# MARINE ECOLOGICAL CLASSIFICATION SYSTEM FOR CANADA

**Marine Environmental Quality Advisory Group**

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# 1 INTRODUCTION

The federal government, under the joint coordination of Environment Canada and Agriculture Canada, is currently undertaking an extensive review of the existing terrestrial ecological classification of Canada. A number of land classifications have been developed for Canada (Rowe, 1977; Ecoregions Working Group, 1989) and one that has received wide acceptance, particularly for the purpose of State of Environment Reporting, is that of Wiken (1986). The subdivisions described by Wiken are being reviewed and updated in consultation with the Provinces and Territories. This revision will incorporate up-to-date information and also integrate, as far as possible, the various ecological classifications that have been carried out over the past several years by various Provinces and Territories. The result will be one consistent, national, ecological framework for Canada developed as a result of strong regional advice and input.

With this major revision of the 1986 terrestrial ecozones of Canada taking place, the time was opportune to extend the classification to the marine areas of Canada with the view to integrate marine and terrestrial ecozones. This paper proposes a marine ecological classification system for Canada that will extend the existing ecological classification to marine waters.

# 2 NEED FOR A NATIONAL FRAMEWORK

Canada's Green Plan states: "we must think, plan and act in terms of ecosystems". There is a need to move away from an emphasis on individual elements and move toward a more comprehensive ecological approach. The ecological classification of Canada provides one solid framework that serves to facilitate this ecological approach to gathering information that will allow Canadians, at all levels of decision-making, from the individual to the corporation, to make more informed choices with regard to lifestyles and the environment.

The system currently serves as the basic framework for national State of the Environment (SOE) reporting by Environment Canada and for certain provincial SOE reporting. Environment Canada has adopted it for the development and implementation of a national network of ecological monitoring sites. The Interdepartmental Advisory Committee on Marine Environmental Quality is supporting the marine ecological classification as the basis for a national status and trends monitoring program for marine ecosystems.

Natural Resources Canada is considering adopting the ecological hierarchy for depiction of various forestry theme maps. The Canadian Council on Ecological Areas uses the ecological framework for its initiatives in protected areas. It can be used for assessing the biodiversity of our major ecosystems and for guiding both the provincial and federal governments toward the goal of establishing 12% of the land base as protected areas.

# 3 CONCEPT BEHIND THE CANADIAN SYSTEM OF ECOLOGICAL CLASSIFICATION

This classification has been developed to provide a systematic view of the ecological relationships of the country. It is based on a nested hierarchy of ecosystems which offer a framework for interpreting complex interrelationships among climate, physiography and biota, including humans. The hierarchical system allows us to better understand the diverse parts of Canada in several different contexts: regional, provincial, national and international.

The broadest units are the ecozones, 15 of which make up terrestrial Canada. This report proposes the delineation of five marine ecozones. These ecozones are in turn comprised of ecoprovinces which are divided into ecoregions and ecodistricts.

The concepts behind the terrestrial classification were extended to cover the marine ecosystems. In his compendium of the terrestrial ecozones of Canada, Wiken notes that ecological land classification is:

> "a process of delineating and classifying ecologically distinctive areas of the earth's surface. Each area can be viewed as a discrete system which has resulted from the mesh and interplay of the geological, landform, soil, vegetative, climatic, wildlife, water and human factors that may be present. This holistic approach to land classification can be applied incrementally on a scale-related basis from very specific to very broad ecosystems."

# 4 DEVELOPMENT OF THE MARINE FRAMEWORK

Coastal and Ocean Resources Inc. (CORI), of Sidney, B.C., was contracted to propose an ecological classification system for Canada's marine areas. As a starting point, the Marine Regions of Canada, as developed by Canadian Parks Service (Harper *et al.*, 1993; Mondor *et al.*, 1991; and Croom *et al.*, 1992), were assessed as to their applicability for inclusion within the ecological framework. These regions were originally delineated on the basis of successive combinations of theme maps to develop a biological theme base map and a physical theme base map that were subsequently combined into a "marine region" map. The approach grouped diverse biological and physical themes into more manageable units for use in the National Park selection process.

These "marine regions" were divided on a national geographic scale and did not have a hierarchy of subdivisions. As well, each required a "land base" so all regions included a coastal component. This artificial constraint ignored real, ecological differences between inshore and offshore ecosystems. However, the integration of biological and physical attributes associated with these marine regions did provide a substantial database on which to build a hierarchical marine ecological classification system.

Consultation with regional marine experts of diverse ecological backgrounds was a critical component of this initiative. Coastal and Ocean Resources Inc., in association with LGL Ltd., held a series of seven regional workshops soliciting input and feedback from approximately 70 marine scientists and science managers across Canada, on appropriate diagnostic parameters and

boundaries for various spatial ecological units of the three coasts of Canada (see Appendix for Workshop participants and specialists consulted).

CORI's proposal was presented to the Marine Environmental Quality Advisory Group whose members represent the Conservation and Protection Service, the State of Environment Reporting Service, and Canadian Parks Service (now in the Department of Natural Resources). Their reviews resulted in a revision of CORI's proposed criteria used to delineate the top level division (i.e., Ecozones). This report outlines the system proposed by the Marine Environmental Quality Advisory Group.

# 5 MARINE ECOLOGICAL UNITS

In total, five marine ecozones have been delineated: one in the Pacific Region, two in the Arctic Region and two in the Atlantic Region. These ecozones in turn comprise 12 ecoprovinces, 18 ecoregions and 48 ecodistricts (Table 1 and Map).

One marine ecozone, the Arctic Basin, has not been further subdivided (Table 1). In this case, the ecoprovince, ecoregion and ecodistrict are the same ecological unit. In several cases, ecoprovinces have not been further subdivided. Based on available information, the perceived ecological diversity was such that division into smaller ecological units was deemed unnecessary. As the marine database improves, appropriate ecoprovinces, ecoregions and ecodistricts may be delineated.

A more detailed description of each of the five marine ecozones follows. A general ecological overview of the subdivisions of each ecozone is also provided.

## 5.1 *PACIFIC* Marine Ecozone

This ecozone covers the entire Canadian portion of the Pacific Ocean and extends north to the Bering Sea. Sea ice is absent for the most part from the northeast Pacific. Seasonal ice occurs only at the northern boundary in the Bering Sea, in the Sea of Okhotsk and in the sheltered bays and inlets throughout the zone, particularly those with freshwater discharges.

Physiographic isolation restricts water exchange between the Arctic marine ecozone and the Pacific marine ecozone. Temperature and salinities are higher than in the Arctic Ocean. These environmental differences are reflected in the differing ocean plankton species composition of the Arctic and Pacific oceans (Hemleben *et al.*, 1988). Based on zoogeography and temperature regime, this ecozone may be considered as a boreal transition zone between the polar waters of the Arctic and the temperate waters of the Pacific Ocean in mid-latitudes (Thomson, 1981). Between the southern tip of Vancouver Island and Dixon Entrance, ocean surface temperature declines approximately 3°C and reflects a steadily changing environment with progression northward. At any one latitude within this ecozone, oceanic water temperatures range approximately 7°C seasonally, which is reflected by differences in the characteristics of the biological community.

Marine mammals are represented by Steller sea lions, sea otters, northern fur seals, killer and grey whales and others. Five species of salmon, Pacific herring, halibut and other groundfish

form the backbone of the commercial fishery. Overall, this ecozone provides habitat for approximately 3,800 species of marine invertebrates, representing about 3.5% of the world's invertebrates (B.C. Ministry of Environment, Lands and Parks and Environment Canada, 1993).

Breeding bird populations include petrels, murrelets and auklets, with some puffins and murres. All of the B.C. breeding populations of Brandt's cormorants occur on the west coast of Vancouver Island.

Tables 2, 3, 4 and 5 summarize the general physiographic, oceanographic and biological characteristics of each subdivision of this ecozone.

# Table 1: Marine Ecological Classification System for Canada

| | ECOZONES | ECOPROVINCES | ECOREGIONS | ECODISTRICTS |
|---|---|---|---|---|
| P A C I F I C | Pacific | Northeast Pacific | Northeast Pacific | Northeast Pacific |
| | | Transitional Pacific | Transitional Pacific | Transitional Pacific |
| | | | Continental Slope | Continental Slope |
| | | Pacific Shelf/Fjords | Pacific Shelf/Fjords | Dixon Entrance |
| | | | | Hecate Strait |
| | | | | Queen Charlotte Sound |
| | | | | Queen Charlotte Strait |
| | | | | Johnstone Strait |
| | | | | Vancouver Island Shelf |
| | | | Georgia Basin/Puget Sound | Strait of Georgia |
| | | | | Juan de Fuca Strait |
| A R C T I C | Arctic Basin | Arctic Basin | Arctic Basin | Arctic Basin |
| | Arctic Archipelago | Arctic Archipelago | Arctic Archipelago | Ward Hunt Ice shelf |
| | | | | Nares Strait |
| | | | | Ellesmere/Axel Heiberg Fjords |
| | | | | Western Archipelago |
| | | | | Gulf of Boothia |
| | | | | Foxe Basin |
| | | | Eastern Arctic Shelf | North Water Polynya |
| | | | | Wellington Ch./McDougall Sd. |
| | | | | Jones Sound |
| | | | | Baffin Bay (seasonal ice) |
| | | | | Parry Channel |
| | | | | Lancaster Sound |
| | | | | North Baffin Fjords |
| | | | | Baffin Bay (permanent ice) |
| | | Arctic/Hudson Coast | Beaufort Sea/Amundsen Gulf | Beaufort Sea |
| | | | | Cape Bathurst Polynya |
| | | | | Mackenzie River Plume |
| | | | | Amundsen Gulf |
| | | | Coronation/Queen Maude Gulfs | Coronation/Queen Maude Gulfs |
| | | | Hudson Bay/James Bay | Hudson Bay |
| | | | | James Bay |
| A T L A N T I C | Northwest Atlantic | Davis Strait/Labrador Sea | Davis Strait/Labrador Sea | Davis Strait/Labrador Sea |
| | | Atlantic Shelf | Labrador/Newfoundland Shelf | Hudson Strait |
| | | | | Ungava Bay |
| | | | | Labrador/Newfoundland shelf |
| | | | Gulf of St. Lawrence | North Shore (NW) |
| | | | | NE Gulf |
| | | | | St. Lawrence Trough |
| | | | | St. Lawrence River |
| | | | | Gaspe Current |
| | | | | Magdalen Shallows |
| | Atlantic | Subarctic Altlantic | Subarctic Atlantic | Subarctic Atlantic |
| | | Temperate Atlantic | Temperate Atlantic | Temperate Atlantic |
| | | Grand Banks | Grand Banks | Grand Banks |
| | | Scotian Shelf/Georges Bank | Scotian Shelf/Georges Bank | Scotian Shelf/Georges Bank |
| | | | | Bay of Fundy |

## Table 2: Characteristics of the Pacific Marine *Ecozone*

| Marine Ecozone | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Pacific | Pacific Ocean Basin includes spreading ridges, transform faults and plate subduction zone; moderately wide shelf and partial separation from Arctic Ecozone | Pacific Ocean water masses classified as boreal transition zone; general eastward-setting oceanic current (Subarctic Current) with divergence point off the shelf | unique oceanic plankton community; many species of fish and marine invertebrates, many with planktonic larvae unique to the Pacific Ocean; marine mammals and birds have less ocean-specific mobility |

## Table 3: Characteristics of the Pacific Marine *Ecoprovinces*

| Marine Ecoprovinces | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Northeast Pacific | includes abyssal plain, continental rise and continental slope; a major transform fault occurs along the west margin and a seamount chain trends NW/SE | eastward-flowing Subarctic Current bifurcates at coast with northerly-flowing Alaskan Current; current flow generally northward throughout year | boreal plankton community; summer feeding ground for Pacific salmon stocks; abundance of pomfret, Pacific saury, albacore tuna and jack mackerel in summer; marine mammals plentiful; important seabird colonies including alcids, auklets and petrels |
| Transitional Pacific | includes abyssal plain, continental rise and continental slope; also includes spreading ridges, transform faults, triple junction and plate subduction zone | area of variable currents; southerly areas may be affected by southward-flowing California Current in summer but remainder of area characterized by weak and variable currents; Davidson Current along shelf edge flows north in winter, south in summer | transition zone between southerly, temperate and northerly, boreal plankton communities; mixing of oceanic and coastal plankton communities adjacent to the coastal shelf; feeding grounds for southern fish stocks; marine mammals moderately abundant; seabird breeding grounds for auklets, puffins and petrels |
| Pacific Shelf/Fjords | from shelf edge landward; most water depths less than 300 m except areas of Queen Charlotte Sound and some of the deeper mainland fjords; coastline highly crenulated, rocky and with moderate relief | strongly influenced by freshwater runoff that reduces salinity of shelf waters, increases turbidity, drives coastal boundary currents and creates an "estuarine-like" circulation and stratification | strong coastal, estuarine signature in plankton community; high occurrence of planktonic larvae for coastal fish and invertebrates during summer; feeding grounds for southerly fish stocks in summer; commercially important shellfish; abundant marine mammal populations; important breeding grounds for seabirds and waterfowl such as alcids and auklets |

# Table 4: Characteristics of the Pacific Marine *Ecoregions*

| Marine Ecoregions | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Northeast Pacific | see Table 3 | see Table 3 | see Table 3 |
| Transitional Pacific | see Table 3 | see Table 3 | see Table 3 |
| Continental Slope | the continental shelf drops off sharply near the shelf break at 200 m | the continental slope between the 200 m and 2,000 m depth contours defines general division between oceanic and physical processes characterized by upwelling | mixture of neritic and oceanic plankton communities; rich fishing grounds for salmon, herring and groundfish; feeding areas for large populations of seabirds |
| Pacific Shelf/Fjords | generally shallow, gently sloping shelf (<200 m), except Queen Charlotte Sound which is slightly deeper with a series of banks and channels; numerous fjords and islands | characterized by transitional "estuarine" and "marine" water masses and associated currents; open Pacific wave exposures; generally northerly currents in winter, southerly currents in summer | strong coastal signature of neritic plankton species; high primary productivity; rich benthic community; feeding grounds for temperate fish, mammals and marine birds |
| Georgia Basin/ Puget Sound | large strait characterized by numerous channels, fjords and islands; adjacent coastal lowlands | enclosed basin with large freshwater input (including Fraser River); high turbidity; generally well stratified with "estuarine-like" circulation patterns | neritic, estuarine plankton species; productive and protected habitats for juvenile fish and invertebrates; some productive benthic invertebrate areas; marine mammals such as seals are abundant; feeding area for marine birds (shorebirds, waterfowl and seabirds) |

# Table 5: Characteristics of the Pacific Marine *Ecodistricts*

| Marine Ecodistricts | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Northeast Pacific | see Table 3 | see Table 3 | see Table 3 |
| Transitional Pacific | see Table 3 | see Table 3 | see Table 3 |
| Continental Slope | see Table 4 | see Table 4 | see Table 4 |
| Dixon Entrance | across-shelf trough with depths mostly <300 m; surrounded by low-lying coastal plains (Hecate Depression) | strong freshwater influence from mainland river runoff drives northwestward-flowing, coastal buoyancy-driven current and "estuarine-like" circulation | mixture of neritic and subpolar plankton species; migratory corridor for Pacific salmon; some productive and protected areas for juvenile fish and invertebrate development |
| Hecate Strait | very shallow strait dominated by coarse bottom sediments; surrounding coastal lowlands | semi-protected waters with strong tidal currents that promote mixing; dominantly "marine" waters | neritic plankton communities with some oceanic intrusion; nursery area for salmon and herring; abundant benthic invertebrate stocks; feeding grounds for marine mammals and birds |
| Queen Charlotte Sound | wide, deep shelf characterized by several large banks and inter-bank channels | ocean wave exposures with depths mostly >200 m and dominated by oceanic water intrusions | mixture of neritic and oceanic plankton communities; northern limit for many temperate fish species; lower benthic invertebrate production |
| Queen Charlotte Strait | deep, narrow fjords cutting into high coastal relief | protected waters with restricted circulation and often strongly stratified | unique species assemblages in benthic and plankton communities |
| Johnstone Strait | narrow, constricted channels | protected coastal waters with strong currents; well mixed, poorly stratified | migratory corridor for anadromous fish; diverse species assemblage of benthic fish; rich sessile, hard substrate invertebrate community |
| Vancouver Island Shelf | narrow, gently sloping shelf | open coast with oceanic wave exposures; northward, coast-hugging, buoyancy-driven current due to freshwater influence; seasonal upwelling at outer margin | highly productive with neritic plankton community; northern limit for hake, sardine, northern anchovy, Pacific mackerel; rich fishing grounds for benthic fish and invertebrates |
| Strait of Georgia | broad shallow basin surrounded by coastal lowlands (Georgia Depression) | protected coastal waters with significant freshwater input, high turbidity and seasonally stratified; very warm in summer | neritic plankton community; nursery area for Pacific salmon, herring; abundant shellfish habitat |
| Juan de Fuca Strait | deep trough; a major structural feature accentuated by glacial scour | semi-protected coastal waters with strong "estuarine-like" outflow current (coast-hugging, buoyancy-driven current to north); major water exchange conduit with "inland sea" | mixture of neritic and oceanic plankton species; migratory corridor for anadromous fish; moderately productive |

## 5.2 *ARCTIC BASIN* Marine Ecozone

This marine ecozone has a permanent cover of pack ice that rotates in a counter-clockwise, circumpolar gyre. The freshwater input from adjacent lands is low except for the Mackenzie River discharge at the southern margin. The presence of a permanent ice cover contributes significantly to the predominantly low biological productivity of this ecozone. Overall species diversity is low with species restricted to those adapted to the constant ice cover. Climate is very dry and cold with annual precipitation ranging from 100 to 200 mm; mean daily January temperatures range from -30 to -35°C and summer mean daily temperatures are about 5°C.

Typical mammal species of the pack ice margin include polar bear; beluga whale; narwhal; bearded, harp and harbour seals.

## 5.3 *ARCTIC ARCHIPELAGO* Marine Ecozone

This marine ecozone is inextricably linked with the Northern Arctic terrestrial ecozone and includes most of the Arctic archipelago with its numerous channels, straits and fjords. This ecozone is largely ice-free during the two to three summer months and has landfast ice during winter, although in some areas, in some years, landfast ice persists all year. It encompasses the high Arctic islands and the Arctic/Hudson coast ecoprovince. There is generally a high coastal relief in the east and low relief in the south and west.

The climate is characterized by long, cold winters and short, cool summers. The short summer growing season is enhanced by long periods of daylight; however, mean daily July temperatures tend to average only 10°C. Winter temperatures are variable but with a mean hovering around -30°C.

Locally, intense use of the marine ecozone by migratory birds and marine mammals occurs during the summer ice-free period. Overall, this ecozone is a major breeding and nesting area for birds such as Arctic loons, whistling swans and snow geese. Marine wildlife include walrus, seals (grey, harp, bearded, harbour and ringed) and whales (beluga, narwhal, sperm, northern bottlenose and bowhead).

Tables 6, 7, 8 and 9 summarize the physiographic, oceanographic and biological characteristics of each Arctic subdivision.

## Table 6: Characteristics of the Arctic Marine *Ecozones*

| Marine Ecozones | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Arctic Basin | limited to the Arctic Ocean Basin; water depths mostly >2,000 m | permanent pack ice; affected by easterly winds driving a clockwise circumpolar gyre in basin; no land components | low biological productivity and diversity; polar bears and seals dominate marine mammals |
| Arctic Archipelago | limited to "shelf-type" depths; high Arctic islands, Arctic and Hudson Bay coasts; much is rocky coast-line, numerous channels and straits; high coastal relief in east, low in south and west | seasonal ice; open water 2 to 3 months in summer; relatively high freshwater input along northern continental boundary | higher productivity and biological use than permanent ice area; intense summer migration into region, generally following the ice edge retreat; locally high concentrations of marine mammals and birds |

## Table 7: Characteristics of the Arctic Marine *Ecoprovinces*

| Marine Ecoprovinces | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Arctic Basin | see Table 6 | see Table 6 | see Table 6 |
| Arctic Archipelago | shelf water depths, generally >200 m; numerous ice-congested channels and straits; high coastal relief in east, low to moderate in south and west; ice shelves and ice fronts on Ellesmere and Devon Is.; includes Gulf of Boothia and central Foxe Basin | landfast ice may be present throughout summer; generally more open water in southern half; little terrestrial freshwater influence because of low precipitation and small drainage areas | biological productivity, use and diversity generally low; high productivity and concentrations may occur locally near polynya or intensive mixing areas |
| Arctic/Hudson Coast | depths mostly <200 m | seasonal ice, dominated by freshwater inputs | high biological productivity; important wetland and migratory bird habitat; large numbers of anadromous fish in summer; harp seals, walrus, beluga and narwhal are common |

# Table 8: Characteristics of the Arctic Marine *Ecoregions*

| Marine Ecoregions | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Arctic Basin | see Table 6 | see Table 6 | see Table 6 |
| Arctic Archipelago | see Table 7 | see Table 7 | see Table 7 |
| Eastern Arctic Shelf | dominated by channels and straits; high coastal relief; depths mostly <200 m except in Lancaster and Jones Sounds | seasonal ice, usually ice-free in July through September; 200 m thick Arctic surface water layer with large variations in the upper 75 m; flow generally from west to east | species composition of zooplankton similar to Arctic Ocean; numerous migratory seabird colonies; harp seals, walrus, beluga and narwhal are common in summer; migratory species follow the progressive retreat of the ice edge in spring and summer |
| Beaufort Sea/ Amundsen Gulf | low coastal relief with generally wide shelf; large subaerial delta; mostly soft-sediment shorelines | seasonal ice; dominated by freshwater input from the Mackenzie River, the second largest watershed in North America; highly stratified and fresh; high turbidity | high biological productivity and use; relatively high fisheries production; marine mammal concentrations (beluga, bowhead whales); Mackenzie Delta is important wetland and migratory bird habitat |
| Coronation/Queen Maude Gulfs | relatively large, enclosed basin with constricted entrances; very shallow (mostly <100 m); | seasonal ice cover; summer stratified system is assumed due to constricted entrances and river input; Coppermine, Rae, Hood and Ellice Rivers drain into the gulf | apparently large number of anadromous fish and waterfowl in summer; few marine mammals |
| Hudson Bay/ James Bay | large, shallow inland sea; depths mostly <200 m; drainage basin area of surrounding lands about 2,500,000 $km^2$; mostly low coastal relief | seasonal ice cover; "Arctic" water signature; constricted entrance and large freshwater influence creates strong stratification; freshwater input drives strong outflow through Hudson Strait (coast-hugging, buoyancy-driven current) | generally high productivity; anadromous Arctic char, whitefish and cisco common; some salmon; walrus common in north; high concentration of beluga in west; some bowhead, narwhal; important Brant and snow goose nesting area |

# Table 9: Characteristics of the Arctic Marine *Ecodistricts*

| Marine Ecodistricts | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Arctic Basin | see Table 6 | see Table 6 | see Table 6 |
| Ward Hunt Ice Shelf | ice shelf on northern coast of Ellesmere Is. extends up to 16 km from shore and over 200 km discontinuously along the coast | permanent ice; highly stable system with smooth, non-saline ice of up to 100 m thick | no known biota associated with this ecodistrict due to exceptional thickness of ice |
| Nares Strait | narrow, deep channel between Ellesmere Is. and Greenland | permanent ice zone; heavy pack ice throughout year | biological features poorly documented |
| Ellesmere/Axel Heiberg Fjords | deep fjords often >200 m in depth; high coastal relief | generally permanent ice; some open water near heads in summer; very strong stratification | low productivity and diversity; little used area by marine mammals and marine birds |
| Western Archipelago | Sverdrup Basin, Parry Channel and McClintok Channel | permanent ice; heavy pack ice throughout summer; general west to east flow beneath ice | ring seals and polar bears are the only common marine mammals; small numbers of walrus may occur in summer around edges; Seymour Is. ivory gull colony is the only large bird colony |
| Gulf of Boothia | <200 m water depth | permanent ice; generally more than 90% ice | little known on biota but assumed low productivity and diversity due to ice presence; less frequented by marine mammals due to persistent heavy ice |
| Foxe Basin | shallow, mostly <50 m with maximum about 100 m; low coastal relief | permanent sea ice; high tidal range in Foxe Basin (up to 5 m) suggests that water beneath ice is well mixed and differs significantly from central areas of the permanent ice zone | important area for marine mammals; high densities of bearded and ringed seals; largest walrus herd in the Arctic; polar bears abundant; many large bird colonies |
| North Water Polynya | water depths 200-500 m | area in northern Baffin Bay that is largely ice-free year round | some walrus, beluga whales, narwhal and bearded seals may overwinter in north water |
| Wellington Channel/ McDougall Sound | high coastal relief; depths 150-300 m | seasonal ice; strong currents promote mixing in these channels as compared to southern and northern regions | higher productivity as a result of mixing |
| Jones Sound | deep sound; depths to >800 m; ice shelves at eastern entrance; high coastal relief | seasonal ice; icebergs common; mixing and water exchange significantly lower than Lancaster Sound due to sill and constrictions at eastern entrance | lower productivity and species abundance in comparison to Lancaster Sound to south |

| Marine Ecodistricts | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Baffin Bay (seasonal ice) | continental shelf and slope of western Baffin Bay | seasonal ice; main oceanographic feature is southerly-flowing Baffin Island Current along west shore of Baffin Bay | important area for marine mammals; beluga and bowhead whales migrate through; several large seabird colonies are in the area |
| Parry Channel | wide, relatively deep channels (150-400 m); high coastal relief | seasonal ice; moderate stability of water column | includes most of features of Lancaster Sound but lower overall productivity and abundance; includes important summering areas for marine mammals and major bird colonies |
| Lancaster Sound | deep east-west trough approximately 100 km across land, 800 m deep; ice shelf along north shore | seasonal ice; major flexure in north-south current flow; more intensive mixing; progressive failure of ice edge in spring can be localized zone of upwelling | high productivity at ice and during summer; high bird and marine mammal concentrations along retreating ice edge during spring; major beluga, narwhal, walrus, harp seal and bearded seal migration route along south Devon Is.; major bird colony at Cape Hay |
| North Baffin Fjords | deep fjords often >200 m in depth; high coastal relief; some tidewater glaciers | generally permanent ice (but not as much as Ellesmere/Axel Heiberg Fjord Ecodistrict); some open water near heads in summer; very strong stratification | low productivity and diversity; little used area by marine mammals and marine birds |
| Baffin Bay (permanent ice) | shelf area, seaward of fjord region | area of permanent ice; coast often remains encumbered by ice throughout summer | lower biological activity suggested by the absence of major bird colonies; biological activity may be limited by ice |
| Beaufort Sea | includes area not with plume or polynya area; outer Beaufort Shelf, eastern Amundsen Gulf | seasonal ice; freshwater "signature" of Mackenzie River but not as strong as Plume Ecodistrict; not in Cape Bathurst Polynya area | important summer feeding area for bowhead whales; coastal waters have high seabird and waterfowl concentrations |
| Cape Bathurst Polynya | water depths up to 400 m but very shallow along Banks Is. | seasonal ice zone but leads usually open in early spring between landfast ice and polar pack ice | ring seals, bowhead whales, beluga whales and polar bears may be concentrated around the lead margins; critical spring migratory waterfowl habitat |
| Mackenzie River Plume | shallow shelf area generally <30 m; mud-dominated seabed; low, rapidly retreating coasts | seasonal ice; plume area has strong Mackenzie River signature with warm, fresh, turbid water; winter landfast ice zone with ponded plume beneath; fresh water creates buoyancy-driven, coast hugging current along Tuk Peninsula; plume position highly variable | "estuarine-like" planktonic community but low biomass; however, near plume edge, which is highly ephemeral, Arctic zooplankton with high biomass is present; important rearing area for beluga; Arctic cisco and broad whitefish are common in the nearshore; bowhead whales feed near plume boundaries |

| Marine Ecodistricts | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Amundsen Gulf | large embayment >600 m deep | open-water season is 45-60 days; land fast ice in bays and consolidated pack ice covers gulf and straits | primary and secondary productivity generally low; important summer feeding area for bowhead and beluga whales; ringed and bearded seals abundant |
| Coronation/Queen Maude Gulfs | see Table 8 | see Table 8 | see Table 8 |
| Hudson Bay | broad shallow sea; depths almost everywhere <200 m; generally low coastal relief | seasonal ice; large freshwater input from James Bay and rivers along the west coast; salinities not as low as James Bay; main water mass is Arctic in character | characteristic Arctic plankton assemblages; Arctic char, whitefish, cisco common; some salmon; walrus common to north; high concentrations of beluga; bowhead and narwhal occurrences; important Brant and snow goose nesting along coast |
| James Bay | very shallow with low coastal relief; depths <50 m | seasonal ice; dominated by freshwater input; low salinities (10 ppt) dominate | fish fauna primarily freshwater species: brook trout, cisco and whitefish; beluga whales summer in the area; large populations of shorebirds and waterfowl |

## 5.4 *NORTHWEST ATLANTIC* Marine Ecozone

This marine ecozone maintains higher temperatures than the Arctic marine ecozones. Just as in the Pacific Ecozone, it is a transition zone between the polar waters and the more southerly temperate waters. There is more than a 20°C difference in water temperature between the polar waters and waters under the influence of the Gulf Stream around the Scotian Shelf.

The open water is variable. Ice begins to form off northern Labrador in November/December and moves slowly south reaching the Grand Banks in February/March. Clearing begins in May and the Labrador Coast is ice-free in mid-July. Icebergs are common (Wilson and Addison, 1984).

Much of the continental coastline is characterized by glacially-eroded fjords. Over 444,000 coastal islands occur. The marine waters are under the influence of the south-flowing Labrador Current which transports cold water from the north. This current mixes with the warmer Gulf Stream current around the Grand Banks.

The continental shelf (approximately 150 km wide) supports a wide range of marine mammals. Twenty-two species of whales occur off Canada's Atlantic coast as well as six species of seals (Wilson and Addison, 1984). Concentrations of humpback, bluefin and minke whales are typical in this ecozone. Killer whales, porpoises and dolphins are less common. Sperm whales occur offshore. Seabird colonies include petrels, cormorants and thick-billed murres. Common fish include halibut, cod, redfish and plaice near shore.

## 5.5 *ATLANTIC* Marine Ecozone

This marine ecozone encompasses the Gulf of St. Lawrence, Grand Banks, Bay of Fundy and the ocean waters off Nova Scotia. The continental shelf extends beyond 400 km and covers the Grand Banks. Waters are relatively shallow being less than 150 m deep over broad areas. The Bay of Fundy areas experiences tidal ranges of up to 12 m while tidal ranges elsewhere in the ecozone average one to two metres. The smallest tides occur in the southwestern part of the Gulf of St. Lawrence where the average range is less than one metre.

The waters are generally temperate being influenced by the northward-flowing Slope Water Current and further offshore, the Gulf Stream. Essentially ice-free conditions are found in the Bay of Fundy (except for the upper reaches) and along the mainland coast of Nova Scotia. Seasonal ice is found in the Gulf of St. Lawrence and Cabot Strait. Icebergs occur off the Newfoundland coast to the Grand Banks.

Major fish populations include flounder, plaice, capelin, mackerel, herring, silver hake and halibut. Breeding colonies for several species of marine birds occur. Among these are great and double-crested cormorant, Atlantic puffin, common and thick-billed murre, black guillemot and razorbill. Common marine mammals are seals (harp, hooded and gray), whales (northern bottlenose, blue, beluga, pilot, minke and humpback), harbour porpoises and dolphins (Dunbar and Moore, 1980).

Tables 10, 11, 12 and 13 summarize the physiographic, oceanographic and biological characteristics of the Atlantic subdivisions.

# Table 10: Characteristics of Atlantic Marine *Ecozones*

| Marine Ecozones | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Northwest Atlantic | seasonal ice area includes continental shelf and NW Atlantic Ocean Basin; generally low coastal relief; passive, trailing edge tectonic plate; includes Gulf of St. Lawrence | seasonal ice zone extends from shore to ocean water depths; Labrador Current exerts strong influence both on shelf and offshore | subarctic species in north to boreal species in south; important commercial species include oyster, shrimp, snow crab, haddock, hake, pollock, American plaice, codfish, halibut, flounder, herring, mackerel, capelin, and Atlantic salmon |
| Atlantic | includes the Grand Banks, Scotian Shelf, St. Lawrence Trough and Bay of Fundy, as well as the NW Atlantic Ocean Basin; a passive, trailing edge tectonic plate | generally ice-free except for local pockets of landfast ice and some years of seasonal ice; includes mostly temperate water masses originating from the south; Gulf Stream offshore and Slope Water Current at the shelf break; mixing zone between Labrador Current and Temperate or Gulf Stream waters | includes both neritic and oceanic species; important commercial ground fisheries occur on shelves; important commercial species include lobster, scallop, codfish, haddock, hake, pollock, redfish, halibut, mackerel and Atlantic salmon |

# Table 11: Characteristics of Atlantic Marine *Ecoprovinces*

| Marine Ecoprovinces | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Davis Strait/Labrador Sea | part of the northwest Atlantic Ocean Basin but generally continental slope depths <1,000 m | seasonal ice formation; subarctic water masses; southerly-flowing Labrador Current | subarctic species in the north to boreal species in the south |
| Atlantic Shelf | shelf to approximately 200 m isobath, about 150 km in width; a series of broad banks divided by across-shelf troughs; includes Gulf of St. Lawrence, a major east-coast structural embayment | seasonal ice formation; subarctic water; southerly-flowing shelf current (inshore branch of the Labrador Current); general counter-clockwise current gyre in Gulf of St. Lawrence | zoogeography reflects latitudinal temperature variation; commercial species include shrimp, codfish, hake, redfish, halibut, flounder, mackerel, capelin, salmon; summer concentrations of birds off southern Labrador |
| Subarctic Atlantic | Northwest Atlantic Ocean Basin and continental slope; depths mostly >1,000 m; includes Flemish Cap | subarctic water dominated by the southerly-flowing Labrador Current; seasonal ice only occasionally present | lower species diversity and productivity than shelf areas |
| Temperate Atlantic | Northwest Atlantic Ocean Basin and continental slope; water depths mostly >1,000 m | temperate water masses; northward-flowing, shelf-break current (Slope Water Current); no seasonal ice; northward-flowing Gulf Stream offshore | lower species diversity and productivity than shelf areas |
| Grand Banks | large offshore bank with very gentle slopes (over 500 km from shore to 200 m isobath in some places) | generally ice-free except in severe ice years; influenced by Labrador Current (subarctic water); upwelling along shelf break | high productivity; neritic plankton; large commercial ground fishery; other important species are codfish, haddock, hake, pollock, redfish, plaice, flounder, herring, mackerel, capelin and Atlantic salmon; marine mammals common; winter and summer concentrations of seabirds |
| Scotian Shelf/Georges Bank | large offshore shelf (including Georges Bank) mostly <200 m; also includes shallow Bay of Fundy; Sable Island Bank is a major anomaly of shelf | no consistent seasonal ice although some landfast ice may occur close to the coast; dominated by south-flowing shelf current that originates from Gulf; upwelling occurs near shelf edge | highly productive with important upwelling areas near Cape Breton Is. and at shelf break; relatively uniform flora and fauna from west to east; important commercial species include lobster, snow crab, scallop, codfish, haddock, hake, pollock, redfish, plaice, flounder, herring, mackerel, Atlantic salmon; hake, codfish and haddock spawning grounds, codfish nursery area; whales present; many seabird colonies and wintering area |

# Table 12: Characteristics of Atlantic Marine *Ecoregions*

| Marine Ecoregions | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Davis Strait/Labrador Sea | see Table 11 | see Table 11 | see Table 11 |
| Labrador/Newfoundland Shelf | shelf to approximately 200 m isobath, about 150 km in width; a series of broad banks divided by across-shelf troughs | seasonal ice formation; subarctic water; southerly-flowing shelf current (inshore branch of the Labrador Current) | zoogeography reflects latitudinal temperature variation; commercial species include shrimp, codfish, hake, redfish, halibut, flounder, mackerel, capelin, Atlantic salmon; summer concentrations of birds off southern Labrador |
| Gulf of St. Lawrence | major gulf along the eastern seaboard of N. America; contains shelf and trough areas; coastal relief generally low | freshwater input from St. Lawrence River creates "estuarine-like" circulation pattern; seasonal ice cover except for some local anomalies along North Shore; general counter-clockwise gyre of surface currents | important breeding area for pelagic seabirds |
| Subarctic Atlantic | see Table 11 | see Table 11 | see Table 11 |
| Temperate Atlantic | see Table 11 | see Table 11 | see Table 11 |
| Grand Banks | see Table 11 | see Table 11 | see Table 11 |
| Scotian Shelf\Georges Bank | see Table 11 | see Table 11 | see Table 11 |

# Table 13: Characteristics of Atlantic Marine *Ecodistricts*

| Marine Ecodistricts | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| Davis Strait/Labrador Sea | see Table 11 | see Table 11 | see Table 11 |
| Hudson Strait | deep strait with most depths in the range of 200-300 m but up to 600 m deep | seasonal ice cover; major water exchange conduit between Hudson Bay and Atlantic; high currents; inflow (to west) along north shore; outflow (to east) along south shore | subarctic species dominate; Atlantic salmon common to area in spring and summer |
| Ungava Bay | very shallow embayment, mostly less than 100 m; large 100 km diameter bank in central portion of bay | seasonal ice cover; August temperature about 0°C; very high tides (up to 14.5 m) promote intense vertical mixing | subarctic species composition; Atlantic salmon common in spring and summer |
| Labrador/Newfoundland Shelf | see Table 12 | see Table 12 | see Table 12 |
| North Shore (NW) | shallow shelf area (<200 m) | seasonal ice cover (central portion of coast has only partial ice cover; southerly-flowing Labrador Current component; tidal front in Strait of Belle Isle results in strong mixing area; August sea surface temperature about 12°C | nutrient-rich upwelling area along coast is important wintering area for some species; important commercial species include lobster, shrimp, codfish (nursery area), hake, pollock, redfish, Atlantic salmon; seals present; major seabird area |
| NE Gulf | relatively shallow shelf (depths <200 m) along west coast of Newfoundland | dominated by northward-flowing current; seasonal ice cover; August surface temperature of 12-15°C | important commercial species include lobster, scallop, codfish, haddock, hake, pollock, plaice, flounder, herring (spawning area), mackerel, capelin (spawning) and Atlantic salmon; important winter breeding area for seals; important feeding area for whales; area of summer seabird concentrations |
| St. Lawrence Trough | deep intrusion into otherwise shallow seas (depths mostly 300-400 m) | seasonal ice cover (area at SE Anticosti Is. may be only partial ice cover); much Labrador Current influence compared to rest of shelf; August surface temperature up to 15°C | important commercial species include shrimp, codfish, haddock, hake, pollock, redfish, halibut, mackerel and Atlantic salmon; seals present; important seabird wintering area |

| Marine Ecodistricts | Physiographic Characteristics | Oceanographic Characteristics | Biological Characteristics |
|---|---|---|---|
| St. Lawrence River | relatively narrow, drowned river channel; depth up to 350 m | seasonal ice cover; strong freshwater outflow from St. Lawrence River creates estuary; August surface temperature of 12°C | important commercial species include lobster, hake, pollock, mackerel and Atlantic salmon; beluga whales and seals present; important area for breeding seabirds |
| Gaspe Current | relatively steep nearshore and offshore gradients; depths to 400 m | seasonal ice cover; freshwater influence from estuary outflow; upwelling area | high productivity due to upwelling and nutrient enrichment; important commercial fish species include lobster, snow crab, codfish (nursery area), haddock, hake, pollock, plaice, herring (spawn), mackerel, capelin (spawning) and Atlantic salmon; seabird colonies |
| Magdalen Shallows | wide, shallow shelf; <100 m | seasonal ice cover (earliest to form and latest to break up); August surface temperature of 15-18°C; general southeasterly flow | many "relic" species due to very warm summer surface temperatures; important commercial species include lobster, scallop, snow crab, codfish (nursery area), mackerel (spawning), tuna, capelin (spawning) and Atlantic salmon; winter breeding area for seals; important seabird colonies |
| Subarctic Atlantic | see Table 11 | see Table 11 | see Table 11 |
| Temperate Atlantic | see Table 11 | see Table 11 | see Table 11 |
| Grand Banks | see Table 11 | see Table 11 | see Table 11 |
| Scotian Shelf/Georges Bank | see Table 11 | see Table 11 | see Table 11 |
| Bay of Fundy | shallow, generally <200 m embayment; includes shoal areas around to Cape Sable | landfast ice forms near shore but generally ice-free; strong tidal currents promote intense mixing; mean counter-clockwise current in bay; tidal front at mouth of bay creates upwelling; August surface temperatures of 8°C | most diverse fauna and flora of all of Atlantic Canada due to moderate year-round temperatures and high productivity; many examples of southern species; important commercial species include lobster, scallop, codfish, haddock, hake, pollock, redfish, herring (important nursery area), halibut, mackerel and Atlantic salmon; whale concentrations near upwelling area at mouth; important seabird area especially at mouth of bay |

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# APPENDIX

## Workshop Participants and Specialists Consulted

## British Columbia - 20 October 1992

| Individual | Affiliation | Specialization |
|---|---|---|
| Cross, William R. | LGL Ltd., King City, ON | benthic ecologist |
| Eade, Allen | IOS/DOE, State of the Environment, Sidney, BC | State of the Environment |
| Forbes, J. Roderick | IOS/DFO, Sidney, BC | ocean ecologist |
| Frith, Russ | LGL Ltd., Sidney, BC | marine/fisheries ecologist |
| Harding, Lee | Environmental Conservation, DOE, North Vancouver, BC | marine water quality |
| Harper, John | Coastal & Ocean Resource Inc. Sidney, BC | marine geology |
| Henwood, Bill | Canadian Park Service, North Vancouver, BC | marine planning |
| Mackas, Dave | IOS/DFO, Sidney, BC | ocean ecologist |
| Melling, Humfrey | IOS/DFO, Sidney, BC | Arctic oceanography |
| Searing, Gary | LGL Ltd., Sidney, BC | marine wildlife ecologist |
| Smiley, Brian | IOS/DFO, Sidney BC | ocean information specialist; marine biologist |
| Thomson, Richard E. | IOS, DFO, Sidney, BC | physical oceanographer |

## Winnipeg - 22 October 1992

| Individual | Affiliation | Specialization |
|---|---|---|
| Bergmann, Mary | DFO/Freshwater Institute | |
| Cross, William | LGL Ltd., King City, ON | benthic ecology |
| Lockhart, W. Lyle | DFO/Freshwater Institute | |
| Stewart, Rob | DFO/Freshwater Institute | |
| Welch, Harold | DFO/Freshwater Institute | |

## Newfoundland - 30 October 1992

| Individual | Affiliation | Specialization |
|---|---|---|
| Atkinson, Bruce | DFO, St. John's, NF | fisheries biologist |
| Banfield, Colin | Memorial University | climatologist |
| Catto, Norm | Memorial University | climatologist |
| Chardine, John | Canadian Wildlife Service | seabird biologist |
| Christian, John | LGL Ltd., St. John's, NF | invertebrate behaviour |
| DeYoung, Brad | Memorial University | physical oceanographer |
| Hooper, Bob | Memorial University | marine biologist |
| MacTavish, Bruce | LGL Ltd., St. John's, NF | bird expert |
| Marsh, Gail | Canadian Park Service | ecologist |
| Montevechi, Bill | Memorial University | seabird biologist |
| Parsons, Bruce | National Research Council | ice expert |
| Penney, Kathy | DOE | |
| Prasad, R.W. | Memorial University | primary production |
| Reddin, Ann | Memorial University | primary production |
| Steele, Don | Memorial University | marine ecologist |

## Ottawa - 2 November 1992

| Individual | Affiliation | Specialization |
|---|---|---|
| Cross, William | LGL Ltd., King City, ON | benthic ecologist |
| Bain, Hugh | Biological Sciences,<br>DFO, Ottawa, ON | |
| Bunch, Jim | Oceanography and Contaminants,<br>DFO, Ottawa, ON | microbiologist |
| Gaston, Tony | Canadian Wildlife Service | seabird ecologist |
| Hirvonen, Harry | State of the Environment<br>DOE | ecosystem mapping |
| Mondor, Claude | National Parks Systems Branch,<br>Canadian Park Service | parks planner |
| Osbourne, Jim | Marine Environment Division,<br>Conservation and Protection,<br>DOE | |
| Packman, Glenn | Habitat Management and Sustainable<br>Development, DFO, Ottawa, ON | habitat biologist |
| Welsh, Dave | Canadian Park Service | marine classification systems |
| Yuen, Ken | Oceanography and Contaminants,<br>DFO, Ottawa, ON | |
| Yurick, Doug | National Parks Systems Branch,<br>Canadian Park Service, | marine parks, planning |

## Quebec - 3-4 November 1992

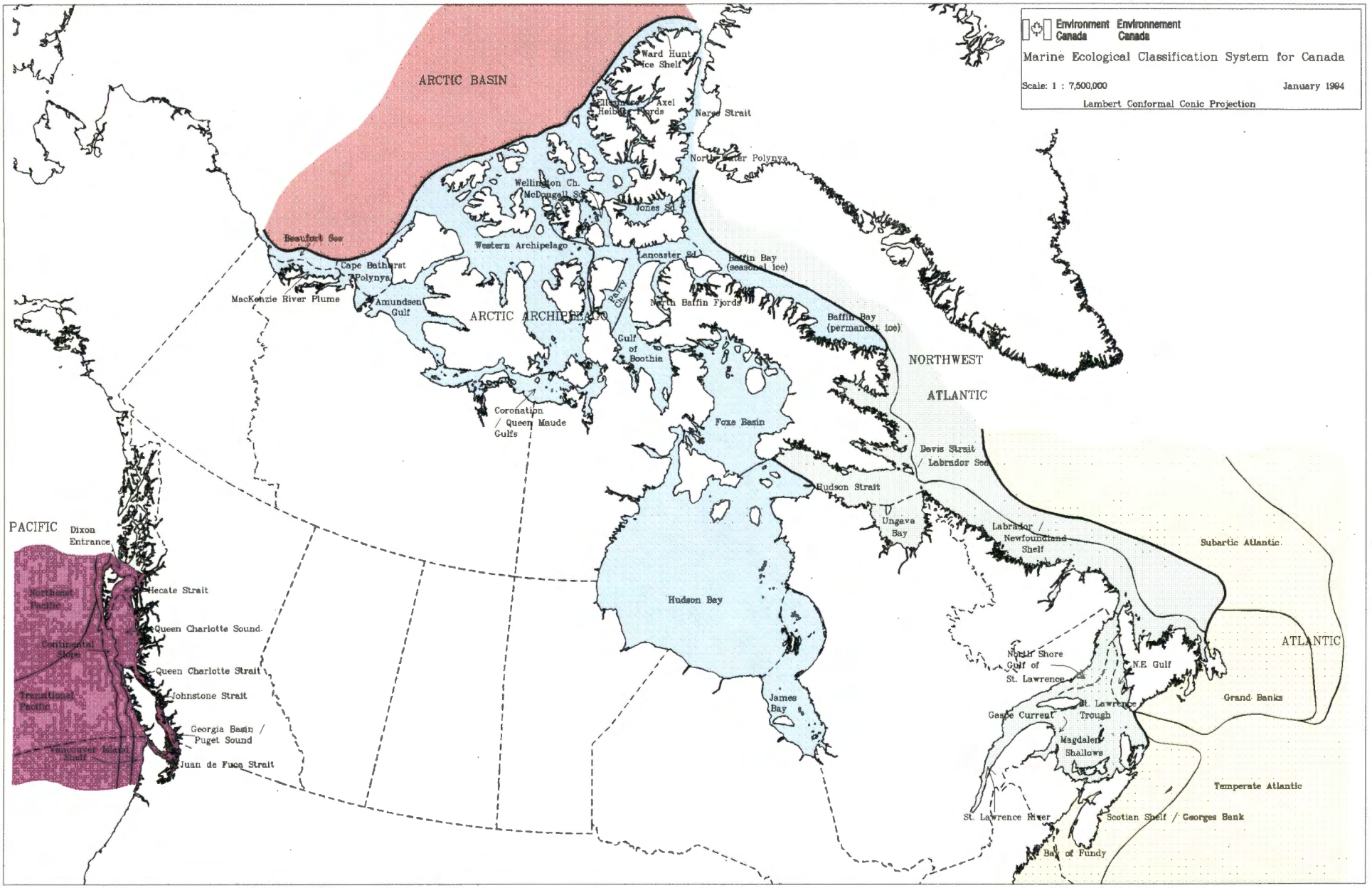
| Individual | Affiliation | Specialization |
|---|---|---|
| Cross, William | LGL Ltd., King City, ON | benthic ecologist |
| Chevalier, Michel | Ocean Dumping, Conservation and Protection, DOE, Montreal, PQ | coordinator |
| Gagne, Jacques | Récherche sur les Pêches, Institut Maurice Lamontagne, DFO, Mont Joli, PQ | |
| Gratton, Yves | Sciences physiques et chemiques, Institut Maurice Lamontagne, DFO, Mont Joli, PQ | |
| Larouche, Pierre | Sciences physiques et chemiques, Institut Maurice Lamontagne, DFO, Mont Joli, PQ | |
| Pelletier, Emilien | Oceanologie, INRS, Université de Québec à Rimouski | |
| Runge, Jeffrey | Oceanographie biologique Institut Maurice Lamontagne, DFO, Mont Joli, PQ | |
| Senechal, Jacque | Shellfish Water Quality Protection Program, Conservation and Protection, DOE, Montreal, PQ | microbiologist |
| Van Coillie, Raymond | Toxicology Branch, Industrial Pollution Abatement, DOE, Montreal, PQ | |
| Vezina, Alain | Division de l'Habitat du Poisson, Institut Maurice Lamontagne, DFO, Mont Joli, PQ | |

## Halifax - 5 November 1992

| Individual | Affiliation | Specialization |
|---|---|---|
| Barchard, Wayne | Ecotoxicology, DOE, Dartmouth, NS | toxicologist |
| Brown, Dick | Canadian Wildlife Service | seabirds |
| Bugden, Gary | Physical and Chemical Sciences, DFO, Bedford Institute of Oceanography | |
| Christian, John | LGL Ltd., St. John's, NF | invertebrate behaviour |
| Cross, William | LGL Ltd., King City, ON | benthic ecologist |
| Davis, Derek | Nova Scotia Museum | mapping |
| Dionne, Suzan | Canadian Park Service, Quebec Region | ecologist |
| Drinkwater, Ken | Physical and Chemical Sciences, DFO, Bedford Institute of Oceanography | |
| Fay, Brad | Nova Scotia Land-Use Committee | mapping |
| Gordon, Don | Habitat Ecology Division, DFO, Bedford Institute of Oceanography | fisheries biologist |
| Greenberg, David | Physical and Chemical Sciences, DFO, Bedford Institute of Oceanography | physical oceanographer |
| Meeuwig, Jessica | School for Resources and Environmental Studies, Dalhousie University, Halifax, NS | environmental studies |
| Montgomery, Andy | Nova Scotia Land-Use Committee | mapping |
| Munroe, Neil | Canadian Park Service, Atlantic Region | marine parks specialist, recreational planner |
| Prindenberg, Simon | Physical and Chemical Sciences, DFO, Bedford Institute of Oceanography | |
| Ross, Jim | Habitat Management, DFO, Bedford Institute of Oceanography | habitat biologist |
| Siebert, Gerald | Science, DFO, Bedford Institute of Oceanography | information officer |
| Yeats, Phil | Marine Chemistry, DFO, Bedford Institute of Oceanography | marine chemist |

## Moncton - 6 November 1992

| Individual | Affiliation | Specialization |
|---|---|---|
| Alexander, Ross | DFO, Moncton, NB | habitat biologist |
| Cassie, Daniel | DFO, Moncton, NB | hydrologist |
| Christian, John | LGL Ltd., St. John's, NF | invertebrate behaviour |
| Clay, Douglas | DFO, Fundy National Park | marine ecologist |
| Langteigne, Marc | DFO, Moncton, NB | biologist |
| MacNeil, Lee | LRIS | coastal zone mapping |
| Smith, John | DFO, Moncton, NB | marine toxicologist |
| Swain, Doug | DFO, Moncton, NB | fisheries biologist |


Environment Canada
Environnement Canada
Marine Ecological Classification System for Canada
Scale: 1 : 7,500,000
January 1994
Lambert Conformal Conic Projection
ARCTIC BASIN
Ward Hunt Ice Shelf
Axel Heiberg Fiords
Nares Strait
North Water Polynya
Wellington Ch.
McDougall Sd.
Jones Sd.
Beaufort Sea
Western Archipelago
Lancaster Sd.
Baffin Bay (seasonal ice)
Cape Bathurst Polynya
MacKenzie River Plume
Amundsen Gulf
Barry Ch.
North Baffin Fjords
ARCTIC ARCHIPELAGO
Baffin Bay (permanent ice)
Gulf of Boothia
NORTHWEST ATLANTIC
Coronation / Queen Maude Gulfs
Foxe Basin
Davis Strait / Labrador Sea
Hudson Strait
Ungava Bay
Labrador / Newfoundland Shelf
Subartic Atlantic
PACIFIC
Dixon Entrance
Hudson Bay
Hecate Strait
Northern Pacific
Queen Charlotte Sound
Continental Slope
Queen Charlotte Strait
Johnstone Strait
Transitional Pacific
Georgia Basin / Puget Sound
Vancouver Island Shelf
Juan de Fuca Strait
James Bay
North Shore Gulf of St. Lawrence
N.E. Gulf
ATLANTIC
Grand Banks
St. Lawrence Trough
Gaspe Current
Magdalen Shallows
Temperate Atlantic
St. Lawrence River
Scotian Shelf / Georges Bank
Bay of Fundy