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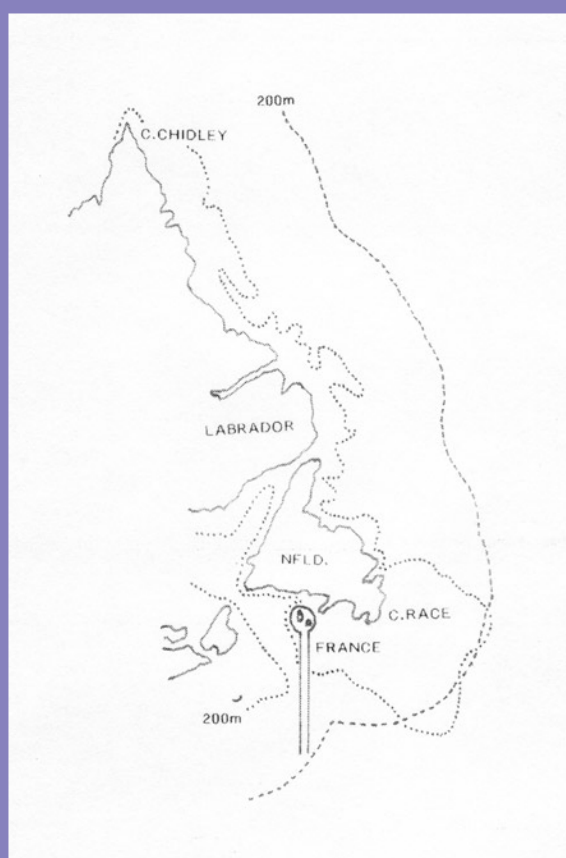

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THE NATURAL HISTORY SOCIETY OF NEWFOUNDLAND AND LABRADOR

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All members are encouraged to contribute articles and materials in accordance with the society's mandate for publication in "The Osprey"

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Cover Artwork: Map of the area described in this special edition of the Osprey.

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Proceedings of the Canadian Parks and Wilderness Society-Newfoundland and Labrador Section Marine Areas Workshop

Tuesday, April 25, 2006

D.H. Steele, Editor
Professor Emeritus, Memorial University of Newfoundland
Vice president, Canadian Parks and Wilderness Societ
Newfoundland and Labrador Chapter

Sponsored by:
Newfoundland and Labrador Legacy Nature Trust
Protected Areas Association of Newfound land and Labrador
Natural History Society of Newfoundland and Labrador

PREFACE

With the establishment of a Newfoundland and Labrador Chapter of the Canadian Parks and Wilderness Society (CPAWS-NL) it was decided to focus on 1) the establishment of Marine protected Areas (MPAs), 2) promoting the adoption by the Provincial Government of the Natural Areas System Plan.

For the first goal, the Marine Committee of CPAWS-NL convened a Workshop on MPAs in April 2006. The intent was to consider the occurrence and distribution of marine ecoregions in Newfoundland waters, the relevance of MPAs to different groups of marine organisms and to compile a preliminary list of areas that might be nominated as MPAs.

The establishment of MPAs has one or more of the following objectives:

1) to protect representatives of the marine ecosystems (biocoenoses) found from the coastline out to and including the continental slope. This will conserve biological and genetic diversity.

2) to protect sites of special concern, such as a unique habitat or the habitat of an endangered or rare species.

3) to provide a refuge from exploitation that will assist in the rational and beneficial management of exploited marine resources.

4) to provide a control site against which the effects of the manipulation of marine resources can be assessed.

5) to be available for educational purposes, such as field trips and field courses.

Only Extended Abstracts of the presentations are presented here, so as not to preclude publication elsewhere. More detailed information may be obtained from the individual authors.

We were very pleased to welcome Dr. Jon Lien as a participant in the workshop, since he was largely responsible for the establishment of the Newfoundland and Labrador Chapter of CPAWs and has a great interest in establishing MPAs.

Overview of Marine Protected Areas with Special Reference to Newfoundland and Labrador

D.H. Steele
Professor Emeritus
Memorial University of Newfoundland
dsteele@mun.ca

Ít must be considered that there is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things, for the reformer has enemies in all those who profit by the order, and only lukewarm defenders in all those who would profit by the new ones this lukewarmness arising partly from the incredulity of mankind who do not believe in anything new until they have had actual experience of it.'(Machiavelli 1525)

Reforms in our way of thinking are necessary if there is any hope of success in establishing Marine Protected Areas.

Following the Second World War and especially in the past twenty five years it has become painfully obvious that marine resources are not inexhaustible and that governments and International Commissions have been unable to prevent the overexploitation of such resources, with the result that many stocks have become commercially extinct. In addition, it has been realized that the increased runoff into the oceans of pollutants from agriculture, deforestation, industry and domestic wastes associated with the growth of the human population is having adverse effects on marine ecosystems. Thus attention has turned increasingly to Marine Protected Areas as a way to mitigate these adverse effects and as a tool in resource management.

However, the use of Marine Protected Areas has been bedeviled for a number of reasons, so that progress in their implementation in Canada has been very slow. It is not possible to extend what is known about terrestrial protected areas into the seas since marine habitats are poorly known, are huge (4/5 of the earth's surface is marine), are three dimensional and are inhabited by organisms that range in size from the ultramicroscopic to the largest that have ever lived. Moreover, marine resources have always been considered a common resource available to whomever could exploit them. Establishment of Marine Protected Areas is then seen as an attempt 'to fence the ocean' and is resisted vigorously. Probably the greatest problem is that different types of Marine Protected Areas are confused.

The two main types of Marine Protected Areas[1] are:

1) Marine Reserve (Marine Ecological Reserve, No-Take Reserve)

As these names imply, no exploitation of any kind is allowed, but studies can be undertaken to assess natural changes and as a bench mark for comparison with areas having exploitation. Sites could be small or as large as a National Marine Conservation Area (National Park) which is representative of a marine Ecoregion.

2) Fishery Reserve.

This is a reserve in which the exploitation of marine resources is specifically regulated. This could be due to conflict between gear types, such as lobster traps and scallop drags, contamination of shellfish by pollution or red tides, spawning sites, unique habitats, such as deep sea corals, or the habitat of endangered or rare species

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[1] Over 50 categories of Marine Protected Areas have been proposed in different jurisdictions by extrapolating from terrestrial habitats, but this level of detail is unnecessary and confusing for marine habitats at the present time.

Wildlife

Although the aboriginal populations of eastern North America exploited marine populations extensively, there is no evidence of overexploitation, except possibly for the coastal Gray Whale and Sea Mink. Western Europeans when they arrived with their superior technology in the 15^{th} century had a devastating effect. Thus, by the 19^{th} century seabirds, except for cormorants and burrow nesting petrels had been 'eaten off' the coast of New England and the Maritimes and the large population of Walrus in the Gulf of St. Lawrence had become extinct.

By the time Audubon began his monumental work on North American birds the Great Auk and the Labrador Duck were almost extinct and he never saw live specimens of either. His famous expedition to Quebec Labrador was dictated by his need for specimens of waterbirds which he could not obtain readily in New England

On his expedition in 1833, Audubon had encounters with commercial eggers of Common Murres at their colonies. He later wrote an emotional denunciation of their activities in the Episode he entitled 'The eggers of Labrador' and concluded 'their war of extermination cannot last many years more'. By 1887 Frazar concluded that the number of eggs laid was one in ten thousand to what were laid there twenty-five years ago'. The egging industry became unprofitable by the end of the nineteenth century, but fishermen continued to collect eggs when not fishing.

Calls for the establishment of seabird sanctuaries along the Quebec Labrador coast were made by Lt. Col. Wood in 1911 and by Charles Townsend in 1918. The Rochers aux Oiseaux (Bird Rocks of the Magdalen Island) and Ile Bonaventure et du Rocher Perce (Bonaventure Island and Perce Rock off the coast of Gaspe) became federal sanctuaries in 1919 and a series of ten seabird sanctuaries along the coast of Quebec Labrador were finally established in 1925. These sanctuaries are now managed by Environment Canada as Federal Protected Areas for Wildlife. It is noteworthy that Newfoundland and Labrador does not have a single National Wildlife Area and only three National Migratory Bird Sanctuaries (Newman Sound in Terra Nova National Park and two small islands). However, the Provincial Government designated a number of seabird colonies as Sanctuaries in 1964 and Section 8 (Newfoundland and Labrador) of the International Biological Programme – Conservation of Terrestrial Areas nominated eight of the main seabird colonies as Provincial Ecological Reserves and some were given recognition as Provincial Ecological Reserves in 1967. In addition the Grand Codroy Estuary has been designated as a Wetland of International Importance.

Bird Life International, a non-governmental organization dedicated to the conservation of the world's birds partnered with Nature Canada and Bird Studies Canada to nominate a network of sites (Important Bird Areas) that would "conserve the natural diversity of Canadian bird species". The Natural History Society of Newfoundland and Labrador undertook to nominate Marine Bird Sites and a total of 29 were listed in 2001. Unless designated as Provincial Ecological Reserves, none of these sites have received special protection as yet.

Strictly speaking none of these Federal or Provincial sanctuaries while they may regulate hunting and fishing offshore, constitute Marine Protected Areas since only the terrestrial habitat of the sites are protected and none of the marine habitat.

Heritage Canada (Parks Canada)

Terrestrial National Parks which are essentially No-Take Reserves have been established in Canada for well over 100 years, but the policy for the designation of Marine National Parks was not adopted until 1986. Recognizing that large No-Take Reserves equivalent to National Parks could not be established in the oceans, their name has been changed to National Marine Conservation Areas in which other uses will be permitted.

Canadian oceans and the Great Lakes have been divided into 29 regions (4 off Newfoundland and Labrador) with the goal of having at least one representative Marine Protected Area in each. However, the regions are two dimensional and take no account of the depth of the oceans, or the hydrodynamics of the water. Moreover the boundaries of the regions have changed so that now they seem more related to political considerations than science.

Several areas off the coasts of Newfoundland and Labrador were suggested for protection, even before 1986, but none have even been recognized as Areas Of Interest, as yet.

Fisheries

The proclamation of the Oceans Act in 1997 made the Minister of Fisheries and Oceans the lead authority for Oceans, including Marine Protected Areas ands thus established a third federal program for Marine Protected Areas. Regulating fisheries had been done for some time. Acting under the Fisheries Act, 150 areas off the coast of Newfoundland and Labrador had already been given some measure of protection by regulating their fisheries (Anderson et al 2000). These included; 28 Fisheries Conservation Closed Areas, mostly pertaining to Atlantic Salmon and Lobsters; 23 Fisheries Management Closed Areas, of which 20 regulated gear conflicts; and 98 Contaminated Fisheries Closed Areas, in which the harvesting of shellfish was banned because of pollution.

The proclamation of the Oceans Act in 1997 made the Minister of Fisheries and Oceans the lead authority for Oceans and responsible for managing Canadian waters. Included for the first time were Marine Protected Areas. These are defined as: An area of the seas that forms part of the internal waters of Canada, the territorial seas of Canada or the exclusive economic zone of Canada and has been designated under this section (35.(1)) for special protection.

The establishment of MPAs by the Department of Fisheries and Oceans will have a number of goals including the conservation of commercial and non-commercial fisheries resources, the formation of a network of unique MPAs that will reflect the diversity of the oceans. They will follow the ecosystem principle, i.e. they will not focus on a single species but will consider an entire ecosystem. Areas selected should be either Ecologically and Biologically Significant or Representative of a region. It is also recognized that with three federal departments involved with MPA's those established by Fisheries and Oceans should complement those of Heritage Canada and Environment Canada and a Steering Committee has been formed to integrate the process.

Progress in Newfoundland and Labrador has been very slow with only one MPA, (Newman Sound) recognized in the world compilation of 1995. Since then Gilbert Bay in southern Labrador with a resident population of Atlantic Cod and the Eastport Lobster Management Area were selected as Areas Of Interest in 2000 and designated as Marine Protected Areas in 2005. Both of these are small Fisheries Reserves. The significance of Gilbert Bay is its unique resident population of Atlantic Cod, but the exploitation of other resources is still allowed. The Eastport Lobster Management Area consists of areas around two small islands (Round and Duck) in which no fishing is allowed so that the lobsters and the ecosystem of which they are a part, are protected from exploitation. In 2001 the habitat around Leading Tickles was also designated as an Area Of Interest

It seems evident that the slow progress in establishing Marine Protected Areas in Newfoundland and Labrador is due to the confusion of stakeholders (fishers, shippers, mining and oil companies)as to what a Marine Protected Area is, and to the complicated bureaucracy of the three federal departments and the province that deal with Marine Protected Areas. To this must be added the interests of non government organizations including Nature Canada, Canadian Parks and Wilderness Society, World Wildlife Fund, and the Protected Areas Association of Newfoundland and Labrador.

Integration of activities and reform in thinking by education will be necessary if more MPAs are to be established in the near future.

Historical Review of Marine Biogeographic Regions of Newfoundland and Labrador Waters

D.H. Steele
Professor Emeritus
Memorial University of Newfoundland
dsteele@mun.ca

Compared to Terrestrial or Freshwater Biogeography, Marine Biogeography is difficult and complex. The oceans are continuous, huge in size and hostile to humans. The study of their faunas requires good systematics, so that the species can be identified, technology so they can be collected and their environmental conditions measured, and the history of the species understood. Sea water is dense, so organisms can be suspended and drift with movement of the water as plankton. Relatively few species are permanent residents (holoplankton), but there are large numbers which are the eggs and larvae of bottom dwelling adults and are temporarily planktonic (meroplankton). Plankton drift with currents , sometimes into regions where the adults may be able to survive, but be unable to reproduce. As such, they may serve as indicators of the origin of water masses, and are useful in oceanography, but are useless for delimiting biogeographic regions. Sea water can also support large organisms(nekton) that can move against currents. The larger they are, the better they can swim, so large fish such as tuna, sharks, or whales can traverse whole oceans. Such species are also largely useless to delimit regions in the oceans, whereas the goal should be to relate the organisms to defined regions.

The density of sea water is not fixed. Dilution with freshwater runoff and the melting of sea ice which has lost salt as it aged, reduces its density so that coastal water floats on top of saltier oceanic water. On the other hand, sea water becomes denser with a decrease in temperature and tends to sink as it loses heat. It is the interaction of salinity and temperature that determines its density. Seawaters of different densities do not mix readily, as can be seen off the mouth of a river where the river water can be clearly seen as a distinct surface layer extending out to sea. In the summer, a thin layer of warm water often caps cold water in coastal areas, but the temperature at the surface can drop precipitously if the warm layer is blown offshore and the cold deepwater is exposed. Strong tides such as are found in the St. Lawrence estuary or the Bay of Fundy force mixing and produce low surface water temperatures.

The significance of these differences in density is that the ocean is three dimensional and the environmental conditions, including in particular temperature can vary markedly with a slight change in depth. Differences that might occur in a thousand miles on land can be found with a few meters difference in depth in the ocean.

As a result, the determination of marine biogeographic regions can be difficult especially in the northwestern Atlantic where the hydrography is complex compared to other regions, such as the northeastern Atlantic.

It is further complicated by the fact that many different names have been applied to the regions and they have sometimes been confused with Provinces. Provinces are distinguished by the presence of endemic species and the focus then becomes the history of the species as Historical Marine Biogeography.

Marine Biogeography

Biogeography has a relatively recent history. Linnaeus in the tenth edition of his *Systema Naturae* published in 1758 listed only 440 animals and few of these were marine. Today we recognize that there are probably several million marine species and the original Linnaean species may consist of up to100 modern taxa, something that continues to bedevil biogeographers.

Marine species have been described continuously since 1758 and at an increasing rate when the use of trawls and dredges became popular at the end of the eighteenth century. Nationalist compilations of species soon followed, but except for Greenland, there wasn't much activity in North American waters, although expeditions in search of the Northwest Passage or an ice free polar sea, collected specimens and thus we have Sabine's Gull and Ross's Gull, as well as marine genera, such as *Rossia* and *Sabinea*.

Although ocean currents were well known to seafarers, the information was not readily available. Benjamin Franklin, as U.S.Postmaster General, became aware of how much longer it took to cross the Atlantic Ocean from east to west than it did to go from west to east when ships sailed the most direct route. Ever the practical man, he took the knowledge of whalers who chased sperm whales and knew about currents, to draw and publish the first accurate map of the Gulf Stream in 1770. Although simplified, it is similar to what we would draw today, and it is noteworthy that it is shown far south of Newfoundland and there is much space for cold currents near the land. He also advised that to determine if a ship is in the Gulf Stream, it should measure the water temperature. Subsequently Mathew Fontane Maury, in his book entitled the Physical Geography of the Sea (1848) included a map of the currents of the whole North Atlantic and included the surface temperatures as well.

Milne Edwards described biogeographic zones in the sea as early as 1838 and this was followed shortly by attempts to map their distribution. William Henry Dana the naturalist on the U.S.Exploring Expediton of 1838-1842 described zones based on the average of the coldest water temperatures in 1852, but they received little attention. Almost simultaneously Edward Forbes summarized his conclusions of the biogeographic regions based on summer water temperatures in 1856 and in a book which he didn't live to complete in 1859. Similar zones wee described for the mollusks by Woodward in 1868.

Based on his observation of the decrease in number of species and numbers with depth, Forbes had concluded erroneously that at depths greater than 300 fathoms, there would be no life. This conclusion had already been disproven by John Ross in the Canadian Arctic, but this disregarded and Forbe's idea gained currency. When live animals were obtained from the bottom in deep water, entangled in transatlantic cables, and strange animals such as stalked crinoids, were collected living at great depths off Norway, the idea of an azoic deep sea was abandoned. Great interest developed in dredging in deep water, first near Scotland where the Wyville Thompson Ridge was discovered, and later around the world on the three year Challenger Expedition.

In the northwestern Atlantic collections were made by Dawson and Whiteaves in the Gulf of St. Lawrence, by Packard off Labrador and on the offshore banks by the U.S.Fish Commission in the latter part of the nineteenth century. This drew attention to the warm water fauna including oysters that were found in the shallow water at the Magdalen Islands and Prince Edward Island, but were not found again until south of Cape Cod. This warm water fauna and its distribution were discussed by Ganong in 1890.

The Canadian Fisheries Expedition of 1914-16 did no dredging but its study of hydrography drew attention to the occurrence of cold water in the Gulf of St. Lawrence and questioned its origin. Captain Bayfield who surveyed the Gulf in the 1830s thought it came through the Strait of Belle Isle and suggested that the Strait should be dammed, since it is only nine miles across at it narrowest point. The Belle Isle Strait Expedition did confirm that cold water enters the Gulf of the north side and warmer water exits on the south. However, tides are important and the flows are not continuous and winter cooling is now considered the source of the cold intermediate layer found both in the Gulf and off the east coast of Newfoundland and Labrador. The sinking of the Titanic focused attention on the source and drift of icebergs off the east coast of Newfoundland and confirmed the presence of the cold Labrador Current flowing south along the east coast to the Grand Bank. Inside the Labrador Current the coastal water circles the island in a clockwise direction and is warmed in the summer as it flows. Below the Cold Intermediate Layer if the depths are great enough, lies the so-called Slope Water which is more saline and somewhat warmer than the layers above it.

Thus the waters around Newfoundland and Labrador are complex and vary more with depth than with location. This is quite different from the northeastern Atlantic. The surface layer (Coastal Water) of relatively low salinity becomes cold in the winter months, but can be warm by late summer when it is visited southern species. In shallow water it will extend to the bottom as it does along the coast, and offshore at Sable island, and the Southeast Shoal of the Grand Bank. The Intermediate Layer remains cold throughout the year and has a fauna with northern affinities. In the Gulf of St. Lawrence and off the east coast of Newfoundland, where it is deep enough and there are no barriers, the saltier and warmer Slope Water is found over a bottom predominantly of mud (below the 'mud line') with species of oceanic affinities.

The general pattern of biogeographic regions having been recognized as consisting of Arctic, Boreal and Temperate regions, with the equivalent Arctic, Acadian and Virginian Provinces. Much of the attention has since focused on their distribution sand on the occurrence and validity of a Subarctic (Low Arctic) Transition Region or Syrtensian Province at shallow depths. It has been difficult to characterize since it is transitional and different species reach their limits at different locations and there are no sudden changes in species composition of the fauna.

Since different hydrographic regimes and biological communities separated by depth are regularly found at one geographic location it is impossible and futile to describe their distribution by a single line. Each should be considered separately, by depth. Since there are only gradual changes in hydrography and species occurrences it can be concluded that all of the coastal inshore waters of Labrador and Newfoundland comprise part of the Subarctic Transition, as does the offshore Cold Intermediate layer, even though the latter remains cold throughout the year and contains more species with Arctic affinities. The only exception would be the southeast shoal of the Grand Bank which could be considered an outlier of the Boreal Region with a number of warm water species. Deep areas with Slope Water need to be considered separately. Those areas (fjord) separated from the ocean by a sill must be considered separately. The same applies to meromictic lakes which have salt water and marine species on the bottom.

Sharing Canada's Experiences in Developing a Classification for Representative Network Planning

J.Smith
World Wildlife Fund – Canada
Atlantic Office

The presentation described the methods used for classifying marine habitat, the maps created for incorporating representation into the design of the Network of priority Areas for Conservation and some lessons learned in the process.

Conservation Goals

The classification was developed as an element of a larger project, a science-and mapping-based "proof-of-concept" that the data and the techniques exist to create a systematic plan for a network of MPAs throughout the Scotian Shelf, Gulf of Maine and Georges Bank and a contribution to the discussion of identifying "Priority Areas for Conservation". The goal was to demonstrate the design of networks that protect not only distinctive, unique and outstanding 'hotspots', but also the full range of biodiversity of the region by incorporating *representation* as a site selection criterion. Representation is a well-accepted strategy for designing an effective network of protected areas. The approach identifies and protects a sampling of each of the main biological communities or habitat types that make up the planning region, rather than focusing solely on individual species or unique habitats.

Approach

Our classification system and maps grew out of an approach advanced by Day and Roff (2000) that is based on the observation that physical habitat types can be used to partially predict distribution of biological communities and species. In this approach, physical habitat types were characterized based on a suite of relatively enduring and recurrent characteristics that are themselves known to influence the distributions of biological communities and species. The resulting classification described the "seascapes"of this region.

Methods

The seascapes classification system characterized physical habitats and distinguished between the pelagic (water column from the nearshore boundary to the open ocean offshore) and benthic (seafloor) realms. In this classification, each pelagic and benthic seascape is defined by a unique combination of characteristics: surface temperature-salinity zone, depth class and degree of stratification within the pelagic realm, and the bottom temperature-salinity zone, depth class and substrate type in the benthic realm. The range of values of each characteristic was split into ecologically meaningful classes appropriate for the region, as defined through a review of the literature and an analysis of the data. These values were mapped, creating a separate layer representing each characteristic. Finally these layers were combined to create the seascape maps for the benthic and pelagic realms.

Lessons learned

Feedback received through peer reviews confirmed that the approach of utilizing physical characteristics is a sound one in this region, where knowledge of biological distributions is incomplete, but that the ideal next step would be to validate with or incorporate biological data. We encountered challenges in dealing with data structure (e.g. "slivers", differing resolution and precision) that were compounded when the seascape product was brought into a site selection programme, and would suggest careful attention to this in other projects. Some feedback from experts indicated that the results of the strict data-driven overlay didn't intuitively reflect their knowledge of the region, even when component layers were well-verified. This kind of response may impede acceptance and uptake of a classification, and may speak to the value of a hybrid approach that blends data and expert knowledge. Perhaps most importantly, our exploration of these data revealed that a wealth of information exists in this region and that perceived information gaps should not hold us back from taking precautionary conservation action.

Climate and Weather Impacts on Coastal Systems, NL

N. Catto
Department of Geography
Memorial University of Newfoundland
ncatto@mun.ca

All organisms resident in coastal areas of Newfoundland and Labrador, including human, are influenced by weather and climatic impacts on their environments. Cyclic patterns of natural climate change and variation are evident over the last 2000 years, and human-induced modifications of the climate have been imposed on the natural cycles.. Individual weather events and regional decadal variations, notably the North Atlantic Oscillation, are significant over short terms, and locally dominate over longer-term trends. Single extreme events must be seen in context of patterns of variation or change. Although any single event in isolation cannot be assumed to indicate fundamental change in climate, sequential events can be used to recognize patterns. The impacts of marine climate changes, including storm and wind activity, and greater inconsistency in ocean current strengths and temperatures, are more important than atmospheric warming.

Climate influences on both human and natural communities have been superimposed on other political, socio-economic, and technological factors. This is particularly evident for coastal communities in Newfoundland and Labrador. The role of climate change on fisheries, fish harvester, and fishing communities has varied throughout the northwest North Atlantic, both by place and over time, from that of "supporting player" to mere "background noise". Only in collapse of fish stocks due to purely ecological causes could climate change be considered as the "driving force".

Impacts resulting from climate change happen, regardless of the cause of the changes. My research focuses on effects and impacts: determining the proportion of 'natural' vs. 'human climate change is not as important as coping with rising sea level, increased coastal erosion, increased frost heave and debris flow activity, increased flooding, or changes in water supply. Changes are being identified and measured right now, and as the climate changes, adaptations are necessary. Many adaptations are already ongoing, and a combination of information, communication dissemination, and planning involving all members of our communities will result in successful adaptation to future climate change.

Climate variations in conjunction with rising sea level, have resulted in increased coastal erosion and narrowing of beaches, coarsening of beach sediments, and increased degradation of coastal dunes. Capelin (*Mallotus villotus*) is one of the most important species, ecologically and economically, spawning on nearshore and beach zones. The beaches used by capelin are marked by wave-dominated, exposed moderate-energy profiles and granule shore lines. Spawning capelin tend to concentrate on well-sorted fine to medium pebble zones, areas of the beaches with gently concave or planar profiles and seaward-imbricated pebbles.

Higher capelin egg density is associated with beaches aligned towards maximum fetch. Minimal fetch beaches have lower modal energy conditions, are susceptible to terrestrial sediment input, and are less likely to develop gently concave profiles dominated by well-sorted medium and fine pebbles. Beaches marked by modally moderate energy and wave-dominated conditions are more suitable than those with modally higher energies and coarser gravel.

Development of these beaches is greatly influenced by storm activity, which steepens beach fronts. Debris transported to the beach derived from terrestrial sources and preferential removal of granules and fine pebble by storm erosion results in a coarser substrate, producing less favorable conditions for capelin spawning. Increased hurricane frequency and severity would result in decreased spawning suitability. If spawning is delayed until the start of hurricane activity, the net result could be a loss of productivity due to modification of beach habitat.

Winter sea ice cover and ice foot development both appear to assist preservation of suitable areas for spawning. In milder winters, when sea ice and ice foot protection is reduced or eliminated, winter storms rework spawning beaches, resulting in coarser, steeper profiles that are less suitable as spawning areas. Years with prolonged sea ice cover that also were marked by effective beach reworking by hurricanes produce conditions less suitable for capelin spawning. Conversely, years with minimal sea ice cover and minimal hurricane activity would produce suitable spawning conditions for capelin.

It is important to recognize that the same suite of weather conditions can produce differing results in adjacent but distinct coastal areas. The adjacent sand-dominated beaches at Golden Bay and Point Lance, on the southern Avalon Peninsula, provide an example. At Golden Bay, where sand contents have varied from>80% to<60% between 1980 and 2005, sand is swept offshore during backwash from storm surges, subsequently returning to the beach. The primary factors controlling textural variation are the amount of snow and ice cover on the beach, and waves driven by southwesterly winds. Golden Bay differs to some extent from more exposed gravel-dominated beaches in its response to variations in snow and ice cover, due to the lower energy level of this system, the source of the sand, and the aspect of te beach with respect to hurricane activity.

Sand is supplied to Golden Bay from Point Lance, located to the west. Consequently, years when ice-foot development occurred on Point lance beach resulted in reduced sand supply to golden Bay. The development of an ice foot at Golden Bay prevented reworking of the underlying material, and collected frost-wedged material from the flanking sandy siltstone cliff, predominantly pebbles. During the subsequent summers, reworking by waves driven by southwesterly winds resulted in preferential removal of sand, increasing the gravel concentration of Golden Bay beach.

During years when ice influence and hurricane reworking were both minimal, Golden Bay beach became more sand dominated. The lack of snow and ice cover allowed removal of sand from Point Lance beach, and it subsequent transport west to Golden Bay beach. Frost wedging continued to contribute pebbles from the flanking siltstone cliff. However, the lack of snow cover allowed reworking through the winter, resulting in erosion of the clasts and increased sand content.

Between 2002 and 2005, a combination of limited snow and ice cover and several strong southwesterly wind events resulted in general coarsening of both golden Bay and Point Lance beaches. Sand was exposed on Point Lance beach, but southwesterly wind events resulted in transfer of the sand eastward (away from Golden Bay). Summer reworking further coarsened Point Lance beach. The supply of frost-wedged pebbles continued, forming laterally distinctive textural zones. The lack of snow cover in January-February 2006 allowed storm reworking and increased the extent of pebble cover on Point Lance beach, in addition to triggering several slumps around the cove. Under these circumstances, Golden Bay beach will become coarser.

The variations in response at Golden Bay, and the differences in behavior between this beach and others exposed to similar environmental stresses, indicate that the impacts to climate change and variation will vary locally. Detailed examination of individual sites is necessary to anticipate specific impacts.

Study of beach systems and their response to weather events throughout Newfoundland and Labrador has revealed differences in morphology, sedimentology, energy regime, and sediment transport. These characteristics change the fate and effect of petroleum contamination on each beach. Beaches can be ranked on their sensitivity to oil pollution based on their physical characteristics. The movement of sediment, litter, and seaweed in the nearshore and beach environments provides analogies for how oil will behave. Lower energy beaches will not self-clean as well as the high energy, steeper sloping beaches, and are thus more sensitive to pollution.

Seaweed Biodiversity and Abundance as Indicators of Marine Areas of Newfoundland and Labrador

R. Hooper
Dept. of Biology
Memorial University of Newfoundland

Species Richness

The seaweed flora of Newfoundland and Labrador includes northern (Arctic) and southern (Boreal to Temperate) components. Many species reach their southern or northern distributional limits in Newfoundland. The highest biodiversity occurs in region with the maximum representation from both groups. The highest species richness has been found in Bonne Bay, western Placentia Bay, the north shore of Fortune Bay and the Goblin Deep area of outer Bay dÉspoir. Lowest species richness occurs on the easternmost Avalon Peninsula and Conception Bay. The highest diversity is associated with the highest tidal ranges, clear water, deepwater upwelling of nutrients, dependable temperatures and refuge from ice scour. The lack of excessive herbivore populations can also be important.

Biological Regions

Similarity analysis divides Newfoundland into three general areas-the West Coast, the South Coast and the Northeast Coast. Approximate boundaries are mid Placentia Bay, Port aux Basques and Cape Bauld. The most important physical parameters are lack of sea ice differentiating the South coast from the others and seasonal temperature regimes differentiating the West and Northeast regions. Labrador is clearly very distinct with a totally Arctic flora. The Strait of Belle Isle is a major biogeographic boundary, in a world-wide context.

Endemic and Rare Species

Endemism is extremely low in Newfoundland. *Phaeosiphoniella cryophila* is known only from south Coast sites from Placentia Bay to Bay dÉspoir. Another undescribed brown seaweed is known only from the Blanc Sablon, L'Anse au Clair section of the northern shore of the Strait of Belle Isle. More undescribed species have been observed in Labrador. These endemic species are possibly relicts.

Special Areas

In addition to biodiversity hotspots, several localized sites are intriguing. Disjunct population of warm water species inhabit sites such as Alexander Bay in Terra Nova National Park and several other isolated sites in Bonavista Bay and Notre Dame Bay. Analogous Arctic disjunctions occur in Fortune Bay and Bay dÉspoir. Gadds Point, Bonne Bay has both Arctic and Temperate disjunct. The former occur below summer thermoclines, while the latter are above. Seagrass beds at Lomond River, Flat Bay and St. Paul's are also important for their diversity and productivity.

Seaweed Biodiversity and Climatic Change

Seaweeds mostly have limited capability for long-distance dispersal as spores do not live long enough to travel far. A few species float or grow epiphytically on floating material. Ice sometimes carries rocks covered with seaweeds. Warmer seawater temperatures are likely to extirpate our Arctic species from Newfoundland making Labrador the new southern boundary. Introduction of new native species will be slow because of their limited dispersal abilities. Invasive exotic species will became more of a problem because they spread more readily –frequently by fouling shellfish, boats and other anthropogenic structures.

Coralline algal (Rhodolith) habitats

Calcified red seaweeds cover extensive areas of seabed around Newfound land. They are important not only as seaweeds but as habitats. Over many centuries they have stabilized previously unstable seabeds and have become a living habitat for many invertebrates and fish, not to mention other seaweeds. In spite of their hardness, they are brittle and susceptible to dragger/dredge/trawling damage. Where this has occurred only muddy/gravel remains. This habitat has received little research attention or appreciation.

Animal/Seaweed Relations

Seaweed communities are usually associated with specific groups of fish and invertebrates and hence areas with special seaweeds also have analogous animal groups. Areas with 'southern seaweeds' are also inhabited by disjunct populations of animals such as the bivalve *Petricola* and the bryozoan *Bowerbankia*. Arctic seaweeds are accompanied by the Arctic soft coral *Gersemia* and the chiton, *Amicula vestita.*

Larval Dispersal and Marine Protected Areas: Complex Solutions for Complex Problems

P. Snelgrove

Canada Research Chair in Boreal & Cold ocean Systems

Ocean Sciences Centre and Biology Department

Memorial University of Newfoundland

Over the last 100 years, many marine environments have undergone dramatic changes in fish stocks, habitat composition and a wide range of ecosystem functions. In response to these changes, there has been widespread interest in ecosystem-based management and the development of Marine Protected Areas. But given the complexity of natural ecosystems and our current level of scientific knowledge, we cannot actually manage ecosystems and must therefore rely on tools such as Marine Protected Areas (MPAs) that help to maintain ecosystem functioning. Most MPAs around the world have been designed around features (e.g. high biodiversity, unique species, large abundance of an endangered species) that have been treated as static, but the efficacy of MPAs hinges heavily on complex, dynamic attributes such as dispersal and source-sink dynamics. Based on my studies of larval fish and invertebrates I believe that dispersal in particular must be a primary consideration in MPA design, if they are to achieve many of the objectives typically used to justify the use of MPAs as a management tool.

Deep-sea Coral Distributions and Conservation Strategies in the Newfoundland and Labrador Region

E.N. Edinger and V.E. Wareham
Departments of Geography and Biology
Memorial University of Newfoundland

Deep-sea corals in Newfoundland and Labrador waters are broadly distributed along the continental slope. At least 23 species of corals are present, including skeletal gorgonians (spp.), antipatharians (2-spp.), sea pens (7-10spp.), scleractinian cup corals (4+spp.), and alcyonacean soft corals (3-4 spp.). Most coral species are found only on continental slopes at depths greater than 150m, except for the alcyonacean soft coral *Gersemia rubiformis*, which occurs at shelf depths. Cold water and lack of hard substrates probably limit most other corals from shelf depths. Areas of greatest deep-sea coral diversity are the southeastern Labrador slope (14 spp.) and the southwest Grand Banks (16spp.). Major concentrations of all types of corals occur in the Davis Strait-northern Labrador area, southeastern Labrador slope, the edge of the northeastern Newfoundland shelf, and the southwestern Grand Bank continental slope. Additional concentrations of soft corals, sea pens and cup corals occur on the north side of the Flemish Cap, but the Flemish Cap data is derived exclusively from fisheries observer data and may be effort-biased. Areas where information on coral distributions are lacking include the south side of the Flemish Cap, the margins of the Orphan Basin, and waters deeper than 1400 m throughout the region.

Seven deep-marine ecoregions based on deep-se corals can be qualitatively delineated: (1) Davis Strait-Cape Chidley, with abundant large gorgonian and small gorgonian corals; (2) central and southern Labrador slope, with a high diversity of all structural types of corals; (3) northeast Newfoundland shelf, dominated by soft corals, especially *Gersemia rubiformis*; (4) Flemish Cap, dominated by soft corals, cup corals, and sea pens; (5)southeast Grand Bank, dominated mostly by small gorgonians, sea pens and soft corals; (6) southwest Grand Bank with a high diversity of all structural types of corals, abundant large gorgonian corals, and the northwest Atlantic distributional limit of *Keratoisis ornata*; (7) the Laurentian Channel dominated by sea pens.

Because corals appear to be broadly distributed, a representative areas approach would be most appropriate for conserving deep-sea corals appropriate. Ideally, each ecoregion should be represented in a network of Marine Protected Areas. Protected areas in each ecoregion should be large enough to encompass a range of habitat types, and should aim to protect areas vulnerable to trawling or oil extraction. The area near Cape Chidley with abundant large skeletal gorgonians, especially P*rimnoa resedaeformis* and *Paragorgia arborea* demands immediate protection.

The use and value of Amphipods (Peracarida, Crustacea) in Delimiting Biogeographic Regions

D.H. Steele
Professor Emeritus
Memorial University of Newfoundland
dsteele@mun.ca

As discussed above, large nektonic organism, such as fish, and members of the benthos with pelagic eggs and larvae (meroplankton) are of limited value in delimiting ecoregions since they may occur far from where they are able to reproduce. This does not mean that such species should not be considered in establishing Marine Protected Areas, since in most cases it is these large species that are exploited and need protection.

Peracarid crustaceans (isopods, amphipods, tanaids and mysids) have a number of advantages in delimiting bigeographic regions. They are small in size and abundant and most importantly they possess a brood pouch in which the relatively few offspring are maintained until they are released as miniature adult. There are no larval stages with different environmental tolerances from the adults to drift with the currents. Reproduction must be possible where they are found.

Of the peracarids, the amphipods are most diverse with an estimated 4-500 species found in the Newfoundland regions out to the continental slope. Some are very numerous since they are well adapted to live at high latitudes and at low water temperature. They live at all depths and are associated with all types of bottom, including algae and other animals. Necrophagous species which feed on dead animals can be caught in large numbers in baited traps. They form an important part of the diet of fish and seals. The only major problem with their use is that they are difficult to identify, since the species described in the 18th and 19th centuries have often been found to consist of a large number of similar (sibling) species, so that any early records and those made by consulting companies have to be treated with caution.

With the exception of species derived from the North Pacific, northern (Arctic) amphipods have circumpolar distributions. With decreasing latitude the Atlantic fauna becomes more distinct from that of the Pacific and the northwestern Atlantic, including Newfoundland and Labrador becomes more distinct from the northeastern Atlantic. This is particularly true of the sand inhabiting fauna, in which a number of species are endemic to the east coast of north America, whereas those found on a rocky substrate are not endemic, but represent a subset of those found off Europe. This is probably related to the Pleistocene glaciations which must have obliterated the rocky fauna north of Cape Cod but allowed the fauna of sand substrates to persist south of Cape Cod.

A variety of amphipods are found on the sandy beaches of Newfoundland and Labrador. Some Arctic species reach their southern limit whereas southern species reach their northern limit. Dahl has discussed the world wide distribution and the zonation of sandy beaches. *Pseudolibrotus litoralis,* a lysianassid circumpolar necrophagous amphipod that Dahl considers to characterize the Arctic is found as far south as the north shore of the Strait of Belle Isle and then reappears in the estuary of the St. Lawrence River where tidal mixing results in low surface water temperatures. However, also found in the infralittoral fringe on the same Strait of Belle Isle beaches are beachhoppers (*Talorchestia spp.*) which Dahl considers as temperate species. Sand dwelling beach hoppers are found on the west coast of Newfoundland but are absent from the Arctic and the east and southeast coasts of Newfoundland. *Amphiporeia virginiana*, a southern species is found only as far north as Placentia Bay.

The Southeast Shoal of the Grand Bank with its shallow depth and warm summer temperatures is inhabited by a number of sublittoral species with disjunct distributions that have not been recorded from the coasts of Newfoundland but are common from Nova Scotia southwards.

There are also differences in the amphipod fauna related to depth. For example, in the genus *Anonyx* another group of necrophagous lysianassids, the circumpolar *Anonyx sarsi* is found in the sublittoral fringe and on the southeast Shoal of the Grand Bank, the circumpolar *Anonyx nugax* is found on the Grand Bank, the Continental Slope and the bottom of the Laurentian channel and with *Anonyx makarovi,* of Pacific origin in the cold intermediate layer.

Newfoundland and Labrador Seabird Needs in Relation To Marine Protected Areas

I. L. Jones
Department of Biology
Memorial University of Newfoundland
iljones@mun.ca

Seabirds are those birds that live at sea throughout the year, coming to land only to breed. As a result, seabird breeding areas are concentrated at a few sites while the marine range is very large for most species. Therefore seabirds have special needs in relation to Marine Protected Areas (MPAs). Due to their unusual demographic characteristics (long life and low fecundity), seabird populations are vulnerable to human activities that cause adult mortality, especially chronic oil pollution, gill nets, light attraction, invasive predators on breeding colonies and uncontrolled hunting and MPAs need to be designed to offer refuge from these threats.

The largest concentrations of breeding and wintering seabirds in North America occur in Newfounland and Labrador, further emphasizing the urgent needs for MPAs here. Nevertheless, three important seabird breeding colonies have no protected status, the Herring Islands (Razorbills), Wadham Islands, Newfoundland (Razorbills) and Middle Lawn island (Manx Shearwater).

The sea around all major breeding colonies is open to commercial fishing using gill nets. Increasing numbers of brightly lit structures at sea (oil platforms and infrastructure) are killing Leach's Storm Petrels and may pose a threat to endangered tropical petrels that occasionally visit our waters. Finally, inadequately monitored and regulated offshore oil developments are producing chronic oil pollution, killing thousand of sea birds. The most crucial habitat for our breeding and wintering seabirds lies along the shelf break south and east of the Grand Bank, an area increasingly affected by light and oil pollution from offshore oil and gas development.

To ensure continued viability of Newfoundland and Labrador seabird populations, MPAs are required that include the three additional colonies listed above and encompass 100 km radii around all major colonies the continental shelf break. Within these areas, fixed or drift gill nets, unshielded lights, flaring after sunset, oil dumping and capelin fishing should be prohibited.

Can we Define Critical Habitats for Highly Mobile and Cryptic Marine Animals?

J. Lawson
Marine Mammal Section
Dept. of Fisheries and Oceans
St. John's, NL

One component of the process to protect marine mammal assemblages in Canada is the definition and protection of habitat critical to their survival. While conservation of large ecosystems has received support, ecosystems" are difficult to" define and identify, which restricts their utility and public support. High mobility and an often patchy prey base make terrestrial models of critical habitat definition difficult to apply to marine mammals; it is useful to consider other models which incorporate spatial and temporal variation. For Blue Whales in the Gulf of St. Lawrence, high-density krill aggregations may be considered critical habitat-even when it drifts in currents. Particular types of sea ice are needed by ice breeding seal species, although they are a dynamic substrate. These examples serve to illustrate how care must be taken when characterizing a particular space, time, or resource as "critical" for marine mammals.

Unlike terrestrial ecosystems, the concept of habitat fragmentation has not received much attention in consideration of the protection of critical habitat for marine mammals. Additional travel between fragmented portion of preferred habitats may increase risk of predation, ship strikes, or incidental catches in fishing gear. Given that considerations of spatial and temporal scales of analyses have significant influence on habitat delineation for marine mammals, considerably more research must be done to provide data necessary to support critical habitat definitions. In the Newfoundland and Labrador region for marine mammal critical habitat include parts of the south coast (such as Placentia Bay), the areas north and west of Funk Island, the northern Strait of Belle Isle, parts of the Grand Bank shelf break and the northern Labrador offshore shelf area.

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http://www.mpa.gov **Marine Protected Areas of the United States**

APPENDIX

Sites nominated as Marine Protected Areas

Sand Substrate

Offshore

Southeast shoal of the Grand Bank

A submerged remnant of the coastal plain, like Sable island and similar shallows on Banquereau Bank. It is highly productive and shallow enough to project into the warm surface layer in the summer months. It is a nursery area for Yellowtail Flounder, a spawning site for capelin and was an important nursery for Haddock before they came commercially extinct. It is inhabited by a number of southern invertebrates that are not recorded from east of Sable Island.

Inshore

1. South Coast of Newfoundland
   Gooseberry Cove or Biscay Bay
2. Northeastern Coast of Newfoundland
   Northern Bay
3. Southern Labrador (North Shore of Strait of Belle Isle)
   Forteau
4. Central Labrador
   Cape Porcupine Strand
5. Western Newfoundland
   Sandy Point

Rocky Substrate

1. Ice Free south Coast
   West of Hermitage Bay (Nominated in 1978)
   La Poile Bay to Hare Bay (nominated in 2003)
2. Bar Haven, Placentia Bay
3. Laurentian Channel
   St. Pierre Bank to Laurentian Channel (Nominated in 1978)
   Much of this area has since been granted to France
4. Northeast Coast of Newfoundland
   Terra Nova National Park Extension
5. West Coast of Newfoundland
   Gros Morne National Park (Bonne Bay Fjord)
6. Labrador
   Hebron Fjord

Important Unique Sites

1 Tessiarsuk Lake, Labrador
   A meromictic lake with resident Atlantic Cod, Rock Cod and the Priapulid *Halicryptus spinulosus* (only North American site).

2. Port au Port Salt Marsh
   New England type of *Spartina* marsh with *Orchestia gryllus* and and probably *Fundulus*.

3. Alexander Bay in Terra Nova National Park
   Warm water disjuncts.

4. Gadds Point, Bonne Bay
   Warm water and cold water disjuncts at different depths.

5. Deep water near Cape Chidley, Labrador
   Diverse fauna of deep water corals.

6. Central SE Labrador Slope
   Deep Sea corals

7. Greenspond
   Unique race of Atlantic Salmon (has some protection)

Seabird Colonies

1. Middle Lawn Island
   Manx Shearwaters

2. Wadham Islands, Newfoundland
   Razorbills

3. Herring Islands, Labrador
   Razorbills

4. Bird Islands, Labrador
   Common Murres, Atlantic Puffins

In addition these, and the existing Provincial Seabird Ecological Reserves need MPAs in the surrounding seas.

The Tuck/Walters Award

This award is named in memory of Dr. Leslie M. Tuck and Captain Harry Walters

Dr. Les Tuck was Newfoundland's first Dominion Wildlife Officer, and Harry Walters was the Director of the Newfoundland Rangers Force. Following Confederation with Canada, Dr. Tuck headed the Canadian Wildlife Service in the province - a position he held for more than twenty-five years. In the latter part of his long and distinguished career, Dr. Tuck held the L. J. Paton Research Professorship in the Psychology Department of Memorial University. He was instrumental in the reactivation of the Natural History Society in the 1950's. **Captain Harry Walters** served for many years as the Head of the Newfoundland Wildlife Division, which he was instrumental in establishing.

Both Walters, working provincially, and Tuck, working federally, were instrumental in establishing our province's first seabird reserves (Funk Island, Cape St. Mary's, Witless Bay, and Hare Bay) and the former Avalon Wilderness Area. Their combined efforts put natural history awareness, protection and appreciation on a solid footing in Newfoundland and Labrador. Although they were employed in resource conservation and management careers, their enthusiasm and dedication transcended their duties, and it is for these qualities that the society has chosen to honor their memory with this award.

The Tuck/Walters Award is discretionary - it does not have to be given out every year. On the other hand, it may be given to more than one recipient if the Nominating Committee feels this is appropriate. **Successful candidates are individuals who have made outstanding and enduring contributions to the advancement of natural history appreciation and protection in Newfoundland and Labrador, outside the parameters of their employment responsibilities.**

Tuck/Walters Award Winners

Dr. Don Barton
George Brinson
Bill Davis
Dr. John Gibson
Dr. Leslie Harris
Stephen Herder
Charlie Horwood
Bernard Jackson
Henry Mann
Jon Lien
Gregory Mitchell
Michael Nolan
Dr. Harold Peters
Dr. Roger Tory Peterson
Tony Power
Dr. Don Steele
Clyde Tuck
Laura Jackson
Lois Bateman

For more information or to make a nomination for the Tuck/Walters Award, contact

Dr. Bill Montevecchi, Chair
Tuck/Walters Awards Committee
Cognitive and Behavioral Ecology Program
Memorial University of Newfoundland
St. John's, NL
A1B 3X9

Telephone: 737-7673

The Natural History Society of Newfoundland and Labrador
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My interests are: (Please be specific, to help us with our program planning.) birds? wildflowers? animals? marine mammals? indoor events? indoor work- shops? outdoor events? walking? interpretive walks? hiking? cross-country skiing? canoeing? cycling? back-pack camping? winter camping?
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I would like to save a tree and have my Osprey(publication of the NHS) sent to my email address
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Annual membership fee enclosed:	$ 25.00
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St. John's, NL A1C 5M3
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Bring this form to the next regular Society meeting at The Memorial University Botanical Garden on the THIRD THURSDAY of each month from September to June.
No meetings during July and August.

Rarities - Only from the Natural History Society

- **Getting to Know the Weeds** - the Collected Writings of Charlie Horwood. Charlie was a faithful and long-serving member of the Society. He was also a thoughtful and insightful naturalist with a gift for capturing his views of the natural world, in writing. This 160 page book reproduces over fifty of Charlie's best short pieces.

  Soft cover $14.95

- **Society Lapel Pins** - Back by popular demand. These four-color enamel pins reproduce the Society's "Osprey", originally designed by John Maunder, in blue, brown and white on a gold back: Oval.

Lapel Pins $3.00

- **Society Jacket Crest** - These crests are based on the original "half moon" design drawn by Newfoundland artist Reginald Shepherd. They feature a stylized osprey snatching a fish. They are embroidered in five colours, and are approximately 4" wide by 1 3/4" high.

Embroidered Crest $4.00

- **Society Memberships** - Any time is a great time to give a membership to the Natural History Society. The cost is $25.00 good for one year. It includes four issues of The Osprey, and notices to all Society functions.

Membership $25.00

The Wild Things Scholarship

The Natural History Society of Newfoundland and Labrador conducts the competition for the Wild Things Scholarship. This annual $500 scholarship is sponsored by Wild Things, a nature gift shop in St. John's, NL. It is awarded to a post-secondary student recognize their committment to the environment and natural history of the province as evidenced by their volunteer naturalist activities. Application forms can be found on our website: www.nhs.nf.ca

Past Recipients

Lynn Hartery	1992	Andrea Carew, Joel Heath	1999
Elaine Goudie	1993	Laura Wareham	2000
Helen Manning	1994	Alana Yorke	2001
Tammy Legge	1995	Diana Cardoso	2002
Michael Sharpe	1996	Juliana Coffey	2003
Craig Purchase	1997	Lesley Blake	2004
Susan Pottle	1998	Cheryl White	2006