THE SCOTIAN SHELF IN CONTEXT

State of the Scotian Shelf Report

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CONTENTS

1 INTRODUCTION

In 1997, Canada became the first country in the world to adopt comprehensive legislation for integrated ocean management. By passing its *Oceans Act*, Canada made a commitment to conserve, protect, and develop the oceans in a sustainable manner. The *Oceans Act* and its supporting policy, *Canada's Oceans Strategy*, affirmed Fisheries and Oceans Canada's (DFO's) mandate as the lead federal authority for oceans and provided a national context for the initiative. Carrying out the Department's responsibilities under the *Oceans Act* requires a great deal of knowledge on the current state of the environment and its users.

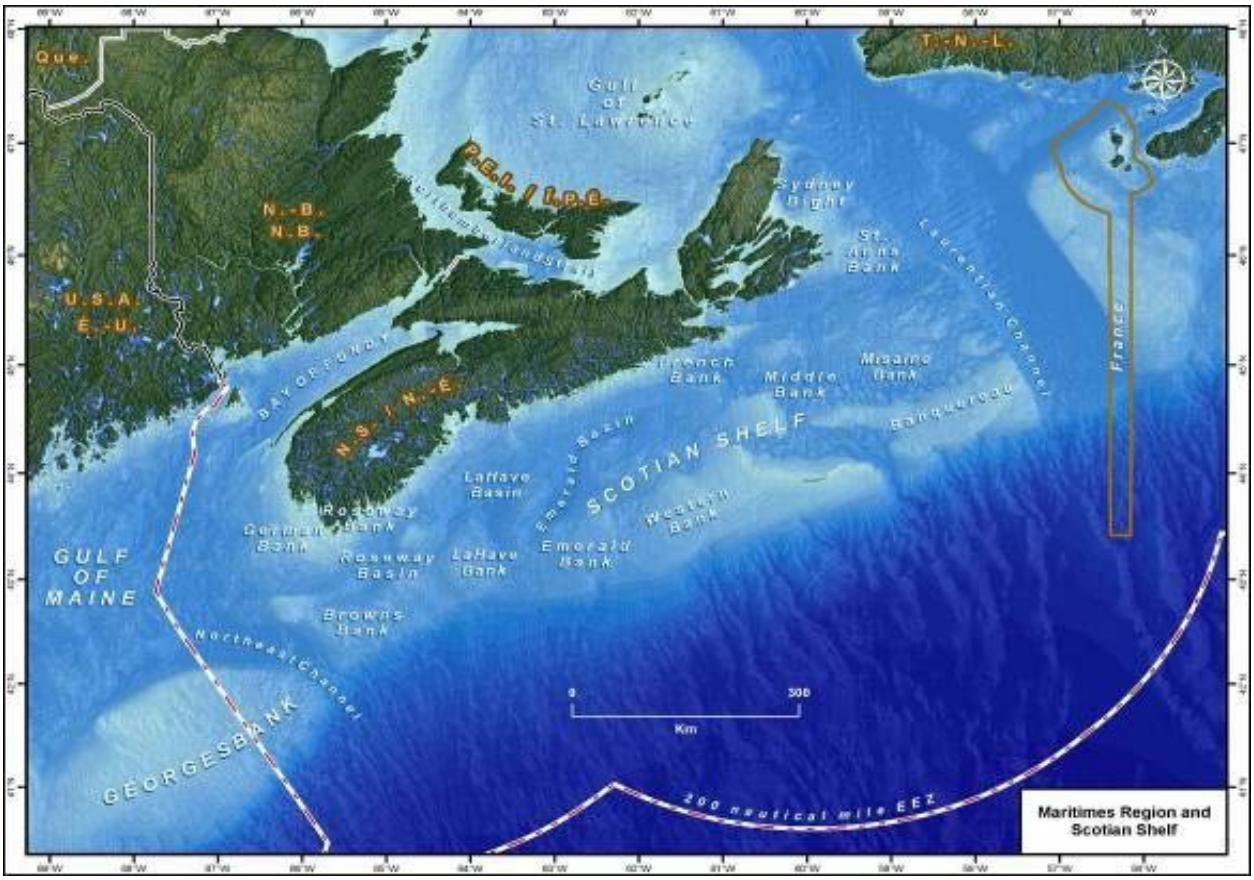


Figure 1: The Scotian Shelf (Source: Oceans and Coastal Management Division, Fisheries and Oceans Canada).

The Scotian Shelf is part of the North American continental shelf off of Nova Scotia (Breeze et al. 2002: figure 1). Over the years, there have been steps taken to catalogue the collective understanding of the Scotian Shelf and surrounding coastal areas (e.g. *The Scotian Shelf: An Ecological Overview for Ocean Planning*, Breeze et al. 2002 and *Implications of Ecosystem Dynamics for the Integrated Management of the Eastern Scotian Shelf*, Zwanenburg et al. 2006), and there are many examples of reports that address aspects of the region (e.g. *Economic Impact of the Nova Scotia Ocean Sector*, Gardner Pinfold 2005; 2009, and *State of Nova Scotia's Coast Report (2009))*. The *State of the Scotian Shelf Report* builds on these documents and links the current status and trends observed on the shelf to human and environmental impacts, as wells as management actions and responses.

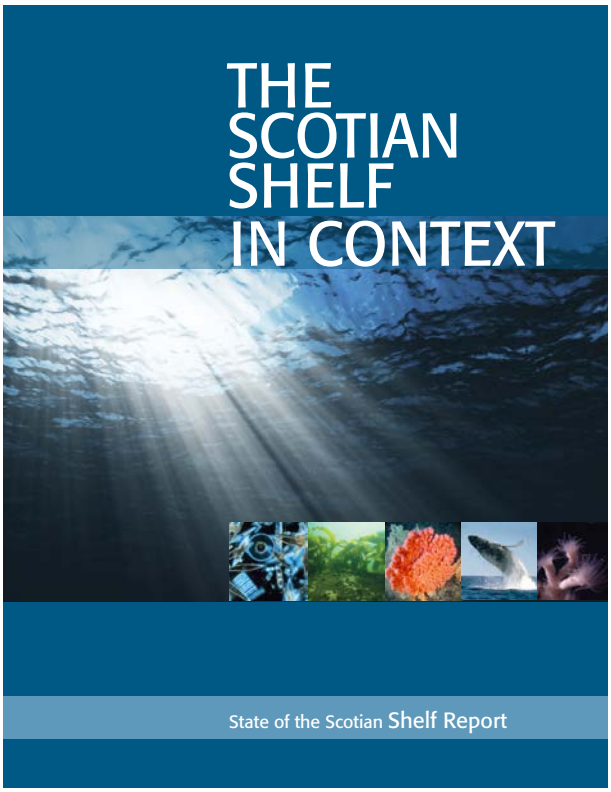


TABLE 1: Theme Papers for *State of the Scotian Shelf Report*

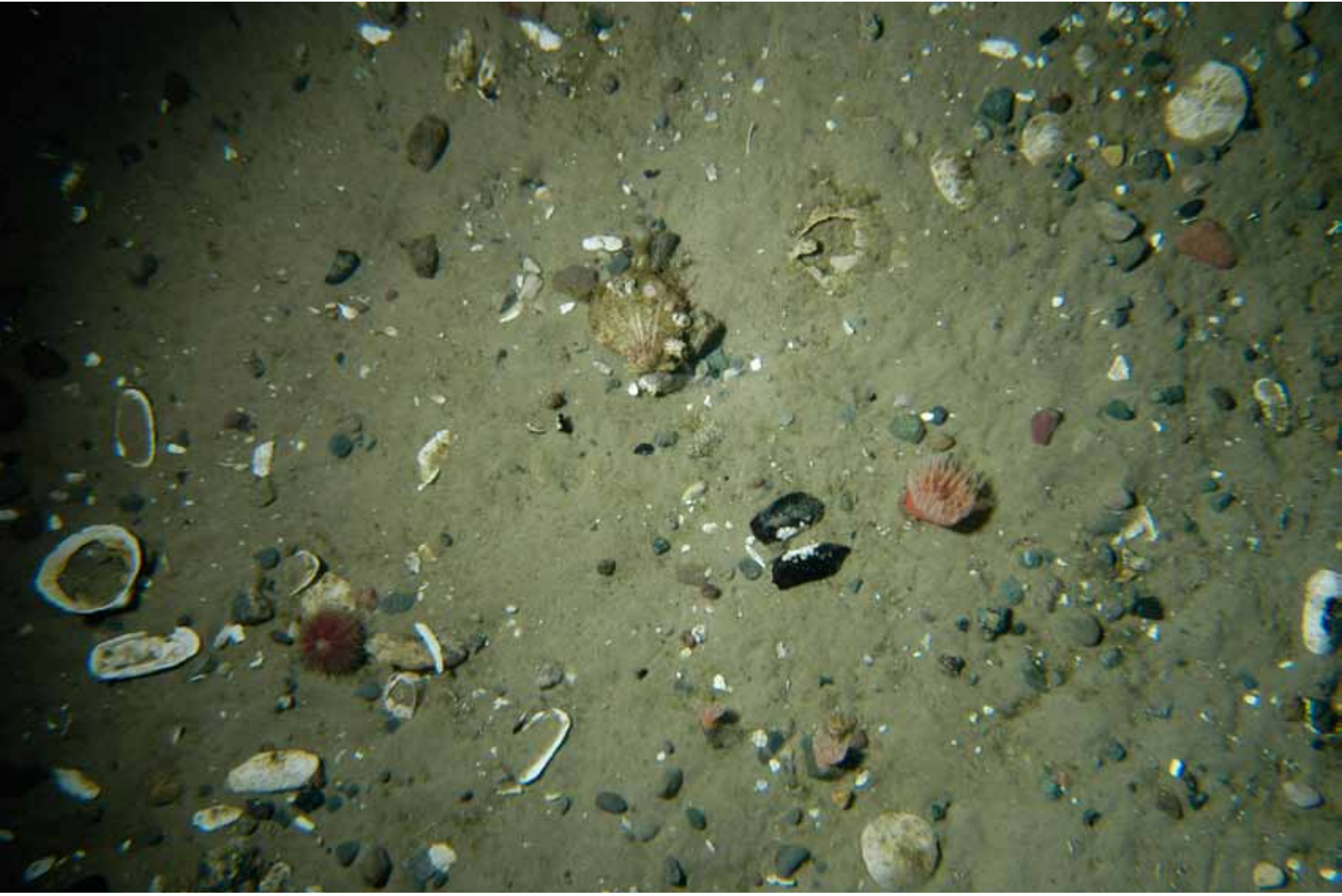
PRIORITY AREA	THEME PAPERS
Biodiversity	Marine Habitats and Communities Incidental Mortality Species at Risk Invasive Species
Productivity	Primary and secondary productivity Trophic Structure Fish Stock Status and Commercial Fisheries
Marine and Environmental Quality	Water and Sediment Quality Ocean Noise Waste and Debris Ocean Acidification
Other	Climate Change and its Effects on Ecosystems, Habitats and Biota Emerging Issues

The *State of the Scotian Shelf Report*, of which this document is a part, is a synthesis of pressures on the environment, biophysical and socio-economic status and trends, and responses to identified issues. It is a living document that consists of several parts, including this context document and a series of sector reports and theme papers. This document, *The Scotian Shelf in Context*, provides an introduction to the natural and socio-economic environment of the Scotian Shelf. The aim is to provide the information in a form that is easily accessible and readable, and familiarizes the reader in the region. It is complementary to the theme papers, which provide a more in-depth look at important issues on the Scotian Shelf (Table 1). Theme papers will be developed incrementally and will be updated regularly, as appropriate. Theme papers will be focused on the priority areas of biodiversity, productivity and habitat.

2 THE NATURAL CONDITIONS OF THE SCOTIAN SHELF

The Scotian Shelf is the wide, submerged portion of the continental shelf lying off Nova Scotia, 700 kilometres long and between 125 and 230 kilometres wide. The Northeast Channel separates the shelf from the Gulf of Maine to the southwest, while the Laurentian Channel is the natural boundary with the Newfoundland and? Shelf to the northeast (**Figure 1**). The shelf edge, where the seafloor begins to fall steeply away, lies at about 200 m depth. For the purposes of this report, the region includes the Scotian Slope and Rise (the area from the edge of the continental shelf seaward to the abyssal plain), and the abyssal plain itself within Canada's Exclusive Economic Zone.

The state of the Scotian Shelf marine ecosystem is influenced by many complex interactions: interactions between the different factors that constitute the physical environment; interactions between the physical environment and the plants and animals that live there; interactions between the various species; and human interactions with the physical environment, including human activities occurring both in this region and far away. This section describes major features of the marine environment in this region and highlights, both the physical environment and characteristic species that are found here. More comprehensive overviews of the region can be found in *The Scotian Shelf: An Ecological Overview for Ocean Planning* (Breeze et al. 2002) and *Implications of Ecosystem Dynamics for the Integrated Management of the Eastern Scotian Shelf* (Zwanenburg et al. 2006). Worcester and Parker (2010) describe recent trends in the ecosystem, while Davis and Browne (1996) provide a description of the area aimed at the informed general reader.



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2.1 GEOLOGY

The ocean bottom, Its shape and the types of sediment that overlay it, help define the habitats of the Scotian Shelf and the types of plants and animals that are found in different areas. The shape of the seafloor in this region and its surficial sediments were influenced by long periods of erosion of the ancient bedrock (King 1980) as well as the last glaciation and the subsequent rise in sea level that started about 10 000 years ago (King and Fader 1986).

GEOMORPHOLOGY

The Scotian Shelf proper can be divided into three regions based on characteristics of the seafloor, an inner shelf, middle shelf and outer shelf (King and MacLean 1976), while the Laurentian Channel, Northeast Channel, and eastern and western Scotian Slope each have their own characteristics (Davis and Browne 1996, WWF 2009).

The inner shelf borders the coast and can be considered an underwater extension of Nova Scotia's coastal areas. It has rough topography and areas with bedrock outcrops, and extends from the coastline to depths of about 100 -120 m (Fader 1991, Davis and Browne 1996). The eastern region of the inner shelf is distinguished by a couple of small banks, St Anns Bank and Scaterie Bank, off Cape Breton.

The middle shelf is characterized by a wide, complex

network of valleys, ridges and small gravel-covered banks in the east; large, deep basins in the central area; and a smaller bank and basin in the western region, with a narrow strip of rough bedrock at the far western extent (Sankerelli and Fader 1999, WWF 2009). The basins have been filled and smoothed first by glaciers and, more recently, by deposition of silt. In places, boulder-covered till ridges protrude through the mud and crater-shaped depressions known as pockmarks are found where natural gas bubbles through the sediments to the surface.

Several large, shallow banks – Banquereau, Sable, Western, Emerald, LaHave and Browns – are the defining features of the outer shelf (Davis and Browne 1996). They function somewhat as a physical barrier between the waters of the shelf and the deep waters of the ocean (Breeze et al. 2002). Sable Island is the only offshore island and the exposed portion of Sable Island Bank. Various seabed features surround the island: sand waves, sand ridges, ripples and megaripples (Amos and Nadeau 1988; Davis and Browne 1996; Dalrymple and Hoogendoorn 1997).

The seafloor begins to descend more steeply starting at about the 200 m isobath to depths of about 2000 m; this area is known as the Scotian Slope. From that point, the depth increases more gradually until the seafloor flattens out at the abyssal plain, at a depth of about 5000 m. A series of steep-sided submarine canyons are found along the shelf edge and slope. At more than two kilometres deep and fifteen kilometres wide, the Gully is the largest of these canyons. (Rutherford and Breeze 2002). Unlike the other canyons, it has a wide basin (the trough) at its head. The size and shape of the Gully are thought to influence water transport to and from the shelf (Rutherford and Breeze 2002). Six smaller canyons are also found along the shelf edge of the eastern Scotian Slope (Piper et al. 1985, WWF 2009); much less is known about these canyons. There are no canyons in the area of the western Scotian Slope (WWF 2009): the slope between Emerald Bank and the Northeast Channel.

The Scotian Shelf is bounded on the east by the Laurentian Channel, a deep trough that originated as a river valley and was later eroded by glacial ice (Davis and Browne 1996). The Laurentian Fan is a large, delta-like deposition area down the slope from the Channel. Deep parts of the Laurentian Channel carry water from the Atlantic Ocean into the Gulf of St. Lawrence (Davis and Browne 1996).

To the west, the Northeast Channel divides Browns Bank on the Scotian Shelf from Georges Bank and the Gulf of Maine. The channel connects the Bay of Fundy and Gulf of Maine with the rest of the Northwest Atlantic. Strong tidal currents carried through the channel helped shape its seafloor.

SURFICIAL GEOLOGY

The sediments covering the Scotian Shelf seafloor are an important structural and functional component of the marine ecosystem. Areas with a variety of habitat types, including a diversity of sediment types, may support greater biodiversity than other areas. Surficial sediments are a determining factor in habitat, supporting diverse communities of benthic organisms that contribute to the regulation of carbon, nitrogen and sulphur cycling, water column processes and pollutant distribution (Snelgrove et al. 1997, Snelgrove 1999). The stability of sediments and the communities living on and in them affects the whole ecosystem.

The depth of the surficial sediment layer varies greatly over the Scotian Shelf. Some areas of the inner shelf have exposed bedrock and no surficial sediments, while other parts of the shelf have layers of silty sand a few metres thick. The large, central basins of the shelf have 100 m thick deposits of silt and till (Davis and Browne 1996). The current distribution of sediments on the shelf and slope is a result of geological history and recent physical, biological and chemical processes (Amos and Judge 1991). Although particles continue to be transported to different areas of the shelf, the broad pattern of distribution is relatively stable. Any shifts are caused mainly by storms.

The shallow bank areas are topped by sands and gravel; some areas have extensive shell beds (Davis and Browne 1996). Deeper areas are covered in finer silt and clay interspersed with coarse glacial materials. The Northeast Channel was highly affected by glaciation, with iceberg furrows and glacial till in many areas of the seafloor (Fader pers. comm. cited in Breeze et al. 2002). The influence of the strong tidal currents is also present: some of the deepest recorded sand waves on the continental shelf are found at depths of 230-260 m (Davis and Browne 1996). On the Scotian Slope, sands and gravels are slumped over the shelf edge in some locations, with silts and clays in others and fine sediments transported by currents moving down the slope (Piper 1991). More details on the surficial sediments of the Scotian Shelf and Slope can be found in publications of the Geological Survey of Canada (e.g., King 1970; MacLean and King 1971; MacLean et al. 1977; Fader et al. 1982; Piper 1991; Fader and Strang 2002; and Piper and Campbell 2002).

2.2 CLIMATE

The ocean has a large influence over the province's climate. In the Maritimes, the waters of the Atlantic Ocean, Gulf of Maine and Gulf of St. Lawrence moderate the climate such that winters are generally long and mild, and summers are short and cool. Generally, regional winter temperatures average -50°C, whereas summer temperatures are around 14°C (AECOM 2010). A detailed description of Nova Scotia's climate is provided in *The State of Nova Scotia's Coast Report* (2009).

The conditions of the North Atlantic Ocean and, therefore, the Scotian Shelf, are largely influenced by the North Atlantic Oscillation (NAO). The NAO affects water properties (temperature and salinity), vertical mixing, sea ice coverage, and circulation through air-sea heat exchange and wind stress (DFO 2008; Hurrell and Deser 2009).

The NAO index is a measure of the difference of the atmospheric pressure at sea level between the Azores and Iceland in winter. A high index brings increased westerly winds, precipitation, and results in warmer water temperatures for the Scotian Shelf. A low index brings drier conditions, a decrease in storms and cooler water temperatures (DFO 2010a).

Air temperatures for the Scotian Shelf are measured at Sable Island. Sable Island air temperature has a weak long term increasing trend, amounting to 1°C over the length of the record (DFO 2008). In 2007, annual air temperatures over the Scotian Shelf were below normal and cooler than 2006 (DFO 2008).

2.3 SEA LEVEL

Relative sea level is measured with respect to a fixed reference point on land (Petrie et al. 2009), averaged over a period of time so that fluctuations due to waves or tides are smoothed out. There are many factors that contribute to short term or periodic sea level changes; however, longer term change can

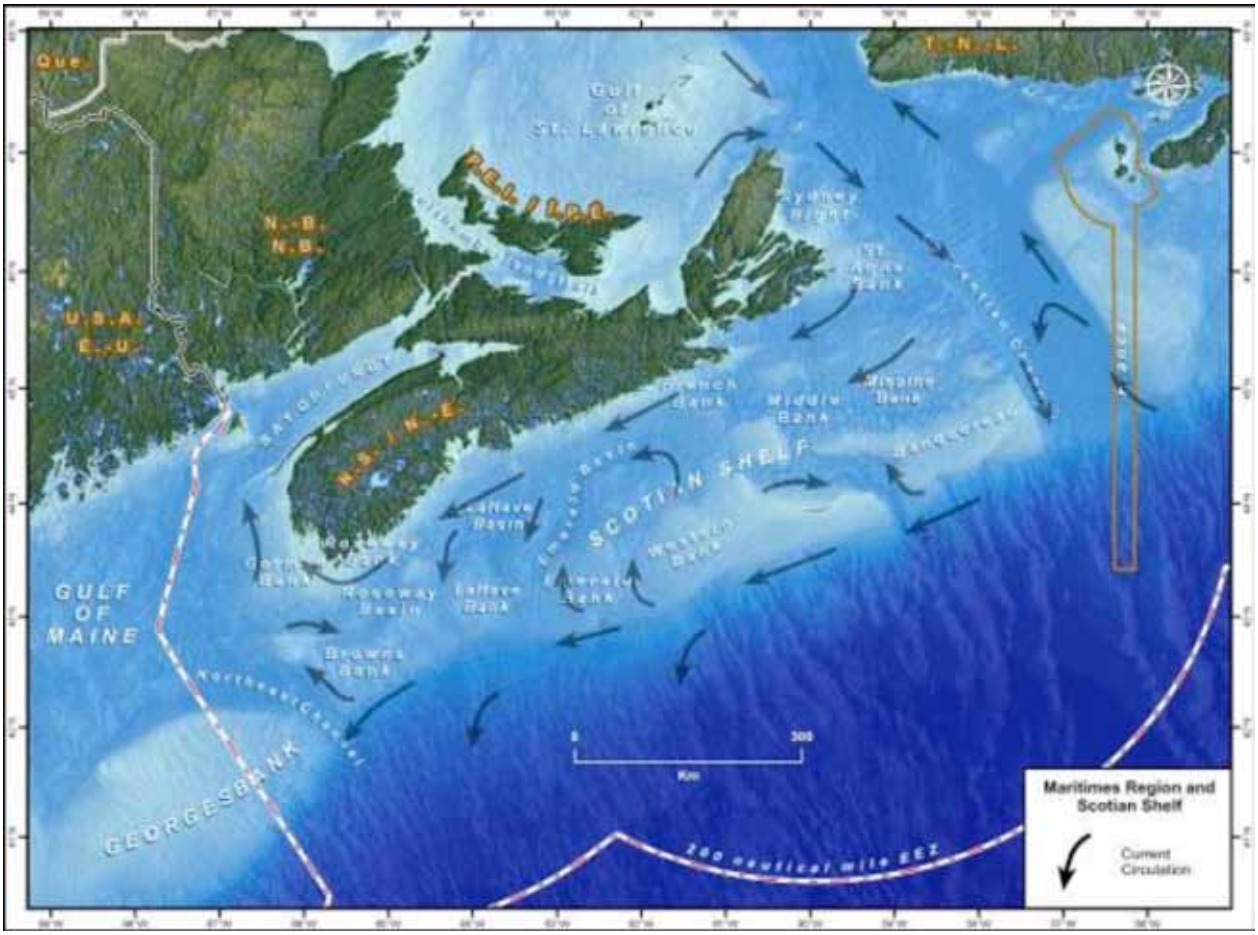


Figure 2: Detailed surface circulation on the Scotian Shelf. (Source: adapted from C.Hannah in Breeze et al 2002).

be attributed to two main causes: a change in the volume of water in the ocean and changes caused by the sinking or rising of land. Changes in the volume of water may be due to rising or lowering of temperatures, leading to the thermal expansion or contraction of water, as well as changes in the amount of water stored in polar ice and on land in glaciers, lakes, rivers, and other reservoirs. In Atlantic Canada, the land is still rising and sinking in response to the retreat of the last glacier more than 10 000 years ago. This rising and sinking, known as post-glacial or isostatic rebound, is causing a large area, including Nova Scotia, to sink and thus sea levels to rise. Overall, there is a general trend of sea level rise on the Atlantic coast of Nova Scotia. Petrie et al. (2009) estimated a total value of 31.9 cm/century at Halifax, with 23 cm/century attributable to post-glacial rebound (Tushingham and Peltier 1991 cited in Petrie et al. 2009).

2.4 OCEANOGRAPHIC CONDITIONS

The Scotian Shelf is most strongly influenced by three currents: the Nova Scotia Current, the Labrador Current and the Gulf Stream. Relatively cool, fresh waters flow from the Gulf of St. Lawrence through the Cabot Strait. Part of this flow turns at Cape Breton to flow southwestward along Nova Scotia's Atlantic coast, while the rest of the flow continues through the Laurentian Channel to the shelf break. There, it turns and joins with the Labrador Current to flow southwestwards along the shelf edge. The third major current, the Gulf Stream, flows northeastwards. Its warmer, saltier waters mix with the cool Labrador Current waters over the Scotian Slope, forming a water mass known as slope water. The slope water periodically

leaks onto the shelf through the channels as well as The Gully submarine canyon. The influence of these currents varies spatially and seasonally, with the cool waters from the Gulf of St. Lawrence and Newfoundland Shelf more strongly affecting the banks of the eastern Scotian Shelf, and the Gulf Stream more strongly affecting the Slope and deep channels and basins of the shelf. Overall, the general flow is from the northeast to the southwest across the shelf, with this flow strongest in the winter and weakest in the summer. Water transports food and oxygen, removes wastes and also conveys certain organisms from place to place. These same currents also distribute human wastes (including municipal, agricultural and industrial wastes) around the marine environment (Zwanenburg et al. 2006). A fuller description, with references, of the major currents and water masses in this region can be found in Breeze et al. (2002) and Zwanenburg et al. (2006).

In addition to the major currents described above, circulation patterns in different areas of the shelf and slope are influenced by local conditions (Figure 2). The topography of the seafloor interacts with currents and creates localized circulation patterns. For example, tidal currents washing over the edges of the banks results in gyres or partial gyres over same of the banks. These gyres retain particles, such as plankton, for a period of time in one area, and may be important for larval stages of fish and invertebrates (see complete references and discussion in Breeze et al. 2002). Tidal currents have a strong influence on circulation patterns of Browns Bank (Hannah et al. 2001).

Oceanic fronts exist where currents and water masses with different water properties meet and create a boundary. The primary front on the Scotian Shelf is the shelf/slope front (Breeze et al. 2002). Organisms like plankton and jellyfish tend to collect at fronts, attracting predators such as sea turtles and whales to the area (Breeze et al. 2002).

TEMPERATURE AND SALINTY

Temperature and salinity have profound impacts on the distribution, growth and survival of marine organisms. Each organism has a particular range of temperature and salinity that is optimal for its success.

Scotian Shelf water temperatures are, from year to year, among the most variable in the North Atlantic ocean. Temperatures vary widely across the Shelf, with the western Scotian Shelf remaining generally warmer than the eastern Scotian Shelf (Breeze et al. 2002). The temperature regime of the western Scotian Shelf is also seasonally and spatially more dynamic than the eastern Scotian Shelf. Surface temperatures show the greatest seasonal variation and can range in places over 15 oC from summer to winter. Trends in the last two decades show that water temperatures between 1987-1993 and 2003-04 were cooler than normal, while 1999-2000 was warmer than normal (DFO 2010a). In 2007 the sea surface temperatures were above normal on the eastern and central Scotian Shelf and below normal elsewhere. Subsurface and bottom temperatures were cooler than normal (DFO 2009a). Variability in water temperature has been increasing in the past decade (DFO 2010a).

Salinity is another important characteristic of the ocean. The Scotian Shelf waters are less saline than both the Labrador Current and the Gulf Stream, which vary between 34-35 parts per thousand (ppt) and 35-36 ppt respectively, and coastal areas tend to be less saline than slope and basin areas (Breeze et al. 2002).

The density of seawater is dependant on temperature, salinity, and pressure and it increases with depth. The difference in the density of water at different depths is referred to as density stratification (DFO 2009a). Increased stratification can affect vertical mixing, decrease nutrient fluxes and decrease phytoplankton production (DFO 2009a). On the Scotian Shelf, stratification has increased since 1960, but most significantly since the 1990s (DFO 2010a). The waters of the Scotian Shelf typically form a layers

that vary by region and season. During the winter: a cooler, fresher surface overlays a warmer, saltier layer. In the summer three layers exists with a warm, low salinity surface layer, a cold intermediate layer and a warm, high salinity bottom layer (Breeze et al. 2002).

A full description of historical temperature and salinity trends in this region can be found in Breeze et al. (2002). Current trends are described in detail in DFO Science State of the Ocean reports available through the Canadian Advisory Science Sectretariat website http://www.dfo-mpo.gc.ca/CSAS/Csas/Publications/SAR-AS/2009/2009_054_e.pdf ; http://www.dfo-mpo.gc.ca/CSAS/Csas/Publications/SAR-AS/2008/SAR-AS2008_025_e.pdf

2.5 HABITATS

A wide variety of habitats can be found on the Scotian Shelf and Slope, from kelp beds that support large populations of sea urchins to bedrock outcrops with a diversity of corals and sponges to deep waters of the open ocean where anglerfish and other rarely seen species live. Habitat is influenced by the characteristics of the seabed, such as its depth, the surficial sediments overlaying it, the degree of slope of the seafloor and characteristics of the water column, such as salinity, temperature, nutrients and currents. It also include plants and animals that may be used as homes for other species. These attributes are important both at a fine scale (millimetres) and coarse scale (tens to hundreds of kilometres).

The ocean is a dynamic environment and changes in oceanographic conditions can change habitat suitability for particular species or groups of species. Highly mobile species may be able to quickly adapt to changes in habitat by leaving areas with less preferred features; however, more sedentary species do not have that ability. At the same time, there are many general habitat features that persist over the long term. Classification schemes have attempted to divide the Scotian Shelf into different habitats based on these persistent features (see Marine Habitats and Communities theme paper).

Several different habitat classification schemes have been developed to help describe the environment of the Scotian Shelf and Slope, each with its own strengths and weaknesses. The *Natural History of Nova Scotia* divided Nova Scotia and its offshore waters into several different theme regions (Davis and Browne 1996). Physiographic features were used to divide the offshore/continental shelf region into four large districts. Those districts were then divided into smaller units using the shape of the seafloor as well as other factors that contribute to habitat. Recently, the World Wildlife Fund (2009) produced a seabed feature map that used similar divisions to the *Natural History of Nova Scotia*, but with more up to date information. A "habitat template" approach taken by Kostylev and Hannah (2007); (see also DFO 2005) classifies habitat along two axes, disturbance and scope for growth, and maps the Scotian Shelf based on those features. From those maps, the degree of vulnerability of benthic organisms to disturbance and their ability to recover from disturbance can be inferred (DFO 2005).

In this region, coastal classification systems have focussed largely on aspects of the coast above the water (see e.g., Davis and Browne 1996, Schaefer et al. 2004). However, this does not necessarily reflect the undersea features or the hydrological properties. More recently, Greenlaw (2009) undertook a classification of inlets along the coast of mainland Nova Scotia, which grouped the inlets into various categories based on hydrographic inlet type, productivity regime and "complexity", with complexity made up of several factors that contribute to habitat heterogeneity (i.e. the range of differences in habitat).

Most classification schemes focus on the physical aspects of the environment. However, structure-forming species also play an important role in providing habitat. Biogenic habitats are areas where dense concentrations of plants and animals provide habitat for other species (Tyrrell 2005). Seaweed beds, eelgrass beds, salt marshes, mussel beds, and aggregations of cold-water corals and sponges are distinguished by high densities of structure-forming species. Biogenic habitats offer surfaces for attachment, hiding places, and refuge from strong currents; they may also be a source of food for the species they host (Tyrrell 2005).

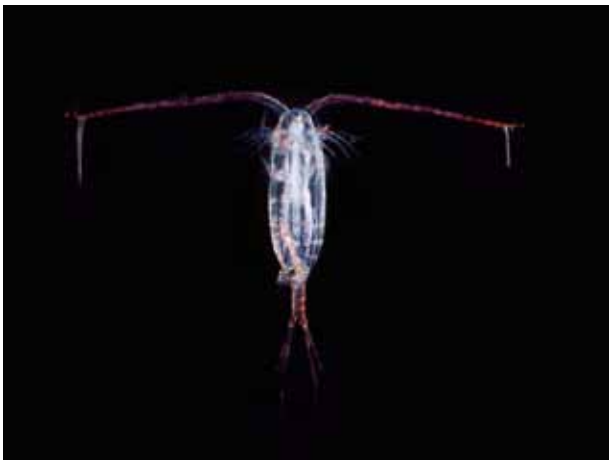
2.6 FAUNA AND FLORA

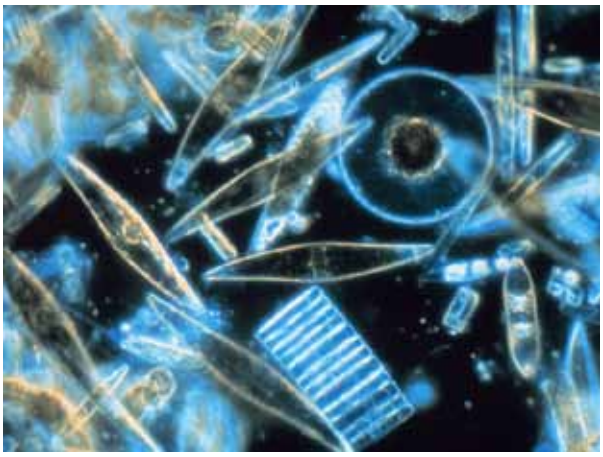
It is internationally recognized by scientists that there remains a lack of understanding of what lives in our oceans. In 2000, world scientists came together to begin the Census of Marine Life, aimed at developing a greater understanding of the diversity, distribution and abundance of marine species (Ausubel et al. 2010). The following section provides an overview of the known flora and fauna of the Scotian Shelf. A more detailed description is provided in Breeze et al. 2002.

PLANKTONIC COMMUNITIES

Plankton refers to animals and plants that drift in the water and are unable to swim against currents.

Phytoplankton are the base of the marine foodweb and the primary food source for the animal component of the plankton (zooplankton). Phyto-





plankton are distinctive among ocean biota in that they derive their energy and structural materials directly from the environment. They require light and nutrients (e.g. nitrate, phosphate, silicate) for their growth. On the Scotian Shelf, diatoms and dinoflagellates are the largest and most common phytoplankton (Breeze et al. 2002). Their abundance is determined by the Shelf's complex physical oceanographic features. There is a distinctive seasonal cycle of growth characterized by a widespread spring spring "bloom" and a more diffuse fall bloom. Blooms are a high concentration of phytoplankton in an area caused by increased reproduction and resulting in a discoloration of the water (Garrison 2005). Blooms vary in duration and scale. Trends in the magnitude and duration of the spring bloom on the Scotian Shelf indicate that blooms begin earlier now than they did in the 1960s and 1970s and are more intense and longer (Zwanenburg et al. 2006).

Zooplankton are divided into three main categories on the basis of size: microzooplankton, mesozooplankton, and macrozooplankton. Zooplankton are important food sources for higher trophic levels, including juvenile groundfish, pelagic fish species and baleen whales (Zwanenburg et al. 2006). The mesozooplankton on the Scotian Shelf is dominated by copepods. Three species of copepods, known as Calanus, make up > 70% of the copepod biomass. *Calanus finmarchicus* appears to be a significant link in the food chain (Zwanenburg et al. 2006) On the Scotian Shelf, zooplankton levels have been lower in more recent years than in the 1960s/70s (the reverse of the phytoplankton trend) and are beginning to recover from the lows observed in the 1990s (Harrison et al. 2007).

Plankton research and monitoring has been occurring on the Scotian Shelf for decades. A more description of research related to plankton is provided in Breeze et al. 2002.

MARINE PLANTS

Marine plants are macrophytic marine algae commonly referred to as seaweeds. *The Natural History of Nova Scotia* produced by the Nova Scotia Museum of Natural History provides a general overview of marine plants in Nova Scotia. Seaweeds along the rocky shores of Nova Scotia can be grouped into the following categories: green algae, red algae and brown algae. Green algae need a large amount of light and are generally found closer to the surface in intertidal or shallow subtidal areas. Nova Scotia has 82 known species of green algae. Red algae are able to grow at greater depths and are generally found in the intertidal zone, below the low water mark. Common red algae in Nova Scotia include irish moss. Brown algae are the dominant seaweeds and are exclusively marine. Kelp is the largest of the brown algae and is found in the subtidal zone. Rockweeds are common in the intertidal zone (Davis and Browne 1996).

THE GULLY

The Gully is a Marine Protected Area (MPA) under Canada's *Oceans Act*. The Gully was Canada's second *Oceans Act* MPA, and the first in the Atlantic Region. The largest submarine canyon in eastern North America, it is located 200 kilometres off Nova Scotia, to the east of Sable Island on the edge of the Scotian Shelf. The canyon plunges to two and a half kilometres in depth below the ocean surface. The Gully was formed thousands of years ago by erosion when sea levels were much lower. Over 65 km long and 15 km wide, the Gully is one of the most prominent undersea features on the east coast of Canada. It contains a rich diversity of marine habitats and species, and is nationally and globally acknowledged as an exceptional marine habitat. The Gully contains the highest known diversity of coral in Atlantic Canada. Many species of marine mammals are attracted to the Gully by the abundant food supply. The deepest part of the canyon is especially important for the Scotian Shelf population of northern bottlenose whales, a population listed as endangered under Schedule 1 of the *Species at Risk Act*. Each whale species that uses the Gully has particular habitat preferences, with distributions determined by prey abundance, temperature and underwater topography. Considering the habitat needs and distribution of these species, waters deeper than 200 m have been identified as a general area of importance to most cetaceans. The northern bottlenose whale is mainly found in areas of the Gully where waters are deeper than 800 m. The Gully has been defined as critical habitat, under the *Species at Risk Act* for the Scotian Shelf population of the Northern bottlenose whale.

Many different species of fish live in the Gully. Halibut are common in ocean bottom environments. Redfish, argentine, dogfish, cusk and several species of hake are among the many demersal fishes that inhabitat the Gully. Swordfish can be found in surface and near-surface waters in the summer and fall when waters are warm. Lanternfishes (small fishes with luminescent organs) are important prey for many larger species. There are still questions about what lives in the deepest parts of the canyon and there are many species yet to be discovered.

Seagrass is a general term for flowering plants that live in low intertidal and subtidal marine environments. Seagrass beds are acknowledged to be highly productive areas within coastal waters (Parker and Worcester 2010). Eelgrass is the dominant seagrass found in coastal and estuarine areas of the western North Atlantic. Eelgrass beds rank among the most highly productive ecosystems in the world (DFO 2009a). Eelgrass also plays an important role in stabilizing sediments and buffering the shore line and offers shelter for many species (DFO 2009b). It was estimated that there were once 20 000 ha of eelgrass beds in Nova Scotia during the 1970s (DFO 2009b). Eelgrass on the Atlantic coast of Nova Scotia has been declining in recent decades. There is limited information for the entire coast however, some locations reported declines from 30% to 90% (DFO 2009b).

BENTHIC ORGANISMS

Benthic invertebrate species include species that live within the bottom substrates (infaunal) and on the seafloor (epifaunal). Generally more is known about species that are found on the seafloor.

Invertebrates: Infauanal and non-commercial

The non-commercial benthic invertebrate species found in Nova Scotia's waters represent many billions of animals, stretching from the shallow intertidal organisms to deep water abyssal species (Breeze et al. 2002). Most of these species are not well studied and not well described beyond the intertidal zone (Breeze et al. 2002). As mentioned previously work is underway to classify benthic communities of the Scotian Shelf. Examples of infuanal non-commercial invertebrates found on the Scotian Shelf inclued various polycheate worms. Epifaunal organisms include certain echinoderms (starfish and sand dollars), anemones, corals, sponges and tunicates. Research is increasing on corals and sponges on the Scotian Shelf.

Cold-water corals are suspension-feeding invertebrates with feathery tentacles that capture food particles from the water column. Unlike their tropical counterparts, cold-water corals do not have symbiotic algae and can live far below the reach of sunlight. Many corals require a hard substrate for attachment; however some species can anchor in soft sediments. Corals can occur in many shapes, sizes and forms and some species can form reefs. They are slow growing and some may be over 100 years old. On the Scotian Shelf, corals are concentrated in areas with high current activity (Breeze et al. 1997, Mortensen et al. 2006). Corals represent a varied habitat for other organisms, such as fish, shrimp and sea stars. They offer shelter from predators, a nursery area for juveniles, and attachment substrate for other organisms (DFO 2010b).

Around 25 to 30 species of corals have been

identified off the Atlantic Coast of Nova Scotia. They can be organized in two major groups, hard or stony corals (Scleractinia) and octocorals. Both solitary and colonial (reef-building) forms of corals are found along the slope of the Scotian Shelf (DFO 2006). A live colony of the reef-building coral, *Lophelia pertusa*, has been found at the mouth of the Laurentian Channel on the Scotian Shelf. The solitary cup corals are widespread in soft sediments along the Slope and are also found in basins of the Scotian Shelf.

Octocorals include sea pens, sea whips, sea fans and "soft corals." The largest octocorals on the Scotian Shelf are the gorgonian corals: bubblegum and seacorn corals. These corals prefer habitats of hard sea bottom and attach themselves to large rocks and boulders. They have only been found in the channels between the banks and in the canyons. Sea pens and small gorgonians are found on soft sediments and are able to anchor to them. A relatively high concentration of sea pens has been identified near Middle Bank on the Scotian Shelf (Kenchington et al. 2010).

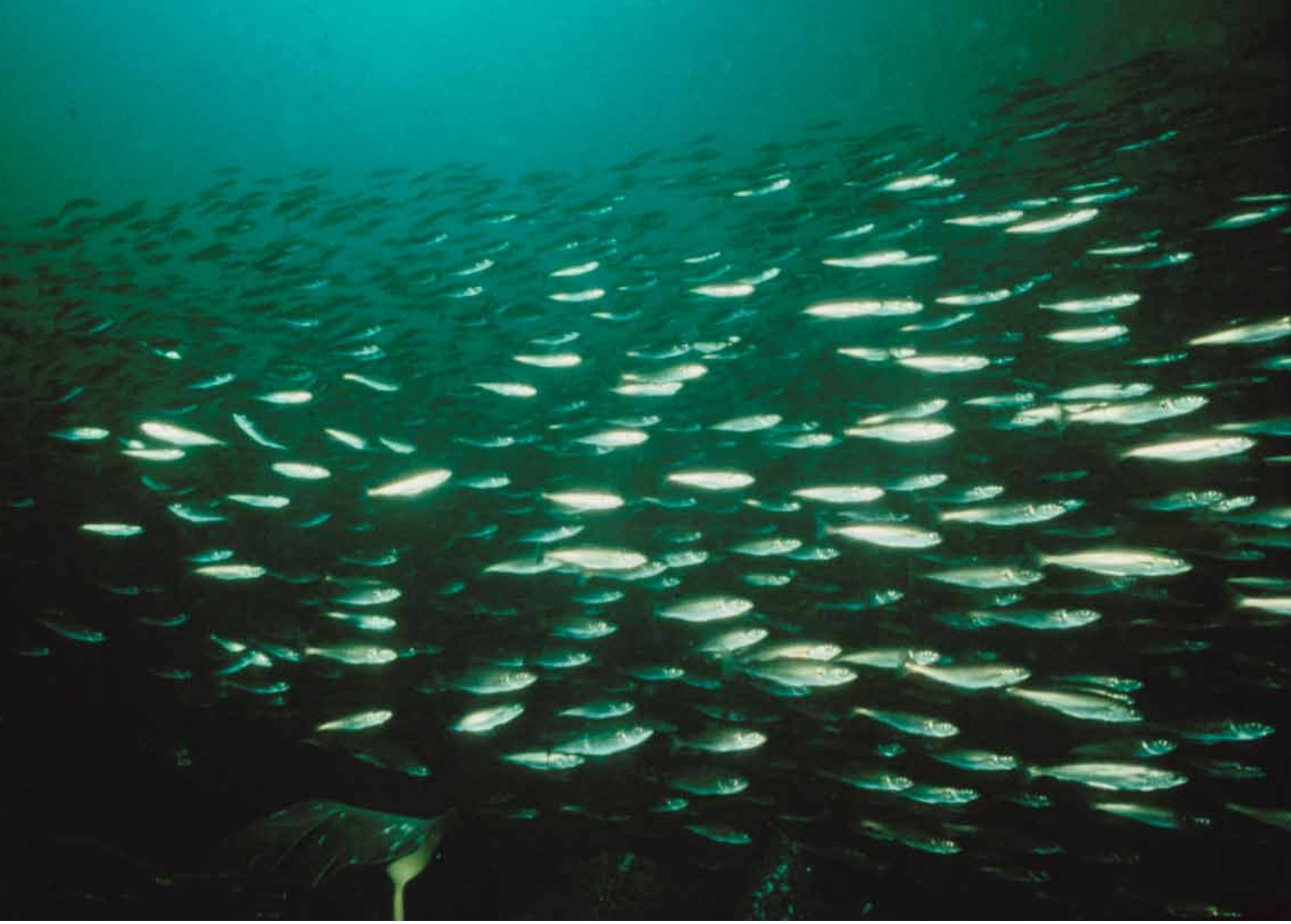
Sponges are marine invertebrates that attach themselves to bottom substrates. Sponges are filter feeders and are generally found at depth below 300 m. Sponges can provide substrate and offer shelter for other organisms (DFO 2010b). A unique and significant population of Russian Hat

sponges has been identified in Emerald Basin. This is the only confirmed glass sponge ground on the east coast of Canada (Boutillier et al., 2010) and the largest known aggregation in the world.

More information on corals and sponges on the Scotian Shelf is available in the Coral Conservation Plan (DFO 2006), *The Current State of Knowledge Concerning the Distribution of Corals in the Maritime Provinces* (Cogswell et al. 2009), *Delineating Coral and Sponge Concentrations in the Biogeographic Regions of the East Coast of Canada Using Spatial Analyses* (DFO 2010b) and the Marine Habitats and Communities theme paper.

Invertebrates: Key commercial species: There are 28 invertebrate species that have commercial value on the Scotian Shelf. These include crustaceans (lobster, snow crab, Jonah crab, rock crab, northern shrimp), bivalves (sea scallop, Atlantic surfclam, Iceland scallop, ocean quahog), snails (periwinkle, whelk), cephalopods (squid), and echinoderms (sea cucumber, sea urchin) (Breeze et al. 2002). Information on selected benthic invertebrates has been collected on DFO's annual research surveys since 1999. Tremblay et al. (2007) provides survey data of selected invertebrate species captured from research vessel surveys. Survey data are the primary source for monitoring trends in species distribution, abundance and biological condition. The data are used by scientists along with other sources of data to develop assessments of a species status. For recent reports of species found on the Scotian Shelf the reader is directed to the Canadian Science Advisory Secretariat (CSAS) website http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

Groundfish: Groundfish spend much of their life near the ocean bottom. Groundfish, including the gadoids (e.g., cod, pollock, haddock), skates and flatfishes (e.g., pleuronectid flounders), are a major component of the marine ecosystems of the Scotian Shelf. DFO has been conducting research vessel surveys on the Scotian Shelf since the 1970s. Clark and Emberley (2009) provide a summary of species captured and trends in abundance for certain species from the 2008 Scotian Shelf summer research vessel survey. Simailar to invertebrates, survey data are the primary source for monitoring trends in species distribution, abundance and biological condition. For recent reports of species found on the Scotian Shelf the reader is directed to the Canadian Science Advisory Secretariat (CSAS) website http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.



A recent National Science Advisory Report (DFO 2010a) summarizes major changes in the status and trends of Canadian marine ecosystems. A significant change in the Scotian Shelf ecosystem was a community shift from a large bodied groundfish dominated system to a pelagic and invertebrate dominated system. There has also been a decline in the size and condition of a number of groundfish species. More information is provided in *Canadian Marine Ecosystem Status and Trends Report* (DFO 2010a) and *The Ecosystem Status and Trends Report for the Gulf of Maine and Scotian Shelf* (Worcester and Parker 2010). The current status and trends of marine species and communities will be discussed in the theme papers: Fish Stock Status and Commercial Fisheries, and Marine Habitats and Communities.

PELAGIC ORGANISMS

Pelagic fish of the Scotian Shelf include highly migratory species such as tuna, swordfish and sharks (Breeze et al. 2002). Pelagic organisms live in the water column and at the surface. There are 19 species of sharks that occur in Atlantic Canada. Five species are considered common residents of the Scotian Shelf: the blue shark, porbeagle, shortfin mako, basking shark and the spiny dogfish (Zwanenburg et al. 2006). Smaller pelagic species include capelin and herring. Although less is known about species that live in the mesopelagic or deeper water of the slope and abyssal plain, over 200 species have been identified in water depths ranging from 1 000 to 4 000 m. Of these Mycophids (lanternfish) are the dominant family making up about 30% of the species composition (Themelis 1996).

Diadromous fish spend part of their lives in freshwater and part in salt or brackish water. Diadromous species (fish that live in both fresh and salt water) found on the Scotian Shelf include Atlantic salmon, gaspereau, sea lamprey, striped bass, Atlantic sturgeon and American shad (Breeze et al. 2002). Anadromous species, which are born in freshwater, migrate to the ocean and return to freshwater to spawn. Catadromous species live in freshwater and migrate to the ocean to spawn. The only catadromous species found on the Scotian shelf regularly is the American eel.

Pelagic invertebrates Shrimp and short finned squid are two pelagic invertebrates found on the Scotian Shelf. For both of these organisms their distribution is directly related to water temperature (Breeze et al. 2002). Aside from these two species, which are commercially fished, there is limited information on the occurrence and distribution of pelagic invertebrates on the Scotian Shelf (Breeze et al. 2002).

SEA TURTLES

Three species of sea turtles occur on the Scotian Shelf and Slope. The Atlantic leatherback turtle forages for jellyfish in the waters of the shelf during the summer and fall, migrating to warmer waters for the winter and nesting in beaches in the Caribbean and Gulf of Mexico (ALTRT 2006). The Atlantic leatherback is listed as endangered and is protected under Canada's *Species at Risk Act*.

Immature loggerhead turtles occur regularly at the edge of the Scotian Shelf and on the slope, preferring relatively warm waters (above 20 °C) (Brazner and McMillan 2008). They migrate north to the shelf edge during the summer months and return south for the winter. The Kemp's ridley turtle has occasionally been reported in waters off Nova Scotia; however, it is generally found further south and the Scotian Shelf is not considered to be its regular foraging habitat (Marquez 1994, TEWG 2000).

The occurrence of a fourth species, the green turtle, has recently been documented on the Scotian Shelf (James et al. 2004). It is not expected to occur regularly in the area.

MARINE MAMMALS

There are three groups of marine mammals that inhabit the Scotian Shelf throughout the year, large cetaceans (large whales), small cetaceans (small whales and dolphins) and seals.

Cetaceans: Whales are an important part of the regional ecosystem. Waring et al. (2000) reviewed the population status for cetaceans in the northwest Atlantic but in most cases it is not possible to determine what fraction of the population might use the Scotian Shelf. In 2007, DFO conducted a large-scale aerial survey of marine megafauna in the Northwest Atlantic (Lawson and Gosselin 2009). During this survey, 20 species of cetaceans were identified on the Scotian Shelf. Common dolphins were the most abundant species, followed by pilot whales and white sided dolphins (Lawson and Gosselin 2009). Other cetaceans identified on the Scotian Shelf include, fin whale, minke whale, humpback whale, sperm whale, pilot whale, sei whale, Northern bottlenose whale, blue whale,

harbour porpoise, North Atlantic right whale, and killer whale (Lawson and Gosselin 2009).

Some whales can be found year-round on the Scotian Shelf, while others are present only at particular times of year. The Scotian Shelf population of Northern bottlenose whales (*Hyperoodon ampullatus*), listed as endangered under Canada's *Species at Risk Act*, are year-round residents of the Scotian Shelf. The most recent analysis estimated a Scotian Shelf population of about 168 whales (DFO 2010c). The Scotian Shelf population of Northern bottlenose whale is primarily found in the Gully, and Shortland and Haldimand canyons on the Scotian Shelf. These areas are used for feeding, socializing and mating and have been identified as critical habitat for this endangered population of Northern bottlenose whale.

The North Atlantic right whale can be found on the Scotian Shelf in the summer months. This whale is listed as endangered under Canada's *Species at Risk Act*. In 2003, the population of North Atlantic right whales in Atlantic Canadian waters was estimated to be 322 whales (Brown et al. 2009). The right whale has been known to occur throughout the central and eastern parts of the Shelf. However, an area of particular importance to this species is Roseway Basin and it has been identified as critical habitat for the North Atlantic right whale (Brown et al. 2009).

Seals: Sable Island is a significant area for seals on the Scotian Shelf. It is important for two breeding populations of seals: it has about 80% of the world's largest breeding population of grey

seals (Thomas et al. 2007) and a much smaller number of breeding harbour seals (less than 50). The Sable Island grey seal population has increased from about 12 000 in 1977 to 242 000 in 2007 (Thomas et al. 2007). However, since the late 1990s the rate of increase has slowed (Bowen et al., 2007). Seals feed in the waters off Sable Island and in the Gully year-round. Harp, hooded and ringed seals are occasionally found on the northeastern Scotian Shelf but are not usually observed in waters further south than Sable Island.

SEABIRDS

The shallow fishing banks of the outer Scotian Shelf and the edge of the shelf are important foraging areas for pelagic seabirds. Both Sable Island Bank and the Scotian Slope have high concentrations of seabirds year-round (Lock et al. 1994). The area north of Sable Island, where there is mixing of waters caused by a gyre on Sable Island Bank, is an area of consistently high seabird numbers (Lock 1998). Few of the species found

Common pelagic birds of the eastern Scotian Shelf

- Greater Shearwater
- Herring Gull
- Great Black-Backed Gull
- Northern Fulmar
- Black-legged Kittiwake
- Thick-billed Murre
- Dovekie
- Sooty Shearwater
- Wilson's Storm Petrel
- Leach's storm petrel

(Bundy 2004)

in the offshore nest in the region; however, Sable Island has been designated a Migratory Bird Sancutary and is an important tern nesting area. The endangered Roseate Terns nests on the island as do Common and Arctic Terns.

The most abundant seabirds on the Scotian Shelf are terns and large gulls (Gaston et al. 2009). The eastern Scotian Shelf has high numbers of wintering Dovekie, Sooty Shearwaters and Greater Shearwaters (Brown 1988, Zwanenburg et al. 2006). The area generally marks the southern wintering range for species like the Thick-billed Murre, Common Murre, Atlantic Puffin, Northern Fulmar, and Glaucous and Iceland gulls (Zwanenburg et al. 2006), although there are a few breeding colonies of Atlantic Puffins in the region (Lock et al. 1994). During the spring and fall migrations, the shelf also lies on the flyway for many species, including birds that nest along Nova Scotia's coasts as well as those that nest much farther north (Lock et al. 1994). During the summer, Leach's Storm Petrels nest on coastal islands but range widely offshore. The Wilson's storm petrel can also be found in the region from the summer (southern hemisphere winter), migrating from its southern hemisphere breeding grounds (Lock et al. 1994), as can the Greater and Sooty Shearwaters.

In 2005, the Canadian Wildlife Service began a renewed effort to survey birds in the marine waters of Atlantic Canada (Gjerdrum et al. 2008). Results from these surveys should improve the understanding of seabird distribution on the shelf and slope. More information on seabirds on the Scotian Shelf and slope can be found in Brown (1986); Lock et al. (1994); Huettman (2000); Breeze et al. (2002); and Gaston et al. (2009).

3 SOCIO-ECONOMIC OVERVIEW

This chapter provides an overview of the current social and economic environments in Nova Scotia with respect to their importance to the Scotian Shelf and sets the context for the ocean use sectors outlined in the subsequent pages. Although the focus is the Scotian Shelf, much of the data relates to the province as a whole. Unless specialised studies have been undertaken, it is often not possible to separate Scotian Shelf information from provincial information, particularly in the socio-economic context. The socio-economic environment includes demographic and economic considerations, public health and safety, culture, and aesthetic factors. Humans have been an integral part of Nova Scotia and activities on the Scotian Shelf since the earliest settlers in the region. To understand the human impact to the marine ecosystem, we must consider the historic and current patterns of human activity within the region.

3.1 HISTORICAL PERSPECTIVE

The ocean has shaped human activities in Nova Scotia from the earliest inhabitants to the present day. Resources from coastal and marine environments have played a major role in the province's history and economy. Human interaction with coastal and offshore waters has shaped Nova Scotia's landscape and human-settlement patterns (Davis and Browne 1996). The Atlantic Ocean and its harbours provided a livelihood, a means of transportation and a portal to the rest of the world.

FIRST INHABITANTS

Before European contact, coastal and offshore waters provided transportation routes, abundant food, and other resources for the Mi'kmaq. They travelled seasonally from the coast to inland areas to take advantage of different resources; along the coast, they fished, collected shellfish, hunted seals and waterfowl, and gathered bird eggs (Davis 1997). While we do not know how far offshore they travelled, the Mi'kmaq had large ocean-going canoes that were capable of travelling across the Bay of Fundy and from Nova Scotia to Newfoundland and Prince Edward Island (Davis 1997). They fished for porpoise, swordfish and small whales in deeper waters off the coast (Whitehead and McGee 1983).

John Cabot's arrival in North America in 1497 and the lure of the cod fishery off its shores began a phase of European exploration of the lands and waters of present-day Nova Scotia. While no permanent European settlements were established in the province until 1605, Portuguese and Basque fishermen began travelling to the rich fishing banks off Newfoundland and Nova Scotia before then (Davis and Browne 1996). They established temporary "fishing stations" on land to dry their fish, with Canso ("Canseau") being one of the earliest, frequented by French vessels from the mid-part of the sixteenth century (Morandière 1962). In 1521, the Portuguese established a fishing station, San Pedro, at the present site of St. Peter's, Cape Breton (Hamilton 1997) and were reported to have left cattle on Sable Island in the early to mid-1500s (de Villers 2004). The early fishermen and explorers traded with the Mi'kmaq, and there were metal pots

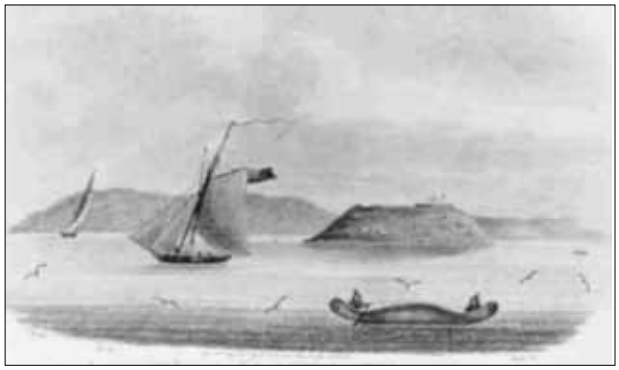
and European clothing in use by the Mi'kmaq by the time of the first permanent settlement in Nova Scotia in 1605 (Whitehead 1991). Interaction with Europeans and the diseases they carried devastated the population of Mi'kmaq, which is estimated to have been reduced by 80 to 90 percent in the first century after contact (Davis 1997).

EUROPEAN SETTLEMENT

Samuel de Champlain mapped much of the coast of Nova Scotia and New England in the period 1604-1607, and the expedition he was part of added several enduring place names to maps and charts of the province, including Lahave (from "La hève"), Port Mouton, and Rossignol. French colonists trickled into Acadie over the next century, and the population grew from about 500 in 1680 to 14 000 in 1755 (StatsCan 2011a, StatsCan 2011b). Although most of the colonists settled around the Bay of Fundy, there were a few communities on the Atlantic coast: Cape Sable Island, Petite Rivière, Lingley (Liverpool), as well as St. Pierre (formerly San Pedro, now St. Peter's) and Port Dauphin (Englishtown), Cape Breton (McLennan 1918, Brown 1922).

Throughout the first half of the eighteenth century, the British and French exchanged territories in North America, largely due to outcomes of European wars. In 1713, mainland Nova Scotia became British. In 1719, the French began construction of the Fortress of Louisbourg, intended to be a strategic centre that would allow it to defend its remaining possessions in North America and the Caribbean. The fortress was captured in 1745, returned to the French in 1748, and surrendered again in 1758. In 1763, Cape Breton was ceded to Britain as part of the Treaty of Paris.

The British initially valued Nova Scotia more for its strategic position than for its settlement potential. In 1749, they set up a fortress in Chebucto Harbour and renamed the area, Halifax. Strategically it was intended to be Britain's primary North Atlantic naval station, to rival Louisbourg. However,



George's Island, Halifax harbour, 1818. A Mi'kmaq canoe is in the foreground. ©Nova Scotia Museum.

the British were uneasy about the large number of Acadians and their level of loyalty to the British Crown. This unease was compounded by the close relationship of the Mi'kmaq with the Acadians. The British did not have good relations with the Mi'kmaq, as evidenced by several scalp proclamations in the mid-1700s (Paul 2000).

The British encouraged German, French and Swiss Protestants to settle in the province to counteract the Acadian Roman Catholic population. The immigrants , known as the "foreign Protestants" settled largely along the Atlantic coast of Nova Scotia, particularly in the Lunenburg area, although their descendants were granted land in Halifax, Guysborough and Queens Counties (Bell 1961). These were the founders of many of the fishing communities that used the resources of the Scotian Shelf to the present day. Still concerned about the Acadians, in 1755, British officials deported the vast majority, significantly diminishing the population of the province. The Acadian presence continued in the province: some Acadians hid or were imprisoned and avoided deportation; others returned a few years later. On the Atlantic coast, several coastal communities in Yarmouth County, Halifax County and Guysborough County were founded by Acadians; they also continued to have a strong presence in Richmond County, particularly on Isle Madame.

By the nineteenth century, lands were being reserved for the Mi'kmaq that represented a small

fraction of their original territory. In Cape Breton, several reserves were on the coast of the Bras d'Or Lakes, allowing the Mi'kmaq access to the resources of the Lakes. There were only a few small reserves provided on the Atlantic coast of Nova Scotia; these were reduced even further with the twentieth century policy of centralization (Paul 2000). The Mi'kmaq continued to use the resources of the coast and the inland waterways; however, their way of life had drastically changed.

Other waves of immigration affected settlement on Nova Scotia's Atlantic coast. New England Planters arrived following the Acadian expulsion, largely settling on the former Acadian lands in the Annapolis Valley but also founding Liverpool on the South Shore (Brown 1922). Twenty-five thousand Loyalist refugees came to Nova Scotia following the American Revolution. They settled along the coast near fish and lumber resources. Shelburne and many communities in Shelburne County were founded by Loyalists, as were Country Harbour and other Guysborough County communities. Black Loyalists founded several coastal communities, such as Birchtown, Shelburne County and Isaac's Harbour, Guysborough County (NS Museum 2001). Another major influx of settlers occurred in the 1770s and early 1800s, when large numbers of Highland Scots and Irish immigrated to eastern Nova Scotia (Davis and Browne 1996).

INDUSTRY AND MARINE RESOURCES

Although Sydney was first settled in the late 1700s, it was the development of industrial coal mining starting in the 1820s that drove expansion of the city and communities in the surrounding area. The mines and subsequent industrial development attracted a diversity of immigrants and drove development of the port. There were coastal mines in other parts of the province as well: nineteen mining companies flocked to Sherbrooke when gold was discovered near there in 1861 (NS Museum 2011).

While there were efforts to farm in most areas of the province, fishing and forestry were the main industries in most rural coastal communities. As the province's timber industry grew, so did the shipbuilding industry, with Yarmouth County one of the nineteenth century shipbuilding centres of the Maritimes (Nova Scotia 2009). Shelburne, Lunenburg, Sherbrooke, and Guysborough were some of the many other coastal communities that had shipyards.

In the early part of the 19th century, boat services connected Halifax with settlements along Nova Scotia's Atlantic coast, such as Arichat, Lunenburg, Shelburne and Yarmouth (Davis and Browne 1996). Halifax developed into the largest trading port, with ties to Britain, the West Indies and the US East Coast (Nova Scotia 2009). Several deep-water shipping terminals were constructed to take advantage of Halifax's ice-free deep water harbour. The industrialization of Halifax Harbour and its growing importance as a hub for trading and shipping allowed manufacturing to thrive.

From the late 19th Century, sailing ships were replaced by steamships and rail. The development of railways changed trading patterns. As central Canada became more accessible through rail connections in the 1900s and new technology changed the fishing industry, the Maritimes' position in the world market diminished (Davis and Browne 1996). During the two World Wars, Halifax was revitalized as a central port and harbour. Its position as a military base continues today. Much of the Halifax waterfront is still occupied by large naval and industrial uses. The waterfront, however, is also increasingly used for special events and cultural activities (Nova Scotia 2009). The number of active fishing ports and coastal communities with working waterfronts in the province has declined, as some traditional marine-related industries, such as fishing and fish processing, have experienced decline or consolidation. While traditional industries remain an important part of coastal economies, there has been a shift towards tourism, recreational and residential development (Nova Scotia 2009).

3.2 DEMOGRAPHY

Approximately 934 100 live in Nova Scotia (Statistics Canada 2009) with about 70% living in coastal communities (Coastal Communities Network 2004). The population in Nova Scotia has remained relatively stable, growing by only 0.0005% per year between 1996 and 2006 (Nova Scotia Community Counts 2008). According to the 2006 Census, about 40% of the province's population lives within Halifax Regional Municipality (372 855 people), followed by Cape Breton Regional Municipality (CBRM) with 11.6% of Nova Scotia's population (105 930 people). Although there are people from varying ethnic backgrounds that live in Nova Scotia, the majority of the population (88.5 %) is of British origin and speaks English as a first language according to the 2006 Census.

It has become increasingly common for Nova Scotians to leave rural communities and move to the urban core of Halifax Regional Municipality. The closure of the groundfish fishery and the steel and coal industries in Cape Breton contributed to making areas outside of HRM less economically attractive (Coastal Communities Network 2004). More recently, there are a greater number of youth completing high school and moving to the urban centre to attain post-secondary education. As a result, there is an increase in the percentage of Nova Scotians with a Bachelor's degree or higher (Nova Scotia Department of Finance 2007).

Another important demographic shift is the aging population. The largest segment of the population is found in the age group from 40 to 60 years. About 15.1% of Nova Scotians are older than 65, and the population of seniors is expected to increase by 70% within the next 20 years (Nova Scotia Department of Finance

2007). Other trends include a decrease in the unemployment rate, a decrease in the number of marriages and a decrease in the number of women having babies (Nova Scotia Department of Finance 2007).

More detailed information on Nova Scotia's demography is available in the *State of Nova Scotia's Coast Report* and *Nova Scotia Social Profile 2001-2006*.

COASTAL COMMUNITIES

Most of Nova Scotia's population lives within 20 km of the coast, reflecting both the Nova Scotians connection to the ocean and the desirability to live and work near the ocean. Coastal communities of the Scotian Shelf include all areas of the region that border the coast and stretch from Clark's Harbour (Shelburne County) to Cape North (Cape Breton). The area encompasses nine out of eighteen counties in Nova Scotia - Shelburne, Queens, Lunenburg, Halifax, Guysborough, Richmond, Cape Breton, Victoria and Inverness.

Coastal communities are changing. The decline of traditional maritime livelihoods, such as fishing is challenging Nova Scotia's coastal commu-

nities sustainability. Coastal communities are also impacted by coastal development, rising property prices, and seasonal residents.

Smaller coastal communities within commuting distance of larger urban centres are experiencing rising household incomes and property values, and stable to growing populations. These changes are driven largely by commuters and seasonal residents from the larger centres (CBCL Ltd. 2009).

Much of the recent discussion about coastal communities has focussed on small rural coastal communities with economies at least partly dependent on their working waterfronts (Coastal Communities Network 2004). In addition to fisheries, this infrastructure supports a thriving tourism industry, boat building activities, public coastal access and is the foundation for numerous additional activities and spin-off businesses (Coastal Communities Network 2004). *The State of Nova Scotia's Coast Report* provides detailed information on Nova Scotia's working waterfront.

ABORIGINAL COMMUNITIES

Today, the Mi'kmaq live throughout the province. In 2006, there were 24 175 Aboriginal people in Nova Scotia, making up 2.7% of Nova Scotia's total population (Nova Scotia Department of Finance 2008). That is an increase from 1.4% in 1996. Nova Scotia has 13 Mi'kmaq First Nations with community populations ranging from 240 in the Annapolis Valley First Nation to approximately 4 000 in the Eskasoni First Nation. In total, there are 13 518 registered Indians in Nova Scotia and of these, 4 752 live off-reserve (Nova Scotia Office of Aboriginal Affairs 2011). The Registered Indian population in Nova Scotia is represented by 13 band councils and two tribal councils, the Confederacy of Mainland Mi'kmaq and the Union of Nova Scotia Indians. The Union of Nova Scotia Indians tribal council represents the five First Nation communities within Cape Breton (We'koqma'q, Wagmatcook, Membertou, Eskasoni, and Chapel Island First Nations) along with two First Nations located in mainland Nova Scotia (Indian Brook and Acadia First Nations). The remaining six communities are represented by the

TREATY RIGHTS

Section 35 of the *Constitution Act*, 1982, recognises existing aboriginal and treaty rights. Aboriginal rights are those rights that peoples have due to traditional use and occupancy of land. These rights encompass all aspects of life, including culture, land and traditions. The term "treaty rights" refers to those guarantees explicitly and implicitly agreed upon through historical treaties. Those that affect the Aboriginal people of Nova Scotia include: Treaty of 1725 (and subsequent ratification treaties); Treaty of 1752; Treaty of 1760; The Royal Proclamation 1763, and Treaty of Watertown 1776. These provide the Aboriginal peoples with rights to coastal resources, but do not currently give them legislated jurisdictional responsibilities (State of the Nova Scotia Coast 2009). In Nova Scotia a tri-partite forum, *The Made-in- Nova Scotia Process* has been established between the Mi'kmaq, Nova Scotia and Canada to resolve issues related to treaty and Aboriginal rights. On February 23, 2007, the Parties signed the Mi'kmaq-Nova Scotia-Canada Framework Agreement, which outlines procedures that will guide the negotiations and the topics to be covered (http://www.gov.ns.ca/abor/office/what-we-do/negotiations/).

DUTY TO CONSULT

The Government of Canada has a duty to consult, and where appropriate, accommodate Aboriginal peoples where the interests of Aboriginal peoples may be affected by a Crown action or decision. In 2007, Nova Scotia and Canada developed a policy to reflect the province's commitment to meaningful consultation with Mi'kmaq of Nova Scotia (Nova Scotia Office of Aboriginal Affairs http://www.gov.ns.ca/abor/office/what-we-do/consultation/). As part of the commitment, the Mi'kmaq-Nova Scotia-Canada Consultation Terms of Reference was developed and was formally approved in 2010.

ABORIGINAL FAST FACTS

- The Aboriginal population is much younger than the general population with a median age of 25.4 versus 41.6 for the total population.
- 9,557 people (less than 1/3 of the aboriginal population) live on reserve in Nova Scotia.
- There are 34 reserve locations across Nova Scotia.
- A growing portion of the Aboriginal population resides in Halifax (5,320).
- 4,980 aboriginal people have knowledge of an aboriginal language.

NS Office of Aboriginal Affairs 2008

Confederacy of Mainland Mi'kmaq (Bear River, Annapolis Valley, Glooscap, Millbrook, Paq'tnkek, and Pictou Landing First Nations). In 2006, the Aboriginal population was comprised of North American Indian (63%), Metis (31.8%); Inuit (1.3%) and others (3.8%) (Nova Scotia Department of Finance 2008).

Other Aboriginal organizations are the Native Council of Nova Scotia and the Maritime Aboriginal Peoples Council, which provides a range of services to Aboriginal people living off-reserve and the Native Women's Association which provides Aboriginal women with a voice in the social, cultural and economic development of the Aboriginal community (Nova Scotia Office of Aboriginal Affairs 2011).

3.3 ECONOMIC OVERVIEW

By improving our understanding of the role of the ocean in the economy, decision-makers are more informed when developing policies aimed at protecting the marine environment, supporting sustainable activities and communities, and providing leadership in ocean stewardship. Nova Scotia's gross domestic product (GDP) in 2009 was $34 billion (Nova Scotia Department of Finance 2011). Between 2003 and 2007, the economy of the province grew by 4.9%. Nova Scotia's economy is largely service based, with 76% of its GDP generated by service industries and only 8% arising from natural resource based industries. (CBCL Ltd. 2009). Activities dependent on the ocean make a substantial contribution to the Nova Scotia economy. In 2005 an overview of the *Economic Value of the Nova Scotia Ocean* Sector was prepared by Gardner Pinfold and subsequently updated in 2009. Gardner Pinfold (2005) defines the ocean economy as "all private sector activities with a direct dependence on the ocean or ocean resources. This includes extractive uses (e.g., fishing, oil and gas production) as well as non-extractive dependence (e.g., shipbuilding, transportation). It also includes public sector organizations and agencies with direct ocean responsibilities." The direct GDP impact of the ocean sector in the Nova Scotia economy is estimated at $2.6 billion and accounts for 8.1% of the provincial GDP (Table 2; Gardner Pinfold 2009). When spin-off effects of ocean activity in the broader economy are considered, the GDP impact rises to just under $5 billion, just over 15% of Nova Scotia's GDP. The Scotian Shelf economy has not been separated from the Nova Scotia ocean economy as a whole.

Household income, a major component of provincial GDP, also benefits greatly from ocean activity. Just over 5.7% of provincial household income is directly attributable to ocean activities. The impact rises to over 10% when spinoff effects are considered. Employment impacts are similarly impressive. With the equivalent of just over 30 000 direct full-time jobs created, the ocean sector accounts for about 6.8% of total provincial employment. The impact rises to just under 14% when spinoff effects are included (Gardner Pinfold 2009).

Table 2: Economic impact of ocean activities in Nova Scotia 2006

Indicator	Ocean Impact	NS Total	Ocean % of NS Total
GDP ($ millions)	2,620	31,737	8.10%
Income ($millions)	1,565	27,527	5.70%
Employment	29,499	432,590	6.80%

Source: Gardner Pinfold 2009

Offshore oil and gas and fishing are large contributors to Nova Scotia's economy, accounting for 23% and 22% of the overall ocean-related GDP respectively. Although National Defence ranks slightly ahead of offshore oil and gas and the fishing industry in its contributions, accounting for 24% of the overall ocean-related GDP. Water transportation (shipping, ferries, ports and harbours) also makes a major contribution, accounting for 11% of the overall ocean-related GDP. National Defence is the largest ocean sector employer accounting for 30% of employment followed by the fishing industry at 23%. Water transportation and tourism are next at 13% and 11% (Gardner Pinfold 2009). As the largest ocean economy employer, National Defence also has the largest income contribution, accounting for 32% of the ocean economy total, followed by fishing at 23% (Gardner Pinfold 2009).

3.4 KEY OCEAN USE SECTORS

There are numerous users of the Scotian Shelf; this context document focuses on eight key ocean use sectors in the area. They were chosen because they are the sectors most often considered in regional ocean and coastal management processes. Each section provides a brief history of the industry and reports on current status and trends.

3.4.1 Commercial Fisheries

Commercial fishing started in the mid-1500s. In 1602, Samuel de Champlain reported meeting a Basque fisherman called Savalet making his 42nd voyage to the Scotian Shelf (Innis 1954) indicating that Savalet would have started fishing there in about 1560. By this, Savalet one of the first Europeans to fish these waters. By 1700, Nova Scotia was exporting cod, mackerel and herring. Exports continued to increase through the centuries. In 1973, total landings of fish from the Scotian Shelf peaked, exceeding 750 000 t (Worcester and Parker 2010). Throughout the 1980s the fishing industry on the Scotian Shelf continued to thrive. However, a few years later, the fisheries resources that many thought could never be exhausted were quickly declining. This had significant impacts on the coastal communities that were dependant on them. In September 1993, the fisheries for the most important groundfish stocks (cod and haddock) were closed due to a collapse in stock. Total estimated biomass of cod was around 2 million tonnes in the mid-1980s and fell to a little over 200 000 tonnes in the early 1990s. On the Newfoundland-Labrador Shelf and eastern Scotian Shelf, this decrease exceeded 90% (Breeze et al.

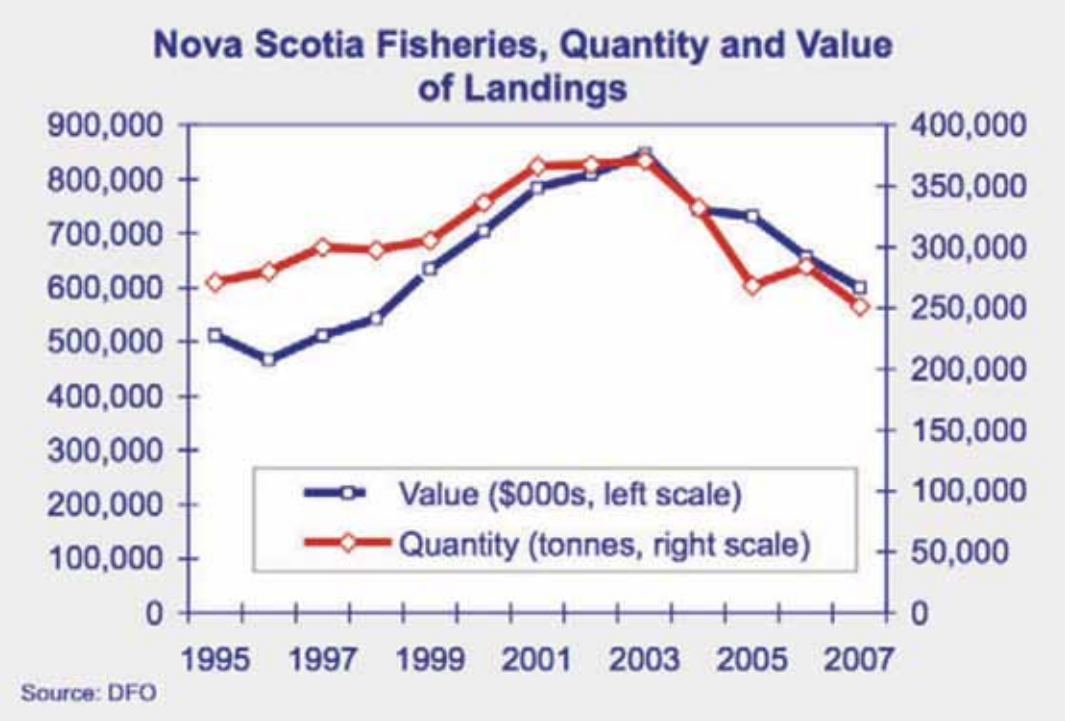


Figure 3: Nova Scotia Fisheries, Quantity and Value of Landings (Gardner Pinfold 2009; DFO http://www.dfo-mpo.gc.ca/stats/commercial-eng.htm)

2002). As of 2011 these fisheries remain closed and groundfish effort is limited in many parts of the area. This, however, did not signify the end of fisheries on the Scotian Shelf. With the collapse of the groundfish species, other species began to flourish. Lobster, scallop, shrimp, crab and surf clam fisheries have increased in significance and shellfish are now the main targeted species group. Large pelagic species such as swordfish, tuna and shark also support extensive fisheries along the outer shelf and slope. The fishing industry has also expanded beyond traditionally fished species. There are now fisheries for species such as sea cucumber, whelk and hagfish occurring on the Scotian Shelf.

ECONOMIC OVERVIEW

The Nova Scotia fishing industry (harvesting and processing) is a major source of direct and indirect employment and income and is the province's leading source of export earnings. In 2006, 26% of the total volume of commercial marine fisheries in Canada was landed in Nova Scotia (DFO 2008b). An important element of the industry's economic significance is derived from its rural location. Fishing and fish processing, together with the industries dependent on them, form the economic base for many of Nova Scotia's coastal communities (Gardner Pinfold 2005).

The past decade has seen an increase in the value of fisheries in the Scotian Shelf/Bay of Fundy (Scotia-Fundy region) (Figure 3), from a landed value of about $496 million in 1998 to $800 million at its peak in 2002-03. The landed value has since declined to $538 million in 2009 (Gardner Pinfold 2005; 2009; DFO 2010d).

Nova Scotia's fishing industry derives its strength from an abundant and diverse resource base. The commercial fishery targets over 30 species. A variety

FISHERIES GOVERNANCE

The key department regulating the Fisheries sector on the Scotian Shelf is Fisheries and Oceans Canada (or DFO).

DFO is the lead federal department for fisheries and fish habitat conservation and protection. DFO responsibilities for fisheries include managing the harvest of commercial fish species, licensing, conservation and enforcement. This is done under the *Fisheries Act* and associated policies and regulations. The focus of DFO's fisheries management program is to ensure that Canada's fisheries are environmentally sustainable, while supporting economic prosperity. Fisheries are managed through the development of Integrated Fishery Management Plans (IFMPs). The IFMP is based on peer-reviewed scientific advice through DFO's Canadian Science Advisory Secretariat (CSAS) and other information from Departmental and stakeholder sources. The IFMP provides a clear and concise summary of the management objectives for the fishery, the measures used to achieve these objectives, and the criteria by which their attainment will be measured. The IFMP incorporates new tools and policies that are being developed through a Fisheries Renewal initiative to include precautionary and ecosystem approaches in fisheries management. For further information on the new tools and policies, such as the sensitive benthic area and new fisheries for forage species, the reader is directed to the DFO website http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/fish-ren-peche/index-eng.htm

of fishing gears are used to capture these species, ranging from bottom-contacting trawls and dredges, to pots and traps, gillnets, seines and harpoons. Shellfish comprise about 80% of the fisheries by value (Gardner Pinfold 2009). Key commercial shellfish species include lobster, scallop, snow crab and shrimp. Groundfish continue to play a significant role (11% of landed value), but landings are much diminished from the 1970s and 1980s, when this group accounted for over 50% of landed value. Cod, haddock, flatfishes and hake are now the leading demersal species for this group. Within the pelagic group (5% of landed value), herring, swordfish and tuna are the main species.

The relative importance of marine fisheries to the Nova Scotia economy has increased gradually over the past decade, with the contribution to the GDP rising from $235 million in 1995 to over $500 million in 2006 (Gardner Pinfold 2005, 2009). Employment is difficult to estimate. Limited entry licensing, seasonal limits, quotas and weather determine the duration of the fishing season and, therefore, employment. Out migration from coastal communities is also making it difficult to recruit crew members (Gardner Pinfold 2009). The fishing industry (commercial fisheries and processing) generated $672.6 million in household income, accounting for 31.3% of the ocean sector total. This is particularly important to the province, given the largely rural nature of the industry.

Fish landed are sold either to local processors or exported directly. The primary market for Nova Scotia seafood exports is the United States with secondary markets in the European Union, Japan and China (Gardner Pinfold 2009). Much of this export value is accounted for by lobsters (sold live), and also species such as northern shrimp and scallops, where all or most of the processing occurs on the harvesting vessel. Exports attributable to the fisheries sector have more or less followed the pattern of landings, rising from $389 million in 1995 to over $600 million in 2002-03 and have since declined to just over $500 million in 2007 (Gardner Pinfold 2005, 2009). The strong Canadian dollar and weak market conditions have contributed to the declines (Gardner Pinfold 2009).

ABORIGINAL FISHERIES

In 1990, the Supreme Court of Canada's Sparrow decision upheld the Aboriginal right to fish for food, social and ceremonial purposes. In response to this decision, DFO initiated the Aboriginal Fisheries Strategy (DFO 2003). This strategy provided a framework for the management of fisheries for food, social and ceremonial purposes. In 1999, the Supreme Court of Canada's Marshall decision affirmed a treaty right to hunt, fish and gather in pursuit of a "moderate livelihood" arising out of Peace and Friendship Treaties of 1760 and 1761 (R v Marshall 1999). Since that time DFO has implemented a number of programs to facilitate the integration of Aboriginal communities affected by the decision into Atlantic Canadian fisheries. The Marshall Response Initiative (MRI) was created to provide the 34 Mi'kmaq and Maliseet First Nations with increased access to the commercial fishery through the provision of licenses, vessels and gear. The Aboriginal Aquatic Resource and Oceans Management (AAROM) program was instituted to facilitate the participation of Aboriginal groups in advisory and decision-making processes for oceans and fisheries resource management (DFO 2008c). The Atlantic Integrated Commercial Fisheries Initiative (AICFI) was developed to build upon the accomplishments of the MRI by increasing the capacity of Aboriginal commercial fishing enterprises and supporting their participation in the co-management of the integrated commercial fisheries along with other commercial harvesters (DFO 2010e). In the decade since the Marshall decision, Aboriginals throughout the Maritimes have participated in training, established administration, governance and business infrastructure, and have substantially increased their involvement in Atlantic commercial fisheries and in the integrated management of ocean resources (Atlantic Policy Congress of First Nations Chiefs 2009).

AQUACULTURE GOVERNANCE

Several government departments are involved in the regulation and licensing of aquaculture in the province. The main departments involved are:

Nova Scotia Department of Fisheries and Aquaculture grants leases and licences for aquculturists and coordinates review of applications by other relevant government departments.

Fisheries and Oceans Canada reviews applications for compliance with *Fisheries Act* provisions.

Transport Canada reviews applications to examine impacts on navigable waters.

Environment Canada, the Canadian Food Inspection Agency, and the Nova Scotia Department of Environment and Labour review aquaculture applications; other departments may also be involved. (NSDFA 2011a)

ECONOMIC OVERVIEW

Inclusion in the commercial fishery has shown benefits to Aboriginal communities, such as increased employment (DFO 2010f). The landed value of Aboriginal fisheries tripled between 2000 and 2006, while fishing employment increased 60% between 2000 and 2007. In 2009, 11% of Aboriginal jobs in Atlantic Canada were in the fishing sector (Atlantic Policy Congress of First Nations Chiefs 2009). Aboriginal fishing licenses generated an economic return of approximately $35 million in 2009 compared to just over $4 million in 1999 (Atlantic Policy Congress of First Nations Chiefs 2009).

3.4.2 Aquaculture

From its start in the mid-1970s, aquaculture grew slowly in Nova Scotia (Gardner Pinfold 2005). The industry experienced rapid growth in the late 1990s, then production took a downturn in the early 2000s (Gardner Pinfold 2005, 2009). Currently, the main species produced are Atlantic salmon and blue mussels, as well as rainbow trout, American oyster, bay quahog and Arctic char. Several other species are produced in very small numbers or are under development, including scallop, striped bass, Atlantic halibut and European oyster.

Different parts of Nova Scotia's coast are considered suitable for different aquaculture products. The Atlantic coast of Cape Breton and the eastern shore from the Strait of Canso to Halifax are considered good areas for blue mussel, sea scallop and steelhead salmon. The south shore from Halifax to Yarmouth is considered suitable for the same species, as well as European oysters. Warmer parts of this area, such as Shelburne Harbour and St. Margaret's Bay, may be suitable for Atlantic salmon. The Bras d'Or Lakes have American oyster and Atlantic salmon leases presently (NSDFA 2011d).

GUYSBOROUGH COUNTY SUSTAINABLE AQUACULTURE INITIATIVE

In 2002, the Guysborough County Sustainable Aquaculture Initiative (GCSAI) was initiated to promote sustainable aquaculture development in Guysborough County that considers community values. The ultimate product of the initiative was the GCSAI Tool, a GIS-based program that helps select more favourable areas for aquaculture. The Guysborough County Regional Development Authority uses the tool to assist potential aquaculturists in selecting a site.

The tool has water quality data for several different areas and can compare the properties of the water with the requirements of 6 common aquaculture species. The tool helps narrow down possible sites, but any site chosen will still undergo environmental review and public consultation. As well, the Guysborough County Regional Aquaculture Development Advisory Committee will review the application. Regional Aquaculture Development Advisory Committees (RADACs) make recommendations to the Minister of Fisheries and Aquaculture for approving or disapproving applications for Aquaculture Licences and Leases. RADAC members are appointed by the Minister from the local community; however, there are RADACs in only a few areas of the province (MDG 2011, NSDFA 2011).

The sector is largely made up of small, independent producers. However, production is concentrated in a few farms and it has been estimated that less than 20 % of the farms produce more than 80 % of the fish and shellfish (Gardner Pinfold 2005). As of 2010, there were about 380 aquaculture sites in the province, however not all of them are in production (NSDFA 2011d).

ECONOMIC OVERVIEW

The aquaculture sector generated more than $50 million in revenues in 2007 from 10 000 t of product (Gardner Pinfold 2009). There were about 750 full and part-time workers in the industry in 2009 (NSDFA 2011c). In 2006, the industry was estimated to have contributed $33.5 million to Nova Scotia's GDP from direct and spin-off effects.

3.4.3 Offshore Oil and Gas

Offshore hydrocarbon exploration on the Scotian Shelf began in 1959 when Mobil Oil Canada was issued the first offshore exploration permit covering the Sable Island area. The first exploration well was drilled on Sable Island in 1967, followed two years later by the first discovery of significant quantities of natural gas on the Scotian Shelf by Shell Canada just south of Sable Island (CNSOPB 2011a). Between 1972 and 1979, several significant hydrocarbon discoveries were made in the Sable Sub-basin with local reserves potentially exceeding 18 trillion cubic feet (Tcf) and about 1 billion barrels (BB) of oil and gas liquids (Breeze and Horsman 2005). There are similar estimates for hydrocarbon reserves in other, less explored basins in Nova Scotia's offshore: the deep water Scotian Slope, the Laurentian Sub-basin, and the Shelburne Sub-basin (Georges Bank) (Breeze and Horsman 2005).

The Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) manages petroleum exploration and development in most areas of offshore Nova Scotia. Currently, certain areas of the offshore are closed to petroleum exploration. One of those areas is Georges Bank, where a moratorium has existed since 1988 and remains in effect to December 31, 2015.

An exploration licence is needed for most petroleum exploration activities, including seismic explo-

OIL AND GAS GOVERNANCE

The principal regulators of the offshore petroleum sector in Nova Scotia are the Canada-Nova Scotia Offshore Petroleum Board (CNSOPB), the Nova Scotia Department of Energy and the National Energy Board (NEB).

CNSOPB is an independent joint agency of the governments of Canada and Nova Scotia and is responsible for regulating petroleum activities in the defined Nova Scotia offshore. The board manages petroleum exploration and development in most areas of offshore Nova Scotia under the Canada-Nova Scotia Offshore Petroleum Resources Accord. It reports to the federal Minister of Natural Resources and the provincial Minister of Energy. The Board has entered into Memoranda of Understanding with Environment Canada and Fisheries and Oceans Canada but maintains the lead in coordinating regulatory activities.

Nova Scotia Department of Energy is responsible for business and economic development of the sector and administers the offshore royalty regime.

National Energy Board (NEB) is responsible under the Canada Oil and Gas Operations Act for the regulation of oil and gas operations in offshore areas outside the jurisdiction of the CNSOPB and the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). It cooperates with the CNSOPB and C-NLOPB to reduce regulatory overlap. Among its responsibilities are regulation of the construction and operation of pipelines.

ration and exploratory wells. The CNSOPB issues a "call for bids" for particular parcels of offshore crown lands for which companies may bid for the exploration licence for that parcel. Exploration licences give the exclusive right to explore a particular area and have a maximum term of 9 years (CNSOPB 2011d). A significant discovery licence may be granted after an initial discovery in an area and maintains an explorer's rights during the period between the first discovery and eventual production. Twenty-five year production licences are granted after the operator proves that a discovery has commercial potential (Chao et al. 2004). The time limit may be extended if production is still in progress or likely to restart (CNSOPB 2001d).

After an active period of petroleum exploration in the late 1990s and early 2000s, there was a slowdown of activity. There was only one call for bids between 2002 and late 2007 (CNSOPB 2011b) and many of the exploration licenses granted earlier had expired. For the most recent call for bids (closing date June 24, 2010), no bids were received (CNSOPB 2011c). As of March 9 2011, there were four active exploration licences, thirty-three significant discovery licences and ten production licences on the Scotian Shelf and Slope (CNSOPB 2011d). In contrast, in March 2003, there were fifty-seven active exploration licenses, thirty-three significant discovery licences and six production licenses (Chao et al. 2004).

There have been three petroleum projects in production in Nova Scotia's offshore. The Cohasset-Panuke Project produced 44.5 million barrels of light crude oil from eleven production wells on two fields west of Sable Island. The project began in 1992 and was completed in 1999 (Breeze and Horsman 2005).

The Sable Offshore Energy Project operated by Exxon Mobil and partners, has been producing gas since 1999 and has a total project life expectancy of about 25 years. The project is made

up of six production platforms that tap natural gas fields near Sable Island, approximately 225 km off the east coast of Nova Scotia. The project also involves a subsea pipeline with landfall at Goldboro, Nova Scotia, a gas plant at Goldboro, a fractionation plant at Point Tupper and an associated pipeline on land, the Maritimes and Northeast Pipeline (NSDoE 2011a).

Encana's Deep Panuke Project is not yet in production. It will extract natural gas from the Deep Panuke field, about 250 kilometres southeast of Halifax on the Scotian Shelf. The natural gas will be transported through a subsea pipeline to Goldboro and then distributed via the Maritimes and Northeast Pipeline constructed as part of the Sable Offshore Energy project. Deep Panuke is expected to go into production in 2011 and is expected to continue for about 13 years (NSDoE 2011b).

ECONOMIC OVERVIEW

Offshore oil and gas projects are usually international in scope and a proportion of the spending, therefore, occurs outside the national economies where the development occurs. This proportion varies depending on the capabilities and competitiveness of domestic suppliers as compared with international suppliers (Gardner Pinfold 2005).

For the period ending March 31, 2008, the Nova Scotia government had received approximately $900 million in royalties from the Sable Offshore Energy Project. Over the life of the project, the Province expects to receive between $1.5 and $2 billion in royalties (NSDoE 2011c). As required by the Canada-Nova Scotia Offshore Petroleum Resources Accord, Nova Scotia also receives Crown share payments from the federal government. Based on Nova Scotia's share of offshore petroleum projects, the Province expects to receive $860 million in total Crown share payments for

Table 3: Economic Impact of offshore oil and gas (2006).

(Source: Gardner Pinfold 2009)

	Development			Production		
	Direct	Spin-off	Total	Direct	Spin-off	Total
GDP ($000s)	15,105	43,675	58,780	809,041	143,394	952,435
Employment	234	839	1,073	426	2,352	2,778
Household Income ($)	11,364	28,585	39,949	29,778	95,285	125,063

Cohasset-Panuke, Sable Offshore Energy and Deep Panuke (NSDoE 2011c). The contribution made by the oil and gas sector to the Nova Scotia economy is summarized in **Table 3**.

Sable Offshore Energy gas production has several more years of sizeable production, but will soon begin a slow decline. Growth of the offshore industry will depend on the development of the Deep Panuke field and also on further exploration and the discovery of new recoverable reserves. While there was growing demand for natural gas in the US and the Maritimes for a period in the 2000s, and a proposal to develop a liquefied natural gas terminal (LNG) near Goldboro (Gardner Pinfold 2009), the demand for LNG decreased in the wake of the recession and the company decided not to go ahead with the project (Park 2010).

3.4.4 Ports and Shipping

A significant amount of international and domestic commercial shipping traffic occurs over the Scotian Shelf (see **Figure 4**). The strategic location of Nova Scotia on the Great Circle Route (i.e., shortest distance over the earth's surface) between eastern North America and Europe makes it important for international shipping. The Cabot Strait links trans-Atlantic shipping routes to the St Lawrence Seaway and the Great Lakes. Commer-

cial shipping in this area is generally in the form of tankers, general bulk and containerized cargo carriers. The area is also transited by a range of fishing vessels, cruise ships and various government vessels. Marine transportation also includes marine towing, ship chartering, cargo handling, harbour and port operations, ferries, pilotage and shipping agencies. The primary commodities being moved in the region include crude oil and gas, minerals and chemicals, paper and forest products, coal and coke and various containerized goods. Other significant cargoes include gypsum, crude and refined oil as well as automobile imports and exports.

Halifax is the largest port, in terms of size, in Nova Scotia with the most diverse cargo base. In 2010 it handled 9.5 million tonnes of cargo (Port of Halifax 2011). It is the largest short sea shipping port in the country, the second largest

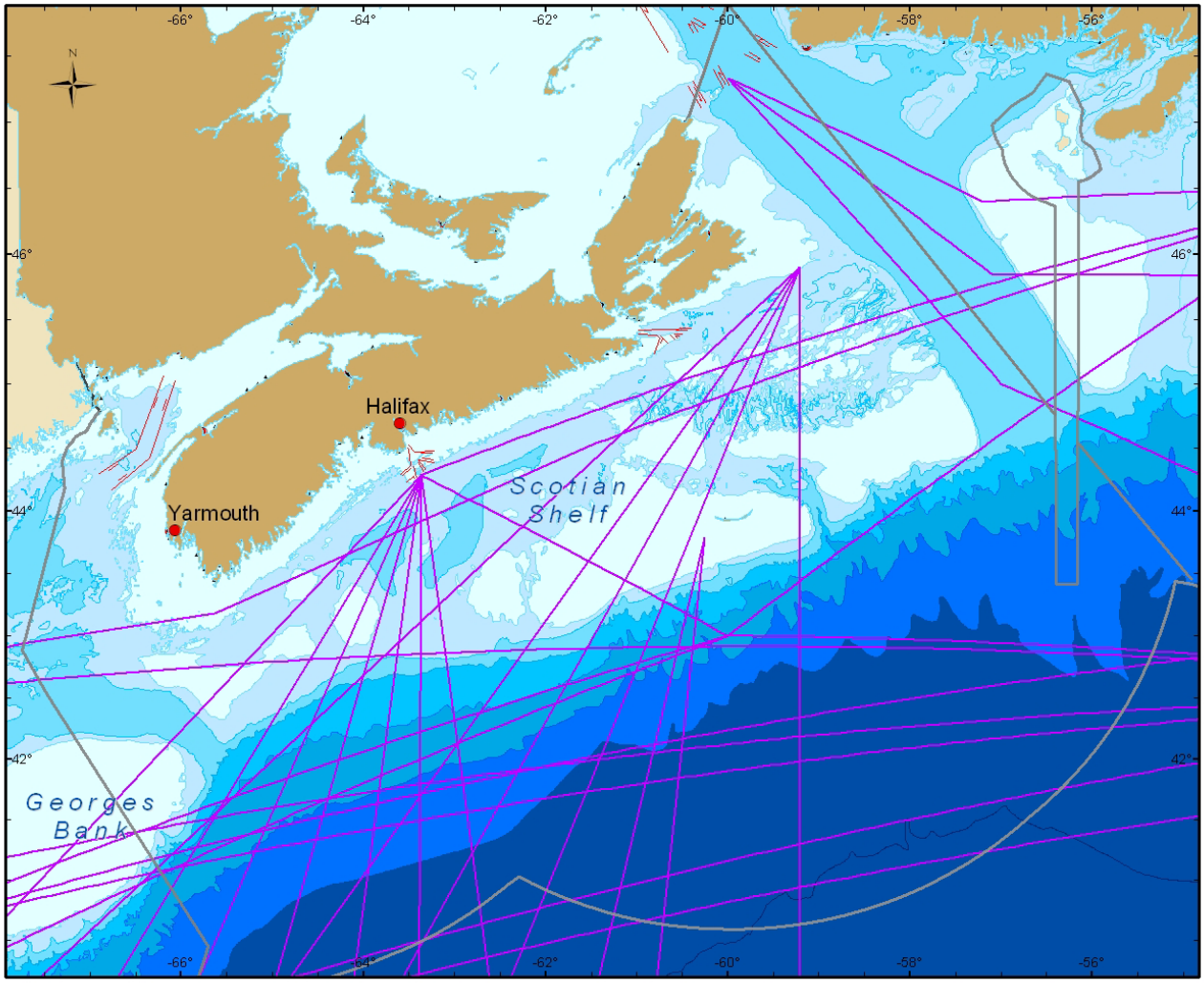


Figure 4: Shipping routes (Source: Oceans and Coastal Management Division, Fisheries and Oceans Canada).

cruise port in Canada after Vancouver and the third largest container port in Canada (Gardner Pinfold 2005).

On the Strait of Canso, the Strait Superport consists of the Mulgrave Marine Terminal and the Port Hawkesbury Pier. In 2009, it handled 33.5 milion tonnes of cargo and had 1 380 vessel movements (Strait Superport 2011). Port Hawkesbury is the largest port in terms of tonnes of cargo handled in this region. Most of the volume is accounted for by the petroleum facility operated by Statia Terminals. Bulk exports of gypsum, paper products, aggregate and imports of coal make up the balance. The Mulgrave Marine Terminal services the offshore oil and gas industry.

In addition to Halifax and Port Hawkesbury there are a number of smaller ports along the Scotian Shelf including Sydney, Liverpool, Shelburne and Sheet Harbour. These ports deal with cargo such as fish, lumber, oil and newsprint (Gardner Pinfold 2005).

Ferry services are another part of the transportation sector that operates on the Scotian Shelf. There are ferry services that link Nova Scotia to Newfoundland and Labrador, and until recently the United States. There are also planned activities that could increase vessel traffic on the Scotian Shelf. These include proposals for a new Liquefied Natural Gas terminal at Bear Head, a new container terminal in Melford (Chedabucto Bay) and the expansion of port facilities in Sydney.

PORTS AND SHIPPING GOVERNANCE

The shipping industry is regulated internationally by the International Maritime Organization (IMO). National governments are required to implement and enforce international regulations through their domestic legislation such as the *Canadian Shipping Act.* Much of Canada's legal framework regarding marine transportation operations is from the implementation of international agreements like the International Convention for the Prevention of Pollution from Ships and the International Convention for the Safety of Life at Sea.

The regulation of shipping operations in Canadian waters falls under the jurisdiction of several federal departments and agencies:
Transport Canada's mandate encompasses the full spectrum of responsibilities related to ship safety and the protection of the environment, including marine pilotage and the provision of marine expertise for general and policy matters.
Fisheries and Oceans Canada – Canadian Coast Guard provides services for safety and environmental response, marine navigation, marine communications, traffic management and ice breaking.
National Defense – Maritime Forces is the lead agency for the national Search and Rescue Program. Maritime Forces Atlantic (MARLANT) provides maritime surveillance, monitoring and control functions in the areas of shipping, marine pollution and safety.
Environment Canada addresses a broad range of pollution concerns and issues. They are also responsible for the *Canadian Environmental Protection Act* and for pollution prevention under the *Fisheries Act*, including the control of discharges into the marine environment.
Port and Harbour Authorities are the primary managers of all ports in Canada. Their responsibilities include environmental management regimes for port related activities.

ECONOMIC OVERVIEW

The marine transportation sector is an important component of the Nova Scotia coastal economy. Maritime transportation in Nova Scotia generated direct revenues estimated at $500-600 million in 2006 and created about 8 000 fulltime jobs (Gardner Pinfold 2009). The Port of Halifax's direct and spin-off impacts of port-related activities include $1.58 billion in gross output and $671 million in GDP (Port of Halifax 2011).

The port of Halifax has seen steady growth in shipping cargo volumes in 2010, relative to 2009 (Port of Halifax 2011). In 2010, containerized, breakbulk and roll on/roll off cargo all increased from 2009. Roll on/roll off (Ro/Ro) cargo (mostly automobiles) is a unique speciality of the port of Halifax. The Halifax Autoport Terminal is one of the largest vehicle processing facilities in North America. The Strait Superport has also experienced steady growth since 2001 (Strait Superport 2011).

3.4.5 Ocean and Coastal Tourism

A variety of tourism activities occur off the coasts of Nova Scotia, such as whale and seabird watching, sport fishing, sea kayaking, yachting, scuba diving and visits to coastal beaches and parks. Cruise ships visit Halifax and Sydney regularly and several other coastal communities occasionally. Comprehensive statistics on the marine tourism industry are not kept, making it difficult to track trends. As well, in most cases it is

Table 4: Tourism and Recreation Businesses in Nova Scotia 2003.

Source: Praxis 2004

TOURISM/RECREATION ACTIVITY	NUMBER OF ENTERPRISES
Whale and Seabird watching tours	57
Diving Operators	7
Canoe/Kayak tour organisations	6
Sport Fishing Tours (Saltwater)	25
Sailing Tours	11
Other Boat Tours	28
Marinas	23
Yacht Clubs	11
Total	174

not possible to separate tourist activities occurring along the Atlantic coast adjoining the Scotian Shelf from those occurring along the province's other coasts. There were at least 174 marine tourism businesses throughout the province of Nova Scotia in 2003 (**Table 4**, Praxis 2004). The industry suffered a decline in the first few years of the twenty-first century (Gardner Pinfold 2009) and there may now be fewer operators.

Whale and seabird watching tours made up the largest category of marine tourism operators, with sport fishing and boat tours the second and third largest categories (Praxis 2004). All tourism activities tend to be concentrated in coastal rather than offshore areas although yachts and cruise ships transit offshore areas. Ocean and coastal tourism is described here under three key themes: cruise ship activity, recreational coastal tourism activities, and marine recreational fishing. However, much of the overall tourism in the province can be attributed to coastal features such as the coastal landscape, waterfronts, and natural features (CBCL Ltd. 2009).

CRUISE SHIPS

The main ports of call for cruise ships in Nova Scotia are Halifax and Sydney. The number of vessels has been increasing steadily in the last few years, with 127 vessels and 261 000 passengers to Halifax in 2010, up from 89 vessels and 170 000 passengers in 2006 (Cruise Halifax 2011). Halifax has benefited from the trend towards four- to five-day cruises and most of its growth has come from this segment (Gardner Pinfold 2005).

COASTAL TOURISM ACTIVITIES

Coastal tourism includes whale and bird watching tours, sea kayaking, yachting, boat tours, and scuba diving. It also includes activities for which the economic value is not well tracked, such as visits to provincial parks or beaches for which there are no expenditures. Even for activities that are tracked, statistical agencies do not systematically track all aspects of these activities. Consequently, reliable statistical information about coastal tourism

is minimal. Accurate information on the economic contribution of activities such as whale watching, bird watching, ocean tours, diving, kayaking, sailing and cruising is not widely available (Gardner Pinfold 2005, 2009). Coastal tourism experienced a decline in the early 2000s, along with the overall tourism industry (Gardner Pinfold 2009). However, prospects for coastal tourism are expected to improve over the next few years with improved economic conditions (Gardner Pinfold 2009). Highlighted below are two components of the coastal tourism sector.

Whale watching and birding tours are expanding components of the tourism economy. Research carried out by the Nova Scotia Department of Tourism indicates that five percent of all visitors to the province participated in whale/seabird boat tours in 2000 (Corporate Research 2001), while nine percent participated in 2004 (Corporate Research 2005). With about 2.2 million visitors to Nova Scotia in both 2000 and 2004 (NS Economic and Rural Development and Tourism 2011), this would equate to about 110 000 boat tour passengers in 2000 and 198 000 in 2004. Based on an average fare of $38 per person (Praxis 2004), total revenues could be estimated at $4.2 million for 2000 and $7.5 million for 2004.

Visits to ocean beaches and parks continue to be an important aspect of the Nova Scotia tourism experience. Thirty-three percent of Nova Scotia visitors in 2004 visited an ocean beach to explore or beachcomb while 10 percent went to an ocean beach to swim or sunbathe (Corporate Research 2005).[1]

MARINE RECREATIONAL FISHING

In 2005, 50 807 licensed anglers in Nova Scotia participated in recreational fishing (DFO 2007a). Of that, 48 674 were Nova Scotia residents and 2

[1] Those participating in the survey could pick multiple activities, thus may have picked both beachcombing and sunbathing.

MARINE TOURISM GOVERNANCE

Multiple government agencies are responsible for regulating marine tourism, with the relevant department depending on the type of activity undertaken.

Transport Canada regulates recreational boating; **Fisheries and Oceans Canada** regulates recreational fishing and provides guidelines for whale watching. Cruise ships are required to comply with a variety of regulations, including requirements of the **International Maritime Organization**, the **Canada Border Services Agency, Transport Canada** and **Environment Canada**. Various departments are responsible for regulating development in the coastal zone, such as the infrastructure supporting coastal recreational tourism.

133 were non-residents, mainly from other regions in Canada. There were approximately 18 000 saltwater anglers in Nova Scotia in 1995 and nearly 23 000 in 2000 (Gardner Pinfold 2005); figures are not available for 2005. Key marine anadromous species include smelt, mackerel and cod. In 2000, marine fishing effort constituted about 22% of total recreational fishing effort (days) in the province; in 2005, saltwater fishing was about 20% of the total recreational fishing effort (DFO 2005). In 2005, Canadian anglers were estimated to spend about $762/year per angler on fishing, an increase of more than $100 over the 2000 total (Gardner Pinfold 2005, DFO 2007a). Total spending by Nova Scotia anglers – both marine and freshwater – was estimated to be $ 21.9 million (DFO 2007a). Spending on saltwater fishing is typically on boats, motors, transportation and camping and fishing equipment.

ECONOMIC OVERVIEW

Coastal tourism in the province was estimated to generate about $300 million in expenditures in 2006, down from about $363 million in 2002 (Gardner Pinfold 2009). Coastal tourism makes up the bulk of the expenditures; these were estimated to be about $319 million in 2002 but declined to $272 million in 2006. The cruise ship industry also experienced a decline in expenditures in the middle of the decade; however, recent figures from the industry show that the number of passengers visiting Halifax have largely recovered (Cruise Halifax 2011a). The Port of Halifax claims that passengers, crew and cruise lines have combined expenditures of $50 million in the local area (Cruise Halifax 2011b).

3.4.6 Maritime Defence

Canada's naval presence on the east coast is provided through Maritime Force Atlantic (MARLANT) and has its headquarters in Halifax. The MARLANT area of responsibility covers approximately 6 million km^2 and extends from the Canada-US boundary in the Gulf of Maine to Greenland and includes Canada's eastern Arctic to approximately 95 degrees west.

Canada's maritime forces engage in a range of operations and activities including sovereignty patrols, maritime surveillance, naval training

[2] The total is based on figures available for Nova Scotia, not the Canadian average per angler.

SUBMARINE CABLE GOVERNANCE

International conventions protect submarine cables and give the right to lay them on the seabed. The 1884 Convention for the Protection of Submarine Cables is intended to protect submarine cables from human-caused damages. The United Nations Convention on the Law of the Sea considers one of the freedoms of the high seas to be the freedom to lay submarine cables, subject to the rights of the coastal state on the continental shelf. In Canadian waters, proponents of cable laying projects must apply for an approval under the *Navigable Waters Protection Act*. They may also be subject to requirements under the *Canadian Environmental Assessment Act*, the *Fisheries Act*, and the *Canadian Environmental Protection Act*. Cables which start and end in Canada do not have any further licensing requirements. Proponents of international cables – those with a landfall outside Canada – must apply for a permit from Industry Canada under the International Submarine Cable Regulations of the *Telecommunications Act* and are subject to environmental assessment requirements (Coffen-Smout and Herbert 2000).

and combat readiness, search and rescue, humanitarian relief and aid to civil authorities, and operational support to other government departments, including fisheries and environmental protection. To carry out its missions, MARLANT uses a range of platforms, including patrol frigates, coastal defence vessels, destroyers, submarines, ship-borne helicopters and long-range patrol aircraft (MARLANT 2010).

In addition to and during the various types of missions and patrols carried out by MARLANT, naval training activities may take place in designated exercise areas off Nova Scotia (Breeze and Horsman 2005).

Canadian Forces Base Halifax is Canada's largest military base and home to Canada's Atlantic naval establishment. It incorporates three main facilities. HMC Dockyard in Halifax is the base for the fleet of frigates, supply vessels, submarines and coastal defence vessels. 12 Wing Shearwater is home to the navy diving school and Sea King helicopter base. About 1 000 personnel are employed here and it also provides a jetty for docking NATO submarines. DND's contribution to ocean activity also includes operations at 14 Wing Greenwood, the base for the Aurora long-range surveillance aircraft patrolling Canada's extensive Atlantic coast.

ECONOMIC OVERVIEW

As an ocean use sector, maritime defence activities comprise a significant portion of Nova Scotia's ocean-related economy through direct and indirect contributions to the province's GDP. In 2006, maritime defence contributed $869 million to the GDP and provided 10 700 jobs and $614 million in salaries (Gardner Pinfold 2009).

3.4.7 Submarine Cables

Nova Scotia has been a landfall for major transatlantic communication cables since the days of the telegraph. Canso hosted a major telegraph cable station from 1884 to 1962, and the first direct connection

DEFENCE FAST FACT

- Maritime Command Operational Training occurs in the region every 2 years and can involve up to 40 vessels.
- MARLANT currently possesses 7 Halifax-class Frigates, 2 Iroquois-class destroyers, 1 Oberon-class conventional submarine, 1 Preserver-class Operational Support Ship, 6 KINGSTON- class Maritime Coastal Defence vessels, 1 Minesweeping Auxiliary, 14 Aurora and 4 Arcturus long range Maritime Patrol Craft and 31 Sea King helicopters.

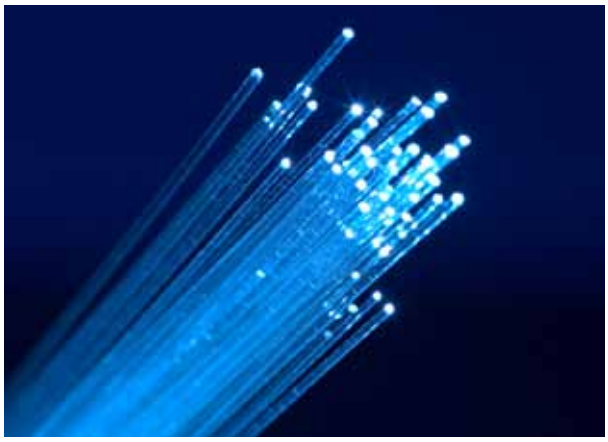
between Europe and mainland North America was at nearby Tor Bay in 1874. Nova Scotia continues to play an important role in international telecommunications, with cables crossing the Scotian Shelf and making landfall in Nova Scotia. As of March 2011, there were seven active international or interprovincial submarine cables crossing the Scotian Shelf that made landfall in Nova Scotia (APOCS 1C, APOCS 2, CANUS 1, CANTAT-3, Hibernia Atlantic Segment A, Hibernia Atlantic Segment D, Hibernia Atlantic Segment E). Other cables cross the Scotian Slope and link the east coast of the United States with Europe. All the existing interprovincial and international cables are for telecommunications, although a high voltage power cable to Newfoundland has been proposed (Office of the Premier 2010). There are also numerous inactive cables.

The international telecommunications cables that land in Nova Scotia are owned by two companies, Hibernia Atlantic and Tata Communications. They have connectivity agreements that allow them to connect to countries and locations where they may not have cables of their own. As well, telecommunications companies in general may purchase long or short term capacity on another company's cable system.

In September 2010, Hibernia Atlantic announced a new subsea fibre optic cable system called Project Express (Hibernia Atlantic 2010). The company plans to lay a cable from the United Kingdom to the Halifax area, connecting with an existing cable that runs from Halifax to Boston. The project is scheduled to be completed by the summer of 2012.

Ships that lay and repair cable are an important part of the industry. As of 2010, at least two cable ships were based in Halifax (ICPC 2010).

In addition to longer interprovincial and international cables, numerous submarine telecommunications and power cables link coastal islands to Nova Scotia's mainland (Breeze and Horsman 2005). There are also military surveillance cables on the Scotian Shelf.



3.4.8 Potential Future Uses

New activities that may be proposed for the Scotian Shelf include the development of wind, wave, or tidal energy and marine mining. The marine renewable energy sector has gained a heightened profile in Nova Scotia with the placement of an experimental tidal turbine in the Bay of Fundy. On the Scotian Shelf, there is some tidal energy potential off Cape Sable Island and Yarmouth, as well as in St Andrews Channel in the Bras d'Or Lakes (Triton Consultants 2006). Technologies to exploit energy from waves are in relatively early stages of development, with few commercial developments. However, Canada's Atlantic coast, including offshore areas, has been identified as having a high potential capacity for wave energy (NRCan 2011). Offshore wind farms have been put in place in many locations around the world. In Canada, wind energy potential has largely focused on land, although there is interest in developing windfarms in the Great Lakes and off the Pacific coast (NRCan 2008).

In the 1990s, there was increasing interest in the offshore as a source of non-fuel minerals. The Scotian Shelf has vast reserves of aggregate (sand and gravel) that is used by the construction industry (Fader and Miller 1994). An intergovernmental task force was created to investigate the development of an offshore minerals mining regime (Coffen-Smout et al. 2001). However, the task force did not complete its work and to date, no offshore mining regime has been developed.

4 OCEAN MANAGEMENT ISSUES

Human use of the Scotian Shelf ecosystem exerts many different pressures on the marine environment. These range from direct removal of fish and invertebrates from the system to increased noise and light in the water column. Some key pressures are listed below and they are described in more detail in the theme papers on each topic. In addition to individual environmental pressures, there are also concerns around cumulative impacts from all ocean activities and multiple use conflicts.

4.1 DIRECT REMOVAL OF FAUNA

Fishing is the main activity that removes organisms from the Scotian Shelf environment. Impacts of fishing on target species have been widely documented, and may include impacts on the size of the population, the structure of the population, its success in reproduction, the area occupied by the species, the size spectrum on the species, as well as many others (see, e.g., Smith et al. 1993,

Zwanenburg et al. 2006). Globally, historic fishing trends have shown fishing progressing from the most valuable and easiest to catch species, which tend to be large, fish-eating fish, to lower trophic levels, such as invertebrates and plankton-eating fish[3] (Pauly et al. 1998). The focus of the fishery has also moved from shallow coastal waters, to deeper offshore waters. Large scale removal of a particular species or multiple species may influence energy flow in the ecosystem as well as other ecosystem properties (see e.g., Zwanenburg et al. 2006). There is evidence that the trophic structure of the eastern Scotian Shelf has changed as a result of the decline of the cod population (Frank et al. 2005).

Fishing removes non-target species from the system, affecting their populations. If the bycatch is high enough, if may have similar effects on particular species as directed fishing.

4.2 INCIDENTAL INJURY/MORTALITY

Many activities on the Scotian Shelf may result in accidental injury or death to the species. Shipping, fishing, aquaculture, and construction of offshore and coastal infrastructure may all result in incidental injury or mortality. Incidental catches of non-target species by fishing (bycatch) are noted above. Incidental impacts may result in a significant overall effect at the population level. For example, two of the key threats to the endangered North Atlantic right whale are incidental impacts: collisions with ships and entanglement in fishing gear.

4.3 BENTHIC HABITAT DISTURBANCE

Human activities on the Scotian Shelf may disturb or damage marine habitat, particularly benthic habitat. Fishing, construction of offshore and coastal infrastructure, discharges from oil and gas operations and disposal at sea may all impact marine benthic habitats. The impacts of different types of fishing gear on benthic habitat have been documented in a number of reports and include changes in habitat complexity, changes in seafloor structure (e.g., through movement of rocks and boulders or creation of furrows), as well as removal of structure-building organisms, such as corals and sponges (DFO 2006). Fishing may also impact the composition of benthic communities (DFO 2006).

4.4 NOISE

Marine construction, seismic surveys carried out by the petroleum industry, various types of SONARs, and vessels used in various activities are the main contributors of noise in the marine environment of the offshore Scotian Shelf. Low-flying aircraft may also be major contributors in certain areas, such as near Sable Island (LGL Limited and Malme 2000). Marine mammals use sound to varying degrees for several purposes: communication; foraging; orientation in the water; and predator avoidance (Götz et al. 2009). Some fish species are known to use sound for communication and may also use it for orientation, although sound use in fish species has not been investigated very thoroughly (Götz et al. 2009). Other marine animals, including invertebrates, turtles and birds, may also be sensitive to sounds, depending on the type and frequency. Marine mammals produce sounds in a wide variety of frequencies and their hearing spans a similarly wide range (Götz et al. 2009). Thus, different sounds will have different impacts on marine species. More information can be found in a report of the OSPAR Commission (Götz et al. 2009), which carried out a review of the impacts of human produced sound in the marine environment. Marine mammals have traditionally been considered the most vulnerable to noise and an assessment of noise issues relevant to two species of

[3]This is a simplification of general trends: there have long been some invertebrates (e.g., lobster, scallops) and planktivorous fish (e.g., herring) that have been fished.

whales, the sperm whale and the Northern bottle-nose whale, was carried out for the Scotian Shelf in light of ongoing petroleum exploration activities in the area (LGL Llimited and Malme 2000).

4.5 POLLUTION

Shipping, petroleum exploration and development, disposal at sea (e.g., of dredging material) and fishing activities all discharge wastes into the marine environment. However, the largest source of marine pollution comes from land-based activities, including agricultural runoff, wind-blown debris, industrial activity, and municipal waste-water (Environment Canada 2004). Stewart and White (2001) provide a general overview of contaminants on the Scotian Shelf. Some marine sources of pollution on the Scotian Shelf are briefly described here.

The offshore oil and gas industry discharges treated water into the marine environment. Oil and gas operators are expected to meet guidelines published by the CNSOPB (CNSOPB/C-NLOPB 2010). Discharges from the shipping industry are regulated; however, there are incidental and accidental releases of fuel, chemicals, ship debris and cargoes (Stewart and White 2001) as well as occasional major events, such as the sinking of the oil tanker, Arrow, in Chedabucto Bay in 1970 (Environment Canada 2010). The major sources of pollution from the fishing industry are lost or abandoned fishing gear and garbage. Two studies carried out in the 1990s found that fishing was the most important source of marine litter in offshore areas of the Scotian Shelf (Lucas 1992; Dufault and Whitehead 1994). Since then, fishermen's organizations have been active in developing programs to encourage fishermen to bring garbage back to shore. The federal government has also developed awareness brochures and other awareness tools (DFO 2007b).

4.6 CUMULATIVE EFFECTS

A cumulative effect may be defined as "a change to the environment caused by an action in combination with other past, present and future human actions" (Hegmann et al. 1999). Cumulative effects are important when the effects of an ocean use are persistent over time (i.e., difficult to reverse), such as pollution with heavy metals and some pesticides or large-scale destruction of habitat, or when activities are in close proximity in time and space. When environmental effects of activities are considered separately, they may all be below the threshold levels that cause impacts. Some effects, although thought to be transitory or of minor importance on the scale of a single source (e.g., a vessel discharge, an otter trawler, an oil well, or a seismic survey) may prove to be of more serious concern when combined. Cumulative effects need to be addressed at varying scales, from local/site-specific to broader regional ecosystems.

4.7 MULTIPLE USE

Some portions of the Scotian Shelf experience relatively high or intensive levels of use, such as heavily fished areas, hydrocarbon production areas, and high vessel traffic areas. Parts of the outer shelf and shelf break, for example, has been subject to an increasing intensity of multiple use, including oil and gas development and a variety of fisheries. Other areas remain little to moderately used. Current and anticipated expansion, however, of existing uses (e.g., deep water fisheries) coupled with the potential for new ocean uses, such as offshore minerals development or wind power generation, underscores the growing requirement for effective multiple use management practices.

5 OCEAN GOVERNANCE AND MANAGEMENT

Governance is the way by which society has instituted objectives, priorities and systems of cooperation (IUCN 2005), and establishes the framework for management. Governance is constituted by institutions, formal and informal agreements and behaviours, how resources are used, how the problems and chances are assessed, the actions permitted or prohibited; and the regulation and sanctions that are applied (OMRN 2003). The governance of any geographical area, including marine spaces, is actually the management of stakeholder relationships with regard to resource use in the pursuit of many sanctioned economic, social, political, and environmental objectives. Good governance is based on recognition of the interests of all stakeholders, and is collaborative, cooperative, and integrative.

INTERNATIONAL LEGISLATION

The United Nations Convention on the Law of the Sea (UNCLOS), signed in 1982, is considered the international constitution of the oceans. UNCLOS incorporates both the codification of customary international law and negotiated treaty commitments relating to the world's oceans. It provides a comprehensive framework for the regulation of the oceans and deals with a range of activities such as access to the seas, navigation, protection and preservation of the marine environment, pollution prevention and control, exploitation of living and nonliving resources, conservation, scientific monitoring and research, and the outline of a dispute settlement mechanism. The Government of Canada ratified the 1982 UNCLOS in 2003. A significant proportion of UNCLOS provisions are reflected in Canadian legislation. There are also numerous other international instruments, processes and institutions dealing with the full range of ocean issues in which Canada is actively engaged to promote and support its interests and responsibilities. These rights and obligations under international conventions and agreements are fully recognized and respected in Canada's Oceans Strategy.

OCEAN-RELATED LEGISLATION AND POLICY

There are various federal and provincial acts and policies that are relevant for the management of ocean activities and the conservation and protection of ocean resources on the Scotian Shelf. Chao et al. (2004) provides a comprehensive *Overview of Federal, Provincial and International Ocean Regulatory and Policy Frameworks on the Scotian Shelf*. Canada's *Ocean Act* outlines the country's responsibilites for an integrated approach to coastal and ocean management. The Act identifies the Minister of Fisheries and Oceans Canada as the lead federal authority for oceans management. Three primary commitments outlined in the Act are: 1) develop a national strategy for managing Canada's oceans (Section 29); 2) establish a national network of Marine Protected Areas (Section 35); and 3) promote the integrated management of Canada's marine activities (Section 31) (Government of Canada 1996).

INTEGRATED COASTAL AND OCEAN MANAGEMENT ON THE SCOTIAN SHELF

In 2002, the *Canada's Ocean's Strategy* was released, which is the Government of Canada's policy statement for the management of estuarine, coastal and marine ecosystems (Government of Canada, 2002a). *Canada's Oceans Strategy* sets out the policy for ocean management in Canada. At the heart of the strategy is an integrated approach to ocean governance. Integrated management requires collaboration between the federal and provincial governments, Aboriginal peoples, ocean industries, academia and the Canadian public. The strategy commits the Government of Canada to implement integrated management and planning. *Canada's Policy and Operational Framework for Integrated Management of Estuarine, Coastal and Marine Environments in Canada* (Government of Canada, 2002b) outlines the process for integrated management in Canada.

An integrated management initiative for the Eastern Scotian Shelf was initiated in 1997. This initiative lead to the development of an integrated management plan and a governance structure that included all levels of government and stakeholders. Elements of the integrated management plan and the governance structure, such as the Regional Committee on Coastal and Ocean Management (RCCOM), have since expanded and now provide intergovernmental coordination for the entire Scotian Shelf. The RCCOM is the senior executive

OCEANS STRATEGY OBJECTIVES

- Understanding and protecting the marine environment.
- Supporting sustainable economic development
- International leadership

level forum for federal and provincial departments and agencies with ocean-related programs. The geographic focus for the RCCOM is Nova Scotia, New Brunswick and Prince Edward Island. Membership is comprised of senior federal (Regional Director-General) and provincial (Deputy-Minister) representatives of government departments and agencies. The RCCOM is co-chaired by alternately by the Regional Directors-General, DFO Maritimes Region and Gulf Region, and a Deputy-Minister of the Province of Nova Scotia, New Brunswick or Prince Edward Island, on a rotational basis. RCCOM meets on an annual basis, or as necessary. The RCCOM provides coordination at the intergovernmental and interdepartmental levels for: planning, management and regulatory matters related to integrated ocean and coastal management, internal oversight, monitoring and performance assessment of regional integrated management processes; and formal and executive level government involvement in the development and implementation of plans for regional integrated management processes.

MARINE PROTECTED AREA PLANNING

Canada's Federal Marine Protected Areas Strategy (2005) sets the direction for building a national network of marine protected areas (MPAs). Further, the *Oceans Act* requires the establishment of MPAs by DFO to protect and conserve important fish and marine mammal species and their habitats, endangered marine species, unique features and areas of high biological productivity or biodiversity. Canada has committed to establishing a network of protected areas to help meet a range of conservation goals. There is currently one area designated as MPAs under the *Oceans Act*, on the Scotian Shelf, The Gully MPA Two other federal agencies, Environment Canada (Canadian Wildlife Service) and Parks Canada Agency, are working in collaboration with DFO to establish and manage federal marine protected areas. In May 2010, Parks Canada selected Sable Island for future designation as a National Park. More recently, a draft *National Framework for Canada's Network of Marine Protected Areas* was created to provide guidance for the planning and implementation of MPA networks within 13 bioregions across Canada (DFO 2010g). The Scotian Shelf (including the Bay of Fundy) is one of these bioregions and DFO and its federal and provincial partners will be leading an MPA network planning process for the bioregion in the coming years.

6 CONCLUSION

The Scotian Shelf in Context gives a brief overview of the region by providing some baseline knowledge of the biophysical, social and economic environment of the Scotian Shelf. It is intended as a useful resource for a broad-based audience, as well as to provide context for the more in-depth discussion in the theme papers. Readers interested in finding out more about the issues facing the Scotian Shelf are encouraged to read the theme papers. The State of the Scotian Shelf Report can be accessed at: http://coinatlantic.ca/index.php/state-of-the-scotian-shelf

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