Boundary recommendations-
Coast of Bays Coastal Management Area; South Coast

D. W. Ings

March 2006

Report to Oceans Division
Oceans and Habitat Management Branch
Fisheries and Oceans Canada

Table of contents

List of Tables

List of Figures

List of Appendices

Preface

Stakeholders from the Coast of Bays (COB) region (see Fig. 3) have expressed interest in integrated coastal zone management for their area. In 2002, the Coast of Bays Corporation (Regional Economic Development Board) partnered with the provincial Department of Fisheries and Aquaculture and the Department of Fisheries and Oceans (DFO) to assess the feasibility of integrated management in the region. Strong support for integrated management was found among local stakeholders and the general public. Moving toward integrated management planning for an area requires detailed knowledge of local marine resources in the context of the broader physical, biological and human systems. To date, information on physical, biological and human use has been compiled, Marine Environmental Quality Atlas and Profile have been completed and preliminary identification of important (biological and social) areas using Traditional Ecological knowledge (TEK) (Summit Consulting, 2005) has been completed for the area bounded by the Coast of Bays Regional Economic Development Board. Compiling information on human systems is ongoing.

This report marks another step toward establishing a coastal marine management area in the COB region. The primary goals of this report are to evaluate criteria for determination of boundary management areas on the south coast of Newfoundland and recommend boundaries for the COB coastal management area.

Acknowledgements

I would like to thank Joan O'Brien (DFO) for her advice during development of this report and for providing assistance with the collection of information and with contacting individuals. Kathleen Blanchard is thanked for discussions on the human systems along the south coast of Newfoundland and for generously sharing resources and collaborating on analysis of landings data. I thank Bret Pilgrim for providing information, assisting with contacting individuals in the COB region and providing layers for Figure 6. Dawn Mercer is thanked for providing information on developing the Placentia Bay Management area. Jason Simms is thanked for a discussion on potential boundaries for offshore management areas. Thanks to Elizabeth Bennett for producing Figure 6.

Executive Summary

The aim of coastal zone management is to balance the impact of human activities with protection of coastal and marine resources. In the Coast of Bays (COB) Region on the south coast of Newfoundland, there is strong support among local stakeholders and the general public for integrated management of coastal resources. One important step toward integrated management is to delimit coastal areas. This report evaluated criteria for delimiting coastal management areas along the south coast of Newfoundland, taking a broad approach that considered physical, biological and human systems. Relevant criteria were applied to determine potential boundaries for the COB region. Among the existing administrative boundaries, most important were the boundary between Canada and St. Pierre and Miquelon and the boundaries between maritime zones established under the UN Convention on the Law of the Sea. At smaller spatial scales, boundaries between Regional Economic Development boards and municipalities were also relevant. The Northwest Atlantic Fisheries Organization management units were considered important because of their general acceptance and practical scales for scientific research and monitoring of living marine resources. This report found that relatively large scale physical features along the south coast of Newfoundland should be considered when determined coastal management areas. Relevant features included water masses, bathymetry, fjord groupings, drainage basins and watersheds. Biological processes were also considered important. Only broad scale information was available on biodiversity and the distribution and migration patterns of marine organisms. The ecology of 10 species at risk (1 invertebrate, 3 fish, 3 marine mammals and 3 birds) was determined to be relevant to coastal management boundary delimitation. When human systems were evaluated, land use by communities and first nations bands plus aspects of various industries were identified as important considerations for establishing coastal management units. For the fishing industry, species fished and landings were important considerations. Logistical issues around the distribution of salmonid aquaculture sites, submarine cables and ongoing research programs were also deemed relevant.

Recommendations on boundaries for the COB Coastal Management Area, based on the criteria above were to extend the management area;
1) alongshore from Point Crew (border with the Placentia Bay Coastal Management Area) to McCallum.

2) offshore to 24 nmiles or the international boundary with St. Pierre and Miquelon

3) landward to encompass the Bay d'Espoir reservoir system and all other watersheds that occur within the alongshore limits.

Application of criteria determined in this report also suggested two other coastal management areas along the south coast of Newfoundland, to the west of the COB region; the boundary between NAFO subdivisions 3Ps and 3Pn would separate these two coastal management areas.

1.0. Introduction

1.1. Integrated Management of Coastal Marine Ecosystems

Integrated management should provide formalized but flexible governance that promotes equity in resource allocation. Integrated coastal management operates most effectively in a closely integrated and coherent management framework within a defined geographical limit (Chua, 1993). The aim of coastal zone management is to balance the impact of human activity with protection of coastal and marine resources. Cicin-Sain and Knecht (1993) consider the objectives of coastal zone management are to exercise stewardship, maintain public safety, control interactions between uses and users and ensure an adequate return to the public from publicly owned resources. All resources and activities associated with coastal lands and waters are included (Global Oceans, 2006).

1.2. The Canadian Approach

As outlined in the *Policy and Operational Framework for Integrated Management of Estuarine, Coastal and Marine Environments in Canada* (2002), Canada's *Oceans Act* (1997) provides a framework for ocean management that is based on an ecosystem approach. Canada's approach is inherently hierarchical. It considers ecosystems to be nested within ecosystems and recognizes that sustainable use of oceans and coastal waters requires a comprehensive and interconnected system with regional and coastal management nested within larger management bodies. The overriding goal is to balance protection of marine ecosystems with economic development and other valued human uses.

1.3. Current Status of Coastal Management in Newfoundland

To aid with integrated management of Canada's oceans, DFO has defined Large Ocean Management Areas (LOMAs) that are generally delimited along NAFO boundaries. Development of five LOMAs was prioritized; the Placentia Bay-Grand Banks LOMA was the only LOMA in Newfoundland assigned high priority. Within all LOMAs, Canada is working toward delineating coastal management areas.

1.4. Approach taken in this Report

This report provides a brief overview of marine boundaries that were suggested previously followed by consideration of criteria that are relevant to delimitation of coastal management areas along the south coast of Newfoundland. The objectives of this report were to: (1) evaluate criteria for delineating coastal management areas on the south coast of Newfoundland (2) apply relevant criteria identified under objective (1) to make recommendations for coastal management area boundaries in the Coast of Bays Region and (3) determine whether other coastal management boundaries are apparent along the south coast of Newfoundland using criteria developed under objective (1).

2.0. Marine Regions

Some coastal regions were defined previously at spatial scales too large to be practical for coastal management boundaries in Canada. Forty nine Large Marine Ecosystems (> 200,000 km^2) were identified following the United Nations Conference on the Environment and

Development in 1992 as part of a strategy to improve assessment and management of coastal resources (Sherman and Alexander, 1986). Boundary criteria included productivity, fish and fisheries, pollution and ecosystem health, socioeconomic and governance (Sherman and Alexander, 1986). Application of these criteria identified the Newfoundland Shelf including the Grand Banks as one region. Another large scale classification of ocean regions was developed by Longhurst (1998) who identified four marine biomes. The coastal biome encompasses all coastal areas and was subdivided into provinces based mostly on biophysical discontinuities in the ocean. In the Longhurst (1998) classification, Newfoundland and Labrador fell within the Northwest Atlantic Shelves Province which ranges from Florida to the Grand Banks. The World Wildlife Fund also classified large ocean regions (WWF Global 200 ecoregions) based on biological criteria (e.g. species richness) to represent major habitat types. All of Newfoundland and Labrador was classified under the North Temperate ecoregion representing a Temperate Shelf and Seas habitat type.

Coastal regions at smaller spatial scales were defined previously according to ecological and physical criteria with human systems and governance receiving relatively little attention. In a report for Parks Canada, Steele *et al*. (1978) suggested that the coastal area to the west of Bay d'Espoir qualified as a Natural Area of Canadian Significance (NACS), but this designation was not assigned. The general criteria for NACS designation were that the area has diverse geological, oceanographical, physiographical and biological themes of natural areas and have experienced minimal modifications by man (Yurick and Vanstone, 1983). Parks Canada continues to take steps toward developing marine conservation areas (Parks Canada, 2005). It has identified 29 marine ecoregions in Canada with plans to develop one marine conservation area in each ecoregion. There are 10 ecoregions in Atlantic Canada; the Laurention Region encompasses the south and west coasts of Newfoundland. Within this region, five locations, including the fjords on the south coast, have been selected as preliminary sites for marine conservation area designation.

To aid with monitoring changes in environmental quality, Environment Canada also developed a hierarchical classification system for marine areas (Harper *et al.* 1993). This system had four levels based on ecological uniformity. At the largest spatial scale were Ecozones which were defined by sea ice character and ocean basins. Within ecozones were ecoprovinces. This level was defined by major assemblages of oceanic scale ecological features. Ecoregions were the next embedded level which corresponded to continental shelf and semi-enclosed seas with distinct salinity, marine flora and fauna and productivity. Ecodistricts were the smallest level of classification. These unique areas were defined by ocean mixing processes and associated biotic communities. For Ecozones without sea ice, there is little subdivision beyond the Ecoprovince level (subarctic, temperate, Grand Banks, Scotian Shelf/Georges Bank). As the south coast of Newfoundland is within the Ecozone without sea ice, employing this classification system does not identify practical zones for coastal management there.

The Protected Areas Association also defined marine regions of Newfoundland. Meades (1990) identified 13 Marine Natural Regions based mostly on bathymetry, oceanography and

physical features. Generally, this classification delineated deep channels (e.g. Laurentian - Esquiman Channels), major banks (e.g. Grand Banks) and broad regions of the continental slope or shelf (Meades, 1990).

3. Evaluation of Criteria for Boundary Selection of Coastal Management Areas

3.1. Administrative Boundaries

3.1.1. International Boundaries

3.1.1.1. National Boundaries

In 1992, a decision by an international court of arbitration led to the establishment of an economic zone off the French islands of St. Pierre and Miquelon. This zone is within 24 miles off the islands with an additional 10.5 mile wide corridor running south 200 miles toward international waters (Fig. 1). St. Pierre and Miquelon are located less than 24 nmiles from portions of the south coast of Newfoundland. Therefore, boundaries for the French economic zone must be considered when determining coastal management boundaries for the south coast of Newfoundland.

3.1.1.2. National and International Law

The UN Convention on the Law of the Sea, agreed upon in 1982, provided coastal states with a 12 nmile territorial sea and a 200 nmile exclusive economic zone for fishing purposes. The *Oceans Act* (Canada) declared a Contiguous zone which extends 12 nmiles beyond the territorial sea. Therefore, within 24 nmiles of the coast, Canada has responsibilities and rights to prevent infringements on customs, fiscal, immigration and sanitation laws (Indexmundi, 2006). Maritime zones should be considered when determining the seaward extent of coastal management areas.

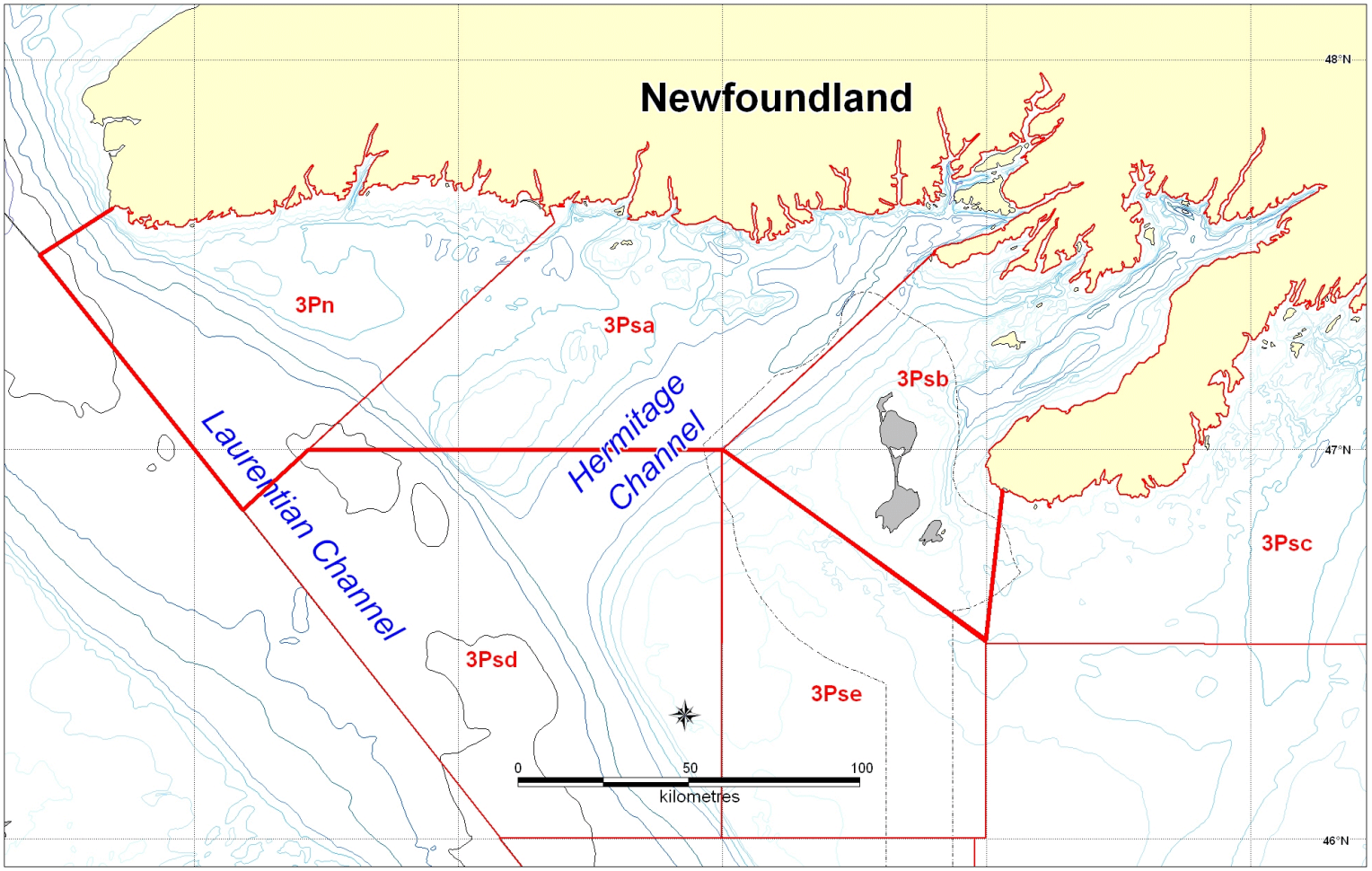


Figure 1. Map of the south coast of Newfoundland showing NAFO subdivision 3Pn and coastal areas of 3Ps. Also, note the dashed line representing the boundary between Canada and St. Pierre and Miquelon.

3.1.2. Federal Boundaries

3.1.2.1 Federal Electoral Districts

The entire south coast of Newfoundland falls within the Random-Burin-St. Georges federal electoral district hence, federal electoral districts are not useful in defining coastal management boundaries along the south coast.

3.1.2.2. Census Divisions

There are two census divisions along the south coast of the province (Fig. 2). Most of this area is in census division 3. Census data are readily available at a relatively high resolution (community level post 1997) permitting analyses to be performed easily over larger spatial scales. Therefore, demographic analysis can be performed for coastal management areas, regardless of delimitation. Census divisions are not particularly relevant to determining coastal management area boundaries.

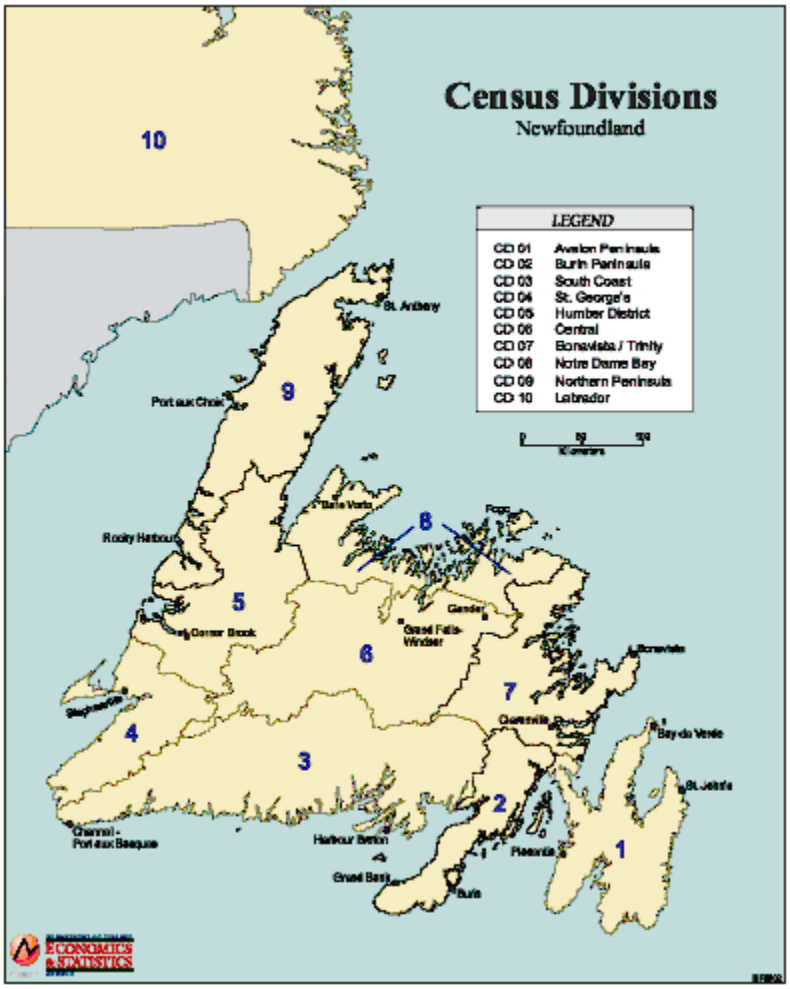


Figure 2.Census divisions in Newfoundland.

3.1.3. Provincial Boundaries

3.1.3.1. Regional Economic Development Boards on the South Coast

There are 20 regional economic development (RED) zones in Newfoundland and Labrador (Fig. 3) each overseen by a board with the goal to facilitate the development of business and economic opportunities in their zone (Newfoundland Government 2006b). Four zones encompass the south coast of Newfoundland. In this area, RED Boards have been involved in a variety of marine and coastal projects including aquaculture, fishery and tourism developments. RED boards have also been active in the collection of information on marine resources in Newfoundland and Labrador through participation in the development of Community-based Coastal Resource Inventories (CCRI). In the Coasts of Bays zone, the RED Board was also instrumental in initiating coastal management planning in their area.

RED zones were logical starting points for determining coastal management boundaries in some areas of Newfoundland. Most zones delineate practical community groupings. As most of the provinces population lives near the coast and marine related activities are so important economically, RED Boards are involved in a variety of aspects of local marine activities.

Figure 3. Map of Newfoundland and Labrador showing Regional Economic Development zones.

3.1.3.2. Electoral Districts

Four provincial electoral districts occur along the south coast of Newfoundland; Grand Bank, Bellevue, Fortune Bay-Cape La Hune, and Burgeo-La Poile. Note that the boundary between the Fortune Bay- Cape La Hune and Bellevue districts corresponds with the boundary for the Coasts of Bays RED Board.

3.1.4. Municipal Boundaries

Municipalities provide local governance and administer various services and infrastructure, but many towns also support or lead community activities and economic development as well. Clearly, management of the coastal areas requires coordinated efforts that include municipalities. Along the south coast of Newfoundland, municipal areas are relatively small, encompassing areas only on the order of tens of square kilometres. Therefore, municipal boundaries are important considerations for the fine scale delineation of coastal management boundaries.

3.1.5. Additional Boundaries associated with Organizations

3.1.5.1. Inter-governmental

The Northwest Atlantic Fisheries Organization (NAFO) and its predecessor the International Commission of the Northwest Atlantic Fisheries were established as intergovernmental fisheries science and management bodies. NAFO was established in 1979 with the overall aim to contribute to the optimum utilization, rational management and conservation of marine resources in the Convention area (NAFO, 2006). Annually, conservation and enforcement measures are considered by NAFOs fisheries commission which decides on fisheries regulations, total allowable catch and quotas.

To aid with the collection of statistical data and with conducting scientific research on marine resources within its boundaries, ICNAF delimited statistical areas that roughly corresponded to those occupied by major fish and invertebrate stocks and distinct areas with respect to physical oceanography. Allowances for convenient management were made in a few instances. The statistical areas of ICNAF were adopted by NAFO and eventually they became know as the NAFO Subdivisions (Halliday and Pinhorn, 1990). General principles for Subdivision boundary delineation, listed by Haliday and Pinhorn (1990), were 1) uniformity of size 2) division of important fishing grounds and fish stocks 3) simplified proposal to provide for prompt submission of complete statistics on landings and fishing effort to the Commission 4) conformity with existing statistical unit areas and fishery-officers districts 5) avoidance of duplication of letters assigned to subdivisions.

NAFO Subdivisions 3PS and 3Pn are located along the south coast of Newfoundland (Fig. 4). NAFO Subdivions form important management units for living marine resources and represent practical scales of scientific research and monitoring. The fundamental basis for subdivision delimitation was fish and invertebrate stock occurrence, for example, along the south coast of Newfoundland, Atlantic cod are referred to as either 3PS or 4RS-3Pn cod stocks and fishery management decisions such as quotas, opening / closings and moratoria are made at the

NAFO Subdivision level. Therefore, NAFO Subdivisions should weigh heavily as criteria for delineating coastal management boundaries on the south coast of Newfoundland.

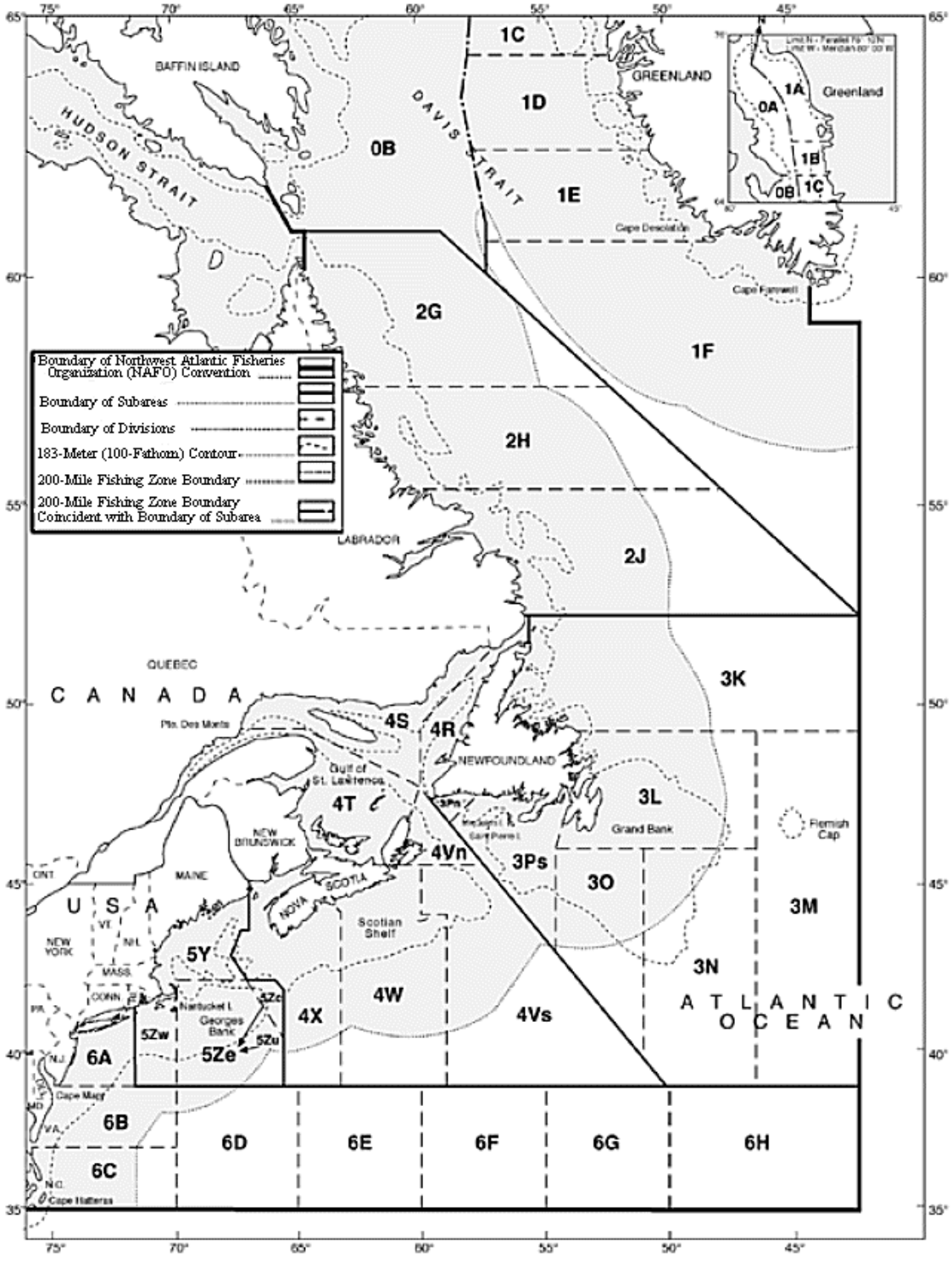


Figure 4. Map of the Northwest Atlantic showing NAFO area boundaries.

3.1.5.2. Non-governmental Organizations

The Fisheries Resource Conservation Council (FRCC) was created in 1993 to advise the Minister of Fisheries and Oceans on a number of conservation issues. Among its 15 members are representatives of government, the scientific community and the fishing industry, all appointed by the Minister of Fisheries and Oceans. The FRCC makes public recommendations on Total Allowable Catch (TAC). Additionally, the FRCC provides advise on Canada's position on stradling and transboundary stocks and suggests priorities for assessment and research (Fisheries resource Conservation Council, 2003). Advice of the FRCC is often pertinent to NAFO Divisions or subdivisions highlighting the importance of this spatial scale in fisheries resource management.

3.1.5.3. Industry

No administrative zones or other boundaries become apparent by considering representative bodies for companies or employees involved in the fishery and fish processing sectors (Fish, Food and Allied Workers Union) or the aquaculture industry (the Newfoundland Salmonid Growers Association and the Newfoundland Aquaculture Industry Association) in Newfoundland and Labrador.

3.2. Physical Features

3.2.1.Geology

Insular Newfoundland contains the northeast zones of the Appalachian Structural Province. This province extends from Newfoundland to Alabama in the southwest with submerged extensions offshore covered by sediments that form the Atlantic Continental Shelf (Williams *et al.*, 1974). Two zones of the Appalachian Structural Province occur along the south coast of Newfoundland. Most of the south coast is in the Dunnage Zone which extends from Cape Ray east to the Connaigre Penninsula (Ullah, 1992). In this zone, the predominate rock types are slate and sandstone. The remainder of the south coast, including a portion of the Connaigre Penninsula, is in the Avalon Zone where mafic and felsic and volcaniclastic rocks are typical (Ullah, 1992). The Fortune Bay/Belle Bay area also has younger rocks. The faults separating these zones and secondary faults in Newfoundland are inactive tectonically (Catto, 2003).

Bedrock, either exposed or covered with a thin layer of sediment, comprises much of the surficial geology along the south coast of Newfoundland. During the last glaciation (Wisconsin), there was little glacial drift in coastal areas of Newfoundland, hence sediment deposits occur infrequently (Yurick and Vanstone, 1983). Soil has accumulated in some localized areas, most notably in the inner Bay d"Espoir fjord and the region between Hermitage Bay and Belle Bay. The rather homogeneous surficial geology of the south coast of Newfoundland does not aid in coastal management boundary determination.

3.2.2. Physiography

The physiography of the south coast of Newfoundland is characterized by limited relief

with a relatively small number of beaches and sandy areas (Catto, 2003; Yurick and Vanstone, 1983). Much of the coast has high cliffs (150 m) adjacent to the sea. The coastline is indented by long and steep walled fjords and both the outer coast and fjords have cirques and hanging valleys. Coastal uplands, known as the Atlantic Uplands of Newfoundland (Yurick and Vanstone, 1983), are irregular and relatively barren. While inland areas are somewhat homogenous, fjord ecosystems on the south coast of Newfoundland can differ greatly (Richard,1987) so fjord groupings are relevant to coastal management area delimitation along the coast.

3.2.3. Drainage Basins and Water Sheds

Located along the south coast of Newfoundland are two major drainage basins; Bay d'Espoir-Fortune Bay and the South Coast Drainage Basins (Fig. 5 a and b). Within these two drainage basins, there area a total of 30 water sheds (Ullah, 1992). Associated with many of these watersheds are relatively large rivers with the largest input of freshwater into the ocean occurring near Bay d' Espoir; there the Bay d'Espoir hydroelectric power plant, Conne River, Southeast Brook, Bay d'Espoir Brook and Salmon River outflow. Relatively large freshwater outflows occur at two other south coast locations; Grey River and the Bay du Nord River. Note that the Bay du Nord river is classified as a Heritage River. Canadian Heritage Rivers are places with outstanding natural and / or cultural values; these rivers offer quality recreational opportunities and showcase the benefits and enjoyment of healthy river environments, now and in the future (CHRS, 2006).

Done and Reichelt (1998) suggest that catchment should be an integral part of coastal zone management. Freshwater runoff may have numerous impacts on local marine environments including effects on water chemistry and clarity, nutrient loading and contamination. Alternatively, activities in marine ecosystems may impact on freshwater systems. There is potential for this in the COB region as illustrated by escapement of cultured salmonids from cages and their subsequent use of local rivers (Dempson *et al.* 2000). Additional benefits of including watersheds in coastal zone management may be realized if coastal stewardship programs include restoration of rivers, for example. In recognition of these potential impacts, integrated management areas typically extend landward to include estuaries, coastal marshes, rivers and streams. Therefore, watershed delineations are logical starting points for determining the inland extent of boundaries for coastal management zones. Along the south coast of Newfoundland, most watersheds are relatively small, extending only a few kilometres from the coast. However, special consideration should be given to whether all or part of the Upper Salmon River Watershed, which supplies the Bay d'Espoir Hydroelectric plant, is to be included in the Coasts of Bays Coastal Management Area. As described in Section 3.2.5.1., there is a thick (2 m) lens of freshwater at the surface in Bay d'Espoir that responds to local forcing during summer (Marine Sciences Research Laboratory, 1980). Watershed boundaries should also be considered when setting along-shore boundaries for coastal management areas as associated rivers and estuaries are often unique biologically and have increased human uses compared to nearby areas.

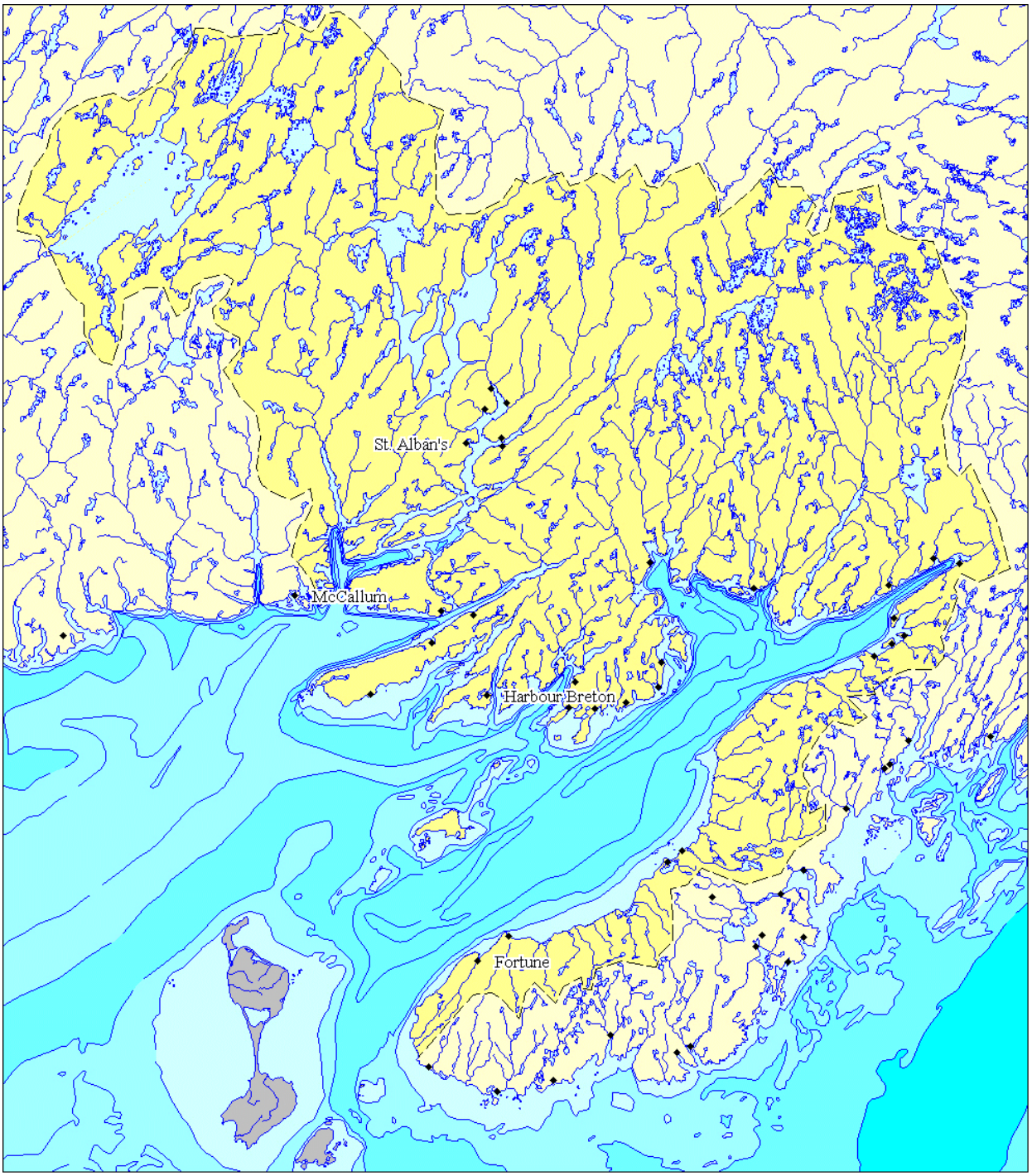


Figure 5a. Map of the Coast of Bays region showing the Fortune Bay-Bay d'Espoir water shed.

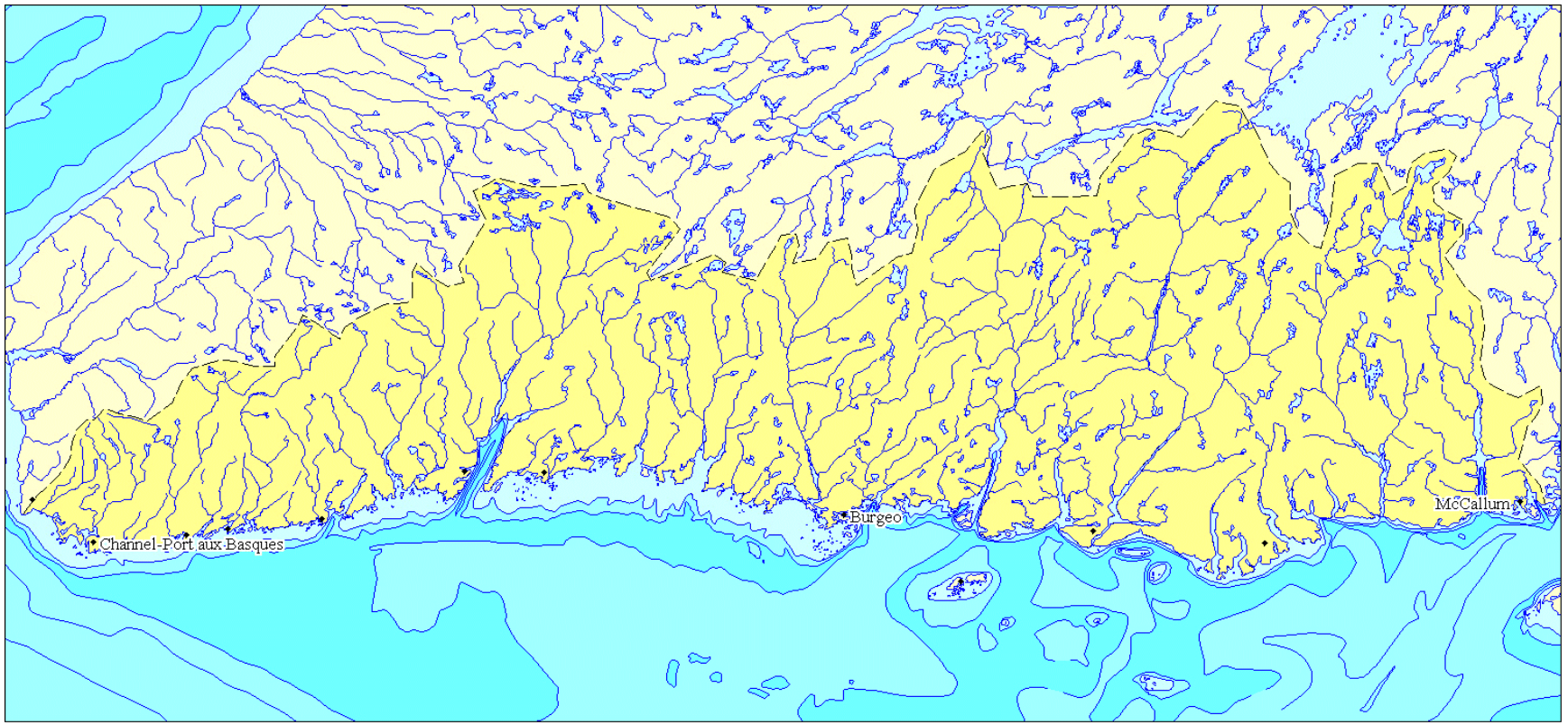


Figure 5 b. Map of the southwest coast of Newfoundland showing the south coast drainage basin.

3.2.4. Bathymetry

The dominant physical feature off the south coast of Newfoundland is the Laurentian Channel which extends from the continental shelf to the Gulf of St. Lawrence (see Fig. 1). Depths in the Laurentian Channel vary between 400 and 535 m. The Laurentian Channel approaches the coast near Port aux Basque and relatively large branches extend from the Laurentian Channel toward the coast in other areas. An eastern branch, the St. Pierre Channel, is oriented parallel with the Burin Peninsula with relatively shallow trenches leading into Fortune Bay and the Hermitage Channel. The Hermitage Channel, also a branch of the Laurentian Channel, is 137 km long and 40 km wide; it leads into Bay d'Espoir and Hermitage Bay along a southwest to northeast axis.

Numerous fjords with relatively deep waters are located along the eastern portion of the south coast of Newfoundland. Furthest east is Fortune Bay, which is 128 km long and 22 km wide with a maximum depth of 420 m in the central basin (deYoung and Hay, 1987) but depths reach over 500 m in Belle Bay. At the entrance to Fortune Bay are three sills. One sill is located between the Burin Peninsula and St. Pierre, another is between Miquelon and Sagona Island and the third sill is between Sagona Island and the coast of Newfoundland. Bay d'Espoir is approximately 38 km long and is the deepest fjord along the south coast of Newfoundland with a maximum depth of 755 m, which is deeper than the Laurentian Channel (535 m). There are 12 sills in Bay d'Espoir. The outer sill is at approximately 280 m depth (Richard and Haedrich, 1991) but other sills are relatively shallow (10-25 m). Many other fjords along the south coast are relatively deep with Bay de Vieux and Facheau Bay over 350 m deep and Rencontre, Chaleur and La Poile Bays greater than 250 m deep. Shallow embayments are rare but water depths in Grey River and Garia Bay are less than 20 m.

Along open sections of the south coast of Newfoundland are but a few islands and banks with associated shallow water areas. Off the Burin Peninsula are the islands of St. Pierre and Miquelon with shallow water ledges to the south and west. Further offshore is the relatively large St. Pierre Bank. Relatively small areas with shallow waters occur around Brunette and Sagona Islands, the Pinnacle Shoal, the Penguin Islands, Grey River Bank and Rocks (<15 m depth) and Ramea Islands. Near Burgeo Island and to the west is the most extensive area of the coast with shallow waters. In this area, fjords occur infrequently. There is also the hooked shaped Rose Blanche Bank that projects from the area near Port aux Basque.

3.2.5. Oceanography

3.2.5.1. Currents

Generally, currents all along the south coast of Newfoundland are relatively weak. Tidal currents are not strong in the area and mean tidal ranges are typically less than 1.8 m although extreme high tides (3.3 m) have been recorded near Conne River during autumn (Marine Sciences Research Laboratory, 1980). Non-tidal flow is associated with a branch of the Labrador Current. It flows along the northeast coast of Newfoundland before turning westward along the south coast but current velocities are generally weak (< 1 knot) although local winds and topographic steering may increases current strength in certain areas (Marine Sciences Research

Laboratory, 1980). The westerly moving current coupled with predominant onshore winds during summer suppress upwelling at the coast. Upwelling may occur most commonly in Bay d'Espoir where there is substantial freshwater input contributing to a distinct surface layer during summer (Marine Sciences Research Laboratory, 1980).

3.2.5.2. Water Masses

Two water masses influence the physical oceanography off the south coast of Newfoundland. The relatively cold (< -0.5 ºC) and low salinity Labrador Current is found above 150 m with warmer (4 to 6 ºC) and more saline Modified Slope Water (MSW) underneath (Richard and Haedrich, 1991). Depending on sill depth, MSW may enter deep fjords only occasionally during winter (shallow sill) or more readily (deep sill) when strong northerly winds occur (Richard and Hay, 1984). Labrador Current water also replaces deep waters in Fortune Bay during summer (de Young,1983). Deep water masses along the south coast of Newfoundland depend on bottom depth and degree of mixing, hence the influence of MSW water is observed in some deep fjords and channels, but is especially notable near the coast in western areas where the Laurentian Channel approaches the coast. The occurrence of different water masses is relevant to boundary delimitation.

3.3. Biological and Ecological Attributes of the Area

3.3.1. Biodiversity and Productivity

Biodiversity is thought to be a potential indicator of ecosystem health as it can be used as a measure of biological interactions (Sherman and Duda, 2002). However, biodiversity is difficult to define and different perspectives on biodiversity approach the concept from an ecosystem level (processes) or treat organisms as categories such as species, populations etc. (Callicot *et al.* 1999). Level of ecosystem functioning may also be indicated by productivity which is determined by the underlying processes that drive ecosystems. Biological productivity is often narrowly defined as the amount of solar radiation that is converted into biomass in an area; functionally, it is the ability of an area to grow vegetation that sustains organisms residing there. Biodiversity and productivity have been used to define large ocean regions in the past (e.g. Sherman and Alexander,1986) and hence should be considered as criteria for delimiting coastal areas.

High biodiversity and / or biological productivity areas were suggested by preliminary work in the Coasts of Bays region, but even this information is not available for other regions along the south coast of Newfoundland. Summit Consulting (2005) identified 32 areas that may be important ecologically and socially (including economically) within the Coast of Bays region through collection of Traditional Ecological Knowledge (TEK). Local residents identified 30 areas having high biodiversity and / or biological productivity. Biodiversity in this exercise referred to the number of species and productive areas were defined broadly by large populations of fish (Summit Consulting, 2005). Collection of TEK also identified known local spawning and feeding sites for species such as capelin, herring, lobster and salmon. Additionally, areas with particular habitats and ecological communities were identified. Each of these biological attributes of areas provides information about the underlying processes that are important in the coastal

zone hence, the distribution of these important areas should be considered when determining coastal management boundaries along the south coast of Newfoundland.

3.3.2.Species Distributions and Migration Patterns

Sharp demarcations of species boundaries are only rarely observed in the ocean with gradual changes in species presence and abundance typically observed (McKelvie, 1985). Such gradations in species composition may be associated with advective processes (Van der Spoel and Heyman 1983). However, faunal boundaries of fishes, for example, have been described and these boundaries are often linked to physical oceanographic changes that impede the transport of individuals (Backus *et al.* 1977). Along the south coast of Newfoundland, both transport (Fortune Bay) and local processes (Bay d'Espoir) are known to determine fish assemblages in fjords (Richard,1987). However, macrozooplankton assemblages were similar between fjords (Richard, 1987). Scientific sampling was not conducted for many organisms or at other fjords on the south coast of Newfoundland, but information on species distributions and migration routes are available from ESBAs identified in the Coasts of Bays Region (Summit Consulting, 2005) and for the entire coast in the Community-based Coastal Resource Inventories (CCRIs).

The goals of integrated coastal management include identifying the underlying processes that are important for coastal areas. Therefore, when coastal management boundaries are determined, species distributions and migration patterns should be considered as they may provide insight into underlying processes.

3.3.3. Species at Risk

The status of wild species and other evolutionary significant units in Canada is determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). It assigns one of six categories to species reflecting level of risk of extinction. Species may be determined to be not at risk, designated as special concern, threatened, endangered, extirpated or extinct. There is also a data deficient category.

A number of species that were assigned a status of special concern, threatened or endangered by COSEWIC are known to occur along the south coast of Newfoundland. These species include the leather back turtle, Atlantic wolffish, porbeagle shark, banded killifish, north Atlantic right whale, blue whale, harbour porpoise, harlequin duck, peregrine falcon and piping plover. The ecology of each of these species is an important consideration when determining boundaries for coastal management areas. Aspects of species ecology relevant to coastal management area boundaries include species range and migration routes, spawning / birthing areas, nursery and feeding areas as well as overwintering areas. The species at risk along the south coast of Newfoundland are considered below.

Leatherback Turtle *(Dermochelys coriacea*)

The global decline of leatherback turtle populations led to listing this species Endangered in Canadian waters in April of 1981; this status was confirmed in May 2001 (James, 2001).

There are no reliable estimates of leatherback turtle numbers in Canadian waters but globally, the population has decreased by more than 70% in 15 years (COSEWIC, 2001). The range of leatherback turtles extends beyond the south coast of Newfoundland and there are no significant areas (e.g. nesting) locally; therefore, ecology of leatherback turtles did not influence boundary recommendations for the COB coastal management area.

Atlantic Wolffish (*Anarhichas lupus)*

A status of special concern was designated to Atlantic wolffish. This species occurs on both sides of the Atlantic. In the Northwest Atlantic, Atlantic wolffish occur from west Greenland and Southern Labrador to the Grand Banks and in the Gulf of St. Lawrence; fish in the most southern range extend from the Scotian Shelf to the Gulf of Maine (Scott and Scott, 1988). Preliminary information on the occurrence of Atlantic wolffish in the COB region was documented by Summit Consulting (2005). Important areas for Atlantic wolffish are located at outer and inner Hermitage Bay, the Pass Island area, Connaigre Bay, Deadman's Bight, the Harbour Breton area, and the Great Bay de L'Eau areas (Summit consulting, 2005). Yurick and Vanstone (1983) observed wolffish at various locations in their study area ranging from outer Bay d'Espoir to White Bear Bay. Unfortunately, the occurrence of Atlantic wolffish has not been documented for coastal areas of eastern Fortune Bay. The spotted occurrence of Atlantic wolffish that has been documented along the south coast does not suggest logical groupings of areas for management.

Banded Killifish (*Fundulus diaphanus)*

In Newfoundland, there are only seven known populations of Banded Killifish occupying ponds mostly (six of seven) on the south and west coasts. This limited distribution and impediments to movement led COSEWIC to designate the Newfoundland population of banded killifish special concern (COSEWIC, 2003). Banded killifish are susceptible to reduced water clarity and habitat loss, often associated with logging. The distribution of banded killifish populations are relevant to coastal boundaries considerations along the south coast of Newfoundland

Porbeagle Shark (*Lamna nasus*)

The porbeagle shark was declared Endangered by COSEWIC in 2004 (COSEWIC, 2004). Porbeagles occur on continental shelves, sometimes inshore, from Raleigh in Labrador to New Jersey- South Carolina (Marinebiodiversity, 2006). There are directed fisheries for porbeagle sharks and they are also captured in recreational shark fisheries in Atlantic Canada. The relatively large range of porbeagle sharks coupled with limited data on their use of the coastal areas on the south coast of Newfoundland precludes use of porbeagle shark ecology as criteria for selecting coastal management boundaries along the south coast of Newfoundland

Harbour Porpoise (*Phocoena phocoena)*

Harbour porpoise range from Cumberland Sound on the east coast of Baffin Island to the coast of North Carolina with three populations in Atlantic Canada classified as special concern (COSEWIC, 2003). Coastal areas are only occasionally inhabited by harbour porpoise. They are

most commonly found further from shore but over continental shelf regions (COSEWIC, 2003). The ecology of harbour porpoise is not considered relevant to coastal management boundary delineation in the COB region because of the large range of this species and limited use of near shore areas.

Blue Whale (*Balaenoptera musculus*)

The population of blue whales in Canada was designated as Special Concern in 1983; the Canadian population was divided into the Pacific and Atlantic populations and up-listed to Endangered in May 2002 (COSEWIC, 2002). Blue whales occur globally and in the western North Atlantic their numbers are estimated to be in the low hundreds. The abundance of blue whales in the COB region is not known. However, some of the most recent observations on blue whales were from the east and south coast of Newfoundland (Lien *et al.* 1990). As the range of this species is relatively large extending well beyond the south coast of Newfoundland and there are no significant areas (e.g.birthing sites) locally, ecology of the Endangered Blue whale is not pertinent to boundaries for coastal management areas considered in this report.

North Atlantic Right Whale (*Eubalaena glacialis*)

Reduction in the number of North Atlantic right whales to 322 individuals contributed to COSEWIC declaring them endangered (COSEWIC, 2003). The western North Atlantic population ranges from Florida to Newfoundland and the Gulf of St. Lawrence (COSEWIC, 2003). Occasionally, North Atlantic right whales occur along the south coast of Newfoundland. Ecology of Northern right whales is not considered further in this report because of their large range and rare occurrence in the study area.

Piping Plover (*Charadrius melodus)*

The Piping Plover was declared endangered in1985 (COSEWIC, 1985). Piping Plovers that breed in Atlantic Canada overwinter in the south Atlantic, on the Gulf Coast or Caribbean. On the south coast of Newfoundland, Piping Plovers nest on Big Barasway (near burgeo) and the area near Great Bay West. They also nest on the French island of Miquelon (COSEWIC, 1985). One of the major contributors to the decline of Piping Plover populations is coastal developments that effectively reduce the size of breeding areas (US Fish and Wildlife Service, 2006). Therefore, ecology of Piping Plovers should be considered when delimiting coastal management boundaries on the south coast of Newfoundland.

Harlequin Duck (*Histrionicus histrionicus)*

The eastern Canadian population of Harlequin Duck is classified as Endangered (Species At Risk, 2006). Harlequin ducks are migrant sea ducks that breed primarily in Labrador and Quebec and overwinter on coasts from the island of Newfoundland (including the south coast) to Virginia. There is one recent observation of a Harlequin duck with young on the Bay du Nord River (IBA, Canada). During winter, Harlequin ducks feed in shallow waters on rocky coastlines (Species At Risk, 2006). As specific winter feeding areas for Harlequin ducks have not been identified on the south coast and they occur over a relatively large range during winter, ecology of Harlequin ducks is not particularly relevant to coastal zone management boundaries on the

south coast of Newfoundland.

Peregrine Falcon (*Falco peregrinus)*

Two subspecies of peregrine falcon occur in Newfoundland; the *anatum* subspecies is classified as threatened and the *tundrus* subspecies classified as special concern (COSEWIC). Peregrine falcons migrate through the south coast areas of Newfoundland. The anatum subspecies breeds in Labrador but not on the island. As there is little information available on the occurrence of peregrine falcons on the south coast of Newfoundland, they are not considered further in this report.

3.4. Human Uses and Activities

3.4.1. Human Settlements

3.4.1.1. Population

There were 27,951 individuals populating the south coast of Newfoundland in 2001 (Statistics Canada, 2003). Most communities on the south coast of Newfoundland are relatively small (< 1000 individuals) and the population of only five towns; Fortune, Burgeo, Harbour Breton, Grand Bank, and Channel- Port aux Basques was larger than 1500 (Appendix 1). A majority of the towns also experienced a 10 to 20 percent reduction in population between 1996 and 2001 (Appendix 1). Overall, the number of individuals distributed along the south coast of Newfoundland is not a significant concern for selection of coastal management boundaries.

3.4.1.2. Communities

Communities often form practical clusters because of their close proximity, similar histories and socio-economic makeup. Commonly, nearby communities in Newfoundland also share services such as water supplies and waste disposal systems. Community groupings are particularly important considerations for selection of coastal management boundaries along the south coast of Newfoundland because some of the communities are relatively remote or distances (by road) between communities are large.

3.4.2. Aboriginal Issues

3.4.2.1. Aboriginal Land Use

The Miawpukek Band Reserve at Conne River was recognized as an official Indian Act Band in 1984. The area of the reserve measures approximately 14 square miles. Historically, the Miawpukek Band also used lands located outside this reserve (Summit Consulting, 2005). Therefore, aboriginal land use is relevant to determining boundaries for coastal management areas on the south coast of Newfoundland.

3.4.2.2. Aboriginal Fisheries

The right of Aboriginal peoples to fish for food, social and ceremonial purposes was defined by the Sparrow decision in 1990. In response to this decision, DFO developed the Aboriginal Fisheries Strategy (AFS) to facilitate fisheries management in areas where DFO has jurisdiction of fisheries and other management regimes have not been established (e.g. under lands claims). Under the Allocations Transfer Program of AFS, commercial fishing licences that

are retired may be reissued to a First Nation. The Miawpukek First Nation at Conne River was first issued a commercial fishing licence in the late 1990s. Currently, there are four enterprises (44 feet 11 inches) held by members of the Miawpukek First Nation (R. Hinks, Pers. Comm.). These enterprises are licenced to participate in local groundfish and snow crab fisheries. The First Nation band also holds an Atlantic-wide large pelagics licence and has been allocated a 750 tonne shrimp quota in Shrimp Fishing Area 7. Aboriginal Commercial Fishing regulations parallel those of non-aboriginal fisheries, hence aboriginal fisheries are regulated by DFO and not considered separate from other fisheries with respect to coastal boundary delimitation in this report.

3.4.3. Industry

3.4.3.1. Fisheries

3.4.3.1.1. Fish Management Boundaries

Management units for fisheries in Newfoundland coastal waters correspond with NAFO delimitations (subareas, Divisions, subdivisions) or fishing areas that are species specific (e.g. lobster fishing areas) as set out in *The Atlantic Fisheries Regulations Act* (1985). These regulations define 14 fishing areas around Newfoundland. Fishing areas 11-12 and NAFO subdivisions 3Ps and 3Pn are located along the south coast of Newfoundland. The relevant management unit for each fishery that is prosecuted along the south coast of Newfoundland is listed in Table 1. Within management units, the DFO establishes Total Allowable Catch (TAC) for each fish stock. TACs may change annually or over multiple years as set out in a management plan, on the advice of the Fisheries Resource Conservation Council (FRCC) or scientists directly. Additional regulations on size restrictions, open fishing seasons and gear restrictions may differ between management units.

NAFO delimitations have some acceptance as management units for many fish stocks because they roughly correspond with the range of major invertebrate and fish stocks. Refer to Section 3.1.4.1. of this report for a more detailed discussion on NAFO boundaries.

Table 1. Management areas for marine fish and invertebrate stocks on the south coast of Newfoundland. SA refers to NAFO subareas

Species	Primary management unit (NAFO subdivisions, subareas)	Other management units
Iceland scallop	3Ps	
Snowcrab	3Ps, 4R3Pn	snow crab management areas 11 East, 11 West, 11 S, 11 SX, 12A (with Gulf)
Lobster	na	lobster fishing areas 11 & 12
Northern shrimp	na,	shrimp fishing area 7 nearby
Short-finned squid	3 & 4	none

Witch flounder	3Ps	none
Winter flounder	3KL(Ps)	none
Wolffish	2J3KLNOPs	none
Redfish	3Ps (4Vs), 3Pn (4Vn), 4Wfgi	none
Atlantic halibut	3NOPs4VWX	none
American plaice	3Ps	none
Monkfish	3LNOPs	none
Roughhead grenadier	SA 2 +3	none
Roundnose grenadier	SA 2+3	none
Lumpfish	3KL(P)	?
White hake	3LNOPs	none
Northern cod	3Ps	none
Northern Gulf cod	4RS 3Pn	none
Haddock	3Ps	none
Pollock	3Ps	none
Herring	3Ps	Fortune Bay, Pass Island to Cinq Cerf Bay
Mackerel	3+4	none
Bluefin tuna	2J3KL(3P4R)	none
Atlantic salmon	na	salmon fishing areas 9-11
Thorny skate	3LNOPs	none
Porbeagle shark	SA 3-6	none

3.4.3.1.2. Species Fished and Landings

Most invertebrate and fish stocks that are fished commercially in 3Ps are currently low or declining and two fisheries are under moratorium (Appendix 2). The fishery for American plaice has been under moratorium since 1993. The biomass in 2001 was only 20% of the average biomass between 1983-87 and there has been only a slight increase since the moratorium (DFO, 2002). The commercial fishery for Atlantic salmon is also closed and stock size continues to be

low compared to pre-closure years. There were increased returns at Conne and Little Rivers between 2003 and 2004 (DFO, 2004). Considered below are species that are fished in NAFO subdivision 3Ps and for which there are data on stock status.

Sea Scallop (*Plactopecten magellanicus*)

Beds of sea scallop were discovered on St. Pierre Bank in 1953 and a fishery for them developed by Newfoundland and Nova Scotia vessels soon afterward. Initially both inshore and offshore areas were fished. However, since 1997 effort has been concentrated in the inshore. During 2004, 3417 t of sea scallop were landed in Newfoundland and inshore CPUE declined by 25% from the previous year (NAFO, 2005).

Iceland Scallop (*Chlamys icelandica*)

The fishery for Iceland scallop began in 1989 and encompasses the trans-boundary stock where France has 70% of the annual TAC and Canada has 30 % of the TAC. However, this stock has not been fished since 1998. Landings of Iceland scallop in the Canadian zone decreased from 5367 t in 1997 to just 87 t in 2003 and 19 t in 2004. Effort diversion to other fisheries is thought to account for some of this decline (NAFO, 2005).

Lobster (*Homarus americanus*)

Lobster landings in subdivision 3Ps increased steadily from 612 t in 1999 to 818 t in 2004 (NAFO, 2005). Annual landings from the fishery in Lobster Fishing Area (LFA) 11 remain high around 700 mt but in LFA 12 landings are low relative to the 1980s and 1990s (R. Collins, Pers. Comm.)

Snow Crab (*Chionoecetes opilio*)

During the initial years (1987-1994) of the snow crab fishery in 3Ps, landings were below 1000 t; landings then increased and during the period 1999 to 2002 averages landings were 7800 t. Landings were lower at 6100 t in 2003. Landings from inshore areas accounted for 43 % of total landings in 3Ps during the period 1999 to 2003 (DFO 2004).

Short Finned Squid (*Illex illecebrosus)*

A single unit stock of short finned squid occurs in NAFO subareas 3-6. In NAFO subareas 3+4, landings of short finned squid averaged 81,000 t during 1976-81 but declined to 100 t in 1986. Between 1987 and 1997, landings varied between 600 t and 16,000 t. Landings of only 300 t were reported in 1999 and 2000.

Atlantic Halibut (*Hippoglossus hippoglossus*)

Atlantic halibut are managed as one stock in NAFO divisions 3NOPs4VWX (DFO, 1997). Landings of Atlantic halibut in NAFO Division 3 were less than 200 t annually between 1995 and 2000 and were somewhat higher during 2001 to 2004 with landings ranging from 317 t to 398 t annually (NAFO, 2005).

Witch Flounder (*Glyptocephalus cynoglossus)*

Annual landings of witch flounder in 3Ps varied between 300 and 1000 t since the early 1970s. During 1997 to 2001, average landings of witch flounder were just over 500 t annually. Landings from Fortune Bay make up a significant part of the total annual landings.

Winter Flounder (*Pseudopleuronectes americanus*)

The management unit for winter flounder is NAFO divisions 3KL and subdivision 3Ps. Landings of winter flounder were relatively high in 1994-95 with over 1000 t reported annually. Between 1996 and 1998, landings were lower at approximately 500 t annually. In 1999, landings increased to 809 t. There are no data on winter flounder independent of the fishery and the effects of effort on catch rates can not be determined.

American Plaice (*Hippoglossoides platesoides)*

American Plaice have been under moratorium since September of 1993. When assessed in 2001, the biomass of American plaice in 3Ps was estimated to be at 20% of the 1983 to 1987 average biomass. There has been only a slight increase in biomass since1993 and fishing mortality is expected to increase in the short term.

White Hake (*Urophycis tenius*)

One stock of white hake occurs in NAFO Divisions 3LNO and subdivision 3Ps. During the past two decades landings have declined substantially, but bycatch restrictions have been imposed during this period. Most of the fishery by Canadian vessels occurs on the border between 3Ps and 3NO. The white hake resource is thought to remain at a low level, but gear changes in the offshore research vessel survey prevent comparisons with years prior to 1995 (DFO, 2003).

Thorny Skate (*Raja radiata*)

Biomass of thorny skate in NAFO Divisions 3LNO and subdivision 3Ps were relatively stable up to 1991, but then declined to 1994. An average of only 2760 t of thorny skate were landed annually between 1999 to 2003. This stock remaind at historically low levels and recruitment to the stock has been relatively low in recent years (DFO, 2003).

Monkfish (*Lophius americanus*)

Monkfish are not under quota restrictions but are managed as one stock in NAFO divisions 3LNO and subdivision 3Ps. Historically, landings of monkfish were low, below 200 t annually between 1977 and 1991. Landings increased precipitously in 2002 -03 to 2795 t. Fishing mortality may now exceed a sustainable level (DFO, 2003).

Redfish (Sebastes spp.)

Landings of redfish in Unit 2 (3Ps4Vs, 3Pn4Vn, 4Wfgi) averaged 20,000 t annually between 1960 to 1968 ten increased to 43,000 t in 1975. Then, landings declined to 8100 t in 1984 and increased steadily to approximately 27,000 t in 1993. Landings decreased to 11,000 t by 1998 and have varied between 10,000 t and 17,000 t since then. Since the last research vessel survey, an industry survey indicates that the stock has declined between 2001 and 2003 (DFO,

2004).

Pollock (*Pollachius virens*)

In NAFO subdivision 3Ps, landings of pollock were relatively high in 1960 at 4500 t, but landings were less than 1000 t between 1962 to 1982. Then, landings increased to a peak of 7500 t in 1986 but decreased to less than 1000 t annually since then. A concern for the status of this fishery is mortality of young pollock associated with bycatch in coastal areas along the south coast (DFO, 2002).

Haddock (*Melanogrammus aeglefinus)*

There has been no significant fishery for haddock in 3Ps since 1957. Peak landings of 58,000 t of haddock occurred in 1955, but only low landings from bycatch have been reported since the late 1950s. Landings of haddock as bycatch in the 3Ps cod fishery varied between 84 t and 267 t between 1997 and 2001. Haddock are taken in offshore waters but also inshore. The future of the stock is difficult to predict as gear changes in the research vessel survey prevent analysis of long term trends (DFO, 2001).

Northern Cod (*Gadus morhua*)

The 3Ps stock of Atlantic cod were heavily exploited by non-Canadian vessels in the 1960s and 1970s with landings peaking at 84,000 t in 1961. After extension of jurisdiction in 1977, landings averaged 30,000 t until the mid-1980s when landings increased to 59,000 t with an increase in fishing effort by France. Then, landings fell to 36,000 t in 1992. This stock was placed under moratorium in 1993 but reopened in 1997 with a 10,000 t TAC. The TAC was 20,000 t each year during the period 1998 to 2001, except during 1999 when the TAC was 30,000 t. The TAC was set at 15,000 t for 2005 and at this level, biomass is expected to decrease in the short term as recruitment has been relatively low in recent years (DFO, 2004).

Landings of the cod stock in 4RS3Pn peaked in 1983 with more than 100,000 t were landed in that year. Average landings of 82,000 t were reported between 1964 and 1985. Landing declined after 1985 until 1994, when a moratorium was imposed. The fishery reopened for fixed gear in 1997, and between 1997 and 2003 quotas ranged between 3000 t and 7500 t. A second moratorium was imposed in 2003. In 2004, the fishery reopened with a quota of 3500t. The quota was increased to 5000 t in 2005 (DFO, 2005).

Herring (Atlantic) (*Clupea harengus*)

The Fortune Bay herring stock is at relatively low levels and catch rates in research gill nets are 42 % of the long term trend. Landings of this stock increased steadily since 1998 with annual landings of 2259 t and 3392 t in 2002 and 2003 respectively. Most of the catch is comprised of the strong 1999 year-class. The last assessment of this stock concluded there was a overall low risk of harm to the stock (DFO, 2004).

3.4.3.1.3. Fish Processing Plants

Along the south coast of Newfoundland there are 11 processing plants licenced for groundfish processing (Table 2); most of these plants also process other species including scallops, lobster, capelin, herring, and mackerel. Additionally, there are three facilities that process invertebrates (mussels, clam, lobster, scallop, and /or whelk) only. Also, there is a facility at St. Alban's that processes Atlantic salmon, trout and cod from the aquaculture industry. Fish processing plants have been major employers along the south coast of Newfoundland, drawing employees from the communities where they are located and from surrounding communities. Clusters of plants with similar licences also indicate shared interests in particular fishing sectors (e.g. offshore bank fishing) within regions. Clearly, the economic importance of a fish processing plant extends beyond the community or town where it is located. Therefore, the locations of fish processing plants are being considered together with community groupings in Section 3.4.1.2.

Table 2. Fish/Seafood Processing Plants located in the South Coast Study Area as of 2006/01/30. (Courtesy of K. Blanchard). Types of processing are; in province Retail Processing (RP), (Primary Processing (PP), Secondary Processing (SP) and Aquaculture Processing (AP)..

Company Name	Location	Species Processed	Contact
All Materials Products	Isle aux Morts, NL	Mussels (Aquaculture) (SP)	P.O. Box 161 Isle aux Morts, NL ADM 1JO Telephone : (709) 698-3600 (709) 698-3835 Fax : (709) 698-3773
Burgeo Fish Market	Burgeo, NL	Groundfish All Species, (RP), Lobster (RP), Pelagics, All Species, (RP) Scallop (RP), Shrimp (RP)	P.O. Box 543 Burgeo, NL AND 2H0 Telephone: (709) 886-1242 (709) 886-2621 Fax: (709) 886-2192
Eric King's Fisheries Limited	Burnt Islands, NL	Crab (PP), Groundfish All Species (PP), Lobster (PP), Lumpfish (PP), Pelagics All Species (PP), Salmonids (Aquaculture (PP)	P.O. Box 10 Burnt Islands, NL AOM 1BO Telephone: (709) 698-3421 (709) 698-3851 Fax: (709) 698-3025
Eric King's Fisheries Limited	Channel Port aux Basques	Groundfish All Species, (RP), Lobster (RP)	P.O. Box 10 Burnt Islands, NL AOM 1BO Telephone: (709) 698-3241 (709) 698-3851 Fax: (709) 698-3025
Billard Fisheries Limited	Margaree, NL	Groundfish All Species (PP), Lobster (PP)	P.O. Box 6, Suite 4 Margaree, NL AOM 1CO Telephone: (709) 698-3241 (709) 698-3866 Fax: (709) 698-3123
Clearwater Seafoods Limited Partnership	Grand Bank, NL	Clam (PP), Lobster (PP), Scallop (PP), Whelk (PP)	P.O. Box 340 Grand Bank, NL AOE 1WO Telephone: (709) 832-1550 Fax: (709) 832-1555
Fisheries Products International Limited	Fortune, NL	Groundfish All Species (PP), Lobster (PP), Pelagics All Species (PP), Scallop (PP)	P.O. Box 550 70 O'Leary Avenue St. John's, NL A1C 5L1 Telephone: (709) 832-1860 (709) 832-1861 Fax: (709) 832-1862
James Cox, trading as Harbour Breton Retail Trade	Harbour Breton, NL	Groundfish All Species (RP), Lobster (RP), Pelagics All Species (RP), Scallop (RP)	P.O. Box 188 Harbour Breton, NL AOH 1PO Telephone: (709) 885-2430 Fax: (709) 885-2431
Ocean Choice International (2005) Inc.	Hermitage, NL	Groundfish All Species (PP), Lobster (PP), Lumpfish	P.O. Box 8274 St. John's, NL A1B 3N4 Telephone: (709) 883-2323

		(PP), Pelagics All Species (PP), Salmonids (Aquaculture) (PP)	(709) 782-8244 Fax: (709) 883-3216
Harvesters Choice Inc.	Gaultois, NL	Groundfish All Species (PP), Pelagics All Species (PP)	25 Trinity Street St. John's, NL A1E 2M3 Telephone: (709) 841-5121 Fax: (709) 841-6151
North Atlantic Sea Farms Corporation	St. Alban's, NL	Atlantic Salmon (AP), Cod (AP), Trout (AP)	P.O. Box 400 St. Alban's, NL A1E 2M3 Telephone: (709) 583- 3231 (709) 583-3020 Fax: (709) 583-3022
Ocean Choice International (2005), Inc.	Burgeo, NL	Groundfish All Species (PP)	P.O. Box 8274, Station A St. John's, NL A1B 3N4 Telephone: (709) 886-2662 (709) 782-6244 Fax: (709) 886-2862
Ramea Co-operative Ltd.	Ramea, NL	Whelk (PP	P/O/ Box 400 Ramea, NL Telephone: (709) 625-2200 Fax: (709) 625-2277
Seafreeze Foods Inc.	Channel Port aux Basques, NL	Groundfish All Species (PP), Lobster (PP), Lumpfish (PP), Pelagics All Species (PP), Salmonids (Aquaculture) (PP), Scallop (PP)	415 Griffin Drive Corner Brook, NL A2H 3E9 Telephone: (709) 695-7067 Fax: (709) 695-7402
Sea King Foods Inc.	Grand Bank, NL	Crab, Snow (RP), Groundfish All Species), Mussels (Aquaculture) (RP), Pelagics All Species (RP Scallops (RP), Shrimp (RP), Whelk (RP)	P.O. Box 765 7 Water Street Grand Bank, NL A0E-1W0 Telephone: (709) 832-0499 Fax: (709) 832-0461

3.4.3.2. Aquaculture

Within the COB region there are 20 companies licenced or approved to conduct aquaculture of finfish, including salmon, steelhead trout, rainbow trout and Atlantic cod (Aquaneuve Solutions Inc. 2005). Most site licences are for salmon (34) and steelhead trout (24) with eight Atlantic cod sites and three rainbow trout sites (Aquaneuve Solutions Inc. 2005). There are also blue mussels sites in the area but the total number of registered sites for 2006 was not available at the time of submission of this report (CCRI).

The importance of the aquaculture industry to the economy of the COB region can be gauged by the value of product and the number of individuals employed directly or indirectly by the industry. Product from salmonid aquaculture in the COB region increased in volume from 1512 t to 5006 t during the period 2000 to 2005; during this period the value of salmonid production increased form $10.455 million to $26.5 million (Table 3). Current employment figures are not available, but the Coast of Bays Corporation (2003) found that 158 individuals were employed directly with activities at the incubator, hatchery, or cage sites. A further 108 individuals were employed in the processing of aquaculture products. Additionally, there are 25 individuals involved in service industries such as diving and net maintenance. With the importance of the salmonid aquaculture industry to the economy of the COB region and the restricted distribution of sites within the province, salmonid aquaculture should be considered when determining coastal management boundaries in the COB region.

Table 3. Volume and value of salmonid products produced by in the Coast of Bays region during the period 2000 to 2005. Data from Newfoundland Government 2006a (www.gov.nl.ca).

Year	Volume (tonnes)	Value (000 $)
2000	1512	10,455
2001	2811	14,952
20002	2870	14,932
2003	2600	12,994
2004	3329	16,980
2005	5006	26,500

Aquaculture is a priority for development in the Coasts of Bays region (C. Collier, Pers. Comm.). The growout of salmonids in Newfoundland has been limited to the COB region because of less suitable environmental conditions at most of the other regions in the province. Traditionally, salmonid aquaculture sites were within the protected reaches of bays and fjords in the COB region but companies recently moving into the area are transferring finfish cage design employed elsewhere and establishing growout sites in more open and exposed areas (Conrad Collier, Pers. Comm.). As such, the distribution of aquaculture sites may be expected to expand to areas outside of Bay d'Espoir, especially into Fortune Bay where some infrastructure for aquaculture already exists (S. Moyse, Pers. Comm.).

3.4.3.3. Tourism

3.4.3.3.1. Parks and Natural Areas

Camping sites located along the south coast of Newfoundland include the provincial parks; J.T. Cheeseman (Port aux Basque), Sandbanks (Burgeo) and Frenchmans Cove

(Frenchmans Cove) and the Jipujijkuei Kuespun Nature Park near Conne River.

Another attraction is the Fortune Head Ecological Reserve which is located 1.6 km west of Fortune and covers an area of 2.21 km. In 1992, this area was designated by the International Union of Geological Scientists as a Global Stratotype Section and Point; this designation is assigned to the best example in the world of a significant global stratotype. The Fortune Head site best represents the boundary between Precambrian and Cambrian Periods. Fossils observed at the site represent the first skeletal and bioturbating organisms.

In addition to parks and reserves, there are many other tourist attractions along the south coast. Within the COB region alone, 20 areas were identified that were potentially important for tourism because of the traditional appearance of a community or local recreational fishing (Summit Consulting, 2005). While the tourism industry holds much promise for expansion along the south coast of Newfoundland, it is not currently a significant consideration for coastal management area delimitation.

3.4.3.4. Hydroelectric Developments

The largest hydro-electric generating station in Newfoundland is located at Bay d'Espoir. Seven generating units on the reservoir system produce a rated output of 640 MW and the average annual production is 2657 Gwh. The reservoir system constructed to supply the station diverts water from the White Bear and Grey Rivers to Long Pond on the Salmon River, which has also been dammed, raising water levels at Long Pond. Water from Long Pond is channelled through penstocks to the Hydrogenerating station and into inner Bay d'Espoir (Yurick and Vanstone, 1983).

There is also a 6 megawatt hydroelectric generating station near Rose Blanche. This station on the Rose Blanche River became operational in 1999 with the completion of a forebay dam and flooding of river habitats (Newfoundland Power, 2006).

Hydro-electric developments in the COB region encompass large spatial scales and have significantly altered local drainage basins (see Section 3.2.3.). Because of their impact over large coastal areas in the COB region, hydro-electric developments should be considered when delimiting coastal management areas.

3.4.3.5. Forestry

The south coast of Newfoundland is within the Maritime Barren Ecoregion. Typical landscape patterns in this ecoregion are pure stands of stunted Balsam fir with expansive areas of heathland (Newfoundland Government, 2006). Good forest growth occurs only in localized areas. Three forest management districts (3, 7 and 14) occur along the south coast of Newfoundland. Domestic harvesting occurs in limited areas in district 3 (Burin Peninsula) and there are no commercial harvesting areas in this district. In district 7, commercial wood harvesting is centred in two areas; the Bay d'Espoir area and near Harbour Breton and Belleoram. Annually, nearly 800 Domestic Cutting Permits are issued in district 7. There are two areas in

district 14 (between Grey River and Port aux Basques) that are designated for domestic harvesting along the south coast of Newfoundland; within district 14, no commercial harvesting occurs along the south coast. As domestic harvesting occurs along the south coast and commercial harvesting is restricted to only two areas near Bay d'Espoir, the forestry industry is not considered relevant to boundary delimitation along the south coast of Newfoundland.

3.4.3.6. Non-extractive Use

There are many areas of coastal zones that are important for their non-extractive value. Such areas are not catalogued for much of the south coast of Newfoundland, but collection of Traditional Ecological Knowledge in the COB region (Summit Consulting, 2005) has identified areas that are potentially significant for economically or social reasons. Among these areas are locations of significant cultural interest such as aboriginal sites, archaeological sites, historic sites, and the presence of fossils or rare minerals. Recreational areas such as kayaking, pleasure boating, diving, recreational fishing, hiking, and presence of cabins or cottages were also identified. Other areas identified were those important for research or education and areas that are particularly scenic with no direct economic benefits. Groupings of sites that are significant socio-economically would indicate similar uses and values associated with particular regions along the coast. Therefore, the distribution of such sites is criteria for coastal management boundary delimitation.

3.4.3.7. Mining

There are few mining operations along the south coast of Newfoundland. In this area, the only producer listed on the Geological Survey website (www.gis.geosurvey.gov.nl.ca) is the Milltown quarry for flagstone. Developed prospects include Grey River Tungsten (2 sites), Great Burnt Lake copper (1.5 km northeast of Salmon River Dam) and South Pond Copper (10 km from North Salmon River Dam). There is a new quarry for aggregate proposed for Belleoram; if approved, aggregate will be shipped from the site. While mining would be a component of integrated coastal zone management, the relatively low level of activity along the south coast of Newfoundland would preclude mining from consideration in coastal management boundary delimitation.

3.4.3.8. Submarine Cables

Sub-sections of the trans-Atlantic telephone cable that connect Oban, Scotland and Penmarch, France to Clarenville Newfoundland (submarine cables TAT-1 and TAT-2 respectively) span from Terrenceville in Fortune Bay to Sydney Mines in Nova Scotia. These cables have separate routes through Fortune Bay with TAT-1 running north of Brunette Island and TAT-2 to the south. The maintenance authorities for these cables include AT&T, British Telecom, Teleglobe Canada, PTT France, and Deutsche Bundespost (International Cable Protection Committee, 2006). As activities in the vicinity of submarine cables are restricted and they span large expanses of the coastal zone in the COB region, the location of submarine cables should be considered in coastal management boundary delimitation.

3.5. Research

There have been a number of uncoordinated research efforts at various locations along the south coast of Newfoundland but ongoing studies or studies around certain themes are particularly relevant to coastal zone management. Below are discussed three dominant themes in research along the south coast of Newfoundland; fjord oceanography and fauna, salmonid population ecology and aquaculture.

3.5.1. Fjord Oceanography and Fauna

The unique bathymetry of Bay d'Espoir (Richard and Hay, 1984; Marine Science Research Laboratory 198) and Fortune Bay (de Young, 1983) captured the attention of oceanographers. The focus of these studies was water exchange, particularly in deep basins. Marine ecologists also studied mesozooplankton and fish assemblages in both Bay d'Espoir and Fortune Bay (Richard, 1987; Richard and Haedrich, 1991). The more conspicuous marine plants and animals in fjords, including Northern Arm of Bay d'Espoir, to the west of Bay d'Espoir were catalogued by Yurick and Vanstone (1983) for Parks Canada.

3.5.2. Salmonid Population Ecology

The only ongoing and long term freshwater research in the study area is associated with Atlantic salmon on the Conne River where a fish counting fence has been in operation since 1986 (Dempson *et al.* 2000). Data collection at this fence has provided estimates of upstream migrations of Atlantic salmon. It has also documented first use of the river by Arctic char in 1999 and collected escaped framed brook trout in the same year (Dempson *et al.* 2000). Additional research at Conne River include mark-recapture studies on out-migrating smolt (Dempson and Stansbury, 1991) and the effects of catch and release angling on salmon survival (Dempson *et al.*, 2002).

3.5.3. Aquaculture Research

Research on salmonid aquaculture in Newfoundland has been centred in the COB region with two areas of study predominating. Studies on fish development (Pepper *et al.*, 1987) emerged initially, but continue with respect to different strains or lines (e.g. all-female, diploid) of Atlantic salmon that may be cultured in Newfoundland (Pepper *et al.* 2003; Pepper *et al.* 2004). A second area of research focussed on environmental issues associated with finfish farms. At farm sites, water quality and benthic habitats (Tlusty *et al.* 1999) were sampled to determine the effects of organic inputs from cages and potential for dispersal (Tlusty *et al.* 2000). The potential impact of escaped fish from cages was also investigated by studying the dispersal of domestic triploid steelhead trout (Bridger *et al.* 2001).

4. Boundary Recommendations for Coast of Bays Area

It is recommended that the Coast of Bays Coastal Management Area extend alongshore from Point Crew (border with Placentia Bay Coastal Management Area) to McCallum (western boundary of the Coast of Bays RED zone, extending offshore to 24 nmiles or the international boundary with St. Pierre and Miquelon and extending landward to encompass the Bay d'Espoir reservoir system and all other watersheds that occur within the alongshore limits (Fig. 6).

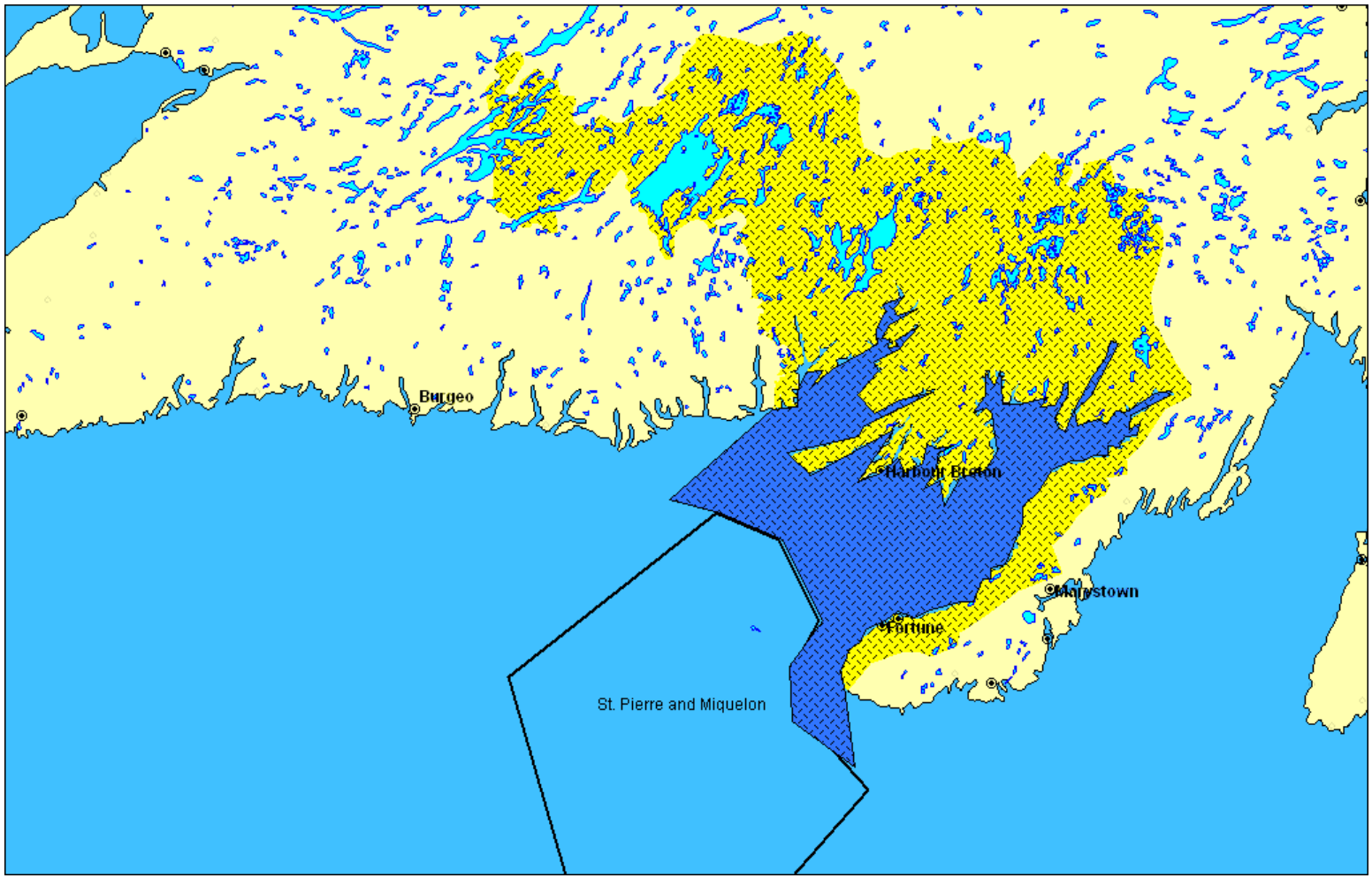


Figure 6. Map of the south coast of Newfoundland showing the boundaries for the Coast of Bays Coastal Management area (hatched area) that were recommended in this report.

4.1. Alongshore Boundary Rationale
4.1.1. Administrative Boundaries
4.1.1.1. Provincial Boundaries
Coast of Bays Corporation

The recommended boundaries encompass the entire Coast of Bays Regional Economic Development zone and the zone's western boundary was selected as the western boundary of the coastal management area. However, the coastal management area extends to the east, beyond the COB RED zone and into the Schooner RED zone. The logistical constraints of joint management of one coastal management area by the COB and Schooner RED boards, which are separated by a considerable distance by road, were considered during the preparation of this report. However, both RED boards share similar interests in the development of coastal resources in Fortune Bay. Joint development of the resources in Fortune Bay between the COB and Schooner Regional Boards may be facilitated by inclusion in one coastal management unit rather than between separate units. Further, it is hoped that inclusion of eastern Fortune Bay into a coastal zone management framework will foster new development initiatives in Fortune Bay.

From the perspective of the COBC, collaboration between the Schooner and COB zones on fisheries, aquaculture and tourism developments in Fortune Bay are prioritized (C. Collier, Pers. Comm.). With reduced access to marine resources to supply local processing plants in both RED zones during recent years, development of fisheries resources in Fortune Bay may benefit both areas. Joint aquaculture developments may also benefit both zones as there is a trend for new salmonid cage sites to be located in more exposed areas, outside of the traditional range of sites in Bay d'Espoir. Another shared interest is tourism development. Attracting more tourists to travel the south coast of Newfoundland by ferry would benefit both the COB and Schooner zone. Addition of a car ferry service (proposed locally) between Bay L'Argent and Pools Cove (currently, passengers only) would allow new marketing options for the area.

4.1.1.2. Municipal Boundaries

Municipal involvement is critical for integrated coastal zone management in the COB region because most towns are located at the coast, providing local governance over various ocean related activities. The operations of towns also impact on the marine environment. Municipal sewage is often disposed of in the ocean and freshwater bodies near the ocean are used as water sources. The sparse distribution of municipalities along the south coast coupled with the relatively small areas encompassed by municipalities present few limitations on coastal management boundaries in the COB region. Analysis of other criteria for coastal management area boundaries did not suggest a delimitation within a municipal boundary.

4.1.1.3. NAFO Boundaries

Boundaries for the COB coastal management area recommended in this report fall within NAFO subdivision 3Ps. This subdivision is further divided into eight units, with 3Ps a,b and c near the coast and 3Ps d - h offshore (Fig. 1). The eastern boundary for the COB coastal management area recommended in this report corresponds with the delimitation of 3Ps b and 3Ps c which is also the western boundary of the Placentia Bay coastal management area. However,

the recommended western boundary is positioned to include a portion of 3Ps a. Most of the fisheries management regulations in 3Ps are relevant at the subdivision scale. Notable exceptions include management of separate herring stocks that are located in Fortune Bay and between Pass Island and Cinq Cerf Bay and regulations restricting fishing for Atlantic cod to individuals with historical attachment to 3Ps a because of mixing between stocks of 3Pn and 3Ps cod in 3Ps a (L. Ryan, Pers. Comm.). Aside from these two exceptions, most fisheries management regulations do not differ between 3Ps a and 3 Ps b.

NAFO also plays an important role in compiling statistical data on fisheries. Unfortunately, the management boundaries recommended in this report do not conform to established statistical sections for reporting fisheries data on the south coast of Newfoundland. The statistical section in the western portion of the COB region ranges from Pass Island to Cape La Hune Cape. This should not be problematic for monitoring fisheries activities in the COB coastal management area. Fisheries data have been available at the community level since 1997.

4.1.2. Physical Attributes

4.1.2.1. Oceanographic Features

4.1.2.1.1. Bathymetry

While Bay d'Espoir has some unique bathymetric features compared to other fjords along the south coast of Newfoundland, it is more similar to Fortune Bay than to other fjords. Bay d'Espoir differs from neighbouring fjords because of its great depth (over 750 m) and complex network of 11 basins. Maximum depths of less than 550 m occur in other fjords along the south coast, including Fortune Bay. Also, fjords other than Bay d'Espoir typically have only two or three basins. Similarities between Bay d'Espoir and Fortune Bay include their connections to the Laurentian Channel by long and deep channels (Hermitage and St. Pierre). Although Bay d'Espoir is much deeper than Fortune Bay, depths in excess of 400 m occur in the central basin and in Belle Bay, within Fortune Bay (Hay and de Young, 1989; Richard and Haedrich, 1991).

4.1.2.1.2. Water Masses

The surface water masses in Bay d'Espoir and Fortune Bay have similar properties but deep water masses differ with exchange schedules varying between fjords (Richard and Haedrich, 1991). Deep waters in Fortune Bay are replaced during winter and summer by MSW and Labrador Current waters respectively. These two sources of water differ in density (different salinities and temperatures); therefore, vertical mixing is responsible for deep water replacement in Fortune Bay and it also contributes to weak stratification except in the deepest areas (Richard, 1987; Richard and Haedrich, 1991). In the outer basin of Bay d'Espoir, deep water masses are composed of MSW that is partially replaced only during spring, by denser MSW (Richard and Hay, 1984).

4.1.2.2. Fjord Groupings

The grouping of fjords recommended in this report is similar to historical fjord groupings. In this report Bay d'Espoir and Fortune Bay, the two largest fjords on the south coast of Newfoundland, are proposed to form one coastal management unit. Groupings of smaller fjords

from White Bear Bay east to the outer reaches of Bay d'Espoir were considered by Parks Canada as National Marine Area of Canadian Significance (Steele *et al.* 1978). More recently, a similar grouping of fjords was proposed as a potential marine conservation area (Yurick and Vanstone, 1983). Both of these reports recognized fundamental differences between most of Bay d'Espoir and fjords to the west. From a scientific perspective, Richard and Haedrich (1991) compared fish and zooplankton assemblages between Fortune Bay and Bay d'Espoir because of their similar size, adjacency and connection to the Laurentian Channel. Arguably, both fjords have unique characteristics, but the spatial extent of other fjords along the south coast of Newfoundland is considerably smaller.

4.1.3. Biological and Ecological Attributes.

4.1.3.1. Biodiversity and Productivity

Plant diversity was found to be similar along the coast of Newfoundland from the Northern Arm of Bay d'Espoir to White Bear Bay in a study by Yurick and Vanstone (1983); they found that generally, plant diversity increased with distance into fjords matching the clines of increasing salinity and decreasing wave exposure. Diversity estimates are not available for marine vegetation at other areas along the south coast. The distribution of marine vegetation described by Yurick and Vanstone (1983) supports fjord groupings as coastal management units.

Biodiversity of deep water macrozooplankton is similar among Bay d'Espoir and Fortune Bay with three species of euphausiids (*Thysanoessa raschii, T. Inermis* and *Meganyctiphanes norvegica*) and one arrow worm (*Sagitta elegans*) most common in the assemblage (Richard, 1987). Information on deep-water macrozooplankton is not available for other fjords or coastal areas. The abundance and diversity of epipelagic (near-surface) zooplankton is higher between Ramea and Chaleur Bay than between Chaleur Bay and Northern Arm (Yurick and Vanstone, 1983). The lowest abundance and diversity of epipelagic zooplankton in coastal areas between Bay d'Espoir and White Bear Bay were found at the entrance to Bay d'Espoir and Northern Arm. Overall, zooplankton assemblages appear more similar between Fortune Bay and Bay d 'Espoir than between Bay d'Espoir and fjords to the west.

A study on mesopelagic fish assemblages (Richard 1987) showed that species richness and evenness is higher in Bay d 'Espoir than in Fortune Bay indicating that local biological processes influence the composition of the fish assemblage in Bay d'Espoir while advective processes are more important in Fortune Bay. Productivity of ecosystems is often associated with advective processes; hence, Fortune Bay would be expected to be more productive than Bay d'Espoir (Richard and Haedrich, 1991). This conjecture is supported by CCRI data (Appendix 3). Large invertebrates and fish that are fished commercially, occur moreso in Fortune Bay than in Bay d'Espoir, examples include snow crab, American Plaice, Thorny skate, flounder, pollock, and porbeagle shark (Appendix 3). Fish diversity and productivity estimates are not available for other coastal areas along the south coast of Newfoundland. This precludes a comparison of fish diversity and productivity between Fortune Bay, Bay d'Espoir and coastal areas to the west.

4.1.3.2. Marine Flora and Fauna

4.1.3.2.1.Marine Vegetation Distribution

In general, the distribution of marine vegetation along the south coast was similar among the protected or inner portions of fjords and among exposed coastlines on the open coast. Kelp patches (Cabbage, Finger and Winged) were relatively common all along the south coast, and particularly common on exposed open coastlines (Appendix 3). Similarly, vast expanses of the coast contained rockweed (Appendix 3). Irish moss was limited to a few areas in the COB region and to the west (Yurick and Vanstone, 1983). Eelgrass occurred only in sheltered areas of Bay d'Espoir and at similar sites to the west. Knotted wrack was common in the COB region, but its distribution is unknown elsewhere along the south coast. None of the species of marine vegetation considered in this report were at the edge of their range. See Appendix 3 for more details.

4.1.3.2.2. Marine Animal Distributions and Migrations

The global distributions and local occurrences of marine invertebrates and fish along the south coast of Newfoundland are summarized in Appendix 3. The following is a summary of marine invertebrate and fish distributions and migrations along the south coast of Newfoundland.

Invertebrates

Marine invertebrates often occurred in patches throughout the study area and migrations are not known for the more conspicuous (commercial) species, for which we have some information. Sea urchins, lobster and rock crab were relatively common and occurred along vast expanses of the coast (DFO Community-based Coastal Resource Inventories). Clams, mussels, and sea scallop were observed in only small and localized areas. These species are typically found in depositional areas that occur infrequently in the COB region. Snow crab occur in large areas in Fortune Bay and off the Connaigre Peninsula, but concentrations of snow crab are less common near the coast further west.

Groundfish

Atlantic cod

At the species level, Atlantic cod occur all along the south coast of Newfoundland. However, the cod stock in 3Ps is recognized as separate from that in 3Pn (one stock in 3Pn and 4RS), with some mixing between these stocks recognized recently in the western portion of 3Ps (L. Ryan, Pers. Comm). Traditional Ecological knowledge on cod migrations in Fortune and Hermitage Bays (3Ps) was collected by Ripley (1995) and described below. During January and February, there is a eastward movement of cod from Pass Island, Hermitage and Harbour Breton areas to Fortune Bay. During mid-May, there is a second migration of cod that are smaller in size and have a different colouration. This capelin scull moves from Grand Bank to Fortune Bay in mid-May and a capelin/herring scull reaches Hermitage Bay in May-June. In late June - July, there is a movement of cod out of Fortune Bay with cod generally moving southward during July through September. During the fall, cod return to Fortune Bay via Placentia Bay.

Pollock

Pollock are know to occur in large areas of Fortune Bay and along the coast from Bay d'Espoir to White Bear Bay (DFO CCRIs, Yurick and Vanstone, 1983). Juvenile pollock (less than age 2 fish) migrate to shallow coastal waters during spring and can be found at harbours along the south coast at that time; they migrate offshore to overwinter in deeper waters. At age 2, young pollock occur in deeper waters near the coast and on offshore banks (Scott and Scott, 1988). Localized stocks and specific migration routes are not recognized.

Atlantic halibut

Atlantic halibut are known to move from deeper waters to more shallow locations where they feed during summer. Juvenile Atlantic halibut are common in shallow waters (37-55 m) relative to the typical depths of adults. (Scott and Scott, 1988; Zwanenburg, 1991). The occurrence of Atlantic halibut in the COB region is not well known.

American plaice

American plaice are common all along the south coast of Newfoundland (CCRI; Yurick and Vanstone, 1983). Adults migrate to deeper waters during winter and return to shallow water during spring (Scott and Scott, 1988), but whether this movement is diffuse or more deliberate is not known.

Witch flounder

Both Fortune Bay and Hermitage Bay have small stocks of witch flounder (Bowering, 1990). This species also occurs at various locations between Bay d'Espoir and White Bear Bay (CCRI; Yurick and Vanstone, 1983). Migrations are not known to occur in the COB region.

Turbot

The occurrence of turbot has been document at various locations along the south coast of Newfoundland (CCRI; Yurick and Vanstone, 1983). Migrations of turbot are not well understood, but turbot are thought to spawn in deep waters (650-1000 m) with some spawning presumed to occur in the Laurentian Channel (Scott and Scott, 1988; Bowering, 1993).

Redfish

Redfish (*Sebastes* spp.) occur at various locations along the south coast of Newfoundland (CCRI). These species are not known to undergo migrations.

Lumpfish

Lumpfish occur along vast expanses of the south coast of Newfoundland (CCRI) where they migrate to deep waters during fall and return to shallow areas during spring (DFO 1999). Spring shoreward migrations are often targeted by fisheries in certain areas of Newfoundland. There are no data on lumpfish migrations in the COB region.

Pelagic fish

Capelin

Capelin occur all along the south coast of Newfoundland (CCRI). During spring, mature

capelin migrate in to coastal waters to spawn at shallow intertidal areas or on beaches; capelin overwinter in deeper waters offshore. There are no data available on specific capelin migration routes in the COB region. However, TEK collected by Ripley (1995) suggested cod migrations (capelin scull) associated with capelin movements toward the coast.

Herring

Two stocks of herring occur along the south coast of Newfoundland; there is a Fortune Bay stock and another between Pass Island and Cinq Cerf Bay (DFO, 2004). Migration routes are not known for herring but herring are known to spawn during spring in shallow and protected sites showing strong site fidelity between years (Winters, 1971). Spawning may occur in deeper waters during summer and fall.

Whales

Four baleen whales are observed along the south coast of Newfoundland from spring to autumn. Humpback (*Megaptera novaeagliae*) and minke (*Balaenoptera acutorostrata*) whales migrate from tropical waters to the south coast of Newfoundland during April and remain there until autumn. Blue whales (*B. musculus*) have been observed off the south coast during March and April while fin whales (*B. physalus*) occur locally from spring to late autumn or winter.

Toothed whales also occur along the south coast of Newfoundland. Pothead whales (*Globicephala melaena*) and harbour porpoise (*Phocoena phocoena*) are observed relatively frequently during summer and autumn. White-beaked (*Lagenorhychus albirostris*) and white-sided (*L. acutus*) dolphins are also commonly observed, particularly during autumn when squid are abundant.

Seals

Only two species of seals, the harbour seal (*Phoca vitulina concolor*) and gray seal (*Halichoerus grypus*), are common along the south coast of Newfoundland. Haulout sites are known for harbour seals near Little Raymond Island at the entrance of Bay d'Espoir and local residents reported observations of harbour seals in various locations between Bay d'Espoir and White Bear Bay (Yurick and Vanstone, 1983). A colony of gray seals occurs at Miquelon (Ling *et al.* 1974). Another small colony of gray seals occurs at Pass Island outside Bay d'Espoir.

Marine Related Birds

The COB coastal management area recommended in this report encompasses some of the important breeding sites for marine related birds along the south coast of Newfoundland. Green Island measures only 800 m by 400 m but 72,000 pairs of Leaches storm-petrels nest there annually (IBA Canada, 2006). Other birds, including herring gulls (*Larus argentatus*), common terns, Arctic terns (*Sterna paradisaea*), Black Guillemots (*Cepphus gyrlle*) and Manx shearwaters (*Puffinus puffinus*) are suspected (IBA Canada, 2006). Yurick and Vanstone (1983) report that local residents identified Pigeon and Little Raymond Islands (outer Bay d'Espoir) as breeding sites for arctic tern. They also reported that herring and greater black-backed gulls (*Larus marinus*) breed on the western slopes of nearby Saddle Island.

Cairns *et al.* (1986) report on relatively small breeding sites for a number of species in the COB region; arctic terns breed on Brunette and Little Sagona Islands and an island near Boxey Harbour Head. Herring or greater black-backed gulls breed on Middle, Duck, Bird, Puffin, Green, and Sterin Islands. Double crested cormorants and Atlantic puffin also breed locally.

Yurick and Vanstone (1983) noted there was at least one pair of resident bald eagles at most of the fjords they visited. Bald eagles are also common in Hermitage Bay and Fortune Bay during spring when herring are spawning (Tuck, 1967). This use of fjord habitats as feeding sites by bald eagles supports a relatively high numbers of eagles along the south coast of Newfoundland (Horwood, 1969). Over the last 20 years, sporadic breeding surveys for bald eagles have been conducted all along the south coast of Newfoundland by provincial Wildlife (J. Brazil, Pers. Comm).

4.1.3.3. Species at Risk

The patchy distributions of two species, piping plover and banded killifish, along the south coast of Newfoundland were considered relevant to boundary delimitation in that area. Banded killifish populations are documented in Rush Pond and Freshwater Pond on the Burin Peninsula, but these ponds are in water sheds that flow into Placentia Bay and anticipated to be managed under the Placentia Bay Coastal Management Zone. Another population of banded killifish is located on Ramea Island. This area was considered too far west to be included in a management unit with the COB region based on other criteria. No other populations of banded killifish are know near the COB region. Therefore, banded killifish distributions were not useful in determining coastal management boundaries in the COB region. Piping Plover nesting locations also occur at isolated locations along the south coast of Newfoundland. As none of these locations (i.e. Big Barasway and Grand Bay West) are located near the COB region, Piping Plover nest distributions did not influence the delimitation of coastal boundaries in the COB region.

4.1.4. Human Uses and Activities

4.1.4.1. Aboriginal Use of Land

The Miawpukek Band Reserve at Conne River measures approximately 14 square miles. Recently, the band entered into negotiations with the provincial and federal governments to increase the reserves size due to an increase in the population of the band. Traditionally, the Miawpukek Band of Conne River used much of the interior of southern Newfoundland, extending far west of the COB region (Miawpukek, 2006).

Aboriginal and archaeological sites pertaining to the Dorset, Beothics and Micmac are scattered throughout Bay d'Espoir and Hermitage Bay (Summit Consulting, 2005). Archaeology sites at Cross Brook (Wilcott Point), Copper Head and Ruben Point are known in Bay d'Espoir and other important sites are presumed to exist there as well. Other important archaeological sites include L'Anse a Flamme, Piccaire, Furbys Cove (2 sites) and Green Point (Summit Consulting, 2005). In addition to the archaeology sites, Cross Brook and the Bay du Nord River are important

to the Micmac of Conne River because waters from these sources are considered to have healing powers (Summit Consulting, 2005).

4.1.4.2. Community groupings

There are four community groupings within the boundaries recommended for the COB management area (Fig. 1). The community grouping at inner Bay d'Espoir includes St. Alban's, St. Veronica's, St. Joseph's Cove, Milltown - Head of Bay d'Espoir, Morrisville and the Conne River Mi'kmaq Reservation (Samiajij Miawpukek). Historically, the economies of these communities were influenced greatly by the forestry industry and hydroelectric power generation. Until recently, salmonid aquaculture development was almost entirely restricted to this area. A second community grouping includes Harbour Breton, Seal Cove, Hermitage-Sandyville, Gaultois and McCallum, with the latter three communities connected by Ferry services. Communities within this group historically relied heavily on the fishing industry. While near-shore fishing continues to contribute to the economies of communities in this group, fishing further from the coast was most important historically. Fishing on the offshore banks and later trawler and longliner fisheries led to the establishment of fish processing plants at Harbour Breton, Gaultois and Hermitage. A third grouping includes communities at the head of Fortune Bay; Wreck Cove, St. Jacques, Rencontre East, Pool's Cove, Mose Ambrose, English Harbour West, Coomb's Cove, Boxey, Belleoram, English Harbour East, Bay de l'Eau, Grand Le Pierre, Terrenceville, Little Harbour East, Harbour Mille, Little Bay East, Bay l'Argent, St. Bernards Jacques Fontaine. At these communities, the economies were based mostly on inshore commercial fishing with salmon, herring and lobster important target species. The fourth grouping includes communities near the tip of the Burin peninsula. Among these are Fortune, Grand Bank, L'Anse au Loup, Molliers, Grand Beach, Frenchmans Cove and Garnish. The economies of many of these communities originally depended on the inshore fishery but the Bank fishery became important in the 1880s. With the need for large fishing schooners, ship yards also developed in this area.

4.1.4.3. Industry

4.1.4.3.1. Fisheries

Landings data provide information about the presence of organisms but rarely are these data interpretable in the context of species abundance. Coast wide trends in landings are provided in Section 3.4.3.1.2. Below is a brief discussion of landings from statistical sections along the south coast of Newfoundland showing the relative importance of various species to the fishing industry of sub-sections of the coast. Note that statistical reporting areas 33 to 36 roughly correspond to the COB management area recommended in this report (but includes Francois) and the remainder of the south coast of Newfoundland is represented by statistical areas 37-39. For brevity, only general patterns are described below. See Appendix 4 for plots of landings by statistical area from 1985 to 2005.

For four species, there were similar trends in landings among most statistical areas. In all areas, there was an increasing trend in lobster landings since 1997. Landings of greysole peaked in most areas in 1987 and 1991, but low landings were recorded in all areas between 1995 and

1997. Landings of lumpfish roe was highly variable over time; however, landings tended to peak during the late 1990s in most areas. Atlantic cod landings were relatively high during 1985 to 1989, but declined sharply from 1990 to 1994, when a moratorium was declared locally. Consistent trends in the landings of these species was not useful in determining coastal management area boundaries.

Landings of redfish were highly variable over time in each statistical area. However, redfish landings were also highly variable between statistical areas and no discernable east to west (or vice versa) was detected. Redfish landings were not useful in determining coastal management area boundaries.

There were some inconsistencies in landings between statistical areas to the east (33-36) and to the west (37-39). Generally, landings of most species tended to be higher in statistical areas 33 and 35. Landings of snow crab were first reported in easterly sections and relatively high landings were reported in statistical areas 33 to 35 during the late 1990s. Relatively high landings of snow crab were recorded in statistical area 37 only in 1999. Landings of Icelandic and Sea scallop were recorded primarily in statistical area 33 with some landings in area 35. Yellow tail flounder landings also differed along the coast with highest landings in statistical areas 33 and 35. These differences in landings between east and west statistical areas suggest some differences in the fishing industry between easterly and westerly sections of the south coast. The division between east and west statistical areas roughly corresponds with the boundary for the COB coastal management area recommended in this report.

4.1.4.3.2. Aquaculture

Currently, operational aquaculture sites (cages) for salmonids in Newfoundland are distributed from Belle Bay in Fortune Bay to Facheux Bay, but this distribution is expected to expand with the movement of new companies into the region (C. Collier, Pers. Comm.). Applications have been submitted for new salmonid cage sites in Hare Bay, Devil Bay, Rencontre Bay, Aviron Bay and La Hune Bay (Fig. 7; AquaGIS, 2006). However, expansion of sites to the east is more likely in the immediate future as the infrastructure required for aquaculture is available in Fortune Bay but not to the west of Bay d'Espoir (S. Moyse, Pers. Comm). Inclusion of all current and likely new aquaculture sites into one management unit is desirable for logistical purposes.

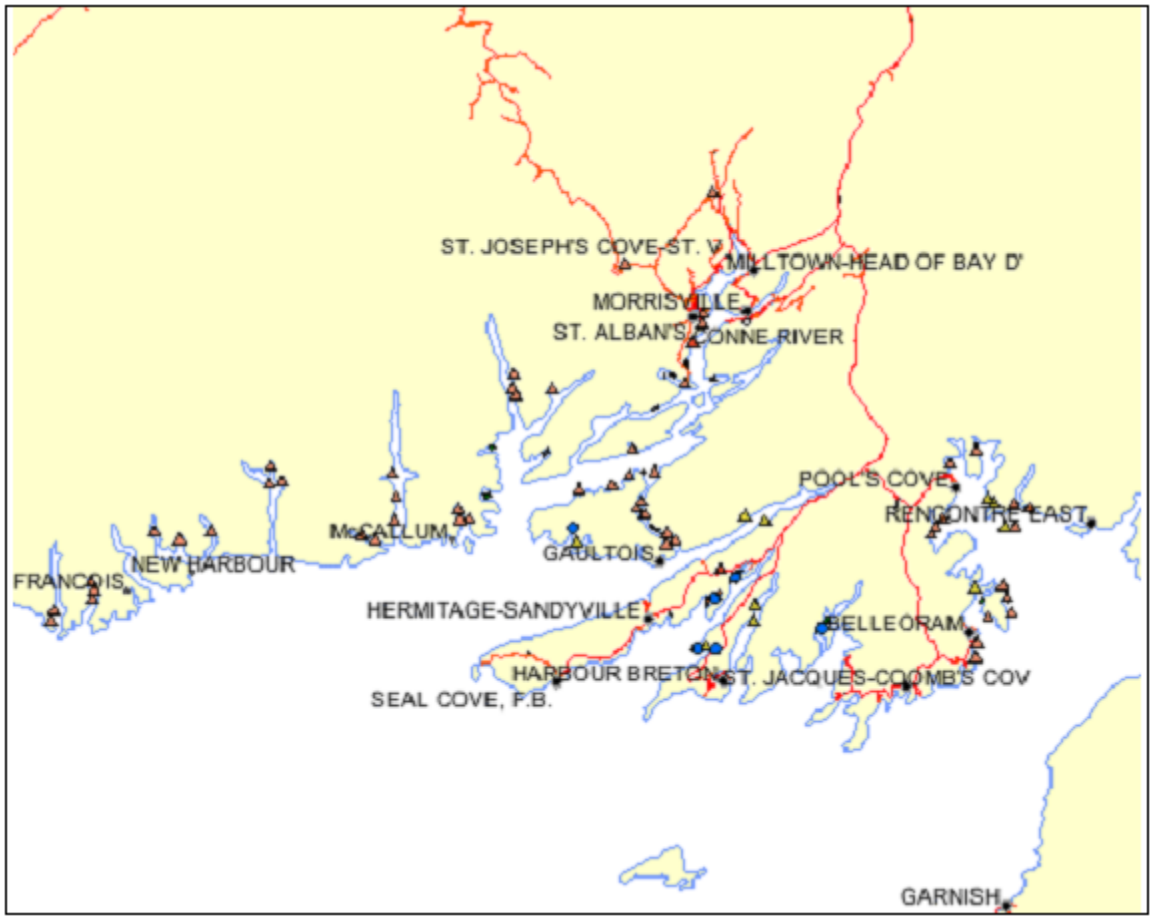


Figure 7. Map of the Coast of Bays region showing current and proposed salmonid aquaculture sites from AquaGIS (2006).

4.2. Offshore Boundary Rationale

4.2.1. Maritime Zones

The offshore boundary for the COB coastal management area is recommended to be positioned 24 nmiles offshore corresponding with the boundary of Canada's Contiguous Zone. Canada's Maritime zones include the 12 nmile territorial Sea and the Contiguous zone to 24 nmiles. Within this zone, Canada has rights and responsibilities to prevent infringements on customs, fiscal, immigration and sanitary laws (Indexmundi, 2006). Beyond 24 nmiles, Canada has special rights only over the use and exploration of marine resouces, and these rights end at a distance of 200 nmiles offshore (Exclusive Economic Zone)

Potential boundaries for offshore integrated management areas were considered important

when determining offshore boundaries for the COB coastal management area. The shoreward boundaries for offshore integrated management zones are not determined but 12 and 24 nmiles (Territorial Sea and Contiguous Zones) are candidate boundaries (J. Simms, Pers. Comm.). An overlap in governance between 12 and 24 nmiles is not problematic for integrated management, but gaps between areas would be undesirable. Extension of coastal management boundaries to 24 nmiles is also practical in Fortune Bay as most of the bay would be included in one unit.

4.2.2. St. Pierre and Miquelon Boundary

The boundary between St. Pierre and Miquelon and Newfoundland falls within 24 nmiles of the coast off the COB region, hence the recommendation to abut the COB coastal management area to this international boundary. There are a number of issues regarding coastal resources off the Burin Peninsula that will require the input of the French government for effective management. Particularly important issues include conservation measures for the bird nesting site at Green Island and preparedness for a potential oil spill in Placentia Bay.

4.3. Landward Extent Rationale

The landward boundaries recommended for the coastal management area in the Coast of Bays region correspond with the boundaries of the Bay d'Espoir-Fortune Bay Drainage Basin. All watersheds within these drainage basins currently empty into estuaries in Bay d'Espoir or Fortune Bay except during planned releases from dams associated with the Upper Salmon hydroelectric development. The impact of freshwater input is obvious in Bay d'Espoir with a two metre lens of freshwater at the surface that responds to local wind forcing (Marine Sciences Research Laboratory, 1980). There are also significant freshwater inputs into Fortune Bay (e.g. Bay du Nord River) but oceanographic conditions within this bay may result in mixing of surface (fresher waters) and deeper waters more frequently than in Bay d'Espoir. During periods of low mixing, freshwater inputs from water sheds in eastern Fortune Bay may be transported around the bay in a counterclockwise direction with typical current flow.

Inclusion of water sheds in a coastal management area is also important because of the important activities that occur on coastal water bodies in the COB region. Programs to enhance local Atlantic salmon stocks were conducted on the Conne River and Little River. On local rivers, escaped farmed salmon have been collected, highlighting potential impacts of marine activities on freshwater systems.

5.0. Recommendations for other Management Area Boundaries along the South Coast of Newfoundland

Two other coastal management areas along the south coast of Newfoundland are suggested by the criteria developed in this report. One area extends from the western boundary of the COB RED zone to the NAFO subdivision 3Pn boundary. Coastal areas in NAFO subdivision 3Pn would form another management unit. Both of these coastal management areas would extend offshore to 24 nmiles and landward to include water sheds.

NAFO delimitation is important criteria for coastal management area boundary on the southwest coast of Newfoundland because some fish stocks differ among subdivisions 3Ps and 3Pn. Most notable is the stocks of Atlantic cod that differ among subdivisions. These two stocks are managed separately and fishing regulations differ between areas.

The boundary between 3Ps and 3Pn also coincides with changes in physical attributes along the south coast of Newfoundland. Physiography to the east of the 3Ps /3Ps boundary is typified by long and deep fjords. Further west, deep fjords are rare. The fjord ecosystems to the west of Bay d'Espoir (3Ps) that would comprise one coastal management unit are considered for National Areas of Canadian Significance by Parks Canada (Yurick and Vanstone,1983). In 2005, Dr. Jon Lien, with the support of the Newfoundland and Labrador Legacy Nature Trust, met with local residents along the south coast of Newfoundland and found some support for developing a National Marine Conservation Area to the west of Bay d'Espoir (Lien, Pers. Comm.). If designated, this NMCA may encompass one entire coastal management area.

Bathymetry also differs between the management areas suggested above. The Laurentian Channel approaches the coast in 3Pn, hence deep water areas occur near shore in vast areas of 3Pn and MSW is present year round. In 3Ps, the Laurentian Channel is further from the coast, and while branches extend to the coast in some areas, MSW only rarely enters deep fjords, following exchange events (e.g. Fortune Bay).

6.0. Personal Communications

Joe Brazil, Senior Manager. Endangered Species and Biodiversity, Wildlife Division, department of Environment and Conservation. Corner Brook.

Conrad Collier, Economic Development Officer,Coast of Bays Corporation, St. Alban's, Newfoundand.

Ross Hinks, Fisheries, Miawpukek Band Reserve, Conne River, Newfoundland.

Jon Lien, Professor emeritus, Memorial University of Newfoundland. St. John's Newfoundland.

Steve Moyse, Aquaculture policy and Planning, Department of Fisheries and Aquaculture, St. John's, Newfoundland.

Lou Ryan, Department of Fisheries and Oceans, Marystown.

Jason Simms, Department of Fisheries and Oceans, St. John's, Newfoundland.

7.0. Literature Cited

AquaGIS, 2006. www.aquagis.com/. Accessed 14 March 2006.

Aquaneuve Sollutions Inc. 2005. Coast of Bays marine infrastructure directory. Report for the Coast of Bays Corporation, St. Alban's. Newfoundland. 42 p.

Backus, R.H., J.E. Craddock, R.L. Haedrich and B.H. Robison, 1977. Atlantic mesopelagic zoogeography. In R.G. Gibbs, Jr. [ed.] Fishes of the western North Atlantic , Order Iniomi (Myctophiformes). Pp. 266-287. Sears Foundation Marine Research. No 1, Part 7. Yale University, New Haven.

Bridger, C. J., B.K. Booth, R.S. McKinley, and D.A. Scruton, 2001. Site fidelity and dispersal patterns of domestic steelhead triploid trout (*Oncorhynchus mykiss* Walbaum) released to the wild. ICES Journal of Marine Science 58: 510-516.

Bowering, W.R., 1993. Underwater world: turbot (Greenland halibut). Communications Directorate. Department of Fisheries and Oceans, Ottawa, Ontario.

Button, T., 2000. Preliminary seaweed biomass survey: economic zone 13. June-August 2000. Coast of Bays Corporation. St. Alban's, Newfoundland. 19 p.

Callicott, J. B., Crowder, L. B. and Mumford, K. 1999. Current normative concepts in conservation, *Conservation Biology* 13: 22-35.

Catto, N.R., D. A. Scrutton and L.M..N. Ollerhead, 2003. The coastline of eastern Newfoundland. Canadian Technical Report of Fisheries and Aquatic Sciences No. 2595. 241 p.

Cicin-Sain B.,and R.W. Knecht, 1993. Integrated coastal zone management. Ocean and coastal Management (special issue): 21 277 p.

Coast of Bays Corporation, 2003. Aquaculture strategic economic plan: May 2003. St. Alban's Newfoundland. 24 p.

COSEWIC, 2001. COSEWIC Assessment and Update status report on the Leatherback Turtle *Dermochelys coriacea* in Canada, Committee on the Status of endangered Wildlife in Canada. Vii + 25 p.

COSEWIC, 2002. COSEWIC Assessment and Update status report on the Blue Whale *Balaenoptera musc*ulus in Canada, Committee on the Status of endangered Wildlife in Canada. vii + 32 p.

COSEWIC, 2003. COSEWIC Assessment and Update status report on the North Atlantic right whale *Eubalaena glacialis* in Canada, Committee on the Status of endangered Wildlife in Canada. vii + 28 p.

Dempson, J.B., G. Furey and M. Bloom, 2000. Status of Atlantic salmon in Conne River, SFA 11, Newfoundland 1999. Canadian Stock Assessment Secretariat 2000/032.

Dempson, J.B., G. Furey and M. Bloom, 2002. Effects of catch and release angling on Atlantic salmon, *Salmo salar* L., of Conne River, Newfoundland. Fisheries Management and Ecology 9:139-147.

Dempson, J.B., and D.E.Stansbury, 1991. Using partial counting fences and a two-sample stratified design for mark-recapture estimation of an Atlantic salmon smolt population. North American Journal of Fisheries Management 11: 27-37.

De Young, B. 1983. Deep water exchange in Fortune Bay, Newfoundland. M.Sc. Thesis. Memorial University of Newfoundland, St. John's, Newfoundland, 146 p.

De Young and A.E. Hay, 1987. Density current flow into Fortune Bay, Newfoundland. Journal of Physical Oceanography 17: 1066-1070.

DFO 1997. Scotian Shelf and southern Grand Bank halibut. DFO Science Stock Status report A3-23. (1997).

DFO, 1999. Newfoundland region groundfish overview. DFO Science Stock Status report A2-19 (1999).

DFO 2001. Subdivision 3Ps haddock. DFO Science Stock Status report A2-05 (2001).

DFO 2002. Science Stock Status report A2-12. 2002. American plaice

DFO 2002. Science Stock Status report A2-07. 2002. Pollock.

DFO 2003. Monkfish in Divisions 3L, 3N, 3O and subdivision 3Ps. DFO Canadian Science Advisory Secretariat Stock Status report 2003/045.

DFO 2003. Thorny skate in divisions 3L, 3N, 3O and subdivision 3Ps. DFO Canadian Science Advisory Secretariat Stock Status report 2003/023.

DFO 2004. Newfoundland and Labrador region groundfish stock updates. Canadian Science Advisory Secretariat Stock Status report 2003/049

DFO 2004. Newfoundland and Labrador Atlantic salmon stock status update. Canadian Science Advisory Secretariat Stock Status report 2004/040.

DFO 2004. Newfoundland and Labrador snow crab. Canadian Science Advisory Secretariat Stock Status report 2004/012.

DFO 2004. Unit 2 redfish.Canadian Science Advisory Secretariat Stock Status report 2004/016.

DFO 2004. 3PS cod.Canadian Science Advisory Secretariat Stock Status report 2004/039.

DFO 2004. East and southeast Newfoundland Atlantic herring. Canadian Science Advisory Secretariat Stock Status report 2004/046.

DFO 2005. A strategy for the recovery and management of cod stocks in Newfoundland and Labrador. Canada-Newfoundland and Labrador Action Team for Cod Recovery. November 2005.

Done, T.J., and R.E. Reichelt, 1998. Integrated Coastal Zone Management and fisheries ecosystem management: generic tools and performance indices. Ecological Applications 8 (Supplement 1): 110-118.

FRCC, 2006. “Fisheries Resource Conservation Council” http://www.frcc.ca/mandate.htm. Accessed 22 February 2006.

GESAMP, 2005. [IMO/FAO/UNESCO-IOC/WMO/WHO/ IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects Of Marine Environmental Protection]

Global Oceans, 2006. (www.globaloceans.org). Accessed 24 January 2006.

Halliday, R.G., and A.T. Pinhorn, 1990. Delimitation of fishing areas in the Northwest Atlantic. Journal of the Northwest Atlantic Fishery Science 10:1-51.

Horwood, H. 1969. Newfoundland. MacMillan, Toronto, 244 p.

IBA, Canada, 2006 "Important Bird Areas, Canada". www.ibacanada.com/. Accessed 7 March 2006.

International Cable Protection Committee. www.iscpc.org/. Accessed 13 February 2006.

James, M.C. 2001. Update COSEWIC status report on the leatherback turtle *Dermochlye coriacea* in Canada Committee on the Status of Endangered Wildlife in Canada. 25 p.

Longhurst, A. 1998. Ecological geography of the sea. Academic Press, New York.

Marine Sciences Research Laboratory, 1980. Bay d'Espoir aquaculture feasibility study: volume II. MSRL contribution No. 409. Prepared for the Bay d'Espoir Development association and the Newfoundland Department of Fisheries. 165 p.

McKelvie, D.S., 1985. Discreteness of pelagic faunal regions. Marine Biology 88: 125-133.

Meades, S.J., 1990. Natural regions of Newfoundland and Labrador. Report for the Protected Areas Association, St. John's. 274 p. + 103 p. appendix.

Methven, D.A. and D.S. McKelvie, 1986. Distribution of *Phycis chesteri* (Pisces: Gadidae) on the Grand Bank and Labrador Shelf. Copeia 4: 886-891.

NAFO, 2005. Canadian research report for 2004. NAFO SCS Doc 05/12.

Newfoundland Government, 2006a. www.fishaq.gov.nl.ca/Statistics/statistics.stm, Accessed 24 March 2006

Newfoundland Government, 2006b. www.intrd.gov.nl.ca/intrd/economicboards.htm. Accessed 15 February 2006.

Newfoundland Government, 2006c. www.nr.gov.nl.ca/forestry/. Accessed 18 February 2006

Newfoundland Power, 2006. www.nfpower.nf.ca/. Accessed 18 February 2006.

Pepper, V.A., T. Nicholls, C. Collier, V. Watkins, E. Barlow and M.F. Tlusty, 2003. Quantative performance measurement of North American salmonid strains for Newfoundland aquaculture. Can. Tech. Report. Can. Fish. Aquat. Sci. No2502. 59 p.

Pepper, V.A., T. Nicholls and C. Collier, 2004. Reproductive technologies applied to Newfoundland salmonid aquaculture to enhance commercial production. Can. Tech. Report Can. Fish. Aquat. Sci. No. 2541. 55p.

Pepper, V.A., T. Nicholls and N. Oliver, 1987. Seminatural rearing of Atlantic salmon (*Salmo salar*) in Newfoundland. Canadian Journal of Fisheries and Aquatic Sciences 44: 337-347.

Richard, J. M., 1987. The mesopelagic fish and invertebrate faunas in two Newfoundland fjords separated with differing physical oceanography. M.Sc. Thesis. Memorial University of Newfoundland. St. John's Newfoundland. 162 p.

Richard, J.M., and R.L. Haedrich, 1991. A comparison of te macrozooplankton faunas in two Newfoundland fjords differing in physical oceanography. Sarsia 76: 41-52.

Richard, J.M., and A.E. Hay, 1984. The physical oceanography of Bay d'Espoir paper prepared for the Conne River Development Association. St. Alban's, Newfoundland. 30 p.

Ripley, P. 1995. A working paper on traditional ecological knowledge and management of the inshore fishery on the south coast of Newfoundland. Eco-Research Program. 28 p.

Robins, C.R. and G.C. Ray, 1986. A field guide to Atlantic coast fishes of North America. Houghton Miflin Company, Boston, USA. 354 p.

Scott, W.B. and M.G. Scott, 1988. Atlantic fishes of Canada. University of Toronto Press. Toronto Ontario. 731 p.

Sherman, K, and L.M. Alexander, 1986. Variability and management of large marine ecosystems. AAAS Selected Symposium 99. Westview Press, Boulder. 319 p

Shevelev, M.S., and A.P. Kuz'muchen, 1990. New data on the biology of the wolffish Anarchichus latefrons. Journal of Ichthyology. 30: 101-108.

Species At Risk, 2006. www.speciesatrisk.gc.ca/search/speciesDetails_e.cfm?SpeciesID=22. Accessed 7 February 2006.

Squires, H.J. 1990. Decapod crustacea of the Atlantic coast. Canadian Bulletin of Fisheries and Aquatic Sciences 221. 532 p.

Statistics Canada, 2006. www.statcan.ca/start.html. Accessed 20 January 2006.

Steele, D.H., J.M. Green and J. Carter, 1978. Classification of the southeast Atlantic marine region and selection of representative areas and unique sites. Department of Biology, Memorial University of Newfoundland. Report to Parks Canada, Otttawa.

Summit Consulting, 2005. Identification of important coastal areas in the Coast of Bays Region, Newfoundland. Report to Oceans Division, Department of Fisheries and Oceans. St. John's Newfoundland, 58 p.

Tlusty, M.F., M.R. Anderson and V. A Pepper, 1999. Assuring sustainable salmonid aquaculture in Bay d'Espoir, Newfoundland. Aquaculture Association of Canada, St. Andrews, New Brunswick.

Tlusty, M.F., V.A. Pepper and M.R. Anderson, 1999. Environmental monitoring of finfish aquaculture sites in Bay d'Espoir Newfoundland during the winter of 1997. Canadian Tech. Report Can. Fish Aquat. Sci. no 2273. 40 p.

Tlusty, M.F., J.E.H. Clark, J. Shaw, V.A. Pepper and M.R. Anderson, 2000. Groundtruthing multibeam bathymetric surveys of finfish aquaculture sites in Bay d'Espoir fjord, Newfoundland. Marine Technology Society Journal 34:59-64.

Tlusty, M.F., K. Snook, V.A. Pepper and M.R. Anderson, 2000. The potential for soluble and transport loss in aquaculture - the Newfoundland experience. Aquaculture Research 10: 745-755.

Tuck, L.M., 1967. The birds of Newfoundland. In: J.M. Smallwood [ed.] The book of Newfoundland. Volume 3. Pp265-316. Newfoundland Book Publishers, St. John's.

Ullah, W., A. Beersing, A. Blouin, C.H. Wood and A. Rodgers, 1992. Water resources atlas of Newfoundland. Newfoundland Department of Environment and Lands, Water Resources Division. St. John's, Newfoundland. 79 p.

US Fish and Wildlife Service, 2006. www.fws.gov/plover/. Accessed 7 February 2006.

Van der Spoel, S., and R.P. Heyman, 1983. A comparative atlas of zooplankton. Springer-Verlag, Berlin. 186 p.

Williams, H., M.J. Kenedy and E.R.W. Neale, 1974. The northeast termination of the Appalachain orogen. In: A.E. M. Nehli and F.G. Stehli [eds.] The ocean basins and margins, Volume 2.The North Atlantic. Pp. 79-123. Plenum Press, New York.

Winters, G.H. 1971. Migrations of the southwest coast Newfoundland stock of herring as indicated by tag captures. ICNAF Research Document 71/108 Series 2591. 6 p.

Yurick, D.B., and M.C. Vanstone, 1983. A biological and oceanographic study of the Baie D'Espoir region, Newfoundland. Volumes 1 and 1. Final report prepared for Parks Canada. Marine research Associates Ltd. St. Andrews, New Brunswick. 238 p.

Zwanenburg, K. 1991. Underwater world: Atlantic halibut. Communications directorate. Department of Fisheries and Oceans. Ottawa, Ontario.

Appendix 1. Census data on the number of individuals populating communities on the south coast of Newfoundland during 1996 and 2001. Statistical districts representing multiple small communities are labelled alphanumeric consistent with Statistics Canada labelling.

Community /district	2001 population	1996 population	% change	Number of dwellings in 2001
Fortune	1615	1969	-18	789
Grand Bank	2841	3328	-14.6	1190
Frenchman's Cove	195	220	-11.4	126
Garnish	665	691	-3.8	308
2H	120	102	17.6	333
St. Bernards-Jacques Fontaine	657	751	-12.5	233
Bay L'Argent	320	377	-15.1	148
Little Bay East	144	180	-20	67
2I	182	224	-18.8	286
Terrenceville	630	737	-14.5	238
Grand Le Pierre	294	327	-10.1	107
English Harbor East	217	253	-14.2	76
2K	692	752	-8	461
2L	0	7	-100	0
2	162	175	-7.4	60
Rencontre East	202	215	-6	60
Belloram	484	564	-14.2	155
Pool's Cove	206	241	-14.5	85
Harbour Breton	2079	2290	-9.2	665
Seal Cove	370	419	-11.7	135
Hermitage-Sandyville	602	687	-12.4	220
Gaultous	321	423	-24.1	110

Milltown-Head of Bay d'Espoir	884	1124	-21.4	335
St. Albans	1372	1563	-12.2	505
Morrisville	151	194	-22.2	45
Samaijij Miawpukek	837	751	11.2	255
St. Jacques-Coombs Cove	707	827	-14.5	260
3D	323	348	-7.2	110
Ramea	754	1080	-30.2	342
Burgeo	1782	2098	-15.1	740
3F	174	188	-7.4	142
Harbour Le Cou-Rose Blanche	668	814	-17.9	304
3J	115	175	-34.3	45
Burnt Islands	810	919	-12.8	266
Isle aux Morts	813	988	-17.7	316
Channel Port aux Basque	4637	5243	-11.6	1918
3H	745	928	-19.7	318
3I	181	205	-11.7	94

Appendix 2 . Status of invertebrate and fish stocks and their fisheries along the south coast of Newfoundland summarized from most recent stock status reports available.

Species	Stock status	Fishery status	Management area
American plaice	low, slight increase since 1993 but fishing mortality expected to increase in short term	under moratorium; bycatch only	3Ps
Atlantic halibut	low	open	3NOPs4VWX
Atlantic herring	low (42% of long tern mean)	open	Fortune Bay
Atlantic salmon	low	closed	SFA 9-11
Haddock	low	bycatch only	3Ps
Iceland scallop	na	open	3Ps
Lobster	declining	open	LFA 11-12
Lumpfish	na	open with effort controls	3KLP
Monkfish	fishing mortality may exceed sustainable level	no quota restrictions bycatch only	3NOPs
Northern cod	decline in short term	open	3Ps
Pollock	low, but abundance up slightly in inshore areas between 1999 and 2002	bycatch only	3Ps
Porbeagle shark	na	open	SA 3-6
Redfish	no DFO survey available after 2001, industry survey indicates decline between 2001 and 2003	open	unit 2 = 3Ps4Vs, 3Pn4Vn
Roughhead grenadier	na	unregulated bycatch	SA 2+3

Roundnose grenadier	na	bycatch	SA 2+3
Short finned squid	na	open	SA 2+3
Snow crab	no biomass estimates; inshore CPUE declined 40% between 1999 and 2003	open	3Ps
Thorny skate	low	open	3LNOPs
White hake	low	bycatch only	3LNOPs
Witch flounder	stable (FRCC 2001) mean biomass for 1996-2002 was 75% of 1983-90 biomass	open	3Ps
Winter flounder	na	open	3KLPs
Wolffish	low	Species at Risk bycatch only	2J3KLNOPs

Appendix 3. Distributions of marine related species in the Coast of Bays and eastern Fortune Bay area and for other areas along the south coast of Newfoundland as determined from the literature, CCRI data and preliminary EBSAs (Summit Consulting , 2005) and Yurick and Vanstone (1983). Note that EBSAs have not been identified for areas outside of the Coast of Bays region.

Species	Range of occurrence	Occurrence in Coast of Bays region and eastern Fortune Bay	Occurrence along south coast, west of Coast of Bays region
Plants			
Cabbage kelp	Arctic south to Long Island Sound (DFO 1999)	Great Bay de l'Eau, Chapel Island, Pools Cove, Belle Harbour, Cinq Islands Bay, Rencontre East (Button, 2000); Belle Bay (Fowler et al. 1975)	in fjords (Yurick and Vanstone, 1983)
Eelgrass	Labrador to South Carolina (DFO 1999)	throughout Bay d'Espoir (Yurick and Vanstone, 1983)	Connoire Bay, Big Barasway, SW Arm of Grey River, Bay Le Moine, Garia Bay (CCRI)
Finger kelp	Arctic south to Long Island Sound (DFO 1999)	Deadman's Bight, Harbour Breton, and St. John's Bay (Button, 2000)	in fjords (Yurick and Vanstone, 1983); kelp common throughout (CCRI)
Irish moss	Northern Labrador to Long Island Sound (DFO 1999)	limited in St. John's Bay (Button, 2000); Northern Arm of Bay d'Espoir (Yurick and Vanstone, 1983)	in fjords (Yurick and Vanstone, 1983); Muddy Hole Bay, off Burgeo (CCRI)
Knotted wrack	Arctic south to Long Island Sound (DFO 1999)	Seal Cove, Sandyville, Great Bay de l'Eau, Chapel Island and Pools Cove (Button, 2000)	no accounts
Winged kelp	Arctic south to Long Island Sound (DFO 1999)	Seal Cove, Deadman's Bight, Harbour Breton and St. John's Bay (Button, 2000)	in fjords (Yurick and Vanstone, 1983); kelp common throughout (CCRI)

Rockweed (Fucus sp.)	North Atlantic	Seal Cove, Sandyville, Hermitage, Connaigre Bay, Deadmans Bight, Great Bay de l'Eau, Boxey-English harbour west and Belle Bay (Button, 2000)	Grey River (Yurick and Vanstone, 1983); large expanses of coast (CCRI)
Invertebrates			
Bar (surf) clam	Labrador to Gulf of Mexico (DFO 1999)	no concentrations known in area, mostly on Grand Banks and Banquereau Bank (Offshore surf clam integrated management plan, 1998)	Not observed
Blue mussel	Circumpolar, extending to South Carolina	few localized areas throughout (CCRI).	Patchy along coast (CCRI)
Sea scallop	North shore of Gulf of St. Lawrence to Cape Hatteras	7 EBSAs were sheltered areas of bays or fjord; various size areas throughout (CCRI)	Ramea, Northeast Arm, Frenchman's Cove, La Hune Bay, Devil Bay, Hare Bay (CCRI)
Green sea urchin	Arctic south to Cape Cod	small areas throughout with extensive areas around Riches Island and Long Island (CCRI)	Port aux Basque, Connoire bay, Muddy Hole Bay, Cowlest Barasway, Burgeo, Bay de Loup, Northwest Arm (CCRI)
Lobster	Strait of Belle Isle to north Carolina	vast expanses along coast (CCRI); 17 EBSAs where lobster feed or spawn	expanses throughout (CCRI)

Rock crab	Labrador to Florida	2-3 relatively small areas (CCRI); Brunette Island, Sagona Island, Grand Beach and Garnish areas of Fortune Bay (www.schooner.nf.ca/Final%20report%202004.pdf)	expanses throughout (CCRI)
Short-finned squid	Labrador to Florida (www.nefsc.noaa.gov/sos/spsyn/iv/sfsquid/)	large areas throughout region (CCRI)	patchy throughout (CCRI)
Snow crab	Greenland to the Gulf of Maine (www.fao.org/figis/servlet/FiRefServlet?ds=species&fid=2644)	large areas of Fortune Bay and off Connaigre Peninsula (CCRI)	not observed
Soft-shelled clam	Labrador to Cape Hatteras	few localized areas; Connaigre Bay, St. John's Bay, Boxey Harbour, Blue Pinion Harbour, and Bay d'Espoir (CCRI)	Connoire Bay, Big Barasway, Rencontre West (CCRI)
Spider crab	Newfoundland to New Jersey	unknown	unknown
Toad crab	Greenland to Rhode Island (Squires, 1990)	unknown	unknown
Fish			
American eel	Hamilton Inlet-Lake Melville south to the Gulf of Mexico, Panama and the West Indies (www.dfo-mpo.gc.ca/zone/underwater_sous-marin/american_eel/amreel_e.pdf)	few localized areas (CCRI).	common throughout (Yurick and Vanstone, 1983; CCRI)

American plaice	Labrador to Rhode Island (Bigelow and Schroeder, 1953)	large area of Fortune Bay (CCRI),	common throughout (Yurick and Vanstone, 1983; CCRI)
Atlantic cod	The 3Ps stock of Atlantic cod occurs from Cape St. Mary's to west of Burgeo Bank and on St. Pierre and Green Banks.	Broad areas throughout (CCRI), 17 EBSAs with spawning in inner Hermitage Bay; Hardys Cove and Lillys Cove; migrations into Fortune Bay from Hermitage and Harbour Breton area in February (Ripley,); Doctors Harbour Fortune Bay (www.coastofbays.nl.ca/Coastal%20Planning/docs)	common throughout (Yurick and Vanstone, 1983; CCRI)
Atlantic mackerel	Southern Labrador to North Carolina (DFO 1996)	large areas throughout (CCRI); EBSAs at Belle Bay and Bay du Nord	common at various locations (Yurick and Vanstone, 1983; CCRI)
Atlantic salmon	Rivers and streams throughout Newfoundland (Smith 1993)	scattered areas throughout (CCRI); 7 EBSAs;	common throughout (Yurick and Vanstone, 1983; CCRI)
Atlantic wolffish SAR	west Greenland and Southern Labrador to the Grand Banks and in the Gulf of St. Lawrence (Scott and Scott, 1988)	7 EBSAs	wolffish are common (Yurick and Vanstone, 1983)
Black dogfish	Laurentian and Hermitage Channels (NAFO 2002)	unknown	unknown

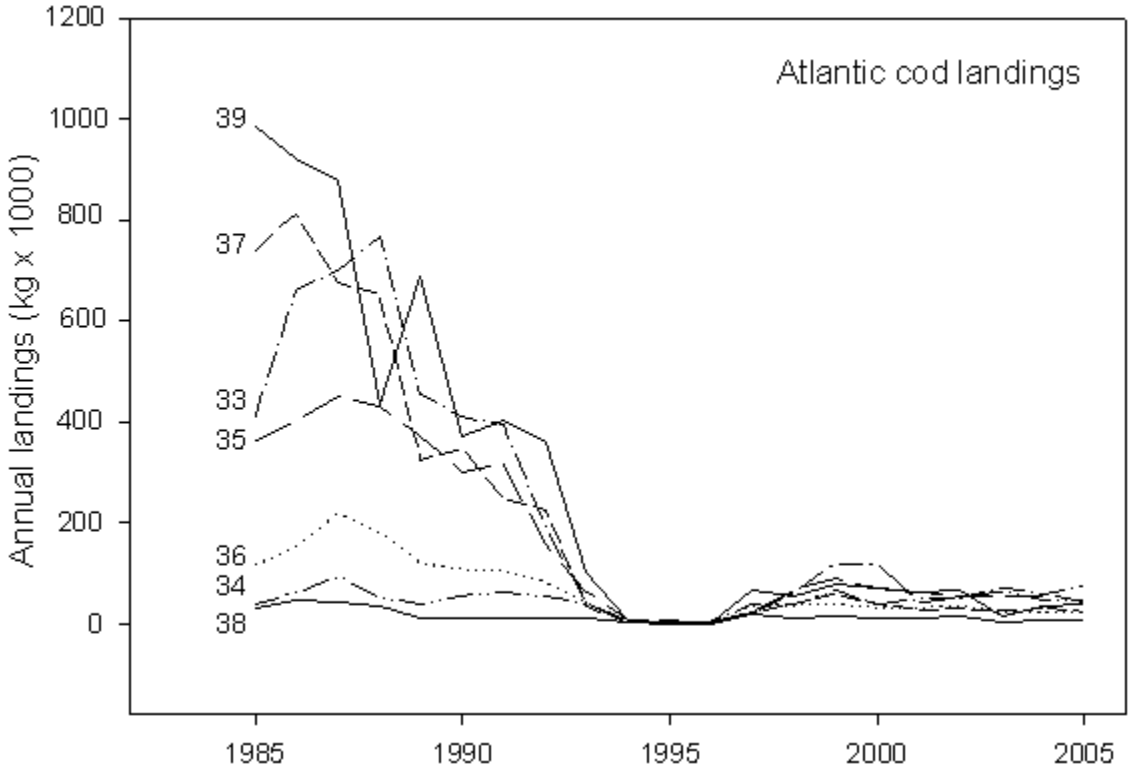
Bluefin tuna	Labrador to Gulf of Mexico (www.bigmarinefish.com/bluefin.html)	observed in Bay d'Espoir (Conrad Collier, Pers. Comm.)	common (Yurick and Vanstone, 1983)
Capelin	Hudson Bay to Nova Scotia	St. Pierre-Green Bank Stock (Carscadden 1981); common, in various coastal locations, spawning beaches present (CCRI)	common throughout (Yurick and Vanstone, 1983; CCRI); beaches at Cape Ray, La Poile Bay, Cinq Cerf Bay, Connoire Bay, inside Gull Island, Bay de Vieux, Gulch Cove, Cape la Hune, Rencontre West (CCRI)
Haddock	Grand Banks to Rhode Island	St. Pierre Bank (O'Boyle 1994);	common throughout (Yurick and Vanstone, 1983); off Burgeo Islands, Aviron Bay, Chaleur Bay and Hare Bay
Herring	Southwest Greenland and Labrador to South carolina. (www.fishbase.net/). Seven stocks in Newfoundland coastal waters ()	Fortune Bay stock (Winters et al.); common, in various coastal locations (CCRI); 19 EBSAs total and12 EBSAs for spawning	common throughout (Yurick and Vanstone, 1983; CCRI)
Longfin hake	mid-Labrador shelf south to Grand Banks and Flemish Cap, Laurentian Channel, Gulf of St. Lawrence to the Straits of Florida (Scott and Scott, 1988)	Laurentian Channel Slope (NAFO 2002); reported in south coast fjords (Methven and McKelvie 1986)	common throughout (Yurick and Vanstone, 1983)

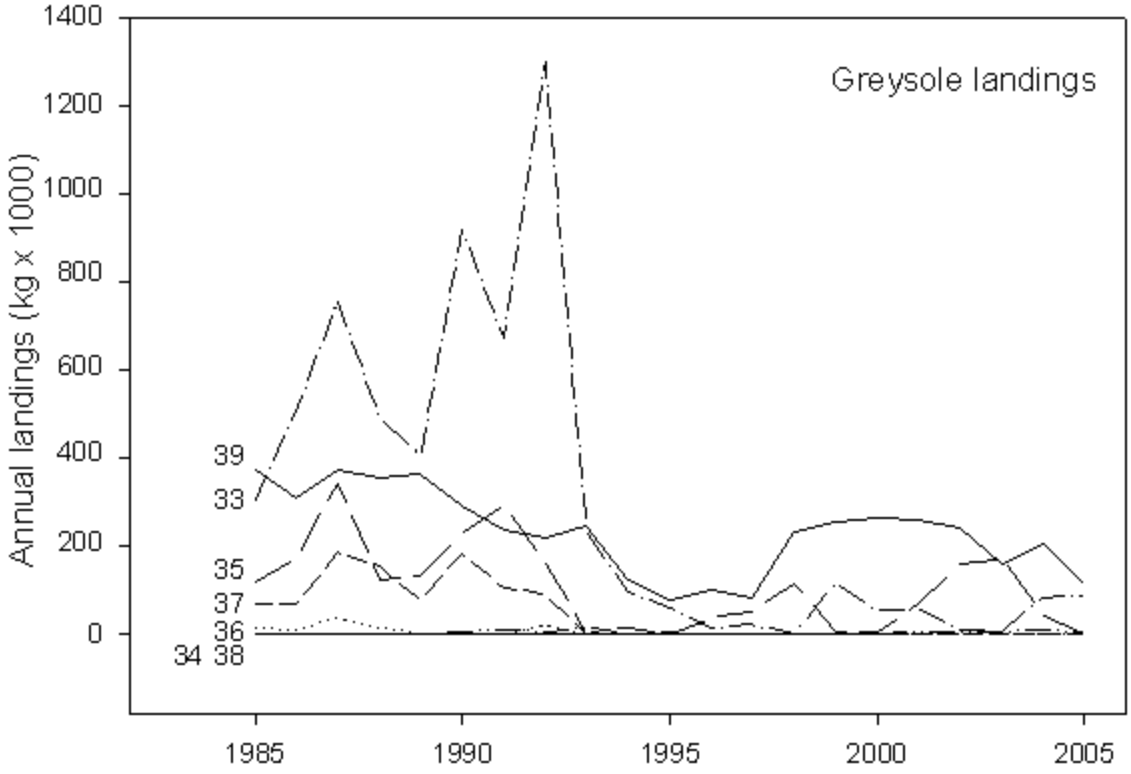
Lumpfish	Hudson Bay to James Bay and Labrador to New Jersey (www.fishbase.net/www.fishbase.net/)	common, in various coastal locations (CCRI)	at various locations (Yurick and Vanstone, 1983) large expanses throughout (CCRI)
Monkfish	Northern Gulf of St. Lawrence and Grand Banks south to northern Florida (Scott and Scott, 1988)	Laurentian Channel (DFO 2000)	unknown
Northern wolffish	Greenland to the Flemish Cap and the Grand Banks, in the Gulf of St. Lawrence estuary and on Sable Island Bank (Scott and Scott, 1988)	unknown	unknown
Pollock	Southwest Greenland, Hudson Strait to North Carolina (www.fishbase.net/)	large area in Fortune Bay (CCRI), juvenile pollock inhabit harbours along south coast (DFO 1999)	common throughout (Yurick and Vanstone, 1983); Devil Bay to Hare Bay (CCRI)
Porbeagle shark	Raleigh in Labrador to New Jersey- South Carolina (www.marinebiodiversity.ca)	sharks observed in 2-3 areas of Fortune Bay (CCRI)	?
Redfish	Hamilton Inlet Banks to southwest Grand Bank, the Flemish Cap, and the Gulf of St. Lawrence (DFO 1991)	areas of various sizes scattered throughout (CCRI);	common at various locations (Yurick and Vanstone, 1983; CCRI)
Red hake	Placentia Bay to Cape Hatteras (Markle, 1994)	unknown	?

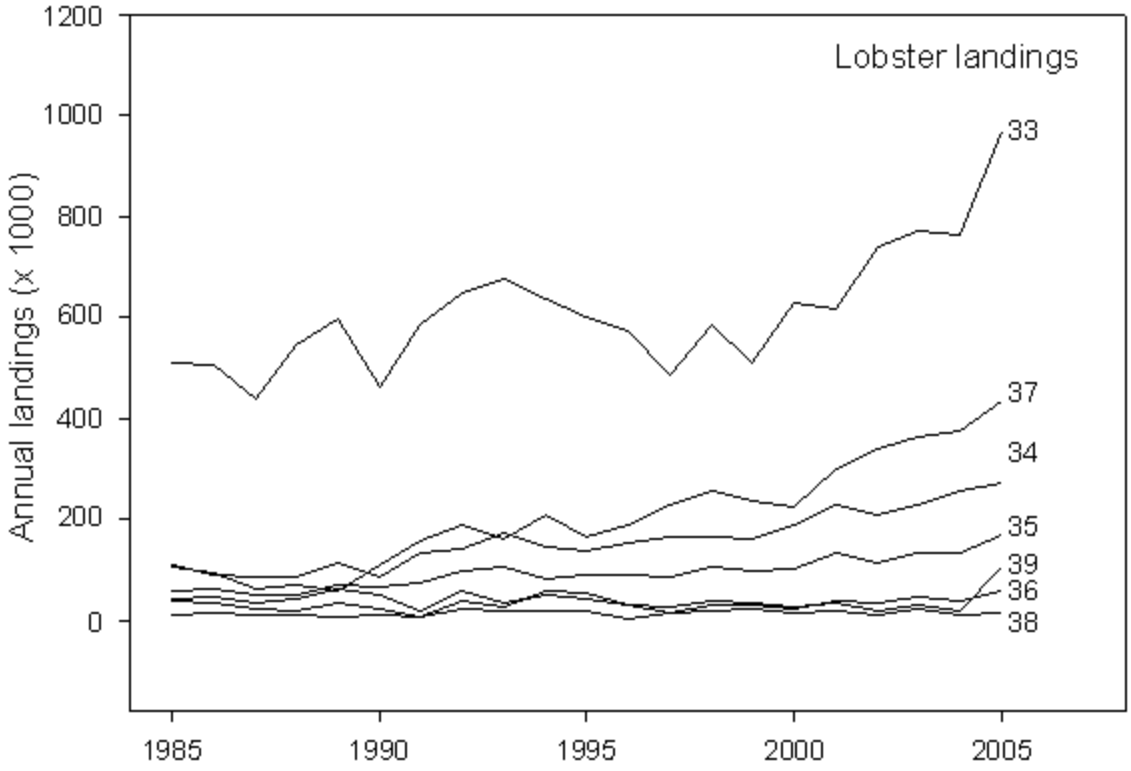
Sandlance	Labrador to Cape Hatteras (Scott 1993)	?	common (Yurick and Vanstone, 1983; CCRI)
Smelt	Labrador to New Jersey (DFO 1984)	infrequent, in small areas of Coasts of Bays (CCRI)	common (Yurick and Vanstone, 1983; CCRI)
Smooth skate	Labrador to St. Pierre Bank and Gulf of St. Lawrence (McKone and LeGrow 1983)	occurs below 50 m and most frequently caught between 90 and 325 m (www.mi.mun.ca/mi-net/fishdeve/skate.htm)	uncommon (Yurick and Vanstone, 1983)
Spotted wolffish	Greenland to the Grand Banks and in the Gulf of St. Lawrence (Scott and Scott, 1988)	unknown	not recorded
Thorny skate	Greenland and Hudson Bay to South Carolina (Robins and Ray, 1986)	expanse of coast of Fortune Bay (CCRI)	occurs, but not common (Yurick and Vanstone, 1983)
Turbot	Western Greenland to George Bank, rarely in Bay of Fundy and Gulf of Maine (Scott and Scott, 1988)	Upper Bay d'Espoir, Little Passage, Fortune Bay, Belle Bay (CCRI)	common at various locations (Yurick and Vanstone, 1983) Hare Bay (CCRI)
White hake	Southern Labrador, Gulf of St. Lawrence and southern Grand Banks south to Cape Hatteras (Bishop 1984; Scott and Scott, 1988)	concentrations in Laurentian Channel (Scott and Scott, 1988).	Devil Bay to Hare Bay (CCRI)

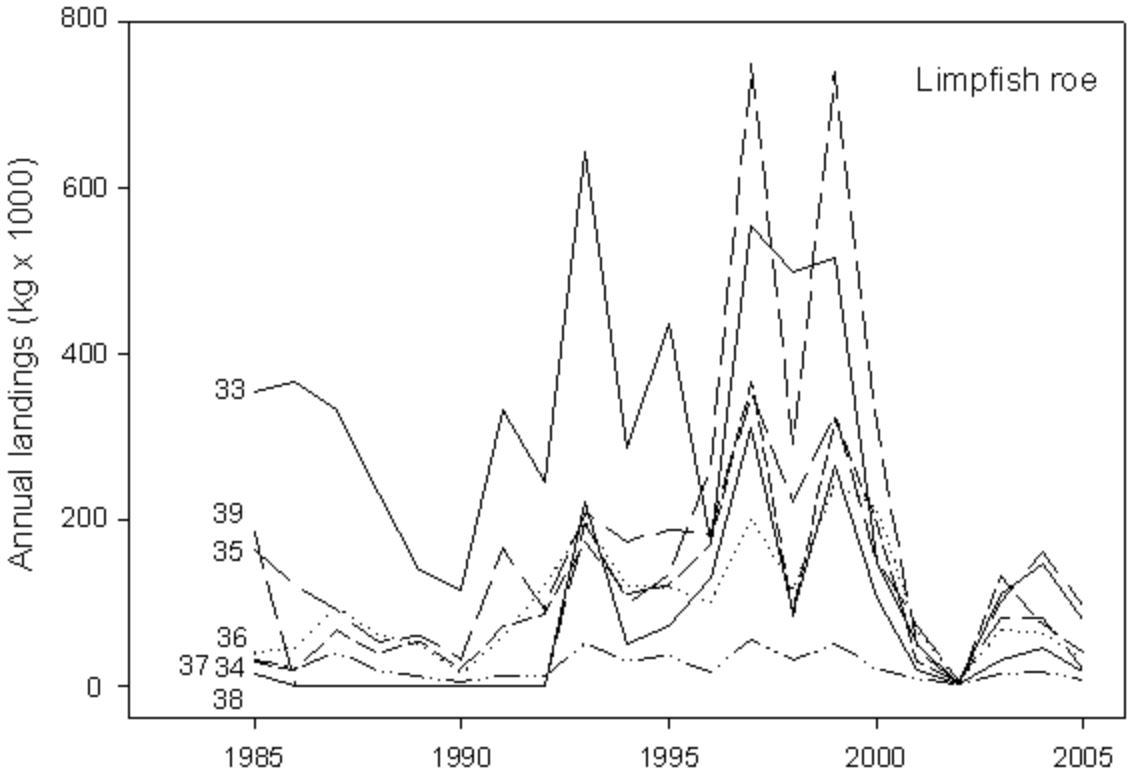
Winter flounder (blackback)	Southern Labrador to Chesapeake Bay (Pitt 1994)	Flounder found along expanses of coast in Fortune Bay (CCRI)	common at various locations (Yurick and Vanstone, 1983; CCRI)
Witch flounder	Hamilton Inlet to North Carolina (www.dfo-mpo.gc.ca/zone/underwater_sous-marin/atlantic/witch-plie_e.htm)	Flounder found along expanses of coast in Fortune Bay (CCRI)	common at various locations (Yurick and Vanstone, 1983) La Poile Bay (CCRI)
Yellowtail flounder	Southern Labrador to Chesapeake Bay (www.fishbase.net/)	Flounder found along expanses of coast in Fortune Bay (CCRI)	common at various locations (Yurick and Vanstone, 1983)
Reptiles			
Leatherback turtle	Have been found beteen 71ºN and 27ºS (www.dfo-mpo.gc.ca/zone/underwater_sous-marin/turtle/turtle-tortue_e.htmwww.dfo-mpo.gc.ca/zone/underwater_sous-marin/turtle/turtle-tortue_e.htm)	migrates to area between June and October (Minister of Public Works and Government Services Canada 1999)	migrates to area between June and October (Minister of Public Works and Government Services Canada 1999)

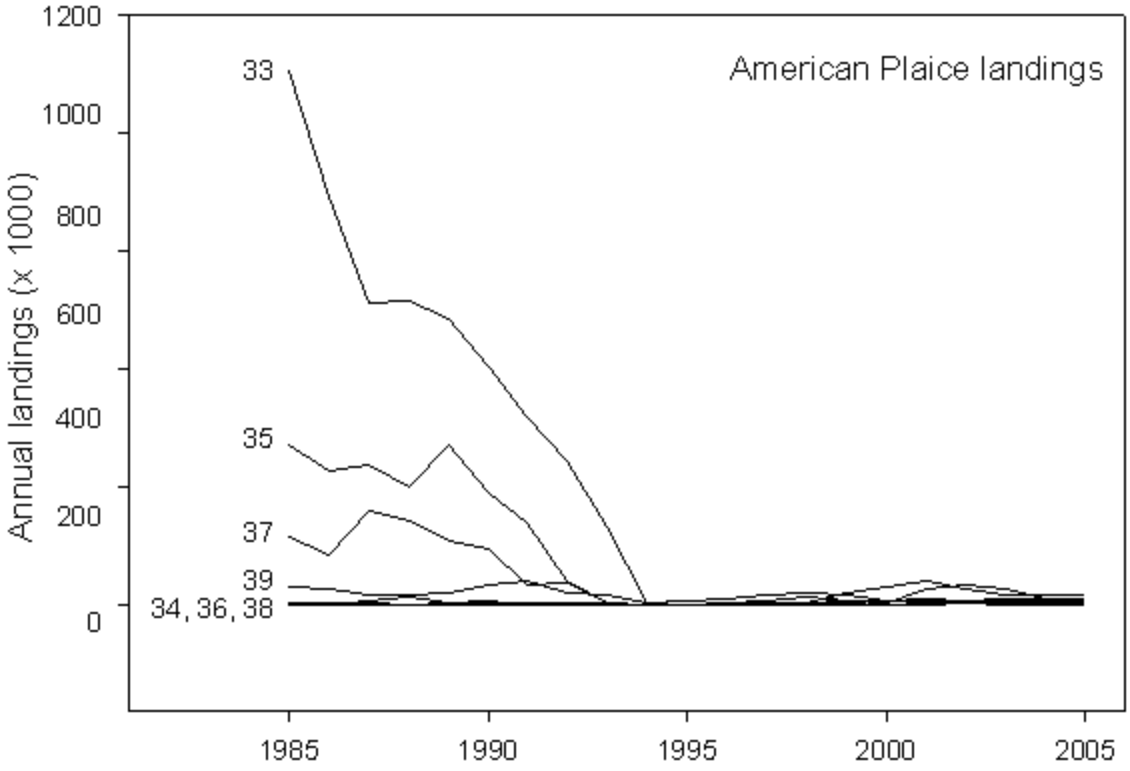
Appendix 4. Landings of marine invertebrates and fish on the south coast of Newfoundland during the period 1985 to 2005.

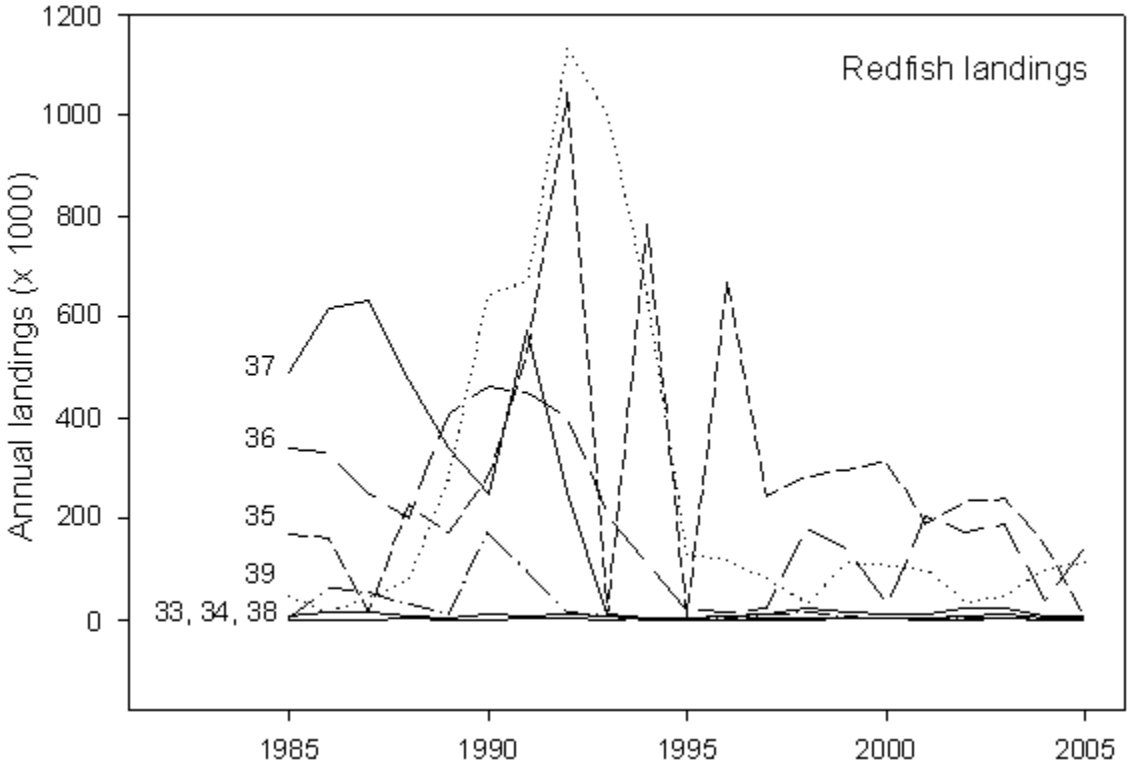


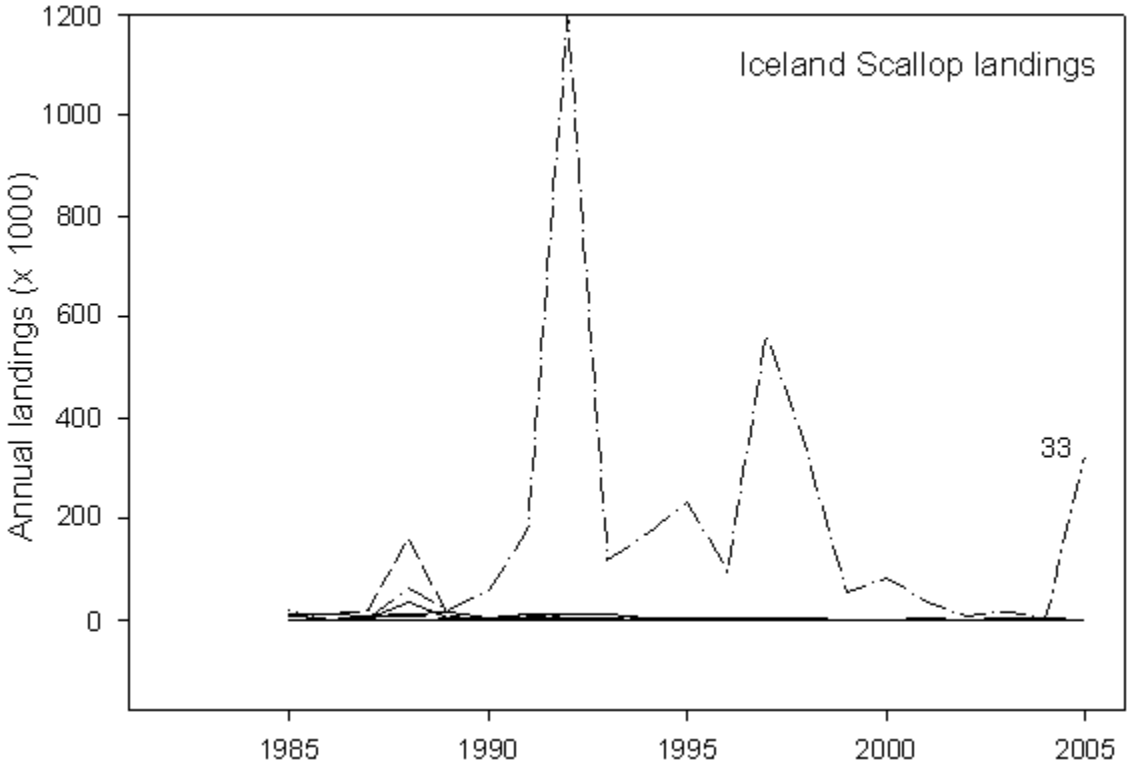

Greysole landings
Annual landings (kg x 1000)
1400
1200
1000
800
600
400
200
0
1985
1990
1995
2000
2005
39
33
35
37
36
34
38

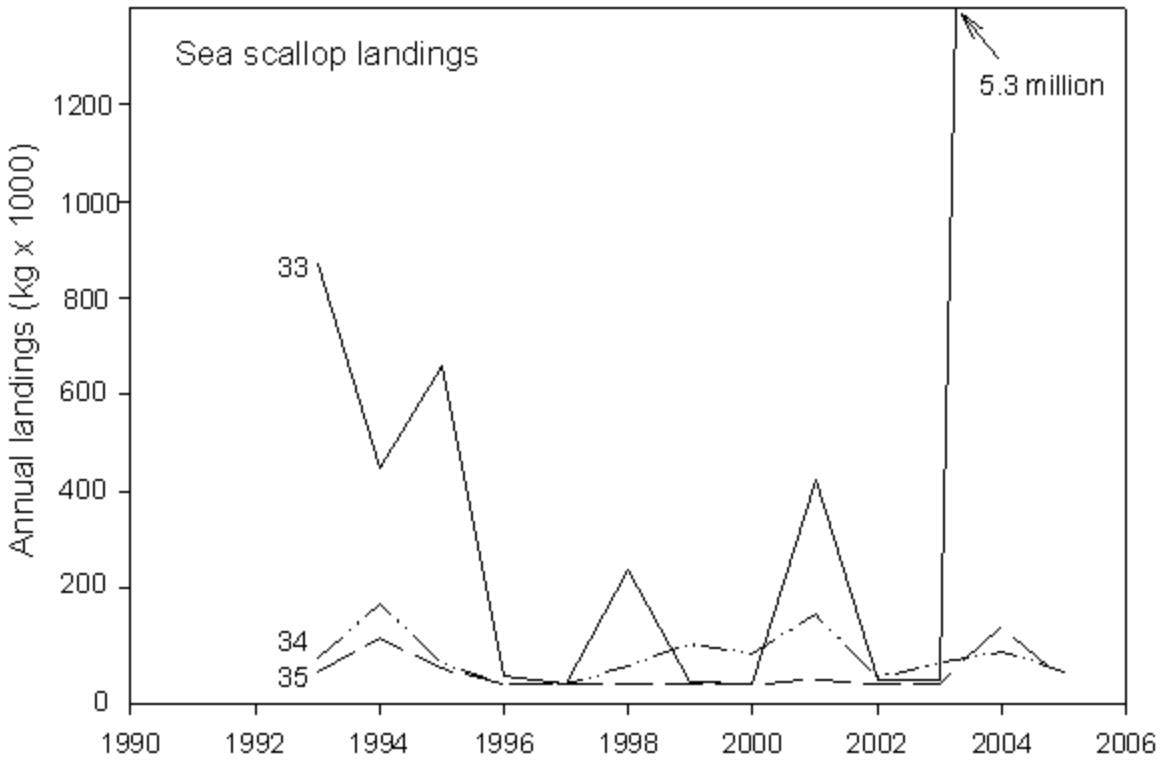

Lobster landings
Annual landings (x 1000)
1200
1000
800
600
400
200
0
1985
1990
1995
2000
2005
33
37
34
35
39
36
38

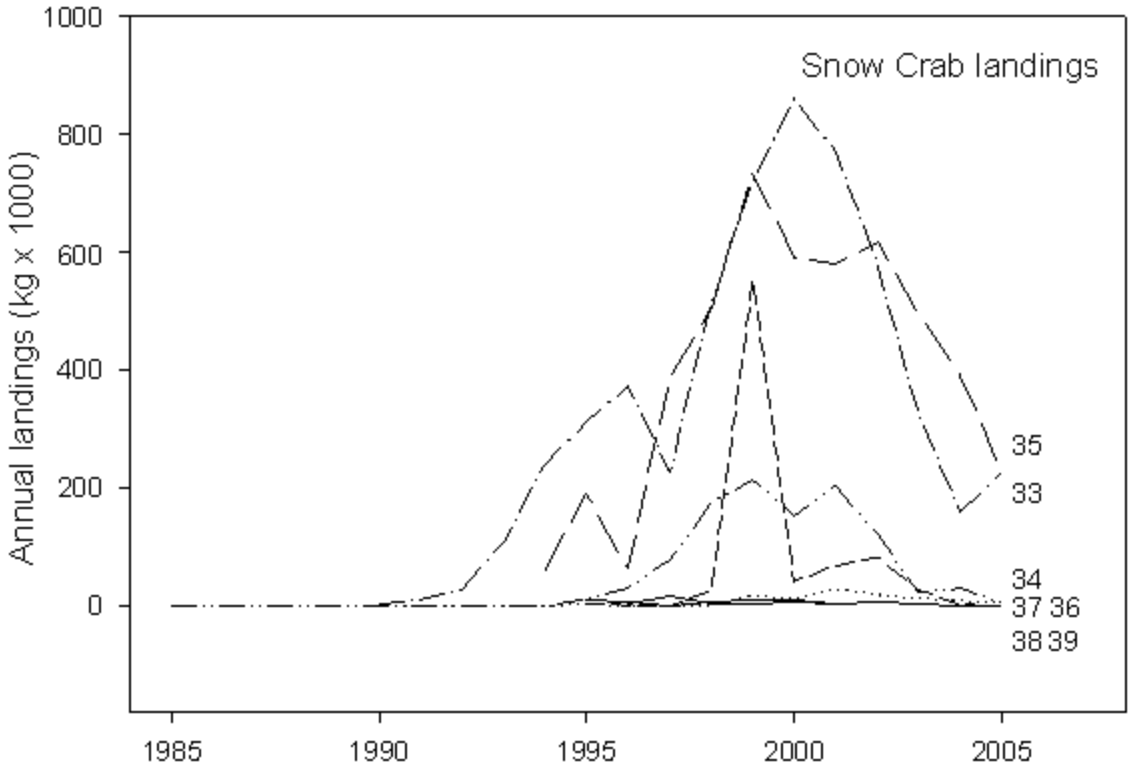

Limpfish roe
Annual landings (kg x 1000)
800
600
400
200
0
1985
1990
1995
2000
2005
33
39
35
36
37
34
38

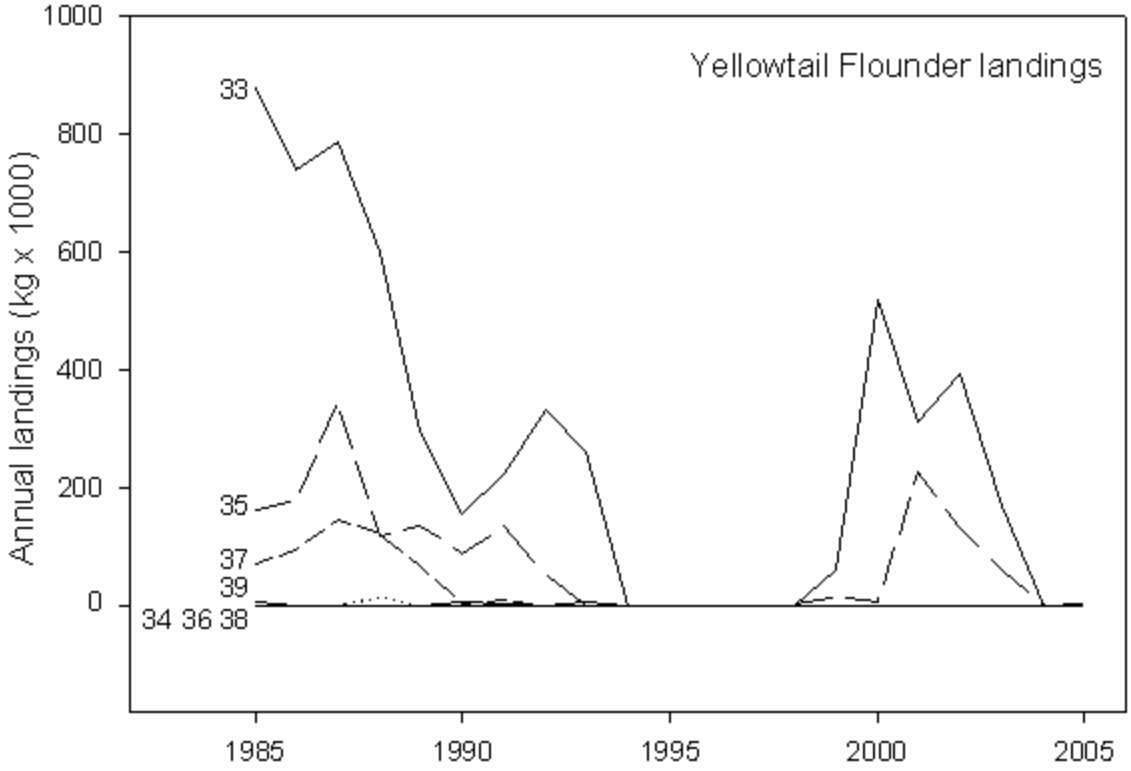

American Plaice landings
Annual landings (x 1000)
1200
1000
800
600
400
200
0
33
35
37
39
34, 36, 38
1985
1990
1995
2000
2005


Redfish landings
Annual landings (x 1000)
1200
1000
800
600
400
200
0
1985
1990
1995
2000
2005
37
36
35
39
33, 34, 38


Iceland Scallop landings
Annual landings (x 1000)
1200
1000
800
600
400
200
0
1985
1990
1995
2000
2005
33


Sea scallop landings
5.3 million
Annual landings (kg x 1000)
1200
1000
800
600
400
200
0
33
34
35
1990
1992
1994
1996
1998
2000
2002
2004
2006


Snow Crab landings
Annual landings (kg x 1000)
1000
800
600
400
200
0
1985
1990
1995
2000
2005
35
33
34
37 36
38 39


Yellowtail Flounder landings
Annual landings (kg x 1000)
1000
800
600
400
200
0
33
35
37
39
34 36 38
1985
1990
1995
2000
2005

Appendix 5. List of acronyms

AFS	Aboriginal Fisheries Strategy
CCRI	Community - based Coastal Resource Inventory
COB	Coast of Bays
COBC	Coast of Bays Corporation
COSEWIC	Committee On the Status of Endangered Wildlife in Canada
CPUE	Catch Per Unit Effort
DFO	Department of Fisheries and Oceans
EBSA	Ecologically or biologically Significant Area
ESSA	Economically or Socially Significant Area
FRCC	Fisheries Resource Conservation Council
ICNAF	International Commission of the Northwest Atlantic Fisheries
LFA	Lobster Fishing Area
LOMA	Large Ocean Management Area
MSW	Modified Slope Water
NACS	Natural Area of Canadian Significance
NAFO	Northwest Atlantic Fisheries Organization
NMCA	National Marine Conservation Area
RED	Regional Economic Development
TAC	Total Allowable Catch
TEK	Traditional Ecological Knowledge
SMA	Snow crab Management Area