Warbler	4 - 07
Downy Woodpecker	7 - 05	Common Yellowthroat	4 - 07
Veery	7 - 05	Blue Jay	4 - 05
Northern Parula	6 - 07	Purple Finch	4 - 05
American Redstart	6 - 05	American Robin	4 - 05
Ovenbird	6 - 05	Yellow Warbler	3 - 08
Magnolia Warbler	6 - 05	American Goldfinch	3 - 07
White-throated Sparrow	6 - 05	Red-eyed Vireo	3 - 05
Myrtle Warbler	5 - 05	Nashville Warbler	3 - 05
Gray Catbird	5 - 05	Boreal Chickadee	3 - 05
Alder Flycatcher	4 - 08		

Contributions from Summer banding

During June and July, the banding operation is curtailed in order to fit into the protocol for the MAPS Project (Monitoring Avian Productivity and Survivorship). This nationwide program, set up in 1989 by the Institute of Bird Populations, Point Reyes, California, measures yearly population changes in selected species, over broad regions of North America. Numbers from bird banding data might look impressive on the surface but when broken down into species the sample sizes are often small. This makes it difficult to see trends. MAPS combines data from a number of different stations and by concentrating on a few target species, it has calculated yearly fluctuations in populations. The St. Andrews Banding Station started contributing to the program in 1991 when only 65 stations were involved. Now the program has expanded to include over 326 stations.

A few results from Fall banding

As the days get shorter and cooler, many passerines from New Brunswick head south. Where exactly do they spend the winter? In Europe where there are many more banders in a much smaller area, the wintering grounds of some songbirds are known quite precisely. Here in North America we can only locate general areas. Knowledge of precise wintering areas has many implications in the conservation of threatened populations but foreign recoveries of small songbirds are few and far between.

Three birds banded at St. Andrews have been recovered at other sites: A Magnolia Warbler in Tocoa Honduras, a Yellow Palm Warbler at Island Beach State Park in New Jersey and a Cedar Waxwing in Kouchibouguac the other side of New Brunswick. The Magnolia Warbler is of particular interest as it was banded in May 1993, recaptured at St. Andrews four times in 1994 and five times in 1995 before being found in Honduras.

Foreign recaptures are always exciting, especially when one stops to think about what the individual bird has actually accomplished. Honduras is 3700 km away in a straight line. Yet, the true value of a banding is in long term monitoring and in providing a standardized database from which data can be analyzed and changes detected.

SESSION TWO
EMAN PARTNERS

Thursday, November 13, 1998

SESSION CHAIRMAN:

H. O'Neill

Fundy National Park and the Greater Fundy Ecosystem (GFE): their function as an EMAN site

D. Clay
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Abstract

This presentation provides a background of past management strategies for Fundy National Park, New Brunswick, and its' adjacent lands, and outlines opportunities for future regional co-operation and management. It places the management of the park in context by discussing the parks' physical, biological and cultural resources and how these can provide support for the EMAN program. This information was derived from the parks' recently updated Resource Description and Analysis. Background information is also provided on the partnerships formed with the Greater Fundy Ecosystem and the Fundy Model Forest research groups in southeastern New Brunswick, and how both the park and its partners hope to benefit. Suggestions are made as to how future management actions can be broadened from issue-based concerns to more encompassing ecosystem-based concerns.

The key challenges to the success of future ecosystem management are identified and the "how?" and "why?" of the science-based resource management program of the park is described. Examples are provided of the data management process that has been developed at the park. These include the use of standard data recording forms, protocols, and archiving strategies. Documentation was identified as the major data management issue. Details of how park staff have addressed this concern are provided, including, project protocols, metadata catalogues, and peer-reviewed reporting. The importance of Quality Control / Quality Assurance is stressed. With these actions we feel that Fundy National Park is on its way to becoming a fully functional research and monitoring EMAN site.

Kejimkujik National Park

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Kejimkujik National Park
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Abstract

Kejimkujik has been the focus of significant ecological research activity since its designation as an EMAN site three years ago. This study activity has necessitated the development of systematic research proposal and permitting procedures and subsequently an integrated information management system which incorporates provision for metadata cataloguing, data dictionary documentation, and provision for data sharing with other agencies and institutions. Explanation of the system, illustrated with sample information sheets, was provided.

The parks ecosystem conservation plan priorities (*in prep.*) were also presented including use of the airshed, watershed, terrestrial ecosystems categories for resource issue description. Techniques used for issue identification and preparation were also described, and comments invited.

Terramon

M. Wadleigh
[presented by Tom Clair]
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St. John's, N.F.

Abstract

The Salmonier Nature Park Site was established in 1994. TERRAMON is part of the Earth Resources Research (CERR), within the Department of Earth Sciences, Memorial University of Newfoundland. Its members are from various federal and provincial government departments, as well as other departments within Memorial University.

Various studies have been carried out within the Park itself and within the drainage basin in which the park is located. Some of these studies took the form of inventories, others were research projects that operated over a short period of time, and still others continue on a regular basis. Existing information has been collected in the physical environment (geology, soils, atmospheric inputs, water quality, climate), and biological environment (birds, small mammals, lichen, forest types).

Current activities are focusing in three areas:

1) Work on fish, including salmonids and eels, to examine questions of partitioning of the available environment by species and productive capacity of the watershed;

2) Focusing on the vegetation of the riparian zone and the peatlands leading to classification, mapping, and permanent plots in each area; and

3) Studies of macroinvertebrates to examine the effect of diversity on stream process and efficiency in terms of energy and nutrient flow in the system.

This past fall a new set of lichen samples were collected for continuing biomonitoring studies related to sulphur sources and trace metal deposition.

Delineation and overlay of critical species habitat as a tool for their protection

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Abstract

In order to quantify the real estate value of coastal and marine areas, a number (27) of species, important to *Homo sapiens*, were identified and their habitats delineated and evaluated. By superimposing habitat areas for each species, two composite habitat maps were produced: One for species inhabiting littoral and sublittoral zones; the other for species found in open water. In determining the total quantitative value for each area three factors were taken into account. These were: (A) The relative importance of the species to *H. sapiens*; (B) The relative importance of the specific area to the species concerned; and (C) The relative scarcity of the specific habitat in relation to the whole area (Quoddy Region) studied. Each factor was converted (normalized) to a scale of 1-8 (low to high value) and multiplied together. The products, or total quantitative values, were assigned colours ranging from blue (low) to red (high) and individual maps printed for each species. By superimposing maps, various colour combinations resulted showing which areas were important for many species and which for only a few. This graphic representation provides managers and decision makers with a useful value index for different areas within the whole Quoddy Region in southwestern New Brunswick.

Marine protected areas: moving from theory to designation

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Abstract

The passage of the Canada Oceans Act on January 31, 1997 provides new legislation for the establishment of marine protected areas (MPAs) and a real opportunity to accelerate the protection of marine natural regions. According to the Act, MPAs can be established for: conservation and protection of fishery and non-fishery resources; endangered or threatened marine species; unique habitats; marine areas of high biodiversity or productivity; and any other marine resource or habitat that is necessary to fulfill the mandate of the Minister of the Department of Fisheries and Oceans (DFO), the lead federal agency for MPAs. This presentation explores some of the scientific and technical issues associated with establishing a network of representative MPAs.

Building a marine protected areas network in the Gulf of Maine: An ecosystem approach to management

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Marine protected areas (MPAs) have been identified as an important tool for managing, protecting and understanding marine resources in the Gulf of Maine. A coherent network or system of MPAs can a provide a framework for promoting the sustainable use and conservation of regionally significant marine resources. Through careful planning and transboundary coordination, a Gulf-wide MPAs initiative will offer benefits not gained through traditional *ad hoc* or reactive approaches to marine protection. The Gulf of Maine Marine Protected Areas Project is an international effort to consider the establishment of a network of MPAs. By bringing together a diversity of parties to think about and work on common issues, the Project seeks to use MPAs as a tool to understand and protect Gulf of Maine resources.

The Gulf of Maine, a 36,000 square mile basin stretching from the tip of Cape Cod to the Bay of Fundy, is experiencing negative impacts from human activities, such as over-harvesting of fishery resources, the presence of toxic contaminants, nonpoint source pollution, and the destruction of habitat from coastal development. The Gulf of Maine is an intricately linked marine system distinguished by a counter clockwise water current called a gyre. The ecosystem is constantly in flux and, as a result, habitats are often linked through the movements of priority species and other organisms. Due to the nature of the Gulf ecosystem, and marine systems in general, many marine resource issues are regional in scope, crossing multiple jurisdictions and administrative boundaries.

There has been increasing emphasis on MPAs as a tool to help manage marine systems and reduce resource-based conflicts in the Gulf region. Their use is consistent with the goals and objectives of many existing programs including: the Canada Ocean's Act, the US National Marine Sanctuary Act, the NMFS Habitat Conservation Program, and the Gulf of Maine Council on the Marine Environment to protect regionally significant habitats. MPAs are flexible in their design and range from small, highly protected areas to larger multiple-use areas in which conservation measures are balanced with human activities. In this respect, MPAs can address a wide range of resource and management dilemmas and can be used to: protect biological diversity; enhance commercially valuable fish stocks; support marine research and education; and create areas for tourism and recreation. There currently exist several types of MPAs in the Gulf of Maine under a broad definition. However, each area has its own set of conservation objectives and there is little coordination between the sites.

An ecosystem-based approach to the establishment MPAs may offer an effective means for protecting some of the transboundary resources in the Gulf and better address environmental and socioeconomic issues contributing to the decline of the marine ecosystem. In this sense, an ecosystem-based MPAs initiative will offer benefits not gained through traditional *ad hoc* or reactive approaches to marine protection. First, by accounting for habitat linkages and the constant movement of resources through the system, a network approach will more effectively achieve conservation and management goals held Gulf-wide. Secondly, by coordinating across jurisdictions, scientific, educational and management oriented information can be transmitted more easily from one area to the next. Transboundary collaboration can reduce duplicative efforts and leverage limited resources, fostering a better understanding and management of Gulf of Maine ecosystems.

The structure of the MPAs Project and its workplan was determined through a binational workshop held in Freeport, ME on the subject of MPAs in the Gulf of Maine. Participants representing marine industries, management, and science came together to discuss the need for and value of a coordinated approach to designating MPAs in the Gulf of Maine. The goal of the workshop was to identify the benefits of applying MPAs on an ecosystem level and collectively move forward on developing a MPAs program. Special attention was paid to generating policies which seek to meet both the needs of human communities and protect the ecological and economic value of the marine resources on which they depend.

Workshop participants collectively agreed upon:

- a working definition for MPAs;
- a vision statement for a future Gulf of Maine program;
- specific guidelines for developing and implementing MPAs; and
- a list of recommended activities.

They also concluded that an MPAs Committee will be formed to work in partnership with the Gulf of Maine Council on the Marine Environment (GOMC). This Committee will help decide upon, coordinate, and oversee activities related to designating MPAs in the Gulf of Maine. While this body will have no regulatory powers or permanent headquarters, it will represent the Gulf of Maine community to ensure that future MPAs initiatives meet the needs and goals of all important stakeholders. The Project is currently engaged in evaluating existing protected areas, laws, and designation processes under the concept of an ecosystem-based approach to establishing MPAs. By tying together information and gaining input from a diversity of sources, the Project will help those depending on the Gulf of Maine to think about, and act upon, a regional framework for marine protection.

Developing a Canadian biodiversity information infrastructure

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Environment Canada's Biodiversity Convention Office, in partnership with Agriculture & Agri-Food Canada, Natural Resources Canada and the Canadian Museum of Nature, has established a Canadian "National Biodiversity Information Initiative" with the vision of increasing our national ability to access electronically the authoritative biodiversity information needed to support sound natural resource management decisions in a global economy.

As a Party to the Convention on Biological Diversity, Canada needs to track the effectiveness of its implementation strategy for the conservation and sustainable use of biological diversity for domestic policy and decision making and for periodic national and international reporting. No single Canadian agency has all the information needed to provide a complete picture of the status of Canada's biodiversity. The biodiversity data and the expertise to interpret these data are located in many federal and provincial government agencies, universities, museums, botanical gardens, etc. In addition to our international commitments, Canadian scientists and managers in public institutions, NGO's and industry throughout the country also need to have access to biodiversity data, and to the tools that will enable them to locate, analyze, combine, and manipulate this information, in order to improve the quality of policy and decision making.

In the USA, similar needs are being addressed through the development of a National Biological Information Infrastructure (NBII) designed to help identify, prepare and increase access to their sources of biological data and information. A broader initiative, the Inter-American Biodiversity Information Network (IABIN) is proposing similar solutions for sharing biodiversity information among the nations of the America's.

The fundamental elements of both of the US and IABIN initiatives are:

- identifying potential partners with an interest in sharing biological resource information;
- a distributed model, in which partners act as stewards for the information they generate or maintain; and
- a willingness among partners to collaborate on voluntary guidelines, protocols, and standards that will facilitate the sharing of information.

The Canadian NBII partners sponsored a workshop held on July 7th and 8th in Ottawa, to explore the feasibility of developing a similar Canadian initiative with the goal of increasing access to Canadian biodiversity data. This workshop brought together more that 50 national and international biodiversity stakeholders. The clear consensus of this meeting was that there was an urgent need to develop a complementary framework for accessing biological data within Canada.

The participants acknowledged that better management of, and access to, the ever-increasing amount of Canadian biodiversity data would result in increased use and more cost-effective use of this resource. Some examples of potential benefits identified included:

- enhancing the availability, quality and breadth of data for decision makers;
- identifying opportunities for interdisciplinary and synergistic activities;
- identifying gaps in our data holdings;
- increasing the value of individual data sets;
- providing more soundly based resource management decisions for forestry, fisheries, agriculture and wildlife;
- safeguarding historical data;
- minimizing duplication of collection effort;
- increasing the efficiency for data users; and
- increasing the support for data providers.

In response to this workshop, a steering committee composed of representatives from the supporting agencies officially launched the Canadian "National Biodiversity Information Initiative" as a capacity-building and enabling exercise with the vision of increasing our national ability for electronic access to the authoritative biodiversity information needed to support sound natural resource management decisions.

The mission of this initiative is to facilitate the formation of a distributed federation of Canadian partners that will have the content, expertise, tools and willingness to share electronically biodiversity data.

The initial focus of the initiative will be on scientific biodiversity data sets and the methodologies needed to facilitate their electronic comparison, exchange and integration as well as the tools needed to gather, analyze, integrate and display biological data in support of natural resource management. It is expected that a number of projects will be identified that could be used to demonstrate the value of these approaches.

Phase I of the Initiative is planned for completion by March 31, 1998. This is a fact-finding and planning phase which will result in a thorough analysis of the state of biodiversity data accessibility in Canada, a costed work plan for future phases and a roster of partners and participants.

Canada's Ecological Monitoring and Assessment Network: Where we are at and where we are going

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Introduction

Multidisciplinary environmental studies, particularly at the small watershed level, have been carried out in Canada for several decades. Studies were initiated by Governments and academic institutions, usually to deal with environmental problems of interest to the specific location. For example, in the 1960s, the Federal Government initiated studies on lake eutrophication at the Experimental Lakes Area near Kenora, Ontario (Hecky, *et al*, 1994) and Laval University began the Centre for Arctic Studies at Kuujjaauapik which has focused on Arctic and sub-Arctic ecological processes. Studies at Kejimkujik National Park, also began in the 60s, looking at nutrient processes in surface waters. In the mid 1970s, the Ontario Government conducted a comprehensive study of the effects of cottage development on lakes in the Muskoka area (Hutchinson, *et al*, 1991). The Last Mountain Lake site was established as a National Wildlife Area. Many other sites have been established across the country to look at a variety of research questions and environmental factors. As new issues have emerged, other sites, for example, Turkey Lakes in Ontario and Duschenay in Quebec, were established in response to the need for more information on acid rain. These multi-year, interdisciplinary studies were very effective in resolving the site-specific scientific and policy questions set out by the supporting agencies.

Many urgent environmental problems confronting society, such as global warming (Intergovernmental Panel on Climate Change, 1995 Report), UV-B, depletion of the stratospheric ozone layer (Scientific Committee on Problems of the Environment (SCOPE, 1992 Report), and acid rain, etc. are connected with man-made changes to the atmosphere; these have an impact at the multination regional level and, are of global concern. The ecological effects of these stresses are subtle and show up over long periods of time. Equally, reversing the effects by pollution control measures will take a long time. The input of data collected for over 10 years at some of the 15 ecological study sites across eastern Canada and the United States, provided enough information to establish the deposition targets in eastern North America. This represented a scientific basis for action and defined a solution that lead to defining control measures needed to address the acid rain problem. Understanding the ecological consequences of global climate variability/change will require long-term ecological monitoring sites around the globe. These current environmental problems are scientifically much more complex in their ecological effects and they affect larger areas. Therefore, it has become necessary to develop further the concept of long-term (i.e. decades) multidisciplinary studies. Understanding how ecosystems are changing and developing the scientific information required by decision-makers, are beyond the resources and abilities of any single Department or agency. Consequently, it is necessary to develop partnerships within all components of the Canadian and International environmental science community. This is necessary to maximize the quality of the science and the efficiency of conducting the work at a time of economic restraint. These concepts lead to the creation of the Ecological Monitoring and Assessment Network.

Where we are at and how does EMAN operate?

In April 1994, Environment Canada established the Ecological Monitoring and Assessment Network (EMAN) with an overall goal of conducting long-term multi-disciplinary research and monitoring sufficient to provide answers to the questions of what is changing in ecosystems and why. To conduct this network's business, the Ecological Monitoring Coordinating Office (EMCO) was located at Canada Centre for Inland Waters, Burlington, Ontario, Canada. The EMAN has four overall objectives: 1) to provide a national perspective on how Canadian ecosystems are being affected by the multitude of stresses on the environment; 2) to provide scientifically defensible rationales for pollution control and resource management policies; 3) to evaluate and report to Canadians on the effectiveness of these policies; 4) to identify new environmental issues at the earliest possible stage.

The Ecological Monitoring and Assessment Network (EMAN) is a cooperative partnership of academic, governmental (local, provincial, and federal) and private sector scientists and EMCOs goal was to coordinate the ecological monitoring and research to meet national, regional and local environmental needs for environmental information on ecosystem function and change. The Ecological Monitoring Coordinating Office staff of five was given the responsibility of organizing the EMAN into a cohesive network of existing sites and also promoting the development of new sites where feasible. Some of these sites mentioned above, have been established over the years for a number of reasons and most of these are operated by Federal Departments, Provinces, Universities, Industries and NGOs. The EMCO staff worked in conjunction with seven Regional Leaders in the five Environment Canada Regions. Pacific and Yukon, and Prairie and Northern Region each have assigned a leader for the southern and northern halves of these geographically large regions, while Atlantic, Quebec and Ontario Regions have one leader each. Site-specific and program leadership are provided by staff of other Federal Departments, Provinces and Territorial agencies, universities, schools and the private sector.

As of January 1997, the EMCO included 85 sites into the newly formed Ecological Monitoring and Assessment Network. Canada has been divided into fifteen land-based ecozones plus five marine ecozones and it is the EMAN objective to have a least one monitoring site in each of these ecozones. These sites are organized into 17 terrestrial Ecological Science Cooperatives (ESCs) and are included in the National Directory (EMAN Occasional Paper Series, Report 2, 1996a). Where there is more than one monitoring site, they will be loosely linked in an Ecological Science Cooperative, since sites in the same Ecozone will have a number of common interests. For example, it will be important to compare all of the results from the Boreal Shield forest with regard to issues, such as climate change or UV-B radiation. Equally, it will be important to compare all sites within the Prairie Ecozone regarding the response to issues such as increasing average temperature. For some issues, such as climate change or plant phenology, it may be relevant to compare results from all sites across the country. It is therefore anticipated that some new sites will be added and, in this time of restraint, some sites may cease to operate. Each of these sites have developed a statement of their Goals, Objectives and Deliverables (GODs) Declarations (EMAN Occasional Paper Series, Report 3, 1996b) indicating the nature of the work being carried out at the site. There are over 100 agencies involved in conducting ecological monitoring and research, including the Federal government, Provinces, universities, private sector and NGO's. We anticipate that the issues covered will expand as new problems are found and new partners join the program.

A fundamental start up procedure has been to conduct organizational workshops within each region or Ecozone. These workshops bring together the interested parties to get to know each other, exchange information across disciplines and sectors and compile a list of issues and sites within a given area. Out of a small EMCO budget, the "grease and glue" money is used to provide travel and organizational resources for these workshops. Such workshops have produced many comprehensive reports on environmental issues.

An annual national science meeting is held each January, rotating among the five Environment Canada Regions. This multidisciplinary meeting has representatives from Governments, EMAN sites, universities, NGO's and industry. The meeting is to help with the Network "construction" and to promote discussion on the scientific issues and results coming from the long-term multidisciplinary studies.

Where we are going?

In June 1996, The EMCO was combined with the indicators group of the substantially down-sized State of Environment Reporting Branch of Environment Canada. The newly formed Indicators, Monitoring and Assessment Branch (IMAB) was given a coordinating and facilitating role in the generation of data, the use of standard indicators, and assisting in the production of issue- or area-related assessments to provide a report to the Canadian people and decision-makers with information on the ecological condition of Canada. IMAB has two offices: the Ecological Monitoring and Coordination Office (EMCO) in Burlington, Ontario is responsible for the coordination of EMAN and the second, the Indicators and Assessment Office in Ottawa, Ontario is responsible for developing and reporting the environmental indicators and assessments. The overall operating objective of IMAB is to promote the gathering and use of scientific environmental information for the policy and management decision-making processes and to provide a better link between the policy requirements and the scientific community.

The most important function of the Network will be to serve as a major source of ecological and environmental information that is driven by a series of policy- or issue-related questions. The information will be assembled in the form of periodic issue or area related assessments. In addition, some components of the information will be used for the ongoing production of indicators, which will provide Canadians with the current status of various issues which will be dealt with in greater depth by the periodic assessments.

Substantial support activities for EMAN sites are being carried out by IMAB in the development of standard parameter lists, standard measurement protocols, data management systems and Quality Assurance/Quality Control through the EMAN QA/QC Steering Committee and Biodiversity Science Advisory Board (See EMAN web site http://www.cciw.ca/eman/). This Committee and Board has the mandate to promote and develop protocols and standard procedures for environmental sampling, analysis, data collection, recording and also in organizing the data into a structured system to allow for easy inputting of new data, data updates, and to ensure that data are in the most shareable form possible for any type of user using appropriate quality assurance and control measures. Indicators and Assessment Office of IMAB is committed to improving the practical usefulness of environmental information and optimizing its delivery in a manner that permits the easy integration of environmental, social and economic perspectives in support of sustainable development. Biodiversity Science Advisory Board will also address the biodiversity issue, including Canadian commitments to the Convention on Biological Diversity.

EMCO has a major interest in, and applying some resources to, the development of extensive volunteer networks. The participants in the networks, such as a weather network, breeding bird surveys, plant phenology and amphibian surveys, have effectively gathered data for decades. These programs greatly assist various Departments in obtaining extensive environmental information. It is the objective of EMCO to have as many as possible of these extensive networks collecting data from EMAN sites. This will provide additional possibilities of being able to explain any changes that are observed in these measurements, and in turn, being able to extrapolate the results from the EMAN sites to larger geographical areas covered by the extensive network. Within three years we hope that virtually all of the extensive volunteer networks, such as breeding bird survey, DAPCAN, plant phenology, ice phenology, frog watch, tree watch, etc. will have participants at every appropriate EMAN site. This, we hope, would promote the involvement of more professionals in the volunteer network activities and also provide some increased ability to interpret changes identified in the extensive volunteer network by using the detailed information available at the EMAN sites. In this way we can cover huge areas of the Canadian landscape with a coordinated monitoring network.

It is expected that the scientists and supporting agencies for all sites will become increasingly familiar with the nature of the policy issues and policy concerns at the local, regional, national and global levels. Monitoring and research programs need to be oriented towards these issues.

All supporting and funding agencies need to be aware of the overall organization and, during the resource allocation process, give priority to the EMAN activities. To this end, EMAN coordinators have already met with the Natural Science and Engineering Research Council (NSERC) to explain the Network operations. There have been meetings with industries to explain the Network and the role of the private sector and this has resulted in funding for a number of sites and projects.

The Network will only be as effective as the scientists, governments, universities and the concerned public, make it. Many scientists have already seen the Network as an opportunity to develop joint projects over larger areas or with other disciplines. Pooling of data, and even resources, can result in an enhanced program and output form individual projects. The EMCO invites and encourages the scientists in all parts of the Network to take the initiative in organizing programs so that the scientific total is greater that the sum of the individual parts. The EMCO would like to see the day when more scientists become well-known as experts on issues or components of issues. That does not mean that they do, or direct, all of the work, but that the serve as a focal point for speaking to the public and the media on a particular issue and for improving the communications among the scientific community dealing with their particular area of expertise. Overall, we see the Network as providing substantial opportunity for individual scientist development and recognition.

We would like to see teaching institutions, particularly at the high school and university level, incorporate EMAN concepts and activities in their curricula. The goal is to have the entire EMAN structure as a fully integrated "package" of policy question, appropriate monitoring and assessment activity leading to policy answers followed up by routine reporting of indicators.

More information about EMAN?

Point your Web browser at the EMAN Web site http://www.cciw.ca/eman or call Tom Brydges, Director, Ecological Monitoring Coordinating Office at 905-336-4410.

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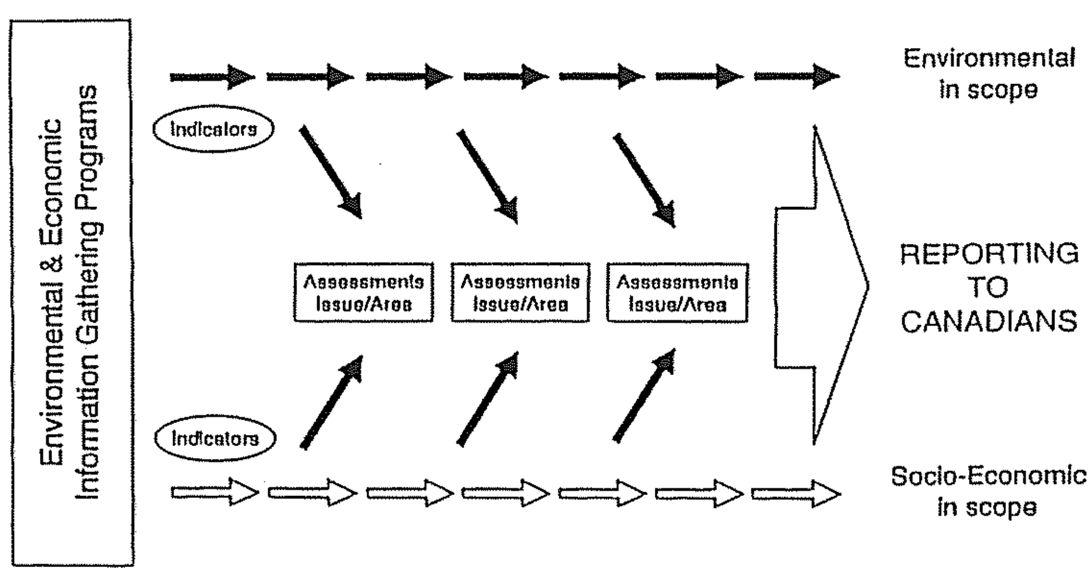

Figure 1

SESSION THREE

BAY OF FUNDY ECOSYSTEMS

Friday, November 14, 1997

SESSION CHAIRMEN:

G. R. Daborn and P. G. Wells (morning)

J. A. Percy (afternoon)

Introduction to the Fundy Marine Ecosystem Science Project

G. R. Daborn and P. G. Wells
Acadia Centre for Estuarine Studies, Acadia University
Environmental Conservation Branch, Environment Canada

The Fundy Marine Ecosystem Science Project (FMESP) was initiated in 1995 in response to concerns about the environmental quality of the mudflats in the Upper Bay of Fundy, so important to the survival of millions of migratory shorebirds, and the realization that no single group was looking at the Bay of Fundy holistically. A small steering committee was formed, from government (Environment Canada, Fisheries and Oceans), Acadia University (ACER) and Dalhousie University/DalTech, and the Clean Annapolis River Project (ACAP)[1]. FMESP's first project was a review of current knowledge on the Bay and the Fundy Science workshop held in January-February 1996 (Percy *et al.* 1997)[2]. In 1996 and 1997 a number of presentations were made on the Bay of Fundy, including a panel discussion at the Rim of the Gulf Conference in Portland, Maine, and a presentation at the Gulf of Maine Council on the Marine Environment. Work was initiated through working groups, the *Corophium* WG being started in March 1997. The group envisaged a broader body of stakeholders, changing its name to BOFEP in mid-1996 as a result, and outlining and promoting a plan early in 1997 to have a "Virtual Institute" for the Bay.

The aim is to seek a broader membership for BOFEP, discuss and reach consensus on its vision, principles and objectives, and move towards resourcing and setting into place the new virtual BOFEP and new science and community initiatives on the Bay of Fundy. BOFEP, and its science arm (FMESP), are co-sponsors of this Workshop, aimed at enhancing information exchange on, and understanding of, the Bay's oceanography, biology, ecology, resources including wildlife, and sustainability. Discussion of the broader objectives will take place on the last day of this workshop[3].

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M. Brylinsky (ACER), G. R. Daborn (ACER) (Chair, 1997-, A. Evans (DalTech) (Coordinator), S. Hawboldt (CARP), P. Hicklin (CWS, DOE), J. Percy (CARP) (Secretariat), P. G. Wells (DOE) (Chair 1995-97), L. White (DFO).

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See Session Four, in these proceedings.

Storm surge events in the Maritimes

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1496 Bedford Highway, Bedford, NS
[2] *Canadian Hydrographic Service, PO Box 1006, Dartmouth, NS*

Abstract

Storm Surges are the meteorological effects on sea level and can be defined at the coast as the difference between the observed water level and the predicted astronomical tide. Large positive storm surges at times of (high) high tide are events which may lead to coastal inundation. Any assessment of the possible increased risks of coastal flooding in a future, warmed climate must include an assessment of the present storm surge climatology of the region. To this end, statistics of storm surge events in excess of 60 cm in the Maritimes are presented. Typical weather patterns associated with these episodes are identified and water levels associated with some extreme historical events such as the Groundhog Day Storm and the Saxby Gale are presented.

**Published:Proceedings; 1997 Canadian Coastal Conference; 21-24 May, University of Guelph, ON, pp. 115-129*

Modelling tidal flows in Passamaquoddy Bay

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Abstract

Work on modelling M_2 tidal flows in Passamaquoddy Bay is being done with a suite of three numerical 3D finite element models. A linear harmonic model gives a first order estimate of tidal currents and elevations. A second model, fully nonlinear, demonstrates the significant effects of quadratic friction, tidal elevation and the advection of momentum on the tidal flows and as well as the generation of a residual circulation. A third model has been developed from the second that will take into consideration the drying of intertidal areas on the falling tide. Given the complex shoreline, topography and strong tidal currents in Passamaquoddy Bay, it is felt the third model will be necessary to accurately predict flows in the area. Results given here are still preliminary and it is anticipated that comparisons with observations will show where further tuning of the model is necessary.

Introduction

Interest in aquaculture in bays around the Maritimes has raised many concerns. Three of these are, the limits on the carrying capacity of a region, the interaction of sites in the same area and the interaction of aquaculture sites with other uses (natural and anthropogenic) of the water. All of these have emerged as concerns in Passamaquoddy Bay. Fundamental to understanding these issues is a knowledge of the currents in the area. This initial work looks at the currents driven by one tidal constituent (the dominant M_2) simulated in three progressively more complex finite element models. Our models use a common triangular element rid and topography (Figures 1,2). We have taken advantage of the variable resolution capabilities in themodel to cover areas of more interest in better detail (Figure 3).

We need to emphasize the limitations of our work. We are looking at one tidal constituent only, although; the modelled M_2 tide dominates the area and can be considered to be the mean, other constituents will lead to significant variations about that mean. We have not considered the effects of fresh water or temperature which are known to drive considerable density currents in the Bay. Similarly, we have not included wind as a driving force which is also significant. Although all model runs have been done computing the three dimensional current, we have only examined the depth averaged current to date. Even the computations we have made are preliminary and we expect them to be revised as we adjust model parameters to best fit to the observations.

Figure 1

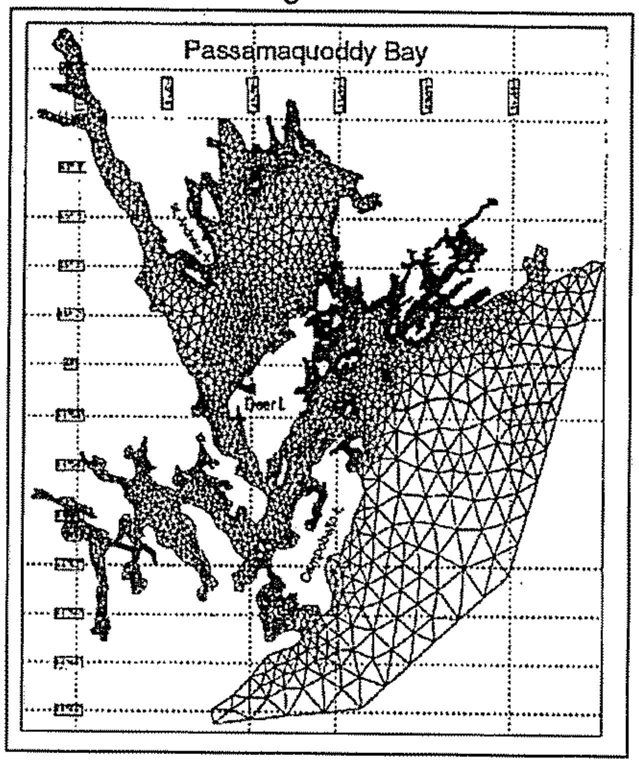

Figure 1: Location map for the Passamaquoddy Bay region showing the extent of the model domain and the variable rsolution of the finite element grid.

Figure 2

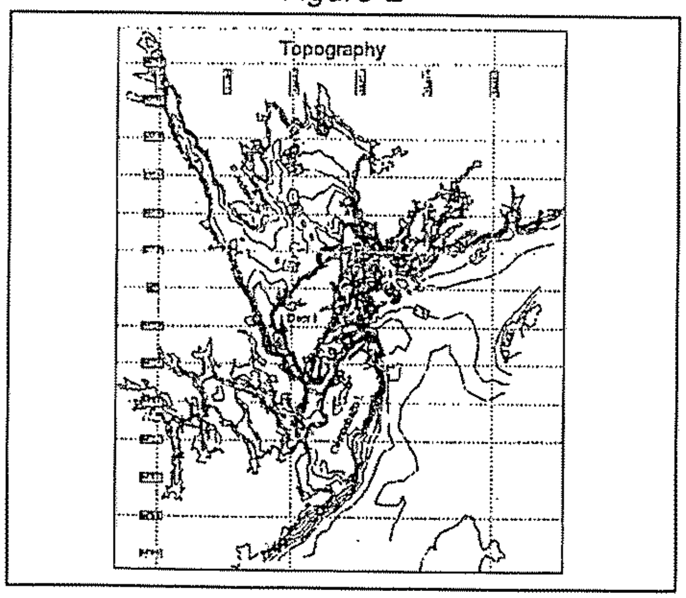

Figure 2: Topography for Passamaquoddy Bay. Note the region of complex bathymetry between Campobello and Deer Islands and the mildly sloping bathymetry of the inner north of Deer Island.

Figure 3

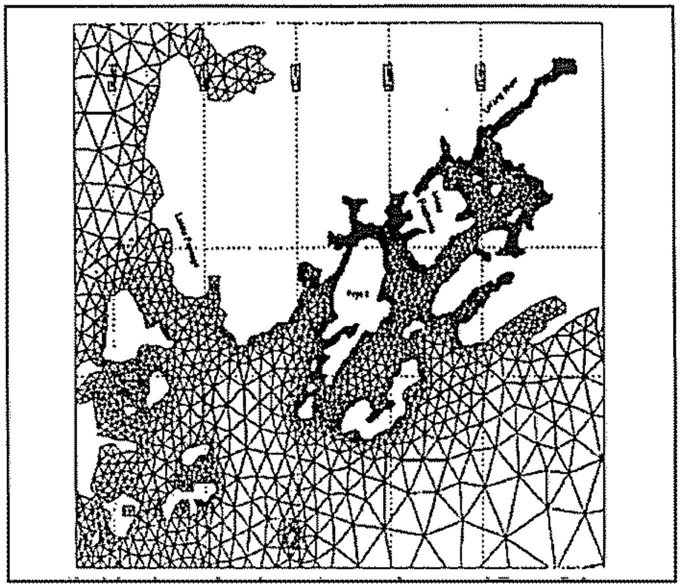

Figure 3: A detailed look at the domain northeast of Deer Island around Frye Island and the Letang Peninsula, an area of intensive aquaculture activity. There are extensive drying areas in this region when the tide is out.

The Models

Velocity fields were computed for the Passamaquoddy Bay region with a barotropic mean density field with three different models (Fundy5, Quoddy4 and Q4_dry). The resulting depth averaged velocity fields are then used to investigate fixed depth particle transport.

Fundy5 is a linear diagnostic finite element model which computes a harmonic solution of the 3D linearized shallow water wave equations using elevation boundary conditions on the open ocean boundary ([2, 4]).

Quoddy4 is a nonlinear, hydrostatic, free-surface, 3D model which operates in tidal time ([3, 1]). Boundary conditions for the M_2 tidal and residual elevations and initial conditions were generated from a Fundy5 solution computed on a larger domain.

Q4_dry is an extension of Quoddy4 that uses numerical techniques to add and subtract intertidal areas as the tide rises and falls.

It should be noted that the minimum depth in Fundy5 is 2 m whereas, a minimum depth of 10 m is necessary in Quoddy4. There is no minimum depth implemented in the Q4_dry model, in fact, areas above sea level can be included in the model.

Model results

Figure 4 shows typical model flow field characteristics for the Passamaquoddy Bay region for the tidal current during a flood tide. Figure 5 shows the residual currents in the inner basin which are tending to follow the depth contours. These model flow fields are taken from the Q4_dry solution. Particle tracks from the Fundy5 solution represent movement induced by the linear motion of the M_2 tide. The net desplacements over the tidal cycle arise from spatial variability in the size and orientation of the tidal ellipses.

Figure 4

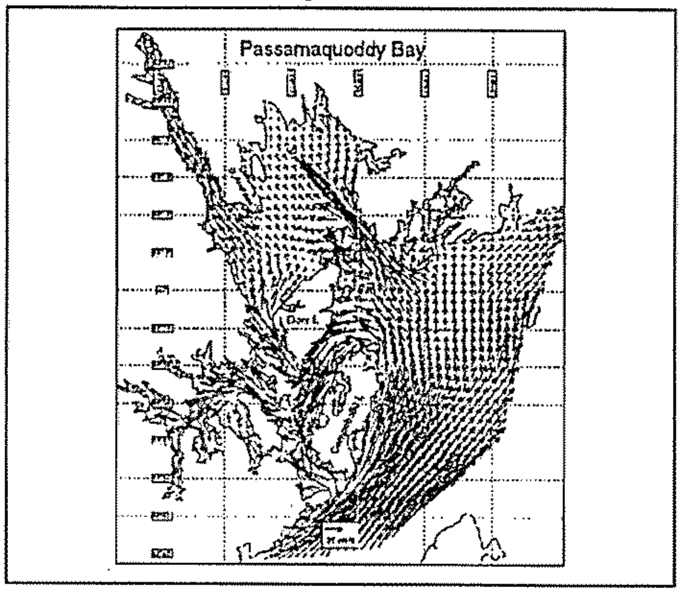

Figure 4: Q4_dry tidal velocities during a flood tide.

The dynamics of the Quoddy4 model are highly nonlinear and particle movement is the result of the tide plus the tidally induced residual. The Q4_dry particle tracking results are expected to be similar to the Quoddy4 results except that the addition of the drying areas implies that there is no minimum depth thereby giving rise to shallower water and stronger friction effects.

In general, the particles move quickly through the constrained passages northeast and southwest of Deer Island. Particle behaviour in the inner basin shows less net displacement over a tidal cycle in the Fundy5 solutions due to the absence of the tidal residual in these solutions compared to the other nonlinear model solutions. This particle behaviour is typically what we might expect from the models.

Differences between model solutions can be seen in the detailed region near Frye Island and Letang Peninsula (Figure 7). The few particles to the north and northwest of Frye Island which are content to oscillate back and forth in the linear solution act far less oscillatory in the Q4_dry solution. Particle behaviour in the quoddy4 solution falls somewhere between the other two model solutions. Particles directly south of Frye Island have reversed direction between the linear and nonlinear with drying shores solutions.

Figure 5

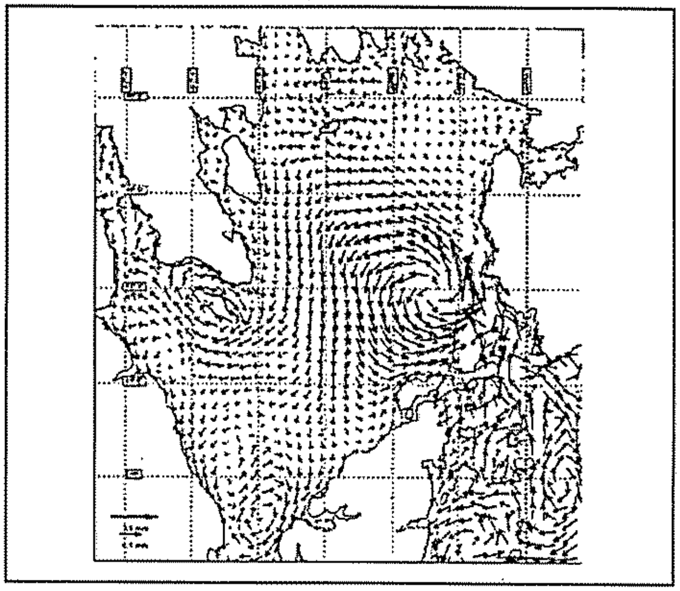

Figure 5: Q4_dry tidally forced time-mean velocities in the inner basin north of Deer Island. Vectors are scaled by the square-root of their magnitude.

Concluding remarks

Our models show considerable promise for contributing to an understanding of the dynamics of Passamaquoddy Bay. In future work we hope to be able to better tune and verify these results and move on to look at more complex forcings with additional tidal constituents as well as density and wind driven motions.

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Figure 6

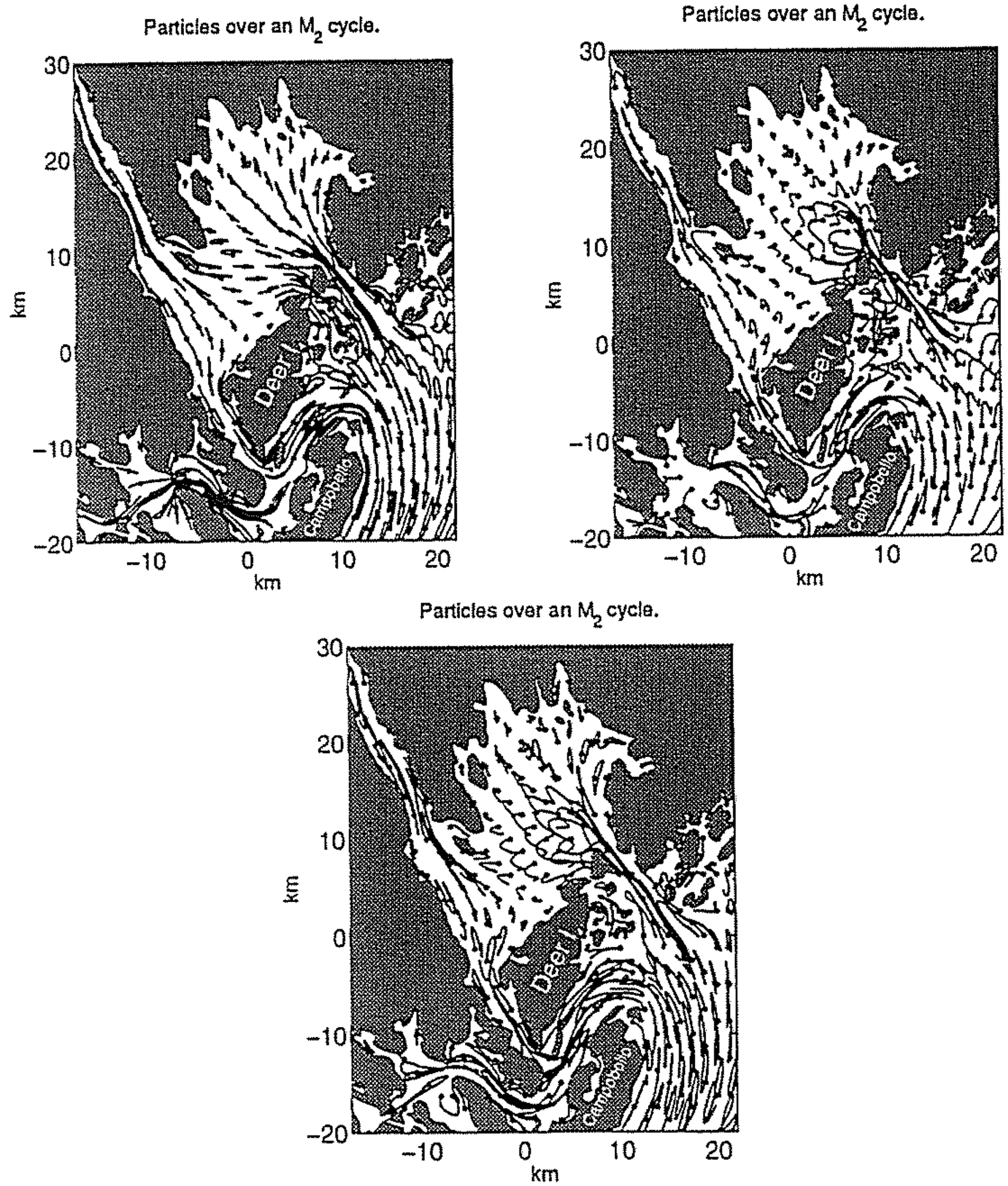

Figure 6: Particle tracks over a large part of the Passamaquoddy model domain for each of the model solutions: Left) Fundy5 Right) Quoddy4 and Bottom) Q4_dry. The dot at one end of each track indicates the strarting position.

Figure 7

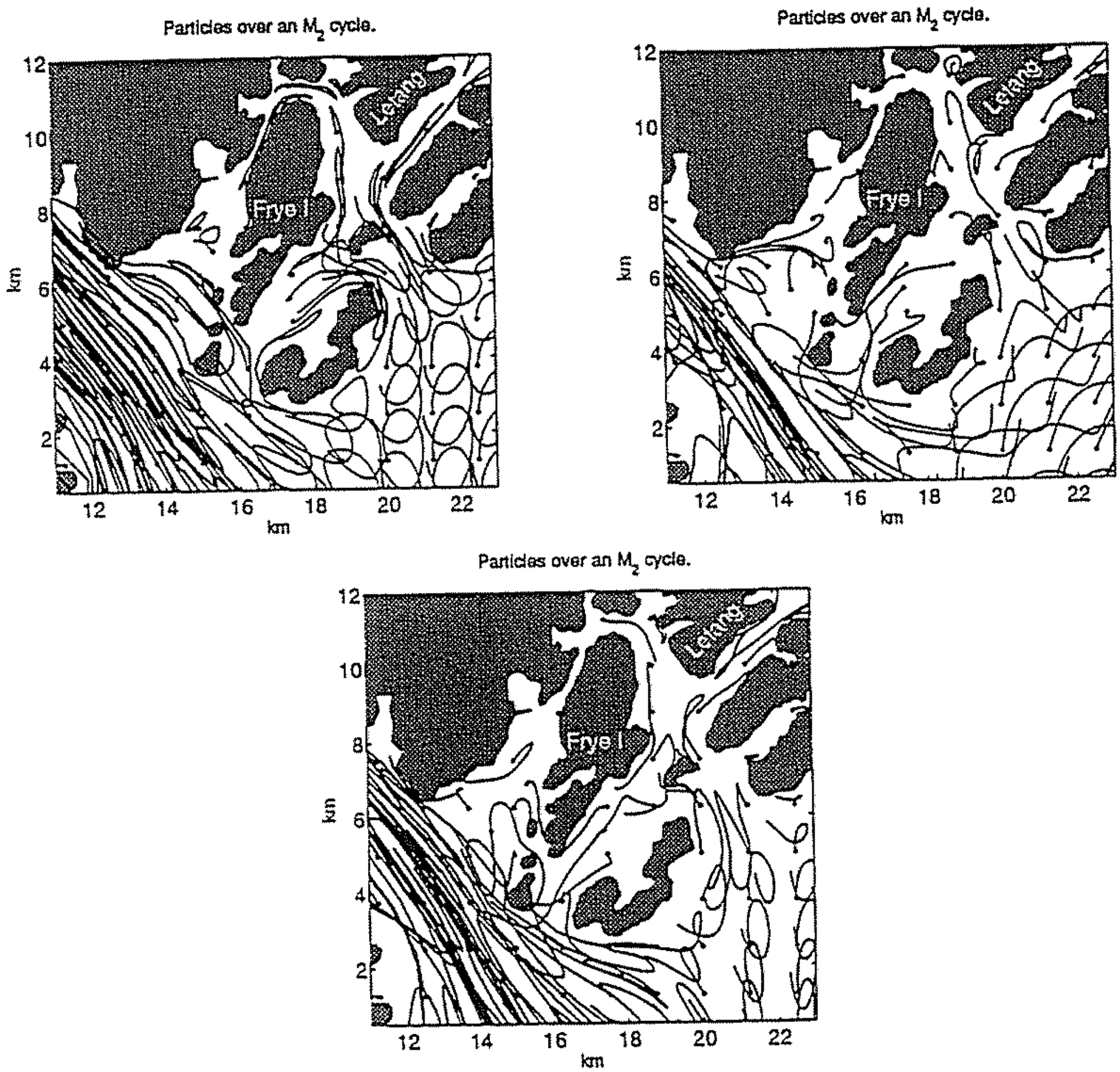

Figure 7: Particle tracks over a small part of the Passamaquoddy model domain for each of the model solutions: Left) Fundy5 Right) Quoddy4 and Bottom) Q4_dry. The dot at one end of each track indicates the starting position.

Changes in SPM concentration and composition over a tidal cycle in the lower Bay of Fundy

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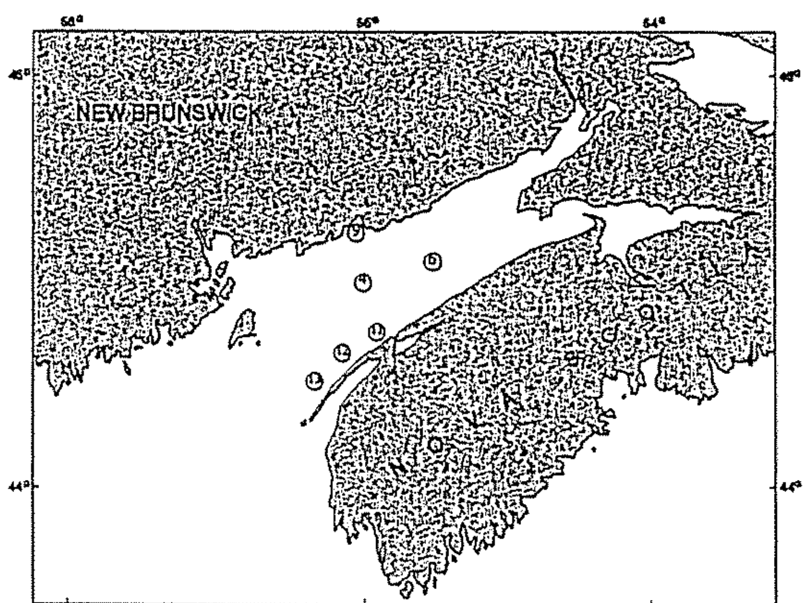
Bedford Institute of Oceanography, Dartmouth, NS

The dynamic nature of the tidal energy of the Bay of Fundy is especially apparent in the Benthic Boundary Layer, the near-bottom region where bottom friction creates large shear forces in the flow, which in turn resuspend sediments and determine the vertical distribution of suspended particulate matter (SPM). Determining the nature of near-bottom particle fields, and how these might be affected by the large tidal currents in the Bay, is an important step in understanding the trophic dynamics - and likely the distributions of - benthic suspension feeders such as the sea scallop, *Placopecten magellanicus*.

To explore the benthic boundary layer environment of the Bay of Fundy a number of specialized oceanographic gears were deployed during C.S.S. Dawson cruise 87-038 in October of 1987. These included CTD/rosette casts with 5L Niskin bottles for SPM determination in the water column and BOSS (Benthic Organic Seston Sampler) casts for SPM values at ten heights from 5 to 50 cm above the seabed. Water from these samplers was filtered through 0.8 Millipores, weighed, ashed (60°C Plasma ashing oven) and analyzed on a model TAII Coulter Counter for the particle size spectrum of inorganic components. Casts of the Benthos 373 Silhouette Camera were made to assess the *in situ* size distribution of flocculated particulates. A hull-mounted ADCP provided current speed and direction profiles.

Figure 1

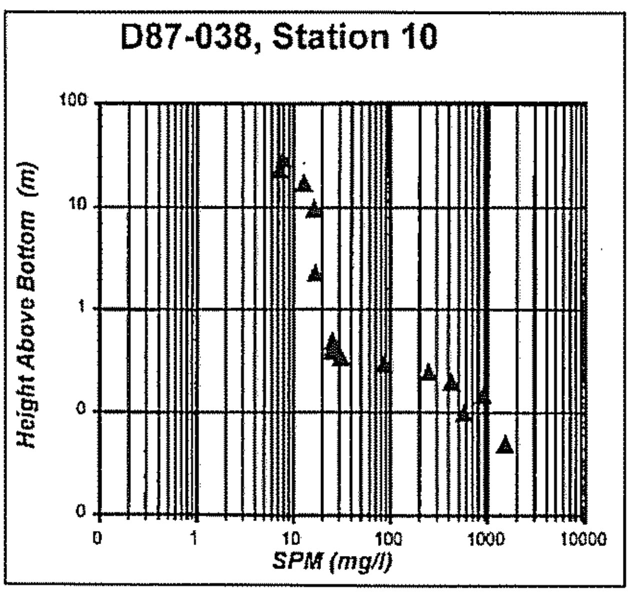


Six stations in three general areas of the lower Bay were sampled (Fig 1). Stations 4 and 6 were in the central Bay in approximately 120 m of water. Station 9, at 30 m water depth in outer Saint John Harbour, was located in the outflow plume from the St. John River. Stations 11, 12 and 13 were in approximately 100 m depth along the Nova Scotia coast from Digby Bight to Digby Neck. Station 12 was occupied over a 12 hour period to study changes occurring through the tidal cycle.

SPM values in the central Bay of Fundy (Stations 4 and 6) ranged from 0.6 to 2 mg L^{-1} in the upper water column and from 3.0 to over 100 mg L^{-1} in the benthic boundary layer. Generally, the closer to the seabed the higher the SPM concentration, with highest values recorded at 0.05 m above the bed.

SPM values were considerably higher in the St. John River outflow plume. A typical profile is shown in Fig 2. The station was in 30 m of water and the upper water column SPM values were on the order of 10 mg L^{-1}. This increased through the mid water column and values in the benthic boundary layer exceeded 1 gram per liter, reaching as high as 1500 mg L^{-1}. On one cast the value at 0.05 m above bottom was over 7,000 mg L^{-1}. The samples from stations 11, 12 and 13 were all qualitatively similar, while the time series sampling at station 12 elucidated changes occurring over a tidal cycle. Tidal current velocities, measured at 20 m above the seabed (water depth was 100 m) by the Ametek Straza ADCP, gave an indication of the stage of the tide and ranged from 19.6 to 101.3 cm s^{-1}. Figures 3 and 4 show SPM profiles within 50 cm of the seabed at current speeds of 23.1 and 99.3 cm s^{-1}, respectively.

Figure 2



At 23.1 cm s^{-1} the vertical distribution of SPM concentration was quite uniform, with values in the 50-60 mg L^{-1} range down to 0.05 m above bottom (Fig 3). Three hours later, when the current recorded at 20 m above bottom was 99.3 cm s^{-1}, SPM values above 25 cm were on the order of 10 mg L^{-1} while between 25 and 5 cm above bottom SPM ranged from 30 to over 1000 mg L^{-1} (Fig 4). The profile then returned to one of vertically uniform and relatively low SPM concentration three hours later on, when the current speed had dropped to 30.4 cm s^{-1}. Particle size analysis confirmed that the majority of the SPM concentration increase was due to resuspension of bed sediments in the 200 m size range during the high current flow. The increase in large particles was confined to within 25 cm of the seabed. During the tidal cycle sampling at Station 12 SPM values in the upper water column were constant at close to 1 mg L^{-1}, increasing to 4 mg L^{-1} at 10-20 m above the seabed.

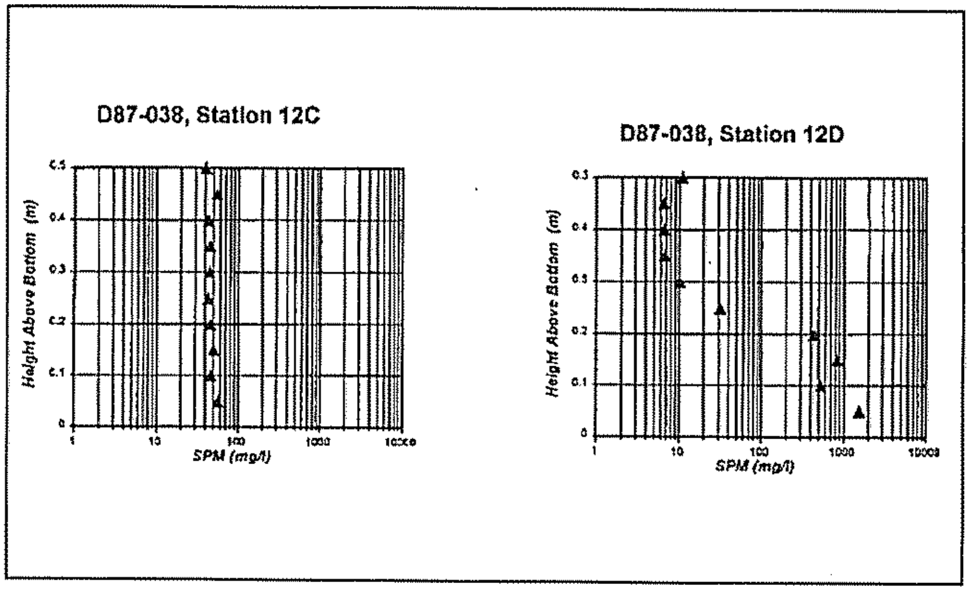


Figure 3 Figure 4

Analysis of the BOSS samples for % total organic content showed that the material present at low current flow (23.1 cm s^{-1}) was high in carbon content at 51.6% TOC. At high current flow (99.3 cm s^{-1}) the average TOC from 5 to 50 cm above bottom had been reduced to 9.5%. Within 25 cm of the seabed the average was only 2-3%. Thus, in spite of a higher overall horizontal flux of SPM, the nutritive content of the particulates was very low during high flow periods. Analysis of C:N ratios of the SPM showed no vertical partitioning at either high or low flow periods.

The results from cruise D87-038 show the truly dynamic nature of the benthic boundary layer in the lower Bay of Fundy. Both concentration and composition of the SPM change dramatically in the near-bed region on timescales of a few hours, driven by changes in tidal current energy. The significance for benthic suspension feeders, such as sea scallops, is that there must be a significant time during each tidal cycle when feeding is not productive. *P. magellanicus* has obviously adapted to deal with these variations in seston supply, since the measurements at Station 12 were made over productive scallop grounds.

Future applications of combined SPM and current measurements in the Bay of Fundy should provide a basis upon which to assess habitat suitability - or change - in a variety of nearshore and mid-Bay environments. Routine sampling in the benthic boundary layer could be an important monitoring tool for contaminants, as the near-bed region retains higher concentrations of fine particulates than the water column and the finer material spends more time in suspension and available to suspension feeding fauna.

Distribution of scallop larvae in relation to the hydrography of the Bay of Fundy

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[1]*Fisheries and Oceans Canada, St. Andrews, NB, E0G 2X0*
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The life-history characteristics of marine invertebrates have evolved over time to match the specific characteristics of the environment in which they live. Many of these environmental characteristics, especially the physical ones, are conservative in nature and have relatively little inter-annual variation in comparison to their biological counterparts. Examples of physical characteristics would be the annual temperature cycle, the tidal flows through an area or seasonal events such as the spring freshet. When animals have a planktonic phase, these factors can become major structuring forces in the distribution of the animals.

In 1989, an eight-year study was initiated in Passamaquoddy Bay to examine the larval distribution patterns of the sea scallop, *Placopecten magellanicus*, in relation to the hydrographic features in the bay. A uniform grid of twenty-five stations was established and was sampled monthly with a CTD. Japanese spat bags were deployed annually in August and retrieved in December to monitor the annual settlement rates. The results indicated that there was a good correlation between the distribution of the scallop larvae and earlier data on the residual surface circulation patterns in the bay. The same stations consistently had the highest settlement rates and were found in a gyre region in the northern part of Passamaquoddy Bay. These stations also produced the largest spat. Analysis of the CTD data indicated that the high-density areas were in warmer, stratified waters that generally had higher chlorophyll a values. The conclusion from this study was that scallop larvae are associated with concentrating mechanisms, like gyres, and that there is a direct benefit to the larvae in the form of growth and, possibly, survival.

To test this hypothesis further, we examined offshore hydrographic features in the Bay of Fundy in relation to larval densities. In October 1997, we conducted a cruise in the region between Campobello Island and Digby; this is an area known to have a gyre from previous oceanographic studies. A cruise track was created based on the thermal signatures from the water surface determined from the NOAA 12 and 14 satellite. Daily passes of the satellite were recorded at the University of Maine, navigated and then downloaded over cellular modem to the survey vessel. Vertical plankton tows using a 64μm mesh net were made at 31 stations. The results from the satellite images showed strong thermal patterns and gradients at the water surface that closely reflected the position of the gyre in the area. The vertical plankton haul samples showed much higher larval densities within the gyre and much lower numbers away from it towards the mouth of the Bay of Fundy, suggesting that retention of the larvae was occurring.

The results from both of these studies support the concept that the early life history of scallops is coupled with the local hydrographic features, especially those that would tend to act to create a retention area. Based on Passamaquoddy Bay results, the larvae obtain an advantage from these areas through faster growth and, possibly, higher survival. These characteristics fit the definition of a nursery area. From an applied perspective, these areas are important to identify and protect for the natural resources in the region, especially if they are acting as nurseries.

Field techniques for studying spatial pattern and scale in nearshore benthic communities

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This study introduces both a new fisheries ecology program and field approaches for studying spatial pattern and scale in juvenile lobster distribution and abundance. Canadian Lobster Atlantic-Wide Studies (CLAWS) is a Department of Fisheries & Oceans high-priority program designed to solve the lobster paradox: sustained landings over two decades during a period when assessments have indicated the fishery has been overexploited. The program brings researchers from a number of government and university laboratories together to investigate four general problems: (1) Assessment of lobster stock status; (2) Catchability of adult lobsters; (3) Growth and reproduction; and (4) Pre-recruit dynamics.

Within the Pre-recruit dynamics sub-program are three areas of investigation: (1) Significance of fish predation on juveniles; (2) Interannual variability in growth and survivorship of juveniles; and (3) Distribution and abundance of juveniles in relation to habitat characteristics. The focus of the juvenile lobster habitat study is to investigate: the relationship between the spatial arrangement of benthic habitats and patterns of distribution and abundance of juveniles; the effects of lobster density and the spatial distribution of habitat patches on dispersion and movement patterns; and various modelling approaches for investigating benthic settlement and recruitment linkages.

The rocky subtidal zone is characterized by a high diversity of bottom types and organisms. Landscape ecology approaches this heterogeneity under the basic premise that the composition and spatial form of a landscape mosaic fundamentally affects the way ecological systems function. Landscape ecology provides conceptual and analytical approaches for studying spatial pattern and scale. The main factors in an analysis of landscape spatial pattern are the amount of habitat in the landscape, the size of habitat patches, the inter-patch distance and landscape connectivity. An analysis of spatial pattern must account for the inter-dependency of the amount, size and inter-patch distance and that observed patterns change with changes in the scale of analysis. Connectivity refers to the ease at which organisms can move between patches; for example, two adjacent shelters may represent isolated patches for a small lobster if the space between them is too dangerous to traverse whereas the shelters may effectively form one patch for a larger lobster.

We studied spatial patterns of lobster habitats at sites in Northern New Brunswick, Southwest Nova Scotia and the outer Bay of Fundy. In order of decreasing scale and increasing spatial resolution, we employed the following techniques: Side-scan sonar mosaics of benthic habitats, remote surface-deployed video surveys, and video-taped transects and quadrants. Habitats quantified were ledge, boulder and cobble (with or without kelp) and gravel, sand and mud.

We first conducted preliminary video surveys of potential field sites. Suitable sites were then mapped using side-scan sonar mosaics (produced by G. Fader & R.O. Miller, Geological Survey of Canada, Atlantic) which were subsequently ground-truthed using remote and diver operated video methods. Within this large-scale (~5 km^2) mapping of benthic habitats, we mapped the precise location of each lobster and its associated shelter using a geographic positioning system with differential signal (dGPS). Detailed habitat and lobster sampling, for a range of spatial scales, was conducted on 1 x 100m transects and on nested quadrants ranging from 0.25m^2 to 6.25m^2 in area. The position of each lobster was mapped by hand and referenced to the video record of the habitat.

Field data will be interpreted in light of our laboratory studies on density-dependent habitat selection, movement rates and dispersion patterns in determining spatial patterns of juvenile lobster distribution. Our studies will link with others (population dynamics and physical processes) using population models which will ultimately lead to an improved theoretical framework and sound conservation and management decisions.

Benthic communities in the Lower Bay of Fundy: Linking traditional systematics with community ecology

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Ecology Action Centre, Halifax, NS

Abstract

During the summer of 1997, a study of the faunal bycatch of scallop drags was carried out. Two hundred and fifteen tows were made on known commercial scallop grounds off Digby, Brier Island and Grand Manan Island. The object was to obtain baseline species information and to compare the results with those from previous studies. A total of 242 species was identified. This was an increase by over 100 species over the number previously recorded for these scallop grounds. Forty-eight epifaunal species were recorded using the shell of the sea scallop (*Placopecten magellanicus*) as a substrate. One of the most significant changes in species distribution observed during the past 30 years was the spread of Lemon Weed (*Flustra foliacea*) from the Minas Basin to below Digby Gut in the Bay of Fundy.

There are both advantages and disadvantages to assessing the fauna directly from drag contents. This method is simple, easy to replicate and data collected directly from the fishing community can be used. Little quantitative data can be obtained due to variability in drag volume and area covered. Detailed community interactions cannot be obtained from the assessment of drag contents. The results of this study indicate that there is still information lacking on community structure and species composition of scallop ground communities in the Northwest Atlantic. There has been an increase in research on the effects of fishing practices on the seafloor. Before any true assessment of the effects of human activity can be made, it is imperative that species continue to be collected, identified and recorded so that baseline data are available.

Influence of ice cover and sediment temperature on intertidal benthic invertebrates on the Windsor Mudflat, Minas Basin, Bay of Fundy

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Abstract

Although the ecology of the intertidal mudflats of the upper Bay of Fundy has been extensively studied during the warmer months of the year, the winter ecology remains largely unknown. Of particular interest is how benthic invertebrates, an important food source for shorebirds and fish, survive the winter. Sediment deposition downstream of a tidal dam, the Windsor Causeway, on the Avon River near Windsor, NS, has created an intertidal mudflat which is becoming an increasingly important feeding area for migratory shorebirds as the mudflat stabilizes.

In the winter and spring of 1996, subsurface sediment temperature, meteorological conditions, and benthic macroinvertebrate density in the upper intertidal zone at this mudflat were monitored.

Although air temperatures ranged from -22 C to 12 C from January through mid-March, subsurface sediment temperatures remained virtually steady at about -1 C, corresponding to periods of ice cover. Tidal inundation had little or no influence on sediment temperature during that time, indicating that the ice effectively insulated the sediment bed from temperature changes in the surrounding environment. As soon as the major ice departed in mid-March, sediment temperatures began to rise. When the sediment was not ice-bound, the temperature fluctuation within any 24-hour period was predominantly unimodal, correlating strongly with air temperature, but also contained secondary peaks and valleys, reflecting the temperature of the seawater during periods of tidal immersion.

Because sediment temperatures rarely dipped below -1 C, freeze-resistant organisms, such as the important prey species *Corophium volutator*, may be able to survive the winter conditions quite well in place. While the ice may serve as a protective insulator from extremes of cold and wind, it may also present a threat to the survival of the organisms by freezing into and lifting off surficial sediment and the invertebrates therein. The impacts of sediment removal on invertebrates include removal of large portions of the population, removal of microalgal and detrital food sources, exposure to the elements, and disturbance of habitat.

Source-sink relationships in recruitment of American lobsters in the Gulf of Maine, with comments on exchange processes in the Southern Bay of Fundy

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Lobsters (*Homarus americanus*) develop through three larval stages and a neustonic (near- surface) postlarval stage before they settle to the benthos (Ennis 1995). Development of these four planktonic stages is temperature-dependent and in the Gulf of Maine may require upwards of 50 d (MacKenzie 1988, Incze *et al.*, 1997). Because of this long development time in a region of strong currents, lobsters may drift considerable distances between hatching and settlement. The cyclonic circulation of the Gulf of Maine is well known (Brooks 1985, Beardsley *et al.* 1997), and schematic generalizations of the flow regime, along with drifters and other observations, have been used to infer plausible trajectories and distances for planktonic transport (Harding and Trites 1988, 1989). Improved quantification of these processes is now posssible using hydrodynamic models of the gulf-wide circulation. Such models are simplifications of the natural system, but they provide a formal, quantitative basis for calculating and depicting transport, making testable predictions, and incorporating improvements based on new data and better understanding of fundamental processes. Lynch *et al.* (1996, 1997) developed a seasonal, climate-averaged finite element model for the Gulf of Maine with high resolution in the coastal domain. We used particle-tracking routines with inverse solutions of this model (Dartmouth Circulation Model, "Quoddy4") to back-calculate the possible hatching locations of planktonic lobsters entering known or hypothetical recruitment sites, and forward solutions to examine the length scales of transport from various points around the Gulf.

Lobster larvae hatch from eggs attached to adult females, which are abundant and broadly distributed around the Gulf of Maine at depths mostly less than about 120 m (unpubl. survey data from U.S. and Canadian fisheries agencies). Most hatching occurs in early summer (Ennis 1995). Along the central coast of Maine the postlarval season extends from early July to early September (7 years of data: Incze *et al.* 1997) and back-calculations based on development rates and sea surface temperature records for those years indicate that the majority had hatched in June (Incze *et al.*, In prep.). Larvae are found in the upper mixed layer, although the precise depths and their variation with stage and environmental conditions are not well known (Ennis 1995). The postlarvae occur mostly in the upper 0.5 m in coastal waters (Harding *et al.*, 1982; Hudon *et al.*, 1986; Incze *et al.* 1997) but may occur deeper offshore (Harding *et al.* 1987). Although lobsters may settle in deep water, studies to date have focussed on nearshore, shallow sublittoral environments where settlement is known to occur (Wahle and Steneck 1991) and where it is feasible to conduct regular surveys and experimentation (Incze *et al.* 1997, Wahle and Incze 1997). Our studies, therefore, focus on the distribution of planktonic stages primarily inside the 100 m isobath, and on the question of "how?" and "how many?" get advected to near-shore regions.

The summer season and nearshore environment, in particular, present challenges in terms of resolving the coastal meteorology and ocean response. During summer, a coastal diurnal sea breeze develops which is not represented in the climatic mean seasonal circulation. We divided preliminary work into two components. First, we examined the long distance transport of larvae throughout the gulf using the climatological mean circulation broken into one-week increments to smooth seasonal transitions. These calculations reflect the averaged influence of wind on water circulation but do not impose additional wind dynamics. We followed this strategy because we do not know either the depth of larvae or the spatial variations in the wind field over their range sufficiently well, both factors that should be explicitly explored in the future. Secondly, we constructed a simple model of a moderate sea breeze extending 20 km offshore (see Simpson , 1994) and used it to examine its effect on postlarval transport in the mid-coast region of Maine, where: a) we have wind data to back up our model; and b) we know that postlarvae are abundant in the upper half meter well offshore (Incze *et al.* submitted).

We began with inverse solutions of the model from mid-coast Maine. Model runs to date demonstrate that settlement in the Boothbay Harbor region can be influenced by sources of larvae along most of the eastern Maine coast and as far away as Grand Manan Island in southwestern Bay of Fundy. Most transport is effected during the larval stages because of the stronger residual currents to the east, the stronger flows in June compared to later, and the comparatively low water temperatures coupled with a steep temperature response during larval development. Shorter distances were transited by the postlarval stage. Model runs which incorporate realistic sea breeze scenarios show that dynamics of the near-shore wind-field figure prominently in onshore transport of this final, neustonic stage. Even a modest sea breeze (maximum 5 m/s attained for 4 hours each day) appreciably shortens the along-shore transport of postlarvae and delivers a significant portion of individuals from the region of the 100 m isobath to the nearshore environment. The model thus quantifies the importance of neustonic existence and permits a comparison of onshore transport in the varying weather patterns of different years and possible modifications to recruitment due to long-term climate change.

We used both inverse and forward runs of the model to examine larval transport to and through the outer Bay of Fundy. According to our runs, larvae may be transported to the Fundy Isles region from the shelf south of Nova Scotia, or may short-circuit the Bay and be transported southwest between Jordan Basin and the Maine coast. In the mean residual flow calculations, the directional fate of larvae is determined by their distance offshore. Here, it is obvious that a better understanding of depth distribution of reproductive lobsters and exchange processes between the Gulf of Maine and the Bay of Fundy is needed. We have not yet modeled the transport of postlarvae in this region between southern Nova Scotia and eastern Maine because we did not have adequate spatial and temporal wind data. The shallow distribution of postlarvae and our results for mid-coast Maine argue for an examination of wind data for this region.

Using inverse and forward runs of the model we examined transport paths of larvae arriving at, or hatching from, various points around the Gulf of Maine. Differences in residual current speeds and water temperature (because of their effect on development times) produced large differences in transport. Some transport patterns may give rise to varying length scales of source-sink recruitment patterns around the gulf, including along-shore and offshore-inshore patterns. A better understanding of these patterns may explain regional differences in productivity and may have implications for management of various regions for fisheries.

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Seaweeds:
a coastal component to integrate into the ecosystem research approach and the sustainable development of the Bay of Fundy.

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Behind this "catchy-buzzwordy" title, this presentation describes some of the projects conducted in our Laboratory of Eco-Physiology and Biochemistry of Seaweeds, and relevant to the Bay of Fundy.

We have been investigating phosphorus (P) and nitrogen (N) metabolisms in the red alga *Chondrus crispus* and their impact on carrageenan production (Chopin *et al.* 1995). We demonstrated an effect of P nutrition, *i.e.* an inverse relationship between seawater P enrichment and carrageenan content, similar to the so-called Neish effect for N nutrition (Chopin *et al.* 1997b). To observe this effect, plants should first be markedly depleted in P, then the proper combinations of P and N enrichments, not N:P ratio, should be provided. Determination of the proper combinations of P and N enrichments is of major importance for aquaculture systems for three reasons: 1) optimizing carrageenan production; 2) minimizing the direct cost of nutrients; and 3) minimizing the levels of dissolved inorganic P and N in effluents and, therefore, the indirect cost of nutrients due to their treatment to avoid excessive enrichment of coastal waters. Proposals to move finfish aquaculture activities on land will address the present problem of nutrient enrichment in coastal waters due to cage aquaculture only if integrated aquaculture systems are developed.

By combining chemical analyses, transmission electron microscopy and energy dispersive X-ray microanalysis, the presence in *C. crispus* of polyphosphates (as cytoplasmic granules and precipitates along the plasmalemma, particularly near pit plugs) was unequivocally demonstrated for the first time in a red macroalgal species (Chopin *et al.* 1997a). We are presently investigating the same form of P storage in *Porphyra purpurea* for two reasons. First, from an evolutionary viewpoint, as it will be very interesting to find if a representative of the Bangiophycidae (*Porphyra*), considered to be the more primitive of the two sub-classes of red algae, also synthesizes polyphosphates, as does *C. crispus*, a member of the more advanced Florideophycidae. The presence of polyphosphate granules in these different rhodophycean macrophytes would confirm the assertion that, through the evolution of P metabolism, high molecular-weight polyphosphates in primitive organisms were able to fulfill the functions which, in higher plants and animals, are mainly carried out by ATP. The second reason for working on *P. purpurea* is that it could be used for the development of integrated aquaculture as a biological nutrient removal system and as a marine crop of high value (nori and biotechnological applications). For the development of a commercially-viable nori aquaculture industry, it is paramount to know seawater quality and its seasonal variations, as well as the nutrient requirements of the plants, in order to select the appropriate sites and species.

Chondrus crispus is also an interesting organism because of its extreme morphological plasticity which has been puzzling phycologists for almost two centuries. No study has been able to conclude unambiguously what its nature is (environmental and/or genetic). We are reinvestigating this enigma, this time at the molecular level (Chopin *et al.* 1996b). Seven samples of *C. crispus*, representing widely contrasting forms from both sides of the North Atlantic, were compared by restriction endonuclease digestion (RFLP) of their plastid DNA. The similar banding patterns confirmed that the seven forms were conspecific and distinct from *C. ocellatus* f. *ocellatus* from Japan, used as an outgroup. The number of variable positions and autopomorphies in the sequences of the internal transcribed spacers (ITS 1 and ITS 2) and the intervening 5.8S ribosomal nuclear DNA region of the seven forms was low, indicating that comparison of the sequences of the ITS region does not discriminate among intraspecific morphotypes in *C. crispus*. However, at the interspecific level, when comparing sequences of *C. crispus* and *C. ocellatus* f. *ocellatus*, the number of variable positions and autopomorphies was markedly higher, confirming that the latter taxon, closely related to *C. ocellatus* f. *crispoides* and *C. nipponicus*, is a separate species from the North Pacific Ocean, and not synonymous with *C. crispus*, which is confined to the Atlantic Ocean. We are now developing and adapting recent techniques, such as amplified fragment length polymorphism (AFLP), which hopefully will provide taxonomic and genetic markers at the level of populations to reveal a genetic correlation with polymorphism.

We are also working on the brown alga *Ascophyllum nodosum* (rockweed), experimental harvesting of which started in 1995 along the New Brunswick side of the Bay of Fundy. Several projects are presently undertaken:

- Is a tip a tip, whatever its position, on *Ascophyllum nodosum* (rockweed)? This project is studying whether axial, apical segments have the same physiology as lateral, terminal segments in plants of different ages, whether apical dominance exists in this species, whether nutrients are redistributed within the plant, what are the consequences on the morphology of the plant following harvesting and this will help us in our sampling strategy (analysis of any tip or the position on the plant should be considered?).

- The physiological impact of harvesting on *Ascophyllum nodosum* (rockweed). In this project, we measure monthly carbon (C), hydrogen (H), N and P content of apical parts, basal "shoots", mid-thallus sections, and harvested (truncated) ends of plants in non-harvested 10 m x 10 m plots and plots harvested at a rate of 17% of the available biomass, which is the rate of harvesting by the industry.

- Seasonal and geographical variations in *Ascophyllum nodosum* (rockweed) and its associated species. To help define the appropriate strategy of the harvest to ensure its optimization in a sustainable and integrated manner regarding the rockweed resource, the consistency of the products extracted from it, and the other organisms in the same habitat, this project:

1) pursues an initial study (Chopin *et al.* 1996a) on seasonal variations of nutrients (especially N, P, and carbon/organic matter which are important components of algal fertilizers) to identify the storage zone(s), as this could have implications on the part(s) of plants to be harvested and the design of the harvesting tools;
2) analyzes the seasonal variations of growth, which are linked to the above variations, and which should be taken into consideration to determine the harvesting season and frequency;
3) analyzes the seasonal variations of biomass allocated to reproductive organs. [Before the short period of gamete release (late spring/early summer), the biomass allocated to reproductive organs is significant (up to 20%). Their production has impacts at three levels: contribution to sexual reproduction, change in chemical composition of the extracts, and release of a significant amount of organic matter which contributes to the coastal food web];
4) analyzes the seasonal variations of biomass and nutrients of the associated species *Polysiphonia lanosa* and *Pilayella littoralis.* [These two species represent at certain times of the year a significant by-catch, and can be considered contaminants of *A. nodosum* extracts, which could alter their consistency (Chopin *et al.* 1996a). The harvesting strategy could be modified around the seasonality of these associated species, which can also represent seasonal variations of food supply, habitat, and recycled nutrients for other organisms];
5) analyzes geographical variations of the above parameters as these could have consequences on the chemistry and development of *A. nodosum.* [This should be taken into consideration by both the manager of the resource (possibility of different growth rate in different locations) and the industrial user (deciding where to harvest according to the chemical, physical, and biological properties sought). The study of these geographical variations could also be used, in the future, to investigate the possibility of utilizing *A. nodosum* as a nutrient accumulation indicator to monitor the nutrient loading in the Bay of Fundy resulting from human activities [agriculture, aquaculture, fish and paper industries, etc.)].

Another project we have been working on since 1995 (Chopin 1997) is the utilization of seaweeds as biological nutrient removal systems to sustain and improve the productivity and carrying capacity of coastal waters, especially in regions of intensive fish aquaculture activities, to contribute to the development of a responsible management of nearshore coastal waters. After a rapid expansion throughout the world, and particularly in the Bay of Fundy, the salmon aquaculture industry is starting to realize that it also has some economic and environmental limitations, that each habitat can carry only a certain level of mono-activity, and that exceeding the carrying capacity can generate severe disturbances (including diseases, eutrophication, toxic blooms and "green tides") in the receiving waters.

One emerging consequence of fish aquaculture is a significant loading of nutrients (especially dissolved P and N, and particulate material) in coastal waters. Different methods have been used to try to minimize the effect of nutrient loading, such as reducing nutrients and their leaching from diets, and trapping or stabilizing the faecal matter. However, 20 to 30% of N and 60 to 70% of P are still not consumed or released as faeces (Soto 1996). Another approach is to develop polyculture systems by integrating the culture of macroalgae and suspension-feeders to fish culture. Moreover, by selecting seaweeds of commercial value (for the food, textile, pharmaceutical, biotechnological, cosmetics and other industries), additional profits can be realized by industry.

Kautsky *et al.* (1996) developed the interesting concept of an ecological footprint, which is the life support area needed per square meter of aquaculture activity. For 1 m^2 of salmon aquaculture, the N production requires 340 m^2 of pelagic production to be assimilated, and the P production requires 400 m^2 of pelagic production. By integrating the culture of *Gracilaria* to salmon aquaculture in Chile, these authors were able to reduce these ecological footprints to 150 m^2 for N and 25 m^2 for P. We are developing, with colleagues at several universities in New England and the company Coastal Plantations International, Inc., from Eastport, Maine, a similar programme of integrated aquaculture by replacing *Gracilaria* (for the agar market) by *Porphyra* (direct human consumption, as nori, and biotechnology markets). Preliminary results (Chopin and Yarish 1998) showed that *P. yezoensis* and *P. purpurea* can be considered as extremely efficient nutrient pumps and, consequently, could be excellent candidates as biological nutrient removal systems integrated with salmon aquaculture.

Salmon/nori integrated aquaculture should offer several advantages at different levels:

- The seaweed farming component represents an additional income for salmon farmers. Moreover, by diversifying the sources of income and labour training, the farmer protects himself/herself from a dangerously fluctuating salmon market at the national and international level, of which he/she has very little control. *Porphyra*, either as a source of food for direct human consumption or for developing biotechnological applications, is a crop with a high added value.

- There should be substantial savings as there should be no fertilization costs. Nutrients produced by the salmon farm will fertilize, at no cost, the seaweeds (put it another way: the wastes of one resource user become a resource for others!). Consequently, a higher nori production can be anticipated in an integrated system compared to a uniquely nori farm.

- Integrated aquaculture improves water and habitat quality of coastal waters (bioremediation) by increasing nutrient removal by seaweeds naturally and, hence, at a net profit.

- If *Porphyra* reveals itself as an efficient biological nutrient removal system, one can even contemplate the possibility of increasing the number of salmon cages at a particular site, hence, creating even more revenue.

- Integration of economically important marine plants in an aquaculture system allows the management of eutrophication problems associated with present fish mono-aquaculture and coastal agriculture/urban/industrial practices. Any amount of nutrients that can be utilized by marine harvested crops will reduce that available for the growth of opportunistic and undesirable algae such as *Ulva*, *Enteromorpha*, and *Cladophora* (which are responsible for low-value "green tide" biomass, the disposal cost of which becomes rapidly prohibitive) or toxic phytoplanktonic species. Moreover, the periodic short-time harvest of *Porphyra* assures a constantly renewed removal of nutrients from the coastal ecosystem. This is not the case with bloom-forming macro- and micro-algae which recycle their nutrients back to the water column when they die and decay, and consequently perpetuate conditions favourable for future blooms. Even if the complete replacement of problem species by introducing this competition for nutrients is not achieved, partial replacement may be sufficient to reduce the biomass of problem species below the threshold of hypertrophic events (Merrill 1996).

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Seabird surveys and selected environmental data sets in the Bay of Fundy: findings and conclusions from monthly ferry transects Saint John-Digby-Saint John

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Introduction

The Bay of Fundy is of major importance for water birds from all over the Atlantic. Due to a couple of unique oceanographic features in the Bay of Fundy, the "seascape" provides several seabird breeding sites, a migration flyway for seaducks and songbirds, and it comprises a major wintering ground for a variety of water birds. Despite its importance as one of the most productive oceanographic areas in the Northern Atlantic, the avian component is neither fully researched nor monitored. Monthly transects across the central Bay of Fundy from St. John to Digby, roundtrip, have been carried out by the author since February 1996 in order to investigate questions of seabird biology and monitor seabird distribution in the Bay of Fundy. Results from one year, 12 monthly transects, are analyzed and presented.

Methods

Using the overall scheme of the PIROP (Programme Intégré des Rechereches sur les Oiseaux Pélagique) database from the Canadian Wildlife Service (CWS) (Brown *et al.* 1975, Brown 1986, Lock *et al.*1994, Diamond *et al.*1993) and research on seabird distribution in the Canadian North Atlantic (Huettmann and Lock 1997), standardized monthly ferry transects (65 km, 15 knots, ca. 2.5 hours one way) were carried out from the public ferry "Princess of Acadia" between St. John - Digby - St. John since February 1996 (see also Thomas 1981, Nettleship and Tull 1970, Finch *et al.* 1978 a, 1978 b, Tasker *et al.* 1984). The seabird observations were overlayed with environmental data sets available for the Bay of Fundy, such as: bathymetry (see also Gaskin *et al.* 1985), tidal heights (Foreman 1993), Department of Fisheries and Oceans 1996, 1997), Saint John River freshwater run-off and interpolated weather data (Wind Speed, Wind Direction, Dry Bulb Temperature) from Saint John airport, Digby airport and Brier Island. Furthermore, number of observed seabirds in the Saint John harbour and distance from Saint John were also included in the analysis.

Results

The surveys produced four different data sets: ship-following species, harbour counts for Saint John (New Brunswick) and Digby (Nova Scotia), seabirds at sea, and sea mammals. All data sets show a distinct seasonal pattern. In terms of numbers and diversity the seabird data peaked during the pre-breeding and during the post-breeding season. This indicates that this part of the Bay of Fundy, during the pre- and post-breeding season is used heavily by waterbirds. This applies in particular to the waters around the Saint John Harbour region, which includes sea mammals (Harbour Porpoise *Phocoena phocoena*, Harbour Seal *Phoca vitulina concolor*), waterfowl (Common Eiders *Somateria mollissima* , Loons *Gavia immer, Gavia stellata*) and especially gull species (Great Black-backed Gull *Larus marinus,* Herring Gull *Larus argentatus*). During the winter, Iceland Gulls (*Larus glaucoides*) and to a lesser extent Glaucous Gulls (*Larus hyperboreus*) were found throughout the whole Bay of Fundy (see also Erskine 1992 and Tufts 1986). The region around the Digby ferry harbour (Digby Neck) had less birds than the Saint John harbour but was of major importance for waterfowl (e.g. Oldsquaw *Clangula hyemalis* , Red-necked Grebes *Podiceps grisegena*), Harbour Porpoises and Black-legged Kittiwakes (*Rissa tridactyla*). Bonaparte Gulls (*Larus philadelphia*) were abundant in early winter; the Digby Neck area forms, for them, the most important resting ground after the Niagara Falls region (Stabb 1997).

Almost all of the ship-following species were found close to the Saint John harbour. They were clearly independent of tourist activities, e.g. feeding on offal, and composed mostly of Great Black-backed Gulls and Herring Gulls. During the winter, some Iceland Gulls could be observed to follow the ship far off shore. Seabird distribution patterns between morning and afternoon transects did not reveal the same distribution pattern indicating that seabird distribution was very dynamic (see also Huettmann 1997) and factors on a small scale and time of the day are important parameters to consider. Scoters (*Melanitta nigra, M. fusca, M. perspicillata*) and Eider ducks migrate mostly close to the coastline, but were also observed to a lesser extent offshore, whereas Red-throated Loons and Common Loons use the full Bay for migration. Nevertheless, most loons were found resting at sea close to the coast. Northern Gannets (*Morus bassanus*) showed a clear pattern of abundance on the shelf area off Digby, and sometimes also close to the Saint John Harbour region. In summer, all of the Gannets were clearly non-breeding birds, whereas in fall and winter almost all birds were adults with white plumage (see also Finch *et al.* 1978 b). In late summer and fall, Gannets were also part of the seabird community, usually associated with drifting seaweed patches and driftwood off shore (see also Parsons 1986). Further members of this summer seabird community are Atlantic Puffins (*Fratercula arctica*) in lower numbers, Greater Shearwaters (*Puffinus gravis*) in large numbers, Sooty Shearwaters (*Puffinus griseus*) in roughly one tenth of Greater Sherwater numbers, Arctic Terns (*Sterna paradisaea*), Common Terns (*Sterna hirundo*) and Harbour Porpoise. Minke whales (*Balaenoptera acutorostrata*), Finback whales (*Balaenoptera physalus*), Pomarine Jaeger (*Stercocarius pomarinus*), Parasitic Jaeger (*Stercocarius parasiticus*) and Storm-Petrels (*Oceanites oceanicus, Oceanodroma leucorhoa*) were observed only rarely; Phalaropes (*Phalaropus lobatus* and *P. fulicaria*), Dovekies (*Alle alle*) were never observed during the transects. Observations from other regions [Bluenose Ferry observation by Charles Duncan (*pers com.*), and Finch *et al.* (1978 a, 1978 b), observation west of Grand Manan from Dalzell (1991), Moira Brown (*pers.com.*) and the author and reports from Brier Island] indicate that the latter two species make intensive use of the waters of the southern Bay of Fundy and northern Gulf of Maine (see also Huntington *et al.* 1996), so their absence from the Saint John-Digby route is helpful in determining the limits of their range.

Winter transects had a much lower number of species observed, but waterfowl, auks, in particular Razorbills (*Alca torda*) (see also Chapdelaine 1997, Finch *et al.* 1978 b, Brown 1985), Iceland Gulls, Glaucous Gulls and Black-legged Kittiwakes evidently use the waters of the Bay of Fundy regularly for wintering (see also Erskine 1992, Tufts 1986, Veits and Petersen 1993).

During the migration period, songbird and raptor migration, as well as insect migration, was observed across the Bay of Fundy, mainly from July until November.

Transect observations of sea mammals consisted of Harbour Porpoise, Harbour Seals, Minke whale and Fin whale. Harbour Seals were observed all year round in the Saint John harbour but they were not found off shore, whereas the other species could be found all over the Bay of Fundy (Colbourne and Terhune 1991). The Harbour Porpoise population in the Bay of Fundy is the best researched population in the world (Gaskin 1992, Gaskin *et al.* 1985, Gaskin and Watson 1985, Gaskin and Smith 1979, Schulze 1996); during the transects individuals were found all year long in the Bay of Fundy with the highest densities in the eddies and gyres of Digby Neck, which has an average tidal current of 2.6 m/s, has fresh water inflow and is only 50 m deep (Gaskin *et al.* 1985). The number of sea mammals observed seems to vary with tidal level and air temperature. The highest concentration of Harbour Porpoises in the Bay of Fundy area was found by Gaskin *et al.* (1985) near Deer Island.

Although the sample size was relatively small, fog events seemed to change the regular distribution patterns of seabirds, in particular for visual species like gulls. Wind also had an impact on the soaring species such as fulmars, shearwaters and gulls. Tidal information and freshwater run-off from the Saint John River [the biggest source for freshwater inflow in the whole Gulf of Maine region (Drinkwater 1996)] were important for the numbers of birds observed off Saint John harbour. The air temperature at Brier Island was found to be related to overall biomass per transect during the late summer/early fall, underlining the role of seasonality in the Bay of Fundy. For the seabird distribution on the transects, none of the investigated environmental parameters was of major relevance to explain seabird distribution at sea. The data did not reveal any relationships of wind direction at Brier Island on seabirds, so far.

Discussion

As found in previous studies the results emphasize the importance of the Bay of Fundy Ecosystem and its unique oceanography for marine animals, such as seabirds, waterfowl, songbirds, sea mammals, phytoplankton, fish and crustaceans (Parks Canada 1995, Conkling 1995, Thurston 1990, The Clean Annapolis River Project 1996 , Mawhinney and Sears 1996, Harvey and Friends of the Bay of Fundy 1994, Brown *et al.* 1995, Brown and Gaskin 1989, Smith *et al.* 1984, Murison and Gaskin 1989, Woodley and Gaskin 1996) .

In order to understand seabird distribution better it is likely that the whole Bay of Fundy system needs to be considered as being a true coastal system, heavily impacted by human activities. Fish spawning (Jovellanos and Gaskin 1983), tidal patterns (Greenberg 1986) and freshwater supply on islands for gulls need to be looked at in more detail. Knowledge about population trends of waterbirds in the Bay of Fundy are unknown, so is the role of the Bay of Fundy as a wintering ground. Information on the winter diet of seabirds is missing (Nettleship and Birkhead 1985, but see summer diet of Guillemots in Passamaquoddy Bay: Braune and Gaskin 1982 a, 1982 b); the songbird and waterbird migration flyway is not fully understood. Seabird research in the Bay of Fundy is mostly carried out on Machias Seal Island (Amey and Diamond 1997) and Pasamaquoddy Bay (e.g. Nol and Gaskin 1987, Gaskin and Smith 1979, Winn 1950). So far, any nocturnal activity of waterbirds and the impact of human activities (e.g. oil tankers, fisheries, garbage dumps and sewage/waste water inflow) are unknown.

The author suggests that a full inventory of the islands in the Bay of Fundy be carried out (see also Nettleship 1980). This would include updating geographical maps, compiling an inventory of the flora and fauna, surveying and banding waterbirds. It is likely that new findings, such as the first breeding record of Manx Shearwaters (*Puffinus puffinus*) in the region can be found.

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The migration of shorebirds in the Bay of Fundy: the El Niño effect?

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Between 28 July and 12 August, 1997, we captured, banded, measured and weighed 1,744 Semipalmated Sandpipers at a roosting site in Johnson's Mills, New Brunswick. The project was initiated following extensive reductions in the densities of the burrowing amphipod, *Corophium volutator*, in 1993 and 1994, the sandpipers' favoured prey while in the Bay of Fundy during southward migration. Consequently, in 1995 and 1996, the birds' peak numbers remained high during migration for longer periods than was recorded in the 1980s. The sandpipers captured in 1997 were banded, weighed and colour-marked to compare their weights, movements and turnover rates with similar data recorded in 1982 in order to determine if the reductions in *Corophium* densities were responsible for the birds' longer length of stay in 1997. The birds captured in 1997 were found to be of the same weights as birds captured 15 years previously, displayed the same movement patterns and did indeed stay one week longer in the area. The only significant difference between the 1982 and 1997 field seasons was the significant lack of southerly winds in 1997, a predicted El Niño effect, which could explain the sandpipers' longer turnover rate in the Bay of Fundy during the fall migration of 1997.

Community consequences of habitat use and predation by common eiders in Passamaquoddy Bay

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Abstract

Marine intertidal communities have been extremely well studied. However, until recently, vertebrate predators, especially waterfowl, have received little attention as intertidal predators. I used a series of predator exclusion cages to examine the effect of Common Eiders (*Somateria mollissima*) as predators under disturbed and undisturbed conditions in two intertidal communities in Passamaquoddy Bay, New Brunswick. In blue mussel (*Mytilus edulis*) beds, eider predation reduced total invertebrate biomass, and that of blue mussels in particular, by nearly 50% within 8 months of initiation of the experiment. Effects of predation interacted with abiotic disturbance in the system in that disturbance delayed the effect of predation, but ultimately allowed it to persist longer. This result stemmed from an indirect effect of eider exclusion. Blue mussels under exclosures in undisturbed sites became dense. These in turn attracted a high concentration of dogwhelks (*Nucella lapillus*), predatory gastropods which also feed heavily on blue mussels. By feeding differentially under cages, whelks obscured the effect of ducks in the system. The same result did not occur in disturbed sites because initially mussels were not abundant there, and later they grew large (as a result of compensatory growth under uncrowded conditions). Whelks are size-selective predators and prefer prey smaller than those found under cages in disturbed sites. Therefore, effects of ducks, which continued to feed in unprotected areas, were not obscured.

In adjacent rockweed (*Ascophyllum nodosum*) beds, effects of predation were much weaker. Eiders had little effect on blue mussel biomass, but mussel cover increased and rockweed declined in cages relative to controls. It is therefore possible that predation by eiders in rockweed beds contributes to the maintenance of rockweed by removing mussels which might otherwise outcompete it. Duck predation significantly reduced biomass of common periwinkles (*Littorina littorea*), one of their secondary prey species, early in the experiment, but effects did not persist. As in the mussel bed, dogwhelks became important after duck exclusion, and may have obscured effects of ducks. Differences in results in the two systems can be explained by a combination of habitat heterogeneity and dimensionality, and by variation in relative abundance of invertebrates in the systems. Overall, results demonstrate that ducks are significant predators which should be considered in intertidal community studies.

Acoustic Harassment Device (AHD) use in the aquaculture industry and implications for harbour porpoises (*Phocoena phocoena*)

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Abstract

The number of aquaculture facilities in the Bay of Fundy using acoustic harassment devices (AHDs) in attempts to deter seals from approaching salmon cages has increased, yet our understanding of the effects of these devices on both target and non-target species, in the short and long term, is still largely incomplete. There are growing concerns about the impacts of such AHDs on non-target species such as the harbour porpoise, *Phocoena phocoena*, in the vicinity of operating devices. This paper illustrates the areas within the Quoddy Region and Grand Manan Island area where harbour porpoises are likely to perceive and be affected by AHD sounds. These results indicate that AHD sounds may effectively reduce the availability of marine habitat to harbour porpoises in these areas.

Metal transport in the Gulf of Maine and the outer Bay of Fundy

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Abstract

In recent years, concerns have been expressed about the level of contaminants found in the flora and fauna of the marine environment of the Gulf of Maine and Bay of Fundy. Attempts to model the contaminant transport through this system and its food webs has required a knowledge of the levels of contaminants in the water and sediments of the marine environment. Scientists from the marine Environmental Sciences Division of the Department of Fisheries and Oceans have used the findings of past and present research programs which have studied the levels and distribution of metals in the Gulf of Maine and the Bay of Fundy in an attempt to address these contaminant concerns. This presentation will describe the findings from the past and recent research studying levels and distribution of metal contamination in the sediments and water column of this region. A recent application of this data, in a study sponsored by the Gulf of Maine Council to determine the significance of atmospheric flux of contaminants to the Gulf of Maine, will be described. The data from a recent program studying the inorganic chemical content of the major rivers flowing into the Bay of Fundy will be discussed and compared to the atmospheric flux into this region. Finally, a description of a recent oceanographic expedition to the Scotian Shelf, Gulf of Maine and outer Bay of Fundy in September of this year and an expanded mercury research program that will be studying the levels and distribution of organic (methyl-Hg) and inorganic Hg from the major run-off rivers and coastal waters of the Maritime region, will be described.

Environmental chemistry and the Bay of Fundy

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Environmental chemistry means different things to different people. A common impression is that it describes concentrations of *environmentally significant chemicals* in *environmental compartments*. Environmentally significant chemicals (ESC) may also be defined in various ways. It may mean *contaminants* or *pollutants* (according to GESAMP contaminant is a substance in the wrong place; it becomes a pollutant when it causes an undesirable effect). With tongue in cheek, ESC may also mean *chemicals that can be measured*, in which case the number of measurements is directly proportional to the ease of measurement (more data available on PCBs or PAHs than on chlorinated or cycloparaffins), and the detection limit is inversely proportional to equipment cost (Mackay's Law). ESC obviously include *chemicals that we know of*. Consequently, a lot of work involves the usual heavy metals (Cu, Zn, Pb, Cd), PCBs, total DDT, and "oil" and little attention is given to less known chemicals such as synthetic musks and industrial organophosphates. Pure chemicals, as such, seldom enter the environment. In most cases they are components of *formulations*. As such, they may or may not be declared in the respective *MSDSs*. Some years ago, we detected an undeclared fungicide TCMTB in an antifouling paint formulation whose declared active ingredient was the herbicide chlorothalonil. Recently we detected an undeclared flame retardant DBDE in fibreglass that is now replacing painted wood in fish laboratories, according to the directives of CCAC. (History repeats itself. Twenty-five years ago, elevated levels of PCBs in hatchery-reared Atlantic salmon parr were traced to PCBs in antifouling paint used in the hatcheries. As a result of our work, PCBs were replaced by equally undeclared chlorinated paraffins, which are extremely difficult to measure in biota. Fortunately, the practically non-toxic high-molecular-weight paraffins were used in the paint.) In theory, MSDSs are a good idea; their implementation, unfortunately, leaves much to be desired. One cannot even rely on declared label concentrations. A "concentrated bleach" with a label concentration of NaOCl 'min. 12%' contains 12% NaOCl. On the other hand, bleaches labelled 'min. 5%' and 'min. 3%', both contain 11% of NaOCl. *Toxic chemical* is not a well-defined term, since toxicity depends not only on the chemical but also on the dose (exposure). It is also worth mentioning that chemicals toxic in the lowest concentrations are natural toxins. *Environmental compartments* are numerous and include dissolved, suspended, and bound (to humic substances) subcompartments of the 'water' compartment, dissolved in pure water, solid as such, solid in lattice, and adsorbed subcompartments of 'sediment', and things become even more complex when dealing with biota.

A broader definition of **environmental chemistry** covers chemistry contributing to the knowledge and understanding of the environment. It includes chemicals used by the biota for communication (pheromones) and defence, and requires ***curious and prepared minds and well equipped laboratories.***

The Bay of Fundy is an area extremely suitable for studies of uptake, accumulation, and cycling of persistent pollutants. This was also recognized by the U.S. Panel on Hazardous Substances, which suggested that it be a submodel for PCB studies [Environmental Research 5(3), 352 (1972)], but took no further action.

The Bay supports a number of commercial fisheries and, at the same time receives:

- industrial effluents (several pulp mills, the largest oil refinery on the Eastern Seaboard, a potash mine, an intermittently operating tin-molybdenum-indium and other 'exotic' metals mine, etc.);
- municipal wastes;
- aquaculture wastes;
- long-range fallout of hydrogen ions, mercury and other heavy metals, and polynuclear aromatic hydrocarbons (PAHs).

The Bay is the site of considerable commercial shipping, with some 23 million metric tons of cargo and 1800 ships per year visiting the Port of Saint John and another 50 tankers bringing crude oil to Canaport and exporting refined products from the Courtenay Bay terminal. In addition to the commercial importance of the Bay, there are several hydrographic, biological, and chemical factors which make the Bay a good site for studies of the behaviour and effects of toxic chemicals in the environment.

The hydrographic factors of importance are [Iles 1975, personal communication]:

1. Bottom inflow of water on the S.W. Nova Scotia coast in the Yarmouth area.
2. Flow of water from this area around Digby Neck and along the Nova Scotia coast of the Bay of Fundy.
3. Crossing over of this water inside the Bay of Fundy.
4. Freshwater inflow predominantly on the New Brunswick side which then flows out of the Bay of Fundy on the New Brunswick side and to the east of Grand Manan. This "entrains" salt water and causes "indraw" on the Nova Scotia side.
5. Mixing on the Grand Manan shelf.

The biological features of importance are [Iles 1975, personal communication]:

1. Two distinct herring larval populations, one associated with the Nova Scotia inflow and the other with the New Brunswick outflow.

2. Several populations of zooplankton organisms which can be described as "local, persistent, self-replicating biological units at the infra-specific level". Some of the zooplankton populations (e.g., Euphausiids) contain more than one year-class so that the possibility of studying "time effects" is possible.

3. A complex mixture of herring stocks, including cross-Bay migrants and emigrants from unknown areas. These include both juvenile and adult stages. Some of these populations are associated quite closely with either the "inflow" system of the "outflow" system so that any differential levels or pollutants from the Bay of Fundy "inflow" and "outflow" sources may be traceable through their own particular biological pathway.

4. The Bay contains extensive beds of long-lived horse mussels.

The chemical features of importance include:

1. Historical data on *organochlorine compounds* in porpoises, herring gull and cormorant eggs, and in herring. The levels of organochlorines (particularly PCB and DDE) were sufficiently high to warrant a more detailed examination of changes over a period of more than 20 years. Some more exotic organochlorine compounds are also present and may indicate input pathways. The Bay of Fundy is the first area in the world where polychlorinated terphenyls (PCT) have been detected in environmental samples. Little is known about the fate and effects of the flame retardant HBCD, present in expanded polystyrene floats used by aquaculture. *Oil spills* are not limited to common uses of liquid hydrocarbons as fuels or lubricants, but may include also hydrocarbons used as solvents for pesticides or other industrial products or as components of various commercial formulations. In investigations of spills from unknown sources it is important to determine rapidly the nature of the spilled 'oil'. As an example, the investigation of a recent oil spill revealed that the spilled 'oil' contained the typical diesel fuel range of hydrocarbons (C13-C23, with a maximum at C15), over an unresolved envelope, also maximal at C15 and, in addition, contained a second, smaller unresolved envelope with a maximum at about C28. The UV spectrum indicated a 65:35 mixture of diesel fuel and lubricating oil. The IR spectrum had small broad peaks at 1720 and 1050 cm^{-1}, and peaks at 1600, 1160, 820, and 745 cm^{-1}. N,N-diethyl decanamide, butylbenzyl phthalate, trimethyl carbazole, tributyl acetyl citrate, and piperonyl butoxide were tentatively identified by GCMS. Additional, as yet unidentified substances were present. The oil also contained 2,6-di-tert-butyl phenol and its decomposition product, identified by UV and TLC, Zn compounds, identified by TLC and dithizone, and a phenolphthalein-type compound, noticed by its indicator-like colour change, and as yet unidentified. The detection of piperonyl butoxide is significant. The compound is a synergist of pyrethrum pesticides, which have been used in the area.

2. Historical data on *mercury* in freshwater and marine fish.

3. Historical data on *acid rain* and *heavy metal* fallout.

4. The *sediments* in Saint John harbour are characterized in respect to heavy metals and PAHs. An up-coming remediation of a recently discovered source of PAHs makes the harbour a good site for a study of transport and biodegradation of these compounds.

5. The sediments in the Bay are quite well characterized geologically and in terms of trace metal concentrations.

6. The presence of an *aquaculture industry* provides good field conditions for studies of the effects of organic loading on the marine environment and of transport processes.

7. A long data series of the occurrence and intensity of *paralytic shellfish toxin* blooms.

Future work should form a comprehensive multidisciplinary study of the ecosystem to establish the current 'status' of the environment, which would provide a scientific base for decisions on future developments in the Bay of Fundy and better understanding of the behaviour, fate, and effects of chemicals in the environment.

Such a study may consist of projects such as:

1. Concentration in the environment and effects of chemicals used in aquaculture;
2. Ecological effects of chemicals used in aquaculture;
3. Migration patterns of Atlantic salmon in the Bay and their possible link to environmental contaminants;
4. Phytoplankton diversity and abundance and possible links to environmental contaminants and nutrients;
5. Microbiological communities ('biofouling') in relation to nutrients, organic loading, and chemicals used in aquaculture;
6. Horse mussels as long-term monitors of persistent compounds;
7. Chlorinated organics and PAHs in biota;
8. Heavy metals and methyl mercury in biota;
9. Atmospheric fallout of heavy metals and organic compounds;
10. Not-anticipated, and new, chemicals in the Bay.

Petitcodiac River trial gate opening project

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Abstract

The purpose of this presentation is to give a brief overview of a project that has generated much public interest and debate in the Petitcodiac River watershed at the Head of the Bay of Fundy. The construction of causeways and barrages in the estuaries of the Fundy were a common occurrence in the 1960s. Next year will see a trial "opening" of the gates on the Moncton-Riverview Causeway that spans the Petitcodiac River. Though only a limited scope trial, this project has the potential to lead to a long term solution of the fish passage and environmental questions surrounding the causeway. This project is being carried out with a high degree of cooperation between the four agencies involved. This presentation will highlight some of the monitoring work associated with the project.

Background

The Petitcodiac River flows through southeastern New Brunswick, from its headwaters past the communities of Petitcodiac, Salisbury, Riverview, Moncton, and Dieppe to Shepody Bay at the Head of the Bay of Fundy. The estuary was cut off between Moncton and Riverview in 1968 by the construction of the Petitcodiac River Causeway. In January 1960, Moncton City Council requested that the Province of New Brunswick conduct a feasibility study into the construction of a new crossing of the Petitcodiac River between Moncton and the Town of Riverview due to the limitations of the Gunningsville Bridge crossing. The feasibility study was conducted by the Maritime Marshland Rehabilitation Agency (MMRA). In November of 1963 the decision was made to construct a causeway with control gates, and the MMRA was requested to carry out the engineering. A construction contract was eventually awarded in January of 1966, and construction started on the 1036 metre causeway that ultimately cost approximately $3M. The causeway was opened to traffic in the fall of 1968 even before paving had been completed. As a result of construction, the flooding of agricultural land was prevented, a second river crossing was opened and a freshwater head-pond was created.

Almost immediately the debate started as to the appropriateness of a causeway as a river/estuary crossing. Some wanted to restore the river to a free-flowing tributary to revitalize the river's estuarine ecosystem and cited reasons such as enhancing anadromous fish passage (American smelt, alewife, striped bass, shad and Atlantic salmon), restoring the estuarine mixing zone (over 20 km of estuary had been cut off by the causeway), and removal of the artificial freshwater head-pond. Others wanted the head-pond retained for its freshwater and recreational values such as the property value of head-pond access, the aesthetics of the head-pond and intrinsic values of freshwater species. The debate continues to divide the communities 30 years after completion of the structure. Even with all the debate, both sides of the issue maintain that such a project would not be approved today.

The Department of Fisheries and Oceans, Environment Canada, the New Brunswick Department of Transportation, and the New Brunswick Department of Environment have now entered into a "Memorandum of Understanding (MOU) Respecting A Trial Opening of the Petitcodiac Causeway Gates". Signed on December 5, 1996, by senior personnel from the four agencies, the MOU has established a Project Steering Committee, to oversee project coordination, and three Working Groups each with specific roles. The purpose of the MOU is the "...implementation, monitoring, and evaluation of a trial gate exercise involving the manipulation of the gates on the Petitcodiac River Causeway"....to ultimately "...identify and achieve a long term solution for the fish passage and ecosystem issues...". It was recognized by the agencies involved that the "...causeway has a direct impact upon fisheries resources and the environment", relates to the mandates of the four agencies, and that these agencies "...wish to proceed in a careful, measured, and step-wise manner."

Trial Opening Project

The 1998 Trial Opening Project (tidal clipping) is a limited scope trial that will see the gates manipulated for a seven month period (post-freshet) so as to attempt to maintain a 2.5m maximum head-pond as river discharge permits. This water level was identified in the ADI-Chiasson report as an option that would permit the experiment to be stopped should unacceptable effects be observed. A limited opening also ensures minimum silt deposition in the head-pond as the trial will be, to the extent possible, restricted to the river channel. Next year's work will provide information to serve as basis for deciding what action should be taken in the long term. There has been a public commitment at both levels of government that any continuation as a result of the trial will require an Environmental Impact Assessment.

Three working groups have been established for this project: an Engineering Working Group, tasked with developing gate management guidelines; a Monitoring Working Group, tasked with environmental monitoring coordination and asked to include public stakeholder participation; and a Communication Working Group, tasked with advising the Steering Committee on public input and communication issues. The Monitoring Working Group has representatives from four signatory agencies, three stakeholder representatives (Lake Petitcodiac Preservation Association, NB Wildlife Federation, Rabbit Brook Stakeholder group), and municipal representatives from Moncton, Riverview, and Dieppe.

Thus far in 1997, project activity has focused on the installation of erosion control measures, the ongoing development of an environmental monitoring plan, the collection of baseline data for key variables, and the ongoing development of Gate Management Guidelines. 1998 will bring gate operation for the tidal clipping, monitoring of key variables, and the evaluation of results.

It is most likely that the work of the Monitoring Working Group and some of the data collection that has taken place, or is planned, will be of interest to the participants of this workshop. There are two aspects to the monitoring that have been established: 1) Monitoring activities have been defined by the Project Steering Committee to be sufficiently narrow to address the limited scope of the trial opening. That is, to determine if the gates can be manipulated to meet the 2.5m guideline in the ADI-Chiasson Report, and to ensure that erosion control measures are adequate. 2) Signatory agencies must also ensure data collection to meet legislated or mandated responsibilities such as fish passage, migratory birds, and water quality. Highlights of the monitoring to date are presented as follows:

Water Quality

Sampling has taken place in the head-pond for a range of water quality parameters such as major ions, metals, nutrients, and faecal coliform bacteria, and down stream at the Gunningsville bridge to monitor a tidal cycle for nutrients and faecal coliform bacteria. Dissolved oxygen and salinity have been included in the latter. Advice and some chemical analyses have been provided to the volunteer Petitcodiac Watershed Monitoring Group to assist in their basin-wide water quality inventory. "Microtox" toxicity tests were included on three transects of the head-pond concurrent with other water quality sampling.

Sediment Monitoring

A transect of bottom sediment samples from the Gunningsville Bridge have been collected for chemical analyses (metals, PCB, PAH) as well as 10-day amphipod survival and Microtox toxicity tests. A suspended sediment sample was also collected and screened with the two toxicity tests. Interim results from these toxicity tests indicate no toxic response. This fall, a series of bottom sediments from the head-pond will be collected for chemical analyses, and Microtox screening. Sedimentation is being monitored by the use of in-stream sensors of turbidity, one in the head-pond, and two downstream of the gates.

Migratory Bird Monitoring

Extensive monitoring of shorebird (semi-palmated sandpiper) ecology, and populations on downstream mudflats has taken place and will be discussed in detail by one of the next speakers. In addition to the CWS shorebird studies, 23 volunteer monitors from Salisbury to Hopewell have begun recording migratory bird species and activity along the watershed. CWS has also conducted a breeding pair, and brood survey between the causeway and Turtle Creek (both sides of the head-pond).

Fisheries Related Monitoring

Benthic and macrophyte distribution and abundance in the head-pond has been monitored. Monitoring has also taken place to examine fish abundance and distribution in the head-pond and downstream and to relate observations to tidal cycles and operation of the fishway. Monitoring of the thermal regime is underway both in the head-pond and downstream, and a historical review is being planned to document the decline of diadromous stocks. There is concern downstream of the causeway about the potential impacts of sediment deposition on lobster catches and to that end historical and current lobster and scallop landings are being reviewed through logbook surveys and interviews. Fish and invertebrate samples are being collected both in the head-pond and at the Head of the Bay of Fundy for dioxin, furan, PCB, and PAH analyses pending results of sediment analyses.

Physical Conditions

Monitoring of physical aspects will be most important in order to determine if the gates can be operated in a manner to clip the tides and to determine if the erosion control measures installed this year are adequate for the conditions of the experiment. These aspects are critical to finding a long term biological solution to the Petitcodiac Gates issue. Gate Management Guidelines are currently being developed to provide operational guidelines with respect to managing the freshet, ice build up, siltation control, precipitation events, and the conditions of the ADI-Chiasson B-1 option for a 2.5m head-pond. Survey work has been completed to measure the stream channel at several cross sections in the head-pond as well as downstream to Hall's Creek, and, depending on freshet conditions, a channel survey may be repeated downstream in the spring of 1998. An aerial survey is anticipated this fall by the New Brunswick Department of Transportation to describe pre-trial conditions.

The Bay of Fundy - current program activities and management issues of the Federal Natural Resource Departments

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Abstract

The Federal Natural Resource departments in Atlantic Canada i.e. Environment Canada, Fisheries and Oceans, Natural Resources Canada (Canadian Forest Service, Geological Survey of Canada), Agriculture and Agri-Food Canada, and Heritage Canada (Parks Canada) have recently reviewed their current program activities and management issues pertaining to the Bay of Fundy. This talk summarizes the review, covering programs and managment issues, connections between programs and issues, program gaps, opportunities for collaboration, and recommendations. Sixty-seven programs and projects pertaining to the Bay of Fundy are underway, with a concurrence of the general program/project research areas with 18 of the 25 main issues identified at the 1996 multi-stakeholder Fundy Workshop (Percy *et al.* 1996). Opportunities for innovative collaboration, between departments and between the federal departments and their various partners in other sectors, for the Bay of Fundy, exist in the areas of: 1) integrated coastal (zone) management; 2) hazards of chemicals, pathogens and sediments, especially from land-based activities; 3) hazards of chemicals that are air-borne; 4) hazards of introduced species; 5) macro-scale changes to the system; and 6) public education and participation. This survey is being completed and distributed as a working document (Wells 1998) of the Federal Natural Resource Departments Coordinating Committee to enhance Bay of Fundy research initiatives and to support the overall goal of long-term sustainability of the Bay's living resources, natural ecosystems and wildlife.

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POSTER PAPERS

Composition of UVB effects on low and high DOC lakes located in Nova Scotia, Canada: preliminary results

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Abstract

First Summer studies 1996

The objective of the enclosure experiments was to compare the structure and function of pelagic and/or attached planktonic and microbial organisms as well as water chemistry in two lakes with different levels of dissolved organic material and with exposure to, or shading from, ambient UVB radiation. The two lakes chosen were Pebbleloggitch Lake (mean depth 2.50 m) and Beaverskin Lake (mean depth 2.20 m). The experimental design for the enclosure experiments in each lake consisted of six $4x4m^2$ enclosures. In the summer of 1996, three enclosures were shaded from ambient UVB and UVC with Mylar film while the other three were left open.

The *in situ* enclosures were constructed of impervious UV-treated polyethylene sidewalls suspended from wood/styrofoam floats and anchored into natural bottom sediments. The enclosures were arranged side by side in two groups of three in each lake and deployed in an area where bottom slope was minimal and sediments suitable for sealing of the enclosures were found. Deployment of the enclosures involved attaching sidewalls to floats and a metal frame (angle-iron usually in a hem in the bottom of each sidewall) and then lowering the frame into the bottom sediments. This deployment produced relatively undisturbed columns of water with natural phytoplankton and zooplankton communities isolated from the open lake. Average depth of the enclosures was approximately 1.5 m. Each experimental unit was inspected by scuba divers to ensure complete submersion of the bottom frames into the sediments. The presence of fish in an enclosure can result in problems with replication of phytoplankton and zooplankton communities temporally, so every effort was made to ensure that the enclosures did not contain any fish. Sampling of the enclosures was conducted form the sides. Major ions, specific conductance and water temperature of each enclosure was done weekly. Sampling was also done of the open lake to provide an ultimate control with which we could compare the unprotected mesocosms.

Due to wet weather and lack of access to the site, the experimental setup was finally ready on June 27. Primary productivity, major ions, acid-base and DOC chemistry were all studied in the first year. The study was ended in late August.

Second Summer studies 1997

In order to understand better the systems we were studying, a new treatment was instituted in 1997. Two enclosures in each lake were covered with polycarbonate film which shielded the mesocosms against UVB + UVA. Moreover, instead of being left open to ambient light, two enclosures were covered with polyethylene film which allowed all portions of the light spectrum through. Therefore, each lake contained two enclosures protected against UVB + UVA, two protected against UVB only, and two covered controls. As before, the open lake was also sampled.

Studies began on June 15, 1997 and ended on September 21, 1997. Work in the second year included, primary productivity, periphyton populations and chlorophyll, blue-green algae dynamics, acid-base and major ion chemistry, as well as, biochemical and genetic investigations of blue-green algae adaptations to UVB. At the end of the experiments, we also investigated the amount of water exchange which occurred between the enclosures and the outside lake waters.

Ecological studies of American shad, blue-back herring and alewives in the Annapolis River and Gaspereau River watersheds

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Abstract

The Annapolis River and Gaspereau River systems are two watersheds that support *Alosa* (American shad, blueback herring and alewives) stocks and have been extensively modified for hydroelectric generation. Various aspects of the life history and ecology of *Alosa* in these watersheds are currently under study at the Acadia Centre for Estuarine Research, with a focus on aspects relating to hydroelectric generation.

Modifications to the Annapolis River system include the construction of a tidal dam at Annapolis Royal in 1960, and a tidal generating station at this location which came on-line in 1984. Comparisons of American shad life history characteristics before and after the turbine came on-line identified a number of trends, including: decreases in mean length, mean age, maximum length, maximum age, percent repeat spawners and theoretical maximum lengths; and increases in age at first spawning and growth coefficients. Total annual mortality has apparently increased by an additional 30 % but sampling biases would lead to an overestimation of this increase.

Studies of the distribution and abundance of young-of-the year (YOY) *Alosa* within the Annapolis Estuary during 1994 indicate that YOY utilize the estuary as a nursery throughout the summer and fall. American shad were most abundant at the upper reaches of the estuary, alewives were located furthest seaward and blueback herring occupied a range in between. The populations also appeared stratified with respect to size, as larger fish were found further seaward. Using multiple mark-recapture methods, the population size of YOY *Alosa* was estimated at c. 1,600,000 individuals, an estimate that is probably biased low.

Five generating stations and numerous storage dams are currently present in the Gaspereau River watershed. Alewives in this system are fished both recreationally and commercially as they ascend the system to spawn during May and June. During 1996, fishermen harvested an estimated 611,000 alewives. Escapement from the fishery (96,433 alewives; 13.6 %) was estimated by counting fish ascending the fish ladder at White Rock. Migration time from the White Rock ladder to spawning areas in Gaspereau Lake (2 to 13 days) was positively correlated with river flows.

A fish diversion screen exists at Trout River Lake to divert young-of-the-year alewives from passing through 4 of the 5 hydroelectric stations in the Gaspereau River watershed. An assessment of the effectiveness of this screen in 1996

indicated that eggs pass freely through the screen, that the screen is a semipermeable barrier for larval alewives, and that the screen is an effective barrier for juveniles. Impingement of larval and small juvenile alewives on the screen was identified as a potentially serious problem when the small mesh screens are deployed.

Age and size structure of spiny dogfish, *Squalus acanthias* Linnaeus, 1758, of Atlantic Canada

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Abstract

The spiny dogfish *Squalus acanthias* Linnaeus, 1758, is a common shark of Atlantic Canada appearing in the Bay of Fundy usually from May to December. Dogfish are in abundant supply and are easy to capture, but Canadian fisherment see it as a nuisance or undersirable species.

A total of 1424 dogfish were sampled from three regions in Atlantic Canada and measured for total length (TL) (cm) and sex. The posterior dorsal spine was removed from 655 dogfish for age verification. Ages were determined from the spines under a dissecting light microscope and annuli lost to wear were calculated from a spine dimension standardized equation. Between the three regions, male dogfish sizes were 53-87 cm TL and ages ranged from 2 - 29 years, female dogfish sizes ranged from 51 - 113 cm TL and ages ranged from 3 - 34 years. The Minas Basin of the Bay of Fundy had predominantly large females and almost no males were present througout the entire sampling season. There were statistically significant differences among the total lengths of males and females in the three sampling regions and statistically significant differences among the ages of only female dogfish of the three regions. These differences could indicate more than one unit stock of spiny dogfish in the Northwest Atlantic.

In the United States a recent lucrative European and Japanese market has developed within a short time, targeting large females. Atlantic Canada's fisheries have seen a decline in other commercial catches and more underutilized species will be exploited to enhance the depressed fishing industry. The spiny dogfish could be a new source of revenue for Atlantic Canada and could become a directed fishery in the Bay of Fundy due to higher numbers of large females. Before this happens, it is imperative that the biology of spiny dogfish be better understood so that proper managment will allow for long term productivity and financial reward to fishermen.

Using an ecosystem approach for air issues: The Ecological Monitoring and Assessment Network (EMAN)-Canada

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Abstract

Many agencies are turning towards the "ecosystem approach" to environmental management, where a multi-disciplinary balance of physical, chemical and biological information is amalgamated in a holistic manner. The Ecological Monitoring and Asessment Network (EMAN) framework is designed on the ecosystem approach and is built on the concept of cooperation and partnerships. It is being developed by federal, provincial, university, industry, and private agencies. EMAN is lead by Environment Canada, and administered by the Ecological Monitoring Coordinating Office (EMCO) which was established in 1994. EMAN's primary goal is to bring independent monitoring activities together to understand better the priority stressors that are affecting ecosystems on a local, regional or global scale. A number of atmospheric variables are measured and assessed at the EMAN sites. Mercury is one pollutant that has been given high priority within the Canadian network and is presently monitored at EMAN sites in New Brunswick and Nova Scotia. Linkages with extensive North American and global monitoring and research networks are essential in studying global air pollution and EMCO is encouraging international partnerships in the study of mercury.

The EMAN sites will:

- provide multi-disciplinary data and assessment for better policy decisions on sustainable management of resources within each jurisdiction;
- coordinate monitoring, assessment and integration of activities relating to local, regional and global environmental issues;
- facilitate communication and cooperation amongst participants;
- use common standards to ensure comparability of results across time and space;
- promote ecosystem-based education for better understanding and management of our environment.

Rockweed and Periwinkle Harvests Conflict or Complement

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Rockweed

Rockweed, (*Ascophyllum nodosum*) a brown fucoid alga is the dominant seaweed of the intertidal zone in Atlantic Nova Scotia and the Bay of Fundy . It ranges from the Arctic circle to New Jersey. It forms a floating canopy on the rising tide supported by floats (vesicles) on its branches. Rockweed harvesting began in southwestern Nova Scotia in 1959 to provide the raw material for alginate extraction. The industry was static in development until 1985; landings remained below 6,000 t. A change of operators and a new demand for raw material lead to a rapid expansion to over 30,000 t annually (Sharp and Semple, 1997a). Expansion to new areas included southern New Brunswick in 1995. Harvesting was based on a maximum of 10,000 t annually for the first three years. Most commonly a cutter rake is used to cut and load rockweed into a 5 - 6 m outboard powered vessel . Catch per tide ranges from 2 to 6 tons per person. The fishery is managed in New Brunswick and Nova Scotia by exclusive leasing of the resource to purchasing companies. Under the terms of the lease, effort and landings are limited by area. Cutting height, gear type and incidental holdfast retention are regulated both by DFO and provincial agencies.

Periwinkles

The common periwinkle or winkle (*Littorina littorea*) is widely distributed in the North Atlantic. This snail can have a maximum shell height of 37 mm but is usually less than 25 mm (Sharp and Semple, 1997b). It was reintroduced from Europe about 150 years ago and the first live specimens were collected in 1840 (Brenchley and Carlton, 1983). The common periwinkle lives from the high water mark to depths of 40 m on diverse substrata ranging from rock to sand. Aggregations can be found on subtidal drift algae, in tide pools and along rock crevices. Hand gathering of periwinkles is an open fishery not requiring a licence. There is no active management strategy or regulations but policy requires the licensing of mechanical harvesters. Access to the periwinkle resource is largely tide dependent. Although periwinkles can be found throughout the intertidal zone, they are more concentrated near the low tide mark or in areas of low algal cover. There are a minimum of 10 buyers, 150 regular harvesters and hundreds of occasional periwinkle harvesters in the region. The periwinkle harvest from southern New Brunswick dominated the landings in the 1980's in the Maritime region, accounting for 85% to 90% of the total. Total Maritime landings increased sharply in the mid 1980's and exceeded 200 t in 1987. The Digby - St. Mary's Bay area represent >90% of the Nova Scotia's landings. Landings in southern New Brunswick have declined since 1993. However, recent changes in reporting structure and the very casual nature of this industry places these statistics in some question.

Conflict or Complement

Until 1993 the rockweed harvest was managed largely on goals of single species sustainablity. However, a review of potential impacts of rockweed harvesting in New Brunswick recognized the resource as a habitat for a range of species from fish to birds (CAFSAC, 1992). Most species are not commercial nor of a commercial size for exploitation; however, *L. littorea* is an exception. The common periwinkle can be found on or under the canopy on all tides. In general, the distribution of common periwinkle overlaps with rockweed in the mid to low range of rockweed distribution. In southern New Brunswick rockweed covers the intertidal zone, from 1 m to 4 above chart datum (Thomas *et al.* 1983). Intensive surveys of macrophyte cover and primary invertebrate inhabitants find *L. littorina* in all degrees and types of algal cover (Hawkins, 1997) . Although there is a great deal of overlap in the range of the snail and the plant, macrophytic rockweed is not the preferred food (Watson and Norton, 1985). Among adult algae, *Littorina* prefer the ephemeral algae such as *Enteromorpha spp.* and *Ulva spp*. However, fucoid seaweeds are vulnerable to *Littorina* grazing at the germling stage and *Ascophyllum* recruitment is inhibited by grazing at this stage (Hawkins, 1997). Differential grazing of fucoid germlings can structure the population of tide pools.

Harvesting impact on structure of the rockweed habitat

The cutter rake is size selective; however, it does not cut at a homogeneous height above the substratum. The average height of stumps in a harvest zone is 52 to 57 cm in a normal distribution. At the present exploitation rate, 17% of the harvestable standing stock is annually taken but the distribution of harvest is patchy. Total plant cover does not change under the present harvesting regime. In general, harvesting reduces the height of the rockweed canopy in parts of the intertidal zone. There is some spatial separation of the two harvests within the intertidal zone. Periwinkles are more accessible at the bottom of the intertidal zone where rockweed cover is replaced by ephemerals and tufted seaweeds.

Indirect impact on periwinkles

Spat settlement of the common periwinkle is wide-spread in the intertidal zone and is not restricted to rockweed canopy. However, loss of algal canopy frequently leads to increased settlement or production of ephemerals. Juvenile periwinkles will graze preferentially on ephemerals. Denudation of algal cover after ice scouring has been correlated with enhanced ephemeral production and recruitment of periwinkles (Archambault, D. and E. Bourget 1983). The present level of rockweed exploitation does not open the canopy sufficiently to promote enhanced ephemeral algal production. After settlement, periwinkles are at risk of predation by man, fish, waterfowl, crabs and lobsters. The majority of animals have a life span of 3 to 4 years (Gardner and Thomas, 1987). A reduction in rockweed canopy could increase predation rates simply by making the animals more visible. However, canopy changes have been only structural and are not sufficient to change low tide cover. *Littorina littorea,* although not moving large distances, are capable of moving vertically on the shore line both above and below rockweed distribution (Gendron 1977, Lambert and Farley, 1977). Since the harvest focuses on large animals near the low tide mark the adjacent intertidal and sub tidal populations will act as reservoirs to repopulate the depleted populations simply by random movements. An impact on the adjacent populations could reduce recovery of densities of the targeted area. Temperatures under rockweed canopy at low tide are significantly cooler or warmer than outside the canopy. The common periwinkle is tolerant of a range of temperature from -1 to 41 C (Hawkins, 1997). Movement to the low tide mark in temperate climates avoids freezing temperature. Periwinkles can be found high in the intertidal without algal cover on hot summer days. However, optimal temperatures are 18 C and feeding activities may be affected by extremes of temperatures. To have a significant effect on cover and potential temperature refuges, exploitation rates must exceed 50% of the biomass (Shaw, 1997).

Direct impacts on periwinkles

Since the common periwinkle was the only other species commercially exploited on rocky shores, a monitoring program was initiated to determine their abundance in the harvested rockweed. Samples were taken directly from the harvester's vessels as they arrived at the dock. The maximum abundance of common periwinkles in the catch was from Blacks Harbour 2.4 kg^{-1} and nil from some Grand Manan samples. The highest weight per kilogram of 8.3 g was at Blacks Harbour. The size of animals ranged from small 7 mm juveniles to large 26 mm adults. The abundance of the common periwinkle is generally higher in the canopy 3.3 SD 7.6 to 8.2 SD 9.9 kg^{-1} than was found in the by catch (Thonney, 1994). The difference is not surprising. *Littorina littorea* cannot hold on to the fucoid thallus as well as *L. obtusata* and other gastropoda. When rockweed is severed and lifted in to the vessel most common periwinkles will fall off. During unloading more fall to the bottom of the vessel. Similarly if there is wave action or current the densities of the common periwinkle are lower in the canopy (unpublished data). There is also a great deal of variation in the abundance of animals in the canopy at any site. Periwinkles were common in the St. Andrews area in summer while they were low in abundance at Grand Manan sites. Heavy spat settlement can dramatically effect the density of littorinds during the peak recruitment periods changing abundance temporarily by a factor of 100 or more (Thonney, 1994). The annual loss of the common periwinkle due to the rockweed harvest was based on the following assumptions: the harvest will reach 10,000 t annually, the average biomass per kg of harvest is typical for the entire harvest area, there is no attempt at mitigation and all captured animals die. A total of 11.7 tons of periwinkles will be removed annually as a by-catch. This by-catch is spread over the entire harvest area and the impact is cycled in a three year harvest strategy. There have been no recent, comprehensive assessments of *L. littorea* stocks, although there have been a number of studies that have provided detailed population information at selected sites (Cook, 1976, Thonney, 1994). There is a minimal biomass of 2594 tons of *L. littorea*. in the Bay of Fundy on the substratum. A biomass of animals in the rockweed canopy can be added of another 2100 t if we assume an even distribution at 5 periwinkles kg^{-1} of rockweed.

Conclusion

Under the present harvesting regime the structure of the rockweed habitat is not changed to a degree to cause indirect impacts on *L. littorea* populations. The by-catch of periwinkles of all sizes is less than 10 % of the reported landings for directed harvest in the Bay of Fundy. By-catch mortality is less than 1% of the most conservative estimate of periwinkle biomass. The harvest of rockweed and periwinkles do overlap in parts of the intertidal zone and some parts of the coastline. Harvesting is directed for rockweed not for periwinkles and cannot be considered as giving comparative mortalities to the directed periwinkle harvest. We do not have a clear enough understanding of the dynamics of recruitment and immigration in exploited populations to determine if by-catch mortality in these areas will significantly affect recovery of exploited populations. In these areas, a policy of mitigation should be instituted in the future including return of by-catch animals captured in the bottom of harvester vessels to the intertidal zone within 24 hours.

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Dalhousie University Science Co-operative Education
A world of knowledge ◆ A world of opportunity

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Abstract

What is Co-operative Education?

Co-operative Education is a program where academic study is combined with career-related work experience. Students alternate four work terms with academic study terms and graduate with a Bachelor of Science Co-op. Workterms are real employment positions with hands on experience in the application of scientific and business principles. Students are available to work year round.

Science co-operative education programs are available in Biochemistry, Chemistry, Computing Science, Earth Science, Marine Biology, Mathematics, Physics, and Statistics. Students may choose a combined honours or advanced double major where only one of the disciplines is a recognized co-operative education program. Students may also choose a Bachelor of Science, Minor in Business with a co-op option.

Students must maintain a high academic average for entrance to co-op. The program is optional and students choose to participate. Our students are the elite, highly qualified and strongly motivated.

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Dalhousie's Faculty of Science, the primary centre in the region for science education and research, consists of eleven departments. Complete details concerning particular programs of study are contained in the Dalhousie University Calendar. The Co-operative Education program is an academic program which is an integral part of the excellence in science education which Dalhousie provides.

The principal mission of the Faculty of Science is the discovery, organization, dissemination and preservation of knowledge and understanding of the natural world. The Faculty is dedicated to excellence in the pursuit of this mission. Students in the Faculty of Science are challenged to develop the capacity for inquiry, logical thinking and analysis, to cultivate the ability to communicate with precision and style, and to acquire the skills and attitudes for lifelong learning. With Co-operative Education, our students take that excellence to the workplace.

Graduates of the Faculty include Rhodes Scholars, one of NASA's first female astronauts, world renowned scientists, educators, doctors, business professionals, lawyers, policymakers, dentists, engineers, writers, health professionals, artists and entrepreneurs.

The Marine Biology Co-operative Education Degree

The Biology Department offers Co-operative Education options in both the Honours and Advanced Major degrees in Marine Biology which take four and a half years to complete. Students receive a broad background in Biology in their first two years, including marine diversity, cell biology, genetics, molecular biology, and ecology. They also take introductory classes in Oceanography, Chemistry, Mathematics, Statistics, Computing Science and communications studies (both written and oral). In later years, students may choose classes in fish biology, marine mammology, invertebrate diversity, algae, aquatic microbiology, physiology of marine animals, aquaculture, resource and field ecology, oceanography (biological, fisheries, physical and chemical), resource economics, and politics of the sea. Most Honours students minor in Oceanography and may choose to do their honours research at Dalhousie or with marine scientists at fisheries, oceanographic or other related institutions in Atlantic Canada.

About Dalhousie Science Co-operative Education

Dalhousie, a world class university, is unique for its size in the diversity of its undergraduate and graduate programs. We are ranked in the top ten universities in Canada for research and development funding and enjoy extensive collaborative linkages with government and business laboratories. A leader in Co-operative education programs in Atlantic Canada since 1980, our first Co-operative education program began in the faculty of Science.

The Science Co-operative Education office provides a full range of human resource services for both employer and cooperative education students seeking the best that Dalhousie science can offer.

Forest bird monitoring and research at Kejimkujik National Park

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Abstract

In addition to detection of long-term avian population trends within protected areas, monitoring programs in national parks permit comparison to population trends in areas influenced by disturbance factors (e.g. roads, forestry, agriculture), and to trends detected in more widespread surveys (e.g. BBS). The Kejimkujik Forest Bird Monitoring and Research Program was developed in 1996 in accordance with the goals of monitoring and maintaining the ecological integrity of national parks, through a partnership among Parks Canada, Canadian Wildlife Service (CWS), and Dalhousie University. This integrated long-term monitoring and research components of forest ecosystems, as well as with regional CWS programs for bird monitoring, by incorporating standardized protocols as promoted in the Canadian Landbird Conservation Strategy. Major integrated components of the program include:

- an extensive network of survey points for trends;
- a few large sites for intensive population study;
- research which is integrated with collection of monitoring data;
- contributions to regional CWS monitoring programs; and
- links to monitoring other ecosystem components.

Specific objectives are to:

(1) assess long-term avian population trends;
(2) determine productiviey of target species;
(3) place bird data into regional contexts;
(4) link birds with other ecosystem components;
(5) determine species-habitat associations;
(6) link with short-term research projects;
(7) address trans-boundary issues;
(8) develop data management protocols; and
(9) link with forest-inventory databases.

Fisher's knowledge of localized spawning and nursery areas of marine species in the Bay of Fundy

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Abstract

A study was undertaken to interview 280 fishers to examine the basic premise of population definition within statistical management units spanning from northern Nova Scotia to southwestern New Brunswick. It was found that multiple spawning grounds exist within each managment unit for the species examined. In the inshore areas, there existed numerous small spawning areas, whereas in the offshore areas there were found to be fewer, but larger, spawning areas. Many of the inshore areas have never been documented previously. Also identified were some lost spawning components of Atlantic cod (*Gadus morhua*), particularly in the eastern Scotian Shelf and in the Bay of Fundy. The great majority of these critical habitats remain unprotected to exploitation throughout the year. Re-evaluation of marine protected areas may be warrented. The protection of spawning grounds may the key to greater sustainability of groundfish populations within traditional management units.

The *Corophium* working group, BOFEP/FMESP

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Abstract

A Working Group of the Fundy Marine Ecosystem Science Project, a component of BOFEP (Bay of Fundy Ecosystem Project) was set up in March 1997. The objectives are:

(1) to summarize knowledge of *Corophium* and its role as a keystone species in Bay of Fundy mudflats;
(2) to identify key research questions and approaches, especially with models; and
(3) to facilitate research opportunities and mechanisms for cooperative research.

The first working meeting identified Environment Canada's concerns involving *Corophium*, established a list of research needs, and identified immediate activities for the Group. Research needs included summarizing existing knowledge of *Corophium*; standardizing methods of sampling and sorting; conducting biological research on taxonomy and origin, diet, predators and parasites; investigating sediment interactions and requirements; investigating sediment stability-relationships; investigating stressors (toxics, physical disturbance and winter conditions); investigating population dynamics and modelling; and continuing research on linkages to shorebird ecology. There is a general invitation for any interested person to participate and contribute to the Working Group goals and new projects.

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Heeding the Bay's Cry - the Bay of Fundy Ecosystem Project

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Abstract

Over the past few year, a number of environmental indicators suggest that the Bay of Fundy ecosystem is undergoing numerous changes, many of which are not easily explained on the basis of current scientific knowledge. These include collapses and extreme population fluctuations of fisheries resources, apparent changes in patterns of sediment distribution or properties, and changes in abundance and feeding behaviour of migratory shorebirds and fish. New recognition of the role of saltmarshes and seaweeds challenges notions that such habitats and species can be modified or harvested without system-wide consequences for other resource species and wildlife. Our understanding of the system, however, is insufficient to identify, unequivocally, the causes or to select between alternate causes.

For these reasons, including the concern for migratory wildlife, and the obvious need for multi-partner ecosystem research initiatives, the Fundy Marine Ecosystem Science Project (FMESP) was initiated in March 1995. It was renamed the Bay of Fundy Ecosystem Project (BOFEP) in July 1996. The group started as a small working committee, with representatives from Environment Canada, Fisheries and Oceans, Acadia University (Acadia Centre for Estuarine Research), the Clean Annapolis River Project (CARP) of ACAP, and two consultancies.

Several activities have been underway since early 1995. The first was the development of an synopsis and review of recent Bay of Fundy scientific knowledge, especially from the mid-1980's onwards. This was accompanied by establishing an electronic bibliography of the recent literature with nearly 1000 records. Secondly, and following from this, a Fundy Scientific Workshop was held in Wolfville, N.S., early in 1996, involving primarily the scientific community around the Bay of Fundy. The objective was to discuss recent science and identify key issues affecting the Bay. The Workshop strived to reach consensus on marine ecosystem research priorities, to identify coastal management and conservation requirements, and to map out a plan for timely, multi-partner interdisciplinary research and management initiatives on the Bay. The review and the workshop proceedings were published as *Bay of Fundy Issues: A Scientific Overview (Percy, Wells, Evans, eds.)* in April, 1997. Key issues also have been written by Jon Percy as Fundy Issues fact sheets, 10 to date, and widely distributed. A BOFEP Web Site

is set up at Acadia University with the bibliography, fact sheets and additional information about BOFEP and the Bay of Fundy marine ecosystem (see http://ace.acadiau.ca/science/cer/bofep/home.htm). The full Fundy Issues report is also on Environment Canada's Green Lane (see http://wwwi.ns.ec.gc.ca/). General information can be obtained from "fundy@fundy.acadiau.ca".

Thirdly, the draft multi-partner Bay of Fundy Ecosystem Action Plan as derived at the Workshop was published in *Bay of Fundy Issues* and is being activated wherever possible. It uses an ecosystem perspective to define a set of guiding principles, strategies and actions for scientific research, integrated coastal management, and community involvement in support of the Bay's natural ecosystems, unique biota and marine resources. With BOFEP, the Fundy Marine Ecosystem Science Project continues work through Working Groups; current ones (mid-1997) are considering *Corophium*, contaminants and physical barriers.

Fourthly, the BOFEP initiative in 1996 and 1997 has been actively building an awareness of the Bay of Fundy, and also determining its own structure, course of action, and funding routes. Presentations on the Bay of Fundy and BOFEP were made at the Blomidon Field Naturalists Meeting in June, 1996; the Coastal Zone Canada '96 Conference in Rimouski, Quebec; the RARGOM Conference at St. Andrews, N.B., in September 1996; the Gulf of Maine Council on the Marine Environment meeting in Fredericton in December 1996; the Federal Natural Resource Departments (the "4-NR") Steering Committee in December 1996; and the Rim of the Gulf Conference, Portland, ME., May 1997.

Finally, the 4-NR presentation led to that Committee adopting the Bay of Fundy as one of its first areas of focus, with the departments reviewing their program activities in 1997. A proposal to set BOFEP up as a Virtual Institute also was made to the Committee in March, 1997. The plan is to establish BOFEP as a Virtual Institute ie. with no bricks and mortar, but a comprehensive network and programme of activities linking the efforts of community groups, resource users, managers and scientists. There was considerable interest expressed by the 4-NR group, but no commitments as yet for funding.

The commitment made at the 1996 Workshop to have a Bay of Fundy Science Workshop every two years was fulfilled by the joint venture of the Huntsman Marine Science Centre, EMAN (Ecological Monitoring and Assessment Network) and BOFEP for the present November 1997 Maritime Atlantic Ecozone Science Workshop.

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Microtox(R) evaluation of mudflat sediments from Upper Bay of Fundy

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Abstract

The Microtox(R) Solid-Phase Test (SPT) is used extensively to describe toxicity of sediments, yet a quantitative understanding of key variables affecting EC50s has been largely ignored. We are parametizing the influence of known variables, accounting for bacterial loss onto particles as a function of particle concentration, particle size, water content, organic carbon (OC) and quality of particle surface available for bacterial interaction. Halifax Harbour studies showed that the 25-min EC50 was associated with OC and silt-sized sediments, both of which were highly correlated to metals. One control sediment showed unexpectedly high toxicity, likely a false positive (Type One Error). Studies on Bay of Fundy sediments focused on the relationship between location, particle size, OC, water content and EC50s. Sediments were of low toxicity (5,000-15,000 mg/l); EC50s correlated with location on beach, particle size and OC content. Novel microbiological experiments addressed bacterial loss during the SPT to particles at the filtration stage. Experiments compared toxicity of raw sediments, autoclaved sediments (axenic particles) and autoclaved/washed sediments (axenic, stripped particles). Bacterial loss and sediment concentration were positively correlated for pooled, autoclaved and washed Bay of Fundy sediments, but no significant correlation was generally found for autoclaved-only sediments. Autoclaved and washed sediments were more toxic than autoclaved-only sediments, possibly reflecting increased exposure of test bacteria to particle surfaces. The study points to some fundamental considerations when developing and applying sediment bioassay techniques.

**Also given at the 24th Annual Aquatic Toxicity Workshop, Niagara Falls, ON, October 1997.*

ASSOCIATION
AND
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INFORMATION SESSIONS

BAY OF FUNDY
AND
GULF OF MAINE

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*I*ssues;
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*N*etworking.

Association and Institutional Information Sessions
Bay of Fundy and Gulf of Maine

Acadian Centre for Estuarine Research (ACER)

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Aquaculture Association of Canada (AAC)

The Aquaculture Association of Canada is a nonprofit, charitable organization which serves its members and the Aquaculture Industry in Canada. Membership is open to individuals, institutions, companies, and agencies. Receipts for tax purposes are issued for membership dues and donations to the Association.

The AAC publishes its **Bulletin** four times a year (March, June, September, and December) for the benefit of its members. The **Bulletin** contains accounts of scientific and technical presentations given at the Annual Meeting of the Association as well as news items, information on other meetings of potential interest to members, positions available, letters to the Editor, and advertisements. Although material in the **Bulletin** is not protected by copyright, AAC would appreciate being cited as the source of any material used in other publications.

The affairs of the Association are managed by a 10-member, Board of Directors which currently includes members of the Aquaculture Industry, Government and University Scientists. The **Bulletin** is managed by five officers, three or four directors, and a Bulletin staff consisting of the Managing Editor and three Contributing Editors. The **Bulletin** is abstracted and indexed in Aquatic Sciences and Fisheries Abstracts (ASFA).

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Atlantic Coastal Action Program (ACAP)

In 1991, Canada's Green Plan provided resources to Environment Canada to establish a regional program in Atlantic Canada which would facilitate and support the efforts of coastal communities to achieve sustainable development in their own local areas. *The Atlantic Coastal Action Program* (ACAP) was initiated as a pilot effort in 13 watershed /estuary complexes throughout the four Atlantic provinces - Industrial Cape Breton, Lunenburg/Mahone Bay, Pictou and the Annapolis in Nova Scotia; St. John's Harbour and Humber Arm in Newfoundland; Cardigan Bay and Bedeque Bay in PEI; and Madawaska, Miramichi, Saint John, Eastern Charlotte, and the St. Croix in New Brunswick. Four of these ACAP sites are located on the Bay of Fundy.

ACAP represents a very different way of doing business for government. Instead of the traditional command-and-control and top-down approaches that have been common for many years, the participating community-based organizations within ACAP are partners with government in achieving common goals. Each ACAP group is an independent, incorporated organization, with its own Board of Directors, that strives to include as many 'interests' as possible. The program is founded on the principles of the multi-stakeholder approach, the integration of environmental, social and economic objectives, and a long-term, holistic perspective.

Environment Canada entered into five-year agreements with each of the ACAP organizations. For its part of the bargain, EC provided $40-50k/year to each site in core funding, technical and in-kind assistance as required, sits as one member of each Board of Directors, and required the completion of a Comprehensive Environmental Management Plan (CEMP) by the community. In return, the ACAP groups strive to include all interests in the community, undertake long-term planning and action projects, and conduct extensive education and outreach efforts. It is the ACAP groups themselves, that invite other government departments (at all three levels), private sector organizations, academic institutions and citizens at large, into the process. Over 400 action projects have been completed by the 13 sites to date.

Through the process of preparing a CEMP in each community, the sites have established a long-term vision for their area, compiled extensive inventories and information about their local resources that is understandable and believable, prioritized the key issues, selected the preferred means of addressing them, and secured broad partnerships to achieve these goals. The contribution of federal dollars has been levered by about 5 times by the sites, and is supplemented by substantial in-kind and volunteer effort (i.e., over 2500 people volunteer their time each year).

Based on the strong support for this community-based approach, the completion of comprehensive management plans in 13 ecosystems, and a clear call to continue working in a government-community partnership, EC is currently negotiating a broader regional partnership with other federal and provincial agencies in an effort to expand this experiment and enshrine it as an effective means of environmental management in Atlantic Canada.

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The Atlantic Cooperative Wildlife Ecology Research Network (ACWERN)

Overview

The Atlantic Cooperative Wildlife Ecology Research Network (ACWERN) is a collaborative initiative of Acadia University, Memorial University of Newfoundland and the University of New Brunswick. It operates in partnership with the Canadian Wildlife Service of Environment Canada (CWS), with matched funding support from the Natural Sciences and Engineering Research Council of Canada, and in collaboration with Parks Canada, Department of Fisheries and Oceans, Canadian Forestry Service, and the governments of New Brunswick, Nova Scotia and Newfoundland.

ACWERN is a regional research network focused on wildlife ecology in the marine, coastal and terrestrial ecosystems of Atlantic Canada. The network brings multi-disciplinary scientific approaches to bear on fundamental and applied problems in wildlife ecology and habitat relationships. The research program is designed to improve the understanding of ecosystem dynamics in Atlantic Canada and complement and enhance the abilities of government agencies to conserve wildlife populations and habitats.

Objectives

The goals of ACWERN are to:

- improve understanding of Atlantic Canadian ecosystems most at risk, and to conserve wildlife populations and habitats in marine, coastal and terrestrial environments;
- develop protocols to use wildlife as indicators of environmental condition and change;
- create ecologically-based strategies for coping with environment changes, such as habitat modification and climate change;
- provide a scientific and ecological basis for sound, practical advice to government and industry concerning means of conserving large-scale ecosystem processes, biodiversity and species potentially at risk; and
- facilitate ecologically sustainable developments through basic and applied research programs.

Approach

The basis of this collaborative research network is the establishment of one Senior and two Associate Research Chairs at the partner universities - with expertise in seabird and marine ecology at Memorial University of Newfoundland, ecology of forest and marine birds at the University of New Brunswick, and in conservation biology and landscape ecology at Acadia University. A complementary focus on coastal wetland and fresh water systems is integrated through the Acadia Centre for Estuarine Research (ACER). The Senior Chair at the University of New Brunswick serves as the director of the network, with the support of the ACWERN Coordinator from the Canadian Wildlife Service. Projects and expertise of the Chairs are shared among the three sites, and with other research staff at the Canadian Wildlife Service and member universities.

Research priorities

Each Chair addresses important scientific activities in the region, and takes advantage of complementing the expertise existing at the universities and resource management agencies. The network pools available resources and expertise, and coordinates cooperative multi-disciplinary research to address large-scale ecological issues in the fields of wildlife ecology. Many of these issues have been difficult to address given the nature of the relatively small research communities scattered across Atlantic Canada. The network is now able to approach research problems from the perspectives of population, community and behavioural ecology, conservation biology and ecosystem modelling.

Current research projects investigate, for example, effects of landscape structure on forest songbirds (including the threatened Bicknell's Thrush) and on amphibian movement; plot-based approaches to monitor terrestrial biodiversity; the use of seabird diets to predict changes in fish stocks; movements and persistence of tern colonies; brood ecology of common eider, and interactions with gulls; effects of acidification and mercury on common loon productivity; and impacts of tourist activities on seabird breeding colonies.

Administration

The ACWERN program is directed and supported by a management board composed of senior representatives form the member universities and the Canadian Wildlife Service. Research projects are selected through discussion among university and government researchers and managers, to best apply ACWERN research expertise to key conservation concerns in Atlantic Canada.

Resources

The total cost of the Atlantic Cooperative Wildlife Ecology Research Network is about $4,000,000 over a five-year period. $1,000,000 is provided by the Canadian Wildlife Service of Environment Canada, with $1,000,000 provided as matching funds through the University-Government Research Partnership Program of the Natural Sciences and Engineering Research Council, and the remainder is shared by the partner universities and by other federal and provincial agencies.

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Atlantic Coastal Zone Information Steering Committee (ACZISC)

Background

The coastal zone encompasses a multitude of activities and the management of its resources overlaps several jurisdictions; therefore, intergovernmental cooperation is essential for coastal zone management. Another necessity is access to appropriate information.

In 1991 a Coastal Zone Information Workshop was organized by LRIS, a former agency of the Council of Maritime Premiers, to further the process of cooperation on a regional basis. The Workshop participants recommended the establishment of a Steering Committee to address the urgent need for a coordinated regional response to coastal zone information management. The Atlantic Coastal Zone Information Steering Committee (ACZISC) was established in response to this need.

The ACZISC meets on a quarterly basis and rotates its meeting venue amongst the three Maritime provincial capitals. The ACZISC Secretariat is located at the Oceans Institute of Canada, Halifax.

ACZISC Projects & Activities

The following projects and activities, identified in the ACZISC Workplan, are considered to be key components of an Atlantic coastal zone information infrastructure. ACZISC Working Groups have been established to address these components:

ACZSC Database Directory: The Atlantic Coastal Zone Database Directory, compiled by the ACZISC, lists and describes databases of relevance to ICZM in Atlantic Canada. Version 1 of the Directory was published in 1992 and Version 2 in 1994. Version 3, published in 1996, contains 608 database descriptions and is available on the WWW via the ACZISC Homepage located at http://is.dal.ca/aczisc/aczisc. Planning is under way to produce Version 4 using electronic forms on the WWW.

Coastal Mapping: This Working Group is focusing on the acknowledged need for the identification of the major parameters and databases required for coastal mapping, a prerequisite for ICZM. In addition the agencies responsible for the collection, maintenance and update of the major databases are also being identified. An Inventory of Atlantic Coastal Mapping Projects has been compiled by the ACZISC and is also available via the ACZISC Homepage. Current activities are focused on the convergence of the major regional CZ mapping projects.

C-Code: The consortium for Coastal and Ocean Data Exchange (C-Code) is developing a set of agreements and procedures which will encourage and facilitate the flow of data and information in support of ICZM.

Coastal Information Standards: A series of workshops is addressing the immediate requirement for standards regarding the management and use of coastal information. Workshop recommendations are sent to appropriate provincial and federal agencies for their consideration.

GOM: The Gulf of Maine Council on the Marine Environment is mandated to maintain and enhance environmental quality and sustainable resource use. Membership on the Council includes NB, NS, Maine, Mass and NH. Members of the

ACZISC participate on the GOM Working Group and Committee which ensures liaison and coordination between the ACZISC and Gulf programs. The GOM Program is being used as a pilot project by NAFTA's Commission for Environmental Cooperation.

Coastal Zone Canada Conferences: CZC'98 will take place in Victoria, BC from 30 August to 3 September 1998. CZC 2000 will take place in Saint John, NB from 18-23 September 2000. An organizing committee has been established.

CZC'96 was held in Rimouski, Quebec in August 1996. The inaugural CZC Conference was held in Halifax in 1994 (CZC'94). The development of the CZC'94 program was led by the ACZISC. Six volumes of the CZC'94. Proceedings and the Conference Call for Action have been distributed.

For more information, contact: Larry Hildebrand, Environment Canada
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Tel: 902-426-9632; Fax: 902-426-8373; Email: hildebrandl@ns.doe.ca

Bay of Fundy Ecosystem Project (BOFEP)

During the period 1977-82, a large-scale, cooperative study of the bay of Fundy was coordinated by the Fundy Environmental Studies Committee (FESC) in response to proposals for tidal power development. Initially an ad-hoc organization of government and university scientists, it was 'adopted' by the Atlantic Provinces Inter-University Council on the Sciences (APICS). Following its last meeting (Moncton 1982), it was formally disbanded because the tidal power issue had receded, and because there was a feeling that many aspects of the Bay were reasonably well understood. Aspects recognized as being poorly known included fish ecology, fish mortality on passage through turbines, and the dynamics of fine cohesive sediments.

A number of more-or-less independent scientific studies were carried out during the 1980s and 1990s by government agencies and universities. At the same time, cooperative institutional structures came into existence (e.g. Gulf of Maine Council on the marine Environment 1989; Atlantic Estuaries Cooperative Venture 1989; Atlantic Coastal Action Programme, 1991) to address coastal issues in a more holistic way. In addition to formal structures, numerous community-based organisations have arisen, reflecting deep concerns and commitment of local residents and resource-users for sound management in the Bay.

In recent years, unexpected changes to phenomena and processes in the bay have called into question the assumption that this ecosystem is adequately understood. Examples include: changes in behaviour and distribution patterns of the Northern Right Whale; changes in distribution and abundance of benthic invertebrates such as *Corophium volutator*; changes in foraging behaviour of migratory shorebirds; and changes in sediment characteristics. In order to address these issues rigorously in the context of current knowledge of the Bay ecosystem, the Fundy Marine Ecosystem Science Project (FMESP) was initiated in 1995, and held its first review meeting at Wolfville in January 1996. The outcome of that review[1] was acceptance of the need for further integrated research on the bay, at an ecosystem scale.

Given the changed nature of coastal management, it was recognized that a broader organization was needed that could serve to link the scientific enterprises with which FMESP is concerned, to the many other nongovernmental stakeholders (e.g. community groups, resource users, private sector interests) that share the bay and its resources. This was the initiation of the idea for the Bay of Fundy Ecosystem Project.

BOFEP is conceived as an inclusive, flexible and multidimensional mechanism for encouraging cooperation and communication between stakeholders. Described as a Virtual institute, its objective is to foster wise conservation and management of the Bay's resources and habitats, through dissemination of information, monitoring of the state of the ecosystem, and integration of research activities (in the broadest sense). Membership will be open to all interested persons and groups.

For more information, contact: Graham R. Daborn
Acadia Centre for Estuarine Research
Acadia University, Wolfville, N.S. B0P 1X0.
Tel: 902-542-2201; Fax: 902-585-1054; Email: gdaborn@ace.acadiau.ca

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[1] Percy, J.A., P.G.Wells and A.J.Evans. Eds. 1997. Bay of Fundy Issues. A Scientific Overview. Environment Canada - Atlantic Region, Occasional Report No. 8. 191p. Environment Canada, Dartmouth, N.S.

Bay of Fundy Fisheries Council (BOFFC)

A one-day workshop will be held on April 25, 1998 in St. Andrews to identify the Advisory Committee. The Fisheries Council is soliciting the aid of conservationalists, biologists, scientists, and others who support our mission statement. If individuals/groups are interested in contributing please contact Lana Langille, (506)833-4889 phone/fax.

Mission Statement

The mission of the **Bay of Fundy Fisheries Council** is to implement and establish fisheries management in the Bay of Fundy according to the following principles:

(a) That the Bay of Fundy fisheries must be managed so as to ensure the sustainability of the fisheries in the Bay of Fundy ecosystem as a whole.

(b) That the fishermen in their communities have the primary stewardship and management of the resource.

(c) That the organization will be geographically-based and driven by democratic, transparent, trustworthy decision-making processes and structures.

Objectives

The objectives of the **Bay of Fundy Fisheries Council** are to:

(a) Develop and implement a comprehensive ecosystem plan to be applied to the Bay of Fundy fisheries, with a primary focus on spawning and nursery areas, food species and habitat.

(b) Encourage participation by all Bay of Fundy fisheries.

(c) Support local management boards and resolve overlapping fisheries management issues.

(d) Act as an advocate for the Bay of Fundy ecosystem and fisheries.

(e) Develop a research agenda, coordinate knowledge on Bay of Fundy fisheries and ecosystem and foster two-way interaction with the research community.

Terms of Reference

Board of Directors: The Board of Directors will be made up of one representative of each Bay of Fundy fishermen's organization which adheres to the guiding principles and meets one of the following criteria:

- is an incorporated, non-profit fishermen's association
- represents the majority of fishermen in a specific geographical area
- represents a majority of licences in a fleet sector in the Bay of Fundy
- other criteria to be identified by the Board.

Decision Making: The Board will operate on the basis of consensus or, where consensus cannot be reached, by a 2/3 majority.
Executive: The Executive Committee will be elected by the Board.
Advisory Committee: The Board will appoint an Advisory Committee to:
- advise the Board from an ecological perspective
- ensure that the Board and its members adhere to ecological principles
- provide the Board with a non-voting chairperson for each meeting
- other roles as determined by the Board.

Observer Status: Board meetings will be public and open to observers.

For more information, contact: Local Fishermen's organization

Clean Annapolis River Project (CARP)

For more information, contact: Jon A. Percy, Clean Annapolis River Project
Annapolis Royal, NS
Tel: 902-582-5129; Fax: 902-678-1253; Email: jpercy@auracom.com

Community Action Partnership Program [Grand Manan] (CAPP)

Mission

Partnering with government/industry to recognize and respond appropriately to potential environmental disasters, the emphasis being oil spills.

Mandate

-Development of a Community Contingency Plan, outlining community resources that might be available in the event of an emergency.
-Development of community involvement, identification of vessels of opportunity, shoreline surveillance, response to oiled wildlife, and awareness and education.
-Self-Protection

Involvement

- Local environment group and Grand Manan Whale & Seabird Research Station
- Village council
- Fishermen and aquaculture associations
- Concerned citizens
- Canadian Coast Guard
- Atlantic Emergency Response Team
- NB Department of Fisheries and Aquaculture
- Department of Fisheries and Oceans

Actions

-Involved in initial organizational meetings for oil spill awareness, priorities, etc., beginning in 1992
-Meetings with Coast Guard, ALERT, Environment Canada in 1996
CANUSLANT exercise in September 1996
-Upcoming oil spill workshop with ALERT
-Representative on newly formed Fundy New Brunswick CAPP Committee (FNBCC)
-Basic training for volunteer response to oiled wildlife via UPEI
-Preliminary identification of vessels of opportunity

Funding sources

None, volunteers only

Effects

Limited community awareness at this stage but good groundwork established with government agencies involved

For more information, contact: Laurie Murison, Whale and Seabird Research Station
P.O. Box 9, North Head, Grand Manan Island, NB E0G 2M0
Tel: 506-662-8316 (winter); 506-662-3804 (summer)
Fax: 506-662-9804; Email: gmwhale@nbnet.nb.ca

Coastal Zone Engineering Association (CZEA)

For more information, contact: Jeff Ollerhead, Department of Geography
Mount Allison University, Sackville, NB E4L 1A7
Tel: 506-364-2428; Fax: 506-364-2625; Email: jollerhead@mta.ca

Conservation Council of New Brunswick (CCNB)

The Conservation Council of New Brunswick (CCNB) was established in 1969 as a non-profit membership organization to serve as a citizen watchdog for the public good, safeguarding our land, air and water and to develop and promote solutions to pollution and resource degradation. CCNB acts on this mandate through public education, advocacy, policy development, and special programming. CCNB is a registered charitable organization governed by a 24-member board of directors from all parts of New Brunswick and all walks of life. All directors are active volunteers, serving as spokespersons on issues where they have expertise while others organize local conservation efforts in their home areas. The Conservation Council employs three permanent staff, an Executive Director, Policy Director and Office Manager. Project staff are contracted as programming requires.

CCNB responds to emerging public issues as required, but also acts on its mandate through four program areas: Marine Conservation Program, Ecological Forestry Program, Sustainable Agriculture Program, and the Healthy Environment Program.

Marine Conservation Program

In 1985 CCNB became concerned with the cumulative impacts of pollution and habitat destruction on the health of the Bay of Fundy ecosystem. In response, the Bay of Fundy Project was initiated to raise public awareness about issues in the Bay and to encourage community stewardship to address these problems. The Bay of Fundy Project produced a number of publications (*Voices of the Bay: Reflections on Changing Times along Fundy Shores* and *Turning the Tide: A Citizens Action Guide to the Bay of Fundy*) and carried out high profile activities (Clean the Bay Campaign and Coastal Convergence Conferences). In 1995, CCNB consolidated its marine-related activities under the broad program heading of Marine Conservation. Through this program CCNB seeks to protect and restore marine ecosystems in the Maritimes, and safeguard the coastal communities that depend on them. The Program has four priority areas: (1) the development and promotion of a community-based ecological alternative to conventional fisheries management (2) the conservation of fish habitat and marine ecological functions (3) an analysis of the sustainability of finfish aquaculture, and (4) the development of regional appreciation for, and identification with, the Bay of Fundy/Gulf of Maine as an internationally significant marine ecosystem. Specific projects which address these priorities include the Ecological Fisheries Project, Gulf of Maine Estuary Restoration Project, and Salmon Aquaculture Case Study. Recent publications include *Beyond Crisis in the Fisheries: A proposal for Community-Based Ecology Fisheries Management* and *After the Goldrush: The Status and Future of Salmon Aquaculture in New Brunswick.* CCNB has been an active participant in the discussions that led to the creation of the new Fundy Fisheries Council.

Sustainable Agriculture Program

CCNB's contemporary work on sustainable agriculture was initiated in 1986 in response to health concerns arising from reports of widespread nitrate contamination in the well water of the potato belt and the 1985 conclusion of the Hatcher Task Force Report that indicated the incidence of neural tube birth defects found in the region were associated with agricultural chemical use. This led CCNB to initiate the Tula Project whose aim was to publicly demonstrate organic farming practices and increase public awareness about the role consumers can play in encouraging sustainable agriculture. The project established a community-supported farming operation called Harvest Share to raise awareness about ecological agriculture, initiated the Maritime Diet campaign, and culminated with the production of a documentary film, "What's on the Table?". By 1993, CCNB's focus in promoting sustainable agriculture shifted from consumers to the farm community in the *Farmer to Farmer Project*. This project documented farm people's views on sustainable agriculture in *Grounds for Change: Linking Experience with a Vision of Sustainable Agriculture*, designed a series of extension bulletins aimed at reducing chemical inputs, and established a pilot project in farmer-led, on-farm research which is now being scaled-up by the National Farmers Union as a sustainable agriculture transition program for its national membership.

Ecological Forestry Program

Following the widespread discontent expressed by citizens at the public forums held by the Premier's Round Table and the Commission for Land Use and the Rural Environment CCNB embarked on a long-term campaign to promote community forestry that is ecologically-based. A position paper concerning the management of Crown lands was widely circulated in 1993 for endorsement, a major conference on community forestry was organized in 1995 and, in 1996, *Working with the Woods: Restoring Forests and Community* was published. CCNB is developing an Internet site to provide information on ecological forest management and is pursuing a pilot project in community forestry in southeastern New Brunswick. CCNB continues to be an active participant at all levels in the Fundy Model Forest Program.

Healthy Environment Program

Dating back to its founding, CCNB has been active on pollution issues ranging from securing the clean-up of the Saint John River in the '70s through campaigning against the spruce budworm spray program's use of chemical insecticides and against atmospheric pollution, to pushing for the responsible management of hazardous wastes management program. In 1985, responding to the widespread contamination of well water, the Conservation Council launched a province-wide campaign to protect groundwater. As a result, throughout the province, CCNB is currently developing projects designed to reduce the release of toxic chemicals into both the terrestrial and marine environments. Specific projects deal with mercury, endocrine disruptors in the Gulf of Maine, pesticide use in potato production and lawn care.

The Conservation Council is a founding member of the Canadian Environmental Network and a member of the Environmental Liaison Centre International. For its efforts on behalf of the environment, the Conservation Council was appointed to the United Nations global 500 Roll of Honour in 1991. It was the only Canadian appointment that year.

For more information, contact: David Coon
180 St. John Street, Fredericton, NB E3B 4A9
Tel: 506-458-8747; Fax: 506-458-1047

Commission for Environmental Cooperation (CEC)

Profile

In North America, we share vital natural resources, including air, oceans and rivers, mountains and forests. Together, these natural resources are the basis of a rich network of ecosystems, which sustain our livelihoods and well-being. If they are to continue being a source of future life and prosperity, these resources must be protectd. This stewardship of the North American environment is a responsibility shared by Canada, Mexico and the United States.

The Commission for Environmental Cooperation (CEC) is an international organization whose members are Canada, Mexico and the United States. The CEC was created under the North American Agreement on Environmental Cooperation and environmental conflicts and promotes the effective enforcement of environmental law. The Agreement complements the environmental provisions established in the North American Free Trade Agreement (NAFTA).

The CEC accomplishes its work through the combined efforts of its three principal components: the Council, the Secretariat and the Joint Public Advisory Committee (JPAC). The Council is the governing body of the CEC and is composed of the highest level environmental authorities from each of the three countries. The Secretariat implements the annual work program and provides administrative, technical and operational support to the Council. The Joint Public Advisory Committee is composed of fifteen citizens, five from each of the three countries, and advises the Council on any matter within the scope of the Agreement.

Mission

The CEC facilitates cooperation and public participation to foster conservation, protection and enhancement of the North American environment for the benefit of present and future generations, in the context of increasing economic, trade and social links among Canada, Mexico and the United States.

For more information, contact: Commission for Environmental Cooperation
393 rue St-Jacques Ouest, bureau 200, Montreal, PQ H2Y 1N9
Tel: 514-350-4300; Fax: 514-350-4314; Internet: http://www.cec.org

Fisheries and Oceans, Canada (DFO)

Vision

To be a leader in oceans and aquatic resources management.

Mission

To manage Canada's oceans and major waterways so that they are clean, safe, productive, and accessible, to ensure the sustainable use of fisheries resources, and to enhance marine trade and commerce.

Mandate:

- Understand oceans and aquatic resources
- Manage and protect fisheries resources
- Manage and protect the marine and freshwater environments
- Maintain marine safety
- Facilitate marine trade, commerce, and ocean development

The Maritimes Science Branch has defined five business lines by which it delivers this mandate:

1) **Marine Safety:** to provide relevant information for safe navigation.

2) **Waterways:** to ensure efficient navigation.

3) **Conservation of Aquatic Environments:** to provide the scientific basis for, protection of fish and their habitat, from man-made perturbations and to develop and / or increase the fish-production capacity of natural habitats.

4) **Aquaculture:** to provide the scientific basis for the development of a sustainable aquaculture industry.

5) **Harvest Fisheries:** to provide a scientific basis for the conservation and sustainable exploitation of fisheries resources.

The Maritimes Science Branch delivers its program through facilities located in St. Andrews and Moncton, New Brunswick and Dartmouth and Halifax, Nova Scotia.

The Maritimes Science Branch has two major groups of clients; internal federal regulatory agencies and a wide range of external clients, including the fishing and aquaculture industries, offshore resource extraction industries, provincial and municipal governments, community groups, various non-government organizations, etc. A significant part of science resources are directed at the provision of advice on fisheries management and habitat alteration, disruption or destruction.

For more information, contact: Paul Keizer, Habitat Ecology
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Tel: 902-426-3843; Fax: 902-426-2256
OR
Bob Rutherford, Oceans Act Office, Bedford Institute of Oceanography
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Email: RUTHERFORDB@mar.div.mpo.gc.ca

Eastern Charlotte Waterways Inc. (ECW)

Eastern Charlotte Waterways Incorporated (ECW) is a not for profit, community based environmental assessment, resource and reference centre. Our group provides that very important link between government, science, industry and community, addressing environmental issues important to all. We encourage public participation towards the common goals of environmental studies, education and sustainable results.

As with all ACAP site, Eastern Charlotte Waterways Inc. began under the Green Plan released by the Federal Government in 1990 which contained a program called the Atlantic Coastal Action Program (ACAP). The organization is mandated, through the ACAP program and with public participation, to develop a CEMP (Comprehensive Environmental Management Plan) for the watersheds and coastal areas in Eastern Charlotte County with a focus on the L'Etang Estuary.

Mission Statement

Community awareness and participation which will promote viable means to the safe, accountable management and development of the environment.

This organization, in the last four years, has accomplished a diverse list of programs which are designed and developed surrounding public concerns and participation. Examples of these are the Water Quality Monitoring program which sees numerous community volunteers each year from June to November monitoring 23 freshwater sites for such parameters as DO, pH and temperature. The Swim Watch program which addresses water quality as it pertains to recreational waters in our watershed and the measurement of fecal coliforms at these sites. Other annual events that encourage public participation and provide education while doing so are the Annual Tree Trade, Community Appreciation Day, K-2 Education Program, Beach Sweeps and various workshops. Information about these and other programs can be obtained at the ECW office.

As with many organizations, Eastern Charlotte Waterways full and part-time staffing, our programs and the resource tools necessary to fulfil these programs are provided through various sources. The organization itself has a Map and Aerial Photo sales outlet which provides a cash turnover while expanding our onsite resource tools for environmental studies and providing a service to the community. Provincial, federal, and municipal organizations as well as local industries and organizations provide ECW support through program and event partnerships.

Eastern Charlotte Waterways Inc.'s progress can be confirmed in the success of its diverse stakeholder board, dedicated executive, committed volunteers, numerous 'result-driven' committees and the community's use of the site resources. The measure of activity through community awareness/education, profile and data developments, government and organizational partnerships, and community enhancement programs are all evidence of the accomplishments possible through community-based initiatives and public participation.

Eastern Charlotte Waterways Inc. under the ACAP program and through stakeholder participation, will continue its focus on building community-based environmental management partnerships in the approaching millennium.

For more information, contact: Susan Farquharson, Eastern Charlotte Waterways Main Street, St. George, NB E0G 2Y0
Tel: 506-755-6001; Fax: 506-755-6187

Ecology Action Centre (EAC)

For more information, contact: Mark Butler, Ecology Action Centre, Suite 31, 1568 Argyle Street, Halifax, NS B3J 2B3
Tel: 902-494-1842

Ecological Monitoring and Assessment Network (EMAN)

Why do we exist? (What is your mission?)

There are numerous stresses affecting ecozones in Canada, such as increased UVB radiation from stratospheric ozone depletion, increasing average annual air temperatures, increasing atmospheric CO_2, acid rain, tropospheric ozone, toxic chemicals, etc. These stresses affect all of Canada and overlap geographically. As a result, there will be Regional and National changes in ecosystems which are a result of the individual and collective effects of theses stresses. Many of the resource-based components of our economy will be affected; we need to know what is happening so we can control stresses or adapt our management practices.

What do we do? (What is our mandate?)

The overall objective of being able to understand what changes are occurring in the environment and why those changes are occurring. Detailed objectives are to understand the nature of ecological change in response to these stresses, design scientifically defensible pollution control and management programs, evaluate the effectiveness of these control and management programs and to define new issues.

How do we do it? (Who is involved/helps/funding sources?)

There are currently over 80 sites across Canada that have become part of the Network and while all are conducting long-term studies, not all have a complete suite of multidisciplinary measurements. However, all of the sites within a given ecozone are considered as an Ecological Science Cooperative (ESC), so that all of the available information may be pooled, thereby adding benefit to the individual sites and developing a collective understanding of changes within the ecozone. There are over 100 agencies involved including governments, First Nations, universities, industry and NGO's.

So what?

There are many examples where ecological monitoring has provided the necessary scientific data to develop policies. Experiments at the Experimental Lakes Area indicated that phosphorus control should reduce lake eutrophication. Studies on calibrated watersheds at Dorset, Ontario resulted in establishing the Ontario Government's policies for managing cottage development on recreational lakes. In the early 1980s, the Aquatic Effects Group, established under the Canada - U.S. Memorandum of Understanding on acid rain, was asked to determine an acceptable amount of acid deposition. The 20 kg per year deposition target was established "to protect all but the most sensitive ecosystems" and could only have been achieved by comparing results from a number of sites (15 were used) located across the deposition gradient. Lakes are being monitored to measure the effect of the Canadian and U.S.A. sulphur dioxide control program. Lake water quality is improving but the results also show that the interaction of climate variability, the effects of acid rain, and the effects of UV.B reduction are complicating the recovery process.

For more information, contact: Tom Brydges, Environment Canada
Ecological Monitoring Coordination Office
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Tel: 905-336-4410; Fax: 905-336-4985; Email: tom.brydges@cciw.ca

The Federal Natural Resource Departments Committee (FNRDC:4-NR)

The original goal of the project was to examine the feasibility of regionalizing the 4-NR MOU and to prepare an action plan. Steering and Co-ordinating Committees, chaired by EC-AR staff, were set up, and a number of meetings held. The following Departments were active participants in the Pilot Project:

- EC - AR
- DFO
- Forestry Canada
- Geological Survey of Canada
- Agriculture and Agri-Foods
- Parks Canada

Despite very significant challenges perseverance with the Pilot has borne fruit, with substantive progress eventually made on a number of joint initiatives. The main focus was on:

- ecosystem-wide changes in the Bay of Fundy
- long-term ecological monitoring

Formal reports on these activities are being finalized. In addition the following activities have been supported or undertaken:

- Regional climate change conference
- Southern Gulf of St. Lawrence Environmental Workshop
- Identification of the negative ramifications of a "Cost Recovery" climate on inter-departmental co-operation
- initiative to enhance knowledge of internal laboratory capacities of EC, Forestry, GSC and DFO

The Atlantic Regional Fed NR project is seen as a useful forum for interchange of information between the Departments involved. It is felt that the true benefits of this initiative will likely only become fully apparent with time.

The lead for the project, now considered operational, has recently passed from EC-AR to DFO. There are a number of lessons to be drawn from the Pilot and these should be carefully considered prior to initiation of any other regional initiatives. A full overview of the Pilot project and lessons learned will be presented at a meeting of the 4NR MOU ADMs to be held in late February.

For more information, contact: Alex Bielak, Environment Canada,
45 Alderney Drive, Dartmouth, NS B2Y 2N6
Tel: 902-426-8874; Fax: 902-426-4457; Email: alex.bielak@ec.gc.ca

Why do we exist? What do we do? How do we expect to do it? So what? (is anyone listening?) Add What can we do to help, a question I asked at our first meeting.

As I look at these questions I see that I should first answer the other "W", "Who are we?" We are the Wabinaki's, The People of the Dawn. We are the original users of this very territory which we are here to discuss today. When you walk these shores, you will step on a Passamaquoddy footprint. When you sail these waters, you go where Passamaquoddy paddles have gone before you.

Personally, I have worked for Fisheries since 1965, first as a student, then as a technician in such areas as estuarine ecology, chemistry, benthic ecology, and salmon aquaculture. I believe I have an understanding of the need for science as well as a native perspective of the environment!

Why do we exist?

This is like trying to answer, "Why are there Englishmen in England?", or "Why are there Germans in Germany?" or "Why are there Japanese in Japan?"

I would take the question of "Why..." as to mean "Why do we exist in this specific location?", for I can see how it applies to others in this fashion. Irving exists (here) because of the resources in the area, Connors because of the fishing resources in this area, DFO is here to monitor/study the salt water resources in the area, etc., etc. So this we have in common, we too are here because of the resources in the area. Why are we different from anyone else in the room? We are different because we do not believe we were put here to monitor, police, or even to just use this place. (i.e. We have not been created to use this resource to make money! We are not an organization created to protect or to study these same resources to perhaps enhance their financial capacity.) We live here, your resource is our home. Our very existence as a people is linked to this land and these waterways that you need for a resource. I was always taught that when you go to another's home you ask before you touch anything. We have never been asked even to sit at the table when it came time to divide up our home. I would hope my presence here indicates a change in your hearts (you might call this "respect"). I would also hope that this change will carry over as a new appreciation of the resource.

What do we do?

Again, we live here. We continue to fight for our land and our rights. And we remind others that these were never extinguished and for you to enjoy them you should consult with us as partners and not as paternal beings dealing with a naughty child. We would like to live as we have lived for eons by not giving up historical and cultural values, upon which there can be no price. As to what do we do with this resource? Not nearly what we used to do and not nearly as much as we would like to do. The resources are just not there anymore to pursue the historical lifestyle of our people, especially if they are to be shared with so many other users.

How do we expect to do it?

Why with your help of course. I would seek that you not ask us as a people to approve of unlimited access to these resources with no restrictions on its use or its treatment. I would hope that gathering in this room is a start. I would hope that we are honestly here to listen to each other and not just to put our own agendas forward. Which brings me to the fourth question.

So what? (Is anyone out there listening?)

We think that we are no longer alone. We believe that someone out there is listening. If you read the newspapers then you must know that Mr. Justice John Turnbull is listening. We can only hope that cultural and ceremonial values can be preserved but to do this we need your appreciation and understanding of these values, for in this room are the big users and in your hands is the future of this resource! It has to be better to share this resource rather that fight over it. Perhaps the best allusion would be a reference from your own bible, with the wisdom of Solomon, I tell you that if you dissect this baby, **we all lose!**

Let me add another question, one which was asked at the last board meeting.

How can we contribute?

Native believe that they have a feeling for the land and its creatures, and when they refer to the earth as their mother, they mean it! Natives do not have a monopoly on this feeling and many in this room may feel the same way. When I say that we live here, I am not forgetting that you do too. However, when it comes to living here, your history goes back a few hundred years; whereas ours goes back thousands. You should take advantage of that experience. We have a second chance and it would be nice to think that we might get it right. Natives see a depleted fishery, species going extinct at an alarming rate, and others on the verge of extinction (including whales). Native rights have been in exile for hundreds of years and though many wondrous things have been done, we find it sad to see that the resource has fared badly. Perhaps modern civilization has excelled in its efforts to develop a thriving world. But is it not time to look at the price. The native sees himself as having an expertise in natural resources. He has learned from his long existence in this area that he must take only what he can use. His feeling for his mother earth is that no one would harm his mother, he would rather take care of her. The Native concept of time is basic to much of this belief. If you attend Native function, you will notice the importance of the circle. The "normal" way of life in today's world seems to be: maximum amount of energy in the minimum amount of time. This simply means getting from point A to point B as fast as you can without worrying as to what you might be leaving behind. This in known as the "linear" concept. The "Native" way is to look at life (and time) as a "circular" concept. You will always come back to the same point on that circle so it is important that you leave things just as you found them so they will be that way when you return. I tell you these things, not to make you Native, but to convince you not to remove the Native from me! To convince others on this board not to use the "My way or no way" attitude. To convince you to leave you baggage at the door. You see Natives think they are very close to mother nature especially in the treatment both have received at the hands of the European civilization. Both have been raped and badly treated as a price to be paid for getting to where we are today. I hope that we are her to see that this does not happen again.

So how can we contribute, perhaps we could act as your social conscience.

For more information, contact: Hugh Akagi St. Andrews, NB E0G 2X0
Tel: 506-529-8854; Fax: 506-529-5862

Fundy Marine Ecosystem Science Project (FMESP)

FMESP is the science arm of BOFEP and the co-sponsor of the Fundy Science Workshops, the second of which is being held here in St. Andrews in November, 1997. FMESP started in 1995 with the view to assessing the state of knowledge on the Bay of Fundy and establishing research priorities in the framework of an Action Plan on the Bay. The first Science workshop, January, 1996, reviewed what we understand about the bay and recent changes (real and perceived), and identified research priorities and a course of action. Activities since then have included a number of presentations at science and coastal management meetings, completion of the Fundy Issues report, completion of 10 fact Sheets on the Bay, and the establishment of a Working Group on *Corophium* (a keystone intertidal species in the Upper Bay) (see poster abstract in theses proceedings). Work underway includes projects of the *Corophium* Working Group, possible establishment of other working groups (e.g. contaminants, mammals, fisheries concerns) a third Science Workshop at Mount Allison University in 1999, research on the Bay linking science and community management, and additional articles and presentations on the science, issues and conservation concerns of the Bay in the context of the greater Gulf of Maine. A new FMESP steering committee will be formed in 1998, linked to BOFEP but with the view of establishing cooperative efforts on research, monitoring and communication of scientific information. Its agenda will reflect both that of BOFEP and other scientific groups working on the Bay of Fundy.

For more information, contact: P. G. Wells, Environment Canada, Dartmouth, NS
Tel: 902-426-1426; Fax: 902-426-4457; Email: peter.wells@ec.gc.ca

Fundy Marine Resource Centre (FMRC)

For more information, contact: Arthur Bull

Fundy North Fishermen's Association (FNFA)

Fundy North is a fishermen's association with approximately one-hundred active members. Fundy North is a non-profit organization. The sole means of funds are membership fees collected each year. Some projects and most meeting expenses are absorbed by the members. Vast quantities of time and labour are also contributed to projects and on-going research by the Fundy North membership.

The **mission** of the association is to establish a community-based sustainable fishery that is ecologically based.

Our management plans are reflective of **principles** that are community-based and are of an ecological plan. Inclusive is the philosophy:

- That the fisheries must be based on marine ecological integrity that must be restored and maintained;
- That the fish harvest is based on a plan with fish life-cycles and biology in mind;
- A fisheries science that focuses on information inherent in eco-systems and lifecycles; oriented management that accounts for fishermen's knowledge and science knowledge;
- Proprietary rights to the common fishery should be allocated to those communities most dependent on it; dependency is social and cultural economics;
- Management of the fisheries should be placed in public hands at the community level and not privatized to individual and enterprise level.

These principles have been adopted by Fundy North. They are based on "A Proposal for Community-Based Ecological Fisheries Management", a guideline provided for us by the Conservation Council of NB (David Coon and Janice Harvey).

Fundy North has taken the initiative in various areas of the fishery to carry out the stated principles. We are currently conducting a Scallop Enhancement Program. This program is focused on rebuilding the declining scallop stocks in the Mid-Bay Zone. Under the present conditions of resource scarcity, scallop enhancement offers the opportunity to maintain or increase income levels and employment, avoid redirection of fishing effort to the other fisheries, and significantly contribute to the long-term sustainability of the scallop resource and fishing communities in the area. A one-day information workshop will be held in St. Andrews April 25/98. All interested are welcome.

Other initiatives include research on the identification of nursery and spawning grounds in the Bay of Fundy. This research is in conjunction with the CCNB. Fundy North is also active in the newly established Fundy Fisheries Council.

For more information, contact: Lana Langille, Community Manager
Fundy North Fishermen's Association, St. Martins, NB
Tel / Fax: 506-833-4889

Friends of the Petitcodiac (FOP)

For more information, contact: Gerald M. Tingley, PRHS
P.O. Box 259, Petitcodiac, NB E0A 2H0
Tel: 506-756-8253; Fax: 506-756-3110; Email: tingleyem@nbed.nb.ca

Global Program of Action on Land-Based Activities (GPA)

Land based sources of marine pollution were determined to be the number one pollution priority facing coastal seas by the United Nations GESAMP (Joint Group of Experts on Scientific Asps of Marine Environmental Protection) in 1990, amongst other groups worldwide. This resulted in considerable intergovernmental activity prior to and during the 1992 Rio "Earth Summit" conference, resulting in a decision for member states of the UN to seek a mechanism other than a new Convention for comprehensively tackling the problem. Further intergovenmental meetings and work led to the Washington Protocol of November, 1995, called the Global Program of Action on Land-based Activities (LBA). This committed signatory nations to developing their national programs of action on LBA. Canada is currently developing regional components of its National Plan of Action on LBA, through a multi-stakeholder approach. This effort is also linked to the CEC effort in the Gulf of Maine on LBA, conducting reviews, identifying priorities, developing action plans.

For more information, contact: Joe Arbour, Environment Canada
15th Floor, 45 Alderney Drive, Dartmouth, NB
Tel: 902-426-1701; Fax: 902-426-4457; Email: arbourj@ns.doe.ca

Gulf of Maine Council on the Marine Environment (GOMCME)

In 1989, the Governors of the U.S. states of Maine, New Hampshire and Massachusetts and the Premiers of the Canadian provinces of Nova Scotia and New Brunswick, signed the *Gulf of Maine Agreement on the Marine Environment*. Recognizing that the Bay of Fundy and Gulf of Maine is a common resource of inestimable value to the residents of this binational area, and the fact that there was no existing governance framework that looked at the region as one ecosystem, or addressed all issues in a comprehensive fashion, the five jurisdictions agreed to work cooperatively for the conservation and protection of this shared ecosystem. To this end, *The Gulf of Maine Council* was formed in 1990 to administer this partnership agreement.

The Council's membership is comprised of the Ministers of the Nova Scotia and New Brunswick departments of Environment as well as Fisheries & Aquaculture, and two senior U.S. state administrators (depending on the State) of Environmental Protection/Affairs / Services or State Planning in each of the three U.S. jurisdictions. Two years into the program, a prominent private sector member from each jurisdiction was added to the Council. While the two federal governments are not signatory to this Agreement, they are, in fact, full participants in the program. They are formally known as *Federal Partners* on the Council, and six federal representatives (Environment Canada, Fisheries & Oceans Canada, NOAA, U.S. Fish & wildlife Service, Environmental Protection Agency and the Army Corps of Engineers) are full members on the Council's Working Group and committees. The Council is supported by a *Working Group* of state/provincial/federal planners and resource managers, and four committees - *Data & Information Management; Marine Monitoring; Public Education and Participation, and Marine Debris*. Operations of the Council are assisted by a Secretariat which rotates among the five state/provincial jurisdictions on an annual basis.

It is the stated mission of the Gulf of Maine Council "*To maintain and enhance environmental quality in the Gulf of Maine and to allow for sustainable resource use by existing and future generations.*" In 1991, the Council issued a 10-year Action Plan which outlined the key areas of focus for the program and the areas of cooperative program activity that they would work cooperatively to support: monitoring and research; coastal and marine pollution; habitat protection; education and participation; and protection of public health. Notable efforts in the first five years of the program include, *inter alia*: establishment of a Gulf-wide marine monitoring program (contaminants in blue mussels); a regional data and information management system; and inventory of point sources of pollutants; agreement on the regionally significant plant and animal species; and substantial public education and outreach initiatives (e.g., newsletters, fact sheets, public conferences).

A revised five-year Action Plan (1996-2001) was released by the Council in December, 1996. The new Action Plan includes: (a) A reaffirmation of support for the program by the Governors and Premiers; (b) five key goal areas under the unifying theme of *Coastal and Marine Habitat* - [1] Protect and Restore Regionally Significant Coastal Habitat; [2] Restore Shellfish Habitats; [3] Protect Human Health and Ecosystem Integrity from Toxic Contaminants in Marine habitats; [4] Reduce Marine Debris; and [5] Protect and Restore Fishery Habitats and Resources; and (c) measurable objectives, specific strategies and actions for achieving those objectives.

For more information, contact: Larry Hildebrand, Environment Canada Environmental Conservation Branch, 45 Alderney Drive, Dartmouth, NS B2Y 2N6 Tel: 902-426-9632; Fax: 902-426-4457; Email: larry.hildebrand@ec.gc.ca

Gulf of Maine Monitoring Network (GOMMN)

For more information, contact: Stephen Hawboldt, CARP, N.S. Tel: 902-532-7533; Fax: 902-678-1253; Email: carp@fox.nsth.ca

Miramichi River Environmental Assessment Committee (MREAC)

Why do you exist?

The MREAC is a citizens-based, multi-stakeholder, non-government organization that was formed in 1988. The group continues to function on a watershed basis, primarily concerned about the environmental integrity of the 20% of New Brunswick drained by the Miramichi River. MREAC's multi-stakeholder profile included membership from Miramichi citizens, industry and four levels of government. In 1993 MREAC became the 13th site of the Atlantic Coastal Action Program (ACAP).

What do you do?

MREAC is currently involved in thirteen programs, outlined in our updated action plan (Spring 1997) Miramichi Watershed Environmental Management Plan - Reaching 2002. These include River Watch, three wastewater programs (Industrial, Municipal and Rural), Swim Watch, Fish Habitat Protection, Environmental Monitoring and Research and others. Our updated plan includes new initiatives including a lead agency role in nominating and designating a Miramichi tributary to the Canadian Heritage River System and in the Air Resource Management Area - Miramichi management plan.

How do you do it?

MREAC has enjoyed funding support from the ACAP program, the New Brunswick Environmental Trust Fund, Action 21, Noranda Mining and Exploration, REPAP N.B. Inc., HRDC (student employment) and others. Our annual budget ranges from 150-200K per annum. Significantly the actual funding support is more than matched by-kind support from an array of sources. MREAC has forty five volunteer board members, one full time director and presently two other staff.

So what?

MREAC's impact on the Miramichi community is best assessed by the Miramichi community at large and MREAC's partners. One indicator of positive community involvement include MREAC's role as host of a well-attended annual science day that serves as a forum for ongoing or upcoming science on the Miramichi watershed. Current MREAC membership is twice what it was in 1988. Media relationships have been exceptional and submitted press releases are regularly printed by local and provincial media. A philosophy of communication and cooperation prior to confrontation has resulted in a MREAC role of community involvement that is at its capacity. Individuals and governments regularly approach MREAC to implement programs that require NGO leadership and, based on the nature of the program, MREAC will often cooperate.

For more information, contact: Harry Collins,
P.O. Box 8, Miramichi East, NB E1N 3A5
Tel: 506-778-8591; Fax: 506-773-9755

NB Department of Fisheries and Aquaculture (NBDFA)

For more information, contact: Marianne Janowicz, NBDFA
P.O. Box 6000, Fredericton, NB E3B 5H7
Tel: 506-453-2253; Fax: 506-453-5210; Email: mariannej@gov.nb.ca

NB Prospectors and Developers Association (NBPDA)

For more information, contact: Peter Fenety, Environmental Geologist,
94 Queen Street, St. Andrews, NB E0G 2X0
Tel: 506-529-1084

Oceans Act (OA)

The *Oceans Act*, enacted in January 1997, outlines Canada's duties and responsibilities in its oceans territories and introduces a new oceans management model - a model based on collaboration among stakeholders and on the principles of sustainable development, integrated management and the precautionary approach. The Maritimes Region, DFO, Oceans Act Coordination Office has been established to lead and coordinate delivery of DFO's responsibilities under the *Oceans Act*.

The *Oceans Act* comprises three parts:

- Part I - defines the oceans area under Canada's jurisdiction and asserts Canada's management and protection rights and responsibilities;

- Part II - assigns the Minister of Fisheries and Oceans the responsibility, *in collaboration with other federal departments and agencies, provincial and territorial governments, affected Aboriginal organizations, coastal communities, and other persons and bodies...*, to lead and facilitate development and implementation of a national strategy for the management of estuarine, coastal, and marine ecosystems. Part II describes the specific tools that may be used to give effect to an oceans management strategy:
    - plans for integrated management of all activities or measures in or affecting estuaries, coastal water and marine waters;
    - marine environmental quality guidelines; and
    - marine protected areas.

- Part III - outlines the powers, duties, and functions of the Minister of Fisheries and Oceans, including the responsibility to provide Coast Guard and Hydrographic services, and marine services (including carrying out scientific research).

The approach envisioned in the *Oceans Act* means collaboration with other government agencies, other government agencies, other levels of government and stakeholders, seeking partnerships, and supporting stakeholders in resolving conflicts at the planning stage.

A number of *Oceans Act* related initiatives are underway now:
- a discussion document on development of a national oceans strategy is being developed and will serve as a cornerpiece in public discussion in 1998;
- a draft national policy and discussion paper on integrated coastal zone management (ICZM) is being developed for release in 1998;
- a public discussion paper on marine protected areas was released early in 1997, public comment was received during a review period and a national policy will be released in 1998.

However, aside from these initiatives, integrated management of coastal areas is advancing now on many fronts. The opportunities and strong interest in ICZM exist throughout the Maritimes, including in the Bay of Fundy area. As a facilitator ICZM, DFO will build on these initiatives - from the ground up - assist in establishing linkages, find and foster common objectives, and in some cases, pursue more formal arrangements. The challenge is not to re-invent the wheel, but to support existing initiatives, to find ways to link coastal management groups and interests, and to pursue a coordinated approach to ICZM by government.

For more information, contact: Faith Scattolon, Oceans Act Coordination Office
5th Floor, Polaris Building, BIO, Dartmouth, NS B2Y 4A2
Tel: 902-426-2065; Fax: 902-426-3855; Email; scattolonf@mar.dfo.gc.ca

Regional Association for Research on the Gulf of Maine (RARGOM)

Purpose:

To provide an independent and neutral forum for discussion and facilitation of Gulf of Maine research; to advocate for regionally focussed research programs at federal and state/provincial levels; to promote awareness of scientific achievements and issues and linkages between science, management and the public.

Methods:

Coordinate and help support meetings and workshops on issues of broad community interest that are most effectively undertaken by a consortium. Represent the region's scientific interests, needs and achievements at federal and state/provincial levels (*e.g.* agencies, *ad hoc* committees) and at "non-science" meetings (non-governmental organizations, public). Seven reports have been issued on various topics since 1992 (see printed listing or web site), plus several bibliographies, frequent newsletters and a web site.

Recent reports (abbreviated titles) include: *Ecosystem Health of the Gulf of Maine* (1996, for NOAA, a requirement for extension of the U.S. Marine Mammal Protection Act); *Gulf of Maine Ecosystem Dynamics* (1997, a binational scientific workshop and symposium); *Mechanisms for Improving the Integration of Science and Management* (1997, a binational workshop of scientists and resource managers).

Current undertakings include coordinated efforts at ensuring adequate ship support in the Gulf of Maine and an ongoing workshop series on observation/monitoring systems needed to support research and environmental monitoring over the next decade.

Membership:

There are 26 members including federal, state and private organizations. Canadian members are the Huntsman Marine Science Centre and DFO. Two membership categories (*Member* and *Associate*) are designed to accommodate different dues-paying capabilities, based mostly on size of GOM research programs. In practice, there is little other distinction between membership levels. Each member officially has a representative and an alternate for policy board purposes, but RARGOM welcomes broad participation in discussions, committees, etc.

For more information, contact: Eugenia Braasch, RARGOM Executive Director, Thayer School of Engineering, Dartmouth College, Hanover, NH 03755 USA Tel: 603-646-3480; Email: braasch@dartmouth.edu; web site: www-nml.dartmouth.edu/rargom/rargom.html

St. Croix Estuary Project (SCEP/ACAP)

Why does SCEP exist?

The St. Croix Estuary Project (SCEP) is a community-based organization dedicated to the environmental preservation and sustainable development of the US and Canadian shores of the St. Croix River Estuary and adjoining coast past St. Andrews to Bocabec, NB. It is membership based (individuals, families and area businesses) and managed by an elected board of 18 area residents. A Program Director is employed full time, with technical and other staff hired on a part time basis as required and as funding permits.

SCEP was founded in 1992 in response to the Atlantic Coastal Action Program, an Environment Canada initiative. Locally this program is meant to develop active community-based organizations to protect the environmental beauty and heritage of the St. Croix and to promote sustainable development of the area for its many stakeholders.

Core funding is received from Environment Canada, with other financial or in-kind support received from other government departments, private companies, organizations and individuals. Although the ACAP program was to last a five year period, Environment Canada, impressed with ACAP results, is working to obtain ongoing funding to see management plans implemented. SCEP is optimistic that core funding for this purpose will continue from Environment Canada, although we recognize that to meet our objectives, new sources of financial support will have to be found.

What does SCEP do?

SCEP is active in water quality testing and other research programs. It engages in public awareness campaigns, beach cleanups and special activities like an extensive water use audit program in 1995 for the Town of St. Stephen.

However, its prime objective as agreed with Environment Canada, was the development and publication of a comprehensive management plan for the estuary area, which was published in April of this year. This plan recommends 50 specific actions for the estuary to address some 25 issues identified through public research and membership input.

How does SCEP operate?

SCEP's Program Director manages the organizations' affairs and is responsible for achieving objectives established by the board and sanctioned by its members. The board develops an annual workplan with projects and objectives spelled out. This plan is sanctioned by members at an annual meeting. SCEP's Program Director is responsible for the implementation of this workplan, manages the organizations' staff, and makes policy and procedural recommendations to the board. In addition to the volunteers who serve on its board and committees, SCEP relies on volunteers and other organizations to carry out many of its activities.

With respect to the management plan, SCEP can undertake many of the recommended actions by itself, but there are others which will have to be dealt with by other organizations, appropriate government departments and/or private companies. SCEP sees its role as a catalyst to see these recommendations carried out.

Who is listening-What effect does SCEP have?

SCEP can report that six months after publication of the management plan, there is movement or potential movement on some 20 of the 50 recommendations, indicating that its activities are given a significant degree of respect. Although the positions we espouse are not always universally accepted, we believe they are listened to by government, private and other organizations. SCEP has a track record of which it can be proud.

For more information, contact: Paul Casey
P.O. Box 480, St. Andrews, NB E0G 2X0
Tel: 506-529-4868; Fax: 506-529-4878; Email: scepnet@nbnet.nb.ca

St. Croix International Waterway Commission (SCIWC)

Structure and Function

The St. Croix International Waterway Commission was established by Maine and New Brunswick legislation to develop a multiple-use management plan for the St. Croix boundary waters and their shores and to help all interests, governmental and non-governmental, to implement that plan together.

The Commission has no direct jurisdictional authority but rather works cooperatively with agencies and local interests to implement the St. Croix Plan. A small office and part-time staff are supported by annual appropriations from New Brunswick and Maine while program funding is solicited from non-governmental and governmental sources on a project-by-project basis (the Commission holds US and Canadian charitable status).

St. Croix Management Plan

The St. Croix's Management Plan was developed in 1989-1990 with the help of users, landowners and managers on both sides of the Waterway and has been implemented voluntarily by these interests since that time. The Plan was formally accepted by New Brunswick and Maine in 1994.

The Plan is a policy document that identifies management objectives shared by Maine and New Brunswick for the international St. Croix. It also lists actions identified by residents and managers to begin to achieve these goals. The policies focus on seven themes:

International Waterway: One policy recognizes the St. Croix's identity as an international heritage waterway.

Environmental Setting: Four policies stress collaboration in setting standards for water quality, shoreland protection and pollution management, and for the maintenance of biological diversity and productivity.

Human Heritage: A single policy guides preservation and interpretation of the waterway's history and culture.

Recreational Heritage: Six policies address public access, coordination of recreational information, integration of planning to minimize conflicts, management of sport fisheries as economic and recreational assets, and the future development and management of land and water recreation compatible with the Plan's heritage goals.

Economic Development: Two policies support actions to capitalize on the waterway's economic strengths and to incorporate heritage concepts into economic planning.

Waterway Management: Five policies stress transboundary objectives to obtain and exchange waterway-based information, develop effective public/private partnerships for management, address longterm management issues on a proactive and international basis, maintain Management Plan coordination through the Commission and review the Plan regularly.

Program Highlights

The Commission is involved actively in all of the theme areas identified in the Management Plan. In 1997 this included coordinating 70 volunteers in water quality, fisheries restoration, shore cleanup, campsite care and public information projects. The Commission also made significant contributions to the conception of a new St. Croix provincial park; design of a coastal heritage travel route; reviews of utility and industrial proposals; planning for a laboratory to support the regional clamming industry; initiatives to celebrate early French settlement and public land acquisition. It promoted heritage and environmental values through publications, events and student projects.

The Commission's past actions have earned the Canadian National River Conservation Award and the Gulf of Maine Council on the marine Environment's Visionary Award.

For more information, contact: Lee Sochasky, SCIWA,
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Tel: 506-466-7550; Fax: 506-466-7551; Email: staff@stcroix.org

World Wildlife Fund (WWF)

The World Wide Fund for Nature (WWF), known in Canada and the United States as World Wildlife Fund, was founded in 1961. WWF-Canada was founded in 1967. The over-riding concern of WWF is the preservation of the world's biological diversity. In Canada, this goal is achieved through four major program areas: Endangered Species Campaign, the Endangered Spaces Campaign, Wildlife Toxicology Program, and an International Program.

As of September 1996, there are 276 species and populations on the official national list of Canadian wildlife at risk of extinction. The goal of WWF's Endangered Species Program is to remove species from Canada's list of endangered wildlife and to prevent additional listings, especially by promoting protection of species, critical habitats and ecosystems. This goal is advanced through funding of scientific research and field work on species at risk throughout Canada, through drafting and implementation of recovery plans for species listed as endangered or threatened, through programs to eliminate illegal commercial trade in species at risk, and through efforts to improve legislative mechanisms available to protect Canadian wildlife.

The world's biodiversity cannot be conserved in an environment filled with harmful chemicals. The efforts of WWF and others to promote the recovery of species at risk and to establish protected areas will be futile if water and air, and therefore the animals themselves, are contaminated. The goal of the Wildlife Toxicology Program is to protect Canadian wildlife and wildlands from harm caused by toxic chemicals. The Program sponsors research on the ecological impacts of toxic substances, develops and works towards the implementation of industrial pollution prevention regimes, promotes public awareness of toxic substance and their effects on humans and wildlife, and lobbies for stronger legislative and regulatory mechanisms for controlling use of toxins.

The goal of the International Program is to conserve wildlife and wild places outside of Canada, primarily in Latin America and the Caribbean. The Program supports research and field projects throughout these areas, promotes public awareness of Latin American/Caribbean conservation issues both locally and in Canada, and works with multi-lateral development organizations to promote environmentally sensitive approaches to development.

Recognizing that Canada's wilderness is disappearing at an alarming rate (approximately 100 hectares per hour), the Endangered Spaces Campaign was launched in 1989 to help protect the nation's dwindling biodiversity. The goal of the Campaign is to establish a national network of terrestrial and marine protected areas that would help conserve the tremendous variety of habitats and ecosystems that make-up Canada's natural heritage. This goal became a matter of public policy when the Canadian Council of Ministers of the Environment, the Canadian Parks Ministers Council, and the Wildlife Ministers Council of Canada signed the *Tri-Council Agreement* in 1992 committing Canada to completing an ecologically representative system of marine and terrestrial protected areas.

The Endangered Spaces Campaign goal is advanced through contract staff working in each province and the territories, as well as Pacific and Atlantic regional marine protected areas coordinators. The Local Action Fund supports not-for-profit, non-governmental groups undertaking public awareness projects to help protect ecologically significant terrestrial and marine sites. Each year, WWF reports on the progress the federal, provincial, and territorial governments make towards meeting the goal of completing a network of marine and terrestrial protected areas. The National Report Card is released every spring.

For more information, contact: Inka Milewski
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SESSION FOUR

BAY OF FUNDY ECOSYSTEM PROJECT

SESSION CHAIRMEN:

G. R. Daborn
J. A. Percy
P. G. Wells

Inaugural Meeting of the Bay of Fundy Ecosystem Project

The Bay of Fundy Ecosystem Project (BOFEP) and its Virtual Institute - how to get there from here?

Session Co-Chairs: G. Daborn (ACER, Acadia), J.Percy (CARP), and P.G.Wells (Environment Canada and BOFEP)

Report on the meeting
Jon A. Percy
C.A.R.P.

The meeting started with short presentations by groups that had been missed on the previous evenings:

- Gulf of Maine Council [Larry Hildebrand]
- NB Prospectors and Developers Association [Peter Fenety]
- Coastal Zone Engineering Association [Jeff Ollerhead]
- NB Dept of Fisheries and Aquaculture [Marianne Janowicz]
- NB conservation Council [David Coon]

The Chairman gave a brief overview of BOFEP concept and outlined the agenda and objectives for the morning session. Forty people attended the session.

There are a lot of diverse groups with an interest in and activities in the Bay of Fundy. These include Government agencies, NGO's (Non governmental organizations) and QUANGO's (quasi- non governmental organizations). Many of these groups do not really know what the others are doing even though there are many areas of overlap in their activities. There is a need for some sort of structure that would facilitate interactions among all these players. But we don't want a top-down, imposed hierarchical structure; it must be a flexible, adaptable arrangement that is permitted to evolve by itself in its own directions.

What is required is a Fundy Ecosystem Network. Such networking can be very productive and is non-threatening. One problem is that it is often difficult to quantify the success of such networking, because although the network itself triggers the initial interactions, the subsequent ramifications and ultimate results often occur beyond the ken of the network itself.

The network should focus on providing a forum for an extended discussion of issues around the Bay. To be effective, such initiatives usually need some common sense of vision and purpose. They can also serve to bring together other sorts of knowledge (such as "traditional environmental knowledge") and link it with the more traditional scientific information. It is important to establish such a network so that people are aware of who is doing what. But it is important to also move rapidly into more concrete things. The Organization cannot simply remain a network and web site. You can only keep people interested by engaging in concrete projects. There needs to be an umbrella organization to bring people together; but, it is important to go beyond that in order to keep the organization alive.

It is important to focus on issues; this is what gets people working together. If we focus on what it is that we want to do in general terms then ideas for specific projects will begin to flow. There is some concern that "health of the Ecosystem" is too fuzzy an issue. However, different people have different foci and there are a lot of issues of concern; there is not a single driving issue as it was in the days of the Tidal Power Project activities (1970-80's). Another issue to consider is that of "perception". Various groups have perceptions that are very narrow in scope; they do not recognize or understand the impacts of their activities on other groups or interest. We need to recognize that many groups are not represented at this meeting and many of these groups have money and influence and might be interested in participating in the network and its activities.

Many other groups are coming together on a Fundy-wide basis. There is no single overriding issue, but we cannot continue along the track of a fragmented approach to issues. There needs to be a more integrated, inclusive approach adopted that is more Ecosystem based. The basic problem here, though, is changing authority. We are continually having to deal with more complex issues and yet government is essentially withdrawing from its traditional management role. There is a need for some organization or body that assumes some of this authority for management of the Bay of its resources.

There was a general consensus that we should not get too hung up on a single issue at present. There are a lot of issues out there. The basic problem has been that a lot of groups haven't been talking to each other. It will be hard to identify a single issue of importance to all groups. It is important that the new organization be proactive in its approach rather than simply reacting to issues. Another role for such an organization might be as an information and data repository. There is a lot of valuable information out there somewhere; but much of it is effectively lost at present.

There appear to be two foci developing in the discussion: a) networking and integrated science and b) integrated management. Are these two compatible? Considering these two approaches as separate is probably not productive. We need to consider science and management in relation to each and how we can better integrate the activities of the two.

It is very important that the groups participating in the network retain their own strong identity. The important thing will be to foster collaboration among groups and assisting them in doing things that they can't do easily themselves within a group (e.g. the science information needs of resource harvesters etc).

There are already many strong initiatives underway that we can start building upon. This is a niche that the new organizations can start filling. One of the problems is that the sea belongs to everyone; it is a commons. The various users feel that they can do what they want because it is a common resource. We need to get everybody involved in making decisions about the use of the common resource and in finding ways of solving problems. [we need to get away from the traditional DFO approach; there is a problem; throw money at it].

It is important that we recognize that there are different levels at which we need to network)e.g. communication among scientists about specific scientific issues). It would be useful to develop a diagram indicating that there are different levels of interaction. We need to build this into the program. It is important that we not recreate traditional hierarchical and authoritarian structures; there needs to be a more egalitarian approach. We have to involve the people who live around the bay as they are the major stakeholders. We need to change their behaviour and activities if we are conserve resources and habitats. At the outset, the network idea is a powerful thing as it levels the playing field a bit and allows for wider participation. It allows the structure to evolve gradually as needed.

The mining industry (and probably other industries) are dealing with many of the same issues. They are also trying to identify and develop promising linkages with other groups. Hover, at the moment there is a perceived fence between industry groups and other groups. And this is something that we need to work towards eliminating.

Vision statement

We need to include "community" somewhere in vision statement. There has to be a stronger statement about sustainability of communities involved and about the interests of the communities. There was general agreement that we incorporate this idea into the vision statement.

Should we add "processes of, and impact on, the BOF Ecosystem"?

In referring to the Bay of Fundy Ecosystem we are really talking about the whole watershed. What about the Gulf of Maine? Someone suggested that GOM be referred to as the "Greater Bay of Fundy". We have to recognize that the boundaries are going to be variable and rather fuzzy according to what the particular interests and issues are. However, to include GOM could be biting off too large a chunk to effectively work with. The organization should primarily focus on activities and issues within the Bay of Fundy while recognizing the broader linkages and interests.

Do we need to include "long-term" as specific wording in a vision statement? This is generally implied in term sustainable. Should we include the phrase "conserving the diversity"?

In addition to this basic vision statement we might also consider developing a more expanded, detailed version that would describe how we would like to envision the Bay of Fundy in 20 or so years time. This would be a more concrete statement that more people could readily relate to.

Principles

It is important to include "first nations" in any listing. Also, delete the word "marine" from the phrase "marine scientists" to allow the broadest possible scientific participation *(e.g. social scientists etc.). Use the term "communities of the Bay of Fundy Ecosystem "rather than just "coastal communities".

"Government" should be included in principle #3 because they have many non-regulatory involvements that would not be included under the term "managers".

There was a suggestion that we should perhaps simply say "groups and individuals with an interest in the Bay of Fundy" rather than specifying the various groups. However, it was felt that we should leave the listing of the various groups in, but make sure that the terms used for the groups are generic enough that they don't exclude anyone, or any group.

There was some question as to whether principle #4 is really a principle. Perhaps it would be better included as an objective. There was some concern about negativity involved in the term "non-hierarchical". Some preferred a more positive term such as "egalitarian" or "all partners who equally share the vision".

Should we use the term "virtual institute"? Are we simply trying to imply that this is not a governing structure?

It was agreed that principle #4 should be divided: the first half dealing with enhancing communication could remain as a principle; the second half should become a mechanism for doing this.

It was emphasised that we don't want to become a lobby group although, at some stage, we may want to promote certain activities and put pressure on funding agencies to ensure that the vision is being met. We must clearly be "promoting and not lobbying". People and agencies who are making decisions should be part of the network, and at the table, so it should not be necessary to lobby as they are part of the process.

Objectives

We need a separate objective: "to develop long-range planning". The present wording sounds a bit too passive. Make it more positive and forceful: "promoting activities that". We need to focus on concrete things to keep members interested. We need concrete projects. Perhaps should add statement regarding acquisition of new knowledge. However, we should not carve the objectives in stone and find that they are an impediment later on. Perhaps we could simply add "BOFEP will initially undertake to ".

The partnerships should also specifically include the term "industry".

Question about whether we should use term "stakeholders". Consensus that we could leave it in, but perhaps include a glossary defining such terms. We don't want the terminology selected to be exclusive, but rather inclusive; perhaps use the term "and industries". In Principle #4 we should use wording to indicate that it is based on inclusiveness.

Structure

Basically we want to appoint a group that will take the spirit of this meeting and develop structures that will fulfil the views expressed by the group. The Steering committee should emphasize the importance of getting together periodically, perhaps by means of an annual workshop and not always at Huntsman.

We need to ensure that the Steering Committee is as representative of the various interests as possible; no one interest group should dominate. One possible option is for the final organization to have a small steering committee and a large representative Board. The Steering Committee to be appointed here is not the final organisational structure, but is merely an interim body responsible for moving the process along. It should be clear that anyone who agrees to serve on the Steering Committee has to make a commitment to attend its meetings.

The following individuals were nominated, appointed or volunteered to the Interim Steering Committee:

Thierry Chopin	Sean Brillant
Bob Rutherford	Maria Recchia (or other)
Mike Brylinsky	Steve Hawboldt
David Coon	Peter Fenety
Jon Percy	Marianne Janowicz
Alison Evans	Graham Daborn
Hugh Akagi (or other)	Larry Hildebrand

It was agreed that the Committee would have the power to co-opt other members if needed. It would take the spirit of BOFEP and rework it as reflected in the opinions of those present at the inaugural meeting. It would develop plans for a more formal organisational meeting in 5-6 months time.

Other activities that this interim Steering Committee should undertake:

- Annual Workshops - first one tentatively in Sackville N.B.
- Revise vision and principles.
- Develop proposal for an appropriate organisational structure
- Ensure comprehensiveness of participation in the new organization.
- Identify potential means of funding organization.
- Other specific activities/projects:
- Explore opportunities for participation at Coastal Zone 2000 in Saint John.
- Continue these discussions and planning activities by means of a list server and other electronic means.
- Identify a list of possible projects/activities.
- Develop web site to enhance communication.

Eventually, the organization will have to consider the land-use issue and how to address conflicting uses.

There was a vote of thanks to Mick Burt for organizing the Workshop, to Peter Wells for helping develop the program and to the Huntsman Marine Science Laboratory and to DFO for providing the facilities.

Meeting adjourned 1240h.

Notes prepared by Jon Percy.

Bay of Fundy Ecosystem Project (BOFEP): Vision, principles, objectives (Draft 2, J.A.Percy, from the Meeting November 15th).

Vision: the Bay of Fundy Ecosystem project is dedicated to:

1) the ecological integrity, vitality, diversity and productivity of the Bay of Fundy ecosystem, and the economic and social well-being and sustainability of its coastal communities.
2) the effective communication and co-operation among groups and individuals interested in understanding, sustainably using and conserving the resources, habitats and ecological processes of the Bay of Fundy.

This Vision is predicated on the following general principles:

1) Conservation and management of resources and habitats should be ecosystem-based and reflect an holistic understanding of ecosystem structure, processes and interactions.
2) Resource development and other coastal zone activities should be based on ecologically integrated coastal management planning.
3) management planning should be transparent and open to participation by resource users, coastal communities, first nations, industry, scientists, governments, managers and other individuals or groups with interests in the Bay of Fundy ecosystem.
4) Effective communication and active co-operation among all individuals and groups with an interest in the Bay of Fundy is vital to this enterprise.

To advance this vision, BOFEP will initially undertake to:

1) Form a geographically dispersed, flexible, adaptable, multidimensional, inclusive network ("Virtual Institute") linking all partners who equally share the vision and the principles.
2) Serve as a readily accessible network for scientific, community and other knowledge pertaining to the Bay of Fundy by:
    2.1) facilitating the timely sharing of information and knowledge (e.g. bibliographies, science publications, directories of individuals, institutions, activities, projects and other initiatives).
    2.2) fostering effective communications among interested groups and individuals (e.g. workshops, meetings, web site).
    2.3) promoting and facilitating partnerships and other linkages among stakeholders and other interested groups or individuals.
3) Promote and facilitate regular assessment of the state of the bay of Fundy ecosystem of specific issues (with reports distributed via newsletter, e-mail,or web site) which will identify issues, priorities, accomplishments and new directions.

4) Promote activities that encourage and facilitate long-range planning in the coastal zone.

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Web Sites:

http://ace.acadiau.ca/science/cer/bofep/home.htm

http://fox.nstn.ca/~carp

http://ec.gc.ca (The Green lane, Atlantic Region)

APPENDICES

Appendix I

Program:

Maritime Atlantic Ecozone Science Workshop

November 11 - 15, 1997

PROGRAM

Maritime Atlantic Ecozone

Science Workshop: November 11 - 15, *1997*

Sponsors:

Quoddy EMAN Site, November 12/13

and

Bay of Fundy Ecosystem Project, November 14/15

Held in St Andrews, N.B. and organised locally by:

Huntsman Marine Science Centre

and

St Andrews Biological Station, Fisheries and Oceans, Canada

TUESDAY, November 11, 1997

18:00 Registration and Reception (**Anderson House; HMSC Upper Campus)**

WEDNESDAY, November 12, 1997

08:30 Registration (continued) (**St Andrews Biological Station Conference Centre**)

09:00 Opening remarks: **Dr John M. Anderson**, Chair, Board of Directors, HMSC; **Dr T. Sephton, Director**, St Andrews Biological Station, DFO.

09:20 Welcome address: **Mr Don Dennison**, Deputy Minister, New Brunswick Department of Environment

09:40 The Quoddy EMAN Site (**W.Pilgrim**)

Session Chairman: **W.Pilgrim,** Chairman, Quoddy EMAN Site Management Committee

10:10 Sporulation of *Chaetoceros furcillatus* in Passamaquoddy Region, N.B. (**I.Kaczmarska, T.D.Peterson, H.L.Schaefer and J. Martin**)

10:30 Passive ozone monitoring and forest health assessment (**R.M.Cox and J.Malcolm**)

10:50 Break/Poster viewing

11:10 After the gold rush: the status and future of salmon aquaculture in New Brunswick (**I.Milewski, J.Harvey and B.Buerkle**)

11:30 Local and regional enrichment effects: an assessment of Lime Kiln Bay and Bliss Harbour (**G.Pohle and B.Frost**)

11:50 Does aquaculture impact harmful algal blooms in the Southwest Bay of Fundy? (**J.Martin and M.LeGresley**)

12:10 Variability in the use of rockweed habitats by fishes: implications for detecting environmental impacts **(R.Rangeley)**

12:30 Lunch break/Poster viewing

Wednesday, November 12 (continued)

Session Chairman: R.M.Cox, Quoddy EMAN Site Management Committee, Natural Resources Canada Forestry Service

13:30 The feeding ecology of the sea cucumber *Cucumaria frondosa* in the Bay of Fundy **(R.Singh)**

13:50 Behavioural responses of Arctic terns (*Sterna paradisea*) to marine food supply **(J.Paquet and A.W.Diamond)**

14:10 Common eiders and great black-backed gulls in the Gulf of Maine: An overview **(K.Mawhinney and A.W.Diamond)**

14:30 The use of seabirds as windows into marine foodwebs **(A.W.Diamond)**

14:50 Break/Poster viewing

15:20 Dispersal patterns in coastal southwest New Brunswick: A progress report **(F.Page, W.Ernst, G.Julien, R.Losier, P.McCurdy, C.Kohler, M.Ringuette, and T.Johnston)**

15:40 Development of marine biodiversity monitoring protocols - the EMAN initiative **(G.Pohle)**

16:00 Horse mussel reefs of the Bay of Fundy **(D.J.Wildish, G.B.J.Fader, H.M.Akagi, B.Hatt, and P.Lawton)**

16:20 Songbird monitoring at Huntsman: an eight-year data base **(T.Dean)**

17:00 Happy Hour (Anderson House; no-host bar)

18:00 Dinner (Anderson House)

19:00 Panel presentation/discussion: Fundy Region Organizations

Session Chairman: M.D.B.Burt, Director, Quoddy EMAN Site

SCIWC-**Lee Sochasky**; EMAN-**T.Brydges**; WWF-**I.Milewski**; CEC-**J.Arbour**; AAC-**S.Waddy**; MREAC-**H.Collins**; DFO-**P.Keizer**; Passamaquoddy Tribe **H.Akagi(?)**; ECWC-**S.Farquharson**; WICEC-**M.Leaman**; ACZISC-**L.Hildebrand**; CCNB-**I.Milewski**; ACAP(Grand Manan)-**L.Murieson**; ACAP(SCEP)-**P.Casey**; NBCC-**D.Coon**; ACWERN-**A.W.Diamond**; GPA/NPA & GOM\GPA-**J.Arbour**

THURSDAY, November 13

Session Chairman: H.O'Neill, Chairman, Maritime Atlantic Ecozone Steering Committee

09:00 The Greater Fundy Ecosystem EMAN Site (**D.Clay**)

09:30 Kouchibouguac National Park EMAN Site (**E.Tremblay**)

10:00 Kejimkujik EMAN Site (**C.Drysdale**)

10:30 Break/Poster viewing

11:00 Terramon EMAN Site (**T.Clair**)

11:30 Terra Nova EMAN Site (**H.O'Neill**)

12:00 Mapping habitats of "important" species in the Quoddy Region (**M.D.B.Burt, C.Bird, G.Chmura, A.W.Diamond, J.Fegley, W.E.Hogans, K.Mawhinney, J.McLachlan, L.Murieson, G.Pohle, W.B.Scott, R.Vadas, and L.VanGuelpen**)

12:30 Lunch break/Poster viewing

13:30 Water classification: A tool for managing estuaries (**J.Tims**)

13:50 Designing marine protected areas: Moving from theory to practice (**I.Milewski**)

14:10 Building a Marine Protected Areas Network in the Gulf of Maine: An ecosystem approach to management (**S.Brody and D.Fenton**)

14:30 National Biodiversity Information Initiative (NBII) - Canada (**L.Speers**)

14:50 Break/Poster viewing

15:20 Guest Speaker: **Dr Tom Brydges**, Director EMAN, Environment Canada.

"Monitoring Challenges for the next millenium"

17:00 Happy Hour and Pre-prandial nibbles (Anderson House, no-host bar)

18:00 Banquet (**Anderson House**)

FRIDAY, November 14

Session Co-Chairmen: **G.Daborn,** Director, A.C.E.R., Acadia University and **P.G.Wells,** B.O.F.E.P., & Environment Canada.

09:00 Introduction to the Fundy Marine Ecosytem Science Project (**G.Daborn and P.G.Wells**)

09:30 Storm surge events in the Maritimes with special emphasis on the Bay of Fundy (**G.S.Parks, L.A.Ketch, and C.T.O'Reilly**)

09:50 Modelling tidal flows in Passamaquoddy Bay (**D.Greenberg, J.Shore, and S.Yingshuo**)

10:10 Changes in SPM concentration and composition over a tidal cycle in the lower Bay of Fundy (**K.Muschenheim**)

10:30 Distribution of scallop larvae in relation to the hydrography of the Bay of Fundy (**S.Robinson, A.Thomas, J.Martin, and F.Page**)

10:50 Break/Poster viewing

11:10 Field techniques for studying spatial pattern and scale in nearshore benthic communities (**R.Rangeley and P.Lawton**)

11:30 Benthic communities in the lower Bay of Fundy: linking traditional systematics with habitat ecology (**S.Fuller**)

11:50 Influence of ice cover and sediment temperature on intertidal benthic invertebrates on the Windsor mudflat, Minas Basin, Bay of Fundy (**V.A.Partridge**)

12:10 Lobster ecology in the Bay of Fundy (**L.Incze**)

12:30 Lunch break/Poster viewing

13:30 Seaweeds: a coastal component to integrate into the ecosystem research approach and the sustainable development of the Bay of Fundy (**T.Chopin**)

13:50 Seabird surveys in the Bay of Fundy: findings from the monthly ferry transects Saint John-Digby-Saint John (**F.Huettman**)

14:10 The migration of sandpipers in the Bay of Fundy: the El Nino effect? (**P.Hicklin**)

14:30 Community consequences of habitat use and prtedation by common eiders in the intertidal zone of Passamaquoddy Bay (**D.Hamilton**)

14:50 Acoustic harassment device (AHD) use in the aquaculture industry; implications for harbour porpoises (*Phocoena phocoena*) (**D.W.Johnston**)

15:10 Break/Poster viewing

Session Chairman: **J.Percy**, Director, Clean Annapolis River Project

15:40 The marine foodweb in Saint John Harbour in relation to the accumulation and movement of toxics (**S.Brillant**)

16:00 Metal transport in the Gulf of Maine and outer Bay of Fundy (**P.Yeats and J.Dalziel**)

16:20 Environmental chemistry and the Bay of Fundy (**V.Zitko**)

16:40 Petitcodiac River trial gate opening project: an overview (**H.O'Neill and H.Dupuis**)

17:00 The Bay of Fundy: Current project activities and management issues of the Federal Natural Resources Departments (**P.G.Wells**)

17:30 Happy Hour (Anderson House; no-host bar)

18:00 Dinner

19:00 Panel presentation/discussion: Fundy Region Organizations

Session Chairman: **J.Percy**, Director, Clean Annapolis River Project.

BOFEP-**G.Daborn**; GOMC-**L.Hildebrand**; RARGOM-**L.Incze**; BOFFC-**A.Bull**; 4NRs-**A.Bielack**; COA-**F.Scattolon**; NBCC-**D.Coon**; NBSGA-**W.Thompson**(?); FOP-(?); ACAPSJ-**S.Brillant**; EAC-**M.Butler.**

Saturday, November 15

The Bay of Fundy Virtual Institute -how to get there from here ?

Session Co-Chairmen: **G.Daborn,** ACER, Acadia University; **J.Percy,** CARP; and **P.G.Wells,** BOFEP, Environment Canada

09:00 Introduction to BOFEP and Session Goals

09:30 Vision statement; principles; objectives; organization

10:30 Break

10:45 Organization continued; priorities; next steps; funding; working groups.

12:30 Science Workshop Closes

Appendix II

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Appendix III

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