Significant Habitats: Atlantic Coast Initiative (SHACI)
Sydney Bight – Unit 11

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by

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Table of Contents

List of Figures

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Abstract

Schaefer, H.L., D.M. McCullough, S.K. Johnston, and D.R. Duggan, 2004. Significant Habitats: Atlantic Coast Initiative (SHACI). Sydney Bight - Unit 11. Can. Manuscr. Rep. Fish. Aquat. Sci. 2650: x + 213 pp.

Coastal areas, including estuaries, bays and continental shelves constitute roughly 7.4 % of the sea's area (Sharp 1988). They are among the most diverse, yet heavily altered marine ecosystems, and thus warrant special consideration and protection. In this light, Significant Habitats: Atlantic Coast Initiative (SHACI) is a project aimed at identifying, mapping, and documenting significant coastal habitats along the Atlantic Coast of Nova Scotia. These coastal areas extend from Yarmouth on the southwest shore to Cape North on the northern coast of Cape Breton Island, including the Bras d'Or Lakes and from the coastal areas onshore to the 12 nautical mile offshore limit of Canada's Territorial Sea. The Oceans and Coastal Management Division, Maritimes Region, Fisheries and Oceans Canada is undertaking this initiative primarily to contribute information to programs and initiatives being developed under the *Oceans Act* for the nearshore Atlantic coast region.

The focus of this document is to summarize what is known about the physical environment and the coastal and marine life of the SHACI Unit 11 area - Sydney Bight. This includes coastal waters off eastern Cape Breton Island, and extends from Scatarie Island to Cape North. Sydney Bight is important habitat for many species of flora and fauna, and its coastline contains a variety of features. Its rugged, exposed rocky shores provide habitat of subtidal seaweeds which in turn provide habitat for many fish and invertebrate species. Based on SHACI criteria, ten significant habitats in SHACI Unit11 were identified, including Bird Islands for which this report provides more detailed information for this section.

Résumé

Schaefer, H.L., D.M. McCullough, S.K. Johnston, and D.R. Duggan, 2004. Significant Habitats: Atlantic Coast Initiative (SHACI). Sydney Bight - Unit 11. Rapp. man. can. sci. halieut. et aquat. 2650 : x + 213 pp.

Les zones côtières, y compris les estuaires, les baies et les plateaux continentaux, constituent à peu près 7,4 % de la superficie des mers (Sharp, 1988). Étant donné qu’elles figurent parmi les écosystèmes marins les plus diversifiés, mais aussi les plus perturbés, elles doivent faire l’objet d’une attention et d’une protection spéciales. À cette fin, l’Initiative concernant les habitats importants de la côte Atlantique (ICHICA) vise à déterminer, à cartographier et à documenter les habitats côtiers importants de la côte atlantique de la Nouvelle-Écosse. Les zones côtières ciblées par cette initiative s'étendent depuis Yarmouth, sur la côte sud-ouest, jusqu'à Cape North, sur la côte nord de l'île du Cap-Breton, englobant le lac Bras d'Or, et depuis la côte jusqu'à la limite des eaux territoriales canadiennes, à 12 milles nautiques vers le large. La Division de la gestion côtière et des océans, Région des Maritimes, de Pêches et Océans Canada a lancé cette initiative principalement dans le but de contribuer à la réalisation de programmes mis en oeuvre sur la côte atlantique du pays, conformément à la *Loi sur les océans*.

Le présent document résume les connaissances actuelles au sujet du milieu physique et du milieu biologique côtier et marin de l’unité 11 de l’ICHICA. Cette zone comprend les eaux côtières situées au large de la côte est de l’île du Cap-breton, et va de l’île Scatarie à Cape North. Le Sydney Bight est un habitat important pour de nombreuses espèces de flore et de faune, et son littoral présente diverses caractéristiques. Ses côtes rocheuses et accidentées à découvert offrent un habitat aux algues de l’étage infralittoral, qui elles-mêmes abritent de nombreux poissons et invertébrés. En se fondant sur les critères de l’ICHICA, on a cerné dix habitats importants dans l’unité 11 de l’ICHICA, notamment l’île Bird, au sujet de laquelle le présent document fournit de plus amples renseignements.

1 – SHACI Introduction and overview

Coastal areas, including estuaries, bays and continental shelves, constitute roughly 7.4% of the sea's area (Sharp 1988). They are among the most biologically diverse yet heavily altered marine ecosystems, and thus warrant special consideration and protection. In this light, Significant Habitats: Atlantic Coast Initiative (SHACI) is a project aimed at identifying, mapping and documenting significant coastal habitats along the Atlantic Coast of Nova Scotia. These coastal areas extend from Yarmouth on the southwest shore, to Cape North on the northern coast of Cape Breton Island, and include the Bras d'Or Lakes. The extents are from the high tide mark to the 12 nautical mile offshore limit of Canada's Territorial Sea. The Oceans and Coastal Management Division, Maritimes Region, Fisheries and Oceans Canada is undertaking this initiative primarily to contribute to programs and initiatives being developed under the *Oceans Act* for the nearshore Atlantic coast region.

Purpose

The *Oceans Act*, passed in 1997, mandates the development and implementation of a national strategy for oceans management, and commits the Government of Canada to a new management approach for the ocean based on the principles of sustainable development, integrated management and precautionary and ecosystem approaches. A guiding principle of this strategy is the integrated management of all activities in estuaries, coastal waters and marine waters that form part of Canada. The Department of Fisheries and Oceans' (DFO) approach to achieving this mandate is outlined in *Canada's Oceans Strategy* and the *Policy and Operational Framework for Integrated Management of Estuarine, Coastal and Marine Environments in Canada* released July 2002. Fisheries and Oceans Canada (DFO) is the lead federal department for the conservation, management, and sustainable development of renewable marine resources. In this capacity, DFO oceans and coastal managers and planners require the identification of significant habitats. Along the Atlantic Coast, these habitats will be identified through this initiative.

Canada is also committed globally to conserving marine biodiversity. In 1994, the International Union for the Conservation of Nature (IUCN) recommended that countries bordering oceans create systems of marine protected areas through legislation. In 1992, the *Convention on Biological Diversity* was opened for signature, and by 2001 had been adopted by more than 180 countries. Canada, an early signatory and the sixth country to ratify the agreement, is now committed to:

- Develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes which shall reflect, *inter alia*, the measures set out in this Convention relevant to the Contracting Party concerned; and,

- Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies (Article 6, 1992).

Through these national and international commitments, Canada is responsible for managing its oceans and their resources in a sustainable manner. The most sensible, efficient and effective way to plan for sustainable ocean use requires the identification of significant habitats and of key gaps in our knowledge. Although much literature exists about specific Atlantic coast marine species and habitats, there is no current and comprehensive mapping initiative and/or documents that have combined this information for the purpose of identifying significant marine habitats.

The maps and reports produced through SHACI are intended for use by a general audience including ocean planners, fisheries managers, non-government organizations (NGOs), consultants, industry, and the public for purposes such as public education, coastal planning and resource management, and environmental assessments. Looking specifically at DFO, this initiative is relevant to several programs under the *Oceans Act*, and will serve as a knowledge base for the creation and development of new initiatives. Generally, SHACI will:

- Provide an overview of what is known about Atlantic coast habitats and help to identify information gaps
- Be a key information source for the Marine Protected Areas (MPA) program by identifying significant areas along the coast that may require a higher level of protection provided through MPAs
- Support DFO's work on the identification of appropriate standards and measures for marine environmental quality
- Assist in identifying appropriate indicators and reference points for monitoring ecosystem health

SHACI is intended to support and influence decision-making regarding the use of the Atlantic coast of Nova Scotia. It will not, however, look in-depth at human activities and socio-economic issues, nor will it identify or recommend specific management actions.

Associated literature and similar initiatives

Atlantic coast in the literature

In a report commissioned by Parks Canada, P. Lane and Associates Limited (1992) reviewed the oceanography, geology, biology and marine history of the Scotian Shelf Marine Region, and identified candidate Marine Natural Areas of Canadian Significance (NACS). This report dealt with both nearshore and offshore regions of the Scotian Shelf. The study area was divided into six sub-regions defined according to geological and oceanographic boundaries, with four sub-regions: the South Shore, the Eastern Shore, Canso to Cape Breton Shore and the Bras d'Or Lakes. Based on this report, a twelve-member study team chose three candidate NACS for further appraisals by the Canadian Parks Service: Cape Sable and Offshore Upwelling, Sable Island and the Gully, and Canso and Offshore Islands.

The Natural History of Nova Scotia Volume One: Topics and Habitats (Davis and Browne 1996a), and *Volume Two: Theme Regions* (Davis and Browne 1996b) contain much information about the Atlantic coast of Nova Scotia. The Davis and Browne approach to creating Theme Regions along the coast was to imagine a person standing in the intertidal zone. What this individual would observe when facing landward was included in the Region 800 Atlantic Coast (Figure 1-1), and what the individual would observe when facing seaward was considered Region 900 Offshore/Continental Shelf (Figure 1-2) (D. Davis pers. comm. 2001). Given the SHACI study area, both marine-based (Region 900) and land-based Regions (Region 800 and others) are relevant. The Theme Regions are then further subdivided hierarchically into Districts and Units.

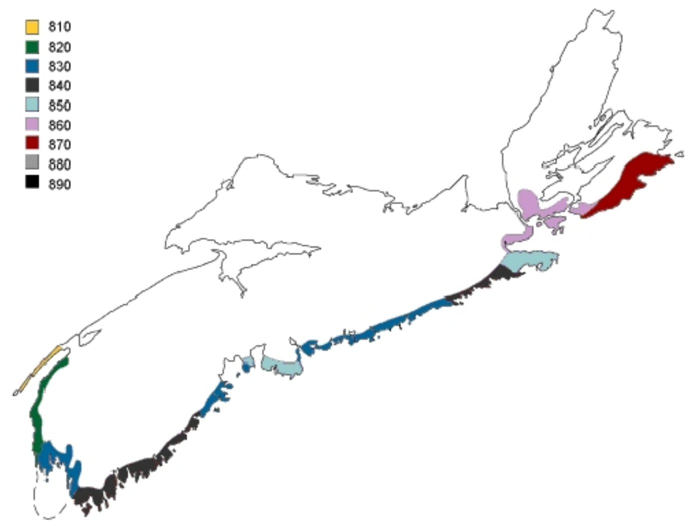


Figure 1-1. Natural History of Nova Scotia Theme Region 800 Atlantic Coast (Davis and Browne 1996b)

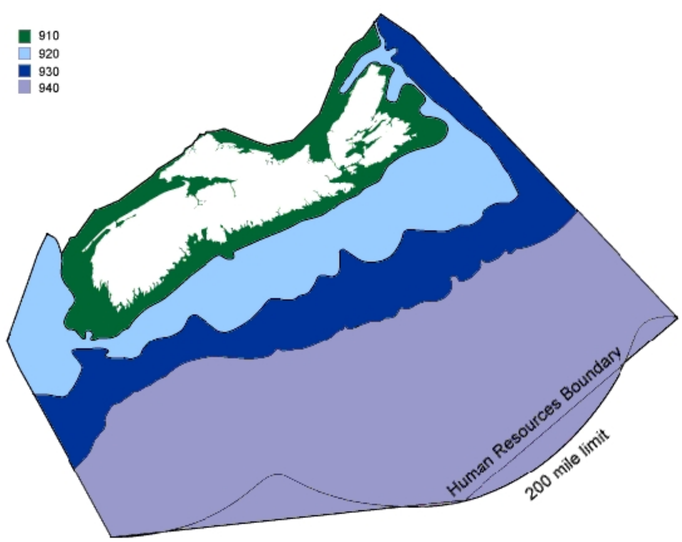


Figure 1-2. Natural History of Nova Scotia Theme Region 900 Offshore/Continental Shelf (Davis and Browne 1996b)

Other studies and reports have examined either a geographical component of a particular species group, or a habitat type found within the SHACI study area. In one of the few comprehensive reports on a particular area, Kenchington (1998) compiled all known information about the Bras d'Or Lakes and the surrounding landmass within their watershed as a basic reference source for integrated management of the Bras d'Or Lakes region.

A series of inventory-type reports entitled *Community Ecological Requirements and Guidelines for Marine Habitats* (Hawkins 1997) provides a detailed ecological overview of rocky intertidal, mudflat and salt marsh habitats along the Atlantic shore of Nova Scotia.

Lock et al. (1994) produced the *Gazetteer of Marine Birds in Atlantic Canada: An Atlas of sea bird vulnerability to oil pollution.* It provides information about sensitive sea bird areas in Nova Scotia.

Similar initiatives in other regions of the Maritimes

Several similar DFO initiatives are in progress in other regions of the Maritimes. The *Preliminary Index of Regionally Critical Habitats for Certain Marine Species of Importance in Prince Edward Island and the Northwest Region of Nova Scotia* (Therrien et al. 2001) and *Preliminary Index of Essential Habitats for certain Marine Species of Importance in the Eastern Region of New Brunswick* (Therrien et al. 2000) are reports aimed at identifying Critical Habitats in these regions. Therrien et al. (2000; 2001) selected four themes to describe essential habitat: Ecological Features, Vulnerability, (threats and human pressures), Socio-economic characteristics, and Support, (favourable and unfavourable factors). Data collected for these reports was gathered in three stages: by consulting DFO and provincial government researchers, by a literature review, and by interviewing fisheries officers. These reports present information in the form of essential habitats for certain marine species. In this case, "essential habitat" refers to a "species habitat" (i.e. a vital habitat for a given species). The majority of areas identified were important for species of commercial or recreational interest; non-commercial species received less attention due in part to a lack of information. Many marine resources (e.g. kelp beds, small concentrations of pinniped or molluscs, etc.) and habitats (estuaries and lagoons) were not included due to their widespread distribution in their respective regions.

In the Bay of Fundy, the *Identification of Significant Marine and Coastal Areas* document was produced in 2003 with the aim to identify significant, community-valued or highly biodiverse marine areas in the Bay of Fundy, and to recommend management initiatives Buzeta et al. 2003). To accomplish this goal, a broad range of stakeholders were engaged in identifying significant marine areas through workshops and written submissions (Buzeta pers. comm. 2003).

An *Ecological Overview of the Scotian Shelf* was completed in 2002 (Breeze et al. 2002). This review provides a description of the major ecological components of the Scotian Shelf, summarizing what is known about its physical environment and marine life. The *Ecological Overview of the Scotian Shelf* will be closely linked with SHACI, as the two study areas abut and thus have linked oceanographic processes and common species and habitats.

Organization of SHACI

For organizational purposes, the SHACI study area is subdivided into twelve different units (Figure 1-3) based primarily on physical environmental factors. The SHACI units closely mirror many of the districts and units of the *Natural History of Nova Scotia* (Davis and Browne (1996b). The *Natural History of Nova Scotia* Districts were divided based upon major geomorphological characteristics, and further divided into Units based upon geomorphological, soil, and vegetation characteristics. The relationship between SHACI ecological units and those used in other systems used to subdivide the coast are indicated in Table 1-1.

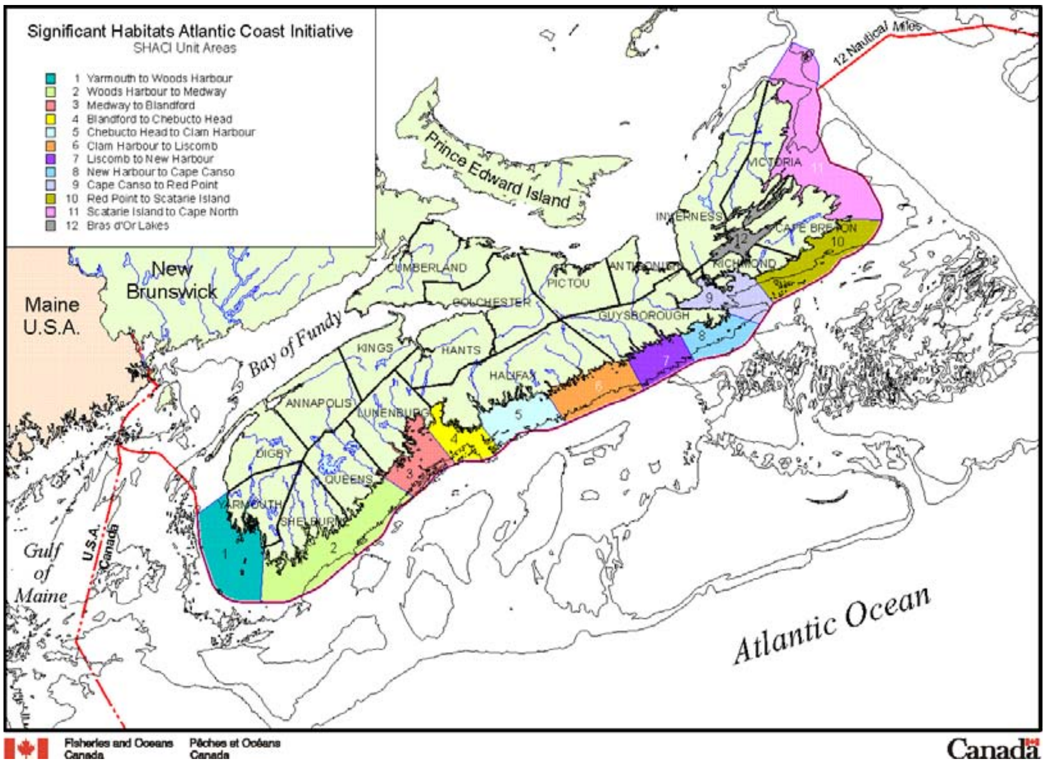


Figure 1-3. SHACI Units

District 910 Inner Shelf (Davis and Browne 1996b) includes the marine habitat from the intertidal seaward. District 910 includes: Unit 911- Atlantic (SHACI Units 1-10); Unit 915 – Sydney Bight (SHACI Unit 11); and Unit 916 - Bras d'Or Lakes (SHACI Unit 12).

Table 1-1. Relationship between SHACI units and those used in other studies

SHACI Unit.	NHNS MarineTheme Regions (Davis and Browne 1996b).	NHNS CoastalTheme Regions (Davis and Browne 1996b).	P. Lane and Associates (1992).
Unit 1 – Yarmouth to Woods Harbour	District 910 Inner Shelf Unit 911 Atlantic	District 830 Beaches and Islands • Unit 831 Tusket Islands	South Shore
Unit 2 – Woods Harbour to Medway	District 910 Inner Shelf Unit 911 Atlantic	District 840 Quartzite Headlands • Unit 841 Capes and Bays	South Shore
Unit 3 – Medway to Blandford	District 910 Inner Shelf Unit 911 Atlantic	District 830 Beaches and Islands • Unit 832 LaHave Drumlins	South Shore
Unit 4 – Blandford to Chebucto Head	District 910 Inner Shelf Unit 911 Atlantic	District 850 Granite Barrens • Unit 851 Pennant Barrens	South Shore
Unit 5 – Chebucto Head to Clam Harbour	District 910 Inner Shelf Unit 911 Atlantic	District 830 Beaches and Islands • Unit 833 Eastern Shore Beaches	Eastern Shore
Unit 6 – Clam Harbour to Liscomb	District 910 Inner Shelf Unit 911 Atlantic	District 830 Beaches and Islands • Unit 834 Bay of Islands,	Eastern Shore
Unit 7 - Liscomb to New Harbour	District 910 Inner Shelf Unit 911 Atlantic	District 840 Quartzite Headlands • Unit 842 Guysborough Harbours	Eastern Shore
Unit 8 – New Harbour to Cape Canso	District 910 Inner Shelf Unit 911 Atlantic	District 850 Granite Barrens • Unit 852 Canso Barrens	Eastern Shore
Unit 9 –Cape Canso to Red Point (Chedabucto Bay)	District 910 Inner Shelf Unit 911 Atlantic	District 860 Sedimentary Lowlands	Canso to Cape Breton Shore
Unit 10 – Red Point to Scatarie Island	District 910 Inner Shelf Unit 911 Atlantic	District 870 Till Plain	Canso to Cape Breton Shore
Unit 11 – Scatarie Island to Cape North (Sydney Bight)	District 910 Inner Shelf Unit 915 Sydney Bight	District 530 Stony and Wet Plain • Unit 531 Sydney Coalfield District 550 Coastal Fringe • Unit 552 Victoria Coastal Plain	Canso to Cape Breton Shore
Unit 12 – Bras d'Or Lakes	District 910 Inner Shelf Unit 916 Bras d'Or Lake	District 560 Submerged Lowland	Bras d'Or Lakes

SHACI Unit overviews

It is useful to gain a general understanding of the study area's ecological features and processes before assigning Significant Habitat status to any given area. Such an examination indicates the important differences between the ecological units found in the marine areas along our coast. As indicated in Table 1-1, many of the *Natural History of Nova Scotia* Theme Regions correspond with the SHACI study area. In their overview of these areas, Davis and Browne (1996b) provide information about marine ecological features which was used as a key reference for the following unit descriptions. These are outlined on the following pages.

Unit 1 – Yarmouth to Woods Harbour

Unit 1 (Figure 1-5) has a submerged coastline with long promontories and inlets. Extensive areas of salt marsh, the dominant feature here, are present due to the ample sediment supply from glacial deposits. Unit 1 has relatively ice-free winter conditions and therefore provides important overwintering habitat for waterfowl. Coastal waters are nutrient rich and support a diverse marine fauna due to upwelling and tidal mixing (Davis and Browne 1996b).

The productive lobster fishery here provides an economic base for this coastal area. Herring, mackerel, crab, scallop, and clams are also important fisheries; however, groundfishing has been reduced substantially in recent years. Rockweed, kelp, and to a lesser degree, Irish moss are commercially harvested. There is a sizeable aboriginal fishery in Unit 1. Sand and gravel were commercially exploited here in the past

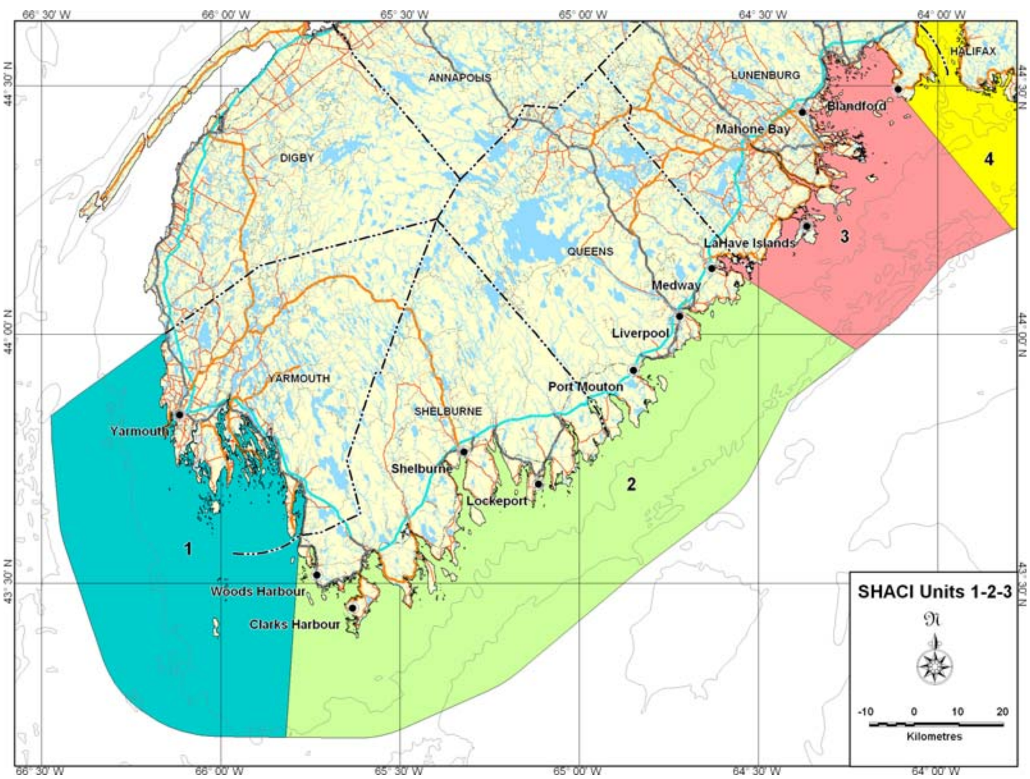


Figure 1-4. SHACI Units 1, 2 and 3

Unit 2 – Woods Harbour to Medway

The coastal terrain in Unit 2 (Figure 1-5) consists of hummocky granite and greywacke bedrock with variable, but usually thin, till cover. The indented coastline is divided into well-developed capes and long narrow bays. Many chain lakes and rivers drain into the Atlantic via many inlets and estuaries in this area, and sand is generally abundant in Unit 2. A diversity of coastal habitats are found here including sand beaches, salt marshes, intertidal muds and sand at the heads of the longer inlets, tidal marshes, barachois ponds and cobble beaches (Davis and Browne 1996b). The sheltered inlets and mild, relatively ice-free winters provide wintering habitat for waterfowl.

Areas within Unit 2 are known for specific ecological features or habitats. Rocky shores are found primarily between Liverpool and Port Medway. Clarks Harbour and Cape Sable are important staging areas for shorebirds, as is Barrington Bay with its extensive mud flats. An important waterfowl wintering area is found between Lockeport and Port Mouton. Further offshore, overwintering pelagic seabirds and whales find nutrient rich waters. Warm water incursions from the Gulf Stream often introduce exotic tropical species to Unit 2 during the summer (Davis and Browne 1996b).

Unit 2 has a history of fishing, shipbuilding and forestry exports. Today, there is still a shipyard and major pulp and paper plant near Liverpool. The major local fishery is lobster. Herring, mackerel, sea urchins, groundfish, and some inshore crab are also fished. Offshore fishing vessels sail from many of the ports along this shore.

Unit 3 – Medway to Blandford

Unit 3 (Figure 1-5) has an ample sediment supply given the many drumlins found both in shoals and on islands offshore. In the southern area of this unit, there are slate bedrock promontories. There is a diversity of coastal habitats here including extensive sand beaches, cobble and shale beaches, rocky shores, tidal flats and salt marshes. Most of the wetlands are tidal, and salt marshes and eelgrass beds are common. The Lahave estuary is very wide where it crosses into this coastal area. Such rivers draining into this unit provide distinct estuarine conditions for brackish water species. The system of sheltered inlets and rocky shore also provides habitat for southern and northern faunal species respectively. Occasional summer incursions of slope waters introduce exotic tropical species to this unit. There are many locally important habitat areas for shorebirds and waterfowl (Davis and Browne 1996b).

Fishing dominates this coast, and access to offshore banks has resulted in a prosperous fishing industry. Lobster is the major coastal fishery; however, herring, mackerel and sea urchins are also harvested. Numerous aquaculture operations exist here, as well as a developing shrimp industry. The LaHave Islands and Mahone Bay area are important tourist and recreational destinations. Shell middens from traditional Mi'kmaq camps have been found in the St. Margaret's Bay area indicating Traditional use of this area.

Unit 4 – Blandford to Chebucto Head

Unit 4 (Figure 1-6) differs from its surrounding units because it is a large granite promontory. The shoreline is rocky with low cliffs that have, in some places, been swept clear of all sediment and are bordered by boulder and cobble shore, or sandy beaches. There is little suitable shorebird or waterfowl habitat in Unit 4. Particularly in the late summer, slope water influence provides productive plankton areas and the presence of whales (Davis and Browne 1996b).

Small fishing operations for lobster and other species exist in this area. Peggy's Cove, a major tourist destination, is located within Unit 4. As well, many commuters who work in the region's major city, Halifax, live in this area.

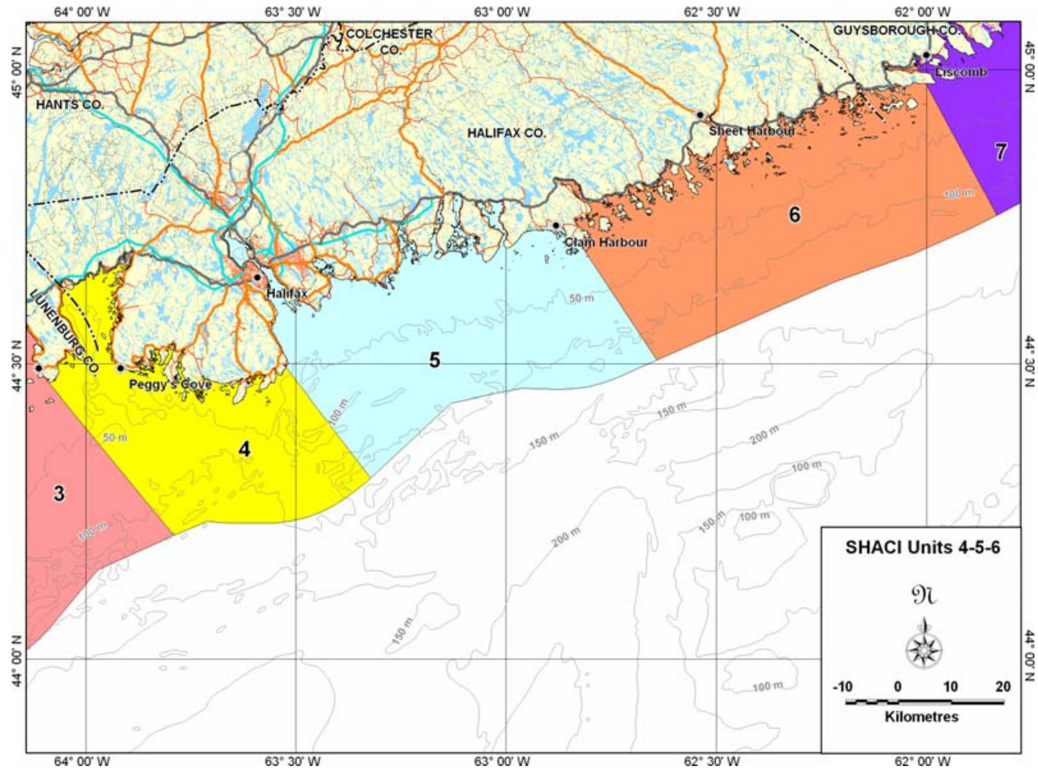


Figure 1-5. SHACI Units 4, 5 and 6

Unit 5 – Chebucto Head to Clam Harbour

Unit 5 (Figure 1-6) is an indented, drowned coastline with headlands, long inlets and drumlin islands. Spits and barrier beaches connect the promontories and islands, thus protecting the large, shallow estuaries from ocean waves and allowing the development of salt marshes. Rocky shore, sand beach, salt marsh, and barachois pond habitats are found in Unit 5. Salt marsh and sand dune plant communities, and large eelgrass beds are therefore common. The many inlets provide overwintering habitat for waterfowl. The system of sheltered inlets and rocky shore provides habitat for southern and northern faunal species respectively, and periodic summer incursions of slope waters introduce exotic tropical species to this area.

Halifax is a major seaport with large volumes of traffic including container vessels, passenger cruise ships, coast guard and naval traffic. Many industries are located along the shoreline and there is little domestic sewage treatment. Fishing remains an important economic activity for some communities in Unit 5 and includes fisheries for lobster, clam, cod, and haddock. Recreational use in Unit 5, includes bird watching, hiking, camping, whale watching, boating, marinas and recreational beach use.

Unit 6 – Clam Harbour to Liscomb

This area has a submerged, rocky coastline and a series of elongated offshore islands (Figure 1-6). The majority of coastal habitat is rocky shore, with some small beach and salt marsh areas. The rocky shores, especially the quartzite shoals, have extensive seaweed beds. The many islands provide habitat for waterfowl and seabirds (Davis and Browne 1996b) including the Eastern Shore Islands Wildlife Management Area.

There is a limited lobster fishery, many aquaculture operations, and developing sea urchin and crab fisheries in this region. Forestry products are processed and shipped out of Sheet Harbour (Davis and Browne 1996b).

Unit 7- Liscomb to New Harbour

Unit 7 (Figure 1-7) has a submerged coastline with long, narrow, perpendicular bays separated by greywacke headlands. The sheltered inlets and islands in this area provide important habitat for seabirds, shorebirds and waterfowl. The colder water along this coast allows for little diversity in marine fauna. Freshwater runoff from the many rivers emptying here creates estuarine conditions and strongly influences the distribution of brackish water species. There is a limited supply of coastal sediment and beaches are typically rocky or cobbly with few sandy beaches. There are few tidal marshes due to the lack of sediment, nonetheless some eelgrass beds are found.

Settlements in this area are sparse. Recent developments have been spurred by the activities of the offshore oil and gas industry. Natural gas comes ashore at Country Harbour and is carried by pipeline to other parts of the province and beyond.

Unit 8 – New Harbour to Cape Canso

This area consists of granite knolls that rise above the upland surface (Figure 1-7). The northern coastline is straight, while the southeastern coastline is indented with many bays and islands. Coastal sediment supplies are extremely limited. Rocky shores provide good substrate for rockweed and kelp growth. The cold water shore is little influenced by slope water, leading to little diversity in marine fauna.

Canso was once an important base for fishing fleets that fished the Atlantic fishing banks. Lobster is now the major coastal fishery, however the shrimp and sea urchin fisheries are becoming more important. Ecotourism is also increasing in this area.

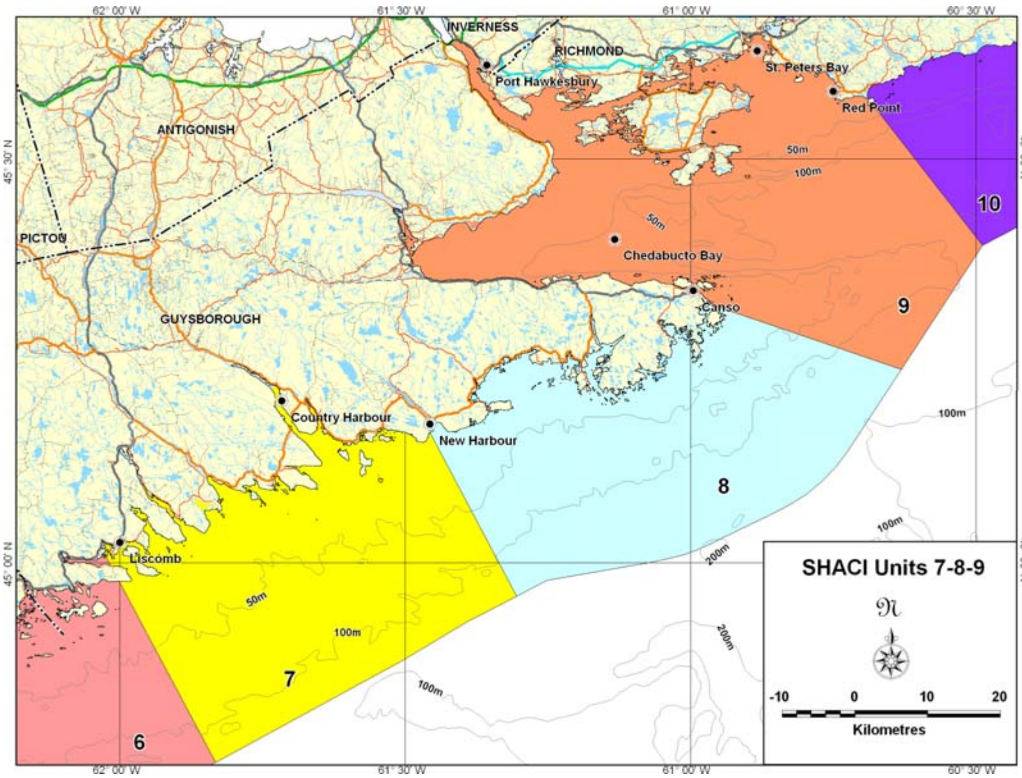


Figure 1-6. SHACI Units 7, 8 and 9

Unit 9 –Cape Canso to Red Point (Chedabucto Bay)

Chedabucto Bay is the largest Bay on the Atlantic Coast of Nova Scotia (Figure 1-7). It was formed by the drowning of an ancient river system that had developed on erodable Carboniferous sediments. Some southern marine fauna species are found here since water temperatures are warmer than on the more exposed coast to the northeast and southwest. The interaction of these species with those of the Southern Gulf of Saint Lawrence has been restricted since the construction of the Canso Causeway in 1955. Fishers attributed the drop in lobster and herring fisheries to the causeway. Drumlins are common in the eastern part of the bay. Marine erosion supplies ample coastal sediment for the many small gravel beaches, which often enclose small lagoons or salt marshes. The salt marsh and estuary areas provide wading bird habitat. Significant winter ice action in this area restricts the growth of seaweeds, the diversity of epifauna as well as winter feeding by waterfowl and seabirds. Whales are occasionally seen in Chedabucto Bay.

The River Inhabitants area is an important nesting area for wood turtles. Isle Madame, the large island in Chedabucto Bay, has salt marshes and is being promoted for tourism. St. Peters Bay is the gateway to the Bras d'Or Lakes and 1200 – 1500 recreational vessels travel through St. Peter's Canal every year. Port Hawkesbury is an industrial centre with a pulp and paper mill and an oil refinery. Small-scale lobster, sea urchin, shrimp and marine fish operations occur in the bay. A major oil spill polluted half of Chedabucto Bay's coastline in 1970, however little evidence of the spill remains today.

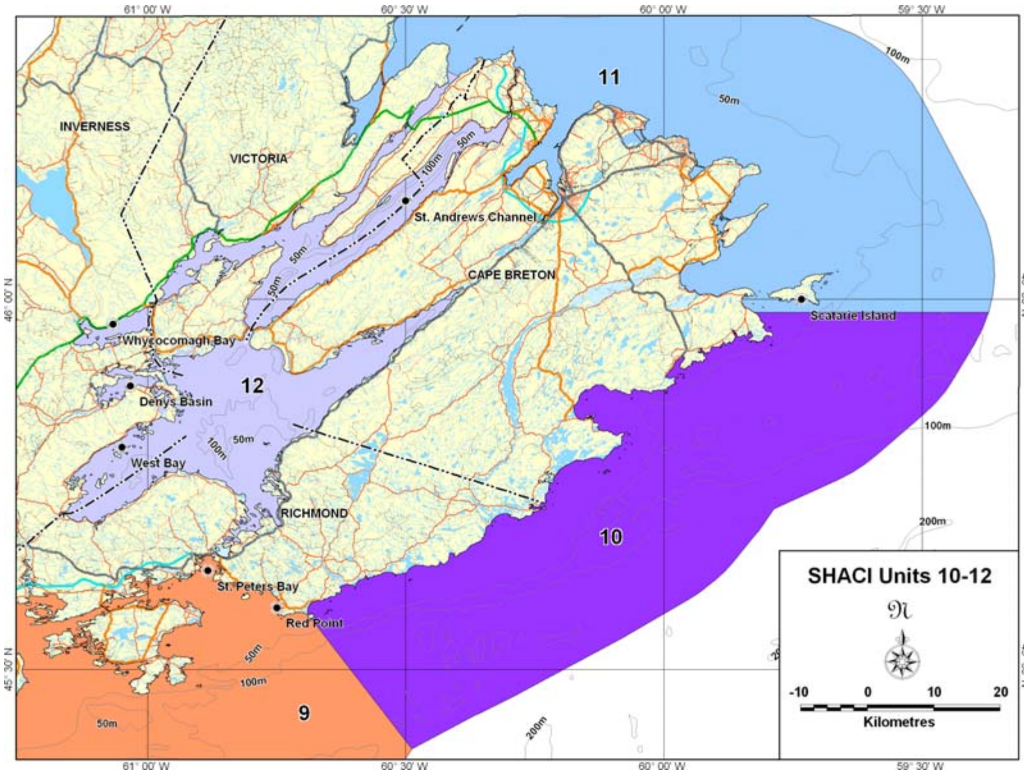
Unit 10 – Red Point to Scatarie Island

Unit 10 is located on Cape Breton Island (Figure 1-8). This coastline is relatively even and dips into the sea, except in Gabarus Bay where sea cliffs are found. The sediment supply along the coast is variable. Rocky shores, boulders and cobble beaches are common north of Gabarus, while south of Gabarus, the coast is indented with protected bays. There are numerous sand, gravel and cobble beaches as well as barachois ponds.

Some tidal marsh and eelgrass beds are found, as are some marine floral species from the Gulf of Saint Lawrence. Seaweeds are generally restricted, however, by the cold water and ice action. The cold water in Unit 10 also results in an impoverished marine fauna. Waterfowl, shorebirds and their habitats exist in coves and islands. Areas of deepwater upwelling attract seabirds. Harbour seals are common here, and Grey seals formerly bred on the Basque Islands.

The coast is sparsely populated with scattered fishing villages. Lobster is the most important fishery, and Salmon and trout fishing occur in the Mira River. Sand and gravel was extracted from the Mira River in the past.

Figure 1-7. SHACI Units 10 and 12



Unit 11 – Scatarie Island to Cape North (Sydney Bight)

Unit 11 includes Sydney Bight and its bordering coastline (Figure 1-9). From Scatarie Island to Cape North, coastal waters are underlain primarily with Carboniferous rocks of the Maritime plain. In the Sydney Basin, there are coal formations that extend from the onshore to Newfoundland. In northern areas, where the Cape Breton Highlands rise up from the sea, nearshore rocks are igneous. The bottom of Sydney Bight is relatively flat and slopes gradually to form St. Anns Bank. At depths less than 100 metres, sediments are a thin layer of sand and gravel mixtures through which bedrock is exposed. Material eroded from the coastal bedrock forms nearshore deposits, and local hydrographic conditions have resulted in the development of sand, gravel or clay deposits in some areas.

In the summer, Sydney Bight is influenced by the fresher, warmer waters flowing in from the Gulf of St. Lawrence. In the winter and spring Sydney Bight is exposed to sea ice moving out of the Gulf of St. Lawrence. Common seaweeds are present at shallow depths, including kelp, rockweed and Irish moss. Atlantic cod form wintering concentrations in deep water before migrating to the Southern Gulf of St. Lawrence to spawn in the spring. Many seabirds are found in the offshore waters.

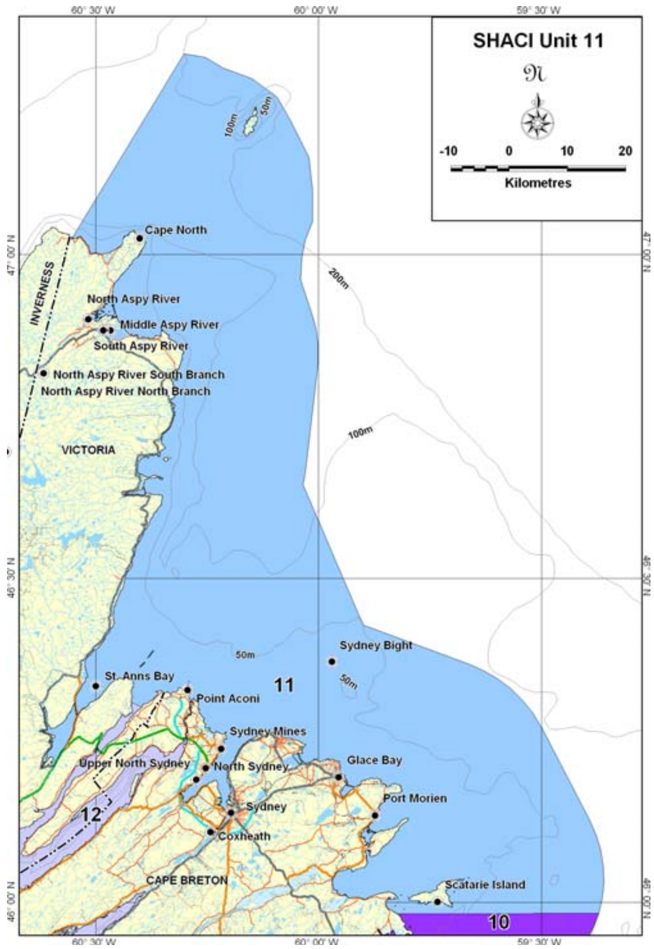


Figure 1-8. SHACI Unit 11

Lobster is the major fishery, however snow and rock crab, groundfish, capelin and herring are also fished. There is significant industrial traffic in Sydney Bight with the transportation of coal and the ferry service to Newfoundland.

Between Port Morien and Point Aconi the coast consists of sandstone with exposed coal seams. Plant fossils can be found in the shales along the beach. Port Morien, Glace Bay and Lingan Bay have salt marshes with eelgrass beds, and ice scouring limits the growth of marine algae. Sheltered bays and beaches found along the coast provide important habitat for shorebirds and waterfowl. Small islands, particularly the Bird Islands located off Point Aconi, provide nesting areas for colonial seabirds. Along the coast northwest of Sydney, there are bays and inlets to the Bras d’Or Lakes. A large portion of this area is taken up by urban land use. At Coxheath, there are numerous sand and gravel deposits that are commercially exploited, and the notoriously toxic Sydney tarponds are also located in this area.

From St. Anns Bay to Aspy River there are small tidal marshes and scattered barachois ponds. There is a diverse aquatic fauna in the barachois ponds behind barrier beaches; however, winter ice scour restricts the growth of marine algae. Lobster, mackerel and crab fisheries are the economic focus in this region. The Cabot Trail and Cape Breton Highlands National Park are major tourist and recreational attractions.

Unit 12 – Bras d'Or Lakes

Unit 12 includes the Bras d'Or Lakes (Figure 1-8). The Bras d'Or Lakes are an irregular brackish body of water covering 260 km^2, surrounded by land, which is in turn surrounded by a larger ocean. The western section of the Lakes is shallow with sheltered bays that include West Bay, Denys Basin, and Whycocomagh Bay. East Bay, St. Andrews Channel, and Great Bras d'Or Channel are the three long, narrow arms to the east. The Lakes connect to Sydney Bight at Great Bras d'Or Channel which is 8 m deep and at Little Bras d'Or Channel which is 6 m deep. A small man-made canal with locks connects the Bras d'Or Lakes to St. Peters Bay.

The lakes lie on regional lowland that developed in soft Carboniferous rocks prior to the Quaternary glacial period. Sedimentary rocks, including shale, sandstone, gypsum, and salt, therefore likely underlie the lakes. Deep channels within the Bras d'Or were probably caused by glacial erosion occurring throughout the Quaternary period. The lake floor morphology is influenced by the deposition of glacial till and pre-glacial silty muds. In the central and western part of the lakes there are drumlins, and there are recessional moraines present in East Bay, St. Andrews Channel and Great Bras d'Or.

Mud sediments are found in most deep areas of the Bras d'Or Lakes, with the exception of the sandy sediments found in areas flushed by tidal currents. Shallow, more exposed western areas of the lake are floored by gravelly-sandy mud that resulted from the erosion of glacial till. Many sandy and gravelly barrier beaches and spits formed due to the coastal erosion of glacial sediments.

Salinity levels in the Bras d'Or Lakes are relatively low, ranging from surface water concentrations of 29 ppt at the entrance to Great Bras d'Or to 20-21 ppt at the east end of East Bay. These low salinities are due in part to the reduced tidal influence and the high levels of fresh water runoff from local rivers. Tidal effects are reduced in the Bras d'Or because connection to the sea is only via two restricted channels. A 10-20 m thermocline and halocline develop during the summer that is probably deeper in the winter. Lake water is a mix of Atlantic water and local runoff, with little contribution from groundwater. The lake is mostly ice-covered in the winter, and warms by more than 10°C between May and July. Circulation in the Bras d'Or Lakes is typically estuarine with brackish near-surface water that flow seaward and deeper saline water that flows into the lake. Tidal currents at the entrance to Great Bras d'Or range between 4-6 knots. Other currents in the lake tend to be weak. In narrow passages between basins, flow may reach 1 knot. Sizeable waves and swells can develop during northeast gales in the eastern arms of the Bras d'Or Lakes.

Seaweed species found in the Bras d'Or Lakes are similar to those in the Gulf of St. Lawrence; and, like in the Gulf, they are restricted to deeper water due to winter ice activity. Marginal salt to freshwater marsh vegetation is found in the many sheltered bays. A variety of northern and southern fauna are found in the Bras d'Or Lakes.

The American oyster occurs due to the warmer water temperatures required for growth and reproduction, and sand shrimp, a southern species, is also found here. The polychaete fauna includes Virginian species as well as some Arctic-boreal species. The fish fauna includes blueback herring, black-spotted stickleback, a southern population of Greenland cod, and a feral population of rainbow trout.

The Lakes are economically important to all residents and of high cultural importance to the First Nations who comprise over 30% of the Lakes residents. Five Reserves are located around the lakes: Membertou, Eskasoni, Chapel Island, Wagmatcook and Waycobah. Eskasoni is the largest and most active in the environmental sector.

The Bras d'Or Lakes area includes numerous human resource uses including commercial and recreational fishing, aquaculture, tourism, forestry, agriculture, mining, recreational hunting, recreational boating, commercial shipping, road and rail transport. Just outside the Lakes watershed, heavy industry has developed and future development will undoubtedly add to these current uses. The commercial fishing activity includes lobster and herring fisheries; however, oyster and to a lesser degree salmonid aquaculture is the most important fishing industry. A gypsum mining operation occurs on the lake shore near Little Narrows and the product is shipped out through St. Patrick's Channel, the Great Bras d'Or Channel and over Middle Shoal outside Big Bras d'Or. The Bras d'Or Lakes are also a popular recreational boating area; between 1200 -1500 vessels visit these waters every year.

Methodology

Phase 1 - Guide to Significant Habitats

Phase 1 involved defining and outlining specific criteria for the selection of Significant Habitats in the form of a Guide to Significant Habitats. Various established criteria for the conservation of environmentally sensitive areas, marine protected areas, and other types of designation were adapted to meet the overall goals of SHACI. These criteria are listed in the SHACI Criteria section that follows.

Phase 2 - Information collection

Phase 2 involved compiling information about the ecological, cultural and recreational features present in the SHACI study area from materials collected in the literature search, through interviews, and from maps and GIS data layers.

Key literature regarding the Atlantic coast of Nova Scotia (e.g., P. Lane and Associates 1992; Davis and Browne 1996a; Davis and Browne 1996b; Kenchington 1998) as well as any documents describing the study area were examined. Individual features such as physical characteristics (geology, oceanography, chemistry, and climate/weather), marine life (plankton, benthos, fish, birds, mammals, marine plants) and marine habitats (salt marsh, estuaries, sand beaches, mudflats, offshore islands, spawning and nursery areas) were noted with the overall goal being to identify Significant Habitats associated with these features.

Comment: Should check entire document to ensure consistency in use of capital and lower case.

To complement and enhance the information collected in the literature review, Phase 2 involved conducting interviews with individual scientists within DFO, universities and research institutes, members of community organizations, and other individuals with information about Atlantic coast habitats.

Phase 3 - Unit overview

Phase 3 involved compiling the information collected during the first two Phases to create a coherent document providing information about the Unit's ecological and cultural/recreational values. The Unit Overview is divided into sections and includes maps of important ecological and cultural/recreational features.

Phase 4 - Significant Habitat selection

To select Significant Habitats, the Unit Overview was reviewed using the criteria established in the Guide to Significant Habitats. Any ecological or cultural/recreational feature or attribute mentioned in the overview was noted. This information was then entered into an Excel spreadsheet, and the data was sorted to be grouped by location. In this manner, locations or areas with several significant attributes became apparent. Such areas, as well as areas with particularly important features (e.g. habitat for species at risk) are considered more significant and are selected as Significant Habitats.

Phase 5 - Significant Habitat descriptions

Ideally, a detailed summary should be provided for each area selected as a Significant Habitat. For Unit 11, one detailed description was prepared for the Bird Islands. The detailed summaries include written descriptions and maps of the location, habitat, and the ecological and/or cultural and recreational features which make the area Significant. The Guide to Significant Habitats can be used again at this stage to ensure that areas selected do meet with the established guidelines. This phase may also look more closely at different methods for the analysis of the data to assess the significance of areas.

Phase 6 - Review

To ensure that the information presented in the SHACI Units 11 document is correct and that the areas selected as significant habitats are accurate and reflect the local knowledge and values, a review of the maps and documents generated by SHACI is required. Each chapter within the document was reviewed by one or more people working in that field and data gaps acknowledged.

2 – SHACI Criteria

A guide to Significant Habitats

Purpose and scope

Significant Habitats can be identified and assessed according to selected ecological and cultural attributes. These attributes are not intended as strict rules or criteria in which future protection, e.g. the establishment of MPAs will be judged. This guide defines 'Significant Habitats' and outlines the suggested ecological and cultural/recreational attributes that should be used to identify significance in each Unit SHACI area. Identifying these attributes will help guide future decisions and ensure that sites are identified and assessed on a consistent and balanced basis.

Internationally, and in Canada, a wide number of approaches and criteria have been developed to examine the sensitivityor importance of an area, or the selection of marine protected areas,(*e.g.* International Union for the Conservation of Nature (IUCN)). This guide was initially developed based on these broad information sources, and modified based on internal discussions within DFO.

This guide recognizes that it will sometimes be necessary to conduct evaluations on the basis of qualitative judgements. In such cases evaluators should take care to render such judgements as explicitly as possible, and set forth their assumptions and findings with a view to facilitating further discussion.

This guide recommends the use of the precautionary approach, established in the *Oceans Act*, in the selection of Significant Habitats. This approach requires that the best information available be used to identify and protect areas that may need protection. This approach also recognizes the value in reconsidering decisions, as further information becomes available. For example, a site may be rated highly as a unique habitat because, given the present state of knowledge, no comparable habitat is known to exist anywhere else within a region. Later, when more comprehensive habitat studiesbecome available, this rating could be reviewed. Similarly, the importance of an area may increase if it is habitat to a species that comes to be classified as endangered.

Weighting

A rating, or weighting system can be useful in evaluating whether particular sites are suitable for a particular designation (e.g. MPA status). No formal weighting system is designed to determine Significant Habitats, other than to recognize that areas with Species at Risk are particularly important. As well, no formal system is used to evaluate which Significant Habitat is more important than another.

Definition

For the purposes of SHACI, a **Significant Habitat** is:

> **Any area of land or water within the territorial sea and internal marine waters of Canada, large or small, under private or public control, that has desirable ecological and/or cultural and recreational attributes. These ecological attributes contribute to the functioning and sustainability of the coastal ecosystem, the conservation and protection of genetic, species, population and/or habitat diversity, and/or other similar vital ecological functions. The cultural and recreational attributes contribute to the health and well being of coastal communities, the conservation of historical and traditional cultures, and other components valued by coastal communities.**

Significant Habitat complexes may be identified. These are Significant Habitats that are either contiguous or in relatively close proximity to each other so as to allow their recognition as a single, interrelated ecological unit. Habitat complexes may be either:

1) contiguous similar habitats (e.g. linear stretches of beaches or dunes running parallel to the coast) or;
2) contiguous dissimilar habitats that may be geomorphologically or ecologically related (e.g. barrier beach/lagoon/saltmarsh complexes) or;
3) discontinuous but not necessarily remote similar habitats that form an essential part (if not the entirety) of a species' population or metapopulation.

Significant Habitats are recognized according to one or more of the attributes listed below. Areas possessing more than one attribute are considered more significant.

Ecological attributes

Significant Habitats are identified and assessed in the following terms:

General

- **Diversity**: the variety or richness of ecosystems, habitats, communities and species. Areas with more diversity are considered more significant

- **Naturalness**: the lack of disturbance or degradation. Natural areas are of more value to fisheries and tourism and make greater biological contributions to the ecosystem. Natural areas are considered more significant

- **Dependency**: the degree to which a species depends on an area or the degree to which an ecosystem depends on ecological processes occurring in the area. Areas critical to one or more species or process are considered more significant

- **Representativeness**: the degree to which an area represents a habitat type, ecological process, biological community, physiographic feature or other natural characteristic. A habitat type that has not yet been protected is considered more significant

- **Uniqueness**: an area that is "one of a kind" (e.g. habitats of endangered species occurring only in one area)

- **Productivity**: the degree to which productive processes within the area contribute benefits to species or to humans. Areas that contribute most to ecosystem sustainability are considered more significant with the exception of eutrophic areas where high productivity has negative effects

- **Vulnerability**: the area's susceptibility to degradation by natural events or the activities of people. Biotic communities associated with coastal habitats may have a low tolerance to changes in environmental conditions, or they may exist close to the limits of their tolerance. Areas that are more vulnerable are considered more significant

Ecological conservation and protection

Areas are considered significant if they are important for the conservation and protection of:

Ecological areas of cultural or community significance

- Areas identified as significant ecological areas by Aboriginal Communities as identified through the gathering of traditional knowledge
- Areas identified as significant ecological areas by the fishing community (or other non-Aboriginal communities) through the gathering of traditional ecological knowledge

Commercial fisheries resources (fish and invertebrates)

- The area supports habitat critical to certain life stages or aggregations of target species (e.g. spawning areas, juvenile areas, overwintering areas, and feeding areas)
- The area is a key component of a migratory route
- The area contains unique or vulnerable genetic stocks of target species
- The area provides critical habitat or an ecosystem function or process important to the survival of a single species or group of species

Non-commercial fishery resources (marine mammals, turtles, birds, fish, invertebrates, etc)

- The area supports habitat critical to certain life stages or aggregations of species during some part of the year (e.g. breeding, calving, feeding, spawning, juvenile, nesting, resting, overwintering)
- The area supports an endangered, threatened or vulnerable population as indicated by COSEWIC
- The area is a key component of a migratory route
- The area is vulnerable to human disturbance
- The area supports concentrations of more than one species

Endangered or threatened species and habitats

- The area supports concentrations of endangered, or threatened species identified on international, national or regional lists of concern
- The area supports key breeding/nesting/calving/birthing habitat for these species
- The area contains endemic, relict, or edge range populations
- The area is vulnerable to human disturbance

Unique habitats

- The area is "one of a kind"
- The area is sub-regionally, regionally, nationally, or internationally rare
- The area provides unique habitat for species or community assemblages
- The area provides unique biogeographic or ecological habitat qualities
- The area contributes to a unique ecosystem process
- The area is a centre of endemism or of rare species unique to a single habitat area
- The area contains a unique geological feature that supports unique associated species or ecological communities/assemblages
- The area is vulnerable to human disturbance

High biodiversity

- The area supports a variety or richness of ecosystems, habitats, communities, populations, and species
- The area has high genetic diversity (in terms of species)
- The area is diverse compared to areas exposed to similar environmental forces
- The area contains one or more habitats or features characteristic of high species diversity (e.g. estuaries, upwelling areas, continental slope, etc.)
- The area supports high variability among species, community types and ecosystem processes
- The area is vulnerable to human disturbance

High biological productivity

- The area contains one or more habitats or features identified as characteristic of high productivity (estuaries, upwelling areas, etc.)
- The area generates large biomass

- The area supports species that are indicators of productivity (e.g. high phyto/zooplankton, marine mammal concentrations, etc.)
- The area is vulnerable to human disturbance

Scientific research

- There are existing, planned and/or possible research activities or surveys within the subject area
- The area could serve as a benchmark for scientific monitoring
- The area's natural, functions and ecosystems are relatively intact
- The area could foster better understanding of natural systems
- The area contains a variety of habitat types/ecosystems relationships that may be relevant for research

Existing or possible designations that protect ecological values

- The area has a national or international designation (e.g., Biosphere Reserve, World Heritage Area/Site) or is the subject of an international agreement
- The area has existing or potential value to local , regional, national and international conservation efforts
- Local authorities recognize the area as representing a site of regional or local ecological significance
- The area is recognized by other federal or provincial protected area or restricted land use designations
- The area is currently recognized informally as a key area for some ecological feature

Cultural and recreational attributes

SHACI also considers cultural and recreational values. Areas that possess the cultural and recreational attributes listed below are considered more significant.

General

- The features or assets of the area contribute to the economic and social well being of coastal communities, including Aboriginal communities
- The area is regularly used by residents of local communities for community purposes, (e.g., local recreational uses, anchoring etc.)
- Areas with cultural and spiritual significance to Aboriginal Communities as identified through the gathering of Traditional Knowledge
- Areas with cultural or spiritual significance to coastal communities as identified through the gathering of Traditional Ecological Knowledge.
- The area supports a traditional food fishery that is part of the local culture

- The area contains significant aesthetic, cultural, religious, or heritage features or resources, e.g., seascape or landscape vistas, archaeological sites, wildlife viewing, shipwrecks, and traditional food collection
- The area is important for social, cultural, religious, or traditional activities
- The area provides the local community the opportunity to use, enjoy and learn about their local environment
- The area offers particularly important education and public awareness opportunities for coastal or marine issues

Existing or possible designations that protect cultural/recreational values

- Local authorities recognize the area as representing a site of regional or local cultural or recreational significance
- The area is recognized by other federal or provincial protected area or restricted land use designations
- The area is currently recognized informally as a key area for some cultural or recreational feature

Socio-economic considerations

Socio-economic considerations are not criteria by which a Significant Habitat is selected or evaluated. Rather, they are factors to consider should the selection of a Significant Habitat lead to the introduction of some eventual protected status for the area, or the development of an integrated management plan with the local community. The following questions should be asked when considering socio-economic issues:

- Do commercial, recreational, or subsistence fishers using the area and are they dependent on it?, and are dependent on the area. The species fished and gear type should be considered. Is this fishery compatible with the ecological, cultural and recreational attributes of Significant Habitats?
- Does the economy of the area depend on industry? Is this industry compatible with the ecological, cultural and recreational attributes of Significant Habitats?
- Would some degree of protection or management affect the local community in the long term?
- What is the existing or potential value of the area to tourism development? Are these developments compatible with the ecological, cultural and recreational attributes of Significant Habitats?
- Is increased management or protection socially and politically acceptable? Is there community support?

Part I– Sydney Bight overview

For organizational purposes, the SHACI study area is subdivided into twelve different ecological units based primarily on physical environmental factors. These units closely mirror the Atlantic Coast Theme Regions used in the Natural History of Nova Scotia (Davis and Browne 1996b) which are based upon major geomorphological characteristics. Threst of this document specifically examines Unit 11, Sydney Bight (Figure 1-1).

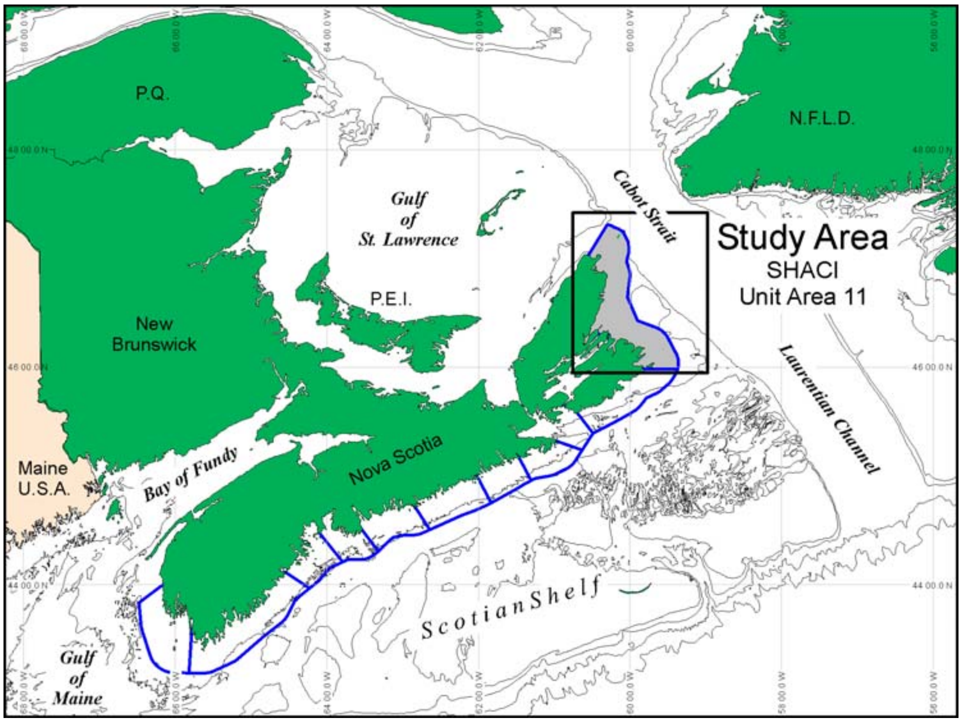


Figure 2-1: Regional context of SHACI Unit 11 study area (shaded)

SHACI Unit 11 includes coastal waters off eastern Cape Breton Island and extends from Scatarie Island to Cape North (Figure 1-2). The major body of water located off this area is Sydney Bight. Sydney Bight is bordered by the deeper waters (>200 m) of the Laurentian Channel to the northeast and by Cape Breton Island to the southwest. The majority of Sydney Bight is fairly shallow (<100 m), with the exception of a deeper 100 m – 200 m section that extends into the northeast side. Physiographic features known to fishermen include: the Gutter, a narrow finger of deeper water off the Cape Smokey – Wreck Cove area; the Edge, at the 200 m isobath where the Laurentian Channel drops off to deeper depths; White Point Bank, a sandy bank off Aspy Bay; and Smokey Bank, a large sandy bank in the eastern half of Sydney Bight (T. Lambert pers.comm. 2002).

Sydney Bight is important habitat for many species of flora and fauna, and its coastline contains a variety of features. Its rugged, exposed rocky shores provide habitat of subtidal seaweeds which in turn provide habitat for many fish and invertebrate species (I. Novaczek pers. comm. 2002). Sydney Bight is an important spawning, nursery and overwintering area for several finfish and invertebrate stocks, and the waters are frequented by various whale species and marine turtles. Seals and seabirds use the coastal islands in Sydney Bight as breeding areas, and several coastal bays and estuaries such as Port Morien, Glace Bay and Lingan Bay have productive salt marshes and eelgrass beds that are important stop-over areas for migratory birds. Between Port Morien and Point Aconi the coast consists of sandstone with exposed coal seams. Plant fossils can be found in the shales along the beach. Along the coast northwest of Sydney, there are bays and narrow inlets to the Bras d'Or Lakes. From St. Anns Bay to Aspy River there are tidal marshes and scattered barachois ponds with diverse aquatic fauna.

Adjacent water bodies are closely linked to the Sydney Bight ecosystem. The Commissioner's Report resulting from public hearings on oil and gas exploration in Sydney Bight suggests that the Sydney Bight ecosystem is so closely linked with the neighbouring Southern Gulf of St. Lawrence that the areas should be considered as one in any impact assessment (MacNeil 2002). Similarly, Kenchington (2001) mentions the close relationship between Sydney Bight and the Bras d'Or Lakes, and cautions that any environmental impacts to Sydney Bight could have effects on the Lakes.

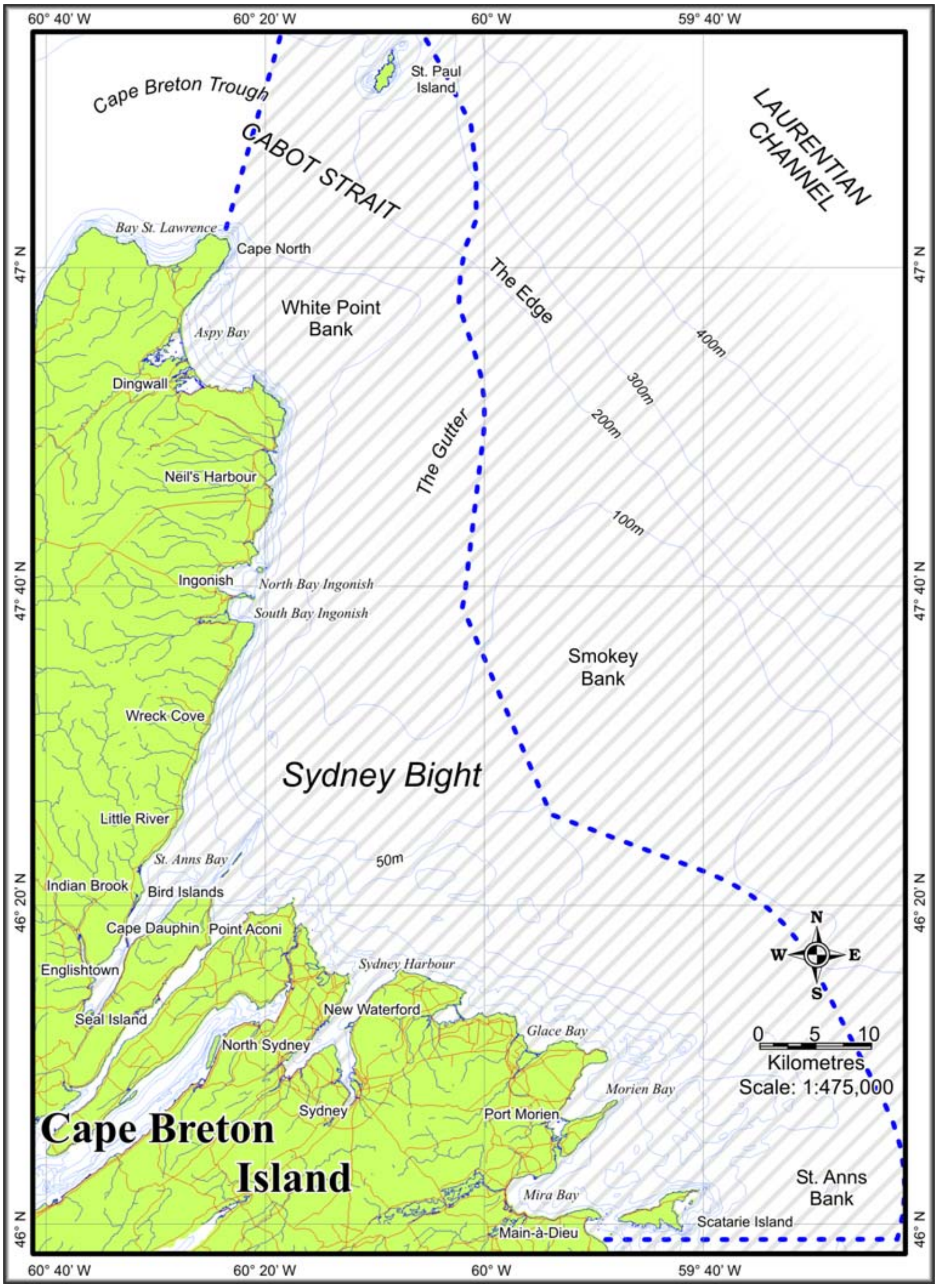


Figure 2-2: SHACI Unit 11 study area and physiographic features

3 - Geology

There are various geological formations underlying the coastal waters of Unit 11. The waters are underlain primarily with Carboniferous rocks of the Maritime Plain. In the Sydney Basin, there are coal formations that extend from the onshore and across the Cabot Strait to Newfoundland. In northern areas, where the Cape Breton Highlands rise up from the sea, nearshore rocks are igneous. The bottom of Sydney Bight is relatively flat and slopes gradually to form St. Anns Bank, the only major bank in the inner shelf zone of Nova Scotia. On Sydney Bight, at depths less than 100 m, sediments are a thin layer of sand and gravel mixtures through which bedrock is exposed. Material eroded from the coastal bedrock forms nearshore deposits, and local hydrographic conditions may lead to the development of sand, gravel or clay deposits (Davis and Browne 1996b).

The benthic substrate pattern in Sydney Bight roughly mirrors its depth contours (Figure 3-1). Areas <100 m generally consist of Sable Island Sand and Gravel (sand with <50% gravel or gravel with <50% sand), while areas between 100 m – 200 m consist mainly of Sambro Sand (silty and clayey sand with < 10% gravel). There is one patch of LaHave Clay (clayey silt) just east of the Gutter in the 100 – 200 m area (Fader et al. 1982).

See next page Figure 3-1

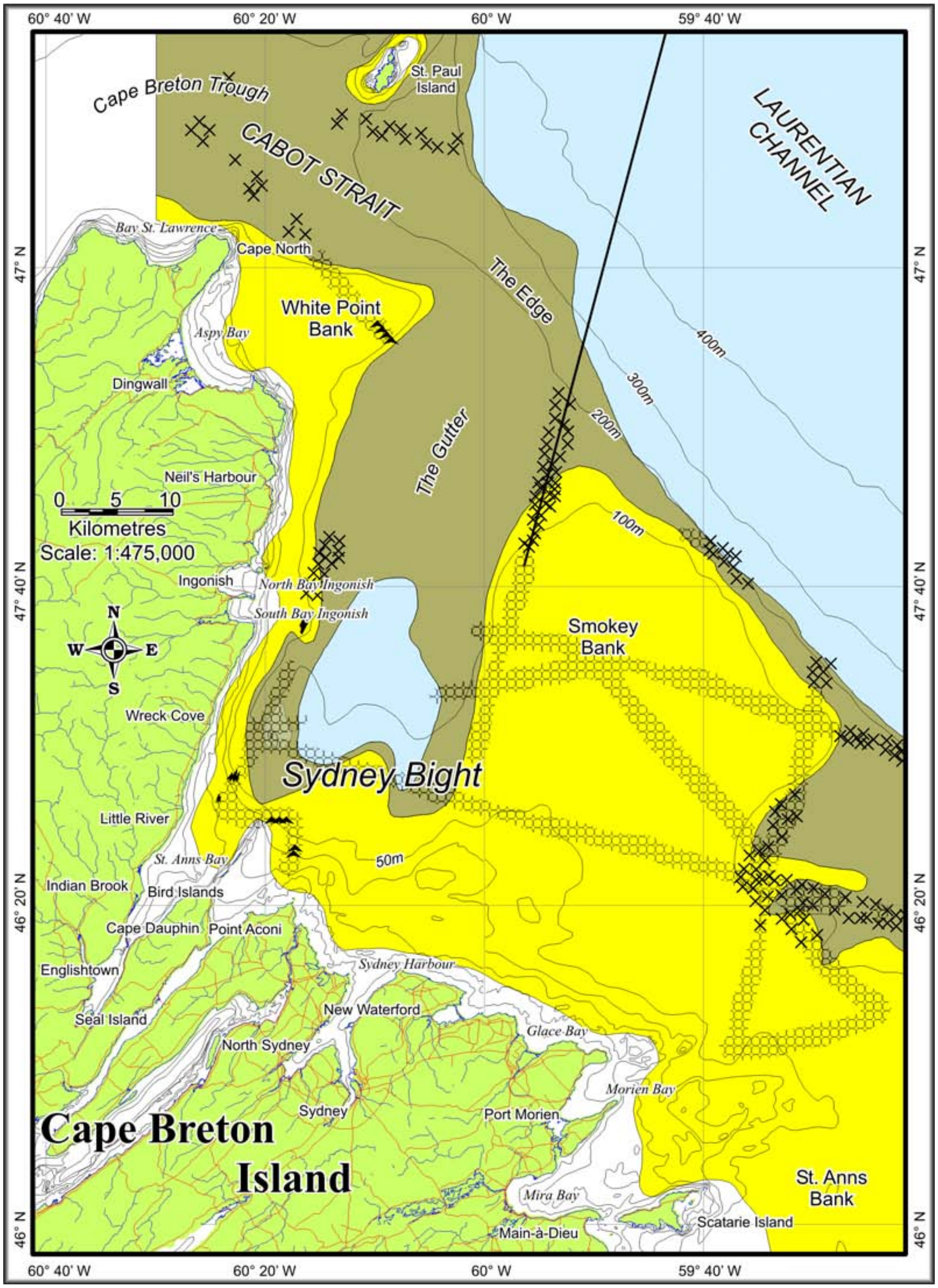


Figure 3-1: Surficial geology of Sydney Bight (Fader et al. 1982)

4 - Oceanography

Very little is known about the oceanography of Sydney Bight. Current meters are present across the Cabot Strait that measure water movement through the Laurentian Channel. Information about water movement south of Aspy Bay is sparse; with the exception of a few consultants' studies that set up moorings close to shore in the 1980s, no one has examined current movement in Sydney Bight in situ (B. Petrie pers. comm. 2002). Numerical simulations have, however, been conducted to determine current patterns in Sydney Bight. The results of these simulations indicate the presence of a gyre deeper in the water column that is masked at the surface by wind circulation (J. Chassé pers. comm. 2002). The major currents that flow around Sydney Bight are indicated in Figure 4-1.

Several oceanographic features are known to influence the coastal waters of Unit 11. In the summer, Sydney Bight is influenced by the fresher, warmer water flowing-in from the Gulf of St. Lawrence (Davis and Browne 1996b). During the winter and spring, ice is a major influencing factor. By early February, ice is present in the Sydney Bight area 16 - 33% of the time (Chassé 2001). Sydney Bight is then exposed to sea ice moving out of the Gulf of St. Lawrence. The scouring effect of this ice on the sea floor limits the growth of marine algae and other benthic marine species.

Figure 4-1: Major surface circulation currents that influence Sydney Bight

In Sydney Bight, temperature and salinity vary seasonally and with depth (Figure 4-2a, 4-2b) (DFO 2000a). In the winter, surface temperatures are coldest (0°C) and water temperature increases gradually with depth. Between June and October, surface waters warm up to 15°C and higher, and the water column stratifies into a warm upper layer, a cold middle layer and an intermediate bottom layer. The cold water found at

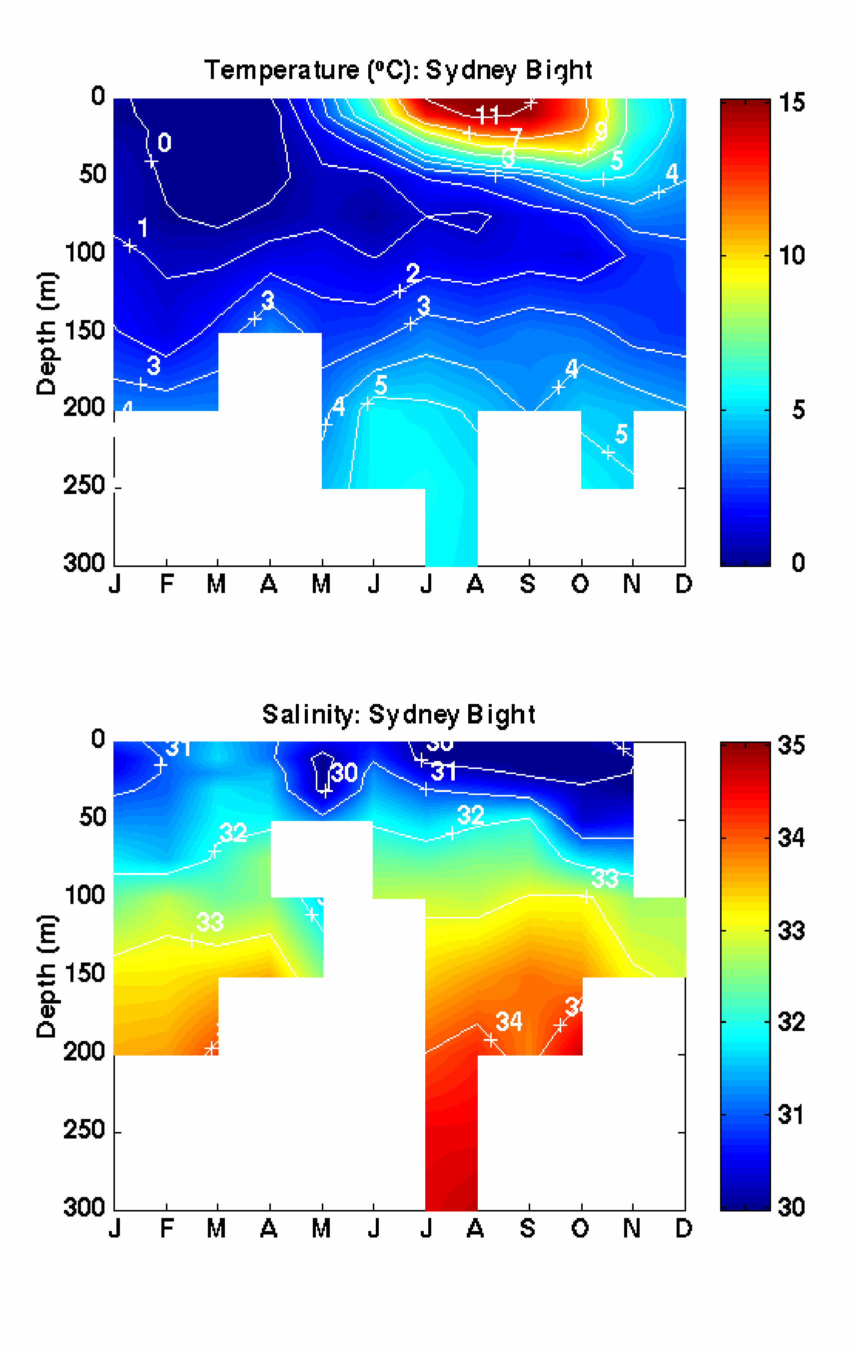


Figure 4-2a (temperature) and 4-2b (salinity): Seasonal temperature and salinity gradients for Sydney Bight (DFO 2000a)

middle depths is the residual cold water from the spring that has never warmed, and that due to stratification, does not mix with the warmer layers during the summer months (T. Lambert pers. comm. 2002). The maximum stratification in the water column occurs in August when surface (17°C) and bottom (5°C) temperatures may differ by as much as 12°C. At depths of 25-30 m, the maximum vertical gradient is reached. The stratification becomes disturbed in the fall due to increased mixing (Chassé 2001).

This seasonal temperature pattern is also evident when examining bottom temperatures. In the spring, shallow inshore areas have bottom temperatures ranging from -1 to 0°C, while in deeper waters further from shore, bottom temperatures are warmer and range from 2 to 3°C. By September, the bottom temperature pattern has changed. Shallow waters have 14°C and warmer bottom temperature, intermediate waters are cold (1°C), and deeper waters have moderate temperatures (2-6°C) (T. Lambert pers. comm. 2002).

During the summer, surface salinity is at its lowest and ranges from 28-29%, and bottom salinities range from 32-35%. By the end of August, the minimum sea surface salinity is observed. This low salinity occurs due to the arrival of the freshwater pulse from the rivers around the Gulf of St. Lawrence (mainly the St. Lawrence River). This freshwater takes roughly 2.5-3.5 months to reach, be mixed with, and change the salinity in waters around Cape Breton (J. Chassé pers. comm. 2002). Winter surface salinities are roughly 31.5% and bottom salinities are up to 34% (Petrie et al 1996; Chassé 2001).

5 - Plankton

Phytoplankton

There is little information available about phytoplankton in Sydney Bight. Generally, coastal waters are much more productive than the open ocean; primary productivity, based on the carbon content of living organisms, is estimated at 500 kg of organic carbon/ha/yr for the open ocean and 1000 kg/ha/yr in coastal waters (Barnabé and Barnabé-Quet 2000). Phytoplankton blooms in the Cabot Strait region are known to occur between February and May (spring bloom) and between August to November (fall bloom). The spring bloom can be quite significant with chlorophyll concentrations reaching from 12.3 mg/m^3 (in situ) to 16 mg/m^3 (Petrie et al. 2001).

Zooplankton

Sydney Bight is an important area for zooplankton. The Nova Scotia Current has a strong influence on zooplankton in Sydney Bight resulting in a community that is more oceanic in nature than that found off western Cape Breton in the Southern Gulf of St. Lawrence (Locke 2001). Head and others (1999) found significant concentrations of zooplankton in the nearby Cabot Strait area; *Calanus* spp. counts were in the order of 10s of thousands/m^2. The Cabot Strait/Laurentian Channel region is also a known overwintering area for *Calanus finmarchicus* and *C. hyperboreous*.

Locke (2001) lists several reasons why Sydney Bight is an important area for zooplankton:

- The larvae of several commercially important crab species are found on the Scotian Shelf only in the vicinity of Cape Breton Island or are found in greater abundance there than elsewhere on the Scotian Shelf;
- It supports a diverse copepod community. Copepods are the most important component of the zooplankton on the Scotian shelf in terms of abundance, biomass and secondary production (Breeze et al. 2002);
- The larval stages of snow crab, rock crab, Jonah crab, and toad crab and early spawning lobster are found in these waters and it is a particularly important area for the earliest planktonic larval stages of crabs (Roff et al. 1984; 1986);
- It is the only place on the Scotian Shelf where stage I – III lobster larvae were found in offshore plankton samples between May and July (Watson and Miller 1991);
- Sydney Bight is an important area for the eggs of cod, witch flounder and plaice. It is used as a nursery area between April and July;
- The diversity of larval fish is as high off eastern Cape Breton as anywhere else along the Scotian Shelf in early spring/summer (Shackell and Frank 2000);

- It is an area of major plaice egg concentration in the Scotian Shelf in May (O’Boyle et al. 1984; Neilson et al. 1988) and is considered an important area for this species;
- Redfish larvae is occasionally common to abundant in waters off Cape Breton in April and May, and very abundant and widespread in Sydney Bight in July (O’Boyle et al. 1984);
- The south and east coasts of Cape Breton are important centres of abundance for cod eggs in May and June compared to other areas of the Scotian Shelf (Brander and Hurley 1992); and,
- Witch flounder eggs are found here from July – August (Brander and Hurley 1992).

Local threats to plankton

There are several possible threats to plankton populations worldwide that may be locally relevant to Sydney Bight and along the Atlantic coast of Nova Scotia. Any threat that induces a change (be it an increase or decrease in population size, or a change in species composition) in plankton populations is potentially quite significant to the greater ecosystem because plankton is at the base of the food chain. Changes that are detrimental to plankton are potentially detrimental to invertebrates, fish, birds and marine mammals.

Ballast water is a primary vector for the introduction of invasive marine species. Ballast water exchange is currently not regulated along the Atlantic coast of Nova Scotia, therefore species introductions from outside ports could occur in Sydney Bight. More information about invasive species is presented in the Marine Bioinvasions section of this document.

Harmful phytoplankton blooms and the uptake of toxins by shellfish grown in aquaculture has caused human health problems and thus problems for the aquaculture industry in Atlantic Canada in the past. Although there are no recorded occurrences of shellfish poisonings in Unit 11, such a problem could presumably occur anywhere in the Atlantic region, including the American oyster and blue mussel aquaculture operations in St Anns Bay and Aspy Bay.

Oil and gas industry
Seismic Planktonic larvae located close enough to an airgun when it is fired will be killed; however, Kenchington argues that the overall lethal effects on populations are generally minor (Kenchington 2001).

Spills and blowouts Any subsurface plume, caused by either blowouts or spills, is of concern for such reasons (Kenchington 2001). Fish eggs and larvae in the Bras d’Or Lakes could be affected by a spill in Sydney Bight since all seawater entering the Lakes is drawn from the near surface layers where hydrocarbons would be concentrated (Kenchington 1998).

6 - Marine plants

Marine plants are important because they provide a resource base, a component of benthic habitat architecture, and because they are significant contributors to nearshore primary production (Mann 1972). With regard to habitat architecture, marine plants have significant influence. Their shape, degree of branching, biomass, surface area, and degree of epiphyte cover can affect the size and density of associated invertebrates, vertebrates and algal flora (Sharp et al. 2001). The presence of marine plants can also alter ambient light levels, water movement and the erosion of substrate. In the nearshore environment and in semi-enclosed bays, marine plants can contribute to a significant portion of the total production and the detrital pool (Sharp et al. 2001).

Plants are primary producers that use photosynthesis to convert the energy from sunlight into chemical energy. The primary producers in coastal areas include phytoplankton, seaweeds (macroalgae) and marine grasses (eelgrass, salt marsh grass and marram grass) (Berrill and Berrill 1981). Phytoplankton was covered in the previous section of this document, and the marine grasses are discussed in the section on tidal marshes, and eelgrass beds. This section, Marine Plants, therefore will focus on the seaweeds.

Seaweeds

Seaweeds are the large plants that grow in coastal waters. They are divided into different groups depending on their colour: brown, red and green. All three types contain the green chlorophyll pigment used to trap light for photosynthesis, but this may be masked by other pigments (brown, red) that give the plants their characteristic colour (Berrill and Berrill 1981).

Seaweed growth is typically well developed on all rocky substrate, but it is best in exposed, clear water conditions (Davis and Browne 1996a). Seaweeds are most diverse on the open, rocky coast where the salinity is high, summer air temperatures are not excessive, and where water temperatures remain fairly low. Conversely, the stress of warmer summer temperatures and varying salinities in estuaries and sheltered areas can considerably reduce the diversity of macroalgae.

There is seasonal change in seaweed growth. During the cold winter, growth ceases. In coastal areas that freeze in the winter, ice scour scrapes perennial seaweeds from the shoreline. Seaweed reproduction occurs in the spring bringing along new generations of annual and perennial plants (Berrill and Berrill 1981).

Unlike land plants, seaweeds do not have roots for the purpose of gathering nutrients. Rather, seaweeds have holdfasts that attach to rocks or hard substrate and receive their nutrients and minerals from the seawater that surrounds them. The surrounding seawater also buoys plants up during high tide so that they can receive adequate light for photosynthesis (Berrill and Berrill 1981).

Intertidal zonation

Plants inhabit different zones parallel to the shoreline depending on their tolerance to air or submergence during the tidal cycle (Table 6-1). The most adaptable seaweeds live at the top of the beach where they are exposed to air for the greatest length of time at low tide (Butler et al. 1996). The zones include the splash zone, upper shore, middle shore, and lower shore (Davis and Browne 1996a). The width of each zone depends on the slope of the beach. Steeply sloped beaches have narrow bands and beaches with a shallow slope have wide bands (Butler et al. 1996).

Splash zone

The splash zone occurs above the extreme high water mark, but is reached by storm waves. This zone is generally devoid of vegetation, but cracks between rocks may be colonized by grasses, and the bare rock by lichens (Davis and Browne 1996a).

Table 6-1. Flora of intertidal biotic zones

Intertidal Zonation	Flora
Splash zone	• Grasses • Lichens (*Xanthoria parietina*).
Upper shore	• Algae (*Codiolum* spp., *Calothrix crustacea*) • Lichens (*Verrucaria* spp.)
Middle shore	• Brown rockweeds (*Ascophyllum nodosum*, *Fucus* spp.) • Red algae (*Porphyra* sp.) • Green algae (*Cladophora* spp.)
Lower shore	• Irish Moss (*Chondrus crispus*) • Calcareous algae (*Lithothamnium* spp. and *Corallina officinalis*).

Source: Davis and Browne 1996a

Upper shore

The upper shore is flooded by the high water of spring tides. Rocks in this zone are bare at the top, but support algae and lichens where they are exposed to tidal water. The upper zone is commonly referred to as the Black Zone because of the line of black, slippery algae and lichens that mark its boundary (Davis and Browne 1996a). Of all the intertidal zones, the species that inhabit the upper shore are the hardiest since they are able to tolerate the greatest extremes of desiccation, heat, freezing and dilution by rain or runoff (Berrill and Berrill 1981). This zone is truly, marine as the plants found within it require the influence of marine waters brought in twice daily with the high tide.

Middle shore

Dense growth of brown rockweeds are found in the middle shore. These species are mainly from the Fucales family and those most commonly found are *Ascophyllum nodosum* and *Fucus vesiculosus*. Rockweeds attach to hard substrate with disc-like holdfasts. Some species have air bladders that buoy the plants up so that they can receive enough light for photosynthesis. Rockweed competes for space in this zone with barnacles and blue mussels.

Many animal species such as fish, crabs, snails and anemones find shelter under rockweed. This protective canopy protects many species, including red and green algae, from desiccation and allows them to survive further up the intertidal than they normally would.

Lower shore

The lower shore is inhabited by a zone of red algae which typically includes *Chondrus crispus* (Irish Moss) and calcareous algae. Irish Moss grows particularly well on stable rock substrate to which it is attached by an extremely strong holdfast. It is shorter and denser than the fucales, but also protects other algal species and small marine animals from wave action and possibly from predation. Other species of red algae that grow on the lower shore include *Gigartina stellata* and *Palmaria palmata* (dulse). Like the Fucales, the red algae compete for space in this zone with barnacle and blue mussels. The common periwinkle, an intertidal grazer, feeds primarily on ephemeral algal species such as *Enteromorpha*, *Ulva*, *Porphyra* and *Ceramium*, and thus aids Irish moss by keeping rock surfaces clean of competitors (Berrill and Berrill 1981). Kelps are present below this zone, but are only visible during low water of spring tides (Davis and Browne 1996a).

Subtidal

The subtidal occurs below where the lowest spring tides occur. The beginning of the subtidal is marked by the kelp zone which is home to species including *Laminaria* and *Alaria*. Kelps are very large species of brown algae that cannot survive any significant exposure to the atmosphere. Kelps occasionally extend into the lowest end of the intertidal. Where coastal waters are clear, kelp may grow to depths of 20-30 metres, but the peak biomass of kelps in our waters is approximately at a depth of 5 metres.

Kelps have thick stipes and large, broad blades. They grow together in dense beds, or kelp forests, that provide protective cover for other animals and algal species. In Nova Scotia, kelps are closely associated with green sea urchins. There have been several documented large-scale shifts in community structure caused by urchin grazing. In these instances, coastal habitat changed from productive kelp bed to less productive, corraline algae-dominated urchin barrens (Breen and Mann 1976a; 1976b; Wharton and Mann 1981; Scheibling et al. 1994). These urchin barrens later returned to kelp beds after a mass outbreak of disease among urchins in the shallow (<25m) subtidal zone (Miller 1985; Scheibling 1986).

Distribution and ecology of marine plants in Sydney Bight

Sydney Bight has a diverse algal flora dominated by <10 species (Sharp et al. 2001). Dobrocky Seatech Ltd. provides the only survey with a comprehensive species list (44 species) from monitoring stations from the Lingan-Phalen/Donkin-Morien Marine Monitoring Program (Drinnan and Knight 1985).

Sharp and others (2001) estimated the proportion of shallow (<10 m) area covered algal beds in Sydney Bight using both 1999 airphotos and traditional knowledge (ECBCRMP 1996; VCCRMP 1997). Neither analysis technique was particularly accurate, and results ranged from 8.4% (1683 ha) algal cover (airphoto analysis) to 72% (20015 ha) algal cover (traditional knowledge). Sharp and others (2001) concluded that generally, areas <10 m with stable substrate will likely be algal covered in the absence of sea urchin populations; however, without a complete bottom survey they could only conclude that algal cover is <72%.

Marine plants in Sydney Bight are affected by the seasonal period of ice cover, ice scouring and a low tidal amplitude (0.9m). These factors result in a narrow intertidal where the algal community in waters <5m consists primarily of fast growing ephemerals and opportunistic species including fucoids, *Chondrus crispus*, and small ephemeral brown algae (Novaczek and McLaughlin 1989; Sharp et al. 2001). Red algaes, including *C. crispus*, dominate at depths between 4-8 m (Novaczek and McLaughlin 1989). The plant canopy in Sydney Bight is low (<0.5 m) and lacks the dense beds of large laminarians that are common along other areas of the Atlantic coast of Nova Scotia. The lack of laminarians likely results from the friable substratum, ice scour, sea urchin herbivory, and perhaps competition from red-algal turfs (Novaczek and McLaughlin 1989).

Sharp and others (2001) examined various temporal changes in Sydney Bight marine algae using previous environmental studies (Drinnan and Knight 1985; Moore et al. 1986; Nova Scotia Power Corporation 1996);, algal collections and their own small-scale ground truthing survey. *Fucus serratus* reoccurred in several studies as the dominant shallow water species indicating that marine plant communities in depths <8 m seem to be stable in a 20 year time frame. Plant communities in depths >8 m, however, were deemed unstable due to sea urchin herbivory which can have dramatic effects on biomass (Sharp et al. 2001). Some seasonal changes in algal biomass are normal (e.g. growth and recruitment of red turf ephemerals), therefore a single sampling date may not accurately reflect the potential algal biomass.

Knowledge gaps

It is possible that Sydney Bight contains unique populations of marine algae. The distribution of marine plant species along the Atlantic coast of Nova Scotia is a result of past post-glacial events and current environmental factors. Disjunct populations of warm temperate algae that became established during the post-glacial hipsithermal period remain today in sheltered bays along the coast. Since these populations have been isolated for over 6000 years, there is a high likelihood of genetic speciation (I. Novaczek pers. comm. 2002). Several such sheltered bays occur in the coastal areas of Sydney Bight; however, these areas require more study to confirm the presence of unique populations.

Vulnerability

Sharp and others (2001) concluded that the perennial species of marine algae in Sydney Bight have life habits and life cycles that are not particularly vulnerable to periodic perturbation – be it natural or anthropogenic. The possible varying effects of different types of perturbation (i.e. physical, chemical, and biological) was not discussed. *Chondrus crispus*, *Fucus serratus*, and *Cystoclonium purpureum*, are noted as dominant species in all studies from this area over the past 40 years as examples of such tolerant, competitive and widespread species by Sharp and others (2001).

Threats to marine plants

Herbivory

One of the best examples of habitat destruction due to overgrazing in natural communities is the destruction of the kelp beds by sea urchins off the Atlantic coast of Nova Scotia. In the 1960's the coast was characterized by extensive kelp beds. Then in the early 1970's, there was a massive population explosion of herbivorous green sea urchins which wiped out the kelp beds along several hundred kilometres of coast. The community which remained was still quite rich, but the three dimensional structure provided by the kelp was lost, and so were the plants and animals for which the kelp had provided habitat (UWC 2004).

Oil spills and disperants

Oil that washes onto the coast is harmful to intertidal plants and animals. The dispersants often used to clean up oil spills are, however, even more toxic. The dispersants can denude the shoreline of seaweed, returning it to an early successional stage. The recovery of a rocky shore from an oil spill can take 5-15 years; this estimate does not include the long term effects of hydrocarbon build up in the sediments of plant tissue (Berrill and Berrill 1981).

Pollution

Pollution from various sources and activities can harm marine plants. These sources include runoff of sediments and pollutants from upland construction sites, increases in freshwater discharge, industrial discharges, chlorinated effluent, oil pollution, stormwater runoff, sewage, and airborne pesticides from agriculture. Pollution can have various effects on marine plants, and these effects may vary depending on life stage. For example, the siltation of organic or non-organic particles can effectively prevent algal recruitment even if adult stages survive. Pollution may also indirectly affect marine plants. Nutrient loading from pollution can cause phytoplankton blooms which in turn reduce light levels thus harming kelp and rockweed beds.

Removal and/or disturbance of habitat

Dredging, blasting of ledges, removal of boulders, impoundment of water, scouring by boat traffic, removal or dragging by fishers, and sediment loading can smother or removes marine plants and damage or destroy their habitat.

Ice scour and storm damage

Breakage can occur to the fronds and entire plants, holdfast and all may be swept away by larger waves during storms (MacKenzie 2003). In coastal areas that freeze in the winter, ice scour scrapes perennial seaweeds from the shoreline.

Eutrophication

Eutrophication is the natural, but more commonly human-induced addition of nutrients (especially nitrogen and phosphorus) to a body of water, resulting in high organic production rates that may overcome the natural self-purification processes. Eutrophication produces several undesirable effects, including algal blooms, seasonally low oxygen levels and reduced survival opportunities for fish and invertebrates. Excessive nutrient inputs are are frequently derived from sources of pollution on adjacent lands (Dunster and Dunster 1996).

Resuspension of sediments

The resuspension of sediments from dredging, filling, boating and fishing activity may smother rockweed and kelp beds.

Invasive species

Shiebling (2001) identified the primary threat to marine plant communities as invasive species, in particular citing the green algae *Codium fragile* spp. *tomentosoides* ("Dead Man's Fingers"), and the colonial invertebrate *Membranipora membranacea*r. The current distribution of *C. fragile* in Nova Scotia is along the southeastern shore. It has not yet been identified in Sydney Bight. The exact distribution of *m. membranacea* is unknown, but it does occur throughout areas sampled to determine the extent of *C. fragile* along the southeastern shore (Shiebling 2003).

7 – Marine invertebrates

Sydney Bight contains a diversity of marine invertebrates found in a variety of habitat types. Invertebrates may live on the seafloor (benthic habitat) or in the water column (pelagic habitat), from the shallow intertidal to the maximum depths of Sydney Bight, and on solid bedrock or buried in the muddy bottom. The marine invertebrates found in Sydney Bight include several important commercial species, as well as many that are little known and little studied. Marine invertebrate distribution is influenced by both present day environmental factors, and by changes which occurred long ago.

Littoral fauna

The littoral zone is the area between the extreme high tide and extreme low tide levels in the sea (Davis and Browne 1996a). Littoral invertebrate fauna from three faunal regions (subarctic, boreal, and temperate) are distributed differently along the coast. Boreal fauna is commonly found on exposed rocky shores, while warm water temperate fauna is found in the more sheltered inner basins and also including St. Anns Bay and the Bras d'Or Lakes (D. Davis pers. comm. 2002). Bousfield and Laubitz (1972) surveyed littoral marine invertebrates along the Atlantic coast of Nova Scotia and found several warm temperate, winter-mild thermophile, and cold-water sub-arctic indicator species in Lingan Harbour (Table 7-1). This was the only Sydney Bight study site. Another temperate indicator species, American oyster, is known in Ingonish Harbour, south of Gooseberry Point, in St. Anns Harbour, and in Otter Harbour (VCCRMP 1997), as well as in the Bras d'Or Lakes (Davis and Browne 1996b).

Table 7-1: Indicator invertebrate species from Bousfield and Laubitz (1972) station 17 Lingan Harbour, Cape Breton

Warm water fauna	*Corophium insidosum, Bittium alternatum, Haustorius canadensis, Mitrella lunatia, Nassarius obsoletus, Mysella planulata.*
Winter-mild thermophiles	*Amphiporeia virginiana, Marinogammarus finmarchicus, Chiridothea caeca, Orchestia grillus.*
Cold-water and subarctic	*Mancocuma stellifera, Mesodesma arctatum.*

Subtidal fauna

Information about the benthic community in Sydney Bight is generally scarce. The distribution of certain subtidal marine invertebrate species in Sydney Bight can be inferred from inshore survey data collected in the western area of Sydney Bight between 1991-1999 (T. Lambert pers.comm. 2002). There are, however, several limitations associated with this data. The inshore survey is restricted to gravelly, sandy and muddy bottom areas since the gear used is not suitable for hard bottoms. For this reason, the hard bottom areas close to shore along the western side of Sydney Bight, and the eastern area of Sydney Bight are excluded from the survey. Also, the plots used to discern species distributions simply indicate areas where the given species has been found during a 10 year period, and do not represent an average distribution over time. Examination of the inshore survey database indicates the presence of at least 47 species or species groups of marine invertebrates in Sydney Bight (Table 7-2).

In addition to the information collected for the inshore survey, some information exists from environmental monitoring stations associated with Middle Shoal, an area at the mouth of Bras d'Or Channel (CEF Consultants 1996; Amirault 1995 cited by Kenchington 1998). Kenchington (1998) summarizes this and other data to provide a list of nearly 50 taxa for the area including sea anemones, nemerteans, nematodes, oligochaetes, polychaetes, amphipods, decapod crustaceans, gastropods, bivalves, chiton molluscs, and echinoderms (Table 7-2).

Table 7.2: Invertebrate species sampled in various areas of Sydney Bight Kenchington (1998)

Common names/synonyms	Species name/group	*Western Sydney Bight	**Middle Shoal
Sipunculids		X	
Sponges	Sponges	X	
Cnidaria			
Sea fan		X	
Soft coral	Alcyonaceas	X	
	Anthozoa		X
Sea pen	Pennatula	X	
Anemones	Zoantharia	X	
Nemertea			X
Nematoda			X
Annelida			
Sea mouse	*Aphrodita hastata*	X	
Polychaeta	*Ampharete balthica*		X
	Apisthobranchus		X
	Capitella capitata		X
	Chaetozone setosa		X
	Exogone hebes		X
	Gonida maculata		X
	Harmothoe fragilis		X
	Laonice cirrata		X
	Lumbrinetis acutus		X
	Unidentified Maldanidae		X
	Naineris quadricuspida		X
	Nereimyra punctata		X
	Nereis sp.		X
	Unidentified Owenidae		X
	Paraonis gracilis		X
	Pectinaria granulata		X
	Pholoe minutaa		X
	Phyllodoce mucosa		X
	Prionospio steenstrupi		X
	Schistomeringos caecus		X
	Unidentified Spirorbidae		X
	Syllis gracilis		X
	Unidentified Syllidae		X
	Terebellides stroemi		X
	Tharyx sp.		X
Molluscans			
Turret shell		X	
	Acmaea testudinalis		X
Quahaug	*Arctica islandica*	X	
Dog whelk	*Buccinum undatum*	X	
Icelandic scallop	*Chlamys islandica*	X	

Table 7.2: Invertebrate species sampled in various areas of Sydney Bight Kenchington (1998)			
Common names/synonyms	**Species name/group**	***Western Sydney Bight**	****Middle Shoal**
Cockle	*Clinocardium sp.*	X	
Propellor clam	*Cyrtoderia siliqua*	X	
Moon snail	*Euspira heros*	X	
Squid	*Loligo sp.*	X	
	Modiolus modiolus		X
Clam	*Mya truncata*	X	
Blue mussel	*Mytilus edulis*	X	
Sea slug	Nudibranch	X	
Octopus	*Octopus sp.*	X	
Scallop	*Placopecten*	X	
	Polyplacophora		X
Surf clam	*Spisula sp.*	X	
	Thyasira flexuosa		X
	Tonicella marmorea		X
Crustacea			
Shrimp	*Argus dentata*	X	
Jonah crab	*Cancer borealis*	X	
Rock crab	*Cancer irroratus*	X	X
	Caprella sp.		X
Snow crab	*Chionoecetes opilio*	X	
	Corophium bonelli		X
	Corophium sp.		X
Sand shrimp	*Crangon septemspinosa*	X	
Lobster	*Homarus americanus*	X	
Toad crab	*Hyas araneus* and	X	
Mysid shrimp	Mysidacea	X	
Spiny crab	*Neolithodes grimaldii*	X	
	Pagurus arcuatus		X
Hermit crab	*Pagurus sp.*	X	
Pink shrimp, Northern shrimp	*Pandalus borealis*	X	
Striped Pink Shrimp	*Pandalus montagui*	X	
	Phoxocephalus holbolli		X
	Potogeneia inermis		X
	Unidentified Caprellid		X
Echinodermata			
	Amphipholis squamata		X
Common starfish	*Asterias rubens*	X	
	Asterias vulgaris		X
Spiny solaster	*Crossaster papposus*	X	
Cushion star, Mud star	*Ctenodiscus crispatus*	X	
Sea cucumber	*Cucumaria frondosa*	X	
Sand dollar	*Echinarachnius parma*	X	
Basket star	*Gorgonocephalus*	X	
Blood star	*Henricia sanguinolenta*	X	
Polar sea star	*Leptasterias polaris*	X	
	Ophiura robusta		X
Brittle star	*Ophiura sp.*	X	
	Psolus phantapus		X
Smooth solaster	*Solaster endeca*	X	
Sun star	Solaster or Crossaster	X	
	Solaster papposus ?		X
Sea urchin	*Strongylocentrotus*	X	X
Ascidians			
Sea squirt	*Boltenia sp.*	X	
Tunicates	Tunicates	X	

***** T. Lambert pers.comm. 2002
****Kenchington 2001**

(T. Lambert pers.comm.2002) generated species distribution maps for ten invertebrates collected in the inshore survey. The information from these distributions is summarized in Table 7-3. It is evident that some species are widespread in Sydney Bight (e.g. *Solaster endeca*), while others are restricted to a specific area (e.g. *Placopecten magellanicus*).

The role of the benthic community in continental shelf and shallow water ecosystem functioning is vital, yet poorly understood (Kenchington 2001). More information about this little studied community in Sydney Bight is clearly needed.

Table 7-3: Species distributions selected invertebrates in Sydney Bight based on DFO inshore survey data (1991-1999) (T. Lambert pers.comm.2002)

Species	Abundance and distribution	Depth preference
Species with a general distribution		
Rock crab – (*Cancer irroratus)*	Common. Slightly higher concentrations around Bird Islands and off Ingonish.	Variable
Sea cucumber –(*Cucumaria frondosa)*	Scarce except for consistent concentrations in one area of central Sydney Bight.	Moderate (50-100 m)
Smooth solaster – *(Solaster endeca)*	Fairly common. Widespread with slightly higher concentrations at extreme western side of study area.	Variable
Snow crab – (*Chionoecetes opilio)*	Very abundant. High concentrations in scattered locations, but mostly deeper areas.	Deeper areas (>50 m)
Spiny solaster – (*Crossaster papposus)*	Fairly common and widespread	Variable
Toad crab – (*Hyas araneus* and *H. coarctatus)*	Low abundance but widespread	Variable
Species with a restricted distribution		
Basket star - *(Gorgonocephalus arcticus)*	Found mainly in northern end of study area. High concentration in Aspy Bay (may not be consistent year to year).	Deeper (>50 m)
Common starfish – (*Asterias vulgaris)*	Concentrations mainly in St. Ann's Bay and around Bird Islands.	Shallow (<50 m)
Urchin – (*Strongylocentrotus droebrachiensis)*	Found mainly along the coast.	General
Species with a very restricted distribution		
Scallop – (*Placopecten magellanicus)*	Found only around Bird Islands and eastward.	Shallow (<50 m)

Commercial species

Sydney Bight is a productive area for many marine invertebrate species, several of which are fished commercially. The lobster and snow crab fisheries are economically important in many Cape Breton coastal communities. Rock crab is a recently developed fishery, and scallops, mussels, and oysters have been harvested sporadically on a small scale for many years. Other species including toad crab, stone crab, sea urchins and shrimp are of commercial interest, but their value as a fishery in Sydney Bight has yet to be proven (Tremblay et al. 2001). Sandworms and bloodworms are also gathered locally from soft bottom areas for the bait fishery (LACRMP 1995; ECBCRMP 1996; VCCRMP 1997).

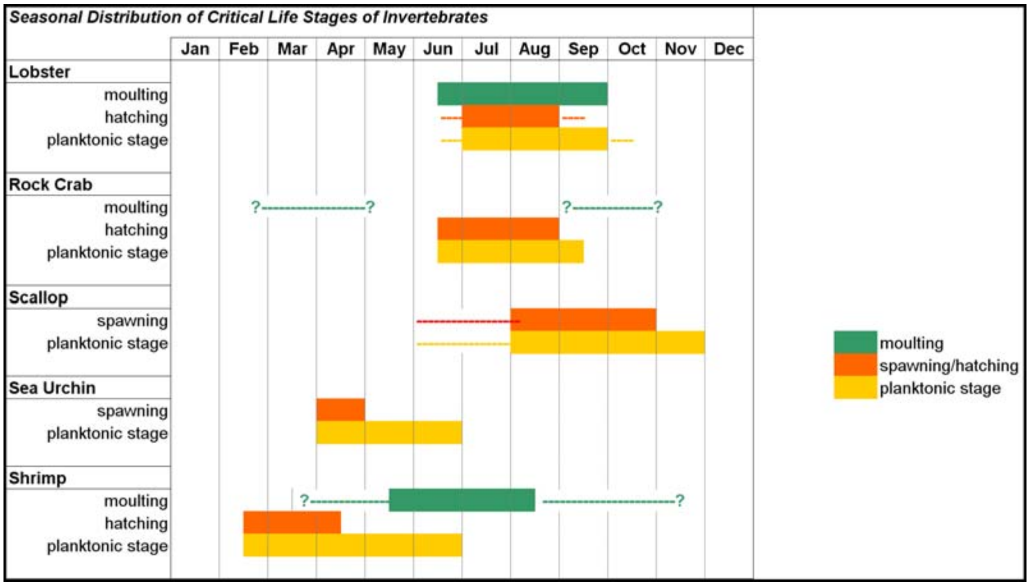


Figure 7-1: Seasonal distribution of critical life stages of invertebrates in Sydney Bight (Tremblay et al. 2001)

The times of key life history events (moulting, spawning, planktonic stage) vary for different species. Tremblay and others (2001) summarized the key life history events for lobster, rock crab, scallop, sea urchin and shrimp in Sydney Bight (Figure 7-1). This information suggests that there are planktonic stage invertebrates in the water column during the majority of the year from mid-February to December.

Despite the economic importance of invertebrates in Sydney Bight, there are significant gaps in our knowledge of these species. General distribution data is available for commercial species and for a few non-commercial species, however high resolution spatial distribution data does not exist. Tremblay and others (2001) summarized known information about many commercial marine invertebrate species in Sydney Bight. Similarly, Biron and others (2001) have summarized information about snow crabs. These summaries, including additional information, are included in the following sections.

Lobster

The lobster stocks in Sydney Bight are historically among the most productive in coastal Nova Scotia. With the exception of soft bottom areas, the entire shore of Eastern Cape Breton could be considered lobster habitat (Tremblay et al. 2001). This observation is supported by Traditional Ecological Knowledge (TEK) which indicates lobster bottom all along Sydney Bight coastal areas (Figure 7-2) (LACRMP 1995; ECBCRMP 1996; VCCRMP 1997; Highland Coastal Mapping 2001).

The year round distribution of lobster in Sydney Bight is not well known. Lobster movement in Sydney Bight has been studied by tagging lobsters during spring and fall, and asking fishermen to record the recapture position of tagged lobsters the following fishing season (May 15- July 15). These studies indicate that greater than 80% of lobsters are recaptured less than 6 km from their release site (Tremblay et al. 1998). This type of study does not indicate where lobsters are between the time of tagging and the time of recapture.

Lobster larvae are potentially released all along the coast of Cape Breton. The eggs hatch in late June or early July, and the planktonic period lasts approximately 42 days from late June to mid-September depending on the water temperature (Figure 7-1) (Tremblay et al. 2001).

Lobsters in Sydney Bight moult between late July and at least mid-September (Tremblay and Eagles 1997). Prior to moulting, lobsters are typically less mobile. They will seek out cover during moulting at which time they are particularly vulnerable. Females mate in the soft shell condition and do not extrude the eggs until the following year.

There are several gaps in our knowledge of lobsters in Sydney Bight. Little is known about (Tremblay et al. 2001)

- early life history stages
- the timing and magnitude of seasonal lobster movement
- whether there are high density areas of ovigerous females
- larval source or sink areas
- the distribution of newly settled juveniles
- lobster distribution in the later fall and spring

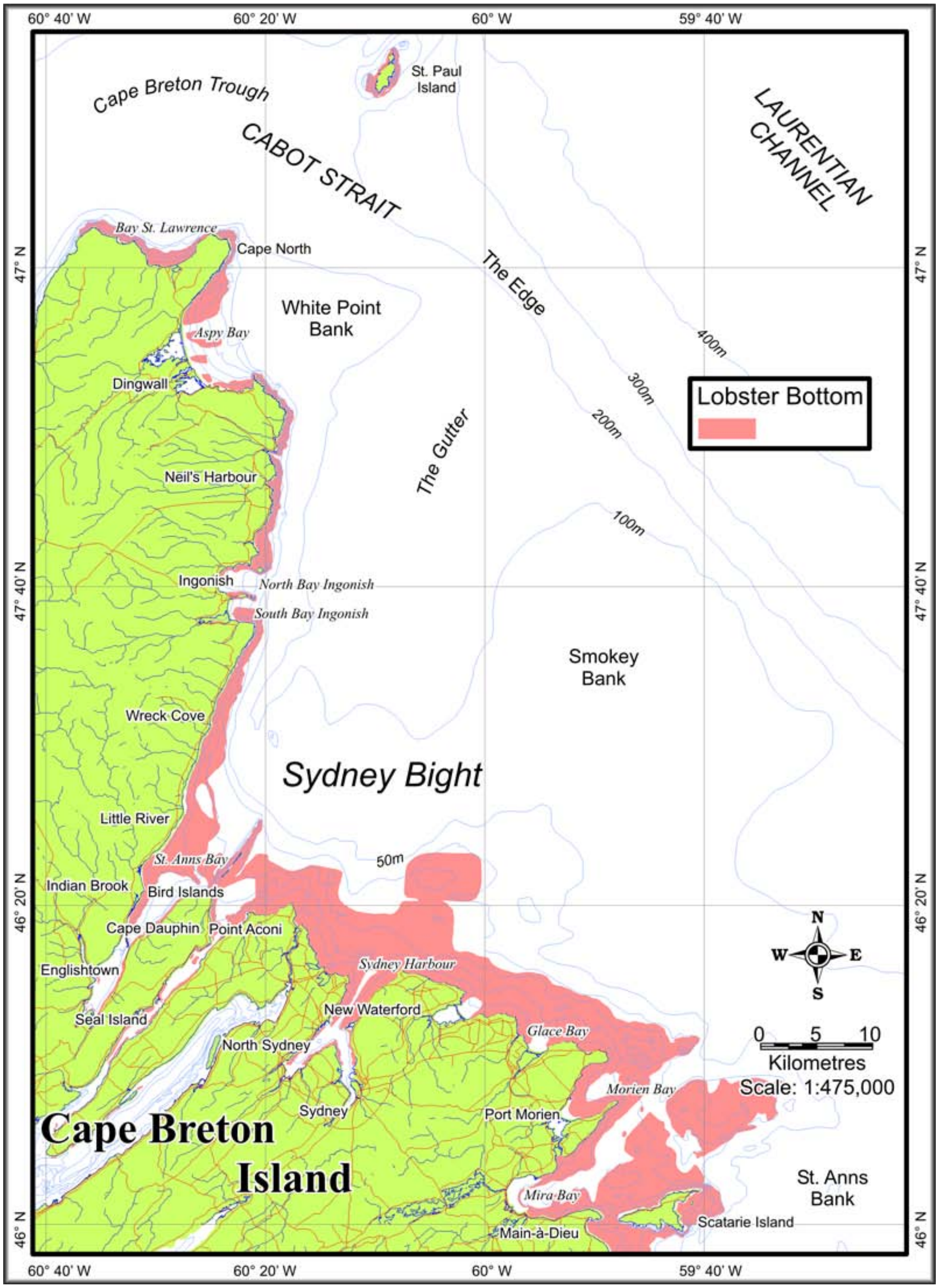


Figure 7-2: Known areas of lobster bottom in SHACI Unit 11 (LACRMP 1995; ECBCRMP 1996; VCCRMP 1997; Highland Coastal Mapping 2001)

Snow crab

Snow crab is found off Cape Breton from depths of 45-245 m. This species generally inhabits muddy or sand-mud bottoms (Powles 1968; Elner 1985) in waters ranging in temperature from –1 to 4.5 °C (Powles 1966). Traditional ecological knowledge, based mostly on fishing activity, indicates that snow crabs are distributed mainly in deep water areas of Sydney Bight (Figure 7-3) (LACRMP 1995; ECBCRMP 1996; VCCRMP 1997; Highland Coastal Mapping 2001). In Sydney Bight, snow crabs are fished roughly between July 22 to September 15. Only mature male snow crabs are kept by the fishing industry.

Distribution

Research indicates that snow crabs inhabit different areas depending on sex, season and stage in their lifecycle (Biron et al. 2001). Figures 7-4a and 7-4b illustrate how distribution and abundance changes over time, and the differences in male and female crab distributions. Both the total female (Figure 7-4a) and immature male snow crab (>76mm) (Figure 7-4b) distribution in Eastern Nova Scotia have clearly changed between 1997 and 2001. In Sydney Bight there were areas with high concentrations of ovigerous females and juvenile males 1997 to 1999 (Biron et al. 2001). In 2000 and 2001, however, snow crab concentrations were predominantly on the Eastern Scotian Shelf. Biron and others (2001) suggest that there are possible larval settlement sites in Sydney Bight, but the specific locations of these sites are unknown.

Changes in snow crab distribution are poorly understood, but are likely influenced by factors including bottom temperature, food availability, and bottom type (M. Biron. pers. comm. 2002). Females and moulting males are found in shallower inshore water (6 to 15 m) during the late winter, and may inhabit these colder, shallower grounds from October to May. This shoaling behaviour may be linked to moulting and reproduction (Biron et al. 2001).

Reproduction and larvae

The snow crab mating period begins between April and May. The female may carry the eggs on her abdomen for roughly two years before hatching occurs in late spring or early summer (Moriyasu and Conan 1988; Moriyasu and Lanteigne 1988). Larvae hatch and are generally known to float in the water column for 12-15 weeks before settling on the bottom (Lanteigne 1985). Once the pelagic larvae settle to the bottom, they moult immediately and then take at least 8-9 years to mature to commercial size (Biron et. al. 2001).

Little is known about the vertical and horizontal movements of the larvae while they remain pelagic. Many species of larvae make daily movements up and down in the

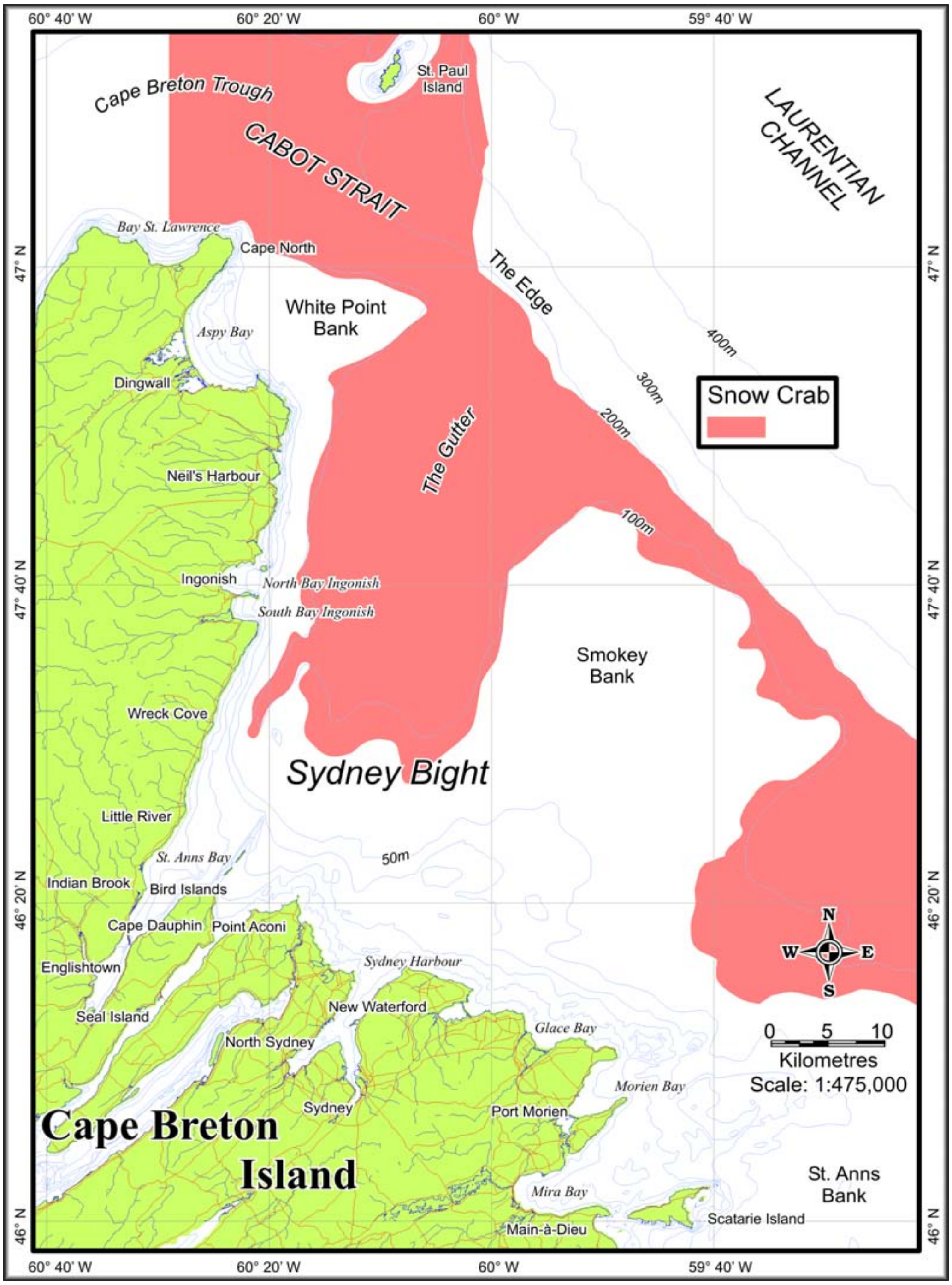


Figure 7-3: Snow crab distribution in SHACI Unit 11 (Highland Coastal Mapping 2001)

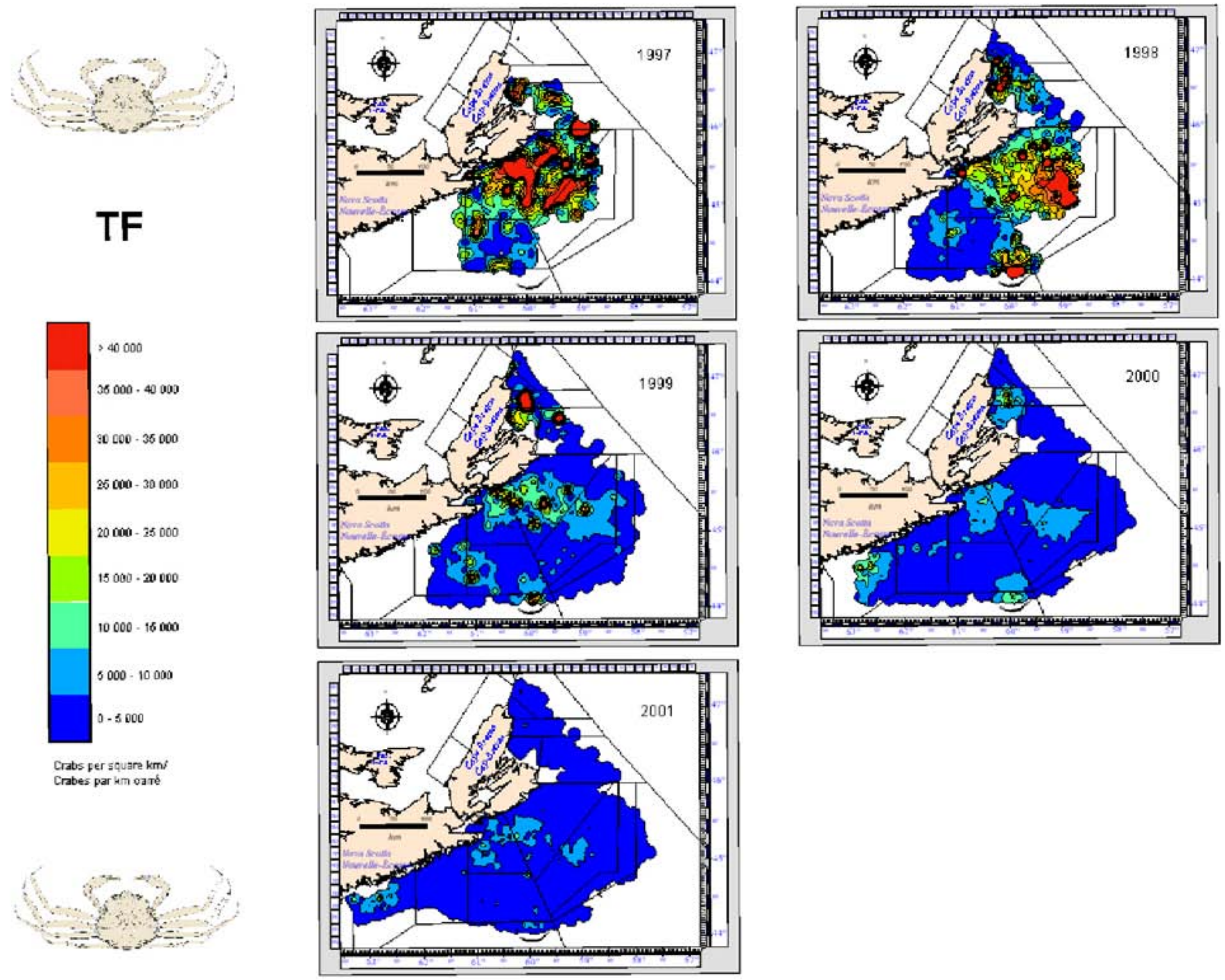


Figure 7-4a : Snow crab density contours for TF (total females) from 1997-2001 (Biron et al. 2002).

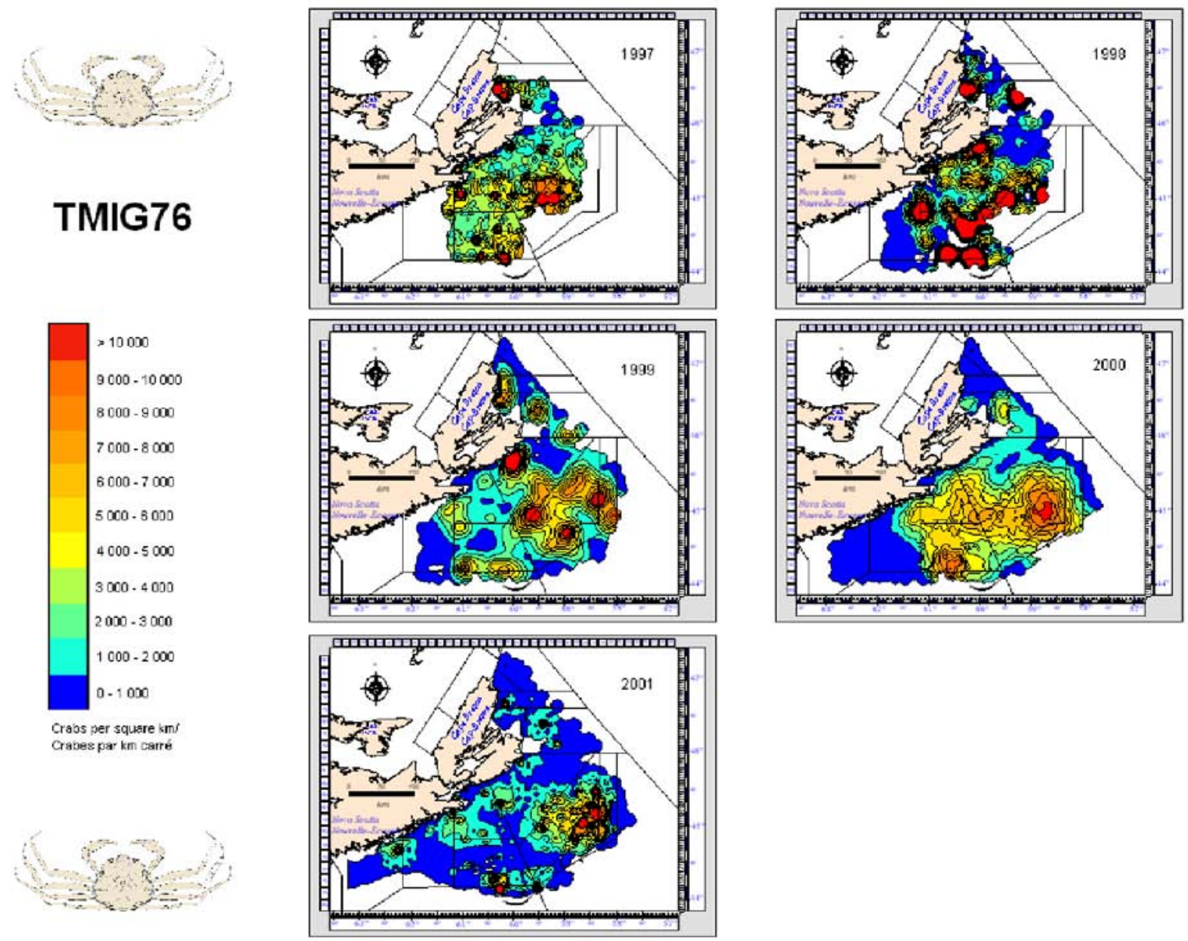


Figure 7-4b: Snow crab density contours for TMIG76 (Total Immature Males <76mm) from 1997 - 2001 (Biron et al. 2002)

water column and are transported great distances from their point of origin by oceanographic currents. Physical oceanographic modeling in the Southern Gulf of St. Lawrence and Sydney Bight suggests that larvae produced in the Gulf and Sydney Bight may be exported to the Scotian Shelf. Data also suggest that there is often a gyre present deeper in the water column in Sydney Bight that might serve to retain larvae within the area. This gyre is masked at the surface by wind circulation. For this reason a particle (such as an egg or larva) that is deeper in the water column is more likely to be retained in Sydney Bight (J. Chassé pers. comm. 2002). Currents move at different speeds and at different levels in the water column, therefore the vertical position of snow crab larvae in the water column strongly influences their distribution. More research is required to determine the vertical distribution of snow crab larvae in Sydney Bight before conclusions can be drawn about larval dispersal (J. Tremblay pers. comm. 2002).

Management concerns

Since 1997, there has been a dramatic decrease in female and adolescent male snow crab populations in Eastern Nova Scotia; however, the population levels of commercially harvestable adult males has remained relatively constant (DFO 2002a). These fluctuations are not altogether unusual. In the past 15 years, male and female snow crab concentrations have fluctuated in the Southern Gulf of St. Lawrence, and snow crab populations generally seem to undergo a wave of recruitment rather than consistent recruitment (M. Biron pers. comm. 2002). The decline observed in Sydney Bight is, however, of concern given that it involves all female categories (primiparous, multiparous, pre-primiparous, etc.), as well as juvenile male recruits. The decrease in immature males presently observed strongly suggests that the biomass of fishable crab will decline in the future (DFO 2002a).

Rock crab

Rock crab is commonly found in the nearshore on a variety of substrate types. Traditional ecological knowledge indicates that rock crab is distributed all along the shallow coastal areas of Sydney Bight, similarly to lobster (Figure 7-5). Rock crab is an important food source for lobsters (Gendron et al. 2001), and is sometimes used as bait by lobster fishermen.

The directed fishery for rock crab in eastern Cape Breton began in 1993, with the majority of landings coming from the central part of Sydney Bight. The rock crab fishing season lasts from late July and through the fall and winter until May, however the majority of activity occurs between August and October (Tremblay et al. 2001).

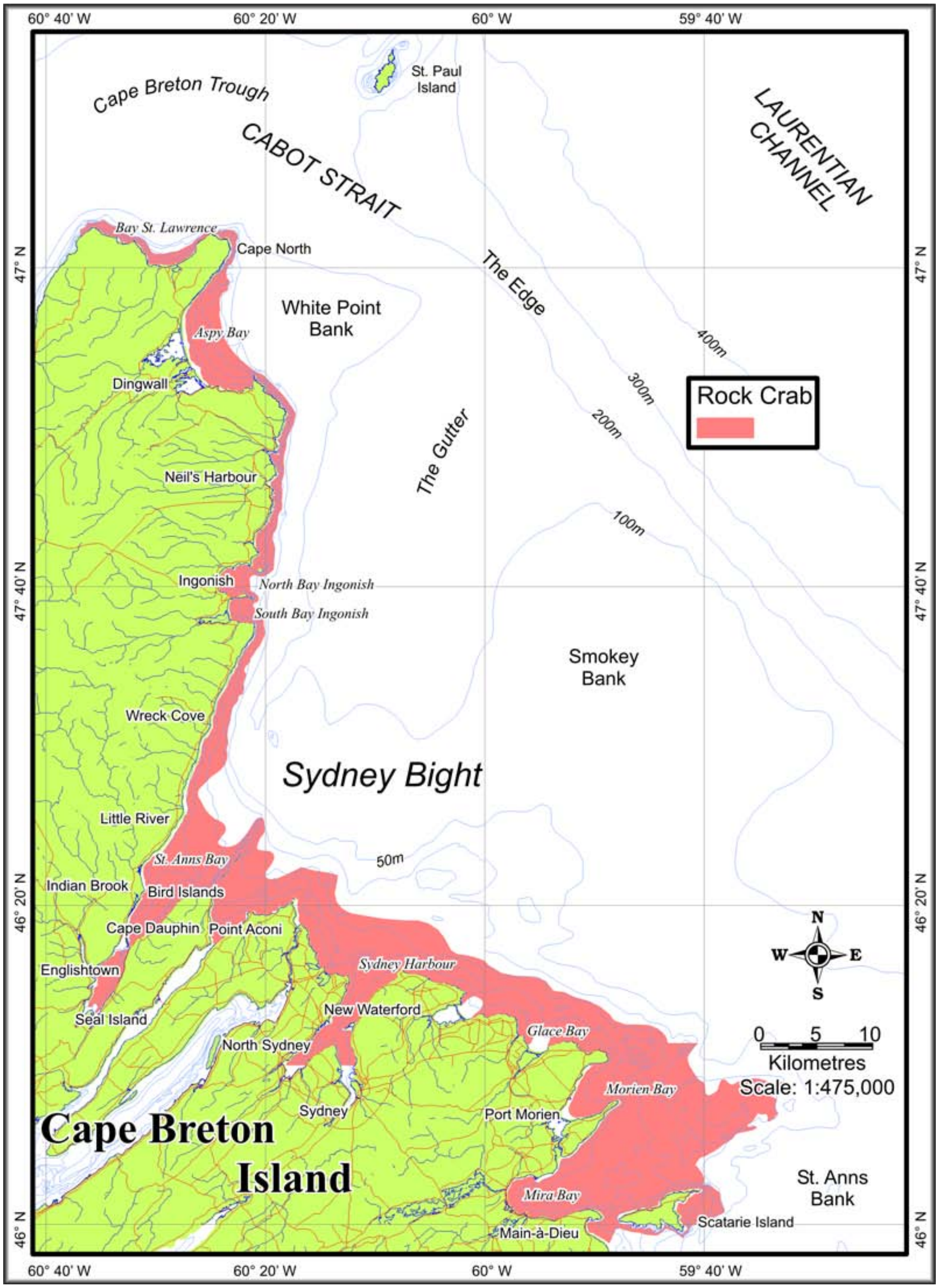


Figure 7-5: Rock crab distribution in SHACI Unit 11 (Highland Coastal Mapping, 2001)

There are many gaps in our knowledge of rock crab in Sydney Bight. Little is known about (Tremblay et al. 2001):

- areas where ovigerous females are highly aggregated;
- sources and sinks of planktonic larvae;
- the distribution of newly settled and juvenile crabs;
- late fall/spring distributions; and,
- the timing of of key life history events.

Northern shrimp

Northern shrimp inhabit cold waters (<6°C) with muddy bottoms high in organic content. Commercial fishing efforts at the edge of the Laurentian Channel and a shrimp trap fishery in Sydney Bight have yielded low catch rates. The planktonic and moulting seasons for Northern Shrimp are presented in Figure 7-1. Shrimp are immobile and potentially vulnerable to predators over the few days when moulting occurrs (Tremblay et al. 2001).

Scallop

Scallops are most abundant in tidally well-mixed areas with gravel bottom. Based on data from other regions, scallop spawning likely occurs between August and October, and larvae are likely planktonic for 4-6 weeks between August and November (Figure 7-1) (Tremblay et al. 2001).

Scallops are fished in localized nearshore areas of Sydney Bight. Traditional ecological knowledge indicates the presence of scallop beds in discrete areas off St. Paul Island, Aspy Bay, around Ingonish Island, St. Anns Bay, St. Anns Harbour, around the Bird Islands, Great Bras d'Or Channel, Mira Bay, Morien Bay and around Scatarie Island (Figure 7-6) T. Lambert pers.comm.2002; Highland Coastal Mapping 2001; VCCRMP 1997; (ECBCRMP 1996; LACRMP 1995;).

Sea urchin

Sea urchins are found in shallow rocky bottom subtidal areas all along the coast of eastern Cape Breton (Moore et al. 1986). During a 1984-1985 survey, Moore and others (1986), found that urchins are most prevalent in exposed areas at depths between 5-10 m. Traditional Ecological Knowledge indicates the presence of sea urchins in discrete areas between Ingonish and Meat Cove (Figure 7-7) (Highland Coastal Mapping 2001).

Urchins are usually found in high concentrations in feeding fronts bordering the deep edge of kelp beds (DFO 2000b). No urchin-kelp cycle has been documented in the

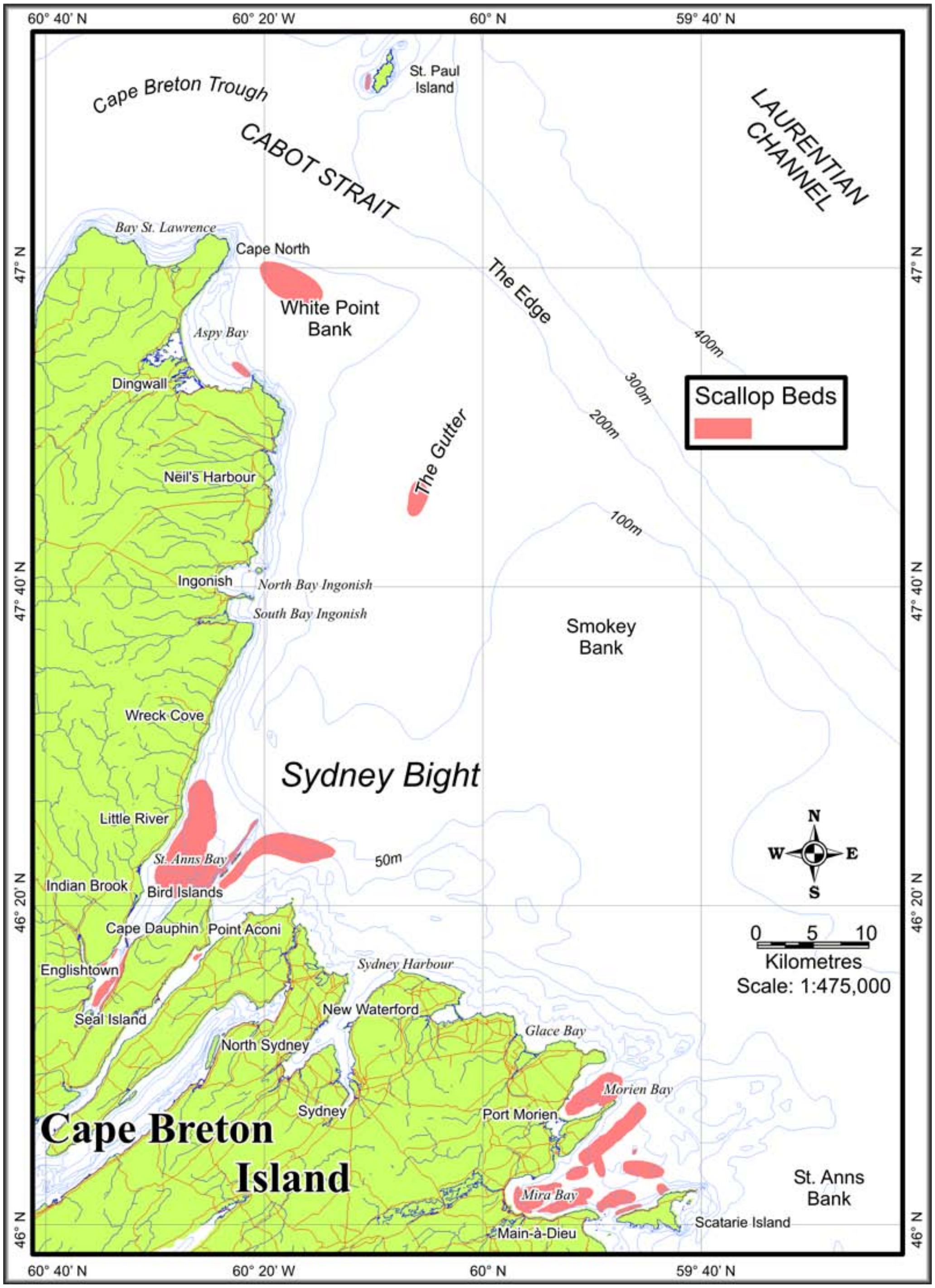


Figure 7-6: Scallop habitat in SHACI Unit 11 (ECBCRMP 1996; VCCRMP 1997; Highland Coastal Mapping 2001)

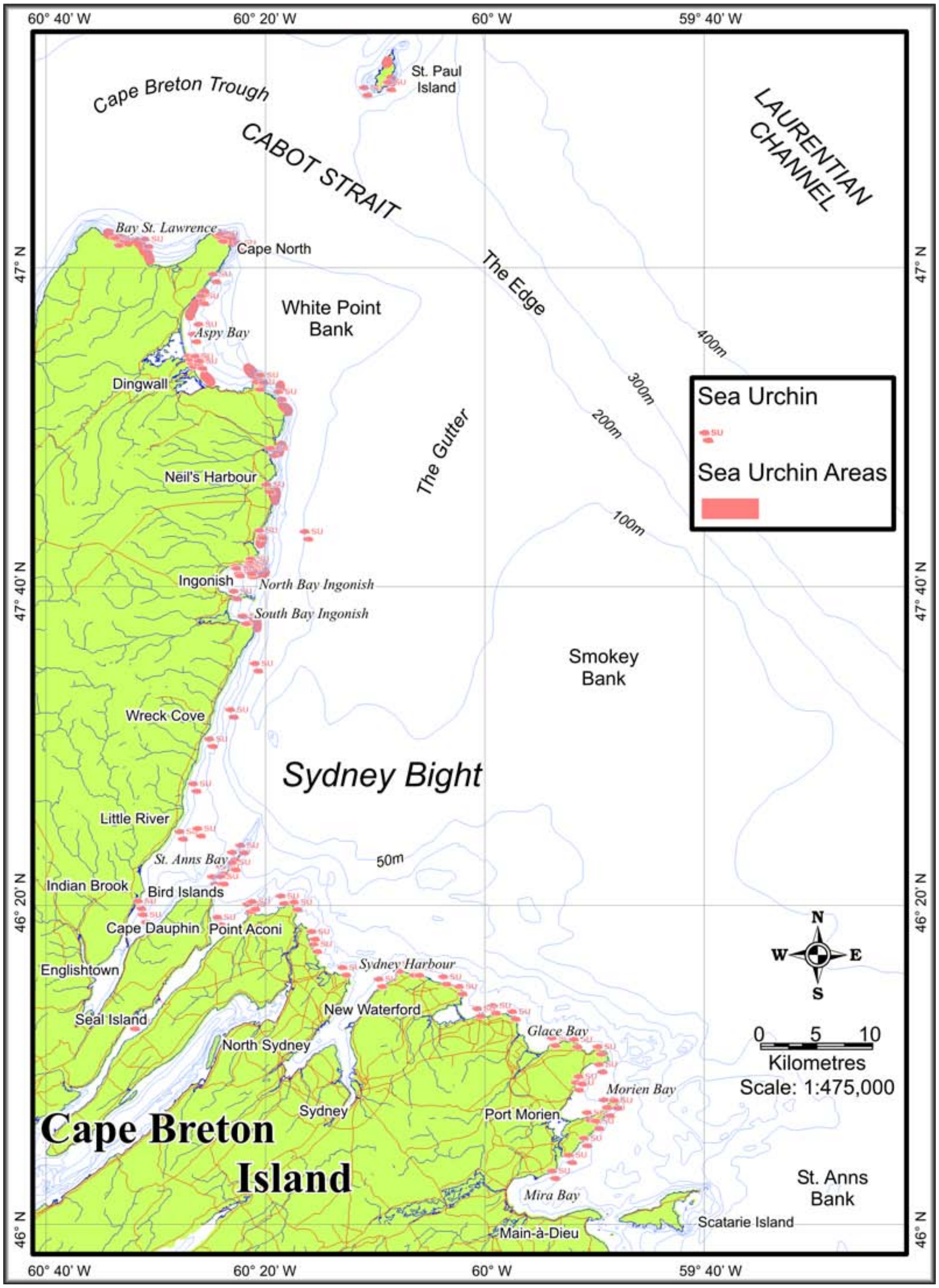


Figure 7-7: Sea urchin distribution in SHACI Unit 11 (ECBCRMP 1996; VCCRMP 1997; Highland Coastal Mapping 2001)

Sydney Bight area; however, detailed information is lacking to make definite conclusions (G. Sharp pers. comm. 2002). An urchin roe fishery has developed off Nova Scotia in recent years; however it is not well developed in Sydney Bight (Tremblay et al. 2001).

Urchin spawning in Sydney Bight likely occurs from March to April, and larvae are planktonic for several weeks. Larval settlement likely occurs between June and July (Figure 7-1) (Tremblay et al. 2001).

Baitworms: sandworm and bloodworm

Two polychaete worm species are dug for fish bait in Unit 11: sandworm (*Nereis virens*) and bloodworm (*Glycera dibranchiata*). These are gathered locally, and there is no known commercial worm harvesting in the area (R. Miller pers. comm. 2002). Baitworms are gathered in sheltered soft-bottomed intertidal areas. In Sydney Bight these areas include: False Bay, Morien Bay, Mira Bay, Indian Bay/Dominion Beach, Northwest Arm Sydney Harbour, St. Anns Bay, North Bay Ingonish, Ingonish Harbour, and Aspy Bay (LACRMP 1995; ECBCRMP 1996; VCCRMP 1997). Gathering is done by hand at low tide using a short-handled fork to overturn the upper 10-20 cm of sediment (Shepherd and Boates 1999).

Baitworm harvesting can have detrimental effects on the surrounding marine environment. Digging destroys habitat, and unearths other marine organisms living in the mudflats, thus exposing, damaging and/or killing them (Wilson 1988). Effects may also be realized further along the food chain in species such as migratory shorebirds that feed on the worms (Shepherd and Boates 1999).

Other commercial species

There is limited information about other crab species with potential for commercial exploitation. There have been intermittent exploratory fisheries for both toad crab and northern stone crab in Sydney Bight, but these fisheries met with limited success (Tremblay et al. 2001). Toad crab is fished at depths between 35 and 80 m and northern stone crab is fished in deep waters at the edge of the Laurentian Channel.

For toad crab, the moulting period in Sydney Bight likely occurs between June and September, however the peak moulting time is unknown. Little is known about the timing of life history events or seasonal or annual movements for both toad crab and northern stone crab (Tremblay et al. 2001).

Threats to invertebrates

Ocean dumping
Hard-bottom assemblages that are smothered by dredge spoil from dumping can suffer drastic changes in macroflora and macrofauna. Dumped sediment provides limited shelter and decreases prey availability for lobsters and crabs (Elner and Hamet 1984). Some dredging like that done in the Great Bras d'Or Channel, could be considered a temporary disruption since lobster have returned to the area.

Fishing activities
The fishing gear (such as draggers) used to harvest certain species may harm the bottom habitat used by other species.

Overfishing could harm invertebrate populations. Even seemingly healthy populations can be threatened by the combination of overfishing and natural pressures.

Biological invasions
The invasive green crab, *Carcinus maenas*, also impacts invertebrates. This species is becoming more abundant everywhere in Nova Scotia and this increased population is affecting nearshore community structure.

Oil and gas industry
The effects of seismic testing, drilling discharges, and blowouts and spills are all potential threats to invertebrates. See the Oil and gas industry threats in the following Section 8 – Fish.

8 – Fish

Sydney Bight is home to a diverse assemblage of fish species which inhabit a variety of habitat types. Some species migrate in and out of the area seasonally, using Sydney Bight as a spawning, nursery or overwintering area. Others species pass through on their way to the Gulf of St. Lawrence, the Bras d'Or Lakes, or to the many rivers and streams that run into Sydney Bight. Still others are resident in the waters year round. There is substantial information available about the species fished commercially in Sydney Bight (part of the 4Vn region) (Figure 8-1). Less, however, is known about the many non-commercial fish present and their role in the Sydney Bight ecosystem. Fish provide food for the marine mammal species (whales and seals) and marine birds that frequent the area.

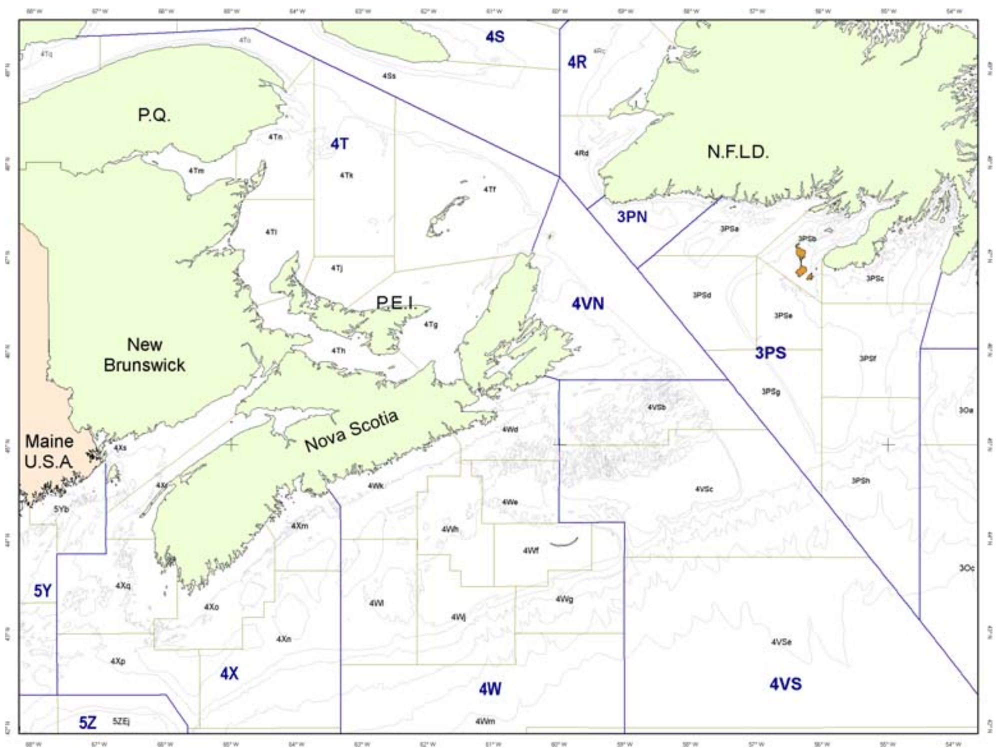


Figure 8-1: Area 4Vn and adjacent NAFO fishing areas

Marine fish

General abundance and distribution

DFO conducts two trawl survey programs in Sydney Bight. The summer research vessel trawl survey series has examined fish in Sydney Bight since 1970. This survey is restricted to relatively deeper waters and only samples summer fish distributions. The 4Vn inshore survey was added to sample inshore areas of western Sydney Bight in 1991. This survey provides information about the fish and invertebrates found in waters less than 20 miles offshore (Zwanenburg et al. 2001).

The summer research vessel trawl survey findings indicate that Sydney Bight hosts at least 88 species (or species groups) of finfish, less than 20 of which are commercially exploited. In other words, Sydney Bight is home to at least 60+ species of non-commercial finfish (Zwanenburg et al. 2001). Redfish is the most common fish species found in the trawls, followed by capelin, cod, American plaice, herring and white hake (Zwanenburg et al. 2001). These fish species may not, however, be the most plentiful in Sydney Bight since trawl surveys do not readily pick up species like snake blennies, cunners and shannies that inhabit rocks and muddy bottoms (T. Lambert pers. comm. 2002). The surveys also do not provide an appropriate way to sample pelagic fishes.

At least 45 different fish species (or species groups) have been identified in the last 5 years of the 4Vn inshore survey sampling program (Table 8-1). The distribution and abundance of selected fish species in Sydney Bight can be inferred from inshore survey data

Table 8-1: Species list of marine fish from DFO Inshore Survey in western Sydney Bight (T.Lambert pers. comm. 2002)

Common name	Species name
Alligator fish	*Aspidophoroides monopterygius*
American plaice	*Hippoglossoides platessoides*
Atlantic cod	*Gadus morhua*
Atlantic sea poacher	*Agonus decagonus*
Atlantic sea snail	*Liparus atlanticus*
Butterfish (Dollarfish)	*Peprilus triacanthus*
Capelin	*Mallotus villosus*
Checker (Vahl's) Eelpout	*Lycodes vahlii*
Cunner	*Tautogolabrus adspersus*
Daubed shanny	*Lumpenus maculatus*
Fourhorn sculpin	*Myoxocephalus quadricornis*
Fourline blenny	*Eumesogrammus praecisus*
Gaspereau	*Alosa pseudoharengus*
Haddock	*Melanogrammus aeglefinus*
Halibut	*Hippoglossus hippoglossus*
Herring	*Clupea harengus*
Hookear sculpin	*Artediellus atlanticus*
Little sculpin	*Myoxocephalus aenaeus*
Little skate	*Raja erinacea*
Longhorn sculpin	*Myoxocephalus octodecemspinosus*
Lumpfish	*Cyclopterus lumpus*
Mailed sculpin	*Triglops murrayi*
Monkfish	*Lophius americanus*
Newfoundland (Laval's) Eelpout	*Lycodes lavalaei*
Ocean pout	*Macrozoarces americanus*
Polar sculpin	*Cottunculus microps*
Redfish	*Sebastes sp.*
Sand lance	*Ammodytes americanus*
Sea raven	*Hemitripterus americanus*
Shorthorn sculpin	*Myoxocephalus scorpius*
Silver hake	*Merluccius bilinearis*
Smelt	*Osmerus mordax*
Smooth skate	*Raja sentra*
Snake blenny	*Lumpenus medius*
Spiny dogfish	*Squalus acanthius*
Thorny skate	*Raja radiata*
Turbot	*Reinhardtius hippoglossoides*
White hake	*Urophycis tenuis*
Windowpane flounder	*Scophthalmus aquosus*
Winter flounder	*Pseudopleuronectes americanus*
Winter skate	*Raja ocellata*
Witch flounder	*Glyptocephalus cynoglossus*
Wolffish	*Anarhicas lupus*
Yellowtail flounder	*Limanda ferruginea*

collected over the past 11 years (Table 8-2) (T. Lambert pers. comm. 2002).
The inshore survey data indicates that some fish species are wide spread in Sydney Bight (e.g. American plaice), while others are restricted to a specific area (e.g. shorthorn sculpin). Some general trends are evident when examining fish distribution and age class. The larger adult fish are found in deep water, while the young fish are found in shallow areas (e.g. cod and hake). These trends indicate the presence of a fish nursery area in the southwest corner of Sydney Bight in the vicinity of the Bird Islands (T. Lambert pers. comm. 2002).

Table 8-2: Species distributions of certain fish species in Sydney Bight based on DFO inshore survey data (1991-1999) (T. Lambert pers. Comm. 2002)

Species	Abundance and distribution	Depth preference
Species with a general distribution		
Cod (all age classes)	Distributed throughout Sydney Bight with concentrations of older fish off Ingonish and near the edge of the Laurentien Channel.	Variable
Age 2 Cod	Distributed throughout Sydney Bight with concentrations north and east of Bird Islands	Shallow (<50 m)
Longhorn sculpin	Common. Distributed throughout Sydney Bight with slightly higher concentrations around Bird Islands	Shallow (<50 m)
White hake (all age classes)	Distributed throughout with concentrations of older fish off Ingonish and near the edge of the Laurentien Channel.	Shallow (<50 m)
Winter skate	Common. Higher concentrations around Bird Islands.	Shallow (<50 m)
Mailed sculpin	Low abundance but wide spread.	Variable
Turbot	Low abundance but fairly widespread	Variable
American plaice	Very common and widespread. Found abundantly in deeper waters.	Deeper (>50 m)
Thorny skate	Concentrations near the edge of the Laurentian Channel.	Deeper (>100 m)
Witch flounder	Fairly common. Concentrations mainly near the edge of the Laurentian Channel.	Deeper (>100 m)
Yellowtail flounder	Fairly common and widespread.	50-100 m
Species with a restricted distribution		
Age 2 White hake	Concentrated in St. Anns Bay, Great Bras d'Or Channel and around Bird Islands. Low concentrations as far north as Ingonish.	Shallow (<50 m)
Winter flounder	Common. Concentrations in St. Anns Bay, off Point Aconi, and around Bird Islands.	Shallow (<50 m)
Shorthorn sculpin	Found only as far north as Ingonish. Slightly more concentrated near Bird Islands.	Shallow (<50 m)
Age 1 Cod	Concentrations north and east of Bird Islands	Shallow (<50 m)
Species with a very restricted distribution		
0-group White hake	Found only in 3 stations: St. Anns Bay and outside Sydney Harbour.	Shallow (<50 m)
Age 1 White hake	Found mainly in St. Anns Bay and around Bird Islands.	Shallow (<50 m)
0-group Cod	Found only in southwest corner of Sydney Bight, mainly around the Bird Islands	Shallow (<50 m)

There are, however, several limitations associated with this survey data. The inshore survey is restricted to gravelly, sandy and muddy bottom areas since the gear used is not suitable for hard bottoms. For this reason the hard bottom areas close to shore along the western side, and a large area on the eastern side of Sydney Bight are excluded. Also, the plots used to discern species distributions simply indicate areas where a given species has been found during a 10 year period, and do not represent an average distribution over time (T. Lambert pers. comm. 2002). Finally, the survey data was collected during the fall for the entire 11 year period, however in earlier years, data was also collected in the spring. The distribution maps from which the information in Table 8-2 was based on did not distinguish between seasons. These maps were intended only to indicate locations favoured by particular species with no concern for seasonality (T. Lambert pers. comm. 2002). The data does indicate that juvenile species distributions were taken from data collected in the fall survey only.

Seasonal changes

Sydney Bight is known as an important overwintering area for migratory populations of cod, plaice, white hake, witch flounder, redfish, and herring (Kenchington 2001).

Environmental changes

Sydney Bight is a relatively dynamic area where oceanographic changes influence changes in biotic composition. For example, capelin abundance increased significantly in recent years, mainly in response to a significant increase in bottom temperature (Zwanenburg et al. 2001).

Commercial species – important habitats

The majority of Sydney Bight (part of NAFO area 4Vn) is commercially fished. Based on landings, the top five commercial species fished in Sydney Bight between 1993-2000 were cod, redfish, American plaice, white hake and herring. During this period, however, the majority of the 4Vn fisheries were closed or severely limited due to low abundance and productivity (Zwanenburg et al. 2001).

Important fish habitats are those areas considered important for spawning, juvenile development, summer feeding or overwintering. Such significant areas are known in Sydney Bight for cod, herring, capelin, redfish, American plaice, white hake and haddock. There may also be areas of importance for non-commercial species.

Cod

Atlantic cod are found inshore or offshore depending on the season. They have been heavily exploited by the fishing industry and stocks off Atlantic Canada are now severely reduced. In Sydney Bight, the resident cod stock (4Vn) declined rapidly in abundance and spawning biomass in the late 1980s and early 1990s.At present stock production is very low (DFO 2001a). In fact, Kenchington (2001) describes the 4Vn stock as probably the most depleted of any of Canada’s cod populations that were once substantial enough to be managed as a single unit. Atlantic cod is considered a species of special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC 2003a).

Cod play an important role in the marine ecosystem. They prey upon a range of species from different trophic levels depending on their age. Cod are also preyed upon by a variety of other fish species and marine mammals depending on their lifestage (Table 8-3) (Scott and Scott 1988).

Table 8-3: Predators and prey of Atlantic cod (Scott and Scott 1988)

Life stage	Prey	Predators
Young - fry	Zooplankton, small crustaceans	Older cod, squid and pollock
Young - juveniles	Euphausiids, mysids, shrimps, small lobsters and spider crabs	
Mature	Capelin, sandlance, redfish, herring, invertebrates	Marine mammals (seals and whales)

Seasonal distribution

Cod spawning, juvenile, and overwintering areas exist in Sydney Bight (area 4Vn) (Chouinard et al. 1995). Lambert and Wilson (1995) summarized the annual cycle of the resident 4Vn cod stock as follows. In late April, cod leave the deeper waters near the Laaurentian Channel to the north and enter the "Gutter" area off Cape Smokey. Large numbers of fish concentrate in this area for roughly a two month period while spawning. After spawning, the cod disperse in an easterly direction; however, their summer distribution is unknown. In the late autumn, the cod then return to the deeper waters of Sydney Bight, near the Laurentian Channel, where they are joined by the overwintering cod from the Gulf of St. Lawrence 4T population.

Spawning and juvenile areas

Spawning and juvenile areas in Sydney Bight have been noted in several studies. DFO Gulf of St. Lawrence ichthyoplankton surveys during the late 60s and early 70s found high spring (May-June) and low fall (October-November) concentrations of cod eggs in western Sydney Bight (Kohler et al. 1974a; 1974b; 1975; 1976; 1977). Later surveys by the Scotian Shelf Ichthyoplankton Program found similar high cod egg concentrations in May and June and low concentrations in October (Gagné and O'Boyle 1984, Brander and Hurley 1992). These earlier findings are supported by more recent 1991and 1992 survey results that found similar cod egg concentrations in western Sydney Bight, north of the Bird Islands (Lambert 1992; Lambert and Wilson 1995). DFO summer groundfish research trawl surveys between 1970 and 1981 recorded ripe cod in several areas of Sydney Bight: off Ingonish, and generally off the Sydney/New Waterford/Glace Bay area. Spawning cod were recorded off New Waterford/Glace Bay (Scott 1983).

Inshore surveys from 1991-1994 found consistent concentrations of small 0-year cod (15 cm) around the Bird Islands. Furthermore, cod size increased in both a northerly and easterly direction away from the Bird Islands area, indicating that 1 and 2 year old cod are also found in this vicinity (Lambert and Wilson 1995; Lambert pers.

comm. 2002). Generally, juvenile cod do not move far from their nursery area during the first two years of life since they seem to settle close to the area where they were spawned (Lambert and Wilson 1995). Although juvenile cod off Nova Scotia will settle in all habitat types (sand, cobble, seagrass, and rock reef), both growth and survivorship are higher in more structurally complex habitats where the cod can avoid predators (Tupper and Boutilier 1995).

Despite the continued records of spawning activity and juvenile fish in Sydney Bight, the 4Vn cod stock has failed to recover. DFO (2001a) attributes this failure to the absence of any strong year classes entering the fishery, and a high natural mortality in recent years which greatly exceeds the level traditionally assumed.

Redfish

Redfish are benthic species that live over rocky or silt-clay bottom in cool areas (3 - 8ºC) along the slopes of banks at depths from 100-700 m. Although generally considered benthic, their distribution in the water column varies diurnally and seasonally (DFO 2001c). Diurnal movements up the water column at night are probably related to feeding. Redfish are pelagic or benthypelagic feeders that eat amphipods, copepods and euphausiids (Steele 1957). Their diet includes increasing amounts of fish as they mature (Scott and Scott 1988).

Three species of redfish are found in the Northwest Atlantic: *Sebastes mentella, S. fasciatus*, and *S. marinus*. These species are not separated in the fishery and are managed together (DFO 2001c). *S. mentella* and *S. fasciatus* are more common in Sydney Bight. *S. mentella* has a deeper distribution and ranges predominantly from the Gulf of St. Lawrence northward, while *S. fasciatus* ranges from the southern Grand Banks southward to the Gulf of Maine. Significant range overlap for these two species occurs only in the Laurentian Channel area (DFO 2001c).

Seasonal movements

Redfish are found in large concentrations in Sydney Bight (Power et al. 1996) and in the Southern Gulf of St. Lawrence during the summer. Most redfish move into the eastern portions of the Laurentian Channel (the Cabot Strait) to overwinter (Archambault et al. 2001; DFO 2001c). For Gulf of St Lawrence redfish, this migration may occur as early as September (Archambault et al. 2001).

Spawning and juveniles

O'Boyle and others (1984) found redfish larvae to be abundant and widespread in Sydney Bight during April and May.

The fishery

The seasonal movements of redfish are considered in redfish management of the 4Vn region. The 4Vn redfish fishery is considered part of the Gulf of St. Lawrence management unit (Unit 1) from January to May, and part of the Laurentian Channel management unit (Unit 2) from June to December (Figure 8-2). This split in the management units is due to the migration of Gulf of St. Lawrence redfish into the 3Pn and 4Vn area in the fall/winter. Unit 1 is currently under moratorium due to low stock abundance and the absence of significant recruitment since the early 1980s (Archambault et al. 2001). The overall prognosis for the stock remains poor and is not expected to improve in the near future (DFO 2001c). No directed fishery is therefore permitted in Unit 1, and Unit 2 is closed in May and June during peak spawning. The directed redfish fishery in 4Vn occurs from July to September (DFO 2001c).

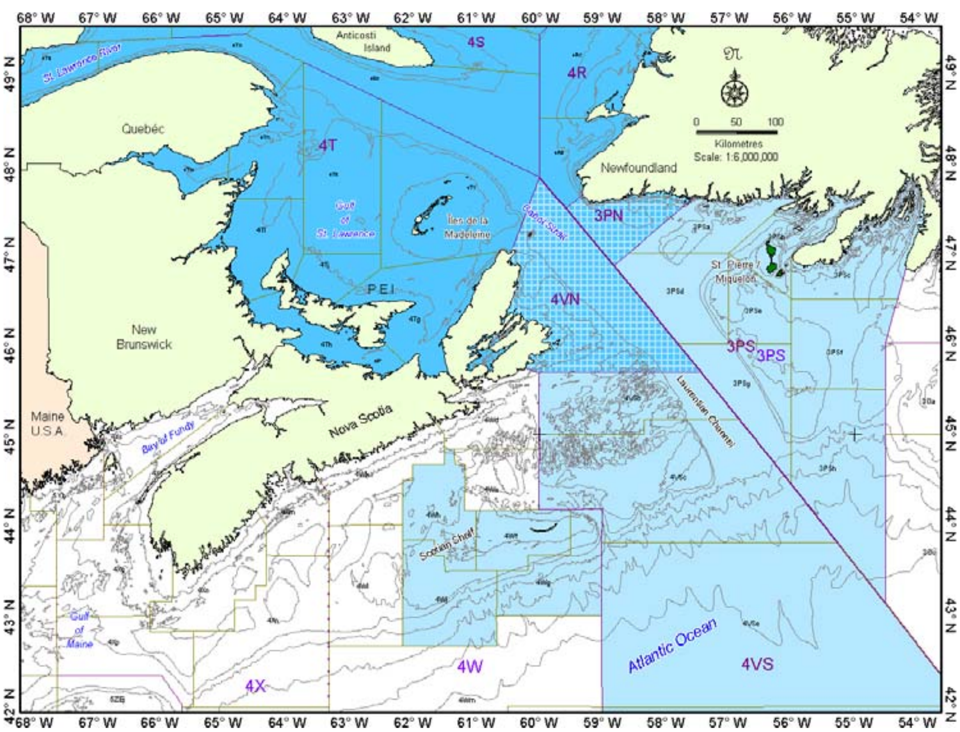


Figure 8-2: Redfish management Units 1(dark blue) and 2(light blue). Unit 1 includes 4T, 4S, 4R and 4Vn and 3Pn (January -May only). Unit 2 includes 4W, 4Vs, 3Ps, and 4Vn and 3Pn

There is some uncertainty surrounding the amount of exchange between redfish in Unit 1 and Unit 2. Within Units 1 and 2, there is no genetic distinction between *S. mentella* and *S. fasciatus*, however, there are clear genetic differences for both species between Unit 1 and Unit 2 and adjacent management units. As well, there is a hybrid redfish found in both units that is not known elsewhere (Desrosiers et al. 1999; Roques et al. in press, cited by Archambault et al. 2001). These findings suggest that enough interbreeding occurs among Unit 1 and Unit 2 redfish to render the populations genetically indistinguishable (DFO 2001c).

American plaice

American plaice are very common and widespread in Sydney Bight (Zwanenburg et al. 2001; T. Lambert pers. comm. 2002) and are slightly more abundant in waters >50 m (T. Lambert pers.comm. 2002)

American plaice feed heavily in the summer and cease feeding in the winter and early spring. This summer feeding cycle is important to the plaice life cycle: the energy stored in the summer is used for metabolism and gonadal development in the winter (MacKinnon 1972; Maddock and Burton 1999). Smaller plaice (<30 cm) eat mainly mysids, amphipods and echinoderms, while larger plaice eat mostly echinoderms, and pelecypod molluscs. The diet of smaller plaice overlaps with that of >50 cm cod, making them potential competitors for food (Powles 1965).

Seasonal distribution

Plaice occupy different habitats in summer and winter. In the winter, they tend to inhabit deeper, warmer waters of the Laurentian Channel while in the summer they are found in cooler, shallower areas (Swain et al. 1998). American plaice migrate from the southern Gulf of St. Lawrence in November and December to overwinter in the Laurentian Channel and Sydney Bight. In the spring, they return to the Gulf to spawn (Powles 1965; Swain et al. 1998).

Spawning and juvenile areas

Sydney Bight is a major area of plaice egg concentration on the Scotian Shelf in May (Neilson et al. 1988). American plaice eggs are small, buoyant, and float on the water surface for roughly 11-14 days at 5ºC (Fahay 1983) before hatching. Specific information about spawning times and areas in Sydney Bight does not exist.

Locke (2001) lists Sydney Bight as a nursery area for plaice between April and May. Specifically, the southwestern corner of Sydney Bight is a known nursery area for juvenile groundfish (T. Lambert pers. comm. 2002).

White hake

White hake is a demersal fish that prefers temperatures from 5- 1ºC (Scott and Scott 1988) and soft substrates (silt, mud, sand) (Musick 1969 cited by Archambault et al 2001). The diet of juvenile white hake consists of polychaetes, shrimps and other crustaceans (Bowman 1981), while adults primarily eat fish, including juvenile white hake. White hake feed selectively on the basis of particle size which could make them particularly susceptible to mortality from ingesting oil globules from oil spills (Coates et al. 1982).

Seasonal distribution

In 4Vn, white hake are generally distributed with concentrations of older fish off Ingonish and along the edge of the Laurentian Channel (T. Lambert pers. comm. 2002).

White hake migrate out of the southern Gulf of St. Lawrence in November and December, when waters cool, to overwinter in deeper waters of the Laurentian Channel. Three groups of white hake use this overwintering area: those from the inshore (Northumberland Strait) and offshore components of the southern Gulf, and those from the 4R and 4S areas of the northern Gulf of St. Lawrence (Clay 1991). Migration back into the Gulf occurs between April and May, and is completed by June (Archambault et al. 2001).

White hake depth distributions seem to be temperature dependent. In September, their distribution in 4T is disjunct, with concentrations occurring in either warmer inshore waters (<100 m) or in warmer deep areas along the Laurentian Channel and Cape Breton Trough (>200 m), but not at depths in between (Clay and Hurlbut 1989; Clay 1991; Morin and Hurlbut 1994). White hake distribution is continuous from 4T into 4Vn (Morin and Hurlbut 1994; Hurlbut et al. 1996) and they increasingly occupy the deeper, eastern portion of the Gulf in the winter (Morin and Hurlburt 1994). In recent years there has been an eastward shift in white hake distribution. The areas of highest biomass include St. Georges Bay, the Cape Breton Trough and along the Laurentian Channel (Archambault et al. 2001).

The fishery

A formerly important directed fishery for white hake in the southern Gulf of St. Lawrence (4T), has been under moratorium since 1995 (Archambault et al. 2001). To conserve this migrating 4T stock, directed fisheries for white hake are closed in 4Vn, 4Rs and 3Pn from January to April (Archambault et al. 2001).

Spawning and juveniles

Spawning locations and timing for white hake are debated in the literature (Markle et al 1982; Scott and Scott 1988; Fahay and Able 1989; Nepszy 1968 cited by

Archambault et al. 2001). Fahay and Able (1989) suggest the existence of two stocks with separate spawning schedules: a shallow water summer spawning population in the southern Gulf of St. Lawrence and Scotian Shelf; and, a deep water, early spring spawning population extending from the northeast Gulf of St. Lawrence, along the slopes of the Scotian Shelf southward to the Middle Atlantic Bight. White hake eggs are buoyant and remain near the surface (Archambault et al. 2001).

In 4Vn, age 2 white hake are found concentrated in shallow waters of St. Anns Bay, Great Bras d'Or Channel and around the Bird Islands. Low concentrations are found as far north as Ingonish (T. Lambert pers. comm. 2002). The distribution of Age 1 white hake is restricted to St. Anns Bay and waters surrounding the Bird Islands while 0-group white hake were found only in St. Anns Bay and outside of Sydney Harbour (T. Lambert pers. comm. 2002). An eelgrass area in St. Anns Bay may provide an important habitat for juveniles of this species. Fahay and Able (1989) suspect eelgrass beds are important habitat for demersal juveniles, and McAllister (1960) observed sand-hiding behaviour in juveniles of this species in shallow waters off PEI.

Haddock

Haddock live in cool temperate waters from the inshore to the edge of the continental shelf (Scott and Scott 1988). They are primarily benthic fish, and occur over hard, smooth, sand or gravel bottoms. Haddock generally prefer temperatures above 2ºC and will maintain a similar range of temperatures by seasonally altering their depth distribution from the shallow banks in the summertime to the deeper water in the winter. In Sydney Bight during the winter, haddock were found at 125 m and at temperatures <1ºC (Collins et al. 2001).

Adult haddock are benthic feeders that consume crustaceans, molluscs, echinoderms, annelids, and other fish. Juvenile haddock are consumed by many predators including cod, pollock, and white hake (Kohler and Fitzgerald 1969; Langton and Bowman 1980); and, adults are eaten by harbour and grey seals (Mansfield 1967; Boulva and McLaren 1979). Haddock compete with cod for food, particularly when cod are feeding on invertebrates (Kohler and Fitzgerald 1969; Langton 1982) or when both species are feeding on capelin eggs (Templeman 1965).

The fishery

The haddock fishery in 4Vn once yielded the third highest haddock landings in eastern Canada. In this area, haddock were fished using shore traps, small gasoline boats and large vessels (McKenzie 1946). Needler (1930) speculated that the haddock fished off eastern Cape Breton moved close to shore when they migrated from their offshore overwintering and spawning grounds on the Scotian Shelf in the spring and into their Gulf of St. Lawrence summering areas. Stomach analysis of haddock caught inshore off Ingonish during mid-May 1928 revealed that the haddock were consuming American eel elvers (Needler 1929). Lambert (pers. comm. 2002) speculates that this population that moved inshore was either fished out, or has moved elsewhere due to colder water conditions.

Collins and others (2001) mention a major concentration of haddock off Ingonish from May to June and from December to January. They state that these fish support a highly seasonal fishery in the area, and may be from a spawning group on the central part of the Scotian Shelf, but do not state whether this is the historical or current population.

Spawning and juveniles

Haddock spawn in Canadian waters from January to July. Scott (1983) reported ripe and spawning haddock in Sydney Bight in July; however, spawning in inshore areas appears to be relatively unimportant (Scott and Scott 1988). McCracken (1965) found catches of haddock <39 cm in the Gutter area, which may indicate a former juvenile haddock area off Ingonish. Haddock larvae remain pelagic until they reach over 50 mm long; then they begin to seek bottom (Fahay 1983). Young haddock exhibit a commensal relationship with the lion's mane jellyfish *Cyanea capillata*. They seek shelter and possibly protection under the disc or bell of the jellyfish (Colton and Temple 1961; Mansueti 1963).

Groundfish in general

The area around the Bird Islands is a general nursery area for a number of groundfish species (T. Lambert pers. comm. 2002). This groundfish nursery area, located in the southwest corner of Sydney Bight, extends from St. Anns Bay east to Point Aconi and north to Cape Smokey (Figure 8-3) (Highland Coastal Mapping 2001). Locke (2001) states that Sydney Bight is an important area for cod, witch flounder and plaice eggs and that it is a nursery area for these species from April to July.

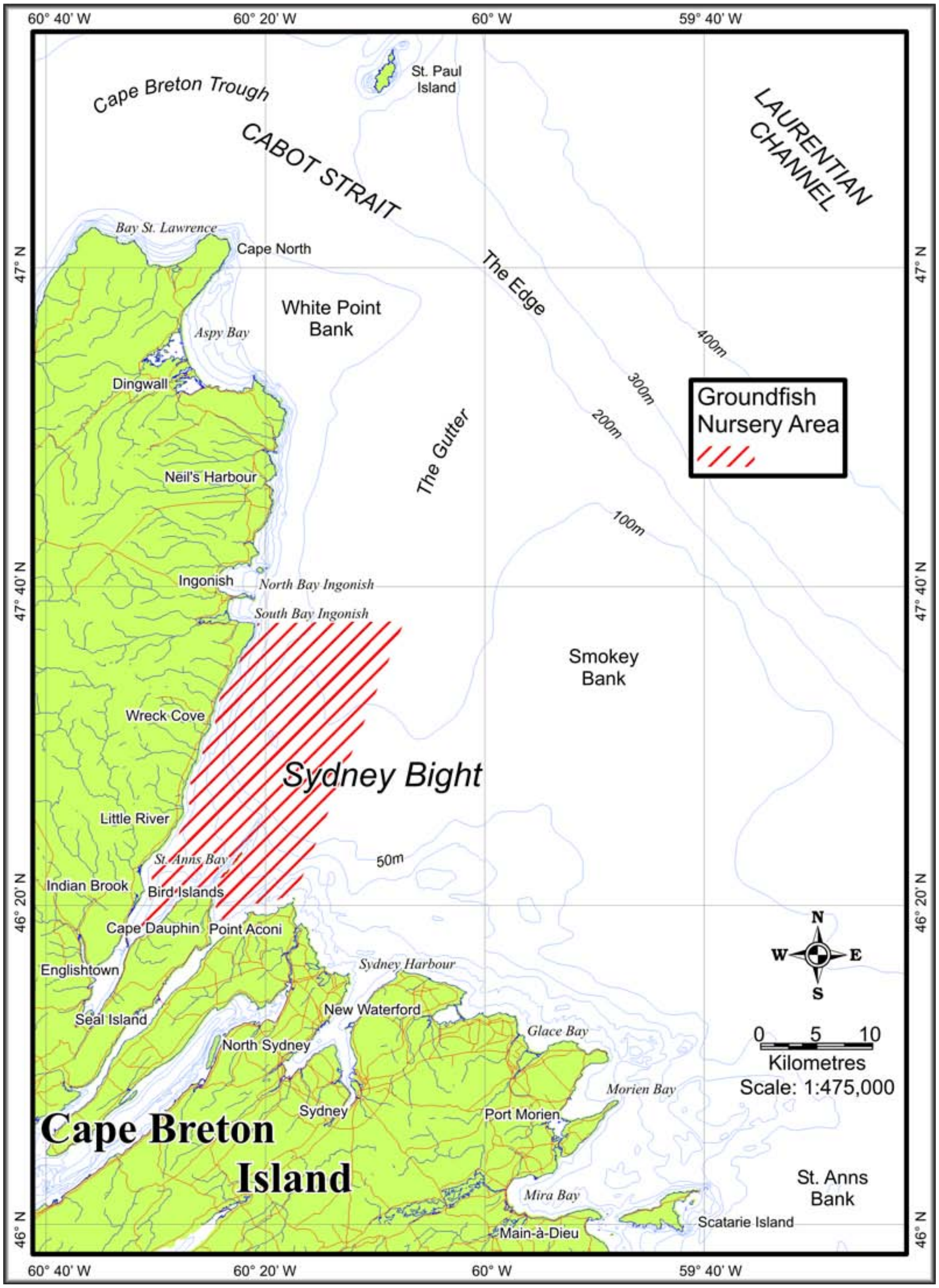


Figure 8-3: Groundfish nursery area in SHACI Unit 11 (Highland Coastal Mapping 2001)

Herring

Herring is a pelagic fish species that inhabits inshore waters and offshore areas to 200 m. Herring stocks form huge schools prior to spawning, and have preferred spawning, feeding, and wintering areas.

Herring are a basic food for nearly all pelagic predators including other fish, seabirds and marine mammals. Their eggs and spawn are food for fish including winter flounder, cod, and haddock. Herring feed on various types of zooplankton (euphausiids, copepods, molluscs and fish larvae, etc.) (Scott and Scott 1988).

Several herring stocks use Sydney Bight during some time of the year: the Gulf of St. Lawrence (4T), Bras d'Or Lakes, Eastern Nova Scotia (4WX) and the local 4Vn population. Of these different stocks, the Bras d'Or Lakes herring are a particular management concern. In recent years they have been absent from their traditional spawning areas, low larval densities have been observed during surveys, and fishing effort has intensified in the few small remaining spawning areas (Stephenson et al. 2000). Bras d'Or Lakes herring are fished primarily in the spring (Denny et al. 1998).

Overwintering areas

Sydney Bight is an important overwintering site for herring from the Gulf of St. Lawrence (4T), Bras d'Or Lakes, Eastern Nova Scotia (4W) and the local 4Vn populations (Claytor and LeBlanc 1998; Kenchington 1998). Each stock has a different migratory pattern into and within the 4Vn area, and the separate spawning stocks intermingle while overwintering (Claytor and Leblanc 1998). Herring are occasionally caught under the ice in the Bras d'Or Lakes indicating that this population does not all overwinter in 4Vn (Kenchington 1998).

Known herring distributions during the fall/winter are largely based on fishing information since the fishery occurs over dense concentrations of overwintering fish. Historical information from the fishery and accoustic surveys during 1990-1997 were used by Claytor and Leblanc (1998) to identify two areas of high overwintering herring concentrations: one off Aspy Bay and the other off New Waterford/Glace Bay. Low herring biomass was found in the St. Anns Bay – Bird Islands area. January bottom trawl data also indicate distinct concentrations of herring in the north, middle and southern portions of 4Vn (Claytor and Leblanc 1998).

Management issues

There are several management issues regarding the species that overwinter in 4Vn. Herring are harvested in the 4Vn areas while in mixed-stock overwintering aggregations, therefore fisheries directed at one stock (in this case mainly the fall spawning 4T stock) will invariably harvest individuals from other stocks as bycatch. Such incidental catches are problematic when the bycatch stocks are very small or

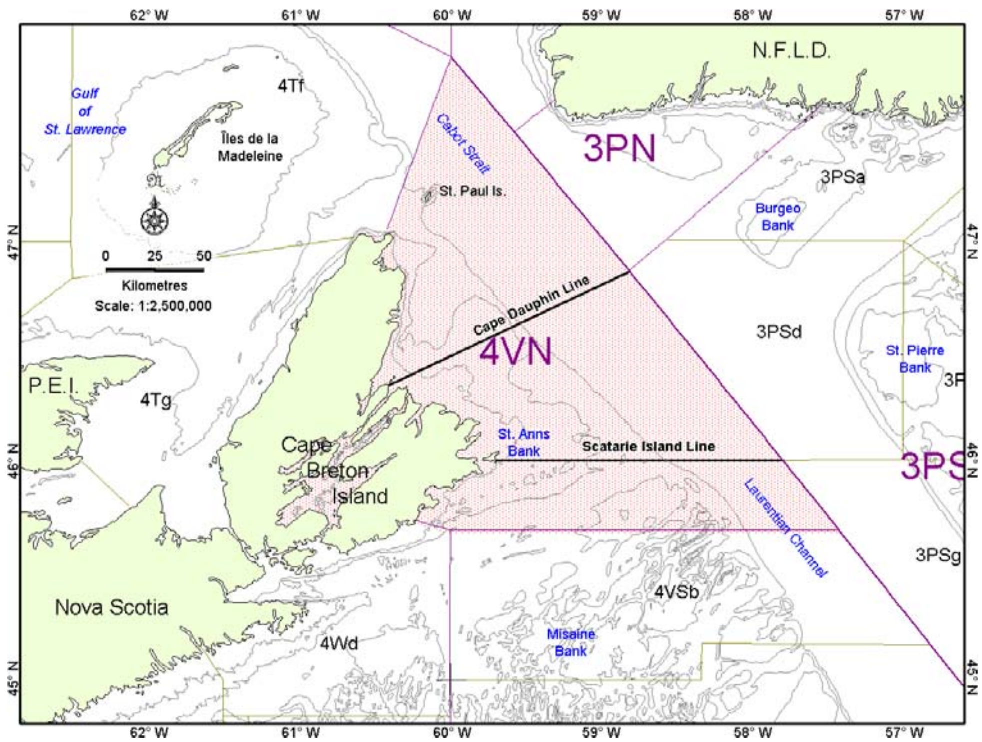


Figure 8-4: Herring NAFO division 4Vn management lines

declining, as is the case with the spring spawning Bras d'Or Lakes herring and the local 4Vn stock whose stock size and status is largely unknown (Claytor and Leblanc 1998).

Due to these management issues, the 4Vn winter herring fishery is managed using size limits, closed areas, and by setting the opening date of the fishery to a date well into the 4T migration into 4Vn (typically November 1) (Claytor 1997). Fishing of overwintering herring is limited to the area above the Cape Dauphin line (north of Cape Smokey) (Figure 8-4). This management strategy focuses the fishery on the 4T population that forms a high proportion of the herring concentrations off Aspy Bay, and avoids the bycatch of Bras d'Or Lakes herring in the St. Anns Bay and Bird Islands area (Claytor and Leblanc 1998). A past purse seining fishery caught Bras d'Or Lakes herring in the St. Anns Bay and Bird Islands area (Claytor and Leblanc 1998) and tagging studies have also noted their presence in this area during the overwintering fishery (Simon and Stobo 1983). The Scatarie line marks the boundary of the 4Wx herring fishery. Fishing by large seiners between these two lines is prohibited (Claytor 1997).

Other concentrations

Claytor and Leblanc (1998) estimated the distribution of herring at other times of the year using various types of fishing information. Bottom trawl data from July and September was used to discern herring distribution during the summer. This summer data indicated the presence of herring only in the St. Anns Bay - Bird Islands area and south of the Cape Dauphin Line, with no major concentrations found north of Cape Smokey. This aggregation of herring was assumed to include only the local 4Vn population. In Sydney Bight, herring is caught as lobster bait from mid-May to mid-July in waters up to 28 m deep. This bait fishery is roughly estimated at 3500 tonnes/lobster season. Using the distribution of lobster licenses to indicate herring location, herring seems to be concentrated south of Cape Smokey during the lobster season (Claytor and Leblanc 1998). Other information indicates that herring are north of Cape Smokey during the summer. Trap netting in Aspy Bay, an area north of Cape Smokey, did occurr during May, June and July from 1989-1997 (Claytor and Leblanc 1998).

Spawning areas

Spawning occurs in inshore areas of Sydney Bight during both the spring and fall. Historical herring spawning areas were documented for coastal Nova Scotia by Sameoto (1971), Crawford (1979), and Crawford and others (1982). More recent reports also document herring spawning areas (Stewart and Arnold 1994; Denny et al. 1998; Clark et al. 1999; Stephenson et al. 2000).

Inshore bait fisheries generally target spawning concentrations. Unfortunately, the bait fishery in Sydney Bight is largely undocumented, and therefore spawning areas may be present but unrecorded (Clark et al. 1999). Clark and others (1999) surveyed fishermen to gain information about the inshore herring fishery, to document spawning areas, and to compare these areas to historical spawning grounds. Highland Coastal Mapping (2001) indicates general herring spawning areas all along the coast within Sydney Bight (Figure 8-5). Results indicated spawning locations all along the coast from northern Cape Breton to Scatarie Island, and overall more spawning locations recorded than by Sameoto (1971) and Crawford (1979). Spawning locations were also labelled as spring, summer or fall spawning locations. Lambert (pers. comm. 2002) suggests that St. Anns Bay is a well known herring spawning area.

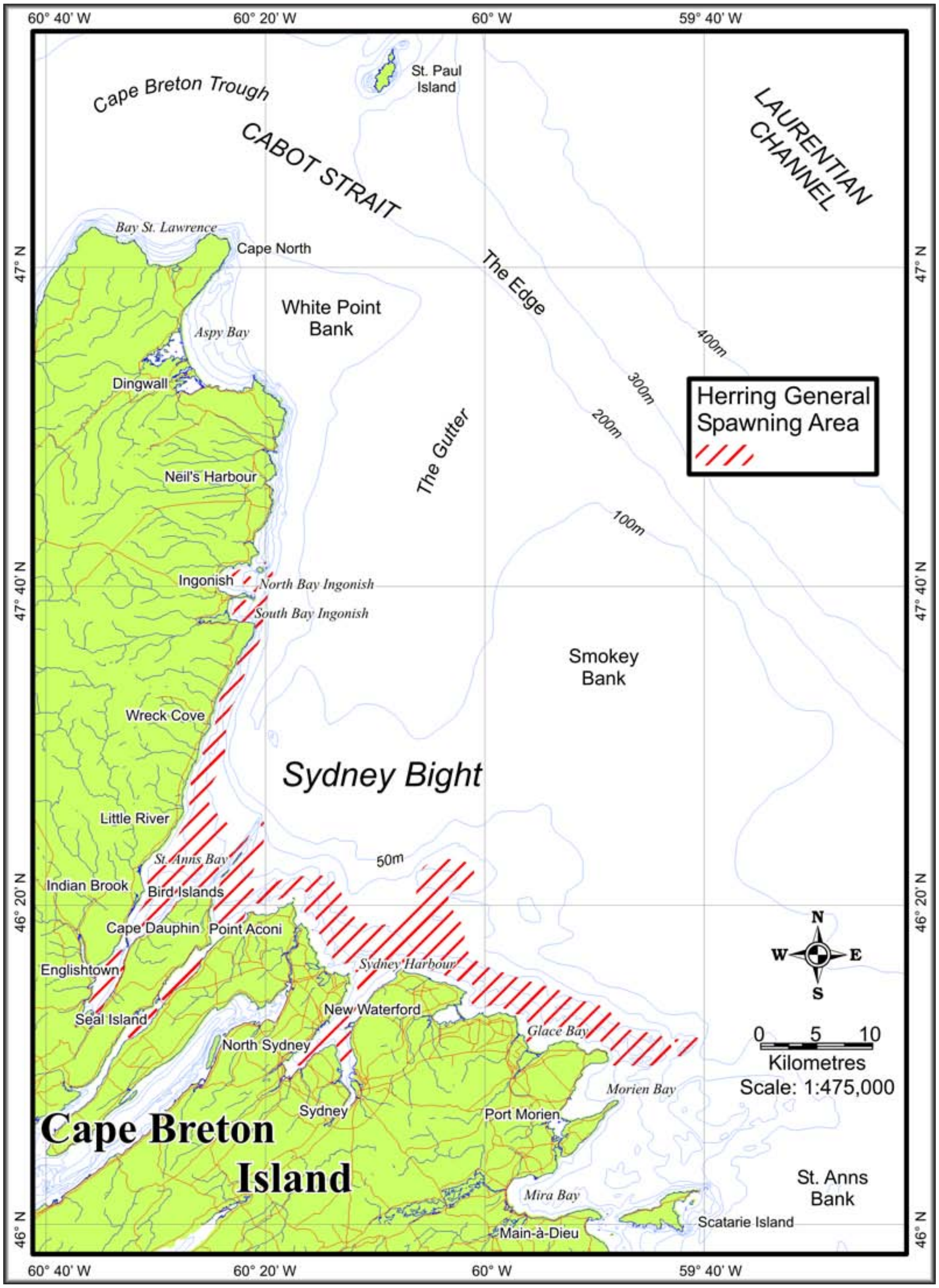


Figure 8-5: Herring spawning areas in SHACI Unit 11 (Highland Coastal Mapping 2001)

Mackerel

Atlantic mackerel (*Scomber scombrus*) migrates along the Atlantic coast of Nova Scotia on the way to its spawning grounds in the Southern Gulf of St. Lawrence. Mackerel prefers warm waters, therefore the timing and routes to migration along coastlines is greatly influenced by water temperature conditions (Grégoire 2001).

Mackerel generally begin their spring migration into the Southern Gulf of St. Lawrence near the end of May. The migration proceeds quite rapidly and has typically ended by early July. Mackerel remain in the Gulf and the immediate vicinity of Cape Breton Island until November. Their presence in this area is associated with their migration, spawning, egg development, larval development and feeding, making it an important area for mackerel recruitment (Grégoire 2001).

Spawning in the Southern Gulf of St. Lawrence generally occurs in June and July (Grégoire 2001). Juveniles form into a school and move into coastal waters, however little is known about this phase in the mackerel life cycle or of the role coastal habitats play in their growth and survival. Grégoire (2001) states that it is reasonable to assume that juvenile mackerel may be present along the coasts of Cape Breton Island in the summer or later in the fall when they head out of the Gulf.

Capelin

Capelin are small pelagic fish preyed upon heavily by cod and other fish, seabirds, seals, and whales. They are at a low trophic level, therefore changes in capelin abundance can significantly influence the survival of other species and ecosystem health. Capelin are not generally abundant on the Scotian Shelf; however, their numbers have increased on the eastern Scotian Shelf since the mid 1980s. A suggested cause of this change is cooler bottom temperatures in the region (DFO 1997).

Capelin occur primarily offshore in cooler waters, but move inshore in large numbers to spawn on beaches with coarse sand or fine gravel (Scott and Scott 1988) where fertilized eggs may be buried up to 15 cm deep in the sediment (Frank and Leggett 1983). Most northwest Atlantic capelin spawn in Newfoundland and Labrador; however, traditional ecological knowledge indicates several capelin spawning areas exist in coastal areas of Sydney Bight (Figure 8-6) (LACRMP 1995; ECBCRMP 1996; VCCRMP 1997). Therrien and others (2001) also identify capelin spawning habitat in Bay St. Lawrence at the tip of Northern Cape Breton Island.

The increased abundance of capelin in the eastern Scotian shelf could lead to an increased abundance of seals, whales and seabirds (their predators) in this region (Breeze et al. 2002). A return to normal water temperatures may lead to declines in capelin abundance in this region; nonetheless, it appears that they have established a spawning population (DFO 1997).

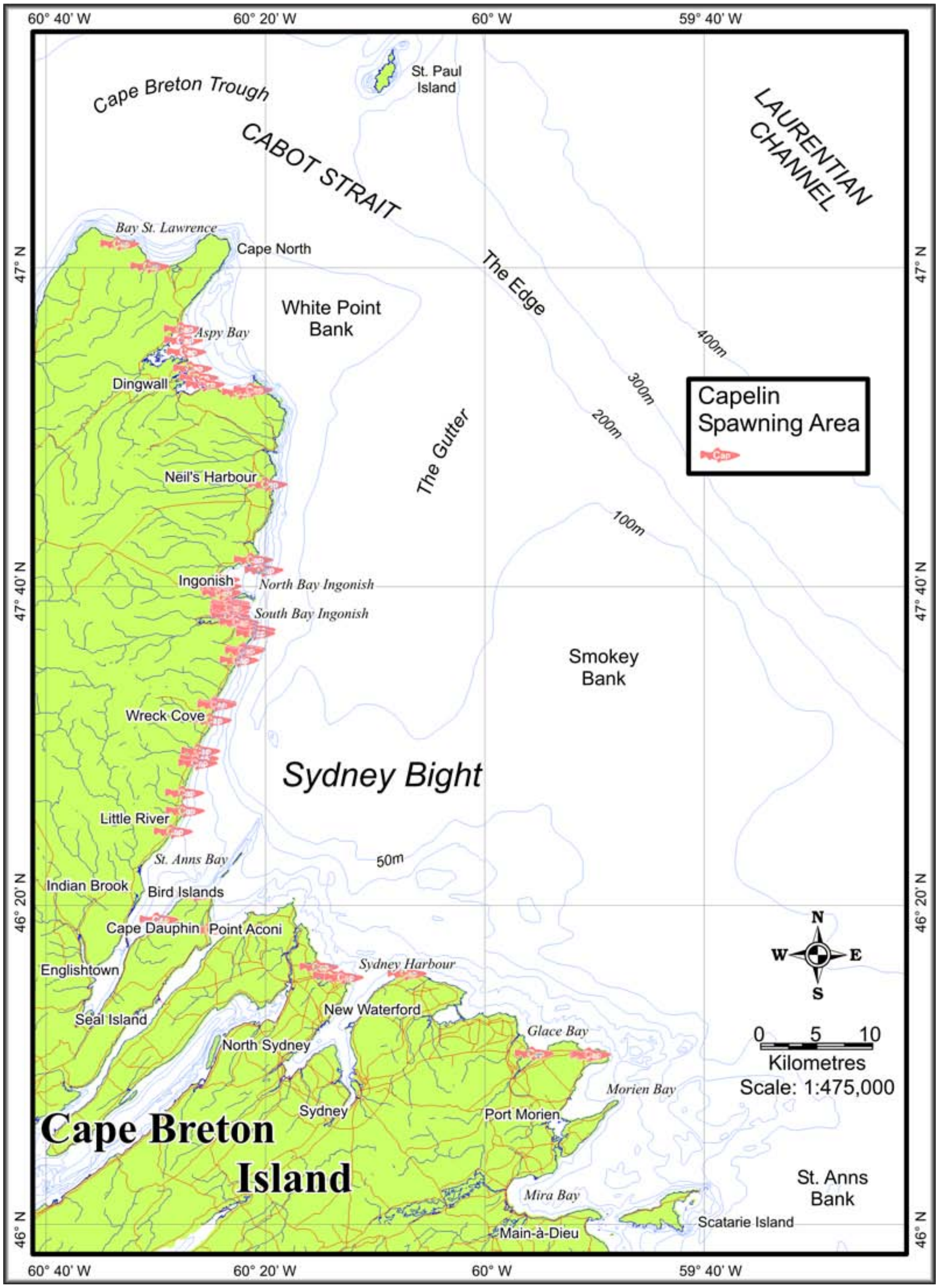


Figure 8-6. Capelin spawning beaches in SHACI Unit 11 (ECBCRMP 1996; VCCRMP 1997; Highland Coastal Mapping 2001)

Bluefin tuna

Bluefin tuna are wide ranging, large pelagic fish that enter Canadian waters in June and remain until December. The distribution of bluefin tuna in Atlantic Canadian waters is often unpredictable, and any information on bluefin tuna distribution comes solely from commercial fisheries data. As 4Vn is closed to the bluefin tuna fishery, there is no distributional data available for this species in 4Vn. Porter and Paul (in Archambault et al. 2001) suggest that bluefin at least migrate through 4Vn on their way to and from the Gulf of St. Lawrence.

Gaps in knowledge of marine fish

There are many gaps in our knowledge of fish and fish habitat use in Sydney Bight. Zwanenburg et al. (2001) found that there is limited information about:

- nursery areas
- pelagic fish
- diurnal and seasonal fish migrations
- trophic linkages between fish and their food
- the relationship between overall system productivity and biological diversity
- spawning times and locations of non-commercial fish species

Diadromous fish

Both anadromous and catadromous fish species are found in the rivers and estuarine areas of Sydney Bight including striped bass, gaspereau (alewife and blue back herring), shad, smelt, trout, eel, perch, and Atlantic salmon (ECBCRMP 1996; VCCRMP 1997). Lake whitefish are also found in the Mira River; however, this population may not in fact be anadromous.

Atlantic salmon

Any river in the Sydney Bight watershed that is not intermittent is potential Atlantic salmon (*Salmo salar*) habitat (P. Amiro pers. comm. 2002). O'Neil and others (1996) list eight major salmon angling rivers in Unit 11: North Aspy, Ingonish, Indian Brook, Barachois, North, Aconi Brook, Mira River and Catalone River. Traditional ecological knowledge also indicates the presence of salmon in these and other smaller rivers and brooks in the Sydney Bight watershed (Figure 8-7) (ECBCRMP 1996; VCCRMP 1997). Generally, rivers that are able to support angling likely have the most productive salmon habitat in the region.

In Sydney Bight, salmon return to rivers either in June or later in October, and many overwinter on the Grand Banks. Those that return in June, but do not enter rivers until October, appear to remain locally along the coast (P. Amiro pers. comm. 2002). Inherited differences in physiology and behaviour may influence the timing of ascent

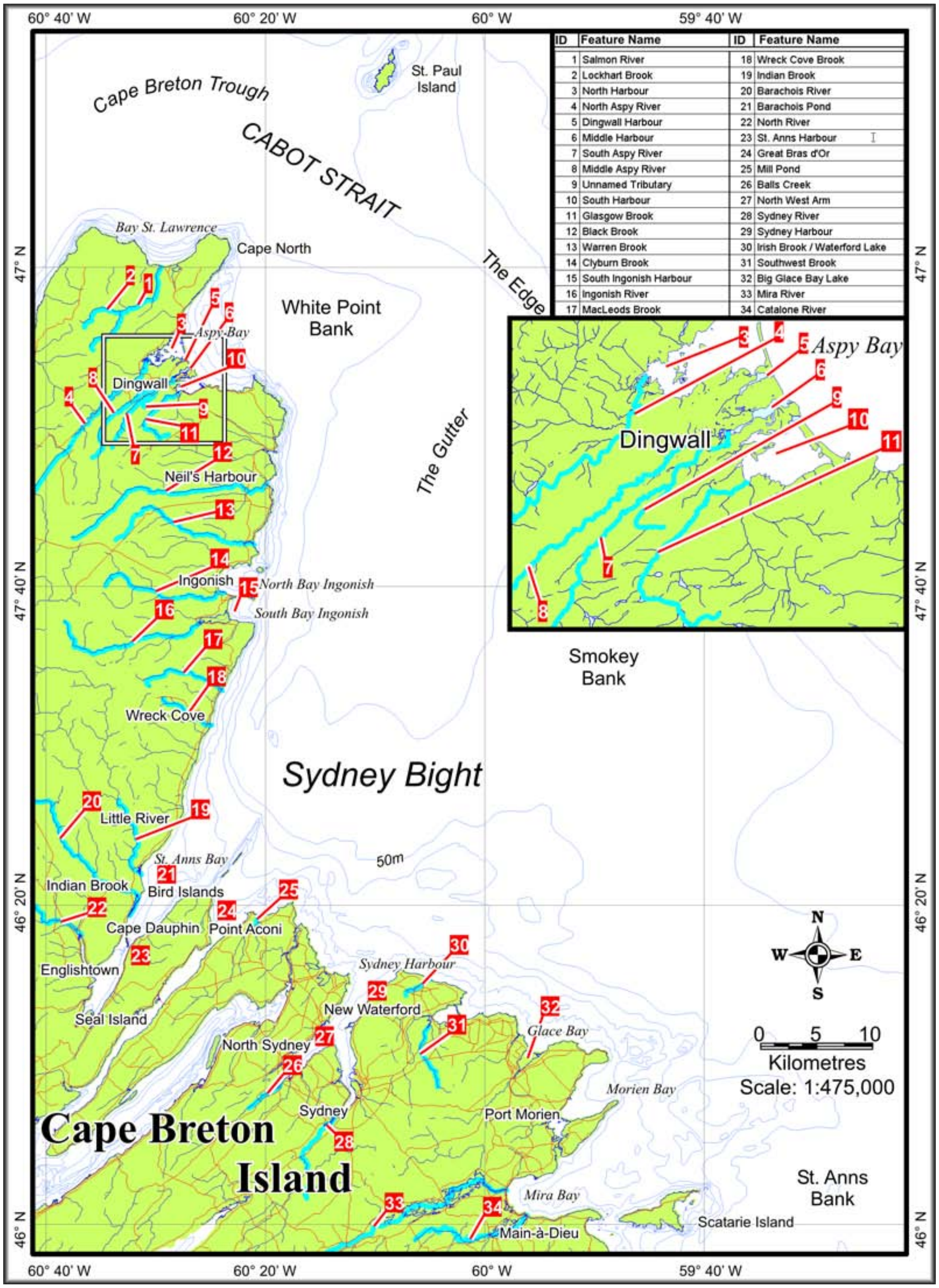


Figure 8-7: Salmon rivers in SHACI Unti 11. Compiled from: O'Neil et al. 1996; VCCRMP 1997; ECBCRMP 1996

up river. The different residence times of salmon in estuaries have important implications when estimating the effect of toxics and pollutants found in estuaries on salmon (Brawn 1982).

Salmon stocks in Unit 11 once supported a small trap and gillnet fishery in Great Bras d'Or, St. Anns Bay, and Ingonish. Now, salmon are fished only recreationally and usually on a catch and release basis. In Unit 11, the North River is the only retention fishery (P. Amiro pers. comm. 2002).

Given that most salmon stocks along the Atlantic coast of Nova Scotia are either extirpated or at risk of extirpation (Breeze et al. 2002), any river that currently supports salmon is important habitat for this species. All salmon supporting rivers are nursery areas for young salmon for 3-4 years and their coastal estuaries are migration zones through which smolts leave and adults return (P. Amiro pers. comm. 2002).

The North River salmon stock is the most important in the Sydney Bight watershed, and in Cape Breton it is second only in importance to the Margaree River . Most of the coastal zone is staging area for Atlantic salmon and should therefore be considered significant habitat (P. Amiro pers. comm. 2002).

Gaspereau

Alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) are two species of clupeid fish known collectively as gaspereau. Gaspereau migrate up Maritime rivers to spawn in the late spring and return to the sea soon thereafter. Gaspereau are known in the estuaries and rivers that run into Sydney Bight (LACRMP 1995; ECBCRMP 1996; VCCRMP 1997) including the Bras d'Or Lakes (Tupper 1997). Blueback herring occur in fewer Maritime rivers and are usually less abundant than alewives where the species co-occur (DFO 2001b).

Gaspereau return to the rivers where they were spawned, but will also colonize new streams or ponds and recolonize areas from which they had been extirpated (Loesch 1987). Alewives' spawning migrations typically begin in late April to early May, peak in late May or early June, and are completed by late June or early July (DFO 2001b). The blueback herring spawning migration usually begins roughly two weeks later than the alewife (DFO 2001b). Where the species co-occur, blueback herring tend to spawn in fast flowing streams with associated hard substrate (Loesch and Lund 1977), while alewives spawn in slow flowing areas of streams or enter ponds and lakes (Loesch 1987). Juvenile gaspereau of the year may spend their first summer and fall in fresh water before migrating to the sea (DFO 2001b). All gaspereau life stages provide forage for many marine and freshwater predators (Loesch 1987).

Both juvenile and adult gaspereau perform vertical diurnal migrations that may be in response to light and/or the movement of prey. They are found deeper during the day, and nearer the surface at night; alewives tend to remain deeper than blueback herring. This vertical separation between species, and the selection of different spawning sites, may preclude interspecific feeding competition between alewives and blueback herring (Loesch 1987).

The freshwater life histories of gaspereau are well known (Loesch 1987), but little information is available on the distribution and movements of gaspereau at sea, particularly in Canadian coastal waters (Stone and Jessop 1992). Gaspereau seem to move offshore in the winter and inshore in the summer. This change in temporal and spatial distribution is greatly influenced by oceanographic features, including temperature and shifts in zooplankton abundance (Stone and Jessop 1992).

The gaspereau that move into Sydney Bight rivers in the late spring likely overwinter along the southwestern Scotian Shelf. This is evidenced in the high concentrations of gaspereau found offshore in the deeper warm water areas of the southwestern Scotian Shelf and Bay of Fundy in the spring, and their rarity at this time in the eastern Scotian Shelf and inshore waters (Stone and Jessop 1992). Sydney Bight may also be part of a migratory route for gaspereau moving from overwintering areas along the Scotian Shelf to spawning areas in Gulf of St. Lawrence rivers. This is evidenced by high fall concentrations of gaspereau in the Sydney Bight area, and the movement of gaspereau tagged in Sydney Bight in the fall to the Margaree River (Gulf of St. Lawrence) in the spring (Stone and Jessop 1992).

American eel

Eels are catadromous species, meaning that they breed in marine waters and return to freshwater early in their development where they remain for 5-15 years until they return to the sea to spawn (Hutchinson and Taylor 1980; Scott and Scott 1988). During the freshwater phase of their life cycle, eels live in streams, rivers and silt-bottomed lakes. Eels are active during the summer, but become sluggish as the water cools; they overwinter in the muddy bottoms of lakes and rivers (Scott and Scott 1988).

The American eel (*Anguilla rostrata*) is found in the estuaries and rivers of Sydney Bight (LACRMP 1995; ECBCRMP 1996; VCCRMP 1997) including the Bras d'Or Lakes (Tupper 1997). There is generally little current biological information about American eels found in rivers and estuaries along the Atlantic coast of Nova Scotia (Jessop 1996).

Eels have a true larval stage called a leptocephalus. These larvae migrate from the eel spawning area in the Sargasso sea and transform from the leptocephalus stage into a small transparent eel (glass eels) during the winter when approaching inshore waters. Glass eels typically enter Canadian estuaries in April. Once in estuaries, the glass eels develop pigmentation and become almost black in colour. Now called elvers, the eels enter rivers in May and June (Scott and Scott 1988), or roughly when the water temperature reaches 8-10ºC (Hutchinson and Taylor 1980). Some elvers move upstream into freshwater lakes, while others remain in estuaries and coastal waters (Hutchinson and Taylor 1980). During the 5-15 period in which eels inhabit coastal waters, they metamorphose into adult yellow eels, and then again into silver eels before they descend rivers in their seaward migration. The timing of the silver eel run is influenced by the lunar cycle; in Nova Scotia, the main run begins with the first new moon in September. Eels are caught commercially at this time (Hutchinson and Taylor 1980).

At sea, larval eels are planktivores, but in freshwater, both juvenile and adult eels are carnivorous. They feed mainly at night on a wide variety of fish and invertebrates. Larval eels and elvers are likely prey for a number of species. Needler (1929) observed large numbers of transparent elvers in the stomachs of haddock taken off Ingonish on May 14 and 15, 1928. These haddock were all caught at or near the bottom in 22-27 m of water, and presumably the elvers were also abundant at these depths.

Rainbow smelt

Rainbow smelt (*Osmerus mordax*) is an anadromous fish that lives in coastal waters and ascends rivers in the spring to spawn. They are found in the estuaries and rivers of Sydney Bight (LACRMP 1995; ECBCRMP 1996; VCCRMP 1997) including the Bras d'Or Lakes (Tupper 1997).

A schooling species, smelts are often seen in large numbers in estuaries and rivers during spawning migrations. In the summer, smelts move to deeper, cooler waters offshore (Bigelow and Schroeder 1953). In the fall and late winter months, smelts move into estuaries to avoid cold waters (Scott and Scott 1988). They are distributed in suitable bays and estuaries along the Atlantic coast of North America from Labrador to New Jersey.

During the spring, spawning typically takes place at night in freshwater stream areas above the head of tide. Spawning will occur below the head of tide if stream obstructions bar access to upstream areas. Smelt eggs are small, spherical and adhesive. They sink to the bottom and attach to substrate, vegetation, and each other. Incubation time varies from 8 to 63 days depending on water temperature. Once hatched, the smelt fry are carried downstream to brackish water (Scott and Scott 1988).

Smelts are carnivorous and voracious fish. In their marine habitat, fry eat copepods and other planktonic organisms. As they grow, amphipods, euphausiids, mysids, shrimp, marine worms and small fish become part of their diet. Smelts are prey for many larger fish and birds (mergansers, cormorants, gulls) because of its schooling behaviour and abundance. Crows are known to consume the post-spawning mortality, and smelts will also eat their own species. At sea, smelts are eaten by Atlantic cod and Atlantic salmon. While in coastal waters, they are eaten by large brook trout and seals (Scott and Scott 1988).

American shad

American shad (*Alosa sapidissima*), an anadromous species, lives at sea and enters freshwater in spring to spawn. Their distribution along the Atlantic coast of North America ranges from near Nain in Labrador to southern Florida (Scott and Scott 1988). In SHACI Unit 11, shad are found in the Mira River (ECBCRMP 1996).

Shad is highly migratory and forms large schools. Shad from Canadian waters migrate southward in the fall (October or November) to overwinter off the mid-Atlantic states (Cheek 1968). In the spring, both spawning adults and non-spawning younger fish migrate northward in the direction of the rivers in which they were spawned (Leggett 1973; 1976). Areas where shad from Atlantic Canadian spawning rivers aggregate in large numbers during the summer and early fall include the Bay of Fundy and the Gulf of Maine (Dadswell et al. 1983). Shad may be vertical migrators that follow the daily movements of their zooplankton prey (Neves and Depres 1979).

In Canadian waters, spawning occurs in May, June or even July when water temperatures reach between 16.5 and 19ºC. Shad home to their natal stream (Dodson and Leggett 1973, 1974; Carscardden and Leggett 1975; Melvin et al. 1986). Spawning occurs at night and peak spawning occurs at temperatures of roughly 18ºC (Leim 1924 cited by Scott and Scott 1988). Shad are repeat spawners and may return to the same river to spawn up to five times (Carscardden and Leggett 1975). Spawning often occurs in brackish waters. Fertilized eggs are slightly heavier than water, non-adhesive and carried along by the current and settle singly (Scott and Scott 1988). Young shad move downstream into brackish waters and then enter marine waters once they have grown to between 50-70 mm long. They remain and mature in marine waters, joining schools with larger, older shad (Scott and Scott 1988).

Shad are opportunistic planktivores, eating copepods, mysids, other crustacean zooplankton, and aquatic insect larvae. Small fish including smelt and sand lance constitute a small part of the shad diet (Scott and Scott 1988). Other than seals and monkfish caught in weirs, shad have few predators besides humans (Scott and Scott 1988).

Lake whitefish

The Mira River is home to a population of lake whitefish (*Coregonus clupeaformis*). Whitefish are roughly 38 cm long, silvery coloured fish with large scales. They usually spawn in November and December in shallow waters at depths less that 7-8 m over hard, stony or sandy bottom. Eggs remain on the spawning ground until April or May and development begins when temperatures reach 0.5 – 6.1 °C. Young whitefish remain in shallow waters during the spring, but move into deeper waters by the early summer. Adult whitefish are benthic feeders that consume insect larvae, molluscs and amphipods (NSDAF 2001).

The status of this population was reviewed by COSEWIC in 2000, and it was placed in the Data Deficient category due to insufficient scientific information (COSEWIC 2003d). Research indicates that the whitefish in the Mira River is a distinct population (Edge 1987); however, it is not known whether this population developed naturally or whether the river was stocked. Whether or not this population is anadramous is also unknown.

Significant fish areas

Areas where fish congregate

As outlined in the above sections, many fish species congregate in different areas of Sydney Bight during different times of the year. Adult fish congregate to spawn, feed and overwinter, and juveniles are found concentrated in specific nursery areas. Spawning areas and juvenile nursery areas are important since both are necessary for the successful recruitment of future fish populations. Feeding areas are key locations for fish to accumulate and store enough energy for migration, overwintering and reproduction.

When fish aggregate in specific locations, they are more vulnerable to the discrete effects of activities such as dredging or oil spills. For this reason, human activities in areas used to complete major life history events should be minimized to ensure that viable populations of fish species are maintained. Key spawning, overwintering, feeding and nursery areas for Sydney Bight fish species are summarized in Table (8-4).

Migration routes

Cabot Strait/Laurentian Channel

Kenchington (2001) argues that the overwhelming biological features of Sydney Bight and the adjacent waters of the Cabot Strait relate not to what happens within the waters, but to what passes through them. The Cabot Strait, beyond Cape North, is the passage way for well over 1 016 046 tonnes of fish, squid, cetaceans and turtles that enter the Gulf of St. Lawrence in the spring, and withdraw again in the fall in a migration that dwarfs anything seen on land in Canada. Fish species participating in the migration include cod, plaice, white hake, witch flounder, redfish, bluefin tuna, saury, gaspereau, shad, striped bass, salmon and eels. During the migration, many species remain within the deeper waters of the Laurentian Channel; however, those confined to continental shelf depths do pass through the shallower Sydney Bight. Among these fish are the roughly 45 722 tonnes adult herring that overwinter in Sydney Bight, as well as other overwintering populations of cod, pollock, white hake, redfish, plaice, witch flounder, halibut and Greenland halibut (Kenchington 2001).

Table 8-4: Summary of spawning, juvenile and overwintering locations in Sydney Bight

Location	Species/event	Time/ season	Reference
Off Aspy Bay	Herring overwintering area	Winter	Claytor and Leblanc 1998
Bird Islands area	0-group cod nursery area		Lambert and Wilson 1995
	0-group, age 1 and age-2 white hake juvenile area		T. Lambert pers. comm. 2002
	Overwintering area for Bras d'Or Lakes herring	Winter	Simon and Stobo 1983; Claytor and Leblanc 1998
	Summer feeding area for herring	Summer	Claytor and Leblanc 1998
Cabot Strait/Laurentian Channel	Gulf of St. Lawrence redfish overwintering area		Power 2001
	4Vn cod overwintering area	November - April	Lambert and Wilson 1995
	Gulf of St. Lawrence white hake overwintering area		Clay 1991
Off Glace Bay	Herring overwintering area	Winter	Claytor and Leblanc 1998
Great Bras d'Or Channel	Age 2 white hake juvenile area		T. Lambert pers. comm. 2002
North River	Most important salmon stock in the Sydney Bight watershed in Cape Breton. Second only in importance to the Margaree River.		P. Amiro pers. comm. 2002
Off Ingonish	Historic haddock juvenile area		T. Lambert pers. comm. 2002
The Gutter (off Cape Smokey)	4Vn cod spawning area	April - May	Lambert and Wilson 1995
Mira River	Only lake whitefish population	Year round	NSDAF 2001
Off New Waterford	Herring overwintering area	Winter	Claytor and Leblanc 1998
Southwest corner of Sydney Bight	Groundfish nursery area		Highland Coastal Mapping 2001
	Age-2 juvenile white hake area		
St. Anns Bay	Bras d'Or Lakes herring overwintering area		Simon and Stobo 1983; Claytor and Leblanc 1998
	Herring spawning area	Spring	T. Lambert pers. comm 2002
	0-group, Age-1 and Age-2 white hake juvenile area		T. Lambert pers. comm 2002
	Herring summer feeding area		Claytor and Leblanc 1998
Sydney Harbour	0-group and Age-1 white hake areas		

Great Bras d'Or Channel

Another important migration route for fish is through the Great Bras d'Or Channel that links the Bras d'Or Lakes to Sydney Bight. Fish using this route include local herring stocks that spawn in the Lakes, mackerel, salmon, bass, gaspereau, and eels, and possibly pollock, cod, flounder and the occasional tuna (Kenchington 2001). Tupper (1997) suggests that at least ten fish species migrate through Great Bras d'Or Channel during the fall months (Table 8-5).

Table 8-5: Synopsis of fish migrations through Great Bras d'Or Channel in the fall months (Tupper 1997)

Species	Migration pattern
Atlantic salmon	Small numbers migrate through the channel, no specific pattern of movement (probably small numbers entering and leaving the channel sporadically)
Brook trout	Uncommon, transient, no specific pattern of movement
Rainbow smelt	Common, entering Lakes
American eel	Adults possibly exiting the Lakes (timing unknown) and elvers entering the Lakes (late arrivers)
Atlantic herring	Common, adults mainly exiting but possibly also entering the Lakes. Possible ingress of juveniles
Gaspereau	Probably common, similar to herring
Atlantic mackerel	Common both entering and exiting the Lakes depending on feeding patterns and the specific time in the fall
Atlantic cod	Present but not abundant, possible summer ingress of adults; ingress of pelagic juvenile stage during late summer
Mixed flounders	Relatively common, possible ingress of early juvenile stages depending on timing and spawning
Cunner	Common, juveniles/adults tend to be sedentary, ingress of larvae during late summer/early fall

Given the far-reaching locations of some of these species' migrations, it is evident that any harmful event occurring in or around this migration pathway could have very extensive consequences elsewhere. Indeed, migration can serve as a mechanism for transporting environmental effects well beyond the range of the initial impacts (Kenchington 2001).

Threats to fish

Many species of marine fish are vulnerable to impacts because they are often found in large groups and in localized areas. For example, the schooling and homing behaviour of herring make it particularly vulnerable to impacts during spawning (Stewart and Arnold 1994) and the same would be true for other fish species. Similarly, larvae maintained in retention areas are also vulnerable to discrete impacts. Several fish species are known to aggregate in such areas within Sydney Bight during various times of the year.

Bottom trawling

Bottom trawling and the use of other mobile fishing gear can cause great disturbance to the seabed and is a major threat to biological diversity and economic stability. Among other types of disturbance, trawling is exceptionally destructive. Its effects are not only severe, they also occur at frequencies that are orders of magnitude higher than other severe disturbances (Watling and Norse 1998).

Mobile fishing gear such as bottom trawls can have deleterious and long-lasting effects on fish and fish habitat, including some juvenile states of commercially important species. Trawling disrupts the structure of benthic communities by crushing, burying and exposing benthic organisms to predation and by altering sediment and water column biochemistry. Trawling converts ecosystems dominated by disturbance-intolerant species to ecosystems dominated by opportunistic, disturbance tolerant species. In this manner, trawling negatively affects fisheries for species that benefit from complex benthic structure (Watling and Norse 1998).

Coastal structures/tidal barriers

The construction of the Canso Causeway between Cape Breton Island and mainland Nova Scotia in 1954 altered circulation and temperature regimes in St. Georges Bay and the Strait of Canso (Stewart and Arnold 1994). Ware (1977) concluded that the causeway likely affected the migration route and spawning time of herring off Antigonish and Inverness Counties but did not lead to a decrease in the abundance of herring in these areas.

Contaminants

Fish that are closely associated with coastal waters are exposed to contamination from aquatic discharges of land-based industry and airborne transport of contaminants (Stewart and Arnold 1994). For herring, impacts from contaminants on natural populations are rarely encountered except in extreme situations like accidental spills, uncontrolled point sources and severely contaminated harbours (Stewart and Arnold 1994). There are several potential sources of industrial contamination in the Sydney Bight area that may be impacting fish populations. (See Section 16- Socio-economic Activity - Table 16-7 of this document for a list of the facilities, locations, types, pollutants and emission types).

Dredging and ocean dumping

Dredging and ocean dumping may have several negative effects on fish and fish habitat. In the area dredged, benthic fish habitat is severely disrupted and may take years to be recolonized. Dredging can cause increases in suspended sediments which, once settled, smothers fish eggs (Stewart and Arnold 1994).

Dredging may also obstruct fish movement. In reviewing information about a dredging project in the Great Bras d'Or Channel (Middle Shoal Project), Tupper (1997) found that dredging may obstruct fish movement in several manners:

- the release of silt into the water column
- the disruption of site specific auditory or olfactory cues used by fish to find the channel
- underwater light created by the dredger
- noise generated by the dredge and work craft

The release of silt into the water column is particularly important for juvenile fish since turbidity is thought to play a role in attracting juvenile herring and winter flounder into juvenile areas. The noise generated by dredging, especially in narrow channels, could be especially significant to herring which are particularly sensitive to sound (Tupper 1997).

Ocean dumping of dredge spoils in designated sites is often done to increase the habitat diversity in the dumpsites, and to attract commercially important species such as lobster.

Oil and Gas industry
Various oil and gas industry activities could harm fish and other marine species. Kenchington (2001) cautions that the limited documented evidence from environmental impacts of offshore petroleum activity should not be mistaken for evidence that such impacts are limited. The same should be assumed for coastal petroleum activity.

Seismic
The sound produced from air guns used in seismic exploration can have lethal, sublethal and behavioural effects on fish during all life stages. Fish are primarily auditory animals that hear and sense lower frequency vibrations. The detection of sound is important for fish to communicate, find food and mates, sense the threat of approaching predators, and to detect water currents and obstacles in their path (Myrberg 1978, 1980; Schwarz 1985). The effects of seismic are reviewed extensively in relation to fish by (Kenchington 2001) and basic information is provided below.

Lethal effects. Generally, any animal, be it larvae or adult, located close enough to an airgun when it is fired will be killed; however, there is general agreement that the overall lethal effects on populations are generally minor (Kenchington 2001). Larval and juvenile fish exposed at short distances to air gun firing can be harmed (National Research Council 1985) and the use of explosives can damage large numbers of fish if ignited near schools (Stewart and Arnold 1994).

Sublethal effects. It is known that animals will suffer sublethal effects due to seismic exploration. Airguns can cause temporary hearing loss and stress induced depressed immune systems. The gravity of the resulting effects, including delayed mortality and reduced productivity, are currently unknown (Kenchington 2001).

Behavioural effects. The behavioural effects of seismic noise on fish populations have received much attention due to their consequences for human concerns such as fishing activity and catches. Beyond fishing, concerns exist over the effects of seismic exploration on fish spawning, mating, feeding and migration patterns. Generally, fish are known to move away from airgun noises by either diving deeper or by moving into hiding places. The disruption of established seasonal behaviours could have dire consequences for fish populations (Kenchington 2001).

Studies relating to fishing show that seismic activity shooting severely affects fish distribution, local abundance and catch rates of cod (Loekkeborg and Soldal 1992; Engaas et al. 1993; 1996) and haddock (Engaas 1993; 1996). The nature and extent of effects of seismic activity on catch rates vary depending on the type of fishery, fish species and season (Soldal and Loekkeborg 1992); however cod and haddock appear to be particularly sensitive (Kenchington 2001).

Regarding spawning and mating, seismic is thought to have substantial negative effects on the vocal communications that play a vital role in the mating dance of some fish species (Kenchington 2001). In fact, Thomson and others (2000) recommended that seismic surveys over spawning fish would be inappropriate, even as part of an experiment to determine the severity of effects.

The disruption of feeding activity by seismic noise could have several effects on fish. Fish species that respond to seismic noise by moving into hiding places would cease feeding as a result (Kenchington 2001). Fish species that dive to avoid noise could presumably also cease or decrease feeding if they are forced to move out of important feeding areas. Reduced food intake could affect growth and subsequent fecundity, and have negative effects on resource rebuilding (Kenchington 2001).

Seismic effects on fish migration could be substantial for fish populations using Sydney Bight. Engas and others (1993; 1996) observed that cod avoid airguns by up to 30 km. Should this distance of avoidance occur in Sydney Bight, a seismic survey could block all movement of fish at continental shelf depths southeastward from the vicinity of Cape North to grounds beyond Scatarie Island (Kenchington 2001).

Drilling discharges

Drilling produces various types of discharges which are described and discussed extensively by Boudreau and others (2001) and Kenchington (2001). Cuttings are the fragments of bedrock that the drill removes when creating the hole that constitutes the well. For technical purposes, the cuttings are coated with muds that may be either oil-based (OBM), alternative oil-based (ABM) synthetic oil-based (SBM), or water based (WBM). When discharged at sea, all cuttings accumulate in piles that extend for several kilometres from the drilling site and smother all benthic life beneath. Also, any cuttings discharged on muddy bottoms will lead to a change in community structure (Kenchington 2001). The oiled cuttings piles resulting from the use of OBMs, ABMs, and SBMs may cause serious local environmental effects since the toxicity of the oiled sediments can remain for several years. Although WBMs do not contain toxic oils, they are not benign. WBMs contain various toxic chemicals including barite and bentonite that are known to have toxic effects on molluscs (Cranford and Gordon 1992; Cranford 1995; Cranford et al. 1999; Cranford et al. 2001). Direct effects of drilling discharges on fish are poorly known, however, any change in habitat structure, or any addition of toxic contaminants to the local environment could have deleterious effects on fish populations (e.g. benthic feeders) and local fisheries (Howarth 1981).

Blowouts and spills

Although very unlikely, blowouts and spills are a potential threat to the marine environment. Subsea gas blowouts cause hydrocarbons to be dispersed in the water column. The consequences of subsea oil blowouts are even more serious, and can lead to severe damage to shorelines.

Fish eggs and larvae are more sensitive to the toxic effects of oil than are adult fish (Howarth 1981). The physical oceanographic features that cause eggs and larvae to be retained in a certain area could also retain spilled hydrocarbons (Stewart and Arnold 1994). For this reason, either a gas or oil subsurface plume could seriously harm the plankton community in Sydney Bight. The 4Vn cod stock, which is dependent on the nursery grounds in the southwest corner of Sydney Bight, is of particular concern for such reasons (Kenchington 2001). Fish eggs and larvae in the Bras d'Or Lakes could also be affected by a spill in Sydney Bight since all seawater entering the Lakes is drawn from the near surface layers where hydrocarbons would be concentrated (Kenchington 1998). Although there are few documented cases of adult finfish killed by oil pollution,this does not mean that oil pollution does not kill fish (Howarth 1981).

Oil spills, and even chronic, low-level discharges of oil can cause significant bottom contamination. When oil is spilled, some zooplankton species will feed on oil particles. The oil then collects in their fecal pellets and when the pellets sink to the bottom, so does the oil. Oil can also reach the bottom when it is adsorbed to particles suspended in the water column that later sink. Oil can collect on the bottom quickly, and in large quantities in these manners, and studies have shown sediment contamination around oil platforms even in the absence of major spills (Howarth 1981). Such oil contamination of benthic habitat likely has detrimental effects on marine fish.

Known effects of oil on marine organisms includes the accumulation of hydrocarbon compounds in the tissues. These hydrocarbons are taken in through the gills, and tend to lodge in the fatty tissues such that more contamination is found in marine organisms than in the water. This type of contamination poses a serious human health risk since some contaminant hydrocarbons are carcinogenic. Fish that feed selectively on the basis of particle size, such as white hake, could be particularly susceptible to mortality from ingesting oil globules from oil spills (Coates et al. 1982).

Overfishing

Overfishing can lead to the depletion of fish populations and their eventual extirpation or extinction. Discrete populations can be overfished since they usually travel together in large schools and gather in known locations. For example, the herring fishery is frequently timed around spawning since large schools arrive at a predictable time and to a predictable place (Sinclair and Iles 1985). Intensive fishing of a known herring spawning bed could deplete one subgroup (Kenchington 1998); this is evident in the fact that several herring stocks in the western Atlantic have collapsed.

Aquaculture (escapes, chemicals, etc.)
Aquaculture operations can negatively impact the local environments they inhabit through high waste production, disproportionately high consumption of natural resources, and the steps in the production process itself (Beveridge et al. 1997). Escaped cultured species such as salmon can threaten genetic integrity of wild populations and put them at risk of biological extinctions (Whoriskey 2002), although there is no evidence of this in Nova Scotia.

Additional threats
In addition to these threats, anadromous fish species are subject to impacts in both freshwater and marine environments. Habitat and stocks are threatened by other fisheries, stream obstructions (Jessop 1993), forestry, agriculture, road construction, water extraction, point source pollution and acid precipitation.

9 – Marine reptiles

Two reptile species frequent Atlantic Canadian waters: the leatherback turtle (*Dermochelys coriacea*), considered endangered, and the loggerhead turtle (*Caretta caretta*), considered threatened (NSLTWG 2002). Little detailed information exists about the abundance, distribution and movements of these two species in local waters.

Leatherback turtle

Leatherback turtles are the rarest of all marine turtles and are classed as an endangered species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and protected under the *Species at Risk Act* (Environment Canada 2002c). In the summer, leatherback turtles inhabit the northwest Atlantic; and, during this time they are typically found singly (Katona et al. 1993). Based on telemetry data and general reports, leatherback turtles use Sydney Bight as a foraging area sometime between early June and mid-November during their migratory transit to their Caribbean nesting areas. Traditional ecological knowledge records the presence of leatherback turtles in Sydney Bight between June and August (ECBCRMP 1996). They may use inshore and offshore areas equally (M. James pers. comm. 2002).

Leatherback turtles feed near the surface or at moderate depths on jellyfish, comb jellies, salps and other jellied organisms. In this region their main prey item is the lion’s mane jellyfish (*Cyanea capillata*) (Katona et al. 1993).

Loggerhead turtle

In the western Atlantic, the loggerhead turtle's range extends from Newfoundland to Argentina (OPR 2003). Fisheries observer data suggests this is the most abundant sea turtle species in eastern Canadian waters, with a distribution corresponding to warmer offshore waters. They are known to associate with convergence zones, drift lines and downwellings in the open ocean (Carr 1986). The distribution of loggerhead turtles is somewhat constrained by temperature; they are not often observed in waters below 15ºC (James 2001). Although less common in coastal areas along the Atlantic coast of Nova Scotia, there have been sightings of loggerhead turtles within Halifax Harbour and its approaches (Hebda pers. comm. 2003). Although an average adult measures 92 cm and weighs 115 kg (OPR 2003), loggerhead turtles found in Nova Scotia waters are typically large juveniles (Ryder pers. comm. 2003). They feed on molluscs, crustaceans, sponges, basket stars and fish (Mortimer 1995). Important nesting sites for this species occur along the southeast U.S. coast from Florida to North Carolina, one of which is the largest in the world (Ross 1995). The loggerhead turtle is not listed by COSEWIC, but is considered a threatened species throughout its range with populations declining in many areas (OPR 2003).

Threats to marine turtles

Commercial fishing
Entanglement in fishing gear is a huge problem, so much so that roughly one third of all leatherback turtle sightings in the Northwest Atlantic are turtles found entangled in lobster fishing gear (Katona et al. 1993). The common theory is that the turtles mistake lobster buoys for food, become entangled in the line running to the trap, and drown while attempting to forage on the buoy. Many other fisheries also threaten turtles. Shrimp trawlers, gillnet hook and line fishing and the longline fishery all may include sea turtles in their bycatch. The bycatch from pelagic longline fishery is considered more of a threat than that of benthic fishing gear. Turtles may also get caught in discarded fishing gear (OPR 2003).

Dredging
Dredging can destroy resting or foraging habitats. The use of hopper dredges can also kill turtles caught in dragheads (OPR 2003).

Marine debris
Marine debris is problematic for marine turtles. They mistake plastic objects such as plastic bags, plastic and styrofoam pieces, tar balls, balloons and raw plastic pellets for prey. Even at low levels of ingestion, the turtles may choke, suffer complications with metabolism or gut function, and absorb toxic byproducts. The gravity of this problem is evident in one study that found plastic objects in the stomachs or intestines of roughly half of leatherback turtle carcasses examined (Katona et al. 1993).

Oil spills
Sea turtle respiration, skin, blood chemistry and salt gland functions are affected when they encounter oil spills (OPR 2003).

Pesticides
Pesticides, heavy metals and PCBs have been detected in turtles and eggs, but the effect on them is unknown (OPR 2003).

Collisions
Recreational boating and ship traffic may result in propeller and collision injuries to sea turtles. There are no reports of sea turtle collisions with boats in Atlantic Canada but they have been known to occur in some areas of the U.S. Propeller and collision-related injuries may represent a source of mortality, particularly in areas where commercial fishing, recreational boating and ship traffic are concentrated (NMFS 2002). Leatherback turtles may be vulnerable to collisions with marine traffic because they are known to bask for extended periods at the surface when foraging in temperate waters.

10 - Marine associated birds

A wide variety of seabirds, shorebirds and waterfowl use the steep rocky cliffs, sandy beaches, and salt marshes of Sydney Bight throughout the year. Most species are present only to breed during the summer months (May-September); however, others visit during the spring and fall migrations, or occur over winter. Many of the summer breeding colonies represent significant concentrations of seabirds and are important areas for these bird species in Nova Scotia (Paquet and Chardine 2001).

Seabirds

Environment Canada (2001) considered seabird habitat within the proposed oil exploration lease sites off coastal Cape Breton. They found that within the lease area, seabirds can occur at average densities of up to 100 birds per km of ship track (or over 300 birds per km^2). This data is based primarily on summer survey data, and there are considerable gaps in Environment Canada's knowledge of seabird distributions off Cape Breton during the winter.

Several seabird species breed in coastal areas of Sydney Bight (Table 10-1). There are important breeding colonies of Atlantic Puffin, Razorbill, Black Guillemot and Leach's Storm-petrel. The Razorbill colony on the Bird Islands is of particular importance from a provincial and regional perspective since it is the largest colony of this species in Nova Scotia (Environment Canada 2001). There is some regional concern for Razorbills.Their populations are relatively small for a seabird (40,000 pairs), and they are impacted by hunting and fisheries bycatch. The breeding populations of Atlantic Puffins, and Black-legged Kittiwakes on the Bird Islands, and along the eastern coast of Cape Breton, are also of particular significance since their populations are dwindling in the Maritimes. Seabird colonies are usually located on offshore islands or in isolated coastal areas. Seabirds have specific breeding requirements (nesting habitat, food sources, etc.) and require areas with minimal disturbance. Cormorants and Black-legged Kittiwakes, for example, nest in cliffs that provide protection from ground and aerial predators. Suitable sites for seabird breeding colonies are scarce and often irreplaceable (Environment Canada 2001).

Table 10-1: Seabirds that breed in SHACI Unit 11*

Species	*Total colonies	**Population trend in Canada	***Location of colonies
Pelagic Seabirds			
Atlantic Puffin (*Fratercula arctica*)	2	Increasing	• Bird Islands (Ciboux and Hertford Islands)
Black-legged Kittiwake (*Rissa tridactyla*)	2	Stable	• Bird Islands (Ciboux Island) • Northern Head and South Head (Cape Perce and Cape Morien)
Leach's Storm-petrel (*Oceanodroma leucorhoa*)	3	Unknown	• Bird Islands (Hertford Island) • St. Paul Island • Scatarie Island

Species	*Total colonies	**Population trend in Canada	***Location of colonies
Razorbill (*Alca torda*)	3	Increasing	• Bird Islands (Ciboux and Hertford Island) • St. Paul Island
Neritic Seabirds			
Arctic Tern (*Sterna paradisaea*)	5	Declining	• South Harbour Beach • Middle Head • Ingonish • Murray • Ingonish Beach Sandbar
Black Guillemot (*Cepphus grylle*)	5	Unknown	• Bird Islands (Ciboux and Hertford Island) • Flint Island • Northern Head • Cormorandiere Rocks (Off Scatarie Island)
Common Tern (*Sterna hirundo*)	17	Declining	• South Harbour Beach • Squires Point • Browns Island (off Scatarie Island) • Hay Island (off Scatarie Island) • Cormorandiere Rocks (off Scatarie Island) • Port Morien Beach • Tern Rock – Cape Breton Highlands National Park • Englishtown Spit • Ingonish • Sheep Island • Dominion Beach • Jersey Cove Beach • North Harbour Beach • Haystack Cove • South Bar • Glace Bay Beach • Southeast Bar • Middle Head • Seymour Point
Great Cormorant (*Phalacrocorax carbo*)	8	Decreasing	• Bird Islands (Hertford and Ciboux) • North Head • Money Point • Ingonish Island • Hay Island (off Scatarie Island) • Northern Head and South Head (Cape Perce and Cape Morien)
Double-crested Cormorant (*Phalacrocorax auritus*)	2	Increasing	• Bird Islands (Ciboux Island) • Ingonish Island
Great Black-backed Gull (*Larus marinus*)	8	Increasing	• Bird Islands (Ciboux and Hertford Island) • Hay Island (off Scatarie Island) • Middle Head • Ingonish Island • Ingonish • Bay St. Lawrence Harbour Mouth • St. Paul Island
Herring Gull *(Larus argentatus)*	6	Decreasing	• Bird Islands (Ciboux and Hertford Island) • Cape Morien • Hay Island (off Scatarie Island) • Ingonish Island • French River

*BSC (2002); Environment Canada Seabird Colony Database (2002).
** Chardine et al. (1999).
*** Bird Studies Canada (2002); Environment Canada Seabird Colony Database (2002); LACRMP (1995); Tufts (1986).

At least 13 non-breeding seabird species frequent Sydney Bight during some part of the year. These include pelagic visitors during the summer and autumn, species migrating through during spring and autumn, and species overwintering along the Atlantic coast (Table 10-2) (Paquet and Chardine 2001). Important overwintering sites for seabirds on Cape Breton Island include the Cabot Strait and adjacent coastal areas (Lock et al. 1994).

Table 10-2: Non-breeding pelagic seabirds known to occur in Sydney Bight

Species	Visitation period
Non-breeding Pelagic visitor	
Greater Shearwater – *Puffinus gravis*	April to November
Sooty Shearwater – *Puffinus griseus*	June to October
Wilson's Storm-petrel – *Oceanites oceanicus*	June to October
Cory's Shearwater – *Calonectris diomedia*	July to October
Migrating along coast during fall and spring	
Northern Gannets – *Morus bassanus*	Fall and Spring
Pomarine Jaegar – *Stercorarius pomarinus*	Fall and Spring
Parasitic Jaegar – *Stercorarius parasiticus*	Fall and Spring
Plong-tailed Jaegar – *Stercorarius longicaudus*	Fall and Spring
Overwintering seabirds	
Northern Fulmar – *Fulmarus glacialis*	Winter
Dovekies – *Alle alle*	Winter
Thick-billed Murres – *Uria lomvia*	Winter
Common Murres – *Uria aalge*	Winter
Black-legged Kittiwakes – *Rissa tridactyla*	Winter

Compiled from: Paquet and Chardine (2001).

Shorebirds

Migration

Many shorebirds use Nova Scotia coastal habitats during their migrations north and south, and some also breed in this region. During the fall migration through Atlantic Canada, huge numbers of shorebirds feed on small invertebrates in the intertidal mudflats in the Bay of Fundy. Smaller numbers, but a greater diversity, of shorebird species also frequent beaches and coastal areas around Sydney Bight (Table 10-3). The species diversity in Sydney Bight is greater than in the Bay of Fundy due to the wider variety of habitats available for foraging and resting (P. Hicklin pers. comm. 2002). For example, Whimbrels feed on blueberries (P. Hicklin pers. comm. 2002), Yellowlegs are known to forage in tidal marshes, Spotted Sandpipers are widespread along the coast, and Willets are common nesters in tidal marshes (Davis and Browne 1996a).

Shorebird surveys are conducted on an informal basis in several Unit 11 locations: South Bar Sydney Harbour, Morien Bar, Dominion Beach, Schooner Pond – Donkin, and the Sydney airport (CWS 2000). Morien Bar, where 22 shorebird species were recorded in 2001 (CWS 2002a), is the most significant shorebird area in Cape Breton

Table 10-3: Shorebird species records and locations in SHACI Unit 11

	Adundance status in Canada *	Overall population trend **	Big Glace Bay Lake	Bird Islands	Cape Breton Highlands National Park	Dominion Beach	Englishtown	Morien Bar	Schooner Pond - Donkin	South Bar (Fall)	Sydney Airport	North Harbour and South Harbour Beach
Black bellied Plover (*Pluvialis squatarola)*	C	▼▼				X		X		X	X	
Golden Plover (*Pluvialis apricaria)*	N/A	N/A				X				X	X	
Lesser Golden Plover (*Pluvialis dominica*)	C	▼▼						X				
Piping Plover (*Charadrius melodus*)	E	N/A	X									X
Semipalmated Plover (*Charadrius semipalmatus*)	C	▼▼				X		X	X	X		
Greater Yellowlegs (*Tringa melanoleuca)*	C	◄ ►				X		X	X	X		
Lesser Yellowlegs (*Tringa flavipes)*	C	▼▼				X		X		X		
Yellowlegs (*Tringa* sp.)	N/A	N/A		X	X							
Dowitcher	N/A	N/A				X		X				
Short-billed Dowitcher (*Limnodromus griseus*)	C	▼▼						X				
Long-billed Dowitcher (*Limnodromus scolopaceus*)	R	N/A						X				
Dunlin (*Calidris alpine)*	C	▼▼						X		X		
Hudsonian Godwit (*Limosa haemastica)*	R	▼				X		X				
Marbled Godwit (*Limosa fedoa*)	R	▼▼				X					X	
Killdeer (*Charadrius vociferous)*	C	▼▼							X		X	
Common Snipe (*Gallinago gallinago*)	C	▼▼						X				
Red Knot (*Calidris canutus)*	C	▼▼				X		X				
Ruddy Turnstone (*Arenaria interpres)*	C	▼▼						X		X		
Sanderling (*Calidris alba)*	C	▼▼				X		X	X	X		
Buff Breasted Sandpiper (*Tryngites subruficollis)*	R	▼						X				
Least Sandpiper (*Calidris minutilla)*	C	▼▼					X	X		X		
Pectoral Sandpiper (*Calidris melanotos)*	C	◄ ►				X		X		X	X	
Semipalmated Sandpiper (*Calidris pusilla*)	A	▼▼				X	X	X	X	X		
Spotted Sandpiper *Actitis macularia*	C	N/A		X								
White-rumped Sandpiper (*Calidris fuscicollis*)	C	◄ ►				X		X	X	X		
Whimbrel (*Numenius phaeopus*)	C	◄ ►				X		X			X	
Willet (*Catoptrophorus semipalmatus)*	C	◄ ►	X			X		X				
Ruff (*Philomachus pugnax)*	N/A	N/A						X				
Wilson's Phalarope (*Phalaropus tricolor)*	C	▼▼						X				

***A** = Abundant, **C** = Common, **R** = Regular, **U** = Uncommon, **Sc** = Scarce, **Sp** = Special Concern, **T** = Threatened, **E** = Endangered, **N/A** = Not Available(Donaldson et al. 2000).
**▼▼ indicates predominantly negative trends or changes across analyses with at least one significantly negative trend or change, ▼ indicates predominantly negative trends or changes or only estimate available is negative, ◄ ► indicates analyses include both positive and negative trends, ▲ indicates best estimate involves significant positive trend (Donaldson et al. 2000).

Compiled from Tufts 1986; LACRMP 1995; Davis and Brown 1996; CWS 2000; Paquet and Chardine 2001;Bird Studies Canada 2002; MIMS database Nova Scotia Musuem of Natural History 2002; CWS 2002a;

(McCorquodale pers. comm. 2002). Several uncommon species were sighted at Morien Bar in 2001 including Long-billed Dowitchers and Lesser Golden Plovers (CWS 2002a).

Breeding

The Piping Plover (*Charadrius melodus*), an endangered shorebird, typically nests on white sand beaches. They are known to nest in two sites in Cape Breton: North Harbour and South Harbour in Victoria County (VCCRMP 1997; CWS Piping Plover Database cited by Paquet and Chardine 2001; Island Nature Trust 2002) and have also been recorded in Big Glace Bay Lake (BSC 2002). North Harbour and South Harbour beaches are in Aspy Bay and are designated Protected Beaches under the Nova Scotia *Beaches Act*.

Greater Yellowlegs breed in the Cape Breton Highlands and are known to occur in the barrens of Cape Breton Highlands National Park at elevations of roughly 400 m (Tufts 1986).

Waterfowl

Coastal marshes and wetlands of Sydney Bight are used by migrating waterfowl for breeding and overwintering (Table 10-4). Their summer distribution in this area is not well documented; many areas along the coast of Cape Breton have never been surveyed (Paquet and Chardine 2001). Generally, waterfowl arrive in late spring and leave the area by October. Breeding typically begins in May and June, and mothers with young are the last to leave the breeding area in July and August. Eiders, both breeders and immature ducks,

Table 10-4: Breeding and overwintering waterfowl species known to occur in Sydney Bight

Species	Breeding	Over-wintering	*Population trend in eastern Canada
Common Eider (*Somateria mollissima*)	✔	✔	Declining
American Black Duck (*Anas rubripes*)	✔	✔	Declining
Common Merganser (*Mergus merganser*)	✔	✔	Stable
Red-breasted Merganser (*Mergus serrator*)	✔	✔	Declining
Common Goldeneye (*Bucephala clangula*)	✔	✔	Increasing
Common Loon (*Gavia immer*)		✔	
Horned Grebe (*Podiceps auritus*)		✔	
Harlequin Duck (*Histrionicus histrionicus*)		✔	
Oldsquaw (Long-tailed Duck) (*Clangula hyemalis*)		✔	
Black Scoter (*Melanitta nigra*)		✔	
Surf Scoter (*Melanitta perspicillata*)		✔	
Bufflehead (*Bucephala albeola*)		✔	

Compiled from Paquet and Chardine 2001.

are the only ducks considered to be found abundantly in coastal zones of Cape Breton during the summer (Lock et al. 1994).

Overwintering waterfowl are spread along the coast fairly evenly during fall and winter, although densities are lowest along exposed coastlines (Paquet and Chardine 2001). During migration, most waterfowl stop to feed in shallow, salt or brackish water areas on eelgrass (*Zostera marina*). Fish-eating birds including cormorants, Great Blue Herons, Osprey, Bald Eagles, gulls and terns, also use coastal lagoons, bays and estuaries for foraging (Davis and Browne 1996a). Other species of waterfowl may breed further inland, and bring their young to coastal marshes in the brackish zone for rearing or after they have attained flight.

Harlequin Ducks are classed as species of special concern in Atlantic Canada by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Environment Canada 2002a). This species breeds further north but migrates along the coast of Nova Scotia and winters in southern Newfoundland and the Bay of Fundy (Lock et al. 1994). In Sydney Bight, Harlequin Ducks have been recorded in Glace Bay, Ingonish, Port Morien, Round Island and Sydney (CWS Harlequin Duck Database cited by Paquet and Chardine 2001). They may frequent other locations as well.

Significant bird areas

Although birds are known to frequent many areas of the coast, certain areas are recognized as important bird habitat. Several different organizations and/or individuals have identified important bird habitats in Sydney Bight (Table 10-5). Information about the different designations is follows below.

Important Bird Areas (IBA)
Bird Studies Canada (BSC) and the Canadian Nature Federation (CNF) in cooperation with Bird Life International (BLI), has an Important Bird Areas (IBA) program that is used to identify sites important for conserving world bird populations. IBAs are sites that provide essential habitat for one or more species of breeding or non-breeding birds and may contain threatened species, endemic species, species representative of a biome, or highly exceptional concentrations of birds (BSC 2002). There is no legal authority attached to the IBA designation; however, in many cases protection may be achieved through conservation easements, land purchases and voluntary stewardship initiatives (BSC 2002).

Migratory Bird Sanctuaries
The Canadian federal government protects migratory birds through the designation of Migratory Bird Sanctuaries (MBS). The MBS Regulations prohibit all disturbance, hunting and collection of migratory birds and their eggs within a MBS. Visitors to these sanctuaries are not allowed to carry firearms or let their pets run at large.

Wilderness Areas
The Nova Scotia government designates Wilderness Areas under the *Wilderness Protection Act* (1998). Areas are selected as representative samples of natural landscapes and ecosystems. This act ensures that ecological integrity, natural ecological processes and biodiversity is maintained in the designated areas. Traditional sport fishing and hunting are still permitted in these areas (McEachern 1997).

Nova Scotia Bird Society Sanctuaries
The Nova Scotia Bird Society owns several sanctuaries along the Atlantic coast. These lands are considered privately owned and have no additional protection status. The Nova Scotia Bird Society generally ensures the protection of its sanctuaries through public stewardship efforts (D. Currie pers. comm. 2001).

International Biological Programme (IBP)
The International Biological Programme identified examples of all major ecosystems in Canada to work toward their protection as Ecological Reserves (Canadian Committee for the IBP-CT 1974).

Threats to marine birds

There are many potential threats to marine birds in Sydney Bight.

Fishing
Overfishing and bycatch - Many marine birds feed on commercially fished species. If the populations of these fish becomes depleted by overfishing, birds will be left with less prey. Diving birds can become caught in fishing nets or get caught on fishing long lines.

Human disturbance to breeding colonies - Marine bird colonies are typically found in isolated locations. Any disturbance to these locations (from increased boat traffic, coastal development, increased tourism, etc.) may cause stress levels that may negatively affect breeding success and cause birds to abandon breeding altogether (EC 2001)

Oil and Gas industry

Light pollution
Some birds, including Leache's Storm Petrels, are attracted to light on ships or oil rigs. As a result, they may die from strikes (when they fly into these objects), become fouled with oil, or be incinerated in open flares (EC 2001).

Oil slicks
Oil may be discharged intentionally or released accidentally; oil may enter the marine environment in large-scale spill events or small-scale chronic releases (EC 2001). In any case, the resulting oil slicks are very harmful to marine birds.

Oil can kill birds in several ways. Firstly, when oil comes into contact with a bird's plumage, the capacity of the plumage to waterproof and insulate is destroyed. For a bird floating in cold water this is a serious problem. Enough body heat can be lost through even a small spot of oil to result in hypothermia, the reduction of the bird's ability to feed and its eventual death. Oil has its second effect on birds when ingested. Oiled birds will attempt to preen themselves to restore their waterproofing, and in the process they ingest and inhale toxic oily compounds. As a result, birds slowly suffer from liver, lung, kidney and intestinal damage as well as damage to other internal organs (CWS 1992). The size of an oil spill is not proportional to its consequences to seabirds since even a small slick can kill large numbers of birds if they are congregated in one area (Russell 2000; EC 2001).

The two main sources of oil on the sea surface are from shipping and oil and gas developments (Russell 2000). Discharges from these sources include discharges and accidental spills from oil and gas developments, oily bilgewater discharge from ships, and accidental oil spills from vessels (CWS 1992; EC 2001).

Oil spills and their effect on marine birds are only noted when dead or dying birds wash up on beaches; yet drift block experiments indicate that most birds oiled off the coast never in fact reach the shore (Russell 2000). Latest estimates from the Canadian Wildlife Service (CWS) indicate that roughly 300 000 birds die each year as a result of chronic oil pollution; this figure is comparable to the impact of the Exxon Valdez spill each year (Whittam 2002). Cape Breton is considered an area of extreme risk for birds oiled at sea since there is both heavy shipping traffic through the Cabot Strait and large concentrations of marine birds that use the area over the winter (Whittam 2002).

Seismic Activities
Airguns detonated during seismic oil and gas exploration can have negative effects on marine birds (EC 2001). Diving birds such as Puffins, Razorbills, Guillemots, and Cormorants may be knocked out or killed by the strength of air gun shock waves detonated in their vicinity (EC 2001). Seismic activity may also indirectly impact marine birds since it can drive fish schools away from habitual fishing grounds.

Water/habitat Pollution
Marine Birds may also be impacted by pollutants released directly into their environment by industrial activities or by runoff from the terrestrial application of pesticides. Sydney Harbour water, sediments and biota have been significantly impacted by a wide variety of contaminants from both industrial and municipal sources. See Section 16- Socio-economic Activity - Table 16-7 of this document for a list of the facilities, locations, types, pollutants and emission types. Specific studies

have identified contaminants in lobster and mussels (Stewart and White 2001). Undoubtedly, these contaminants are also present in species higher up the food chain including birds.

The overuse and misuse of chemical pesticides on land can lead to contamination in the marine environment. Chemicals sprayed on farm fields, forested areas and municipalities can reach the coast through runoff. Coastal birds can ingest pesticides when feeding in coastal ponds and marshes. These pesticides, although not intended for birds, can have serious effects. For example, pesticides such as DDT (discontinued in Canada in the 1970s) persist for decades and build up in the food chain such that birds can accumulate a lethal dose over time.

Table 10-5: Significant bird areas and their associated species*

Identified Bird Area	Designation/recognition	Species
Big Glace Bay Lake	• IBA • Migratory Bird Sanctuary	• Canada Geese • Willets • American Black Ducks • Piping Plovers
Bird Islands	• IBA • Hertford Island Nova Scotia Bird Society Sanctuary • Listed as important by Environment Canada (2001) • Recognized as important by the Canadian Committee for the IBP-CT 1974)	• Atlantic Puffin • Black Guillemot • Razorbill • Great Cormorant • Double-crested Cormorant • Herring Gull • Great Black-backed Gull • Lesser Black-backed Gull • Black-legged Kittiwake • Ruddy Turnstones • Bald Eagles
Ingonish Island	• IBA • Listed as important by Environment Canada (2001)	• Great Cormorant
Lingan		• Shorebirds (P. Lane and Associates 1992).
Morien Bar	• Most significant shorebird area in Cape Breton (McCorquodale pers. comm. 2002)	• Black-bellied Plover • Buff-breasted Sandpiper • Common Snipe • Dunlin • Greater Yellowlegs • Hudsonian Godwit • Least Sandpiper • Lesser Golden Plover • Lesser Yellowlegs • Pectoral Sandpiper • Long-billed Dowitcher • Red Knot Ruddy Turnstone • Ruff • Sanderling • Semipalmated Plover • Semipalmated Sandpiper • Short billed Dowitcher • Whimbrel • White-rumped Sandpiper • Willet • Wilson's Phalarope
Northern Head and South Head	• IBA	• Great Cormorant • Black-legged Kittiwake • Harlequin Duck
Scatarie Island	• IBA • Nova Scotia Wilderness Areas	• Leach's Storm-petrel
St. Paul Island	• IBA	• Leach's Storm-petrel

* Compiled from Tufts (1986); BSC (2002); Puffin Boat Tours (2002) unless otherwise indicated.

11 - Marine mammals

Two groups of marine mammals inhabit Sydney Bight: the cetaceans, a group that includes whales, dolphins and porpoises, and pinnipeds, a group that includes seals. Several marine mammal species forage in Sydney Bight and are thought to move into bays along the coast in pursuit of their prey. Seals forage in Sydney Bight and use coastal areas for haulouts. Very little is known about the seasonal distribution and abundance of marine mammals in Sydney Bight (J. Conway pers. comm. 2002).

Whales, dolphins and porpoises (cetaceans)

Several cetacean species inhabit Sydney Bight at some time during the year or periodically during their lifetime. Essentially, any cetacean species found within the Gulf of St. Lawrence could be found in Sydney Bight since the Cabot Strait is a known migration route for many species travelling in and out of the Gulf of St. Lawrence (T. Wimmer pers. comm. 2002). For example, the Mingan Island Cetacean Study (MICS) indicates that the Cabot Strait is a migration route for blue whales between the Scotian Shelf and the Southern Gulf of St. Lawrence (MICS 2002). Traditional ecological knowledge has identified fin, humpback, minke, blue, and pilot whales, as well as harbour porpoises in the area (ECBCRMP 1996; VCCRMP 1997). Although little documented information exists, white-sided and white-beaked dolphins may also frequent this region, and are in fact seen in Bay St. Lawrence at the northern tip of Cape Breton Island (A. Ottensmeyer pers.comm. 2001).

Scattered reports exist of sighting and strandings of other cetaceans in Sydney Bight. For example, North Atlantic right whales (an endangered species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) are occasionally spotted (J. Conway pers. comm. 2002) and a northern bottlenose whale (endangered COSEWIC species) was stranded in Sydney Harbour in 1992. Other whales and dolphins have also become stranded on Sydney Bight beaches

Table 11-1: Reported cetacean strandings in the Sydney Bight area

Species	Date	Location	Cause
Atlantic white-sided dolphin	7/28/99	New Victoria Mines/New Waterford Area	Unknown
Dolphin	10/18/98	Stranded in New Waterford Area	Unknown
Long-finned pilot whale	10/16/97	Sydney Harbour	Unknown
	10/29/97	Sydney Harbour	Entangled in rope (dead)
Northern bottlenose whale	10/8/92	Sydney Harbour	Live stranded in a river
Dolphin	May/June/01	Sydney Harbour	Unknown
Large unidentified baleen whale	9/05/01	Sydney	Unknown

Compiled from T. Wimmer pers. comm (2002).

(T. Wimmer pers. comm. 2002) (Table 11-1).

Whale watching

There are three major whale watching areas in Sydney Bight: Ingonish, Aspy Bay and Bay St. Lawrence. According to the Destination Nova Scotia (2002) website these areas together support 13 whale watching operations. If these areas can support whale watching operations during the summer months, they are presumably frequented by cetaceans on a regular basis.

Important cetacean areas

Information about cetacean habitat use in Sydney Bight is extremely sparse. It is therefore difficult to discuss the importance of this area for cetaceans, or to identify important sub-areas within Sydney Bight that may be particularly notable. This is not to say, however, that key areas do not exist.

Cabot Strait/Laurentian Channel

It is known that many species including blue, fin (listed as endangered and species of special concern respectively by COSEWIC), and humpback whales migrate through the Cabot Strait. For this reason, Sydney Bight may be considered a significant area for cetacean migration (T. Wimmer pers. comm. 2002).

Bay St. Lawrence

One of the only well-studied areas in Sydney Bight is Bay St. Lawrence. Dalhousie University Biology students conduct cetacean research in this area and it seems particularly important for marine mammals. Other such areas may exist in Sydney Bight.

Bay St. Lawrence is an area of deep coastal water. With its large schools of mackerel, herring and cod, it is good feeding ground for cetaceans. Fin whales are found in this area from June - September and are often associated with dolphin schools, perhaps because they are feeding on the same prey. Minke whales are present whenever there is no ice in the bay. Pilot whales arrive in Bay St. Lawrence in mid-June and remain until October - November. Young pilot whales are often seen in the area, therefore the whales may be using the bay for calving. Dolphins may also be calving in Bay St. Lawrence (A. Ottensmeyer pers. comm. 2001).

Seals (pinnipeds)

Pinnipeds are marine mammals that haulout on to shore to give birth and suckle their young. Four seal species are found in Sydney Bight: grey, harbour, harp, and hooded seals. All four species are present in Sydney Bight during the winter, but only grey and harbour seals are present in the summer. Harp and hooded seals are present until April or May.

Very little is known about the distribution and habitat of seals along the Atlantic coast of Nova Scotia (D. Bowen pers. comm. 2001), or specifically in Sydney Bight (J. Conway pers. comm. 2002; W. Stobo pers. comm. 2002). Known areas frequented by seals include the Bird Islands and Hay Island. The Bird Islands are used as a haulout site by grey seals from mid-August to early September (Highland Coastal Mapping 2000; Puffin Boat Tours 2001), and there is a small grey seal rookery on Hay Island (off Scatarie Island) on the eastern shore of Cape Breton Island. Harbour seal rookeries may exist in coastal areas of Sydney Bight. These areas are difficult to identify because harbour seal pupping takes place over a few hours at low tide, and mother and pups often swim away by the next high tide (J. Conway pers. comm. 2002).

Traditional ecological knowledge has been used to map seal haulout areas in coastal areas of Sydney Bight; however, species specific information is not provided (Table 11-2) (Figure 11-2) (LACRMP 1995; ECCBCRMP 1996; VCCRMP1997). Many of these seal haulout areas also contain other important coastal resources such as seabird nesting colonies and shellfish beds. Other haulout areas may exist, and haulout sites may change from year to year.

Table 11-2: Seal haulout sites in SHACI Unit 11

Location
Noneck Point
South Head
Schooner Pond Cove
MacKeigans Point
Round Island Point
Little Pond
Shag Rock
Aconi Island
Ingonish Island, East Rocks
Cape North (2 locations)
East of Money Point
The Gulch
Blue Point
White Point Island
Island in Little Burnt Head Cove
Ragged Rocks
Near Table Head
Hertford Island
Ciboux Island
*Hay Islands (off Scatarie)
Red Rocks (off Scatarie)
Cormorandiere Rocks (off Scatarie)

*Grey seal rookery

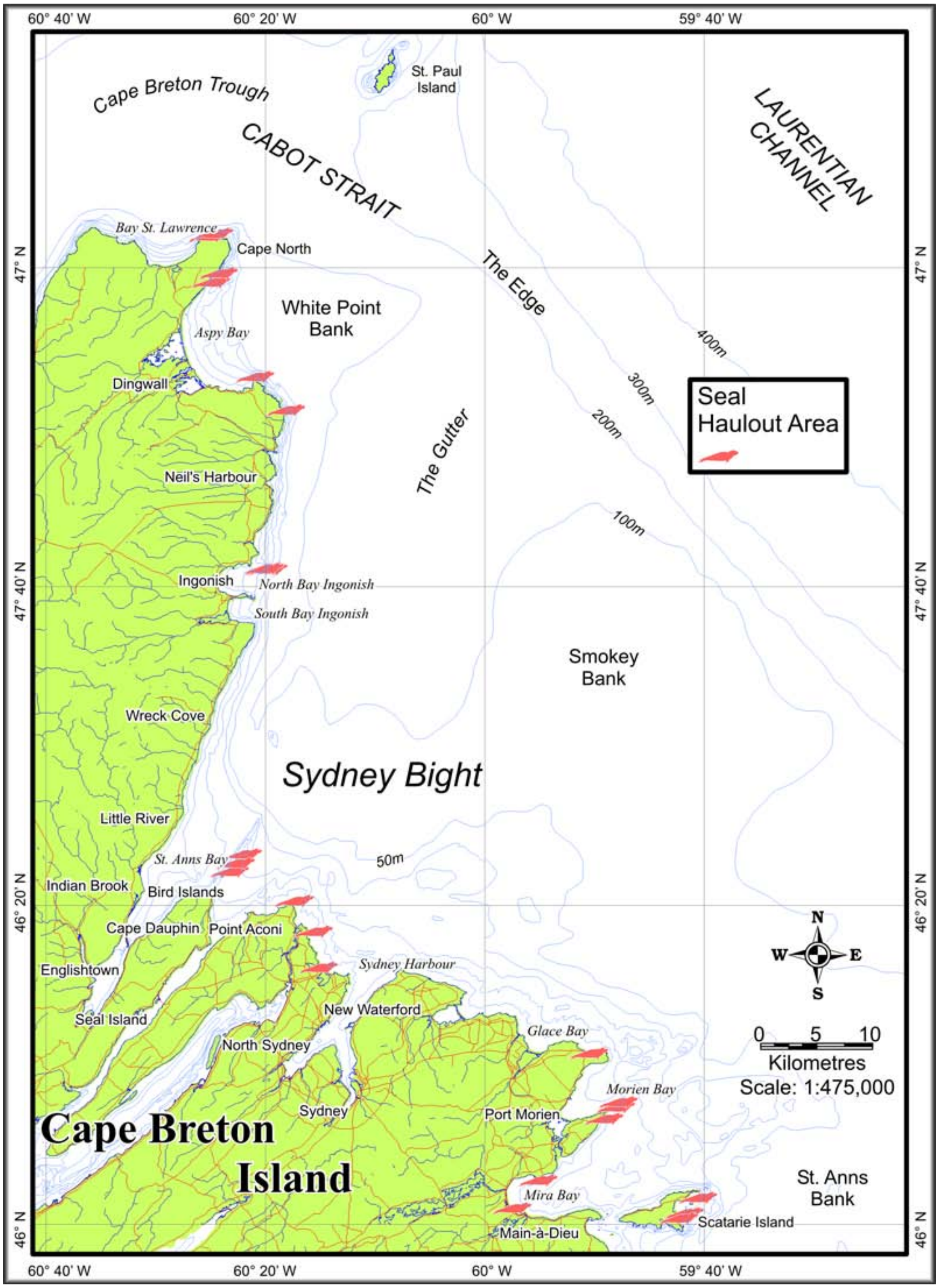


Figure 11-1: Seal haulout locations in SHACI Unit 11 (LACRMP 1995; ECBCRMP 1996; VCCRMP 1997)

Threats to marine mammals

There are several potential threats to marine mammals worldwide that may have relevance in Sydney Bight and other coastal areas along the Atlantic coast of Nova Scotia.

Chemical pollution is a general issue for cetaceans around the world (H. Whitehead, S. Gowans, A. Ottensmeyer pers. comm. 2001). The pollution of coastal waters through land-based sources (including pesticides, fungisides, herbicides and other biocidal agents), psedo-estrogenic compounds, heavy metals and other substances may cause significant problems in coastal waters, especially in and around industrial harbours. No local research has attempted to identify or quantify these threats, but ecotoxicological studies underway at the Marine Environmental Research Institute in Maine may yield some relevant insights (MERI 2003)

The fishing industry
Marine mammals may become entangled in fishing nets, buoys, and other types of gear. Mackerel nets are a particular problem for Harbour porpoises in the Bay St. Lawrence/Cape North area (A. Ottensmeyer pers. comm 2001) Loss of food due to over-competition for food sources by the fishing industry may be a problem for local cetaceans (S. Gowans pers. comm 2001).

Mass strandings may be problematic for several species, and may result from several of the above mentioned threats. For pilot whales, movements close to shoals and shallow bays often lead to mass strandings. A mass pilot whale stranding occurred in Glace Bay (Kingsley, unpublished data cited by Nelson and Lien 1996). For this species, the major factor in mass strandings appears to be social behaviour (Katona et al. 1993); however, high concentrations of heavy metals (Muir et al. 1988), lack of familiarity with inshore waters, disturbances with echolocation, problems with attention, anomalies in geomagnetism and general stress have been suggested as possible causes (Nelson and Lien 1996). Between 1991and 1996 there was one reported live minke whale stranding in Cape Breton which occurred sometime between July and October (Hooker et al. 1997 cited by NMFS 2001).

Oil and Gas activities
There are several potentially harmful impacts to marine mammals associated with oil and gas exploration and production activities (seismic exploration, operational discharges, drilling, oil spills and related boat and helicopter traffic).

Noise
According to Hammill and others (2001), oil and gas exploration might have detrimental effects on certain marine mammal species, primarily through the noise this activity generates. Noise is a problem because marine mammals emit or hear sounds in the same frequency range as those caused by airguns, drilling activities, ships and helicopters. The potential impacts of ship and helicopter noises are outlined below, and many of these

concerns mirror those associated with seismic survey and drilling noises. Specifically, Odontocetes and Pinnipeds have shown strong avoidance reactions to seismic surveys (Richardson et al. 1995).

Operational discharges
During exploratory, development and production phases, different kinds of drilling muds and formation cuttings containing toxic compounds are routinely released into the ocean. The biological effects of such discharges would most likely be short term and at small distances from the point source. Nonetheless, distant impacts could result, including the diversion of marine mammal migration routes or the routes of their fish prey (Boudreau et al. 2001).

Oil spills and blowouts
During exploration, development and production phases, there is a risk of an oil spill or blowout. Both events would release potentially large amounts of oil and/or gas into the ocean, thus contaminating the marine environment. The various potential effects of these events are outlined by Boudreau et al. (2001).

Vesssel Traffic
The underwater sounds emitted from shipping, industrial, military, fishing, and whale watching vesselsmay all have impacts on marine mammals. Air traffic over water (helicopters, low flying planes) may also have detrimental effects.

Noise
Marine vessels are a major contributor to overall background noise in the sea. Noise is a concern because:

1) Increases in background noises from anthropogenic sources may prevent the detection of other sounds important to marine mammals. This could interfere with navigation and communication.
2) Certain sounds may disturb behaviour. Reactions could range from a brief interruption of normal activities (resting, feeding, disruption of mother-pup bond, and other social interactions) to a longer term displacement from the noisy area.
3) Some sounds could cause temporary or permanent reductions in hearing sensitivity.
4) Noise could disrupt the distribution of prey items and thus disrupt feeding patterns (Richardson et al. 1995).

Collisions
Marine vessels may unintentionally strike marine mammals leading to injury and/or death (H. Whitehead, S. Gowans, A. Ottensmeyer pers. comm. 2001).

Whale watching
There are approximately 13 whale watching operations in Sydney Bight. Whale watching may become specifically problematic since these vessels seek out whales. Although not yet considered a problem off Nova Scotia, whale watching has the potential to do harm. Excessive whale watching generally disturbs whale behaviour and may result in vessel strikes (H. Whitehead, S. Gowans, A. Ottensmeyer pers. comm. 2002).

12 - Species at risk

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was initiated in 1977. COSEWIC evaluates the status of wildlife (flora and fauna) in Canada and produces a yearly national listing of Canadian species at risk.

Prior to the passing of the *Species at Risk Act* (SARA) in June 2003, COSEWIC designations had no legal standing. COSEWIC, acting as an advisory body to government, relies on the SARA to confer legal standing on the species listed by COSEWIC (Government of Canada 2004). COSEWIC chooses the species to be evaluated based on nominations by government and external experts. Species listed by COSEWIC do not represent all the species at risk in Canada. Although many species have been evaluated (e.g., almost all cetaceans found off eastern Canada), many others, such as marine fish and invertebrates, have received little attention (Breeze et al. 2002).

Table 12-1: Unit 11 COSEWIC listed species

Species name	Latin name
Endangered	
*North Atlantic right whale	*Eubalaena glacialis*
*Blue whale	*Balaenoptera musculus*
*Leatherback turtle	*Dermochelys coriacea*
*Piping Plover	*Charadrius melodus*
Threatened	
*Northern wolffish	*Anarhichas denticulatus*
*Spotted wolffish	*Anarhichas minor*
Special concern	
Fin whale	*Balaenoptera physalus*
Harbour porpoise	*Phocoena phocoena*
Atlantic cod (Maritimes population)	*Gadus morhua*
*Atlantic wolffish	*Anarhichas lupus*
*Harlequin Duck	*Histrionicus histrionicus*
Yellow Lampmussel	*Lampsilis cariosa*

Compiled from Environment Canada (2002a) and COSEWIC (2003a, 2004).
* Currently protected under SARA

Twelve species found in Unit 11 are named in the COSEWIC 2003 listing of Canadian species at risk categorized as either endangered, threatened or of special concern (COSEWIC 2003a) (Table 12-1).

Of these twelve species, eight are currently protected under *SARA. The remaining four are currently going through the legal listing process.

Endangered species

An endangered species is a species facing imminent extirpation or extinction. Four species found within Unit 11 are ranked as endangered by COSEWIC: the North Atlantic right whale (*Eubalaena glacialis*), the Blue whale (*Balaenoptera musculus*) the leatherback turtle (*Dermochelys coriacea*), and the Piping Plover (*Charadrius melodus*) (CWS 2001a,b,c,d).

North Atlantic right whale

The North Atlantic right whale is one of the most critically endangered marine mammals in the world (Right Whale Recovery Team 2000). In Canada, the known distribution of right whales includes four areas, namely, the lower Bay of Fundy, innerbank basins on the Scotian Shelf (Roseway and Emerald Basins), the northwestern Gulf of St. Lawrence, and coastal waters of eastern and southern Newfoundland (Right Whale Recovery Team 2000).

Initially considered a single species, the right whale was designated endangered in 1980 (COSEWIC 2003a). In May 2003, the population was split into two species to allow a separate designation of the North Atlantic right whale. This species was designated by COSEWIC as endangered in 2003. It was listed as endangered under SARA in January 26 of 2005.

Heavily reduced by whaling, the current population of this species, found only in the North Atlantic, is approximately 322 animals, 220-240 of which are adults (COSEWIC 2003b). High mortality within the population is caused by ship strikes and entanglement in fishing gear. The population has been decreasing over the last decade. The right whale is listed as endangered by the CITES (UNEP-WCMC 2003) and is designated endangered under the U.S. *Endangered Species Act* (USFWS 2003).

The North Atlantic right whale is perhaps not a common inhabitant of Sydney Bight; however, it may be using this area when moving into the Gulf of St. Lawrence through the Cabot Strait (J. Conway pers. comm. 2002). The North Atlantic right whale once summered in the Gulf of St. Lawrence and off Newfoundland. They are now most often seen off Nova Scotia and Newfoundland; however, in the past few years there have been recorded sightings off Gaspé in the Gulf of St. Lawrence, indicating that right whales may be returning to their former range (J. Conway pers. comm. 2002).

Blue whale

Blue whales, the largest of the baleen whales, are rarely observed. Generally found alone or in groups of 2 or 3, they are distributed widely in the world's oceans, primarily along the edges of continental shelves and in the open ocean but can also be found inshore (Yochem and Leatherwood 1985). Blue whales are seen along the Atlantic coast of Nova Scotia during their migration between the Gulf of St. Lawrence and the eastern U.S. coast, from late June or early July through October (Conway pers. comm. 2003).

Blue whales were significantly reduced in number by whaling and are now protected by the International Whaling Commission (Yochem and Leatherwood 1985). In 1983, the blue whale was considered a single unit by COSEWIC and designated species of special concern (COSEWIC 2003a). In 2002, the species was split into two populations, Atlantic and Pacific, and both were designated endangered. It was listed as endangered under SARA in January 26 of 2005.

This species is listed as endangered by CITES (UNEP-WCMC 2003), to which Canada is a signatory, and is designated endangered under the U.S. *Endangered Species Act* (USFWS 2003).

Leatherback turtle

The leatherback turtle is undergoing a severe worldwide decline (COSEWIC 2001). Threats include entanglement in fishing gear (NMFS 1992, Goff and Lien 1988), often resulting in serious injury or drowning, and ingestion of marine debris such as plastic bags (Hartog and Van Nierop 1984) and fishing gear (Starbird 2000) that can block the digestive tract and lead to starvation (Plotkin and Amos 1990). The leatherback turtle was initially designated endangered by COSEWIC in 1981 and retains that status (COSEWIC 2003a). This species is listed as critically endangered by the CITES (UNEP-WCMC 2003). In 1996, the leatherback turtle was designated endangered under New Brunswick's *Endangered Species Act* (Environment Canada 2003a). In the United States, the leatherback is designated endangered by the *Endangered Species Act* (USFWS 2003). Many countries have laws to protect the leatherback turtle, however, enforcement of this protection is difficult in many areas. Abundance estimates of leatherback turtles in Atlantic Canada are not available (James 2001), however, it is estimated that there are at least several hundred thousand animals in the Atlantic population (Sinclair 2004).

The leatherback turtle can be found foraging in Sydney Bight waters in the summer and fall. More information about this species can be found in the Marine reptile section of this document.

Piping Plover

The melodus subspecies of the Piping Plover is a small migratory shorebird that breeds only in North America along the Atlantic coast from Newfoundland to South Carolina. Piping Plovers typically nest on white sand beaches and are known to breed in two areas within Unit 11: North Harbour beach and South Harbour beach in Victoria County (Figure 12-1) (VCCRMP 1997; CWS Piping Plover Database cited by Paquet and Chardine 2001; Island Nature Trust 2002). Piping Plovers have been recorded in Big Glace Bay Lake (BSC 2002); however, it is not known if they are breeding in this area.

Surveys indicate there were approximately 481 adult Piping Plovers in the Atlantic Provinces in 2001, far below the goal of 670 adults set by the recovery team (Environment Canada 2003b). Piping Plovers nest on exposed sandy or gravel beaches above the normal high-water mark. Plovers depend on beaches for nesting and foraging.

Loss of habitat caused by human use of beaches and disturbance of nesting sites is the greatest threat to Piping Plovers (Environment Canada 2003b). Predation of eggs and chicks by crows, gulls, foxes, and feral dogs and cats is another limiting factor. Water level changes caused by seasonal storms and spring tides can threaten nesting efforts.

In Canada, the Piping Plover is protected under SARA as an endangered species, the federal *Migratory Birds Convention Act* of 1917 (Department of Justice Canada 2003) and under the corresponding *Migratory Bird Treaty Act* in the United States. Provincially the plover is protected by endangered species legislation in Quebec, New Brunswick and Nova Scotia (Environment Canada 2003b). Endangered species legislation recently passed in Newfoundland and the *Wildlife Conservation Act* recently passed in Prince Edward Island will eventually provide added protection for plovers. The Piping Plover is designated threatened under the U.S. *Endangered Species Act* (USFWS 2003).

Threatened species

COSEWIC ranks two species found in Unit 11 as threatened: northern wolffish (*Anarhichas denticulatus*), and spotted wolffish (*Anarhichas minor*).

Northern and spotted wolffish

Both the spotted and the northern wolffish are distributed across the North Atlantic, but in the western North Atlantic they are found primarily off northeast Newfoundland (CWS 2001e; 2001f). The spotted wolffish and the northern wolffish have been caught in small numbers in 4Vn research tows (Zwanenburg et al. 2001). Specific areas of importance within Sydney Bight may exist, but are not known at this time.

Numbers of northern wolffish and spotted wolffish in the western Atlantic and the number of their locations have declined dramatically in the last 20 years (Environment Canada 2003 c,d). Although these fish are not targeted by the fishing industry, they are taken accidentally by offshore trawlers. Another threat is the damaging of spawning habitat by bottom trawling for fish and dredging for scallops and clams. Northern and spotted wolffish are not specifically protected under legislation although there is the potential for some protection under the Habitat section of the Canadian *Fisheries Act*. A combined recovery strategy for both species is being developed.

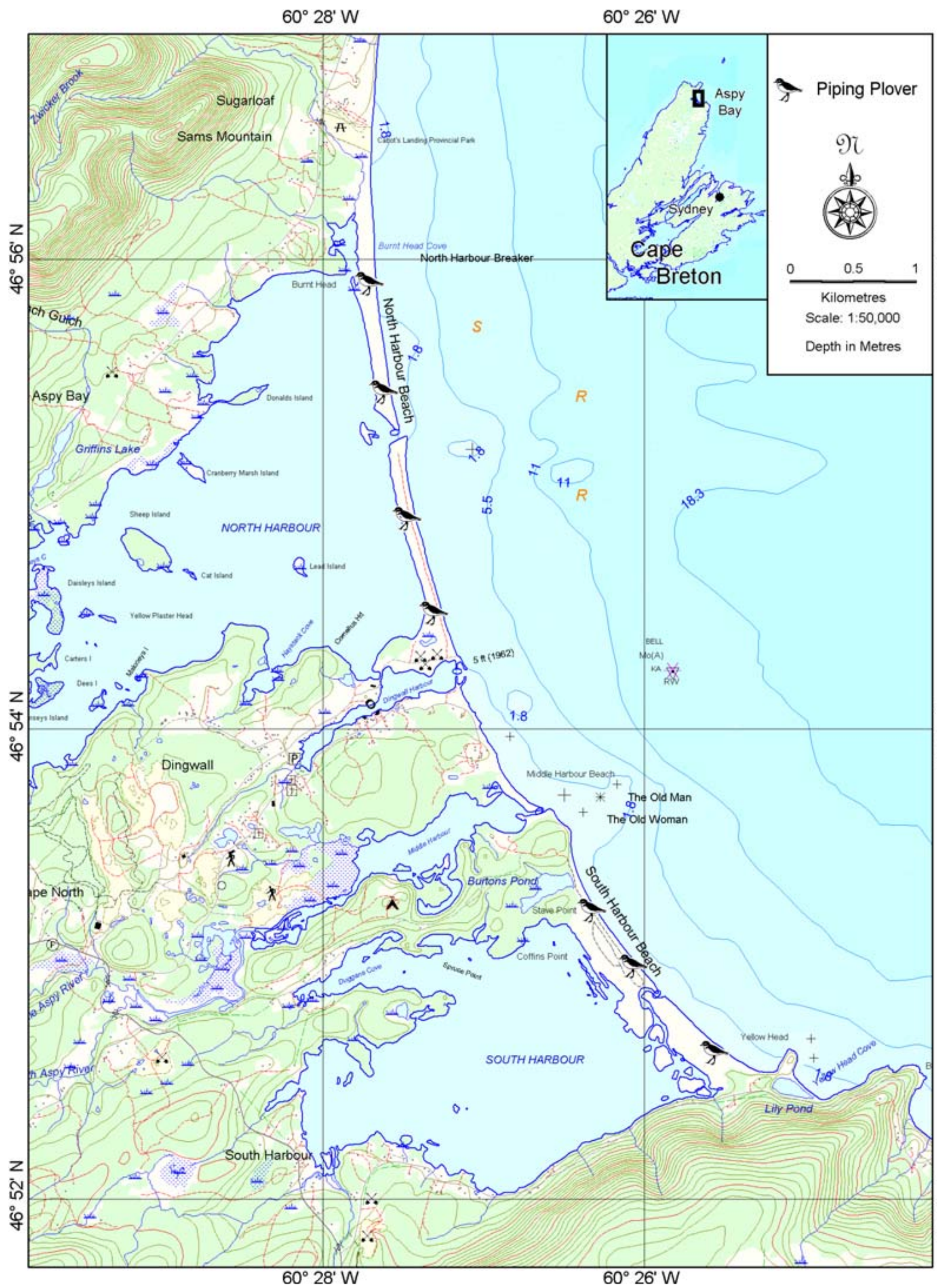


Figure 12-1: Piping Plover nesting areas: North Harbour and South Harbour Beach, Aspy Bay (VCCRMP 1997)

Species of special concern

Six species found in Unit 11 are ranked by COSEWIC as species of special concern: Maritimes population of Atlantic cod (*Gadus morhua*), Harlequin Duck (*Histrionicus histrionicus*), fin whale (*Balaenoptera physalus*), Atlantic wolffish (*Anarhichas lupus*), harbour porpoise (*Phocoena phocoena*) and the yellow lampmussel *(Lampsilis cariosa)* (CWS 2001g,h,i, j; Environment Canada 2004).

Fin whales

Fin whales are migratory baleen whales that spend winters on breeding grounds in deeper offshore waters and migrate closer inshore to feed in the summer (Walker et al. 1992, Agler et al.1993). On Canada's east coast, there are at least two stocks of fin whales: one summers off the coast of Nova Scotia and winters further south; the second stock summers off the coast of Newfoundland and winters off the coast of Nova Scotia and further south (Environment Canada 2003e). Fin whales are commonly sighted in the summer in the Gulf of Maine, Bay of Fundy (Agler et al. 1990), and the Gulf of St. Lawrence (Edds and MacFarlane 1986). Fin whales are known to migrate through the Cabot Strait (T. Wimmer pers. comm. 2002) and have been observed in Sydney Bight (ECBCRMP 1996; VCCRMP 1997).

In 1987, the fin whale was designated a species of special concern in Canada (COSEWIC 2003a). The main reason for the decline of fin whale populations was whaling. On the east coast of Canada and the United States, fin whales were the target of land-based whaling operations (Mitchell 1974). The International Whaling Commission now protects fin whales via a moratorium on the hunting of fin whales. Since the cessation of whaling, populations seem to be recovering (Environment Canada 2003e). Limiting factors for the fin whale include chemical pollution that causes debilitation and death, and the depletion of capelin stocks, an important prey of the fin whale during migration. This species is listed as endangered in the Convention on International Trade in Endangered Species of Wild Flora and Fauna (UNEP-WCMC 2003) and is designated endangered by the U.S. *Endangered Species Act* (USFWS 2003).

Harbour porpoise

The Northwest Atlantic population harbour porpoise is widely distributed and inhabits bays, oceanic canals and harbours, preferring water temperatures of 5 to 16 °C and areas with a great deal of turbulence or changes of current (Environment Canada 2003f). Harbour porpoises can be divided into three populations that summer in the Gulf of Maine/Bay of Fundy, the Gulf of St. Lawrence and Newfoundland-Labrador. The 2003 COSEWIC status report on the northwest Atlantic harbour porpoise indicates that the Bay of Fundy/Gulf of Maine population is transboundary in nature (COSEWIC 2003c).

One of the biggest threats to this species is incidental capture in fishing gear, especially gillnets (COSEWIC 2003b, Environment Canada 2003f). Initially designated as threatened in Canada in 1990, the harbour porpoise was downlisted to special concern in 2003 (COSEWIC 2003b). Reduced fishing activities in the Atlantic and measures to reduce incidental catches in the Bay of Fundy have helped lower the number of porpoises killed accidentally. The harbour porpoise is particularly vulnerable to entanglement in gillnets; mackerel nets are a particular problem in the Bay St. Lawrence/Cape North area (A. Ottensmeyer pers. comm. 2001). However, potential incidental catch levels remain a concern. Since 1982, the harbour porpoise has been protected under Canada's *Fisheries Act*. This species is listed as vulnerable by the CITES (UNEP-WCMC 2003). Although this species was proposed for listing as threatened under the U.S. *Endangered Species Act*, in 1999, U.S. National Marine Fisheries Service determined that the proposed listing was not warranted because bycatch reduction programs implemented in Canada and the U.S. were sufficient to ensure the population's sustainability. In 2001, the U.S. government published its intention to remove this population from the candidate list under the *Endangered Species Act* (COSEWIC 2003c).

Atlantic cod

Atlantic cod has been the dominant commercial species of the Northwest Atlantic where they occur from inshore shallow water areas of approximately 5 m to the edge of the continental shelf and a depth of 600 m (DFO 2003a). Local inshore populations of cod exist along the Nova Scotia coast in Units 4, 5 and 6 such as the Halifax group that occurs within the approaches to Halifax Harbour (Fanning pers. comm. 2003). This group is found in the inshore area from early fall to early winter and migrates to deeper water offshore during winter (Fanning pers. comm. 2003, DFO 2003b).

Although stocks of the southern Gulf of St. Lawrence, Gulf of Maine and Scotian Shelf are all at low levels of abundance, those on the eastern Scotian Shelf are at historic lows and have continued to decline despite the closure of the directed fishery in September 1993 (COSEWIC 2003b, DFO 2003b). The Sydney Bight cod stock declined rapidly in abundance in the late 1980s - early 1990s, and current stock production is very low (DFO 2001a).

In 1998, cod was considered a single unit and assigned a status of species of special concern in Canada (COSEWIC 2003b). In 2003, the stocks were split into separate populations and the Atlantic cod Maritimes population was designated a species of special concern. Although the directed fishery for cod has been under moratorium since 1993, there are no indications that stock recovery is occurring (DFO 2003b). Atlantic cod is sensitive to human activities and is threatened by accidental catch in other fisheries, natural predation, and natural and fishing-induced changes to the ecosystem (COSEWIC 2003b).

Atlantic wolffish

Atlantic wolffish are solitary, bottom-dwelling fish. In the Northwest Atlantic, they occur on the continental shelf and in deeper slope waters from southern Labrador to Cape Hatteras (DFO 2002c). In the Maritimes, wolffish are most numerous in the approaches to the Bay of Fundy, Browns, Roseway and LaHave Banks, the northeastern portion of the Scotian Shelf adjacent to the Laurentian Channel and in the waters off western Newfoundland. They are usually found at depths between 50 and 150 m but have been recorded between 1 and 550 m (DFO 2002c). Seasonal inshore migrations are thought to occur in the spring when mature fish are found in shallow waters of 0 to15 m.

Data suggest that Atlantic wolffish numbers in Canadian waters have declined by 87% from the late 1970s to the mid 1990s (Environment Canada 2003g). Despite the decline, it is thought that the wolffish is still widespread and exists in relatively large numbers, although it is found in fewer locations and the range where it is abundant may be shrinking. There are no data available on the direct causes of the declines in the Atlantic. The Atlantic wolffish, once a targeted species in a commercial fishery, is now only caught accidentally in fisheries for other species. There are no mechanisms in place to protect this species. The Atlantic wolffish is designated a species of special concern by COSEWIC (2003a).

The Atlantic wolffish is a relatively sedentary, bottom-dwelling predatory marine fish that primarily inhabits cold, deep waters of the continental shelf. It is usually found on rocky or hard clay bottoms and only occasionally on sandy or muddy bottoms. The Atlantic wolffish is widely distributed across the North Atlantic and the Scotian Shelf and Gulf of Maine mark the southern edge of its range in the western North Atlantic (CWS 2001i). Specific areas of importance within Sydney Bight may exist, but are not known at this time.

Harlequin Duck

The eastern population of the Harlequin Duck was designated as an endangered species in April 1990, but was downlisted to species of special concern in May 2001 based on an updated COSEWIC status report (COSEWIC 2003b). In Sydney Bight, Harlequin Ducks have been spotted in Glace Bay, Ingonish, Port Morien, Round Island and Sydney (CWS Harlequin Duck Database cited by Paquet and Chardine 2001). They likely visit Unit 11 during their migrations between wintering and summer breeding grounds.

The Harlequin Duck is a small, subarctic marine duck. Four populations of the Harlequin Duck are found worldwide, one of which is the eastern population along the Atlantic Coast. The eastern population, once estimated at 5000-10 000 birds, declined to fewer than 1500 birds (Environment Canada 2003h). Over the last few years, numbers have increased to approximately 1800 individuals (Environment Canada 2003j). The majority of the eastern population breeds along eastern Hudson Bay although a few breed inland on the north shore of the Gulf of St. Lawrence and on the shore of the Gaspé peninsula. About half the population winters in New England. Many Harlequin Ducks winter on the east and south coasts of Newfoundland; the north shore of the Gulf of St. Lawrence; in Nova Scotia, New Brunswick and Maine; and in a few areas south of Cape Cod (Environment Canada 2003h).

Harlequin Ducks breed along fast-flowing rivers in the spring and spend the rest of the year in coastal marine environments. The main factors that have contributed to their decline are destruction, alteration (such as hydro projects) and contamination (e.g., oil spills) of their habitat (Environment Canada 2003h). Under the *Migratory Birds Convention Act*, the Harlequin Duck is classified as a game bird and is managed by the Migratory Game Bird Hunting Regulations (Department of Justice Canada 2003). For the protection of this bird, the hunting season for Harlequin Ducks in the Atlantic provinces has been closed since 1990-91 and is also closed in Maine. In Nova Scotia and New Brunswick, the Harlequin Duck is designated endangered under the respective provincial *Endangered Species Acts* (DNR 2002). Designated endangered in Canada in 1990, the Harlequin Duck was downlisted to special concern in 2001 (COSEWIC 2003a).

Yellow lampmussel

Yellow lampmussel populations are quite large and apparently stable in Canada, but are found only in Sydney River, Nova Scotia and Saint John River watershed, New Brunswick. (COSEWIC 2004). It was designated by COSEWIC as a species of special concern in May of 2004.

The yellow lampmussel, *Lampsilis cariosa*, is a freshwater bivalve mollusk. It is oval-shaped and has a glossy surface that varies in colour from bright yellow to reddish brown with several fine radiating lines. The interior of the shell is coloured white to pink, and there are several strong hinge teeth. Although the yellow lampmussel has been recorded as large as 110 mm in length, it is typically smaller than 75 mm (COSEWIC 2004).

Threats are currently very limited, but there are long-term concerns related to the potential for introduction of Zebra mussels into the Saint John River, and maintaining habitat quality of the sole population in the Sydney River. The breach of the dam on the Sydney River would result in the loss of habitat due to both a reduction in shoreline and an influx of salt water upstream of the dam. Siltation and pollution from suburban and recreational activities could also cause habitat damage. Yellow lampmussel populations could also be affected if areas of Sydney River were treated with molluscicides to control “swimmer’s itch” (COSEWIC 2004).

Species with other designations

The *Nova Scotia Endangered Species Act* protects two coastal species of interest to SHACI: the Piping Plover and the Harlequin Duck. Listed as endangered under this Act, the killing, disturbance and sale of these species is prohibited, as is the destruction and disturbance of their specific dwelling places. If deemed necessary, the core habitat of endangered species must also be protected (DNR 2001).

The Harlequin Duck was also designated as endangered under New Brunswick's *Endangered Species Act* in 1996 (CWS 2001j), as was the leatherback turtle (CWS 2001c).

Several Unit 11 species are also listed under the United States *Endangered Species Act*. The leatherback turtle and Atlantic salmon (Gulf of Maine population) are listed as endangered, and the Piping Plover and the loggerhead turtle are listed as threatened. As well, the barndoor skate is listed as a proposed/candidate species for review under the U.S. Act (NESARC 2001).

Extinct or extirpated species

Five species that may have existed in Unit 11 are now either extinct or have been extirpated from the Northwest Atlantic (CWS 2001k,l,m,n,o). The Great Auk (*Pinguinus impennis*), the eelgrass limpet (*Lottia alveus alveus*), and the sea mink (*Mustela macrodon*) are all extinct. The grey whale (*Eschrichtius robustus*) has been extirpated from the Atlantic Ocean. The Atlantic walrus (*Odobenus rosmarus rosmarus*) has been extirpated from the Northwest Atlantic, the Mackenzie delta and the St. Lawrence River. The walrus is found in Arctic waters from the polar ice-sheet in the Arctic Ocean to the Bering Sea, James Bay and the Labrador coast (COSEWIC 2003b).

Important areas for species at risk

A well recognized means of protecting species is by protecting habitat. There are important areas of habitat for many of the above mentioned species at risk in Unit 11.

Cod areas

There are important areas for the 4Vn cod stock in Sydney Bight. More information about these areas is presented in the section on Marine fish.

- Off Ingonish: cod aggregate to spawn in the spring
- Bird Islands area: juvenile nursery area
- Cabot Strait: cod overwintering area

Aspy Bay - North Harbour beach and South Harbour beach

The Piping Plover is known to nest on North Harbour beach and South Harbour beach. Both areas are long sand spits on the landward side of Aspy Bay at the northern tip of Cape Breton (VCCRMP 1997). These beaches are both designated Protected Beaches under the Nova Scotia 1989 *Beaches Act* and are located just outside Cape Breton Highlands National Park. Protected beaches are managed by the Nova Scotia Department of Natural Resources. As outlined previously, humans pose a major threat to Piping Plover populations. The protection of their habitat is challenging since they breed on beaches that are also preferred for summer use by humans. At minimum, protection of Piping Plover habitat should include restricting human access to breeding areas during the breeding season. Other protective measures may include building exclosures around nests to prevent predation.

Harlequin Duck

In the Sydney Bight area, Harlequin Ducks have been recorded in several scattered locations including Glace Bay, Ingonish, Port Morien, Round Island and Sydney (CWS Harlequin Duck Database cited by Paquet and Chardine 2001). Nesting and overwintering sites are not known in Sydney Bight, therefore the identification of specific habitat requiring protection for Harlequin Ducks in this area is difficult to discern at this time. Generally however, adequate feeding and resting areas are required for this species while it migrates up and down the coast of Nova Scotia. Locations being used regularly by this species should receive some level of protection.

Knowledge gaps

The three species of wolffish (*Anarichas denticulatus, A. minor, and A. lupus*) have all been recorded in the 4Vn area (Zwanenburg et al. 2001). The specific movements and habitat use by this species in this area are not well known. These species are more commonly found off Newfoundland (CWS 2001e, 2001f, 2001i), however more study is required to discern if key habitats might exist elsewhere, including Sydney Bight.

Little is known about the movements and habitat use by the cetacean species in this area. More research is required to determine why these species occur in Sydney Bight and what areas, if any, are particularly important.

13 - Marine bioinvasions

Marine biological invasions (bioinvasions) occur when species are transported to, and become established in, locations outside their natural range. A wide variety of organisms can be marine bioinvaders, from tiny phytoplankton cells, to benthic invertebrates, to highly mobile fish. Marine bioinvaders arrive in new locations by a variety of vectors including ballast water, aquaculture operations, the intentional introduction of organisms for economic benefit or aesthetic purposes, the dumping of species imported for the aquarium trade (Gibson et al. 2001), and marine debris (Ritter 2002).

No comprehensive research to identify marine bioinvasions has been conducted in Nova Scotia, or in the Sydney Bight region. General information available about local marine bioinvasions is presented in Table 13-1

Table 13-1: Known marine biological invasions in Nova Scotia waters

Species	Origin	Invasion vector/s	Impact/s	Known distribution in Nova Scotia
Fucus serratus	Europe	• Ballast water	• Competes with native algae	Yarmouth, Lunenburg, Bras d'Or Lakes, all around Cape Breton Island
Furcellaria lumbricalis			• Outcompetes *Chondrus crispus* (Irish moss)	Sparingly along the Atlantic coast
Codium fragile	Japan	• Cultured oysters • Hull fouling • Packing materials for shell fish products	• Replaces native kelp beds • Attaches to and causes displacement of oysters	Central and southern areas along the Atlantic coast
Littorina littorea (Common periwinkle)	Europe	• Intentionally released as food source, or introduced with ballast rocks	• Predation, grazing and disturbance impact native flora and fauna	Found in the intertidal all along the coast
Carcinus maenas (Green crab)	Europe		• Competes with native crab species	Atlantic coast, Bras d'Or Lakes, Cape Breton coast
Styela clava (Club tunicate)			• Fouls aquaculture gear	
Ciona intestinales		• Ballast water • hull fouling • transfer of aquaculture products	• Fouls aquaculture gear	
Salmo salar (cultured) (Altantic salmon)	Sea pens	• Escapes from sea pens or rearing facilities	• Compete with native fish populations • May threaten genetic integrity and survival of local populations	Possible scattered occurrences wherever salmon are reared in aquaculture

Compiled from: Cameron et al. 2002; Chapman et al. 2002; Mallet 2002; Novaczek 2002; Ricciardi 2002; and Whorisky 2002.

Preventing bioinvasions

Given the ship traffic and increase in aquaculture in the Sydney Bight region, the introduction of exotic marine species is increasingly probable. Despite this, little is being done to monitor the introduction or to limit the spread of marine bioinvaders.

An issue of particular concern to Sydney Bight is proposed siting of a ballast water exchange zone for all ships entering the Gulf of St. Lawrence in the adjacent Cabot Strait/Laurentian Channel (Transport Canada 2000). Petrie and others (2001) suggest that particles released in the Cabot Strait could potentially be advected to Sydney Bight. The exchange of ballast in this could therefore potentially lead to unwanted species introductions to Sydney Bight.

14 – Tidal marshes

Tidal marshes are intertidal areas with soft substrate that are colonized primarily by grasses. In Nova Scotia there are two types of tidal marsh: salt marshes and coastal fresh marshes. These areas occur only in places where there is regular flooding and nearby fine sediment sources (Davis and Browne 1996a).

Salt marsh

Salt marshes occur on stable or emerging coastlines when sediment collects in sheltered intertidal areas in estuaries, behind spits, bars, or islands (Davis and Browne 1996a). A salt marsh consists of two vegetational zones: the high marsh and the low marsh. The high marsh is located above mean high water level and is inundated only during the highest tides or storm surges. The low marsh is located below mean high tide level and is frequently inundated by marine waters (typically twice daily).

Salt marsh flora consists of salt tolerant flowering plants, algae and microscopic fungi (Davis and Browne 1996a). In Atlantic Canada, the high marsh is dominated by salt marsh hay (*Spartina patens*) and the low marsh is dominated by the cord grass (*Spartina alterniflora*) (Hawkins 1997). High salt marsh vegetation is dominant and low salt marsh vegetation is subdominant in salt marshes along the northern peninsula of Cape Breton Island. Dominant vegetation type varies in salt marshes along the bays and estuaries in the southern coast of Sydney Bight (NSDNR 2002a).

Compared to other areas of Nova Scotia, Unit 11 is not known for its tidal marshes. There are, however, tidal marshes scattered in the sheltered bays and estuaries all along the coast from Bay St. Lawrence to Scatarie Island (LACRMP 1995; ECBCRMP 1997; NSDNR 2002a). The most extensive areas of salt marsh are found in Aspy Bay, Spanish Bay, Lingan Bay, Glace Bay, and Morien Bay (Figures 14-1,2,3,4,5) (NSDNR 2002a). In many areas, eelgrass beds are found in the lower intertidal and subtidal zones adjacent to the salt marshes.

Coastal fresh marshes

Coastal fresh marshes form when freshwater runoff moderates the effect of salt water on the low-lying coast. In these marshes, salt tolerant plants are replaced by salt intolerant species. Like salt marshes, coastal fresh marshes are productive areas. Primary production is carried out mostly by the grasses, sedges and rushes that dominate in these areas (Davis and Browne 1996a).

The aquatic fauna found in coastal fresh marshes is considered poor and is made up of insects and their larvae (Corixidae, flies, and mosquitoes), freshwater molluscs and other invertebrates. These marshes do provide important feeding habitat in fall and early winter for migratory waterfowl and important breeding areas for some species of ducks.

A number of small mammal species also inhabit coastal fresh marshes (Davis and Browne 1996a).

Threats to tidal marsh habitat

Human activities have been, and continue to be, the greatest threat to tidal marshes and the cause of considerable habitat loss. These activities include dyking, damming, draining, road and causeway construction, improper culvert sizing and placement, urban and industrial development, pollution, and invasion by non-native plants & animals (Bowron 2001). Hatcher and others (1981) suggest that due to the limited extent and fragile nature of Atlantic coast salt marshes, any sort of intensive activity in these areas should be avoided.

Salt marshes are also subject to many natural pressures including storm surges, flooding, ice scouring and changes in water current and sediment patterns (Bowron 2001)

Eelgrass beds

Eelgrass ecosystems form part of the overall inshore or estuarine system (Kikuchi 1980). Locally, eelgrass beds are common in sheltered bays with soft sediment bottoms along the Atlantic coast of Nova Scotia (Davis and Brown 1996a). Situated below mean tidal low water to 10 m depth (Harrison and Mann 1975), they are typically associated with tidal marshes and require fine sediments in which to anchor their roots (Davis and Brown 1996a).

Within Unit 11, eelgrass beds are found in sheltered bays and inlets along the coast between St. Anns Bay and Mira Bay. They are specifically found in St Anns Bay (Englishtown-Jersey Cove, and Harbourview), Little Bras d'Or River, Sydney Harbour, Lingan Bay, Glace Bay, Morien Bay, False Bay, Mira Bay and Halls Pond (LACRMP 1995; VCCRMP 1997; NSDNR 2002a). The most extensive areas of eelgrass are located in St. Anns Bay and Little Bras d'Or River (Figues 14-6,7), and behind barrier beaches in Lingan, Glace Bay and Morien Bay (Figures 14-3,4,5) (NSDNR 2002a).

Threats to eelgrass beds

Eelgrass ecosystems are fragile and vulnerable to both natural and anthropogenic threats. Regardless of its source, eelgrass beds are also generally slow to recover from most types of disturbance (Davis and Browne 1996a). As a natural colonizing community, however, no replacement community will colonize the disturbed area except *Zostera marina* (Thannnheiser 1984). Potential threats to eelgrass ecosystems are listed below.

Natural biological threats

Wasting disease, caused by the fungus *Labyrinthula* sp., sporadically decimates eelgrass beds. In the 1930s, this disease caused a massive eelgrass die off along the Atlantic coast of North America (Thannheiser 1984). There were resulting adverse effects on geese populations (Davis and Browne 1996a) and eelgrass beds were slow to recover from this event (Thannheiser 1984). Other natural threats to eelgrass beds include storm damage, rain-induced salinity fluctuations and ice scour (Thayer et al. 1984).

Anthropogenic threats

Eelgrass protects the shoreline, therefore human settlements often occurred, and continue to occur, in areas protected by eelgrass beds. Due to the increasing development in such areas, eelgrass beds are threatened by human activities and the by-products of human activities (A.S. Chapman and A.R.O. Chapman pers. comm. 2001). Eelgrass habitats located in unpopulated areas are often in locations identified as potential aquaculture sites (Gregory 2002).

Many different human activities threaten eelgrass by physically removing plants, or by altering physical or chemical environmental conditions. Thayer and others (1984) suggest that the following activities have cumulative and detrimental environmental effects on eelgrass beds:

- Dredging and infilling
- Commercial fishery and harvesting techniques
- Recreational vehicles
- Modification of normal temperature and salinity regimes
- Addition of organic and inorganic chemical wastes
  - Petroleum and related compounds
  - Inorganic nutrient discharges
  - Chemical pesticides

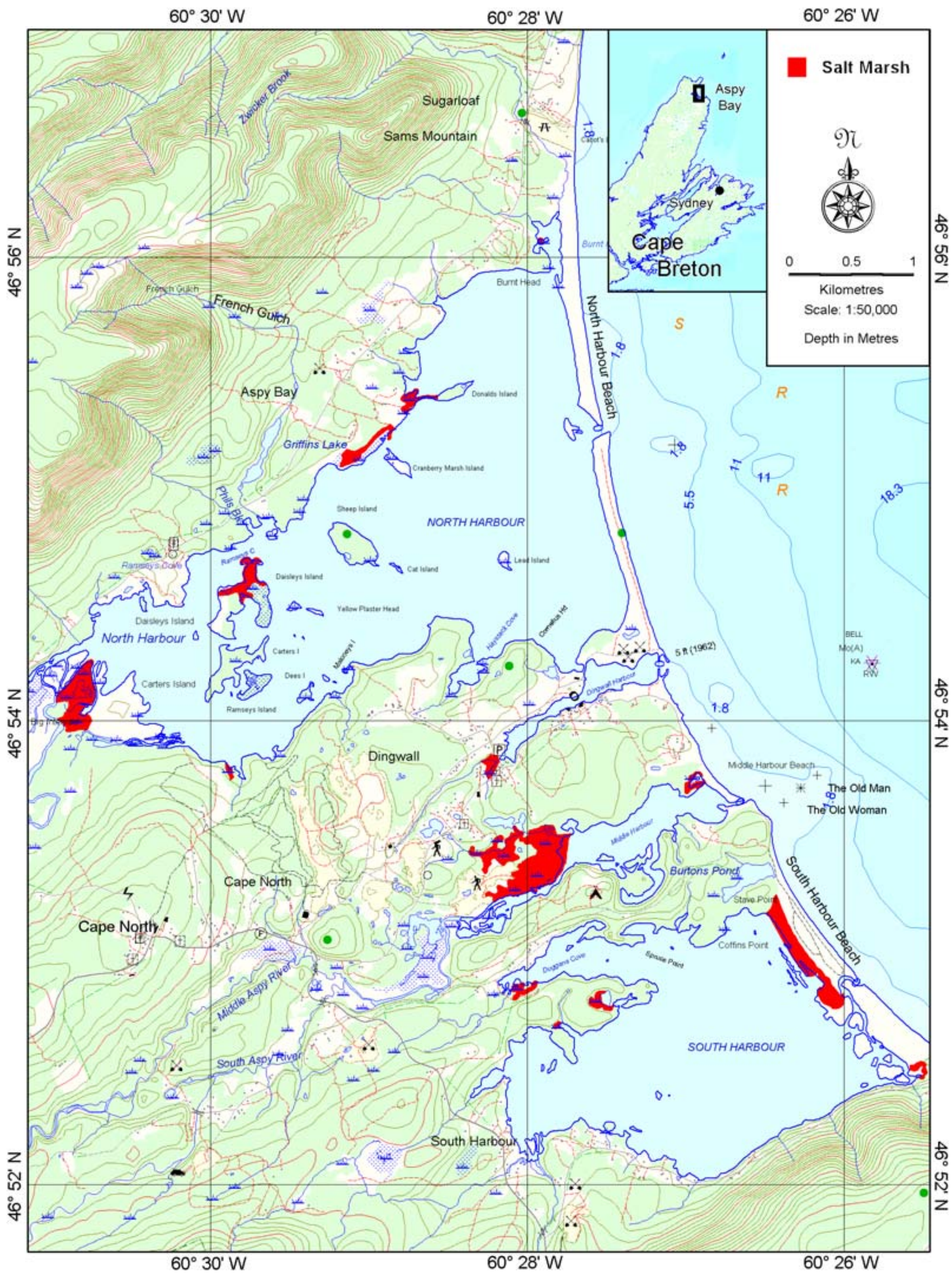


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Figure 14-1: Salt marsh habitat in Aspy Bay

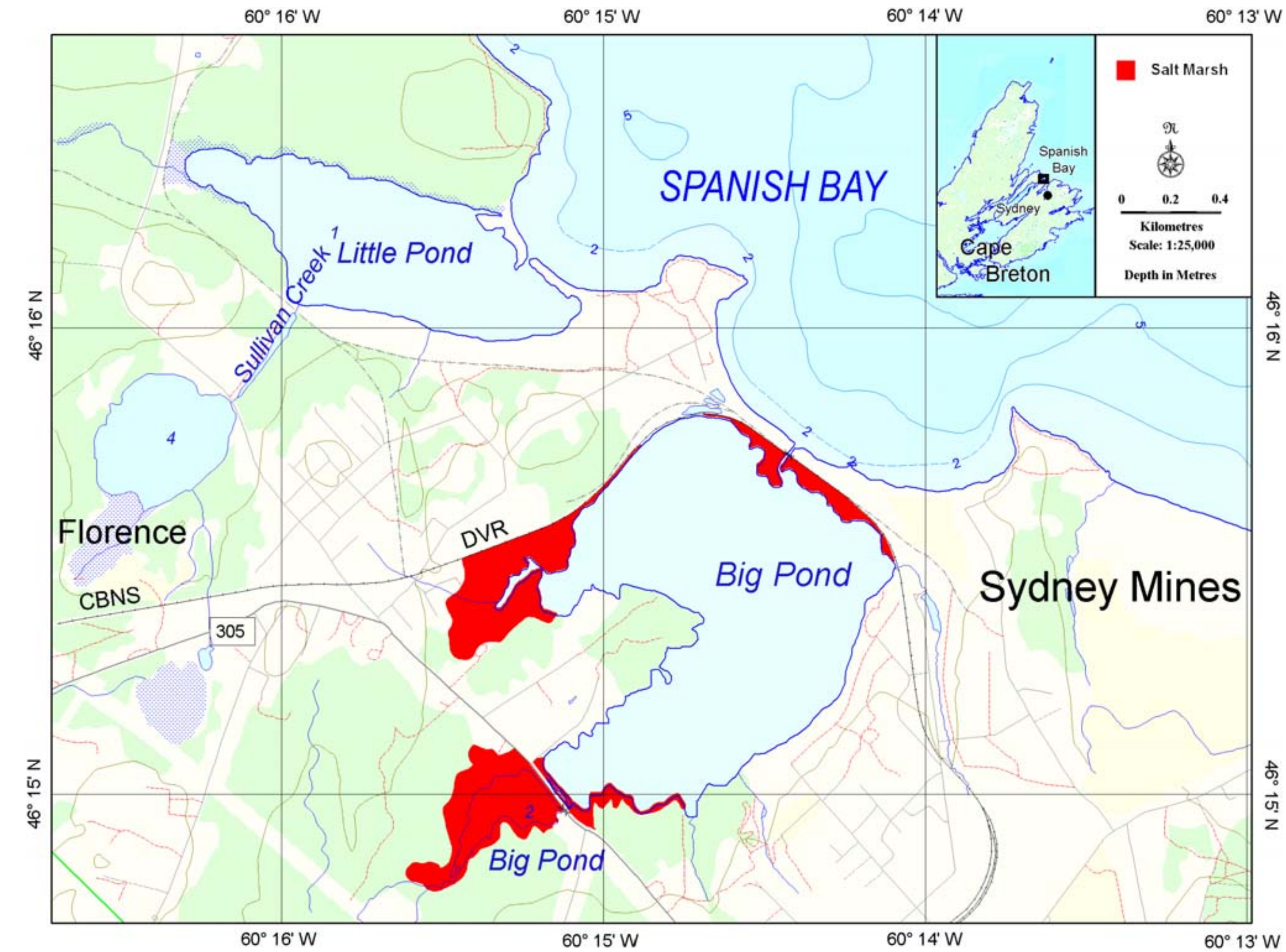


Figure 14-2: Salt Marsh aera in Spanish Bay, Sydeny Bight

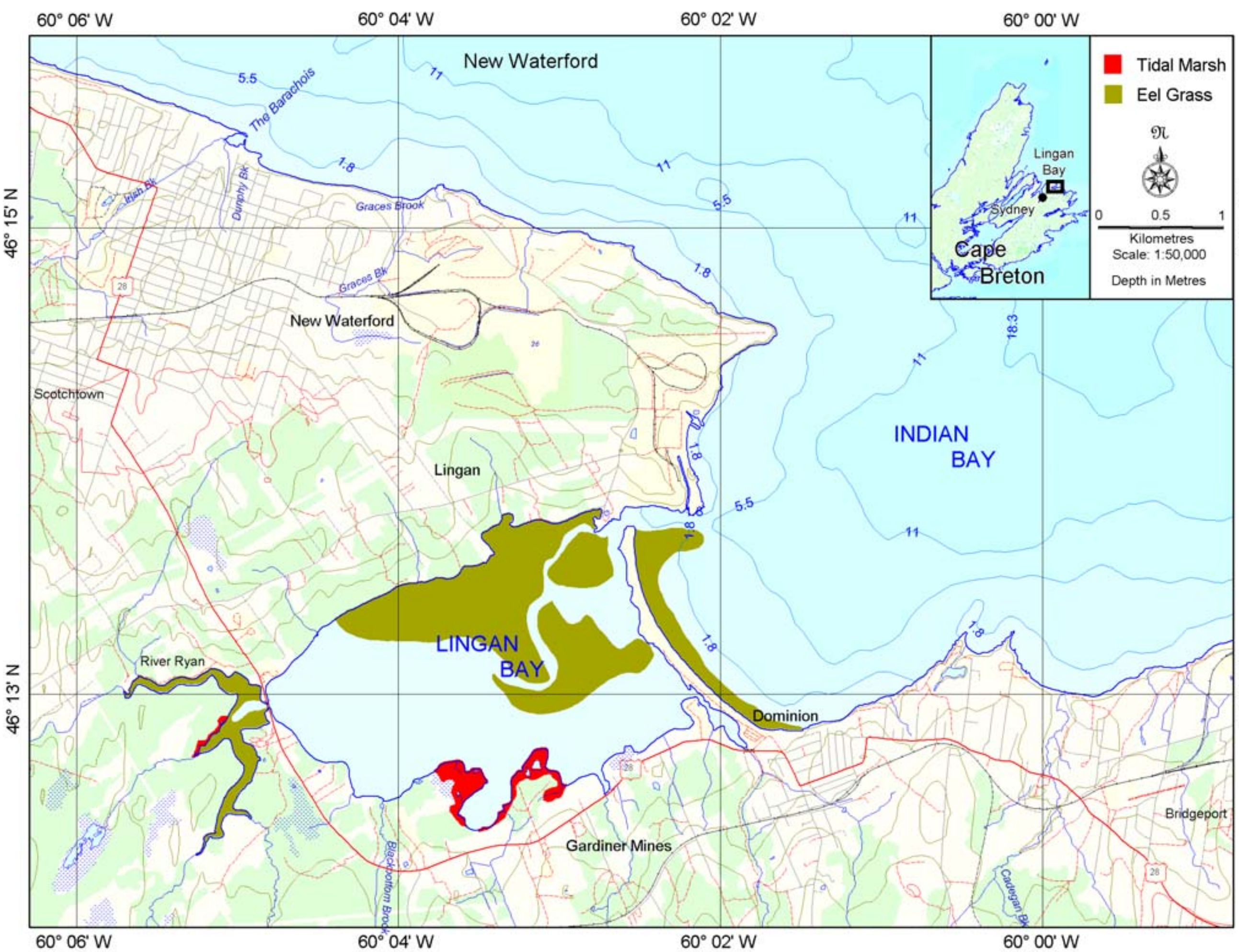


Figure 14-3: Tidal marsh and eelgrass habitat in Lingan Bay

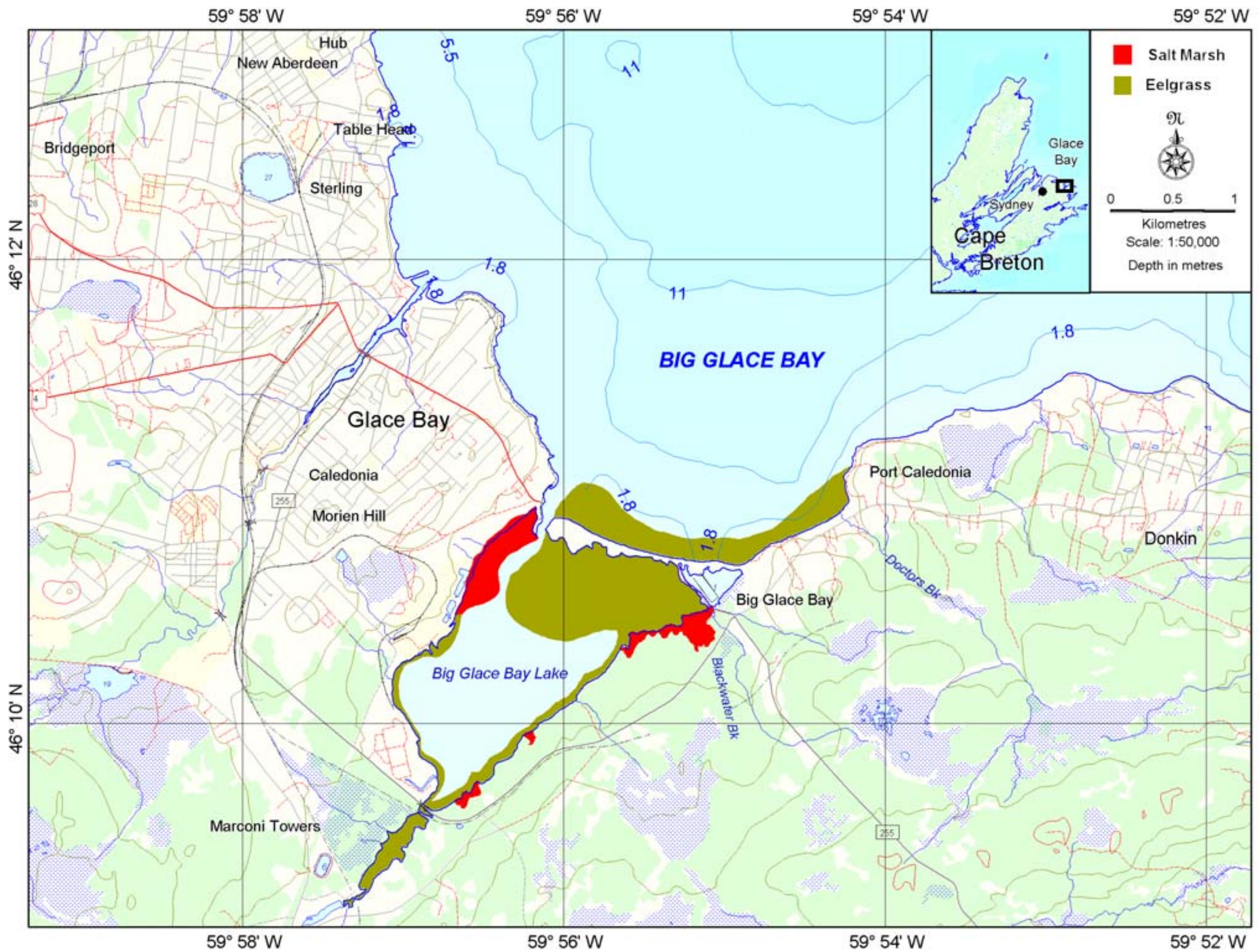


Figure 14-4: Salt Marsh and eelgrass habitat in Glace Bay

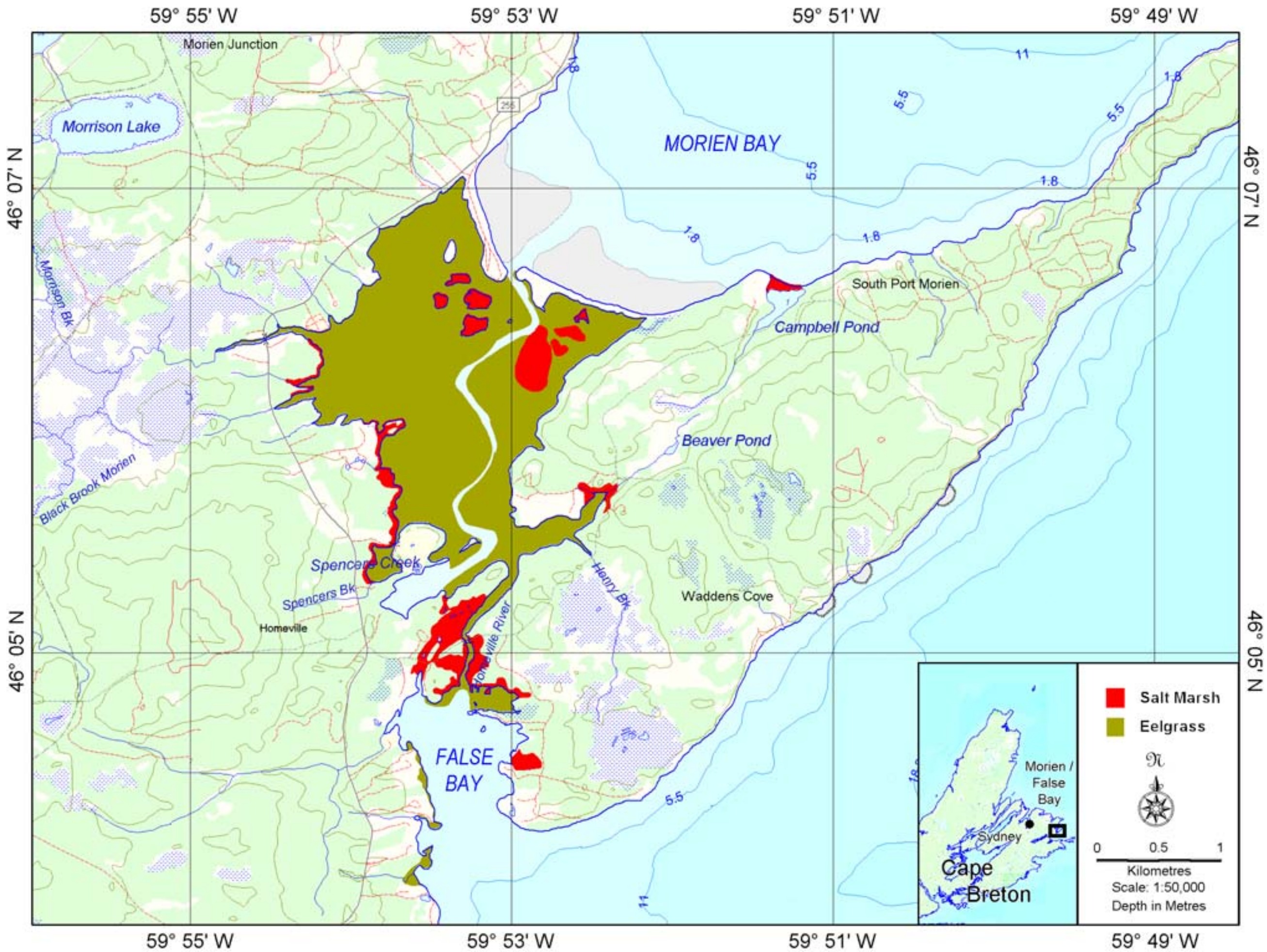


Figure 14-5: Salt Marsh and eelgrass habitat in Morien Bay and False Bay

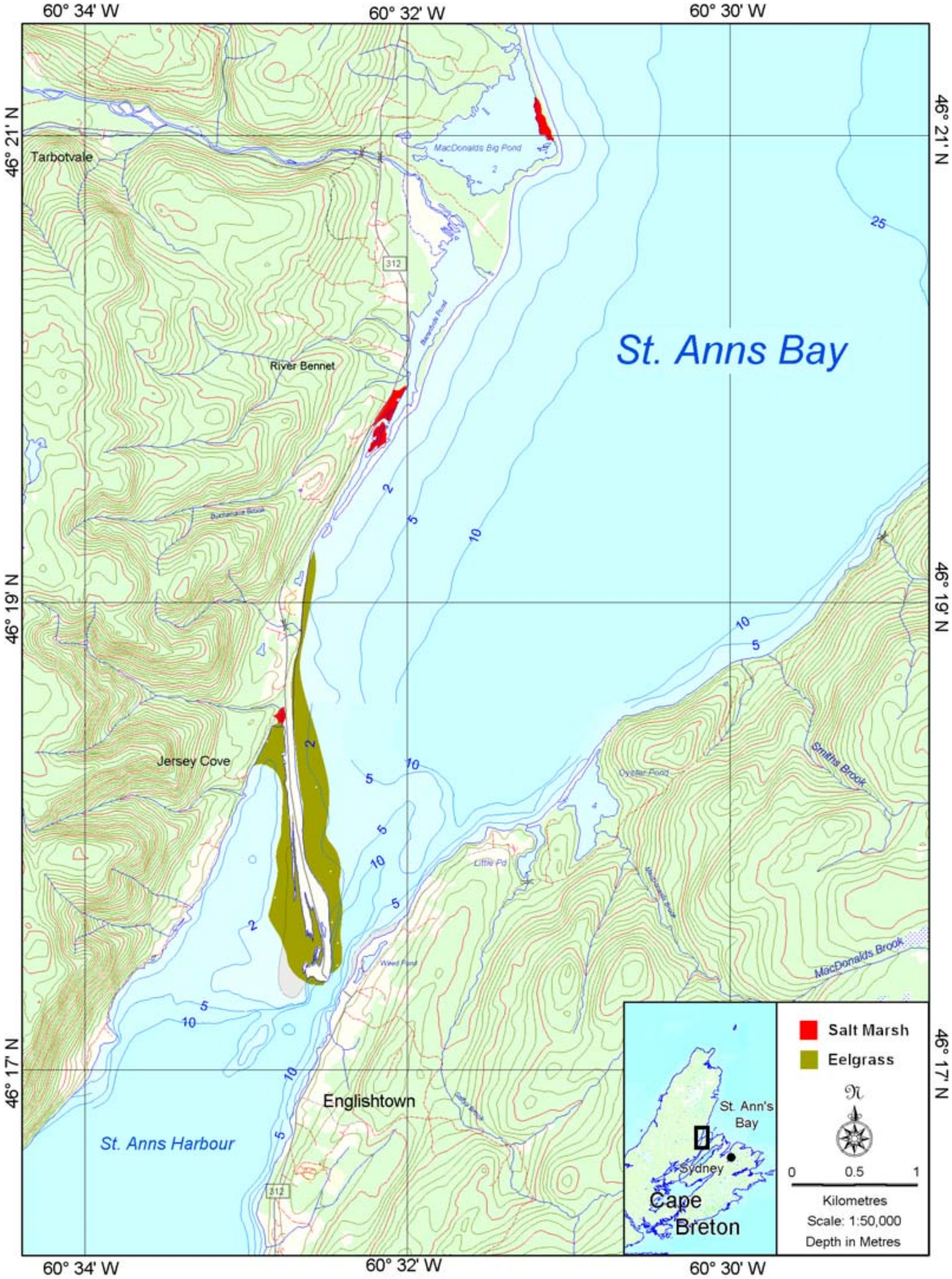


Figure 14-6: Eelgrass habitat in St. Anns Bay and St. Anns Harbour

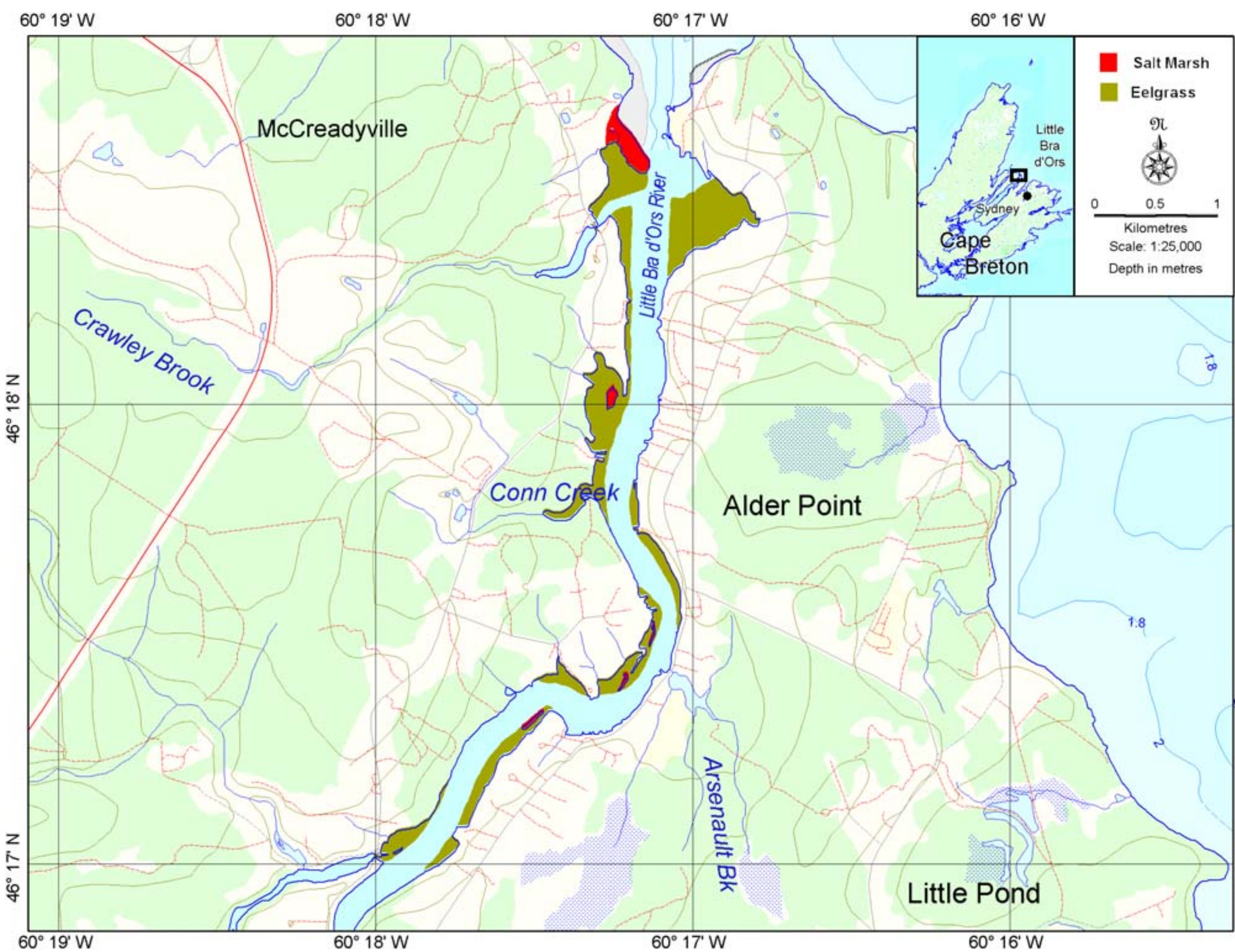


Figure 14-7: Salt marsh and eelgrass habitat in Little Bras d'Or River.

15 - Restricted land use areas

Several coastal areas located within Unit 11 fall under some category of restricted land use. These areas are set aside for different reasons including recreational use, education and enjoyment, wildlife protection and the protection of natural landscape. Varying levels of use are permitted on the different land designations. These areas should not all be considered protected from human activities or other possible threats. In this section, the restricted land use areas found within Unit 11 are listed and briefly described.

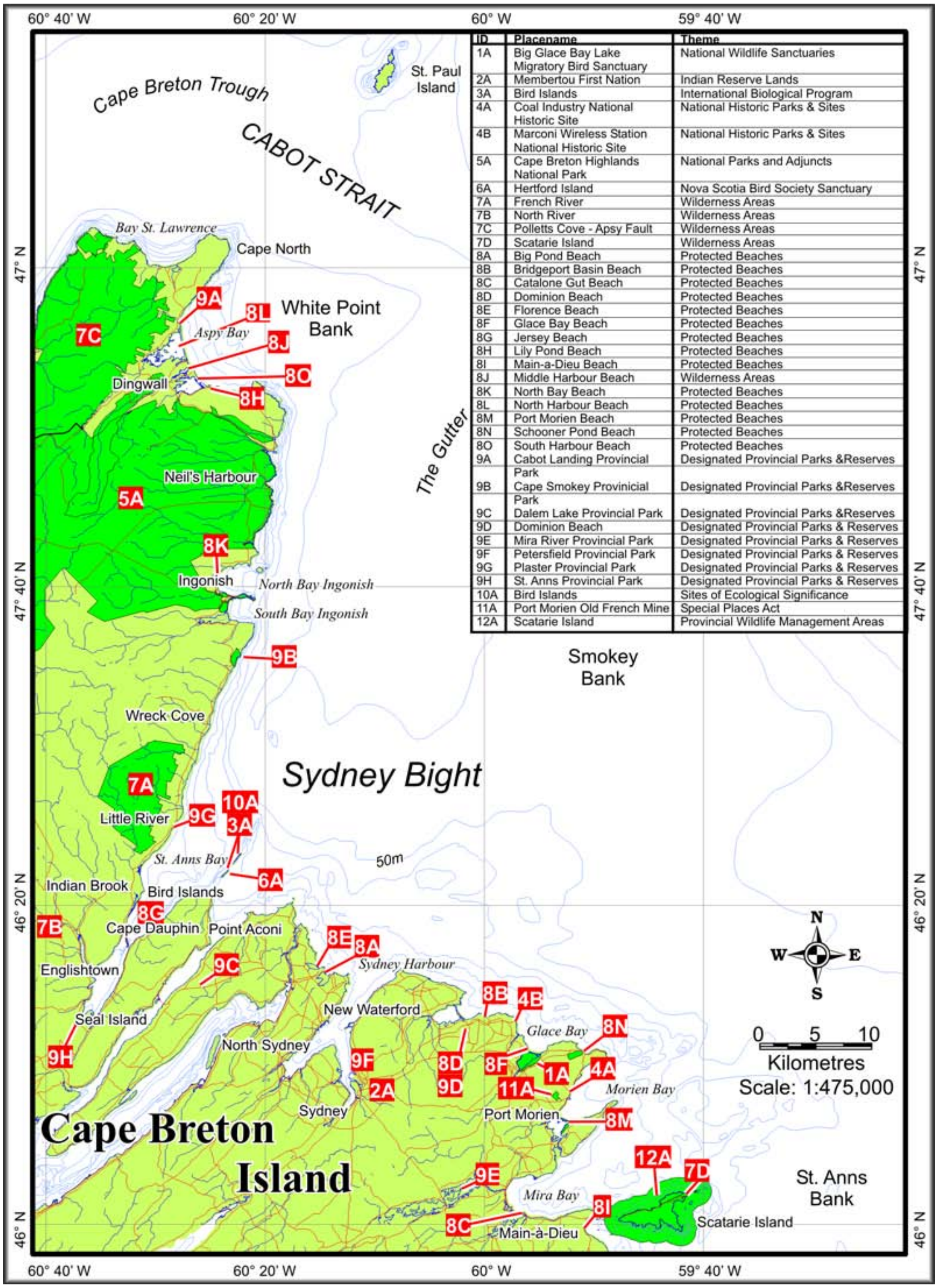
Types of restricted land use areas

There are many different categories of restricted land use areas found in SHACI Unit 11. These areas are designated by various levels of government or by private organizations and have different uses and levels of protection. In this section, the different restricted areas are presented (Table 15-1; Figure 15-1) and the locations are briefly described.

Table 15-1: Restricted land use areas in Unit 11

Designation	Location/s	
Federal Migratory Bird Sanctuary	• Big Glace Bay Lake Migratory Bird Sanctuary	
Indian Reserve Lands	• Membertou First Nation	
International Biological Programme	• Bird Islands	
National Historic Site	• Coal Industry National Historic Site	• Marconi Wireless Station National Historic Site
National Park	• Cape Breton Highlands National Park	
Nova Scotia Bird Society Sanctuary	• Hertford Island	
Nova Scotia Wilderness Area	• French River • North River	• Pollets Cove – Aspy Fault • Scatarie Island
Protected Beach	• Big Pond Beach • Bridgeport Basin Beach • Catalone Gut Beach • Dominion Beach • Florence Beach • Glace Bay Beach • Jersey Cove Beach • Lily Pond Beach	• Main-a-Dieu Beach • Middle Harbour Beach • North Bay Beach • North Harbour Beach • Port Morien Beach • Schooner Pond Beach • South Harbour Beach
Provincial Park	• Cabot's Landing Provincial Park • Cape Smokey Provincial Park • Dalem Lake Provincial Park • Dominion Beach Provincial Park	• Mira River Provincial Park • Petersfield Provincial Park • Plaster Provincial Park • St. Anns Provincial Park
Sites of Ecological Significance	• Bird Islands	
Special Places Protection Act	• Port Morien Old French Mine	
Wildlife Management Area	• Scatarie Island	

Compiled from: Canadian Committee for the IBP-CT 1974; Special Places Program 1991; Burnet and Hundert 1994; Office of the Legislative Council Nova Scotia House of Assembly 1999; Province of Nova Scotia 2002a; 2002b.



ID	Placename	Theme
1A	Big Glace Bay Lake Migratory Bird Sanctuary	National Wildlife Sanctuaries
2A	Membertou First Nation	Indian Reserve Lands
3A	Bird Islands	International Biological Program
4A	Coal Industry National Historic Site	National Historic Parks & Sites
4B	Marconi Wireless Station National Historic Site	National Historic Parks & Sites
5A	Cape Breton Highlands National Park	National Parks and Adjuncts
6A	Hertford Island	Nova Scotia Bird Society Sanctuary
7A	French River	Wilderness Areas
7B	North River	Wilderness Areas
7C	Polletts Cove - Apsy Fault	Wilderness Areas
7D	Scatarie Island	Wilderness Areas
8A	Big Pond Beach	Protected Beaches
8B	Bridgeport Basin Beach	Protected Beaches
8C	Catalone Gut Beach	Protected Beaches
8D	Dominion Beach	Protected Beaches
8E	Florence Beach	Protected Beaches
8F	Glace Bay Beach	Protected Beaches
8G	Jersey Beach	Protected Beaches
8H	Lily Pond Beach	Protected Beaches
8I	Main-a-Dieu Beach	Protected Beaches
8J	Middle Harbour Beach	Wilderness Areas
8K	North Bay Beach	Protected Beaches
8L	North Harbour Beach	Protected Beaches
8M	Port Morien Beach	Protected Beaches
8N	Schooner Pond Beach	Protected Beaches
8O	South Harbour Beach	Protected Beaches
9A	Cabot Landing Provincial Park	Designated Provincial Parks &Reserves
9B	Cape Smokey Provinicial Park	Designated Provincial Parks &Reserves
9C	Dalem Lake Provincial Park	Designated Provincial Parks &Reserves
9D	Dominion Beach	Designated Provincial Parks & Reserves
9E	Mira River Provincial Park	Designated Provincial Parks & Reserves
9F	Petersfield Provincial Park	Designated Provincial Parks & Reserves
9G	Plaster Provincial Park	Designated Provincial Parks & Reserves
9H	St. Anns Provincial Park	Designated Provincial Parks & Reserves
10A	Bird Islands	Sites of Ecological Significance
11A	Port Morien Old French Mine	Special Places Act
12A	Scatarie Island	Provincial Wildlife Management Areas

Figure 15-1: Restricted land use areas in SHACI Unit 11. Compiled from: Canadian Committee for the IBP-CT 1974; Special Places Program 1991; Burnet and Hundert 1994; Office of the Legislative Council Nova Scotia House of Assembly 1999; Province of Nova Scotia 2002a; 2002b

Big Glace Bay Lake

Migratory Bird Sanctuaries (MBS) are sites scheduled under the federal *Migratory Bird Convention Act* (1917) and managed to protect migratory birds, their nests and eggs (Burnet and Hundert 1994). The Migratory Bird Sanctuary Regulations prohibit all disturbance, hunting and collection of migratory birds and their eggs within a MBS. Visitors to these sanctuaries are not allowed to carry firearms or let their pets run at large (CWS 2002).

Big Glace Bay Lake is the only federal Migratory Bird Sanctuary in Unit 11. The 4.5 km^2 sanctuary borders the town of Glace Bay on the northeast shore of Cape Breton. Big Glace Bay Lake is a coastal lagoon enclosed by a barrier beach, with one tidal opening at the northeastern end. The tidal range is 2 to 3 m. At low tide, more than half of the lagoon area is exposed as mud and sand flats or intertidal eelgrass beds. There are industrial plants (thermal power, former heavy water) on the western side of the lagoon. The lagoon has mainly low-lying shores with low cliffs that fringe the seacoast to the east and west and generally remains open to the sea in the winter, except when winds press sea ice onshore in the spring (BSC 2002).

Big Glace Bay Lake is considered a continentally significant spring and fall stopover area for Canada Geese from the Newfoundland and Labrador breeding population. The site is also used by small numbers of ducks, shorebirds and terns. Piping Plovers, an endangered species, have been recorded on the barrier beach and Willets and American Black Ducks frequent the associated salt marsh (BSC 2002).

Threats specific to this site include human disturbance and industrial pollution. Big Glace Bay Lake is one of few sand beaches located near the Glace Bay/Sydney area (125 000 population). A private road on the east side of the beach allows motor vehicle access to the beach.

Membertou First Nation

According to the *Indian Act (R.S. 1985, c. I-5)*, Indian Reserve Lands are reserves held by Her Majesty for the use and benefit of the respective bands for which they were set apart. Subject to this Act, and to the terms of any treaty or surrender, the Governor in Council may determine whether any purpose for which lands in a reserve are used or are to be used is for the use and benefit of the band.

The only Indian Reserve Land located in the vicinity of Sydney Bight is the Membertou First Nation community. Membertou is part of the greater tribal group of the Mi'kmaq Nation, and is situated 1.6 kilometres south of Sydney within the traditional tribal district of Unamaki. The First Nation has a population of about 1000 and resides on approximately 45.2 hectares of land (Membertou First Nation 2002).

Bird Islands

Hertford Island and Ciboux Island, located roughly 4 km off Cape Dauphin, are collectively known as the Bird Islands. The long, narrow islands are oriented in a northeast/southwest line. Ciboux Island is the larger of the islands (1.6 km long, 120 m wide), and is located further offshore. Hertford Island is roughly 1.1 km long and 120 m wide. The habitats associated with the islands include open sea, inlets, coastal cliffs, and rocky shores, and the perimeters of both islands consist of steep, 20 m high cliffs with many holes and ledges (BSC 2002).

The Bird Islands are recognized for their importance as bird habitat by several organizations. The International Biological Programme recognized the important bird nesting sites, particularly for Black Guillemot, Common Puffin and Leach's Storm-petrel, as attributes of exceptional interest (Canadian Committee for the IBP-CT 1974). The Bird Islands were also recognized as a Site of Ecological Significance (Special Places Program 1991). The only official designation related to the Bird Islands is the designation of Hertford Island as a Nova Scotia Bird Society Sanctuary. For more information about the Bird Islands, please refer to the section on Marine associated birds, the Significant Habitats section, or the Bird Islands section.

Marconi National Historic Site

Canadian national historic sites are administered by Parks Canada and are part of Canada's program of historical commemoration, which recognizes nationally significant places, persons and events. Commemorations are essentially an expression of the public's identification of significant aspects of our history. Recently, the view of what constitutes heritage has broadened considerably to include industrial complexes, transportation corridors, urban and rural historic districts, cultural landscapes, and sacred places and traditions (Parks Canada 2000a).

The Marconi National Historic Site of Canada is located in Glace Bay on five acres of land at Table Head, an extensive, barren promontory that juts out into the Atlantic Ocean. The grounds are bounded by 18 m cliffs. The site consists of a visitors' centre where the public can learn about the life and work of Guglielmo Marconi. Marconi was a physicist who proved it was possible to send messages across the Atlantic using electromagnetic waves instead of wires (Parks Canada 2000a).

Cape Breton Highlands National Park

National Parks are natural areas of Canadian significance that have been acquired by Canada. They are designated by Parliament and Parks Canada administers and controls the parks under the authority of the *National Parks Act*. Parks are managed for the benefit, education and enjoyment of Canadians so as to leave them unimpaired for future generations (Burnet and Hundert 1994).

Cape Breton Highlands National Park was established in 1936 as the first national park in the Atlantic Provinces. Stretching across the northern tip of Cape Breton Island between the Gulf of St. Lawrence and the Atlantic Ocean, the park protects 950 km^2 of highland and coastal wilderness (Parks Canada 2002b). On the Atlantic side, coastal areas of the park extend roughly from Ingonish to Neil's Harbour.

Provincial Parks

There are eight provincial parks located in, or associated with, coastal areas within Unit 11 (Table 15-1). Several of these areas are simply picnicking areas; however, others have additional features.

Cabot's Landing Provincial Park

This park is located on the shores of Aspy Bay about 10 km north of the Cabot Trail. Cabot's Landing has picnic tables in open fields and beach access. There is also an interpretive cairn of historical significance. The park is generally open from late May to early October (Tourism Cape Breton 2002).

Cape Smokey Provincial Park

Cape Smokey Provincial Park is located on top of Smokey Mountain on the Cabot Trail. The park has picnic tables, look off views and an 11 km (return) trail along the coast. The park is generally open from late May until early October (Tourism Cape Breton 2002).

Petersfield Provincial Park

Peterfield Provincial Park is located on 10 ha in Westmount, near Sydney. The park is considered a cultural/heritage site and contains the remnants of four cultural periods dating from the late 1700s to the mid 1900s (NSDNR 2002b). The park offers walking trails, a picnic area and interpretive signage. The park is open year-round and has a view of the south arm of Sydney Harbour, picnic tables, interpretive signs and an extensive network of trails (Tourism Cape Breton 2002).

Dominion Beach Provincial Park

Dominion Beach Provincial Park is located on a sandy beach near the town of Dominion. The park has boardwalks providing beach access and protecting the dunes, supervised swimming, facilities for the disabled, canteen, toilet and showers (Province of Nova

Scotia 2002a). The park is generally open from late May to early October (Tourism Cape Breton 2002).

Plaster Provincial Park

This park is located on the Cabot Trail near St. Anns Bay. It is primarily a picnic park with rolling topography and several ponds in sinkholes. There is also a short trail that leads down to St. Anns Bay. The park is generally open from late May to early October (Tourism Cape Breton 2002).

Dalem Lake Provincial Park

This park is located on a small lake on Boularderie Island. It is primarily a picnic park, but also has a white sand beach, a boat launch for non-motorized boats and a 1.5 km trail. The park is generally open from late May to early October (Tourism Cape Breton 2002).

St. Anns Provincial Park

St. Anns Provincial Park is a small picnic park on the shore of North Gut at the head of St. Anns Harbour.

Mira River Provincial Park

Mira River Provincial Park is located on a peninsula with natural coves and swimming areas. It is open from mid-June until early September (Tourism Cape Breton 2002). The park has campsites, a picnic area, boat launch, a trailer dump station and a large unsupervised beach (NSDNR 2002b).

The Port Morien Old French Coal Mine

This site is designated under the Nova Scotia *Special Places Protection Act*. The mine, established by the French in 1720, is the location of the first regular coal mining operation in America (Nova Scotia Museum 1996).

Scatarie Island

Scatarie Island is a large forested island located off the easternmost tip of Cape Breton. The rocky shores lead to stunted forests of spruce and balsam fir, heath barrens and sphagnum bogs. Scatarie Island is recognized as an Important Bird Area for its nationally significant population of male Bicknell's Thrushes (not a marine bird). Other birds that frequent the island include an unknown number (possibly 1000s) of breeding Leach's Storm-petrels, large numbers of southward-migrating Whimbrels that feed inland on crowberries, foxberries, blueberries, bake-apples and cranberries from July to September, and Buff-breasted Sandpipers (BSC 2002).

Scatarie Island is designated both a Wildlife Management Area (WMA) under the *Wildlife Act* and a Wilderness Area (WA) under the Nova Scotia *Wilderness Areas Protection Act*. These designations allow for different levels of activity; however, since the WA protections are more robust, they largely override those of the WMA designation (D. MacKinnon pers. comm. 2002). These designations also differ in that WA are confined to the land, while the WMA designation extends into the water (R. Milton pers. comm. 2002).

Although the island is not inhabited, the nesting and migrating birds may be disturbed by campers, hunters (some who hunt Whimbrels), fishermen, sea-kayakers and others pursuing various outdoor recreational activities (BSC 2002).

Wilderness Areas

The Nova Scotia government designates Wilderness Areas under the *Wilderness Areas Protection Act* (1998). This Act designates areas selected as representative samples of natural landscapes and ecosystems, and ensures that ecological integrity, natural ecological processes and biodiversity are maintained in the designated areas. WA designation does not extend into the water (R. Milton pers. comm. 2002). Traditional sport fishing and hunting are still permitted in WA (McEachern 1997), and in exceptional circumstances intervention by habitat manipulation or other means is permitted if native biodiversity is at risk (D. MacKinnon pers. comm. 2002). Some areas are designated both as WMAs and Wilderness Areas. In such cases, the more robust Wilderness Area protections largely override those of the WMA designation .

There are four Wilderness Areas found in Unit 11. Scatarie Island is mentioned above and the other three areas are described below.

Pollet's Cove-Aspy Fault Wilderness Area

This WA is located in the highlands on the northern tip of Cape Breton. Its coastal areas lie mainly on the Gulf of St. Lawrence side, however land within the Aspy Bay and Bay St. Lawrence watersheds is within the WA boundary.

North River Wilderness Area

The North River Wilderness Area includes land within the North River watershed. While this WA does not include any land bordering Sydney Bight, the North River does drain into St. Anns Harbour.

French River Wilderness Area

The French River Wilderness Area does not include any land bordering Sydney Bight; however, its watershed drains into St. Anns Bay and Sydney Bight. This Wilderness Area lies just inland from the coast and extends roughly from just north of Indian Brook to French River.

Protected beaches

The Nova Scotia *Beaches Act* is protects beaches and associated dune systems. Its regulations control land-use activities on the beach, including recreational activities that may impact the beach ecosystem. The *Beaches Act* also promotes educational programs to encourage and raise awareness of the environmental functions, features, capability, and suitability (DNR 2004).

The Beaches Regulations were developed under Section 13 of the *Beaches Act* and listrestrictions to removing beach aggretate, developing a beach, vehicle access, etc. The regulations also describe management agreements with land owners adjacent to a beach, penalties, and notices (DNR 2004).

Fifteen Protected Beaches found along the shores of Sydney Bight are protected under the *Beaches Act*.

1. Big Pond Beach
2. Bridgeport Basin Beach
3. Catalone Gut Beach
4. Dominion Beach
5. Florence Beach
6. Glace Bay Beach
7. Jersey Cove Beach
8. Lily Pond Beach
9. Main-a-Dieu Beach
10. Middle Harbour Beach
11. North Bay Beach
12. North Harbour Beach
13. Port Morien Beach
14. Schooner Pond Beach
15. South Harbour Beach

16 - Coastal Industry

Fishery

Sydney Bight lies within the NAFO Division 4Vn. In recent years, the main catches in this area have been herring, groundfish, snow crab, and lobster (Table 16-1). Of this groundfish catch, redfish have on average made up 55% of the total (DFO 2002b).

Table 16-1: Principal species in 4Vn catch: 1996 - 2001 (in metric tonnes)

Species	1996	% of Total	1997	% of Total	1998	% of Total	1999	% of Total	2000	% of Total	2001	% of Total
Groundfish	2172.7	19.6	3070.2	27.5	3253.4	36.0	3298.0	35.9	2283.7	30.8	1207.1	18.0
Herring	4782.1	43.2	4325.1	38.8	2205.0	24.4	1761.7	19.2	942.4	12.7	1471.1	22.0
Mackerel	1593.7	14.4	835.5	7.5	553.6	6.1	756.2	8.2	725.1	9.8	121.4	1.8
Lobster	1518.8	13.7	1292.7	11.6	1266.2	14.0	1329.1	14.5	1417.6	19.1	1591.1	23.8
Snow crab	593.1	5.4	637.3	5.7	807.5	8.9	1089.6	11.9	1360.4	18.3	1453.9	21.7
Other	416.5	3.8	998.5	8.9	946.1	10.5	945.0	10.3	692.3	9.3	846.8	12.7
Total	11076.9	100.0	11159.3	100.0	9031.7	100.0	9179.6	100.0	7421.4	100.0	6691.4	100.0

Data source: DFO 2002b

Invertebrates

A variety of marine invertebrates are harvested in Sydney Bight. Catches recorded in Sydney Bight include include: soft shell clam, oyster, scallop, lobster, shrimp, Jonah crab, rock crab, snow crab, stone crab, sea urchin, Stimpson surf clam, squid, and winkle (DFO 2002b). The seasonal timing of fishing activity in Sydney Bight also varies for different marine invertebrates. Known seasons and locations are listed for certain invertebrate species in Table 16-2 (Tremblay et al. 2001; Biron et al. 2001). Generally, fishing activity may be occurring year round; however, most activity occurs between May and October. Fishing activity also occurs at varying depths from <32 m for lobster to depths of over 250 m near the edge of the Laurentian Channel for stone crab.

Table 16-2: Fishing information for invertebrate species in Sydney Bight

Species	Area/Fishing Zone	Depth fished	Season fished
Lobster	Area 27	<32 m	May 15 - July 15
Snow crab	Areas 20 - 22	140 - 250 m	July 22 - September 15
Rock crab			Late July - May. Most activity: August - October
Toad crab		35 - 80 m	Intermittent exploratory
Northern stone crab		Deep water - edge of Laurentian Channel	Intermittent exploratory

Compiled from: (Biron et al. 2001; Tremblay et al. 2001)

Lobster

Sydney Bight is located within Lobster Fishing Area (LFA) 27 (Figure 16-1). Lobster stocks in this area are historically among the most productive in coastal Nova Scotia (Tremblay et al. 2001), and second only to southwestern Nova Scotia in landings per unit of coastline (Hudon 1994). In LFA 27, the lobster fishing season lasts roughly from May 15 to July 15.

Lobster landings in LFA 27 are generally widespread along the coast, but most landings occur in the central part of Sydney Bight. Fishing activity occurs in fairly shallow water (<32 m) and the port of landing is typically within 10 km of where the lobsters were captured (Tremblay et al. 2001). In recent years, lobster landings have dropped from an all time maximum of 3790 tonnes in 1990 to 1591 tonnes in 2001 (DFO 2002b). Five hundred and thirty nine lobster licenses are fished in LFA 27, and each license holder is permitted to fish 275 traps (Collins et al. 2001).

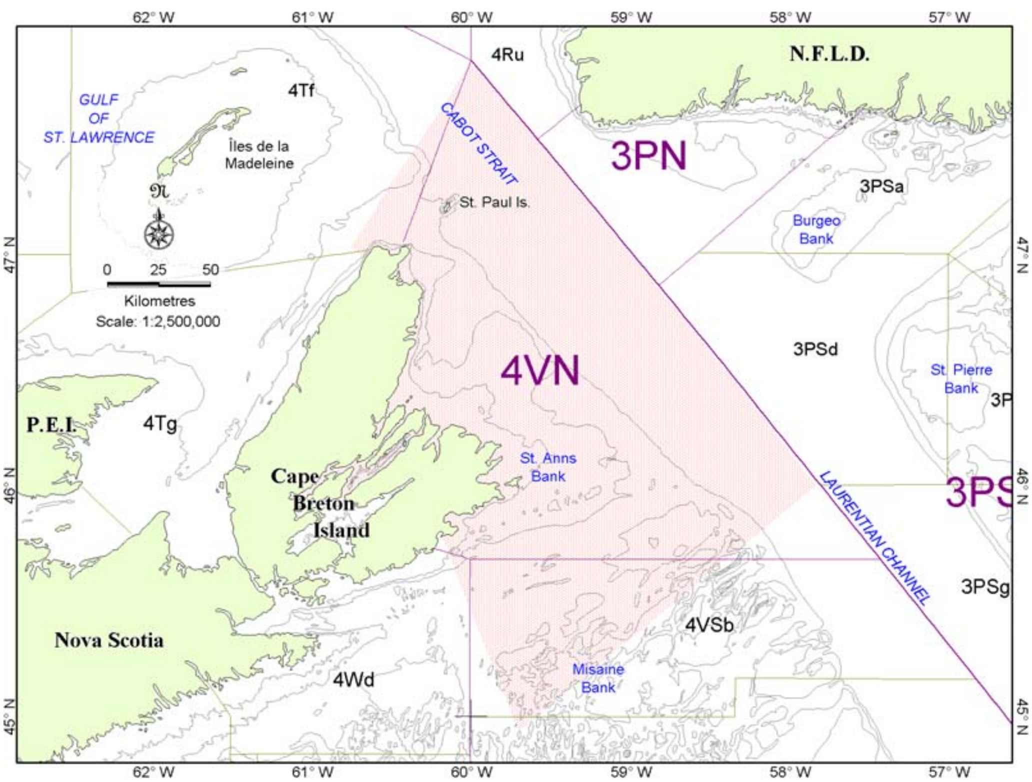


Figure 16-1: Lobster Fishing Area 27 (shaded) in SHACI Unit 11

Snow crab

The snow crab fishery is a major fishery in Sydney Bight. Snow crab are fished in the summer, roughly between July 22 and September 15, when they are typically found in deep water (140-250 m) (Biron et al. 2001). To manage this fishery, fishing grounds are divided into Crab Fishing Areas (CFAs). The Eastern Nova Scotia (ENS) management area includes CFAs 20-24; SHACI Unit 11 encompasses CFA 20, 21 and 22 (Figure 16-2). Crabs are harvested using fixed gear (crab traps/pots). Traps are set singly on the seafloor and marked using a buoy. Snow crab was first harvested commercially off the coast of ENS in the late 1970s. In 1979, landings peaked at 1634 t, but collapsed to near commercial extinction by 1985. Landings gradually recovered and rose again from 1987 - 1993 when peak levels reached 2016 tonnes. After a 23% decline in 1994, landings remained stable until 1996. Since that time, landings have increased steadily to reach 9917 tonnes in 2001. Landings specific to Sydney Bight (CFA 20-22) reached a peak of 1066 t in 2001 (Table 16-3), and have contributed to between 10 - 27% of the total ENS landings since 1990 (DFO 2002a).

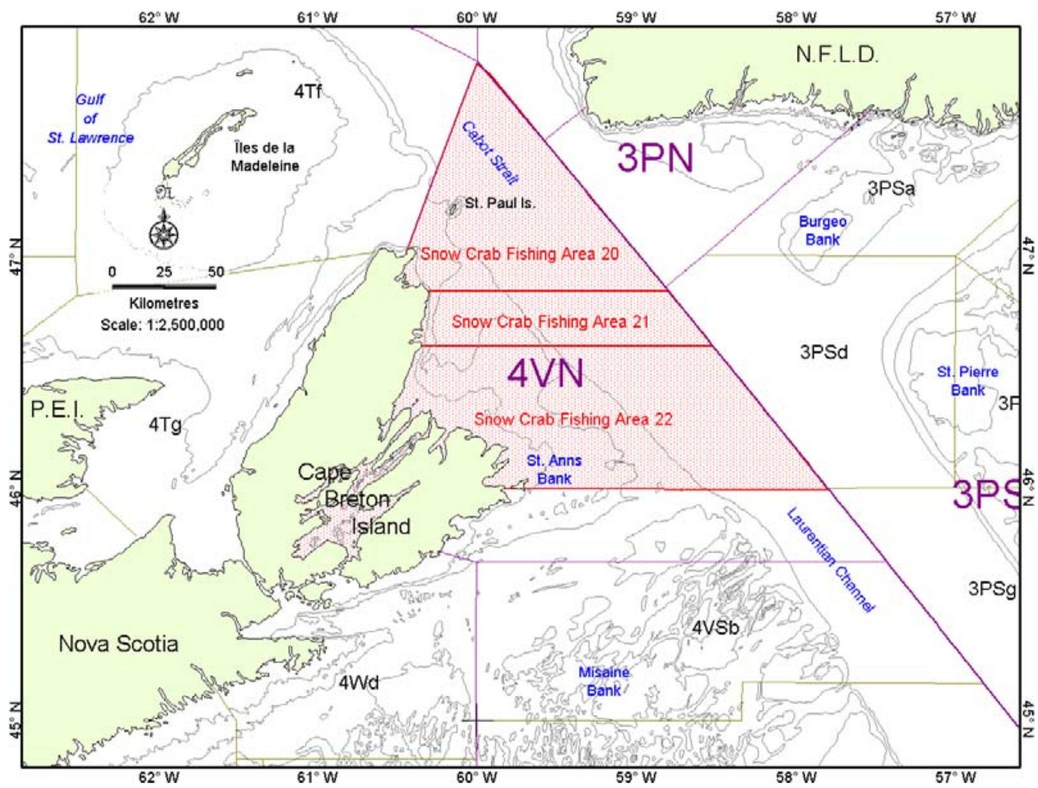


Figure 16-2: Snow crab fishing areas (shaded) located in SHACI Unit 11

Table 16-3: Snow crab licenses and landings (t) for CFA 20, 21 and 22 – Sydney Bight

CFA	Regular licenses	Temporary permits	Traps allowed / license	Average 1990-94	Average 1995-99	1999	2000	2001
20	5	5	30	17	55	90	118	117
21	32	-	25	159	178	291	364	363
22	37	-	30	238	346	518	535	586
Total Unit 11	74	5		414	579	899	1017	1066
Total ENS				1631	2109	3599	9718	9917

Compiled from Biron et al. 2001; DFO 2002a

Scallops

Scallops are fished in localized nearshore areas of Sydney Bight. Most landings come from the southern half of Sydney Bight (Tremblay et al. 2001). Since 1996, scallop landings have varied between 7.9 and 16.4 t/year (DFO 2002b).

Sea urchins

Sea urchins are harvested for their gonads which are marketed in Japan. Since 1996, urchin catches in 4Vn have ranged between 27 and 76 t/year (DFO 2002b). The harvest is conducted by divers. Urchin licenses may be either exploratory or full-time limited access and there are no designated urchin fishery seasons. For permanent licenses there is no minimum landing, and for exploratory licenses, the minimum landing is 4 t/yr. During the 1999-2000 seasons, there were 13 urchin licenses in Victoria and Cape Breton counties; four were active and nine inactive. Fishing primarily occurs between September and March. Disease is a major threat to the biological and economic stability of the sea urchin fishery in Nova Scotia; however, incidences of this disease have not been observed in Victoria, Cape Breton and Richmond counties (DFO 2000b).

Marine fish

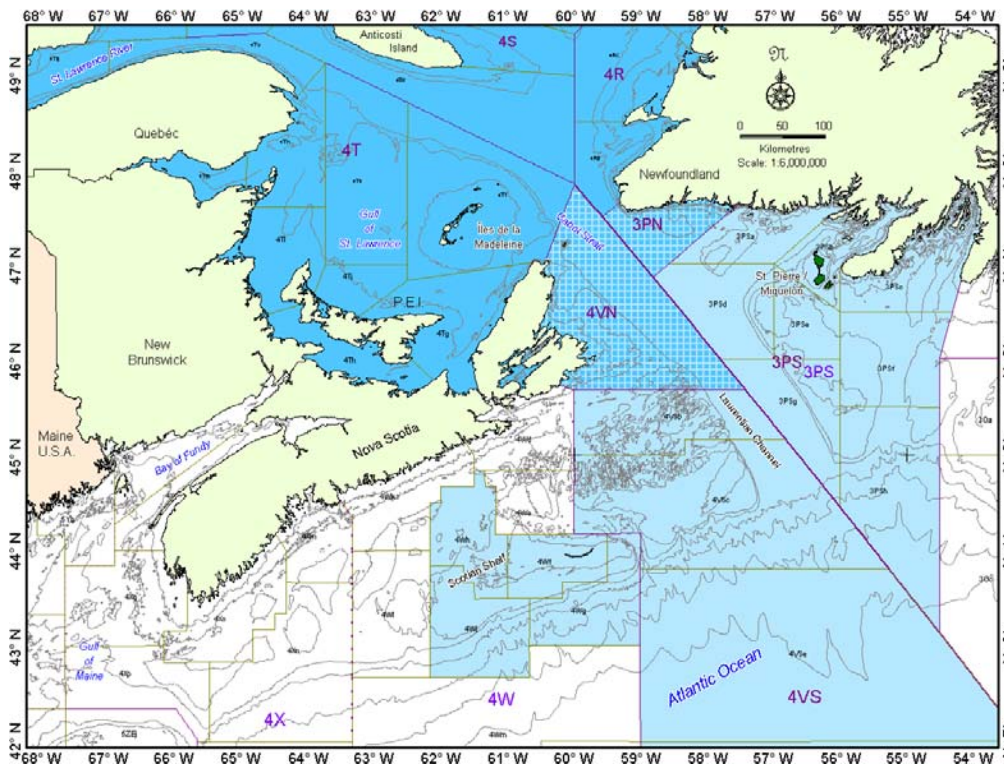
Cod

There is currently no directed cod fishery in 4Vn. Cod was once the most important groundfish species fished in 4Vn; however, this fishery was closed as part of the groundfish moratorium introduced in 1993.

Redfish

Making up approximately 55% of the annual groundfish catch since 1996 (DFO MFD Virtual Data Centre 2002b), redfish is currently the most important groundfish species harvested in 4Vn. It is caught primarily along the edge of the Laurentian Channel in 4Vs, extending into 4Vn (Collins et al. 2001). Gear used to catch redfish includes bottom otter trawls (stern), Danish seines, and longlines (DFO 2002b).

The 4Vn redfish fishery is considered part of the Gulf of St. Lawrence management unit (Unit 1) from January to May, and under the Laurentian Channel management unit (Unit 2) from June to December (Figure 16-3). This split in the management units is due to the migration of Gulf of St. Lawrence redfish into the 3PN and 4Vn area in the fall/winter. Unit 1 is currently under moratorium due to low stock abundance and the absence of significant recruitment since the early 1980s (Archambault et al. 2001), and the overall prognosis for the stock remains poor and is not expected to improve in the near future (Power 2001). No directed fishery is therefore permitted in Unit 1, and Unit 2 is closed in May and June during peak spawning. The directed redfish fishery in 4Vn occurs from July to September (DFO 2002b).



Figre 16-3: Redfish management Units 1 and 2. Unit 1 (dark blue) includes 4T, 4S, 4R and 4Vn and 3Pn (January -May only). Unit 2 (light blue) includes 4W, 4Vs, 3Ps and 4Vn and 3Pn (June-Dec. only)

American plaice

Most 4Vn American plaice catches are made in spring and fall (DFO 2000c). Fishing effort in 4Vn is concentrated on the "Glace Bay Hole" area (Collins et al. 2001). Since 1996, American plaice catches have been roughly 380 t, comprising on average 14% of the 4Vn groundfish catch. In 4Vn, American plaice is fished primarily using Danish seines and otter trawls; however, longlines and handlines are also used (DFO 2002b).

Herring

Several herring fisheries occur in Sydney Bight. North of Cape Smokey, overwintering herring from the Southern Gulf of St. Lawrence are fished commercially by a Gulf-based seining fleet (>65 feet). In 1997 the 4Vn landings were 5669 t (Claytor et al. 1998). The 4Vn winter herring fishery is managed using size limits, closed areas, and by setting the opening date of the fishery to a date well into the 4T migration into 4Vn (typically November 1) (Claytor 1997). Fishing of overwintering herring is limited to the area above the Cape Dauphin line (North of Cape Smokey) (Figure 16-4). This management strategy focuses the fishery on the 4T population that forms a high proportion of the herring concentrations off Aspy Bay (Claytor and Leblanc 1998). The Scatarie line

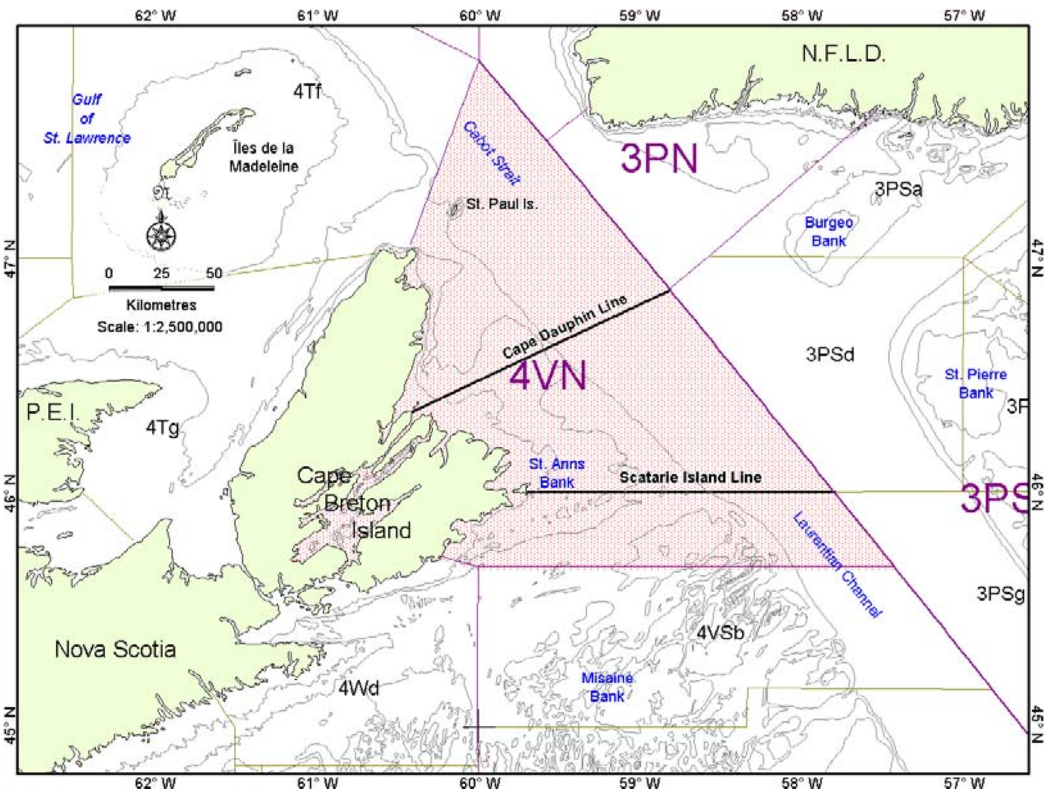


Figure 16-4: Herring NAFO division 4Vn management lines

marks the boundary of the 4WX herring fishery. Fishing by large seiners between these to lines is prohibited (Claytor 1997).

Other herring fisheries in Sydney Bight include the spring/summer bait fishery and the fall roe fishery. The bait fishery, which generally begins by mid-April and continues until the end of the lobster season, is largely to supply bait for the lobster fishery. Set nets, swing nets and trapnets are the gear types used in the bait fishery (Clark et al. 1999). The herring roe fishery occurs primarily off Glace Bay in September and October, but may also extend into November. Gillnets are typically used in the roe fishery, however trapnets are occasionally used as well (Collins et al. 2001). In 1999, this fishery occurred mainly on the “Red Grounds” off Sydney Mines, and in some areas further east (Stephenson et al. 2000).

Mackerel

Mackerel is fished commercially in the Maritimes and Quebec between May and November. In Canadian waters, the largest commercial mackerel landings are made in Nova Scotia in May and June. Landings generally decline through the rest of the summer and then rise again in September and October. Annual landings from the eastern coast of Cape Breton (Statistical District 1) are the third highest in Nova Scotia (average: 1135 t/year) (Figure 16-5). Other important mackerel fishing areas on the east coast of Cape Breton include Statistical Districts 6 and 7. In District 1, the largest landings are made in June, September and

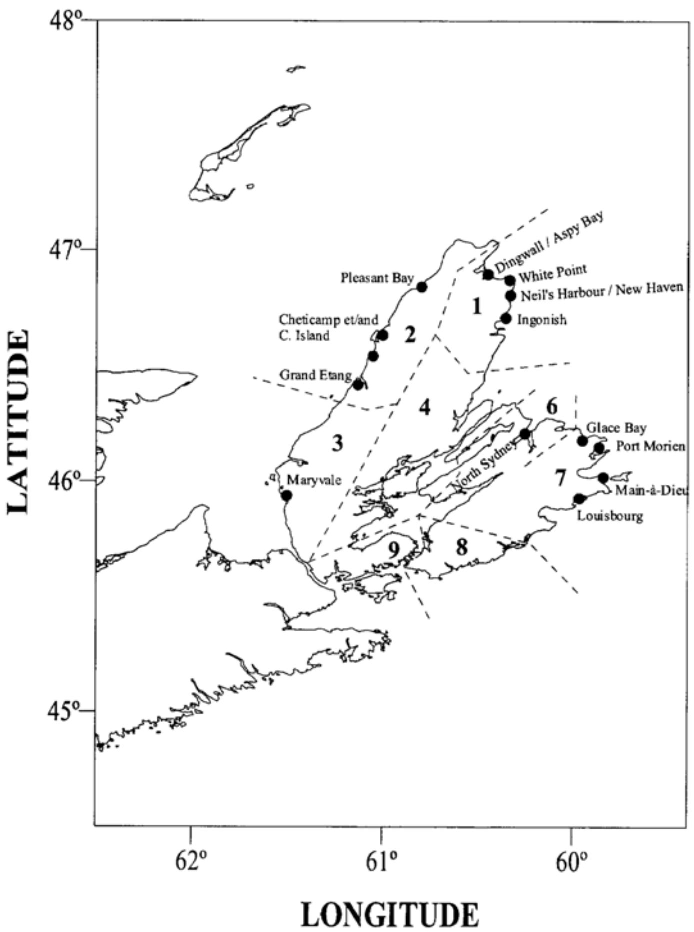


Figure 16-5: Main statistical districts and mackerel fishing communities on Cape Breton Island (Grégoire 2001)

October, while in Districts 6 and 7, the largest landings are made in September and October. Spring landings in District 1 are made primarily with traps, while in the fall in districts 1, 6, and 7 landings are made with jiggers and handlines and purse seines. The highest landings by Cape Breton fishing communities are made in the following order: Dingwall, Aspy Bay, Glace Bay, Port Morien, South Ingonish, Neil's Harbour, New Haven and White Point (Grégoire 2001).

Diadromous fisheries

The diadroumous fisheries are managed by DFO using Statistical Districts. The diadromous Statistical Districts found within SHACI Unit 11 include 1, 4, 6, and 7. These include areas within the Bras d'Or Lakes (Figure 16-6).

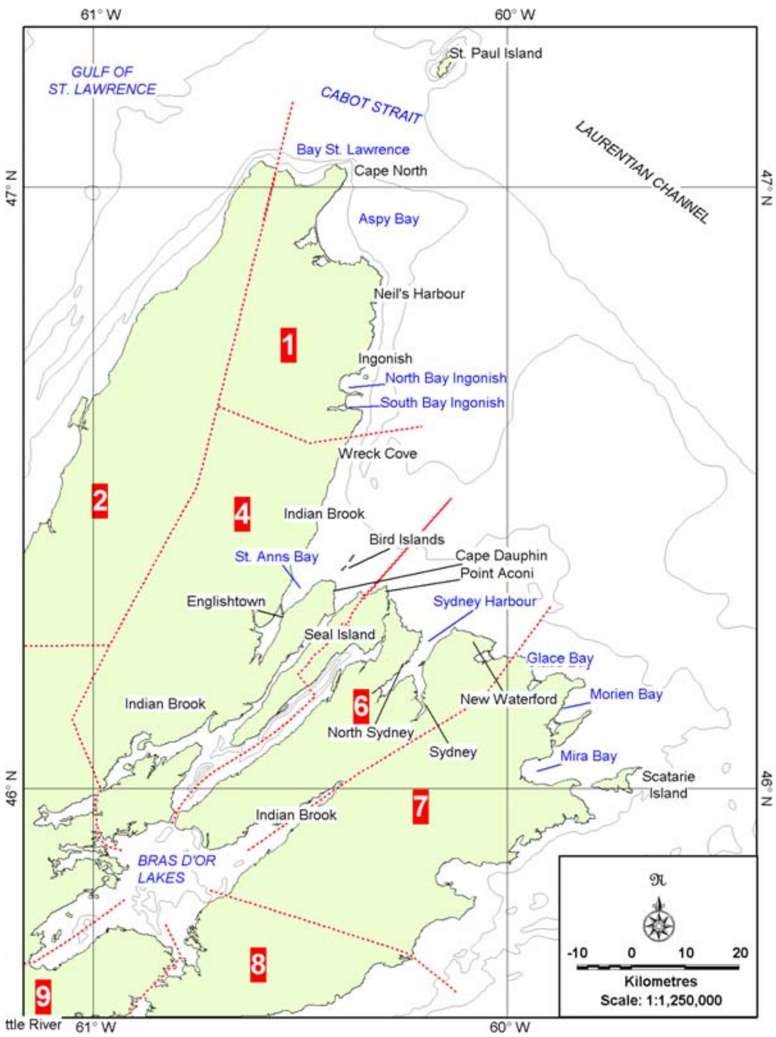


Figure 16-6: DFO diadromous fishery statistical districts in SHACI Unit 11

Gaspereau

In recent years, the gaspereau fishery in SHACI Unit 11 has occurred in the spring and early summer from April until July. Gear types used to fish gaspereau include trap nets, set gillnets and dip nets. Major gaspereau fishing areas include coastal areas around Main-à-Dieu, North Sydney and Sydney, Ingonish, Sydney River, and the Mira River (Table 16-4). In the Sydney Bight region, gaspereau are caught mostly for bait and personal use by fishermen. The bait is likely used in the lobster fishery (Diadromous Fish Division, 2002).

Table 16-4: Reported gaspereau landings in SHACI Unit 11

River/Coastal Area	Statistical District	Recorded Landings (kg) /year		
		1999	2000	2001
Catalone	7	199.5	0	214
Coastal Main-a-Dieu	7	2489	3929.2	2880.3
Coastal North Sydney	6	5099.8	3662.8	2073.1
Coastal Sydney Mines	6	0	578.4	1345
Coastal-Florence	7	229.1	0	0
Coastal-Scatarie Island	7	24.9	288.6	38.5
Ingonish	1	28894.2	294.8	0
Mira River	6&7	6279	5276	2794
Sydney	6	15867.8	10015.7	1451.6
Sydney River	6	0	0	10959.5
Totals		**59082.9**	**24045.7**	**21756.4**

Diadromous Fish Division, 2002

American eel

Eels are fished in many rivers and estuarine waters in Sydney Bight using eel pots or traps. In the past, most eels were sold locally by fishermen in Sydney (Shenacadie Sluice) and Glace Bay (Mira River, Inner Glace Bay Lake, Lingan Bay) or caught for personal use (Eales 1966). Recent recorded eel landings for rivers and coastal areas of SHACI Unit 11 are presented in Table (16-5). Major eel catches in recent years have come from the North Aspy River and the Mira River (Diadromous Fish Division, 2002).

Table 16-5: Reported American eel landings in SHACI Unti 11

River/Coastal area	Statistical District	Recorded landings (kg)/Year			
		1997	1998	1999	2000
Ingonish	1	285	-	590	4305
Coastal	6	-	-	-	39
False Bay	7	3.5	-	-	-
Lingan Bay	6	10	354	578	27
Little River	4	95	-	10	-
Mira River	6 and 7	991	5805	2374	2972
North Aspy River	1	3016	5244	2648	-
Sydney Bight	7	566	-	1150	48
Total		4966.5	11403	7350	7391

Data Source: Diadromous Fish Division, 2002

American shad

The shad fishery in Sydney Bight is very small. Since 1986, there are only two years with recorded landings, and the maximum landings were <0.5 metric tonnes. Gillnets are used to fish shad (DFO 2002b).

Rainbow smelt

There is a small rainbow smelt fishery in the Sydney Bight area. The reported landings in recent years from coastal areas of diadromous Statistical Districts 1, 4, 6 and 7 are presented in Table 16-6. This information does not include landings in the Bras d'Or Lakes. In most areas, set gillnets are used to catch smelts, except in the North River where box nets are used. The smelt fishery in the area typically occurs over the winter beginning as early as October and continuing until February. In recent years, the major rainbow smelt fishing areas have been Lingan Bay, North River and Sydney (Diadromous Fish Division, 2002). In Nova Scotia, reported rainbow smelt catches have generally declined since the mid-1960s (Jessop 1993).

Table 16-6: Reported rainbow smelt landings in SHACI Unit II

River/Coastal area	Statistical District	Recorded landings (kg)/year		
		1999	2000	2001
Ingonish Beach	1	-	20	21
Ingonish	1	52	-	-
Ingonish Harbour	1	25	-	-
Lingan Bay	6	337	477	-
Little Pond Beach	6	40	32	-
Little River	4	-	20	
Mira River	6 and 7	49	70.9	23
Morian Bay	7	40	22	-
North River	4	210	924	1260
River Ryan	6	214	40	-
Sydney	6	534	191	8.5
Total		1501	1797	1313

Data source: Diadromous Fish Division, 2002

Aquaculture

With the decline in traditional fisheries, aquaculture is increasingly providing an important source of shellfish and fish for human consumption (Beveridge et al. 1997) and an important economic base for coastal communities. Bays and estuaries with naturally high productivity, good tidal flushing and protection from heavy seas are ideal locations for aquaculture (Davis and Browne 1996a). Several such areas exist in Sydney Bight and are being used by the aquaculture industry to grow American oysters, blue mussels and salmonids.

The main areas for aquaculture in Sydney Bight are Aspy Bay (Figure 16-7), St. Anns Harbour (Figure16-8). Both waterbodies have extensive American oyster and blue mussel leases. There are American oyster aquaculture lease sites in Mira Bay and Mira River (Figure 16-9) (NSDAF 2005a). There is an Atlantic salmon and rainbow trout aquaculture operation in the Great Bras d'Or (Figure 16-8), as well as land based aquaculture operations in Lingan and Big Glace Bay Lake (Figure 16-10).

Species summaries

Aquaculture operations operate like farms in an aquatic environment, and like terrestrial farms, their success is predicated on adequate knowledge of, and appropriate provisions for, the basic biological requirements of cultured organisms at each stage of their life history. The following pages profile the biology, life cycle, feeding habits, growing techniques and farming areas of four of the more commonly produced species within SHACI Unit 11. The reader is encouraged to consult with the Nova Scotia Department of Agriculture and Fisheries for the most up-to-date aquaculture licenses and sites.

Blue mussels (Mytilus edulis)

Mussels are bivalve shellfish that grow quickly and profusely, two traits that make them ideal for aquaculture. They have two identical, convex shells. These shells are elongate, triangular and joined by a rubbery hinge ligament on the upper side. A commercial sized mussel takes 18-24 months to grow to about 50 mm. Mussels usually become sexually mature in late spring or early summer. Following some spawning stimulus, most mussels release some or all of their eggs and sperm in what looks like whitish or orange clouds in the water. Fertilization is external and in a very short time all the eggs are fertilized.

Once fertilized, the embryo quickly develops small cilia and begins to swim. After 48 hours, it develops into a trochophore larva, feeding on small phytoplankton cells and beginning to develop the distinctly D-shaped larval shell. The next stage is the veliger larvae. In 3 to 4 weeks, the mussel grows to a quarter millimetre in size. The larva develops a foot and gills and is ready to change into a juvenile mussel. It settles on a suitable hard substrate, such as a rock, wharf or boat, extends the foot and withdraws the velum. Finally, it secretes byssus threads and anchors itself to the surface where it will grow into a mature mussel.

Mussels are filter feeders, feeding by actively filtering particles from the water. Phytoplankton cells are their main food source which may be supplemented by decomposed macrophytes or resuspended detritus. Mussels cultured in eastern Canada are usually reared on long lines. These are typically 180 m ropes, anchored securely at both ends, and supported by floats tied at intervals along their length. Growers generally use concrete for anchors and mussel buoys for floats. Mussel farmers need lots of seed for a satisfactory harvest. Hundreds of plastic mesh or rope collectors are hung on the long lines just before the spat are expected to settle in the early summer. By fall, most settled spat have grown to about 15 mm. They are then stripped off the collectors and loaded into lengths of mesh tubing called socks. The socks are then taken to the farm and tied at intervals onto another long line where they will grow to market size. This takes 18 months to 3 years, depending on location, water temperature and the availability of plankton.

Mussels grow well in areas of good currents and clean water which is found all along the eastern shore. Blue mussels are the most widely cultured species of any kind in the Sydney Bight with 10 sites in SHACI Unit 11 (Figures 16-7 and 16-8) (NSDAF 2005b).

American oyster (Crassostrea virginica)

Native to the North American coast from the Gulf of Mexico to northern New Brunswick, this hardy species can live in a range of temperatures from -2°C to 32°C. It has a thick shell with a rough, sculptured appearance and varies in colour. Usually it is a mixture of brown, grey, green and white shades. Most American oysters take between four and seven years to reach market size. American oysters spawn in summer when the water warms up to above 20°C. The oysters release eggs and sperm into the water at intervals over a period of four to six weeks. The eggs become fertilized in the open water, subsequently developing into microscopic larvae that form shells and develop organs to help them swim and feed. For the next three weeks, the larva swims and feeds on microscopic plants in the plankton community. Soon the oyster reaches the size of a grain of pepper and searches for a place to settle. It then attaches itself and remains there to grow into a mature oyster. Adult oysters feed primarily on plankton; when water conditions are favourable, they do so almost continuously.

Bottom and off-bottom culture are commonly used techniques in the Maritimes. Off-bottom culture uses cages, floating long lines. Cultch (a substance used to attach spat) is strung like beads on wire or nylon rope. This wire or rope is then suspended above the bottom to collect the setting larvae. The collected spat are grown in suspension until they reach the desired length. Finally, they are separated from the cultch and either planted on the bottom or placed on trays that are suspended in the water. Held in suspension, the oysters grow quickly and develop plumper meats than those that are bottom grown. The requirement for warm (>20°C) water temperatures for spawning severely restricts the areas where oysters occur naturally. Natural populations are restricted to the Bras d'Or Lakes, northern Nova Scotia and a few pocket populations on the eastern seaboard. In SHACI Unit 11 there are 18 American oyster leases in Aspy Bay, St. Anns Harbour, Mira Bay and Mira River (Figures 16-7, 16-8 and 16-9) (NSDAF 2005a, NSDAF 2005c).

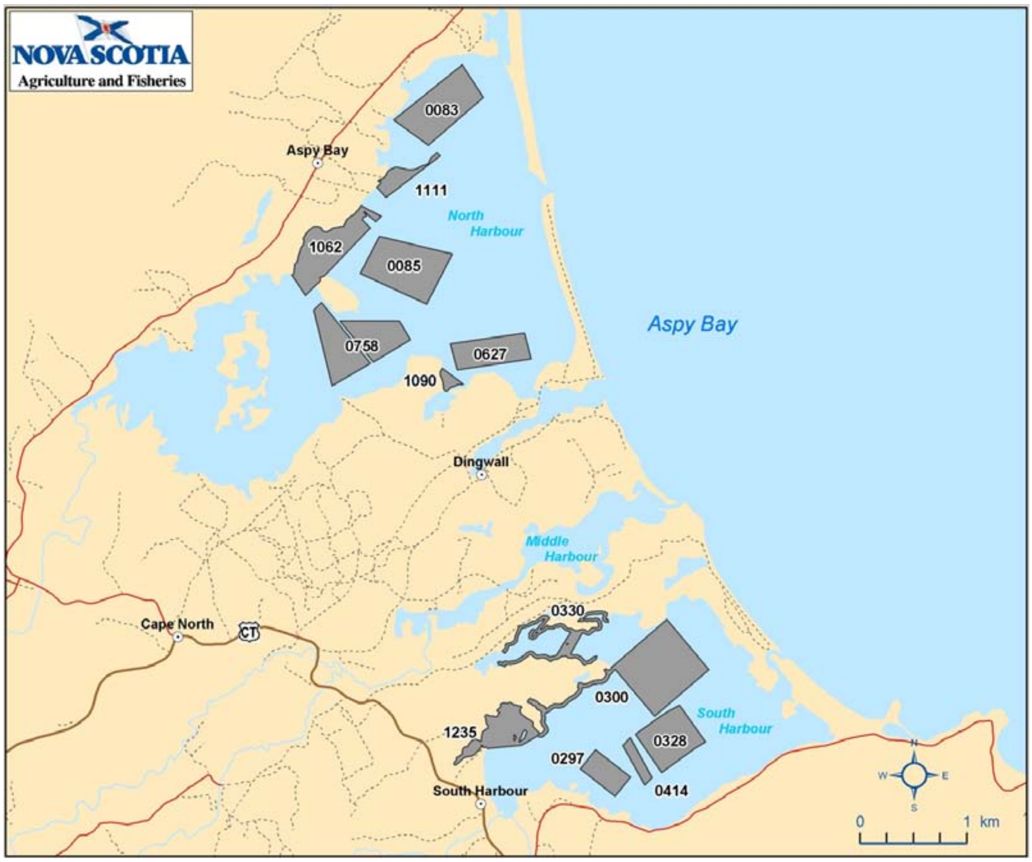


Figure 16-7: Blue mussel (leases 0083, 0085, 0758 & 0627) American oyster (leases 1111,1062, 1090, 0330, 0300, 1235, 0297, 0414 & 0328) aquaculture sites in Aspy Bay (NSDAF 2005a).

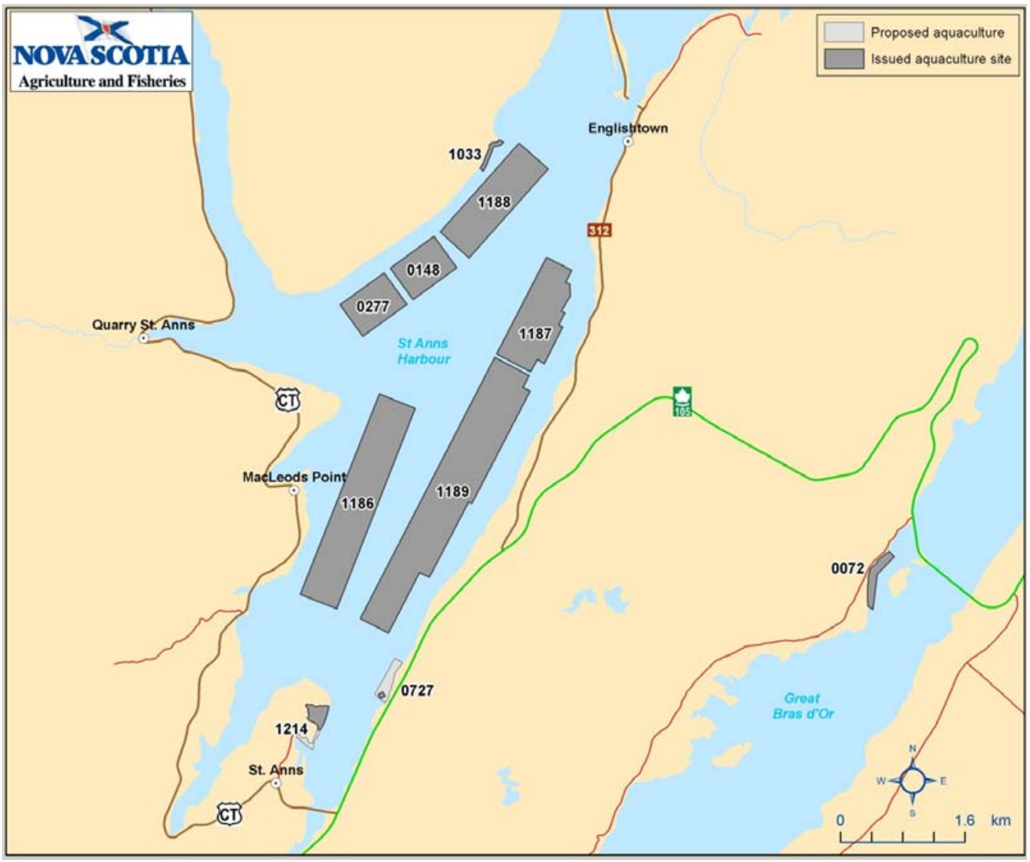


Figure 16-8: Blue mussel (leases 0277, 0148,1186,1187, 1188 & 1189), American oyster (leases 1033, 1214 & proposed 0727) aquaculture sites in St. Anns Harbour and Atlantic salmon, Rainbow trout (lease 0072) in the Great Bras d'Or (NSDAF 2005a).

Atlantic salmon (Salmo salar)

The Atlantic salmon has a long and laterally compressed body, a large mouth, large scales and a fleshy adipose fin on the back just in front of the tail fin. Average adult weights range between 2 and 10 kg, although they may grow much larger. These fish go through a number of different life stages, all of which have bearing on the production life cycle of a salmon aquaculture operation.

Salmon eggs are produced in a hatchery in November and incubated at varying water temperatures. In late winter or early spring they hatch as sac fry, begin to feed on special starter diets, and are kept in tanks designed for feeding. Once they reach a sufficient size, the salmon are graded for uniformity and size, and transferred to rearing tanks in May or June. They are now at the parr stage and feed throughout the summer, until fall, when they are graded again to select potential smolt. When smolts have reached a weight of about 80 g the following spring, they are transferred to saltwater and placed in sea cages (net enclosures supported by floating frames made of plastic, steel, aluminium and wood). They are fed a special diet of fish meal and fish oil until they reach market size, between 2-5 kg. This is usually 14-18 months later, or about two and one-half years after the eggs were first collected. Since Atlantic salmon require relatively warm water throughout the winter, only selected areas in Nova Scotia are suitable for year round production; They are grown primarily in the Bras d'Or Lakes, the Annapolis Basin, Shelburne Harbour and parts of St. Margarets Bay. In SHACI Unit 11 there is one site on the Arm of the Great Bras d'Or Lake (Figure 16-8)(NSDAF 2005a, NSDAF 2005d)

Figure 16-9: American oyster (leases 1202, 1287, 1301, 1215, 1030 & 1130) aquaculture sites in Mira River and Mira Bay (NSDAF 2005a).

Rainbow trout (Onorhynchus mykiss)

This fish, well known for its ability to adapt to different conditions, was first introduced to Nova Scotian waters in 1899. The size of the rainbow trout varies but in Atlantic Canada the average weight is 0.5-1 kg. It has a long, slender body, with an iridescent band running along each side from head to tail. The overall body colour can range from bluish to yellow-green, brown or black.

The farming life cycle begins with harvesting eggs from selectively bred spawners. Once the eggs are fertilized, they are placed in incubator tanks for hatching, where the rate of growth is controlled mainly by water temperature. There are a number of incubator units, including troughs, combi-tanks, stacked tray units, jars and baskets. After they hatch, they are called sac-fry and remain in the tanks, living off the energy reserves in the yolk sacs attached to their bellies. After four to six weeks, the fry are fed a special diet of commercial food pellets, similar to that of salmon, containing 80% fish meal and fish oil with minerals and vitamins added. This provides proper nutritional balance geared toward growth and product quality. Grown in these tanks to a weight of 1-5 g, the fish are then transferred to rearing units, where they grow through the fingerling stage until they reach market size. A number of methods are used for final grow-out; facilities may include earthen ponds, cages in ponds, rectangular or circular tanks, or concrete raceways. The grow-out period usually takes between 12 and 18 months, with harvest size generally between 284 and 397 g, commonly referred to as "pan-sized." Rainbow trout products are sold fresh whole, as fillets and smoked.

There are numerous hatcheries and grow-out ponds in Nova Scotia but none are currently active in the HRM. Hatcheries and grow-out sites must have adequate water supplies to be successful. These operations supply rainbow trout for U-fish or retail markets, as well as seed stock for marine grow-out sites (NSDAF 2005a, NSDAF 2005e).

Figure 16-10: Land based Atlantic salmon and Rainbow trout aquaculture sites (leases 0043 & 0129) in Lingan and Big Glace Bay Lake (NSDAF 2005a)

Aquaculture locations

Marine fish and shellfish are cultured at 33 sites throughout SHACI Unit 11; 31 of these are distributed among three coastal embayments and the other two sites are land-based. (Table 16-7). The majority of the aquaculture sites are shellfish. St. Anns Harbour hosts eleven sites with a total surface area of 584.74 ha. Blue mussel operations in the harbour account for a total surface area of 560.94 ha and American mussels a surface area of 23.8 ha. Aspy Bay as a total surface area of 253.10 ha with blue mussels covering 109.94 ha and American oysters covering 143.16 ha. The sites in the Mira River are all American oyster leases and have a total surface area of 9.43 ha and Mira Bay has a surface area of 0.94 ha. The Atlantic salmon and rainbow trout operation in the Great Bras d'Or has a total surface area of 8.00 ha (NSDAF 2005a).

Table 16-7: Aquaculture site lease profiles (NSDAF 2005a).

Site Licence Number	Water Body	Species Cultured	Area (Ha)
0043	Land Based	Atlantic salmon; Rainbow trout	N/A
0072	Great Bras d'Or Arm	Atlantic salmon; Rainbow trout	8.00
0083	Aspy Bay	Blue mussels	28.23
0085	Aspy Bay	Blue mussels	31.40
0129	Land Based	Atlantic salmon; Rainbow trout	N/A
0148	St. Anns Harbour	Blue mussels	35.00
0277	St. Anns Harbour	Blue mussels	35.00
0297	Aspy Bay	American oyster	9.48
0300	Aspy Bay	American oyster	45.66
0328	Aspy Bay	American oyster	21.34
0330	Aspy Bay	American oyster	11.30
0414	Aspy Bay	American oyster	4.04
0627	Aspy Bay	Blue mussels	17.39
0727	St. Anns Harbour	American oyster	0.39
0727x	St. Anns Harbour	(Proposed) American oyster	7.13
0758	Aspy Bay	Blue mussels	32.92
1030	Mira Bay	American oyster	0.63
1033	St. Anns Harbour	American oyster	2.51
1062	Aspy Bay	American oyster, Cocktail oyster	25.94
1090	Aspy Bay	American oyster	2.08
1111	Aspy Bay	American oyster	6.20
1130	Mira Bay	American oyster	0.31
1186	St. Anns Harbour	Blue mussels	138.65
1187	St. Anns Harbour	Blue mussels	73.23
1188	St. Anns Harbour	Blue mussels	76.95
1189	St. Anns Harbour	Blue mussels	202.11
1202	Mira River	American oyster	0.75
1214	St. Anns Harbour	American oyster, Cocktail oyster	5.85
1214x	St. Anns Harbour	(Proposed) American oyster	7.92
1215	Mira River	American oyster	0.67
1235	Aspy Bay	American oyster	17.12
1287	Mira River	American oyster	3.44
1301	Mira River	American oyster	4.57

Threats of aquaculture operations

Aquaculture operations can negatively impact the local environments they inhabit through high waste production, disproportionately high consumption of natural resources, and the steps in the production process itself (Beveridge et al. 1997). Escaped cultured species such as salmon can threaten genetic integrity of wild populations and put them at risk of biological extinctions (Whoriskey 2002), although there is no evidence of this in Nova Scotia. The aquaculture industry can also socially impact communities due to resource conflicts between it and traditional fisheries, but these issues are addressed during the application and lease/license review phase.

In addition the Nova Scotia Department of Agriculture and Fisheries (NSDAF) is currently leading the implementation of an Industry-wide Environmental Monitoring Program (EMP) which is actively addressing any potential for environmental impacts due to aquaculture operations. To date, the impact has proven to be either limited or negligible and the sites with limited impact are currently being addressed (Balch pers.comm. 2005).

Threats to aquaculture operations

Marine bioinvasions can have significant impacts on aquaculture operations. For example, invasive tunicates such as *Ciona intestinalis* and *Botryllus schlosserii* have become a growing concern for the shellfish industry in Nova Scotia. The green crab, *Carcinus maenas* and the green alga, *Codium fragile* ssp. *tomentosoides* are also potential threats to the shellfish industry.

Industry and transportation

Industry

The onshore region of Sydney Bight was once an industrial centre in Nova Scotia. Land-based industrial activity in the Sydney Bight traditionally involved coal mining and steel production whose byproducts have seriously polluted coastal areas such as the notoriously toxic Sydney tarponds. Steel smelters and coke ovens on the shores of Sydney Harbour were responsible for the release of pollutants including polycyclic aromatic hydrocarbons (PAHs), other organic contaminents and metals into the shallow estuarine system. These operations have since closed, but the area remains the most hazardous toxic waste site in Canada (Stewart and White 2001).

The Coxheath Copper Mine is another historical mining operation in the Sydney area. This deposit was mined underground for discrete periods between 1878-1930. This mine is currently inactive; however, it is used to store crushed rock (Van Dommelen 2001). The Coxheath area also has commercially exploited sand and gravel deposits.

Current industrial activity in the Sydney area is focused on the coastal marine environment. In July 1998, Hunt Oil Company of Canada was awarded exploration licenses EL2364 and 2365 located off the northeast coast of Cape Breton Island. Another exploration license, EL 2368, was granted on the western coast of Cape Breton in the Gulf of St. Lawrence. These licenses encompass over 5800 km^2. According to Collins et al. (2001), past studies indicate the presence of reservoir and source rocks, and that the hydrocarbon present is most likely natural gas. In a region that has experienced the loss of major industries in recent years, the possibility of a new oil and gas industry is highly anticipated, but not by everyone. There is growing concern about the environmental effects of oil and gas exploration, namely seismic activities, and development in the nearshore region. In October 2001, a joint directive of the Federal and Provincial governments initiated a Public Review Commission on the “Effects of Potential Oil and Gas Exploration and Drilling Activities within the Exploration Licenses EL2364 and 2365 and 2368” (MacNeil 2002). As part of this process, DFO also conducted a Regional Advisory Process (RAP) which reviewed many aspects of the local marine ecology and potential effects of oil and gas exploration.

Several industries currently operate in the Sydney Bight area. Environment Canada’s online National Pollutants Release Inventory (NPRI 2001) lists facilities that release emissions into the environment. Land, water and air emissions for Unit 11, in 2000, are presented in Table 16-7.

Table 16-7: Facilities releasing pollutants in theSydney Bight area

Facility	Location	Type	Pollutant/s	Emission type
Precision Finished Components	North Sydney	Motor Vehicle Metal Stamping	Aluminum oxide (fibrous forms)	Transferred to landfill for disposal
Nova Scotia Power Inc. - Point Aconi Generating Station	Point Aconi	Fossil-Fuel Electric Power Generation	Hydrochloric acid Manganese (and its compounds) Nickel (and its compounds)* Sulphuric acid Zinc (and its compounds) Copper (and its compounds) Mercury (and its compounds)* Hexachlorobenzene* Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans*	On site: Air: Released in stack Land: Manganese, Arsenic, Zinc, Chromium are landfilled Water: Copper discharges
Cape Breton Regional Municipality - Cape Breton Regional Inc	Sydney	Waste Treatment & Disposal	Hexachlorobezene* Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans*	None listed
Sydney Steel Corporation - Sydney Steel Corp.	Sydney	Iron & Steel Mills & Ferro-Alloy Mfg	Zinc (and its compounds) Manganese (and its compounds) Lead (and its compounds)* Copper (and its compounds) Chromium (and its compounds)* Aluminum (fume or dust) Cadmium (and its compounds)* Vanadium (fume or dust) Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans* Hexachlorobenzene*	On site: Air: stack Land: Zinc, Mananese, Lead, Copper, Chromium, Aluminum, Cadmium, Vanadium (landfilled). Water: Zinc, Lead discharges.

*known to be toxic/carcinogenic
NPRI datasearch 2001

Nova Scotia Power has two coal-fired thermal generating plants in the area, one at Lingan and one in Point Aconi. Cooling water for the Lingan plant is drawn in from and discharged into Indian Bay (Nova Scotia Power 2002a), and cooling water for the Point Aconi plant is drawn in from and released into the Sydney Bight in the area bordering the north side of Point Aconi (Nova Scotia Power 2002b). Precision Finished Components (PFC) is a manufacturer of automotive parts and assemblies (Environment Canada 2002c). Sydney Steel Corporation was sold in November 2000 and is presently inactive.

Marine transportation

Marine transportation is also prevalent in Unit 11. The Cabot Strait is the major shipping lane for vessel traffic moving into and out of the Gulf of St. Lawrence and the St. Lawrence Seaway. Along the coast of Sydney Bight there are major shipping routes going into the ports of Sydney and North Sydney, and ships move into the Bras d’Or Lakes through Great Bras d’Or Channel. The ferry service between Nova Scotia and

Newfoundland also runs through Sydney Bight. The ferry schedule from North Sydney to Port aux Basques varies seasonally, while the ferry from North Sydney to Argentia only runs from late June until early October. Cruise ships also visit Sydney Bight; in 2001, 31 cruise ships visited Sydney (Collins et al. 2001), most visiting before mid-October (NS Department of Tourism and Culture 2000).

Tourism

Tourism has become an important part of the Cape Breton economy. Communities all along the coast of Sydney Bight are operating tourism-oriented businesses (Table 16-8). Tourism is generally a seasonal business lasting from late June until early September. The Cabot Trail and Cape Breton Highlands National Park are major tourist and recreational attractions. Campsites, hiking trails, kayak rentals, and bird watching tour operations abound all along the coast. There are 13 whale watching boat tour businesses operating in Bay St. Lawrence, Aspy Bay, and the Ingonish areas.

Table 16-8: Coastal community tourism operations in SHACI Unit 11.

Location	Business/Attraction	Features	
Aspy Bay	Cabot's Landing Provincial Park - Cape North	Beachcombing	
	White Point Whale Cruise - White Point	Whales: humpbacks, pilot whales, minke whales, dolphins & seals	
	Sail to the Whales Inc. Dingwall Harbour	Whales, dolphins, porpoise, seals, birds	
Bay St. Lawrence	Sunrise and Sunset Adventures	Boat Tours	
	Fan-A-Sea Adventures Ltd.	Shark fishing	
	Highlander Whale Watch and Scenic Tour	Whales	
	Island Whale Watch and Nature Tours	Whales	
	Oshan Whale Cruise	Whales	
	Double Crow Sailing Charters	Whales, dolphins, seals, eagles, and sea turtles	
	Captain Cox's Whale Watch. Capstick	Whales: humpback whales, minke whales, pilot whales, sei whales, dolphins, seals and fin whales	
	Coastal Whale Watching Boat Tours	Whales	
Bird Islands	Puffin Boat Tours	Bird watching: Atlantic Puffin, Black Guillemot, Razorbill, Great Cormorant, Double-crested Cormorants, Herring Gull, Great Black-backed Gull, Lesser Black-backed Gull, Black Legged Kittiwake, Ruddy Turnstones, Bald Eagles. Seals: grey seals	
	Bird Island Tours	Boat tour, bird watching.	
Cabot Trail	Cabot Trail Outdoor Adventures	Cycling, Hiking, Sea Kayaking, Paddling	
Cape Smokey	Cape Smokey Provincial Park	Hiking	
Dominion	Dominion Beach Provincial Park	Beach, dunes, boardwalk	
Ingonish	Cape Breton Seacoast Adventures	Kayaking	
	Whale Island Boat Charters	Whale watching, deep sea fishing, shark charters, diving charters, tuna charters	
	Seaquarium Whale Watching Tours	Whales	
Ingonish Beach	Ingonish Beach – National Park Beach	Beach	
	Middle Head Trail	Hiking trail, birdwatching (seabird colony).	
	Cape Breton Highlands National Park	Hiking, camping, beach, nature observation	

Table 16-8: Coastal community tourism operations in SHACI Unit 11.

Location	Business/Attraction	Features	
	Wendy Gibbs	Walking tour	
	Atlantic Whale Watch	Whales, seals, Bald Eagles, cormorants, and other sea birds	
Ingonish Ferry	Sea Visions Whale Watch	Whales, dolphins, porpoise, seals, bald eagles, puffins, etc.	
Mira Bay – Louisbourg	Island Seafari Sea Kayaking	Sea kayaking	
Mira Gut	Mira Gut Beach	Beach	
	Mira Boat Club	Boat launch	
New Waterford	Island Windsurfing	Wind surfing	
North River – Baddeck	North River Kayak Tours	Kayaking, Bald Eagle sightings	
North Sydney	Northern Yacht Club	Marina Facilities	
Port Morien	Cape Perce Nature Tours Ltd.	Bird watching: Kittiwakes, cormorants, Guillemots, gannets, Seals, Whales	
St. Anns	St. Anns Provincial Park	Picnic Park	
St. Anns Bay North Shore Cabot Trail	Plaster Provincial Park	Activity and Picnic Park	
Sydney	Dobson Yacht Club	Marina facilities	
	Royal Cape Breton Yacht Club	Marina Facilities	
Sydney – all over Cape Breton	High on life Island Adventures	Hiking, cycling, kayaking, camping	
Wreck Cove	Cape Breton Sea Coast Adventures	Kayaking, whale watching	

Part II - Significant Habitats

The information presented in the Sydney Bight review clearly indicates that SHACI Unit 11 contains Significant Habitat. While many of the important ecological and cultural/recreational attributes within Sydney Bight are associated with specific locations (e.g. Piping Plover beaches in Aspy Bay), others are either associated with Sydney Bight in general, or specific important locations are currently unknown (e.g. Sydney Bight is a general leatherback turtle feeding area).

In Part II, the attributes which make Sydney Bight (in itself) Significant Habitat will be briefly overviewed. Following this, the specific areas considered Significant Habitat will be presented and a sample area will be discussed in detail.

17 - Sydney Bight

Sydney Bight (Unit 11) contains many distinct smaller Significant Habitats within its boundaries, but could also be considered Significant Habitat in and of itself. Broadly describing Sydney Bight as Significant may be appropriate since, for some attributes, there is no information available about particular sub-areas of importance. For example, lobster are commercially important and fairly abundant in Sydney Bight; however, the existence of specific areas of importance to lobster are currently unknown. Another example is the endangered leatherback turtle. Small numbers of this species are known to forage in Sydney Bight; however, specific preferred locations are unknown. In other cases, many small coastal areas of Sydney Bight contribute important habitat to a group of species which might cumulatively contribute to Significant Habitat. For example, although a few major migratory bird stopover areas are specifically listed as significant, many smaller, and unknown coastal areas may also provide habitat, and collectively could be considered Significant. Table (17-1) provides a summary attribute that make Sydney Bight Significant Habitat as a whole. Specific information about the attributes listed in this table is provided throughout the Unit 11 document.

Table 17-1: Non-specific location attributes contributing to the significance of Sydney Bight

Organism	Attributes	Reference
Zooplankton	• Important concentrations of fish and invertebrate commercial species	Locke 2001
Marine plants	• Warm sheltered bays may contain genetically isolated marine alga populations	Novaczek pers. comm. 2002
Marine invertebrates	• Important concentrations of commercial snow crab and lobsters	
Fish	• Contains spawning, nursery, feeding, and overwintering areas as well as migratory pathways for many commercial and non-commercial species • Contains habitat for COSEWIC listed fish species • Fall concentrations of gaspereau	Stone and Jessop 1992
Marine reptiles	• Feeding area for two COSEWIC listed endangered sea turtles	
Marine birds	• Contains breeding, migration stopover, and overwintering areas for many seabirds, shorebirds and waterfowl	
Marine mammals	• Area is used by several COSEWIC listed whales.	

Significant Habitats

For the purposes of this report, the information collected and compiled in the Sydney Bight review (Part I) was used as the basis for the identification of Significant Habitats in SHACI Unit 11. The document was reviewed by the authors, and areas and features were noted according to the SHACI criteria explained in the Introduction and in the SHACI Criteria section of this document. Through this process, a table was generated which grouped important attributes according to the specific locations within Sydney Bight where they were found (Table 17-2). This information was sorted by location to identify specific locations that were important for a variety of reasons, and thus to identify Significant Habitats. Areas with the most features/reasons, or areas with features/reasons considered to be particularly important (e.g. COSEWIC listed species present) were identified as Significant Habitats.

Table 17-2: Areas and attributes of significance in SHACI Unit 11

Location	Attribute	Reference(s)	Page
Aconi Brook	• Salmon angling river	O'Neil et al. 1996	79
Aconi Island	• Seal haulout	*Coastal Resources Mapping	101
Aspy Bay	• Location with scallop bottom	*Coastal Resources Mapping	49
	• Baitworm harvesting	*Coastal Resources Mapping	59
	• Frequented by enough whales to support whale watching operations	Destination Nova Scotia 2002	100
	• Area with substantial tidal marsh habitat	NSDNR 2002	116
	• Protected Beach (Lily Pond Beach, Middle Harbour Beach, North Harbour Beach South Harbour Beach)	Province of N.S. 2002b	124
	• Piping Plover nesting area (endangered species) (North Harbour Beach, South Harbour Beach)	Paquet and Chardine 2001	95
	• Herring overwintering area (off Aspy Bay)	Claytor and Leblanc 1998	73
	• Provincial Park - Cabot Landing Provincial Park	Tourism Cape Breton 2002	127
	• Salmon angling river North Aspy River	O'Neil et al. 1996	79
	• Seal haulout (Blue Point, White Point Island, The Gulch)	*Coastal Resources Mapping	100-101
	• Atlantic salmon recorded in several rivers	*Coastal Resources Mapping	80
Barachois River	• Salmon angling river	O'Neil et al. 1996	79
Bay St. Lawrence	• Frequented by enough whales to support whale watching operations	Destination Nova Scotia 2002	100
	• Area of cetacean research by Dalhousie University • Possible pilot whale calving area • Known area frequented by harbour porpoise (threatened species)	A. Ottensmeyer pers. comm. 2001	99
	• Atlantic salmon recorded rivers	*Coastal Resources Mapping	80

Note: *Coastal Resources Mapping refers to LACRMP 1995; ECBCRMP 1996; VCCRMP 1997.

Location	Attribute	Reference(s)	Page
Bird Islands	• Seal haulout area	*Coastal Resources Mapping	100-101
	• Recognized by International Biological Programme for bird habitat	Canadian Committee IBPCT 1974	92
	• Site of Ecological Significance - recognized for bird habitat	BSC 2002	92
	• Important Bird Area	BSC 2002	92
	• Nova Scotia Bird Society Sanctuary (Hertford Island)	BSC 2002	92
Bird Islands – surrounding area	• Location with scallop bottom	T. Lambert pers.comm. 2002	57
	• 0-group cod nursery area	Lambert and Wilson 1995	65-66
	• Cod settling area	Lambert and Wilson 1995	66
	• Age 2 white hake juvenile area	T. Lambert pers.comm. 2002	70
	• 0-group and age 1 white hake area	T. Lambert pers.comm. 2002	70
	• Overwintering area for Bras d'Or Lakes herring	Claytor and Leblanc 1998	73
Cabot Strait	• Migration route for whales	T. Wimmer pers comm. 2002	99
	• Migration route for whale species of special concern		
	• Important overwintering area for seabirds	Lock et al. 1994	93
	• Migration route for right whales (endangered species)	J. Conway pers comm. 2002	105
Cabot Strait/Laurentian Channel	• Overwintering area for *Calanus* sp. copepods	Head et al. 1999	35
	• Overwintering site for Gulf of St. Lawrence redfish populations	Archambault et al. 2001, DFO 2001c	66
	• Fish, turtle and marine mammal migration route	Kenchington 2001; T. Wimmer pers. Comm. 2002	85,99
Laurentian Channel	• 4Vn cod overwintering area	Lambert and Wilson 1995	65
	• Only area where redfish species ranges overlap	DFO 2001c	66
	• Only area with redfish species hybrid	Archambault et al. 2001	68
	• Overwintering area for Gulf of St. Lawrence white hake	Clay 1991	69
Cape Breton Highlands National Park	• National Park		126-127
Cape North	• Seal haulout (Cape North and East of Money Point**)**	*Coastal Resources Mapping	101-102
Port Morien	• Port Morien Old French Coal Mine. Nova Scotia Special Places Protection Act	Nova Scotia Museum 1996	128
Dalem Lake Provincial Park	• Provincial Park	Tourism Cape Breton 2002	128
Dominion Beach	• Protected Beach		130
	• Shorebird Survey Area	CWS 2000; 2002a	94
	• Provincial Park	Tourism Cape Breton 2002	127
Donkin	• Protected Beach (Schooner Pond Beach)	DNR	130
	• Shorebird survey area (Schooner Pond Beach	CWS 2000; 2002a	94
	• Seal haulout (Schooner Pond Cove)	*Coastal Resources Mapping	101-102

Note: *Coastal Resources Mapping refers to LACRMP 1995; ECBCRMP 1996; VCCRMP 1997.

Location	Attribute	Reference(s)	Page
French River	• Nova Scotia Wilderness Area		130
Glace Bay	• Area with substantial eelgrass beds	NSDNR 2002a	119
	• Area with substantial tidal marsh habitat	NSDNR 2002a	119
	• Migratory Bird Sanctuary (Big Glace Bay Lake)	BSC 2002	125
	• Piping plovers recorded on barrier beach	BSC 2002	125
	• Atlantic salmon recorded in Glace Bay Lake	*Coastal Resources Mapping	80
	• Important Bird Area (Big Glace Bay Lake)	BSC 2002	98
	• Herring overwintering area (off)	Claytor and Leblanc 1998	73
	• Protected Beach		130
	• Recorded as Harlequin Duck stopover area	Paquet and Chardine 2001	96
	• Marconi Wireless Station National Historic Site	Parks Canada 2000a	126
Great Bras d'Or Channel	• Location with scallop bottom	*Coastal Resources Mapping	57
	• Age 2 white hake juvenile area	Lambert pers. comm.. 2002	70
	• Fish migration route to Bras d'Or Lakes for various anadromous and marine fish	Kenchington 2001; Tupper 1997.	86
Indian Bay	• Baitworm Harvesting	*Coastal Resources Mapping	59
Indian Brook	• Salmon angling river	O'Neil et al. 1996	79
Ingonish	• Frequented by enough whales to support whale watching operations (Ingonish Bay)	Destination Nova Scotia 2002	100
	• Protected Beach (North Bay Beach)		130
	• Baitworm Harvesting (North Bay, Ingonish Harbour)	*Coastal Resources Mapping	59
	• Historical haddock juvenile area (off-Ingonish)	McCracken 1965	71
	• Location with scallop bottom (Ingonish Island)	*Coastal Resources Mapping	57
	• Important Bird Area (Ingonish Island)	BSC 2002	98
	• Cape Breton Highlands National Park	Parks Canada 2002b	126-127
	• Salmon angling river (Ingonish River)	O'Neil et al. 1996	79
	• Seal haulout (East Rocks, Ingonish Island)	*Coastal Resources Mapping	101-102
	• Recorded Harlequin Duck stopover area	CWS	96
South of Ingonish (Near Table Head)	• Seal haulout	*Coastal Resources Mapping	101-102
Island in Little Burnt Head Cove - South of White Point	• Seal haulout	*Coastal Resources Mapping	101-102
Lingan	• Area with substantial tidal marsh habitat (Lingan Bay)	NSDNR 2002a	118
	• Bridgeport Basin Beach - Protected Beach (Lingan Bay)		130
	• Area with substantial eelgrass beds (Lingan Beach)	NSDNR 2002a	118
	• Known location of warm water invertebrate indicator fauna (Lingan Harbour)	Bousfield and Laubitz 1972	43
Little Bras d'Or	• Area with substantial eelgrass beds	NSDNR 2002a	122
Main-a-Dieu Beach	• Protected Beach		130

Note: *Coastal Resources Mapping refers to LACRMP 1995; ECBCRMP 1996; VCCRMP 1997.

Location	Attribute	Reference(s)	Page
Membertou First Nation	• Indian Reserve Lands	Membertou First Nation 2002	125
Mira	• Location with scallop bottom (Mira Bay)	*Coastal Resources Mapping	57
	• Catalone Gut Beach - Protected Beach		130
	• Only population of lake whitefish in area (Mira River)	Edge 1987	84-85
	• Mira River Provincial Park (Mira River)	NSDNR 2002b	128
	• Salmon angling rivers (Mira River and Catalone River)	O'Neil et al. 1996	79
	• Seal haulout (MacKeigans Point, Round Island Point)	*Coastal Resources Mapping	101-102
	• Recorded Harlequin Duck stopover area (Round Island)	Paquet and Chardine 2001	96
Morien Bay	• Location with scallop bottom	*Coastal Resources Mapping	57
	• Baitworm Harvesting (Morien Bay and False Bay)	*Coastal Resources Mapping	59
	• Area with substantial tidal marsh habitat	NSDNR 2002a	120
	• Area with substantial eelgrass beds	NSDNR 2002a	120
	• Most significant shorebird area in Cape Breton (Morien Bar)	McCorquodale pers. comm. 2002	98
	• Shorebird survey area (Morien Bar)	CWS 2000; 2002a	93,95
	• Important Bird Area (Northern Head and South Head)	BSC 2002	98
	• Seal haulout (Noneck Point, South Head)	*Coastal Resources Mapping	101-102
	• Port Morien Beach - Protected Beach		130
	• Recorded Harlequin Duck stopover area (Port Morien)	Paquet and Chardine 2001	96
	• Port Morien Old French Mine - Special Places Protection Act	Nova Scotia Museum 1996	128
New Waterford (off)	• Herring overwintering area	Claytor and Leblanc 1998	74
North River	• Most important salmon stock in Sydney Bight area	Amiro pers. comm 2002	81
	• Nova Scotia Wilderness Area		
	• Salmon angling river	O'Neil et al. 1996	79
Plaster Provincial Park	• Provincial Park	Tourism Cape Breton 2002	128
Pollets Cove - Aspy Fault	• Nova Scotia Wilderness Area		130
Scatarie Island	• Location with scallop bottom	*Coastal Resources Mapping	57
	• Nova Scotia Wilderness Area	Office of the Legislative Council, Nova Scotia House of Assembly 1999	129
	• Wildlife Management Area		129
	• Important Bird Area	BSC 2002	98
	• Grey seal rookery (Hay Island)	J. Conway pers. comm 2002	101-102
	• Seal haulout (Red Rocks, Cormorandiere Rocks)	*Coastal Resources Mapping	101-102

Note: *Coastal Resources Mapping refers to LACRMP 1995; ECBCRMP 1996; VCCRMP 1997.

Location	Attribute	Reference(s)	Page
Southwest corner Sydney Bight	• Groundfish nursery area (cod and white hake)	Highland Coastal Mapping 2001	71-72
	• Age 2 white hake juvenile area	T. Lambert pers. comm. 2002	70
Spanish Bay	• Area with substantial tidal marsh habitat	NSDNR 2002a	117
	• Big Pond Beach, Florence Beach - Protected Beach		130
	• Seal haulout (Florence - Little Pond, Shag Rock)	*Coastal Resources Mapping	101-102
St. Anns Bay	• Overwintering area for Bras d'Or Lakes herring	Claytor and Leblanc 1998	73
	• Herring spawning area	T. Lambert pers.comm. 2002	75
	• Location with scallop bottom	*Coastal Resources Mapping	57
	• Baitworm Harvesting	*Coastal Resources Mapping	59
	• Age 2 white hake juvenile area	T. Lambert pers.comm. 2002	69-70
	• 0-group and age 1 white hake area	T. Lambert pers.comm. 2002	69-70
	• Summer feeding area for herring	Claytor and Leblanc 1998	73
	• Area with substantial eelgrass beds	NSDNR 2002a	121
	• Protected Beach (Jersey Cove Beach)		130
	• St. Anns Bay Provincial Park		128
St. Anns Harbour	• Location with scallop bottom	*Coastal Resources Mapping	57
St. Paul Island	• Important Bird Area	BSC 2002	98
Sydney	• 0-group and age 1 white hake area (Sydney Harbour)	T. Lambert pers.comm. 2002	69-70
	• Shorebird survey area (South Bar, Sydney airport)	CWS 2000; 2002a	94
	• Baitworm Harvesting (Northwest Arm Sydney Harbour)	*Coastal Resources Mapping	59
	• Petersfield Provincial Park Provincial Park	Tourism Cape Breton 2002	127
	• Recorded Harlequin Duck stopover area	Paquet and chardine 2001	96
The Gutter (off Cape Smokey)	• 4Vn cod spawning area	Lambert and Wilson 1995	65
Off Cape Smokey (Ragged Rocks)	• Seal haulout	*Coastal Resources Mapping	101-102

Note: *Coastal Resources Mapping refers to LACRMP 1995; ECBCRMP 1996; VCCRMP 1997.

Considering the information presented in the document and summarized in the above table, there are roughly ten areas in Sydney Bight that could be considered Significant Habitat (Figure 17-1). This list may not be exhaustive, and may be subject to public review for further input and consideration. A detailed description of The Bird Islands Significant Habitat is provided in the following Chapter. Ideally, prior to any public review, such descriptions should be completed for each of themidentified Significant Habitat.

1) Scatarie Island

Scatarie Island has already received several important designations (Figure 17-1). The province has designated this island as both a Wildlife Management Area and a Wilderness Area, and Bird Studies Canada recognizes it as an Important Bird Area. Perhaps most significant is habitat this island provides for seals. There are several known seal haulout sites, and Hay Island is the only known grey seal rookery site in the Sydney Bight area. There are also several areas of bottom habitat around Scatarie Island that provide good habitat for scallops.

2) Mira Bay/Mira River

Mira Bay, the southernmost bay in Sydney Bight, contains various habitat types that support a number of different species (Figure 17-1). There is scallop bottom habitat in areas throughout the bay, and several seal haulouts along the shores. Two salmon angling rivers flow into Mira Bay: the Mira River and the Catalone River. The Mira River is also home to a population of lake whitefish which may be distinct from other whitefish populations. Round Island, in Mira Bay, is a known stopover area for Harlequin Duck which is a species of special concern under the *Species at Risk Act* (SARA). The province has designated two restricted land areas in the watershed: Mira River Provincial Park, and Catalone Gut Protected Beach.

3) Morien Bay

Morien Bay contains a variety of habitat types including substantial salt marsh and eelgrass beds, but its most outstanding feature appears to be the habitat it provides to birds (Figure 17-1). The points of land that define Morien Bay, Northern Head and South Head, are designated Important Bird Areas. Morien Bar is a shorebird survey area used by the Canadian Wildlife Service and has been called the most significant shorebird area in Cape Breton. As well, Port Morien is a known stopover area for Harlequin Ducks.

Morien Bay also provides habitat for other species. It contains scallop habitat, supports baitworm harvesting, and has several known haulout areas for seals. The province has recognized and protected two areas in Morien Bay: Port Morien Beach is a provincially designated Protected Beach; and, Port Morien Old French Mine is provincially designated under the *Special Places Protection Act*.

Glace Bay

Glace Bay, an area containing both substantial eelgrass beds and tidal marsh habitat, is considered Significant Habitat primarily due to the outstanding habitat it provides for migratory birds (Figure 17-1). Big Glace Bay Lake is well known as important habitat for migratory birds, being designated both as an Important Bird Area and as a Migratory Bird Sanctuary. Particularly, this area is a known stopover area for the Harlequin Duck which is a species of special concern under SARA. The barrier beach is a provincially designated Protected Beach where there have been records of the Piping Plover endangered species protected under SARA). The area also provides habitat for fish. Traditional ecological knowledge indicates the presence of Altantic salmon in Big Glace Bay Lake, and there is a herring overwintering area located in the waters off Glace Bay. The Marconi Wireless Station National Historic Site contributes to the cultural significance of the Glace Bay area.

4) Bird Islands and surrounding waters

The Bird Islands are representative examples of coastal islands and the coastal cliff environment, both of which provide important nesting habitat for marine birds (Figure 17-1). The Bird Islands are also a resting area for seals, and waters surrounding the Bird Islands are important for commercial fish species. There is a known nursery area for the 4Vn Atlantic cod stock and an overwintering area for the Bras d'Or Lakes herring stock. The surrounding benthic habitat is also suitable for scallops.

5) St. Anns Bay/St. Anns Harbour/North River.

St. Anns Bay, located in the southwest corner of Sydney Bight is significant in several regards, but particularly for the habitat it provides for fish (Figure 17-1). Spawning, overwintering, feeding and juvenile/nursery areas of various fish species are all known to occur in this area. St. Anns Bay is a herring feeding and spawning area, and Bras d'Or Lakes herring (specifically) are known to overwinter in this area. The area is also a white hake nursery and juvenile area. The southwest corner of Sydney Bight is also a known cod nursery area. The North River, running into St. Anns Harbour, is also important habitat for fish. This salmon angling river contains the most important salmon stock in Sydney Bight.

St. Anns Bay also provides habitat for other species. St. Anns Harbour contains scallop bottom, substantial eelgrass beds, and the general area supports some baitworm harvesting. The province has recognized several locations in the area: St. Anns Bay Provincial Park, North River Nova Scotia Wilderness Area, and Jersey Cove Protected Beach.

6) Ingonish – North Bay and South Bay Ingonish

The Ingonish area features two sheltered bays (North Bay and South Bay Ingonish) separated by a rocky peninsula, and lined with white sand beaches (Figure 17-1). The area also includes the rivers running into the bays, the rocky points that define the bays, and the coastal islands found within them. This diversity of habitats supports a number of different species. Baitworms are harvested in the inner bays and scallops are found on the bottom near Ingonish Island. There are records of a past haddock juvenile area in the waters off Ingonish; these waters currently support several whale watching operations. Harlequin Ducks have been recorded in the area, and Ingonish Island is an Important Bird Area. Ingonish Island, and several other locations in the area, are known resting places for seals. Flowing into South Bay Ingonish, the Ingonish River is a major salmon angling river. According to traditional ecological knowledge, salmon are also found in other rivers within the watershed. Several locations in the Ingonish area have already been recognized as important: North Bay Beach is a provincially recognized Protected Beach, and Cape Breton Highlands National Park encompasses portions of coastal land in the area.

7) Aspy Bay

The Aspy Bay area contains a diversity of habitats types including tidal marshes, long white sand beaches, and rugged exposed coastal areas (Figure 17-1). These diverse habitat types support a number of different species. The sandy beaches provide nesting habitat for the endangered Piping Plover, and intertidal areas provide habitat for baitworms. There are also several seal haulout areas found along the coast. Traditional ecological knowledge indicates several salmon rivers in the area, and the North Aspy River is a major salmon angling river. In the outer parts of Aspy Bay there are overwintering areas for herring, bottom habitat for scallops, and the area is frequented sufficiently by whales to support whale watching operations. There are several provincially designated locations in the Aspy Bay area: Cabot Landing Provincial Park, Lily Pond Beach, North Harbour Beach, and South Harbour Beach.

8) Bay St. Lawrence

Bay St. Lawrence (Figure 17-1) is key location for marine mammals in the Sydney Bight area. The area supports several whale watching operations, and Dalhousie University visits this area to conduct cetacean research. Bay St. Lawrence is a possible calving area for pilot whales, and is a known area for the threatened harbour porpoise. Although not major angling rivers, local knowledge indicates the presence of Atlantic salmon in two rivers that run into Bay St. Lawrence.

9) Cabot Strait/Laurentian Channel/St. Paul Island

The Cabot Strait and the Laurentian Channel are representative of deeper water areas in the Sydney Bight region (Figure 17-1). This area is an important migration route for fish, marine turtles, and cetaceans moving between the Gulf of St. Lawrence and the Scotia Shelf. Several of these whale species, as well as the leatherback turtle, are considered at risk by Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This area is also an important overwintering area for several fish species (redfish, cod, and white hake), for seabirds, and for copepods. The Laurentian Channel is also the only known location where redfish species' ranges overlap. The remote St. Paul Island, located in the Cabot Strait, is representative of coastal islands and is an Important Bird Area.

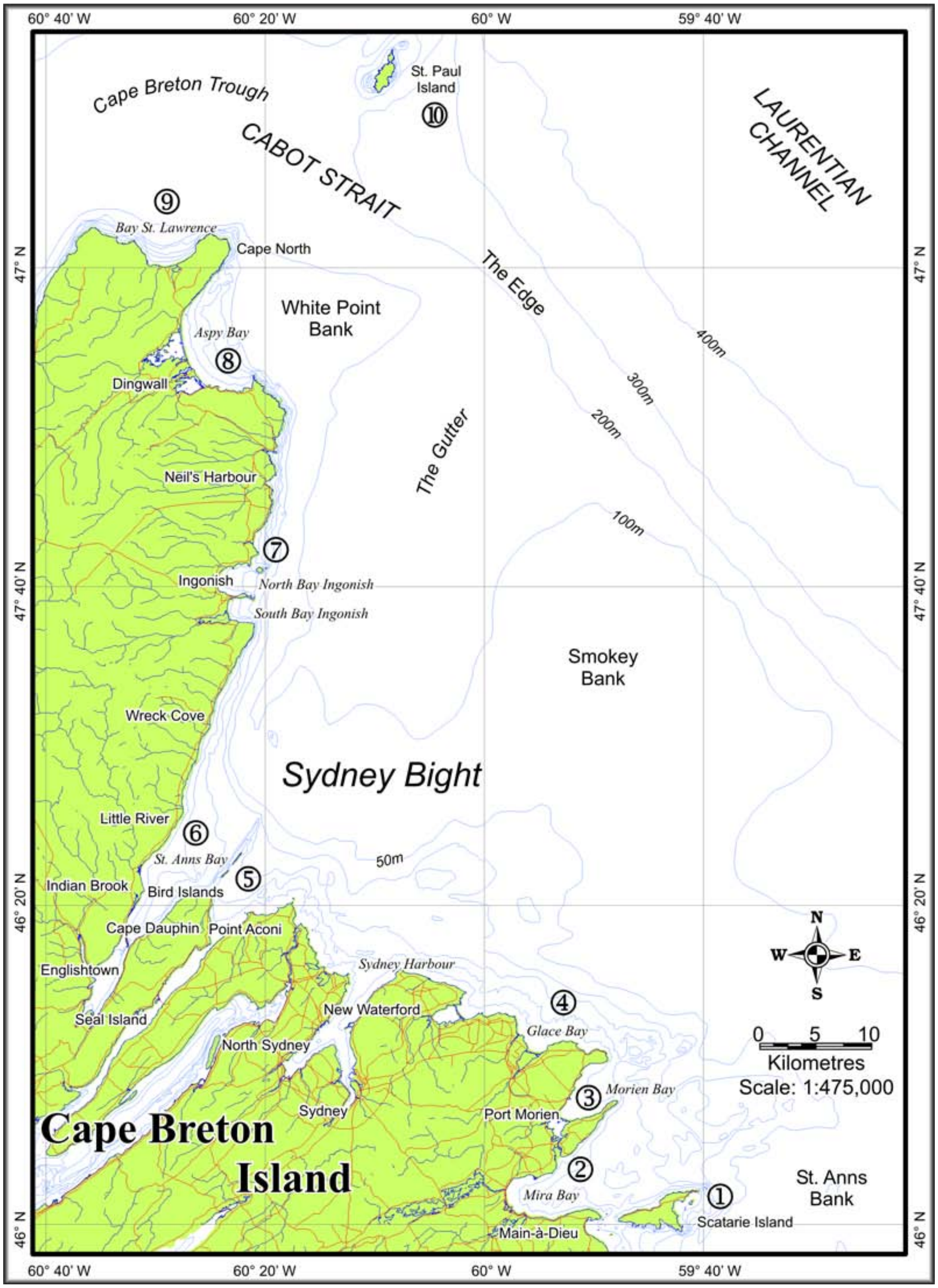


Figure 17-1: Significant Habitats in Sydney Bight

18 - Bird Islands and surrounding waters

The Birds Islands and the waters surrounding them are identified as Significant Habitat by SHACI.

Location

Hertford Island and Ciboux Island, located in Sydney Bight roughly 4 km off Cape Dauphin, are collectively known as the Bird Islands (Figure 18-1). The long, narrow islands lie in waters <50 m deep and are oriented in a northeast/southwest direction.

General habitat description

Ciboux Island is the larger of the islands (1.6 km long, 120 m wide), and is located further offshore. Hertford Island is roughly 1.1 km long and 120 m wide. The habitats associated with the islands include coastal open sea, inlets, coastal cliffs, and rocky shores, and the perimeters of both islands consist of steep, 20 m high cliffs with many holes and ledges. Numerous reefs and rock clusters are located between the islands. The islands' vegetation consists of stunted shrubs, grass and forbs and the grassy tops of the islands were formerly grazed by herds of sheep (BSC 2002).

Significance of the area

Ecological significance

The Bird Islands and the waters that surround them are ecologically significant for several reasons. Generally, the Bird Islands are significant due to their representativeness and their naturalness. There are few coastal islands in Sydney Bight. The Bird Islands are representative examples of coastal islands and the coastal cliff environment, both of which provide important habitat for marine birds. Given that the islands are uninhabited and located offshore, they are likely subject to fewer disturbances than other similar coastal areas. Although the Bird Islands were once grazed by sheep (BSC 2002), they currently exist in a fairly natural condition.

The Islands provide a nesting area for a diverse assemblage of seabirds, and a resting area for seals. The waters surrounding the Bird Islands are important for commercial fish species. There is a known nursery area for the 4Vn Atlantic cod stock, and an overwintering area for the Bras d'Or Lakes herring stock. The surrounding benthic habitat is also suitable for scallops. The ecological significance of the Bird Islands and surrounding waters in relation to commercial and non-commercial species is discussed in the following sections.

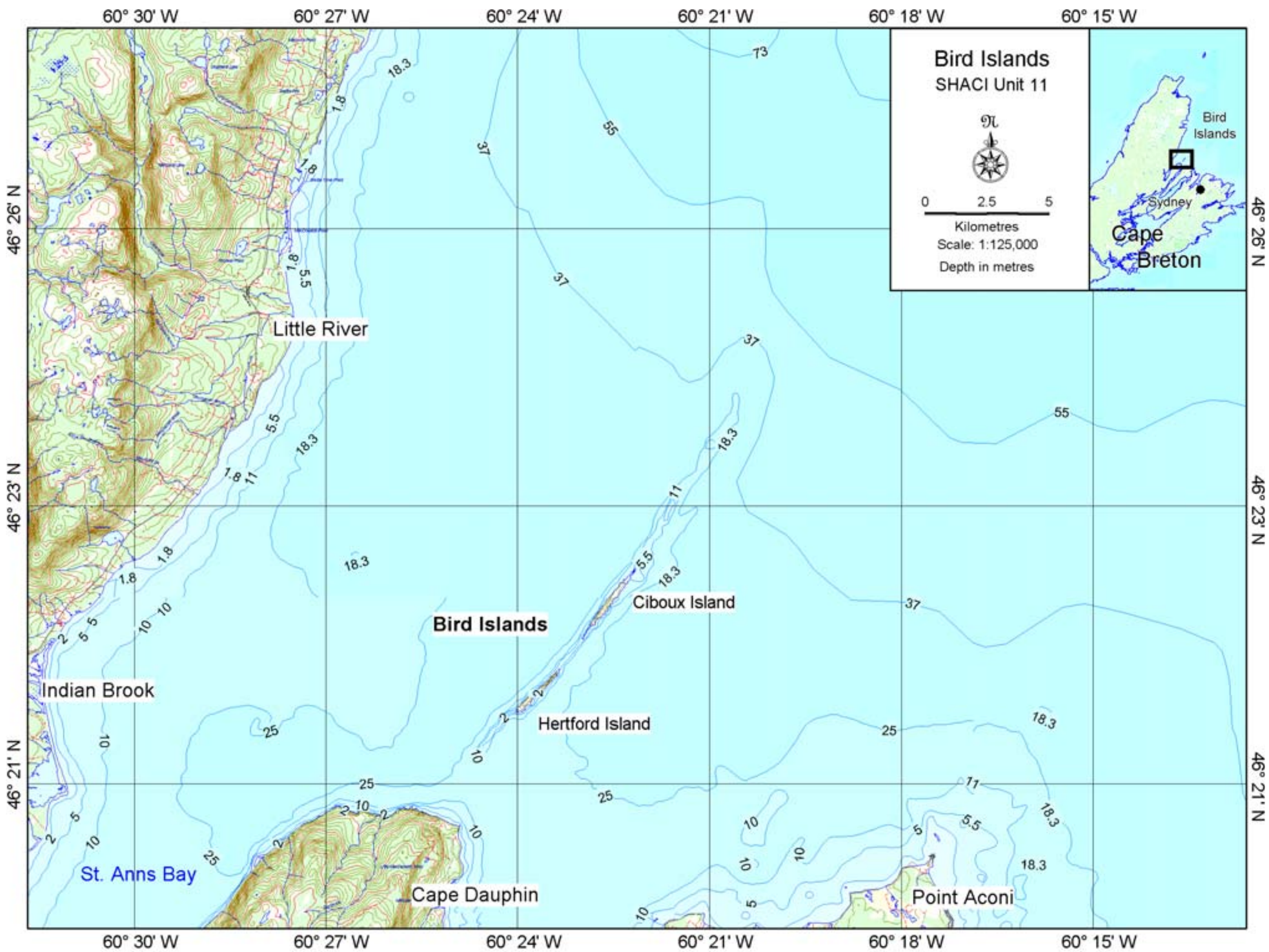


Figure 18-1: Location of the Bird Islands (Hertford Island and Ciboux Island) in Sydney Bight.

Birds

A diverse assemblage of bird species use the coastal cliff habitat provided on the Bird Islands. The islands house the breeding sites of the largest concentration of vulnerable seabirds on Cape Breton Island (Lock et al. 1994), the largest Great Cormorant colony in North America (9% of North American population), and the largest concentrations of breeding Black-legged Kittiwakes, Razorbills and Atlantic Puffins in Nova Scotia (Boates 1992). Many other bird species either breed (Double-crested Cormorants, Black Guillemots and Leach's Storm-petrels) or frequent (Spotted Sandpipers, Yellowlegs, Herring Gulls, and Greater Black-backed Gulls) the Bird Islands (BSC 2001). Birds are generally known to inhabit the Bird Islands between May and mid-September (Table 18-1) (Puffin Boat Tours 2001).

Table 18-1: Birds recorded on the Bird Islands by Puffin Boat Tours (2001)

Bird species	Time period used
Atlantic Puffin	May to the last of August
Bald Eagle	May to September
Black Guillemot	May to mid-September
Black-legged Kittiwake	May to mid-August
Double Crested Cormorant	May to mid-September
Great Black Backed Gull	May to September
Great Cormorant	May to mid-September
Herring Gull	May to September
Lesser Black-backed Gull	May to September
Razorbill	May to mid-September
Ruddy Turnstones	June to August

Figure 18-2 indicates that bird nesting colonies are present on the bird islands but does not indicate the specific nesting locations.

Along with the availability of coastal cliff habitat, the remoteness and the relative lack of disturbance to the Bird Islands are what make the area desirable nesting habitat for seabirds. Given that such large concentrations of seabirds do nest on the Bird Islands, it is possible that many of these species are dependent on the islands as breeding habitat. For many seabirds, nesting habitat is extremely important since only small clutches are laid and the eggs are not well protected. The success of nesting is critically important to ensure healthy future seabird populations. For these reasons, the Bird Islands are considered Significant Habitat for seabirds.

The Bird Islands are recognized as significant bird habitat by several organizations. Hertford Island is a Nova Scotia Bird Sanctuary (Lock et al. 1994). Collectively, the Bird Islands were recognized as important habitat by the Canadian Committee for the International Biological Programme Conservation of Terrestrial Communities Subcommittee (IBP-CT)(1974) , the Nova Scotia Museum Special Places Program (1991) and are currently recognized by Bird Life International and Bird Studies Canada as an Important Bird Area (BSC 2002). In a submission to the Public Review on oil and gas exploration and drilling in Cape Breton, Environment Canada (2001) identified the Bird Islands as an area of particular significance to birds due to its breeding bird colonies.

Seals

The shores of the Bird Islands are used as a haulout site by grey seals from mid-August to early September (VCCRMP 1996; Highland Coastal Mapping 2000; Puffin Boat Tours 2001;). Seal haulouts are onshore sites where seals stop to rest. The Bird Islands are likely a desirable haulout for seals because they are located off the coast and infrequently visited by humans. Figure 18-2 indicates that seals are present on the Bird Islands; however, the seal symbols do not indicate precise locations of seal haulouts.

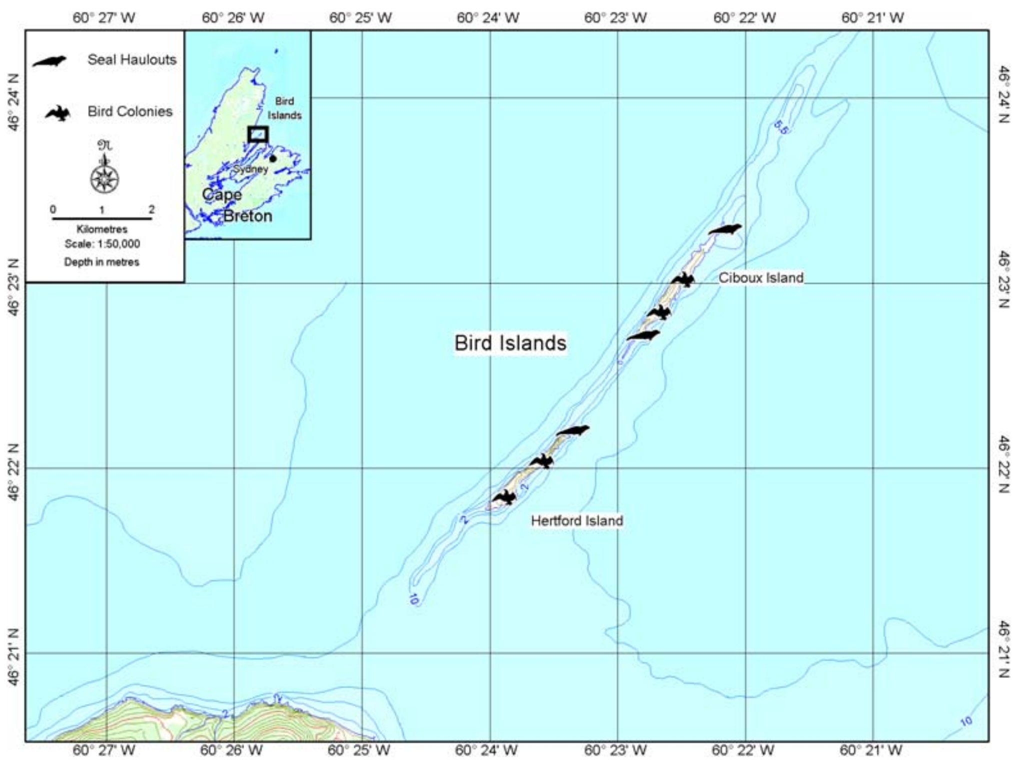


Figure 18-2: Bird Islands: a bird nesting and seal haulout area

Fish

There are likely many fish species that inhabit the waters surrounding the Bird Islands, however the area is specifically known to be important for Atlantic cod and herring. Generally, fish found in large groups and in localized areas, and eggs and larvae that are retained in a certain area are vulnerable to discrete impacts.

Cod

The waters surrounding the Bird Islands are a nursery area for juvenile cod from the 4Vn cod stock which is resident in Sydney Bight. Inshore surveys from 1991-1994 found consistent concentrations of small 0-year cod (15 cm) around the Bird Islands. Furthermore, cod size increased in both a northerly and easterly direction away from the Bird Islands area, indicating that 1 and 2 year old cod are also found in this vicinity (Lambert and Wilson 1995; T. Lambert pers. comm. 2002). Generally, juvenile cod do not move far from their nursery area during the first two years of life since they seem to settle close to the area where they were spawned (Lambert and Wilson 1995).

Fish nursery areas are considered key for successful recruitment and the maintenance of healthy fish stocks. The nursery area in the Bird Islands area is particularly important since Atlantic cod are considered a species of special concern by COSEWIC (COSEWIC 2003a). As well, the 4Vn stock is of particular concern regionally. This stock declined rapidly in abundance and spawning biomass in the late 1980s and early 1990s, and at present stock production is very low (DFO 2001a). Kenchington (2001), in fact, describes the 4Vn stock as probably the most depleted of any of Canada's cod populations that were once substantial enough to be managed as a single unit. To the knowledge of the author, there are no similar known cod nursery areas for the 4Vn resident cod stock in Sydney Bight. For this reason, this cod stock may be greatly dependent on the area surrounding the Bird Islands for future recruitment. For these reasons, the area surrounding the Bird Islands is considered Significant Habitat for cod.

Herring

Herring from the Bras d'Or Lakes overwinter in aggregations in the Bird Islands area and in St. Anns Bay (Claytor and Leblanc 1998). The herring fishery in this area (below the Cape Dauphin line) is closed during the winter months to protect this overwintering population. The Bras d'Or Lakes herring are a particular management concern because in recent years they have been absent from their traditional spawning areas, low larval densities have been observed during surveys, and fishing effort has intensified in the few small remaining spawning areas within the Lakes (Stephenson et al. 1998).

The Bird Islands area clearly provides habitat to support important seasonal herring aggregations. Overwintering areas are important in the life cycle of fish species. These herring aggregations may be particularly important due to the declining and unknown stock sizes of the Bras d'Or Lakes and 4Vn herring populations respectively. For these reasons, the Bird Islands area is considered Significant Habitat for herring.

Invertebrates

Like the majority of coastal Sydney Bight, the benthic habitat surrounding the Bird Islands supports lobster, rock crab and sea urchins. (T. Lambert pers. comm. 2002) has found high concentrations of the common starfish (*Asterias vulgaris*) in St. Anns Bay and the area surrounding the Bird Islands. Extensive species lists do not, unfortunately, exist for the many other benthic invertebrates that likely also inhabit this area. Sessile benthic invertebrates may be particularly vulnerable to certain impacts since they are unable to move in avoidance.

Scallop

Benthic habitat around the Bird Islands is one of few discrete areas in Sydney Bight that supports scallops (Figure 18-3). Generally, scallops are most abundant in tidally well mixed areas with gravel bottom (Tremblay et al. 2001).

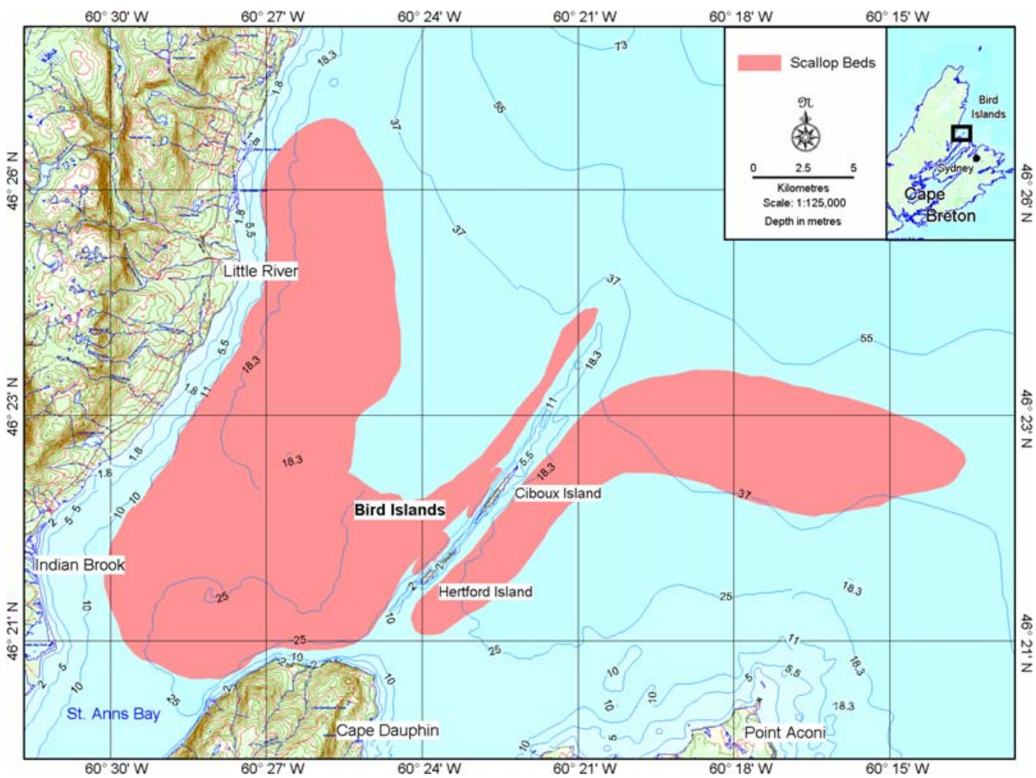


Figure 18-3: Scallop grounds surrounding the Bird Islands

Socio-economic importance

- Two tourism operations that feature birdwatching make daily tours to the Bird Islands between mid-May and late September.
- Commercial lobster fishing occurs around the Bird Islands (Highland Coastal Mapping Association 2001).
- Commercial scallop beds are found around the Bird Islands (Highland Coastal Mapping Association 2001).
- Fishing by dragging, seining and longlining occurs around the Bird Islands (Highland Coastal Mapping Association 2001).

- Mackerel and dogfish areas include waters surrounding the Bird Islands (Highland Coastal Mapping Association 2001).

Threats/vulnerabilities

The Bird Islands and surrounding waters, and the species that inhabit this area are vulnerable to several threats. Both natural and anthropogenic impacts can threaten coastal cliff and island ecosystems. Natural impacts, like storms, can wash bird nests, eggs and young out to sea. Heavy rain on eggs and young can also kill eggs and young by exposure to cold (Butler et al. 1996).

Human disturbance

Marine bird breeding colonies are vulnerable to human disturbance. Generally, any disturbance to breeding areas (be it from increased boat traffic, coastal development, increased tourism, etc.) can cause increased stress levels that may negatively affect breeding success and cause birds to abandon breeding altogether (Environment Canada 2001). Given their location and high cliffs it is unlikely that the Bird Islands will become developed. There is, however, the chance that increased visitation by boaters or tour boat operations could disturb the breeding bird colonies.

Oil and gas exploration

The Bird Islands are located within the Hunt Oil Company of Canada exploratory lease area, therefore activities associated with oil and gas exploration may threaten species and habitats associated with the Bird Islands. In particular, the seismic activity and increased light pollution associated with oil and gas exploration and potential development could harm seabirds, and drilling discharges may have negative effects on benthic invertebrates.

Airguns detonated during seismic oil and gas exploration can harm marine birds (Environment Canada 2001). Diving birds such as puffins, Razorbills, guillemots, and cormorants, which inhabit the Bird Islands, may be knocked out or killed by the strength of the shock waves from air guns detonated in their vicinity (Environment Canada 2001). Seismic activity may also indirectly impact marine birds since it can drive fish schools away from habitual foraging grounds. Some birds, including Leach's Storm-petrels, are attracted to light on ships or oil rigs. As a result, they may die from strikes (when they fly into these objects), become fouled with oil, or be incinerated in open flares (Environment Canada 2001).

Drill cuttings from wells drilled during exploratory activities may contain substances harmful to benthic marine life. Water based muds used to coat drill cuttings contain various toxic chemicals including barite and bentonite that are known to have toxic effects on molluscs. Sea scallops are particularly sensitive to bentonite, which glues-up the feeding apparatus of some filter feeders (Cranford and Gordon 1992; Cranford 1995; Cranford et al. 1999). The ecological effect of barite is unclear, but it is known to be toxic and persistent in the environment and to cause growth suppression and death in bivalve molluscs such as scallops (Cranford et al. 2001).

Oil pollution

As in many other coastal areas, oil spills may pose a threat to species associated with the Bird Islands. The two main sources of oil on the sea surface are from shipping and oil and gas developments (Russell 2000). Oil from these sources reaches the sea through operational discharges and accidental spills from oil and gas developments, oily bilgewater discharge from ships, and accidental oil spills from vessels (CWS 1992; Environment Canada 2001). Cod larvae and seabird populations associated with the Bird Islands are identified above as being ecologically significant. Oil has known effects on these organisms.

Oil kills seabirds by breaking down the birds' waterproofing which exposes them to cold water and induces hypothermia. Birds may also inhale and swallow the toxic oil compounds thereby damaging internal organs. As well, when oil is absorbed by incubating eggs it may either kill the embryos or induce abnormalities (Environment Canada 2001).

Any subsurface plume caused by either blowouts or spills could seriously harm the planktonic eggs and fish larvae in Sydney Bight (Howarth 1981; Kenchington 2001). The physical oceanographic features that cause eggs and larvae to be retained in a certain area can also retain spilled hydrocarbons (Stewart and Arnold 1994). The 4Vn cod stock which is dependent on the nursery grounds in the Bird Islands Area is of particular concern for such reasons (Kenchington 2001).

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