Science and Socio-economic Review of the Georges Bank Prohibition Area

2010-2021

Stantec

Gardner Pinfold Consultants

Science and Socio-economic Review of the Georges Bank Prohibition Area 2010-2021

Final Report

November 12, 2021

Prepared for:

OERA
1001-1690 Hollis Street
Halifax, NS B3J 1V7

Prepared by:

Stantec Consulting Ltd.
102-40 Highfield Park Drive
Dartmouth, NS B3A 0A3

in association with

Gardner Pinfold Consultants Inc.
PO Box 176
Chester NS B0J 1J0

File: 121417122

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Executive Summary

The Governments of Canada and Nova Scotia have maintained a moratorium on petroleum-related activities on the Canadian portion of Georges Bank and certain adjacent areas since 1988 in recognition of the ecological and socio-economic significance of the area and concerns about potential risk associated with proposed exploration drilling.

Since the moratorium was instituted, there has been considerable scientific and socio-economic reviews to assist provincial and federal government decision-making regarding the continuation of the moratorium including an independent panel review in 1999 (NRCan and NSPD 1999) and a Preliminary Review of Environmental and Socio-economic Issues on Georges Bank conducted in 2010 (2010 Review; Stantec 2010a) which helped to inform the most recent extension of the moratorium on petroleum exploration and drilling to December 31, 2022.

Over the last ten years, environmental and energy policies have evolved at the provincial, federal and international levels. Local socio-economic conditions have also changed and warrant a re-examination by federal and provincial governments prior to issuing a decision regarding the future of Georges Bank. Nova Scotia Department of Natural Resources and Renewables (NRR) and Natural Resources Canada (NRCan) have sponsored the Offshore Energy Research Association (OERA) to commission a science and socio-economic review (this study) to provide an update of the review undertaken in 2010 on the state of knowledge for Georges Bank to inform decision-making regarding the future status of the moratorium.

Since 2010 there have been few documented changes to the Georges Bank ecosystem, although climate change is becoming more noticeable with some shifts in species distribution and changes to the ecosystem over the longer term. There has also been increased environmental protection measures for special areas including new conservation areas for corals and sponges and important habitat defined for marine mammal and sea turtle species at risk.

There has been considerable fluctuation in fisheries landings and economic value in recent years, and fewer active fishers and vessels on Georges Bank compared with twenty years ago. However, the key species of importance remain the same, and the Georges Bank fishery remains as important to the economy of southwest Nova Scotia today as it was in 1999.

The last decade has also seen a large change in offshore petroleum activity offshore Nova Scotia, with two active production projects and two exploration drilling projects occurring on the Scotian Shelf and Slope. These projects contributed substantial socio-economic benefits to the province while they were active, with direct and indirect employment opportunities and expenditures, and in the case of production projects, royalty payments.

Despite advances in science and regulatory policy and changes in socio-economic conditions related to Georges Bank and southwest Nova Scotia, key issues and concerns relating to potential impacts of offshore petroleum activity on commercial and traditional fisheries, initially identified by the 1999 Review Panel, remain relevant over 20 years later. These issues include:

- Physical and behavioural effects on marine species from seismic noise
- Drill muds and cuttings
- Produced water
- Accidental discharges (spills and blowouts)
- Greenhouse gas emissions and climate change
- Transportation issues (pipelines and tankers)

Environmental effects monitoring programs associated with recent and/or ongoing exploration and production projects offshore Nova Scotia and Newfoundland and Labrador, as well as collaborative research programs such as the Environmental Studies Research Fund and the Multi-Partner Research Initiative have resulted in additional knowledge and insight to many of these topics, informing effects assessments and key mitigation measures.

Two key factors which have had a strong influence in advancing science and technology and shaping regulatory policy and investment on a global scale over the last decade are the increasing concern and knowledge about the anthropogenic causes of global climate change and the catastrophic Deepwater Horizon oil spill which occurred in the Gulf of Mexico in 2010.

In the last decade, the focus of the oil and gas sector has advanced from greenhouse gas accounting and reduction to striving to achieve net-zero carbon emissions. Although demand for fossil fuels remains relatively high, oil and gas operators are expanding their business strategies to include renewable energy sources and carbon reduction strategies. Future oil and gas exploration and development, if it were permitted to occur on Georges Bank, would need to be structured to support provincial and federal objectives and commitments regarding climate change.

The Deepwater Horizon oil spill, while a tragic event, provided an unprecedented opportunity for research collaboration and development of innovative solutions related to oil spill prevention and response. Considerable knowledge has been gained since the spill event in 2010 including technological advancements in well control, oil spill trajectory modelling and response technology, oil toxicity science, and natural resource damage assessments. In addition to advancing science and technology related to offshore oil and gas operations, this event also served as a catalyst for offshore regulatory updates in Canada and globally. Future oil and gas exploration and development, if it were permitted to occur on Georges Bank, would be subject to more stringent regulatory requirements and incorporate improved procedures around oil spill prevention and response.

Since the 2010 Review, advances in scientific knowledge, mitigation, and regulatory requirements have improved performance and understanding of effects of the offshore oil and gas sector. Despite concerns from the fishing industry, successful co-existence of fisheries and petroleum activities has been demonstrated offshore Nova Scotia, with both industries contributing substantially to the provincial economy. Nonetheless, the offshore petroleum industry in Nova Scotia has had a relatively short lifespan to date. As of 2021, all projects have been decommissioned and there is no current or planned offshore petroleum exploration or development in the Canada-Nova Scotia Offshore Area.

Abbreviations

2D	two-dimensional
3D	three-dimensional
AOI	Area of Interest
ATBA	Area to be Avoided
$CaCO_3$	calcium carbonate
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DFO	Department of Fisheries and Oceans Canada
EBSA	Ecologically and Biologically Significant Area
ECSAS	Eastern Canada Seabirds at Sea
EEM	environmental effects monitoring
EL	exploration licence
EPP	Environmental Protection Plan
ESRF	Environmental Studies Research Fund
FPSO	floating production storage and offloading facility
FSC	food, social and ceremonial
FTE	full-time equivalent
GDP	Gross Domestic Product
GHG	greenhouse gas
IAA	*Impact Assessment Act*
IFMP	Integrated Fisheries Management Plan
IMO	International Maritime Organization
MMO	Marine Mammal Observer
MPA	Marine Protected Area
MT	megatonne (1 millon tonnes)
NAFO	Northwest Atlantic Fisheries Organization
NRCan	Natural Resources Canada
NRR	Department of Natural Resources and Renewables ocean
OA	acidification
O_A	aragonite saturation state
OBM	oil-based mud
OERA	Offshore Energy Research Association
PAM	passive acoustic monitoring

RCP	Representative Concentration Pathway
SAR	species at risk
SARA	*Species at Risk Act*
SOCC	species of conservation concern
SOCP	Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment
SOEP	Sable Offshore Energy Project
TAC	total allowable catch
UME	unusual mortality event
USGS	United States Geological Survey
VSP	vertical seismic profiling
WAZ	wide-azimuth

1.0 INTRODUCTION

Nova Scotia Department of Natural Resources and Renewables (NRR) and Natural Resources Canada (NRCan) have sponsored the Offshore Energy Research Association (OERA) to commission a study to collect and present fisheries and other scientific data in relation to the Georges Bank Prohibition Area. The objective of this science and socio-economic review is to provide an update on the current state of knowledge for Georges Bank to inform decision-making by the relevant provincial and federal ministers regarding the future status of the moratorium on petroleum-related activities. This report was prepared by Stantec Consulting Ltd. in association with Gardner Pinfold.

1.1 STUDY PURPOSE AND OBJECTIVES

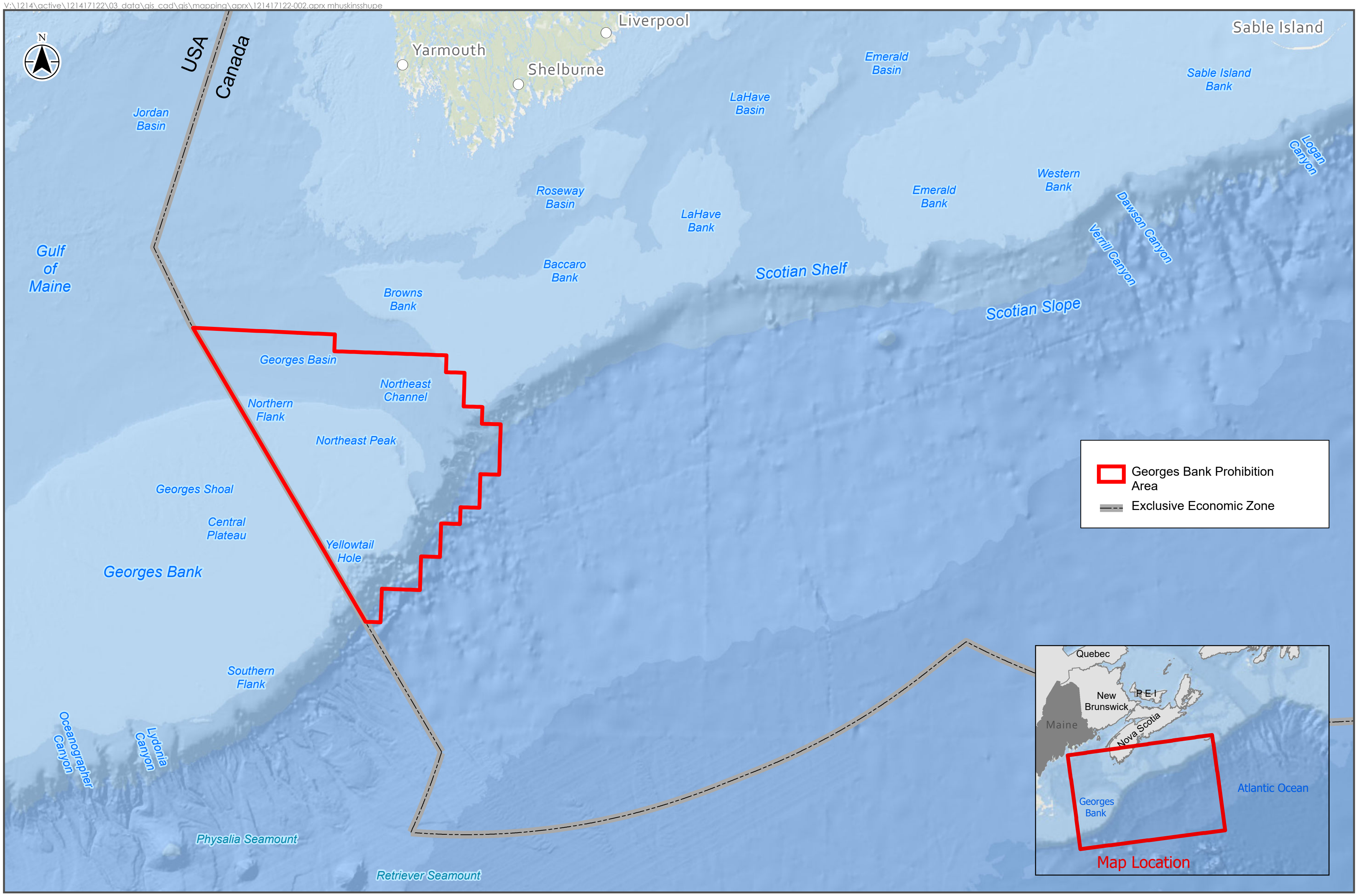
Georges Bank is situated along the continental shelf of Eastern North America between the southern tip of Nova Scotia and Cape Cod, Massachusetts (Figure 1.1). A biologically productive ecosystem, Georges Bank provides habitat to a wide range of marine fish, marine mammals, corals and sponges and other marine organisms and supports important commercial fisheries in Canada and the United States.

In recognition of the ecological and socio-economic significance of Georges Bank and concerns about potential risk associated with proposed exploration drilling, the Governments of Canada and Nova Scotia placed a moratorium on the exploration and drilling for and production, conservation and processing of petroleum on the Canadian portion of Georges Bank and certain adjacent areas in 1988. Following an independent panel review in 1999, the moratorium was extended until 2012 and remained in place until 2015 when government legislation was passed extending the moratorium to December 31, 2022.

As described in s.141 of the *Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act* and s.134AA of the *Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation (Nova Scotia) Act* (the Accord Acts), the Minister of Natural Resources Canada and the Nova Scotia Minister of Natural Resources and Renewables may jointly issue a written notice to extend the prohibition for a period of no more than 10 years following a “review of the environmental and socio-economic impact of exploration and drilling activities in that portion of the offshore area described in Schedule IV” (i.e., Georges Bank Prohibition Area) and any other relevant factor(s).

As directed by OERA, this review is intended to focus on scientific and socio-economic data collected in the Georges Bank Prohibition Area since the previous review was undertaken in 2010, identifying key or emerging social and economic changes based on publicly available data. This report is not intended to be a comprehensive evaluation of the resources of Georges Bank or detailed impact assessment of potential oil and gas exploration and production. No stakeholder engagement was conducted and no new field data was collected for the purpose of this report. For additional context and detail on the Georges Bank Prohibition Area, readers are encouraged to consult the Georges Bank Review Panel Report (NRCan and NSPD 1999) and the Preliminary Review of Environmental and Socio-economic Issues on Georges Bank (Stantec 2010a) (referred hereinafter as the “2010 Review”). These reports are accessible through the OERA’s website (https://oera.ca/research/georges-bank-research-data).

V:\1214\active\121417122\03_data\gis_cad\gis\mapping\aprx\121417122-002.aprx mhuskinsshupe



Sources: Base Data - Canada Nova Scotia Offshore Petroleum Board, Government of Canada, Fisheries and Oceans Canada.
Service Layer Credits: World Topographic Map: Esri, Garmin, FAO, NOAA, NRCan, Parks Canada
World Ocean Base: CHS, Esri, GEBCO, DeLorme, NaturalVue
World Ocean Base: Esri, GEBCO, DeLorme, NaturalVue
World Hillshade: Esri, USGS

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Georges Bank Prohibition Area

Stantec

SCIENCE AND SOCIO-ECONOMIC REVIEW OF THE GEORGES BANK PROHIBITION AREA 2010-2021

121417122-002

Figure 1.1

1.2 BACKGROUND

Georges Bank has played an important role in Canadian fishing history since the mid-1800s (NRCan and NSPD 1999). In 1964, the Canadian government issued the first petroleum exploration permits in the Georges Bank area to Texaco Exploration Company with subsequent permits issued to others in the area. In 1969, the United States objected to Canada's asserted jurisdiction and proposed a moratorium on drilling in the Gulf of Maine until after an international boundary had been drawn and regulations to protect the fishery were established (NRCan and NSPD 1999).

Exploration drilling was conducted in uncontested American waters between 1976 and 1982. In 1984, the international boundary dispute was resolved and the United States placed a moratorium on oil and gas leases on the American side of Georges Bank. Following this decision, Texaco expressed an interest in drilling on the Canadian portion of Georges Bank and initiated stakeholder consultation. Local fishing associations, fish processors and residents of southwestern Nova Scotia expressed strong opposition to Texaco's proposal to drill. In response to these concerns, the governments of Canada and Nova Scotia enacted legislation (Accord Acts) placing a moratorium on all petroleum-related activities on the Canadian portion of Georges Bank and surrounding areas (NRCan and NSPD 1999).

In 1996, in accordance with the legislation, an independent panel was appointed to conduct a public review of the environmental and socio-economic impact of exploration and drilling. The Georges Bank Review Panel commissioned several studies and established an extensive public review process which included introductory meetings, information sessions, and community workshops which culminated in public hearings. The Georges Bank Review Panel Report, published in June 1998, summarized the findings of research (including knowledge gaps) and the public review process, and concluded with the Panel's recommendation that "action be taken to have the moratorium on petroleum activities on Georges Bank remain in place" (NRCan and NSPD 1999).

Based on recommendations made by the independent review panel, the Minister of the Nova Scotia Petroleum Directorate and the Minister of Natural Resources Canada announced on December 22, 1999, that the Georges Bank moratorium would be extended until December 31, 2012. In the decade that followed, there was considerable scientific research focused on the Georges Bank ecosystem (see Kennedy et al. 2011) and updated science and socio-economic reviews were commissioned to research key environmental and socio-economic issues related to Georges Bank (Stantec 2010a; DFO 2011; Lee et al. 2011) and specifically address advances in technology and mitigation (Stantec 2010b) to assist provincial and federal government decision-making on a new public review of the Georges Bank moratorium prior to 2012. The moratorium remained in place by policy until 2015 when the federal and provincial governments passed legislation to extend the moratorium on petroleum exploration and drilling to December 31, 2022.

Over the last ten years, environmental and energy policies have evolved at the provincial, federal and international levels. Local socio-economic conditions have also changed and warrant a re-examination by federal and provincial governments prior to issuing a decision regarding the future of Georges Bank.

On December 12, 2015, Canada and 194 other countries reached the Paris Agreement to fight climate change. Subsequent energy policies at the provincial and federal levels have focused on transitioning to a low-carbon economy with less reliance on fossil fuels. Although oil and gas will continue to be part of the energy mix in Canada and globally, the emphasis will be on producing and using cleaner fuels with lower greenhouse gas (GHG) emissions. Competitiveness in the oil and gas sector will depend on cutting both costs and GHG emissions (NRCan 2018).

This current Science and Socio-economic Review is intended to summarize the current state of knowledge of the science and issues that have evolved since 2010 to inform the Nova Scotia Minister of Natural Resources and Renewables and Minister of Natural Resources Canada as they consider extending the moratorium beyond 2022.

2.0 CHARACTERIZATION OF GEORGES BANK

2.1 GEOMORPHOLOGICAL OVERVIEW

Located approximately 125 km offshore Nova Scotia, Georges Bank is the most southwesterly shallow bank on the southernmost portion of the Canadian Atlantic continental shelf margin (Sproule 2010). It is bounded to the northeast by the Northeast Channel, to the southeast by the continental slope, to the southwest by the Great South Channel, and to the northwest by the Franklin and West Georges basins (Sproule 2010). Within the subsurface, the Yarmouth Arch separates the West Georges Bank (US side) from the East Georges Bank (Canadian side) (Sproule 2010). The East Georges Bank Basin is part of the Shelburne Sub-Basin (Sproule 2010) and is geologically very different from the West Georges Bank Basin (Koning 2011).

The prospective area for potential oil and gas exploration in Canadian waters is the East Georges Bank (9.055 km^2) (Sproule 2010). The structural and stratigraphic evolution of the East Georges Bank Basin has resulted in the development of significant and economically attractive prospects for petroleum resources with well-defined salt structures and indications of possible Jurassic age reefs as defined by seismic data captured by Texaco in the 1980s (Koning 2011). Based on this historic seismic data, in 1983, the Geological Survey of Canada (GSC) predicted that the average hydrocarbon expectation of the basin was 1.7×10^8 m^3 barrels oil (1.06 billion barrels) and 1.50×10^{11} m^3 natural gas (5.3 trillion cubic feet of gas [TCFG]) (Proctor et al. 1984). The GSC's speculative estimate for the basin was 3.5×10^8 m^3 barrels of oil (2.2 billion barrels) and 3.1×10^{11} m^3 gas (10.8 TCFG) (Proctor et al. 1984). While 10 wells have been drilled on the West Georges Bank (US waters), no wells have been drilled on East Georges Bank.

Additional information on the geomorphology of Georges Bank can be found in the 2010 Review (Stantec 2010a) and the Georges Bank Review Panel Report (NRCan and NSPD 1999).

2.2 BIOLOGICAL SETTING

The characterization of Georges Bank is based on publicly available information, drawing substantially on the following resources and references therein:

- The Marine Ecosystem of Georges Bank (Kennedy et al. 2011)
- The Marine Environment and Fisheries of Georges Bank, Nova Scotia: Consideration of the Potential Interactions Associated with Offshore Petroleum Activities (DFO 2011)
- State of the Atlantic Ocean Synthesis Report (Bernier et al. 2018)
- Western Scotian Shelf and Slope Strategic Environmental Assessment (CNSOPB 2021a)

2.2.1 Ecosystem Overview

Georges Bank is in a distinct area defined by biological and oceanographic characteristics on a highly productive submarine plateau located off the New England U.S. coast and the southwest coast of Nova Scotia. The whole Bank is in shallow water, within the 110 m isobath, and is delimited by deep-water channels on the northeast (the Northeast Channel) and the southwest (the Great South Channel). The physiography of Georges Bank contrasts sharply with the adjacent Gulf of Maine, a semi-enclosed continental shelf sea characterized by a complex physiographic structure with major deep basins, a larger number of smaller basins, and two relatively large ledge-bank systems. These physical characteristics provide a sharp demarcation between Georges Bank and the Gulf of Maine that result in important differences in their production characteristics and ecological structure (NEFMC and FMP 2019).

The physical oceanography has been relatively well understood for the entire area of Georges Bank including the Canadian moratorium area on the eastern side of the Bank (Stantec 2010a). Currents on Georges Bank are primarily driven by strong tides, with winds, differences in water densities, and storms also contributing on the short and long-term to spatial variations and strengths in currents and water mass characteristics. The Bank’s topography and bathymetry also have an influence on the current speeds and directions over the entire Georges Bank. Water circulation and seasonal currents on a longer time scale flow in a partial clockwise gyre around the edge of Georges Bank. The most persistent feature is elevated percentages in the phytoplankton on Georges Bank in all seasons, where the high phytoplankton area seems to be largest in summer and smallest in winter. Gulf of Maine has the second highest phytoplankton contribution, with summer and autumn showing high percentages (DFO 2015).

The high phytoplankton biomass on Georges Bank and Gulf of Maine is well known to support groundfish abundance as well. The fisheries include cod, haddock, pollock, flatfishes (e.g., yellowtail, witch and winter flounders, and American plaice), silver hake, and redfish. Other species are white hake, cusk, skate, monkfish, wolffish and sculpin. Scallop and lobster are also abundant in this area (DFO 2020c). The physical oceanographic processes controlling the dispersion of phytoplankton are also important for determining pelagic species and where fish larvae dispersion is also governed by these same oceanographic processes. Fish larvae also appear to benefit in these phytoplankton-rich areas. This was assessed by modelling and analysis of the overlay between community composition and habitat environmental factors during significant time periods in the presence of fisheries species (Fisher et al. 2011).

There are specific ecosystem and management regions that have been identified as having common fishery characteristics based on recent catch histories (NEFMC and FMP 2019). These regions include the Great South Channel where there are more tuna and higher whale and other marine mammal densities, the Canadian Eastern Georges Bank where groundfish, lobster, and scallop commercial fishing is more important, and the Georges Bank southern shelf where silver hake, squid, and red crab fishing is more important (NEFMC and FMP 2019).

Climate change and consequences for warming trends, with the potential to shift species distribution and changes to the ecosystem on the longer term, are becoming more noticeable. Recently, the Department of Fisheries and Oceans (DFO) (2021a) observed in 2019 that monitoring of temperature anomalies in Georges Basin at 200 m was +1.7°C and the second warmest in the region for the eastern Gulf of Maine/Bay of Fundy, after the Emerald Basin at 250 m with the warmest anomaly of +1.8°C and where the last six years were the warmest on record. Eastern Georges Bank at 50 m was at near-normal temperature anomaly conditions. The Georges Basin temperature anomalies were attributed to the slope waters entering the Gulf of Maine through the Northeast Channel (DFO 2021a). DFO's Summer Ecosystem Survey in the Maritimes Region (Bernier et al. 2018) provides information on species distribution and changes in species assemblages; it has been noticeable in the last decade the increase in prevalence of warm-water species. This includes species that have been regularly observed on Georges Bank and are now becoming common on the Scotian Shelf. Observers taking part in the surveys have also noticed an increase in frequency of species that had rarely or never before been caught in the area, such as armored searobin (*Peristedion miniatum*), spotfin dragonet (*Foetorepus agassizii*), glasseye snapper (*Heteropriacanthus cruentatus*), deep-bodied boarfish (*Antigonia capros*), and American John Dory (*Zenopsis ocellata*) (Bernier et al. 2018).

As the concentration of CO_2 in the atmosphere increases from greenhouse gas emissions, so does the concentration of CO_2 in the surface of the ocean. When carbon dioxide dissolves in the ocean, a certain portion reacts with seawater to form carbonic acid, which acts to lower the pH of the water (Curran and Azetsu-Scott 2012). Ocean acidification (OA), which is the gradual change in ocean chemistry attributed to the dissolution of atmospheric CO_2 in seawater, is anticipated over the long term to affect certain marine resources negatively, including shellfish, corals and sponges. The Atlantic sea scallop (*Placopecten magellanicus*) is one of the economically important commercial fisheries on Georges Bank where OA could affect the calcification of scallop shells. Curran and Azetsu-Scott (2012) noted that ocean pH on the Scotian Shelf has been observed to generally decrease through time, from a pH of about 8.2 to 8.05 on average, over the past several decades. This decrease in pH is slightly greater than the average global ocean decrease observed over the same time period. However, the linkages between anthropogenic impacts on changing ecosystems, and particularly in the Gulf of Maine and Georges Bank, and the distribution and abundance of shellfish species of commercial importance, are not as evident or readily discernable.

Ocean acidification affects corals and sponges by reducing the carbonate saturation of the water, whereby corals and sponges use more energy to produce skeletons and shells (Curran and Azetsu-Scott 2012; DFO 2018e). Carbonate saturation is relatively lower in cold waters at high latitudes, meaning that corals and sponges in these areas are particularly at risk of dissolution (Curran and Azetsu-Scott 2012). On the Scotian Shelf, pH has declined by about 0.1 to 0.2 units since the early 1930s (DFO 2018e).

According to Siedlecki et al. (2021), OA trends over the past 15 years have been masked in the Gulf of Maine by recent warming and changes to the regional circulation that locally supply more Gulf Stream waters. In this study, through a review of the sensitivity of the regional marine ecosystem inhabitants, they identified a critical threshold of 1.5 for the aragonite saturation state (Ω_a) below which calcium-rich shells of marine organisms may be subject to dissolution. With a combination of regional high-resolution simulations that include coastal processes to project OA conditions for the Gulf of Maine into 2050, the Ω_a declined everywhere in the Gulf of Maine with the most impacts near the coast in subsurface waters associated with more coastal freshwater inputs. Siedlecki et al. (2021) further indicate that, "Under the Representative Concentration Pathway (RCP) 8.5 projected climate scenario, the entire GOM [Gulf of Maine] will experience conditions below the critical Ω_a threshold of 1.5 for most of the year by 2050. Despite these declines, Siedlecki et al. (2021) also note the projected warming in the Gulf of Maine imparts a partial compensatory effect to Ω_a by elevating saturation states considerably above what would result from acidification alone and preserving some important fisheries locations, including much of Georges Bank, above the critical threshold."

2.2.2 Benthic Invertebrates

There are many benthic invertebrate species that occur in the Georges Bank Prohibition Area. Key commercially fished benthic invertebrates that occur on Georges Bank include sea scallop (*Placopecten magellanicus*) and American lobster (*Homarus americanus*). Water temperature, food and oxygen availability, substrate type and other oceanographic conditions that contribute to spawning and reproductive success all create an ideal benthic habitat for sea scallops on Georges Bank (DFO 2011). Georges Bank is the largest and most productive area in this species' range in the northwest Atlantic Ocean (DFO 2011). Georges Bank is also a very productive area for lobster, which migrate from deeper waters to the central plateau and shoal waters of the bank in the summer. These lobsters may migrate from as far as 100 km away (DFO 2011).

Sea scallop, lobster, and additional benthic invertebrates commonly found on Georges Bank are discussed in Table 2.1.

Table 2.1 Key Benthic Invertebrates Commonly Found in or Near the Georges Bank Prohibition Area

Common Name	Scientific Name	Presence on Georges Bank
Sea scallop	*Placopecten magellanicus*	• Occurs on sandy and gravel bottoms on Georges Bank, typically in shallow waters with depths of 35 to 120 m • Three major aggregations on Georges Bank: Northeast Peak, Great South Channel, and the southern edge of the Bank • There is a significant exchange of larvae among these three aggregations
American lobster	*Homarus americanus*	• Highest abundance on the Georges Bank region is found in the canyons along the bank's outer slope and to a lesser extent along the northeast edge of the bank • American lobsters in the Georges Bank region move from the deeper waters surrounding the bank in summer to the shoal waters of the central plateau in summer to mate and moult • Following mating, females return to the shallow water of Georges Bank after ten months and hatch the eggs the following summer in June and July, which preceded hatching on Browns Bank and German Bank • Pelagic lobster larvae have been observed on the northern edge of Georges Bank in July and August, though it is not known what percentage of lobster larvae is retained by the partial gyre of Georges Bank • Lobsters migrate back to deeper waters in winter though immature lobsters may remain on the shallow central plateau
Deep-sea red crab	*Chaceon quinquedens*	• Atlantic Canada is at the northern edge of this species' range
Jonah crab	*Cancer borealis*	• Seasonal migrations to the Georges Bank area are not well understood; however, inshore movement from spring through fall followed by migration to deeper warmer water toward the offshore edges of the shelf of Georges Bank in winter has been reported
Longfin inshore squid	*Loligo pealeii*	• This species migrates offshore along the edge of the continental shelf in later fall and return inshore during the spring and early summer • Spawning has been reported from early spring and late summer on Georges Bank
Northern shortfin squid	*Illex illecebrosus*	• Inhabits the continental shelf and slope waters of Georges Bank primarily from the spring through to the fall • Georges Bank is on this species migration route to the Gulf of Maine and Georges Bank may serve as an important feeding area
Sources: DFO 2011; CNSOPB 2021a		

As described in the 2010 Review, there are dense colonies of the white calcareous colonizing tube worm *Filograna implexa* on the northern tip of Georges Bank which provide habitat for a variety of benthic species including crabs and brittle starfish (ophiuroids) (Stantec 2010a).

Colonies of the invasive tunicate *Didemnum cf. lahillei* were identified on the American side of the northern edge of Georges Bank by the United States Geological Survey (USGS) (Stantec 2010a). It was confirmed at the time the 2010 Review was published that colonies of this invasive tunicate had spread to the Canadian eastern side of Georges Bank (Stantec 2010a).

Climate Change and Key Commercial Benthic Invertebrate Species

Both sea scallops and American lobster are susceptible to the impacts of climate change including ocean acidification, which has been shown to have a negative effect on the ability of marine invertebrates to produce and maintain their exoskeletons and shells (Byrne and Fitzer 2019). Ocean acidification limits the carbonate available to form the calcium carbonate ($CaCO_3$) minerals used to build skeletons and shells and the reduced saturation state of $CaCO_3$ associated with ocean acidification can also cause shell corrosion (Byrne and Fitzer 2019). The buildup of carbon dioxide in the bloodstream of benthic invertebrates can also induce physiological stress (Byrne and Fitzer 2019).

Harrington and Hamlin (2019) exposed subadult lobsters to current or predicted end-century pH conditions (acidity) for 60 days. They observed that the lobsters exposed to ocean acidification had reduced oxygen carrying capacity, immunosuppression under chronic ocean acidification conditions and reduced cardiac performance under acute warming. It was concluded that while not all the physiological outcomes for American lobsters are impacted by ocean acidification, the stress of ocean acidification will likely be compounded by acute heat shock.

LeBris et al. (2018) used a model that linked ocean temperature, predator density, and fishing to population productivity and found that recent rapid warming in the northwest Atlantic played an integral role in the boom in the lobster fishery in the Gulf of Maine and in the collapse of the lobster fishery in the warmer southern New England region.

Rheuban et al. (2018) determined the potential impacts of ocean acidification and management for a subset of future climate scenarios including a high and lower CO_2 emissions case. The model found that under the lower CO_2 emissions case (but still elevated relative to historic levels), ocean acidification has the potential to reduce the sea scallop biomass by approximately 13% by the end of the century. The high CO_2 emissions case found that that sea scallop biomass may decline by 50% by the end of the century. The model also determined that increased management did not stop the projected long-term decline of the sea scallop fishery under ocean acidification scenarios.

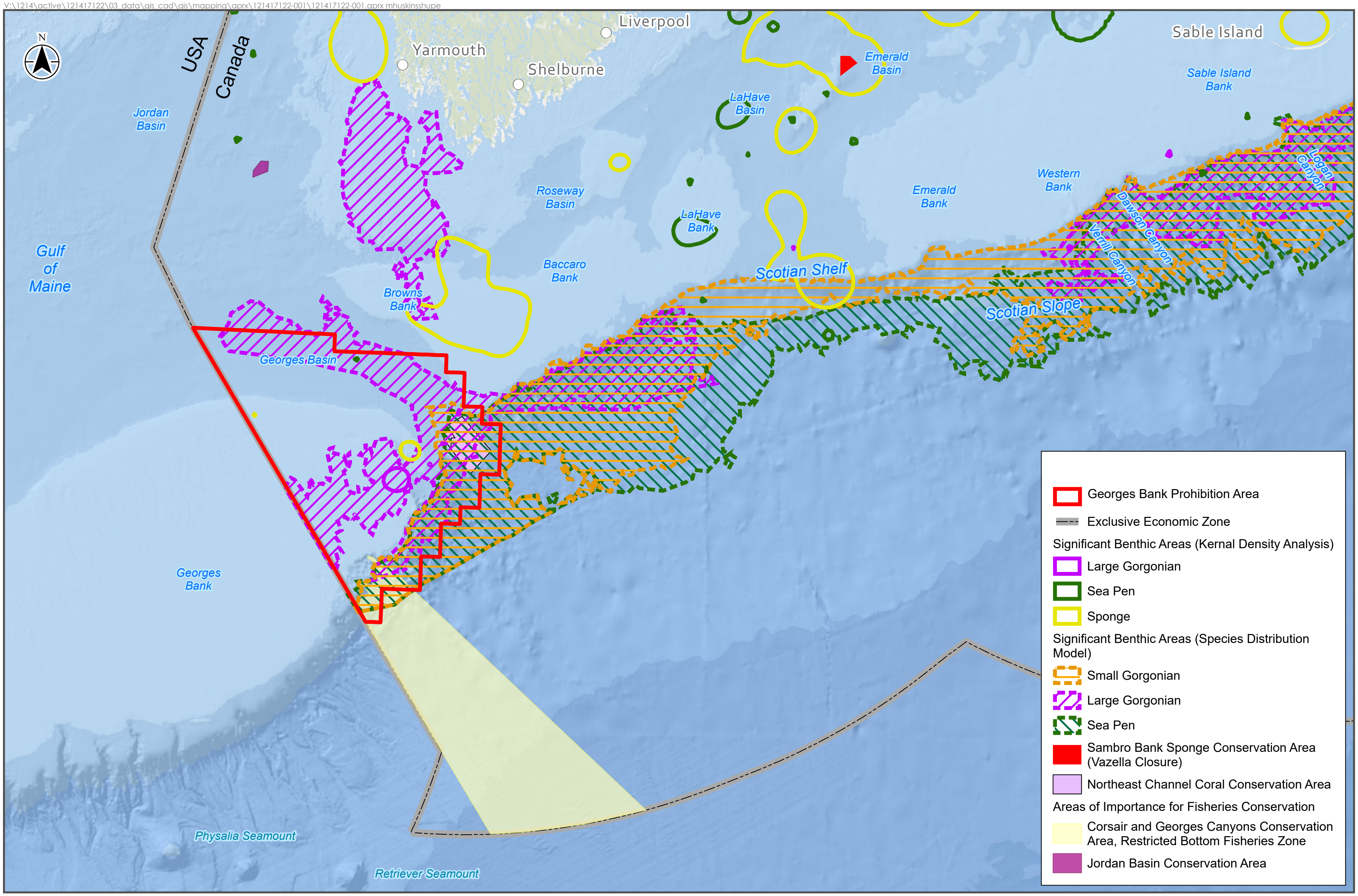
2.2.3 Corals and Sponges

The Northeast Channel Coral Conservation Area is located on the southeast corner of Georges Bank and was established in June 2002. The Northeast Channel area contains the highest density of large gorgonian corals in the Maritimes, specifically bubblegum coral (*Paragorgia arborea*) and seacorn coral (*Primnoa resedaeformis*) (CNSOPB 2021a).

Since the 2010 Review was published, the Corsair and Georges Canyon Conservation Area located to the south of Georges Bank was established in 2016 as these canyons also contain high densities of large gorgonians including bubblegum and seacorn corals (CNSOPB 2021a).

DFO has conducted species distribution modeling and kernel density analysis to delineate significant benthic areas for corals and sponges on the Scotian Shelf and Slope, including the Georges Bank area (CNSOPB 2021a). Figure 2.1 shows significant benthic areas for large gorgonians on and along the edges of Georges Bank, significant benthic areas for small gorgonians and sea pens along the southeast edge of Georges Bank, and significant benthic area for sponges on Georges Bank and nearby Browns Bank. Coral conservation areas are shown on Figures 2.1 and 2.2.

V:\1214\active\121417122\03_data\gis_cad\gis\mapping\aprx\121417122-001\121417122-001.aprx mhuskinsshupe



Sources: Base Data - Canada Nova Scotia Offshore Petroleum Board, Government of Canada, Fisheries and Oceans Canada.
Service Layer Credits: World Ocean Base: CHS, Esri, GEBCO, DeLorme, NaturalVue

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

0 50 100 150
Kilometres

NAD 1983 UTM Zone 20N

Coral and Sponge Significant Benthic Areas

Stantec

Figure 2.1

2.2.4 Finfish

The 2010 Review acknowledged the northeastern tip of Georges Bank, which falls within the Georges Bank Prohibition Area, as having the highest demersal fish richness in the Georges Bank biogeographic area (Stantec 2010a). Since the publication of the 2010 Review, DFO has released an overview of the marine environment and fisheries in Georges Bank (DFO 2011), which identified some additional marine fish species that may be present in the Georges Bank Prohibition Area. Table 2.2 lists fish species that either support or are considered important for commercial fisheries, have been identified as being important by Indigenous peoples, or are considered species at risk (SAR) or species of conservation concern (SOCC).

Table 2.2 Marine Fish with Potential to Occur in or near the Georges Bank Prohibition Area of Commercial, Indigenous or SAR/SOCC Importance

Common Name	Scientific Name	Presence on Georges Bank
Pelagic		
Albacore tuna	*Thunnus alalunga*	• Caught in Canadian fishery on and around the northern edge of Georges Bank
American eel[1,2]	*Anguilla rostrata*	• Rare or vagrant species on Georges Bank • Potential for adult American eels to pass through the Georges Bank Prohibition Area as they migrate from freshwater streams to the Sargasso Sea
American plaice[1] (Maritime population)	*Hippoglossus platessoides*	• Eggs and larvae have been observed on Georges Bank between April and June and major spawning area on Browns Bank, which is near Georges Bank • Closely associated with the seafloor and commonly found in water depths of 100 to 200 m, along banks, basins and the shelf edge
Atlantic bluefin tuna[1]	*Thunnus thynnus*	• Seasonal foraging area for bluefin tuna on Georges Bank • Bluefin tuna move onto Georges Bank in June-July and remain throughout October-November
Atlantic herring	*Clupea harengus*	• Migrate to feeding and spawning grounds on Georges Bank during the summer and fall • Large portion of herring larvae remain on Georges Bank throughout the larval stage • Juvenile herring can be found on Georges Bank throughout the year
Atlantic mackerel	*Scomber scombrus*	• Thought to pass through the Georges Bank area when migrating north in spring and south in fall • When caught in surveys tend to be found along the edges of Georges Bank

Table 2.2 Marine Fish with Potential to Occur in or near the Georges Bank Prohibition Area of Commercial, Indigenous or SAR/SOCC Importance

Common Name	Scientific Name	Presence on Georges Bank
Atlantic salmon (Inner Bay of Fundy population) [1,2] (Outer Bay of Fundy population)[1,2] (Nova Scotia Southern Upland population)[1,2]	*Salmo salar*	• Inner Bay of Fundy population extends from northeastern Nova Scotia (mainland) along the Atlantic and Fundy coasts up to Cape Split. Migration between freshwater rivers and the North Atlantic means the population may be transiently present in the Georges Bank area • Outer Bay of Fundy population of Atlantic salmon extends from the Saint John River westward to the United States border and individuals from this population may migrate through the Georges Bank Prohibition Area; however, their presence would be transient in nature • Nova Scotia Southern Upland populations occupy rivers in a region of Nova Scotia extending from the northeastern mainland near Canso, along the Atlantic coast of the province and into the Bay of Fundy as far as Cape Split; presence on Georges Bank would be transient in nature
Atlantic sturgeon (Maritimes population) [1]	*Ancipenser oxyrinchus*	• Typically found in rivers, estuaries and/or migrating along the coast; however, they have been captured as far out to sea as Georges and Browns Banks
Basking shark[1]	*Cetorhinus maximus*	• Feed in the waters around Georges Bank in summer • Form mating aggregations in summer that may occur in and around Georges Bank
Bigeye tuna	*Thunnus obesis*	• Caught on and around the northern edge of Georges Bank • Present in Canadian waters between July and November
Black dogfish	*Centroscyllium fabricii*	• May occur at the edges of Georges Bank
Blue shark	*Prionace glauca*	• Have been recorded on Georges Bank and Browns Bank • Common offshore from the outer edge of the continental shelf, Georges Bank, to the Grand Bank from May to October
Porbeagle shark[1]	*Lamna nasus*	• Migrate over Georges Bank during their annual migration north • Georges Bank may be an important mating ground for porbeagle sharks. In preparation for mating, mature females congregate on Georges Bank in June and disperse following mating
Shortfin mako shark[1]	*Isurus oxyrinchus*	• Occur on and around Georges Bank • Migrate to Atlantic Canada in the late summer and fall

Table 2.2 Marine Fish with Potential to Occur in or near the Georges Bank Prohibition Area of Commercial, Indigenous or SAR/SOCC Importance

Common Name	Scientific Name	Presence on Georges Bank
Striped bass (Bay of Fundy population) [1]	*Morone saxatilis*	• Rare or vagrant species on Georges Bank
Swordfish	*Xiphias gladius*	• Important seasonal feeding area on the Northeast Peak of Georges Bank
Thresher shark	*Alopias vulpinus*	• Occur regularly on and around Georges Bank
White shark[1]	*Carcharodon carcharias*	• Seasonal migrants belonging to northwest Atlantic population
Yellowfin tuna	*Thunnus albacares*	• Present in Canadian waters from July to November • Caught on and around the northern edge of Georges Bank
Groundfish		
Acadian redfish[1] (Atlantic population)/ Deepwater redfish[1] (Northern population)	*Sebastes fasciatus* *Sebastes mentella*	• Stocks in the Georges Bank area consist of a mixture of *S. fasciatus* and *S. mentella*
American plaice (Maritime population) [1]	*Hippoglossoides platessoides*	• Occur regularly on and around Georges Bank
Atlantic cod (Southern population)	*Gadus morhua*	• Resident spawning population mostly concentrate on the northeastern part of eastern Georges Bank
Atlantic halibut	*Hippoglossus hippoglossus*	• On the Scotian Shelf are most abundant from Browns Bank to Banquereau Bank • Browns Bank may be an important rearing area for juvenile halibut
Atlantic / striped wolffish[1]	*Anarhichas lupus*	• DFO Atlantic wolffish surveys on Georges Bank began in 1986 and have shown a steady decline • The population structure of Atlantic wolffish in the Georges Bank area is unknown. It is possible that there may be small sub-populations of Atlantic wolffish in the area • Species has a sedentary nature with small scale spring spawning migrations to shallower waters
Barndoor skate	*Raja laevis*	• Some seasonal movement on the Bank is evident, however no evidence of widescale migration between Georges Bank and adjacent areas • Fish on both sides of the Canadian – United States border are likely a single population
Cusk[1]	*Brosme brosme*	• Areas of highest catches around Georges Bank are in deeper waters of the Northeast Channel, off the Northeast Peak and in the Fundian Channel
Greenland halibut	*Reinhardtius hippoglossoides*	• Greenland halibut have been observed near Georges Bank • Found in water depths ranging from 90 to 1600 m from western Greenland to the southern edge of the Scotian Slope

Table 2.2 Marine Fish with Potential to Occur in or near the Georges Bank Prohibition Area of Commercial, Indigenous or SAR/SOCC Importance

Common Name	Scientific Name	Presence on Georges Bank
Haddock	*Melanogrammus aeglefinus*	• Major spawning concentration resides on eastern Georges Bank • Net southwest migration towards central eastern Georges Bank plateau during winter • Net northeast migration towards deeper slopes where they reside during summer and fall • In the fall, age 0 haddock are widely dispersed over eastern Georges Bank, and by spring age 1 haddock are more concentrated on the northeast peak and southern flank • Age 3 and older haddock are broadly distributed between central Georges Bank toward the Northeast Peak and northern edge of the Bank
Hagfish	*Myxine glutinosa*	• Hagfish landings recorded within Georges Bank, on the northern bank edge and Georges Basin • Can be found in depths up to 1200 m • Hagfish are a new fishery in the area and are becoming an important source of income within the groundfish fishery
Little skate	*Leucoraja erinacea*	• Widespread and abundant over the Georges Bank area throughout the year • Fish on both sides of the Canadian – United States border are likely a single population • Most common at depths less than 111 m but have been reported as deep as 384 m. It is therefore unlikely that there is wide scale movement between Georges Bank and Browns Bank, given the depth of the Fundian Channel
Monkfish / American angler	*Lophius americanus*	• United States surveys suggest northern and southern components of the stock within Georges Bank, with shallow waters representing a boundary zone, while Canadian surveys do not suggest discontinuity of the Georges Bank stock
Pollock	*Pollachius virens*	• Major concentrations on Georges Bank • Spawning area on northeastern Georges Bank
Red hake	*Urophycis chuss*	• Red hake can be found from the Gulf of St. Lawrence to North Carolina from depths of 10 to 500 m • Red hake migrate to shallower waters during the spring and summer to spawn, returning to the deeper waters of the shelf edge and slope during the winter months • Landings are recorded near (<50km) Georges Bank

Table 2.2 Marine Fish with Potential to Occur in or near the Georges Bank Prohibition Area of Commercial, Indigenous or SAR/SOCC Importance

Common Name	Scientific Name	Presence on Georges Bank
Sand lance	*Ammodytes americanus* *Ammodyte dubius*	• Two species occur regularly on Georges Bank • Stock structure in Georges Bank is unknown and compounded by the two species that are difficult to distinguish • Sand lance are considered a relatively non-migratory species
Silver hake	*Merluccius bilinearis*	• Landings have been recorded within the Georges Bank area • Most commonly found at depths from 150 to 200 m • Seasonal migrations occur between June and September • Spawning occurs from Browns Bank to Sable Island Bank and along the shelf edge
Smooth skate (Laurentian-Scotian population) [1]	*Malacoraja senta*	• Smooth skate population biomass and abundance of the Canadian portion of Georges Bank is very low and has varied without trend since 1987 • They are most abundant on the northeast peak, along the northern edge. Given they are primarily restricted to depths greater than 90 m, they are not common on the bank
Spiny dogfish[1]	*Squalus acanthias*	• Occurs on and around Georges Bank with highest abundance found on the edge of the bank (top of the bank consistently devoid of dogfish) • Dogfish abundance has had a rapid and continued decline between 1986 and 2006 in the Canadian portion of Georges Bank
Spotted wolffish[1]	*Anarchias minor*	• Less common on Georges Bank than the Atlantic wolffish but may be present in low numbers
Thorny skate[1]	*Amblyraja radiata*	• The southern limit of thorny skate range is on the Northeast Peak of Georges Bank and they are uncommon on the shallowest parts of the Bank (<60 m) • Their occupancy has been declining since the beginning of the survey (1987) • Thorny skates found in the adjacent waters of the Gulf and the Fundian Channel are assumed to be the same population as those on Georges Bank
White hake[1]	*Urophycis tenuis*	• Spawning occurs in the Georges Bank region from May to October • Larger fish generally occur in deeper waters whereas juveniles typically occupy shallow areas (e.g., offshore banks) • Landings have been recorded within the Georges Bank area
Winter flounder	*Pseudopleuronectes americanus*	• Species typically migrates to shallow inshore waters to spawn but Georges Bank stock spawns offshore

Table 2.2 Marine Fish with Potential to Occur in or near the Georges Bank Prohibition Area of Commercial, Indigenous or SAR/SOCC Importance

Common Name	Scientific Name	Presence on Georges Bank
Winter skate	*Leucoraja ocellata*	• High concentrations have been found on Georges Bank • Eggs and larvae have been observed on Browns Bank (near Georges Bank area) year-round
Witch flounder	*Glyptocephalus cynoglossus*	• Spawning occurs in the Georges Bank region from April to November with a peak from May to August • Witch flounder stocks on the Western Scotian Shelf are at a critical state
Yellowtail flounder	*Limanda ferruginea*	• Major concentration occurs on Georges Bank from the Northeast Peak to the Great South Channel • Spawning occurs on Georges Bank from late March until early August, with a peak in May • Dense egg concentrations occur on the northeast and southwest part of Georges Bank • Larvae are found on Georges Bank from April to August, with the highest concentrations occurring in June. Juveniles and adults are concentrated on the southern edge and Northeast Peak of Georges Bank in the spring but are more widely distributed on the bank for the rest of the year

Notes:
[1]Species at Risk (SAR) or Species of Conservation Concern (SOCC) -More details provided in Section 2.2.8.
[2]Species identified as being culturally significant by Indigenous peoples
Sources: COSEWIC 2010 COSEWIC 2011; DFO 2011; Kennedy et al. 2011; COSEWIC 2019; CNSOPB 2021a

2.2.5 Marine Mammals

There are multiple species of marine mammals that may occur in the Georges Bank Prohibition Area including baleen whales, toothed whales and pinnipeds (seals). The marine mammals that may occur in the Georges Bank Prohibition Area are provided in Table 2.3.

Table 2.3 Marine Mammals with Potential to Occur in or near the Georges Bank Prohibition Area

Common Name	Scientific Name	Presence on Georges Bank
Baleen whales		
Blue whale[1]	*Balaenoptera musculus*	• Sightings of blue whales on Georges Bank are not common • Important habitat for this species has been identified along the Scotian Shelf/Slope (Figure 2.2)
Fin whale	*Balaenoptera physalus*	• Present on Georges Bank throughout the year as this species undergoes migrations in the Northwest Atlantic

Table 2.3 Marine Mammals with Potential to Occur in or near the Georges Bank Prohibition Area

Common Name	Scientific Name	Presence on Georges Bank
Humpback whale	*Megaptera novaeangliae*	• Present on Georges Bank for most of the year, though for the most part is absent during the winter • Distinct feeding aggregation occurs in the Georges Bank and Gulf of Maine region
Minke whale	*Balaenoptera acutorostrata*	• Normally present on Georges Bank during the spring but have also been observed during the summer
North Atlantic right whale[1]	*Eubalaena glacialis*	• Transit from wintering areas further south to feeding areas in Canadian waters through Georges Bank • Critical habitat in the Great South Channel and the northern edge of Georges Bank are important feeding areas • Aggregations have been occasionally observed on the northern edge of Georges Bank into the summer months during recent years • Found along Georges Bank in the spring, summer and fall months during their seasonal migration with a peak during summer months • Observed feeding on and around the Bank, including along the northern edge of Georges Bank during summer
Sei whale[1]	*Balaenoptera borealis*	• Present on Georges Bank year-round and are concentrated in the area in spring and early summer • Sightings concentrated along the eastern margin and along the southwestern edge of Georges Bank
Toothed whales		
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	• Highly prevalent on and around Georges Bank • Occur in Georges Bank region for most of the year with a decline over the winter
Bottlenose dolphin	*Tursiops truncates*	• Present on Georges Bank year-round and have a higher prevalence in spring and summer
Common dolphin	*Delphinus delphis*	• Highly prevalent on Georges Bank in winter • Large aggregations of this species are found near Georges Bank from the summer through fall
Harbour porpoise[1]	*Phocoena phocoena*	• Migrates through the Georges Bank area in spring to reach coastal summer feeding grounds
Northern bottlenose whale[1]	*Hyperoodon ampullatus*	• Observed in low abundance on and around Georges Bank in spring, summer and fall
Pilot whale	*Globicephala melas* (long-finned) *Globicephala macrorhynchus* (short-finned)	• Present on Georges Bank year-round and are most prevalent during the spring and summer • Long-finned pilot whales are more common than short-finned pilot whales in Canadian waters
Sowerby's beaked whale[1]	*Mesoplodon bidens*	• The seasonal movements and migrations of this species are not known

Table 2.3 Marine Mammals with Potential to Occur in or near the Georges Bank Prohibition Area

Common Name	Scientific Name	Presence on Georges Bank
Sperm whale	*Physeter macrocephalus*	• Males of this species are found year-round on Georges Bank near the continental slope • The centre of distribution for this species shifts northward in spring and includes the southern portion of Georges Bank • In summer, the distribution also includes the areas east and north of Georges Bank and into the Northeast Channel region
Striped dolphin	*Stenella coeruleoalba*	• Present on the southern margin of Georges Bank • Mostly found on Georges Bank during the summer and fall
Pinnipeds		
Grey seal	*Halichoerus grypus*	• Adult grey seals from Sable Island forage throughout eastern Canadian waters including Georges Bank
Harbour seal	*Phoca vitulina*	• Harbour seals forage throughout eastern Canadian waters including Georges Bank
Note: [1]Species at Risk (SAR) or Species of Conservation Concern (SOCC) - Sources: DFO 2011, CNSOPB 2021a		

Between 2017 and 2021 there has been a North Atlantic right whale Unusual Mortality Event (UME) (i.e., significant die-off of a marine mammal population which demands immediate response) in Atlantic Canadian and northeast United States waters (NOAA 2021). The UME is not particularly linked to Georges Bank. However, North Atlantic right whales have been observed feeding in the northern part of the Bank, with critical habitat for the species protected in nearby Roseway Basin. Leading causes of death have been entanglements and vessel strikes (NOAA 2021). Fishing and vessel activities are common on Georges Bank; therefore, there is potential for similar interactions with North Atlantic right whales to occur on Georges Bank. The total number of right whale mortalities at the time this report was prepared was 34 dead stranded whales of which 21 were in Canadian waters and 13 in American waters (NOAA 2021). In addition to these 34 dead right whales, there have been 16 live free-swimming non-stranded whales documented with serious injuries resulting from entanglements and vessel strikes (NOAA 2021). These 50 dead and seriously injured right whales represent more than 10% of the global population of this critically endangered species (NOAA 2021).

2.2.6 Sea Turtles

There are four species of sea turtle that may occur in the Georges Bank Prohibition Area; however, only two of these, the leatherback sea turtle (*Dermochelys coriacea*) and loggerhead sea turtle (*Caretta caretta*), are known to regularly occur in Canadian waters (CNSOPB 2021a). The other two species of sea turtle that are rare visitors to the area are the green sea turtle (*Chelonia mydas*) and Kemp's ridley sea turtle (*Lepidochelys kempii*). A summary of the presence of leatherback and loggerhead sea turtles on Georges Bank is provided in Table 2.4.

Draft critical habitat for leatherback sea turtles has been defined on the Scotian Slope and includes the southwest edge of Georges Bank; this draft critical habitat is shown on Figure 2.2 and is discussed further in Section 2.2.9.

Table 2.4 Sea Turtles that Regularly Occur in or near the Georges Bank Prohibition Area

Common Name	Scientific Name	Presence on Georges Bank
Leatherback sea turtle	*Dermochelys coriacea*	• Occurs in Canadian water from May to December with most turtles present from in the summer and fall (July to mid-October) • From late spring through the fall, turtles use the slope waters adjacent to Georges Bank, and to a lesser extent, the waters within the 100 m isobath of Georges Bank • High use habitat is found in the slope waters to the east and southeast of the Northeast Channel throughout the summer and fall foraging periods, and some turtles may remain in this area until December • Fourteen years of leatherback monitoring off the coast of Nova Scotia has indicated that the population is likely stable
Loggerhead sea turtle	*Caretta caretta*	• Believed to be most abundance in Atlantic Canadian waters in the fall • Uses Georges Bank as foraging habitat from July to October • Juveniles occur in warm offshore waters in summer and fall, and often occur where water is influenced by the northern edge of the Gulf Stream • Loggerhead turtles occurring in Atlantic Canadian waters typically nest in the Southeast US, including Florida and the Carolinas
Sources: DFO 2011; Archibald and James 2016; James and Bond 2018		

2.2.7 Marine Birds

The productive waters of the Northeast Atlantic are important habitat for a variety of marine birds. In the spring and summer months, over 20 species of marine birds breed on the eastern Canadian coastlines (Wilhelm and Smith 2018). Nesting typically occurs on coastal islands. Millions of non-breeding seabirds also occur in the Northwest Atlantic. Over 60 species of migrants use this habitat seasonally, some of which migrate from the Arctic, Europe, or South America (Wilhelm and Smith 2018). Marine birds that commonly occur on Georges Bank are presented In Table 2.5.

Table 2.5 Seasonal Occurrence of Commonly Observed Seabird Species on Georges Bank

Common Name	Scientific Name	Seasonal Occurrence on Georges Bank
Black-legged kittiwake	*Rissa tridactyla*	October to April
Cory's shearwater	*Calonectris borealis*	July to October
Dovekie	*Alle alle*	October to March
Great black-backed gull	*Larus marinus*	Year-round
Greater shearwater	*Puffinus gravis*	May to December
Herring gull	*Larus argentatus*	Year-round
Leach's storm petrel	*Oceanodroma leucorhoa*	March to September
Northern fulmar	*Fulmarus glacialis*	January to July, September to December
Northern gannet	*Morus bassanus*	March to May, October to December
Red-necked phalarope	*Phalaropus lobatus*	May to June, October to November
Red phalarope	*Phalaropus fulicarius*	March, October
Sooty shearwater	*Ardenna grisea*	April to September
Common murre	*Uria aalge*	January to September, November to December
Thick-billed murre	*Uria lomvia*	December to April
Wilson's storm petrel	*Oceanites oceanicus*	March to September
Source: DFO 2011; Bolduc et al. 2018; CNSOPB 2021a		

Monitoring of marine bird populations in Atlantic Canada has been conducted since the 1970s. The 2019 State of Canada's Birds Report indicates that although some marine bird populations are increasing, particularly those nesting in Atlantic Canada, others are decreasing. Overall, the vast majority of seabirds that occur in Canada are considered to be of conservation concern worldwide (NABCI 2019). It is important to note however, that the population trends for the majority (62%) of seabird species are unknown. This is because many nest in remote Arctic locations or outside of Canada. Overall, shorebird populations are also decreasing, while waterfowl populations appear to be increasing (NABCI 2019).

Bird species-at-risk and of conservation concern with potential to occur in the Western Scotian Shelf (including Georges Bank) are presented in Section 2.2.8, Table 2.6. Six species either listed under the *Species at Risk Act* (SARA) or assessed as Endangered, Threatened or Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) have the potential to occur in this area (CNSOPB 2021a). Of these, five have low potential to occur, since they are typically more coastal species. These include roseate tern, Barrow's goldeneye, harlequin duck, piping plover and Savannah (Ipswich) sparrow. Only one species, the red-necked phalarope, has high potential to occur. The red-necked phalarope is listed as Special Concern under both SARA and COSEWIC and occurs on Georges Bank during spring and fall migration. Western Bay of Fundy was historically an important fall staging area for the red-necked phalarope, although numbers have been declining in recent years (COSEWIC 2014).

2.2.8 Species at Risk and Species of Concern

Table 2.6 lists species at risk and of conservation concern that may occur in or near the Georges Bank Prohibition Area.

Table 2.6 Species at Risk with Potential to Occur in or near the Georges Bank Prohibition Area

Common Name	Scientific Name	SARA (Schedule 1) Designation	COSEWIC Designation
Marine Fish			
Acadian redfish (Atlantic population)	*Sebastes fasciatus*	Not Listed	Threatened
Deepwater redfish (Northern population)	*Sebastes mentella*	Not Listed	Threatened
American eel	*Anguilla rostrata*	Not Listed Under consideration for addition[1]	Threatened
American plaice (Maritime population)	*Hippoglossus platessoides*	Not Listed Under consideration for addition[1]	Threatened
Atlantic bluefin tuna	*Thunnus thynnus*	Not Listed	Endangered
Atlantic cod (Southern population)	*Gadus morhua*	Not Listed Under consideration for addition[1]	Endangered
Atlantic salmon (Inner Bay of Fundy population)	*Salmo salar*	Endangered	Endangered
Atlantic salmon (Outer Bay of Fundy population)	*Salmo salar*	Not Listed Under consideration for addition[1]	Endangered
Atlantic salmon (Nova Scotia Southern Upland population)	*Salmo salar*	Not Listed Under consideration for addition[1]	Endangered
Atlantic sturgeon (Maritimes population)	*Ancipenser oxyrinchus*	Not Listed Under consideration for addition[1]	Threatened
Atlantic / striped wolffish*	*Anarhichas lupus*	Special Concern	Special Concern
Basking shark (Atlantic population)	*Cetorhinus maximus*	Not Listed Under consideration for addition[1]	Special Concern
Cusk	*Brosme brosme*	Not Listed Under consideration for addition[1]	Endangered
Roundnose grenadier	*Coryphaenoides rupestris*	Not Listed Under consideration for addition[1]	Endangered
White hake (Atlantic and Northern Gulf of St. Lawrence population)	*Urophycis tenuis*	Not Listed Under consideration for addition[1]	Threatened
Spotted wolffish	*Anarhichas minor*	Threatened	Threatened
Smooth skate (Laurentian – Scotian population)	*Malacoraja senta*	Not Listed	Special Concern

Table 2.6 Species at Risk with Potential to Occur in or near the Georges Bank Prohibition Area

Common Name	Scientific Name	SARA (Schedule 1) Designation	COSEWIC Designation
Spiny dogfish (Atlantic population)	*Squalus acanthias*	Not Listed	Special Concern
Striped bass (Bay of Fundy population)	*Morone saxatilis*	Not Listed	Endangered
Thorny skate	*Amblyraja radiata*	Not Listed Under consideration for addition[1]	Special Concern
Winter skate (Eastern Scotian Shelf – Newfoundland population)	*Leucoraja ocellata*	Not Listed	Endangered
Porbeagle shark	*Lamna nasus*	Not Listed Under consideration for addition[1]	Endangered
Shortfin mako shark	*Isurus oxyrinchus*	Not Listed Under consideration for addition[1]	Endangered
White hake	*Urophycis tenuis*	Not Listed Under consideration for addition[1]	Threatened
White shark	*Carcharodon carcharias*	Endangered[1]	Endangered
Marine Mammals			
Blue whale (Atlantic population)	*Balaenoptera musculus*	Endangered	Endangered
Fin whale (Atlantic population)	*Balaenoptera physalus*	Special Concern	Special Concern
Harbour porpoise	*Phocoena phocoena*	Not Listed	Special Concern
Killer whale	*Orcinus orca*	Not Listed Under consideration for addition[1]	Special Concern
North Atlantic right whale	*Eubalaena glacialis*	Endangered	Endangered
Northern bottlenose whale (Scotian Shelf population)	*Hyperoodon ampullatus*	Endangered	Endangered
Sei whale	*Balaenoptera borealis*	Not Listed Under consideration for addition[1]	Endangered
Sowerby's beaked whale	*Mesoplodon bidens*	Special Concern[1]	Special Concern
Sea Turtles			
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	Endangered
Loggerhead sea turtle	*Caretta caretta*	Endangered[1]	Endangered
Marine and Migratory Birds			
Barrow's goldeneye	*Bucephala islandica*	Special Concern	Special Concern
Harlequin duck	*Histrionicus histrionicus*	Special Concern	Special Concern

Table 2.6 Species at Risk with Potential to Occur in or near the Georges Bank Prohibition Area

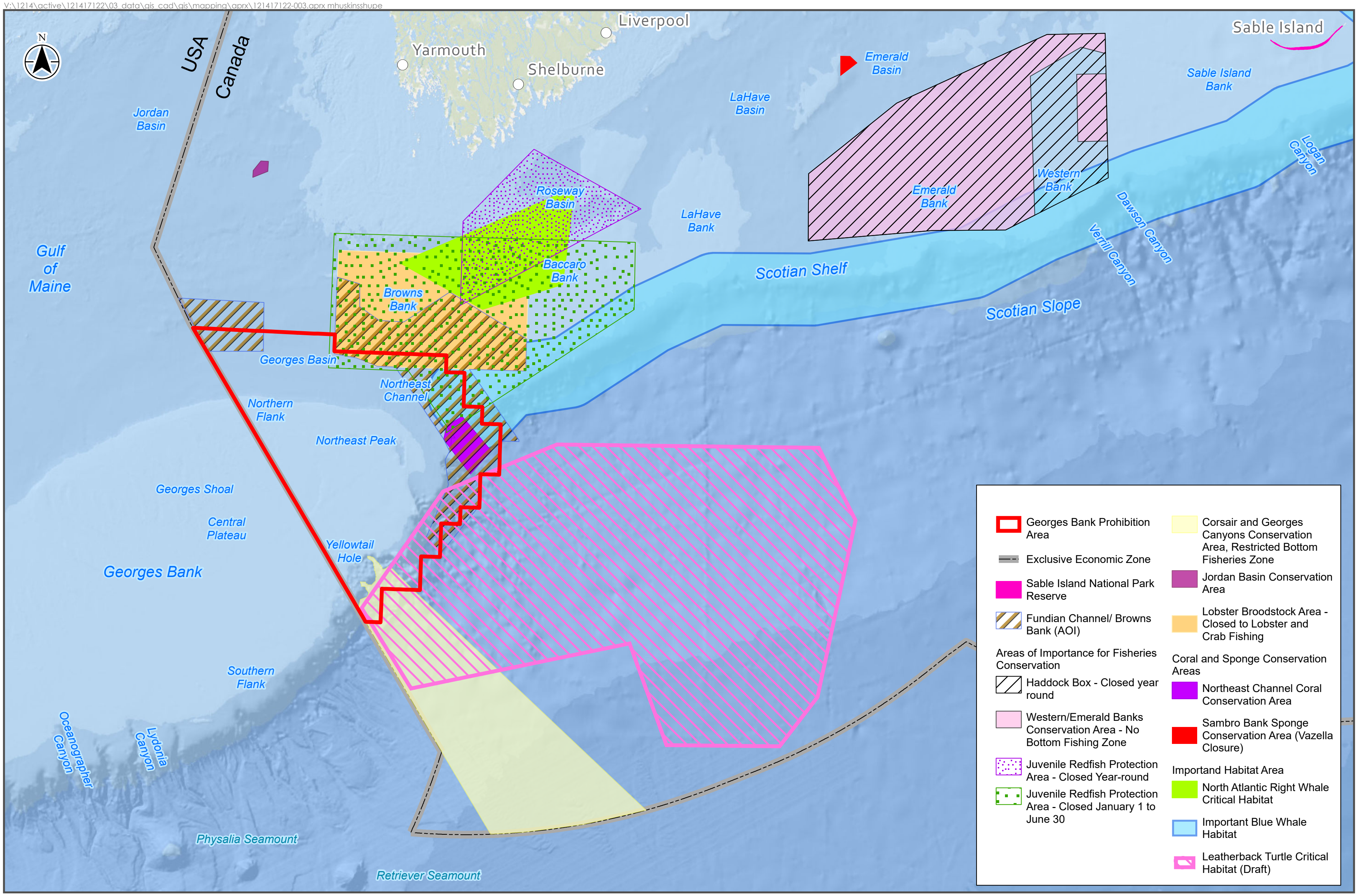
Common Name	Scientific Name	SARA (Schedule 1) Designation	COSEWIC Designation
Piping plover (*melodus* subspecies)	*Charadrius melodus melodus*	Endangered	Endangered
Red-necked phalarope	*Phalaropus lobatus*	Special Concern[1]	Special Concern
Roseate tern	*Sterna dougallii*	Endangered	Endangered
Savannah sparrow	*Passerculus sandwichensis princeps*	Special Concern	Special Concern

Note:
[1]Denotes a change in SARA designation since 2010.

2.2.9 Special Areas

For the purpose of this report, Special Areas are defined as government-designated areas of special interest due to ecological/conservation sensitivities. Several types of Special Areas occur in or near the Georges Bank Prohibition Area, including designated critical/important habitat, conservation areas, areas of interest (AOIs) (under consideration to become a marine protected area [MPA] under the *Oceans Act)*, and Ecologically and Biologically Significant Areas (EBSAs). In April 2019, the Government of Canada adopted a new approach to marine conservation, through which Canada is continuing to develop its marine conservation networks. These networks include two different forms of protection: MPAs and other effective area-based conservation measures, including marine refuges. There are currently no designated MPAs in or near the Georges Bank Prohibition Area; however, the Fundian Channel-Browns Bank AOI, which overlaps the northeast corner of the Prohibition Area (Figure 2.2), may become an MPA under the *Oceans Act*.

Figure 2.2 shows the location of Special Areas in and near the Georges Bank Prohibition Area, many of which have been designated since the 2010 Review as described below.



Sources: Base Data - Canada Nova Scotia Offshore Petroleum Board, Government of Canada, Fisheries and Oceans Canada.
Service Layer Credits: World Ocean Base: Esri, GEBCO, DeLorme, NaturalVue

NAD 1983 UTM Zone 20N

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Special Areas

Stantec

SCIENCE AND SOCIO-ECONOMIC REVIEW OF THE GEORGES BANK PROHIBITION AREA 2010-2021

121417122-003

Figure 2.2

Roseway Basin North Atlantic Right Whale Critical Habitat and Area to be Avoided

Roseway Basin is an important area of North Atlantic right whale aggregations where they feed and socialize in the summer and fall months, as both right whale abundance and concentrations of a preferred food source, *Calanus finmarchicus,* peak during this period (CNSOPB 2021a). Roseway Basin was first designated as a conservation area for North Atlantic right whales in 1993 (CNSOPB 2021a). Since then, the Recovery Strategy for the North Atlantic right whale in Atlantic Canadian waters (CNSOPB 2021a) has identified Roseway Basin as Critical Habitat for this species. Right whale critical habitat is protected by a Critical Habitat Order made under subsections 58(4) and (5) of SARA which came into effect in December 2017. The Order invokes the prohibition in subsection 58(1) against the destruction of the identified critical habitat by activities such as acoustic disturbance. The right whale critical habitat is approximately 3,318 km^2 and is located in Roseway Basin between Baccaro and Browns Banks. To reduce the risk of ship strikes to endangered right whales, the International Maritime Organization (IMO) has also designated the Roseway Basin area to be a seasonal Area to be Avoided (ATBA) by ships 300 gross tonnage and upwards in transit from June 1 through December 31.

Blue Whale Important Habitat

The western Scotian Shelf is an important area of concentration for blue whales where they feed during the summer months. There currently is no legislation associated with the areas that DFO Science has advised are important habitat for the blue whale (CNSOPB 2021a). However, these areas may be identified as critical habitat in an amendment to the blue whale recovery strategy in the future. If this happens, they would be protected by a Critical Habitat Order made under subsections 58(4) and (5) of SARA, which would invoke the prohibition in subsection 58(1) against the destruction of the identified critical habitat.

Leatherback Turtle Draft Critical Habitat

This area has been identified as an important area for leatherback sea turtle and is used for foraging and migration during the summer and fall months. The Draft Critical Habitat for this species shown on Figure 2.2 was identified in the draft version of an amended Leatherback Turtle Recovery Strategy (DFO 2012c). There are currently no legal protections of this habitat area under SARA where it is currently at the draft stage; however, if this area proceeds to be identified as critical habitat in a final version of the amended Recovery Strategy, it is anticipated that the identified critical habitat would be protected under a SARA Critical Habitat Order.

Northeast Channel Coral Conservation Area

The Northeast Channel Coral Conservation Area was established in June 2002 in accordance with the *Fisheries Act* and *Oceans Act* to protect high densities of bubblegum coral (*Paragorgia arborea*) and seacorn coral (*Primnoa resedaeformis*). The highest density of corals is found in the restricted bottom fisheries zone which represents 90% of the area with the remaining 10% being open to authorized fishing activities and is open only to longline gear for groundfish at the time this report was prepared. The Northeast Channel Coral Conservation Area is recognized by DFO as a marine refuge that contributes <0.01% towards Canada's marine conservation objectives (DFO 2019a).

Fundian Channel / Browns Bank Area of Interest

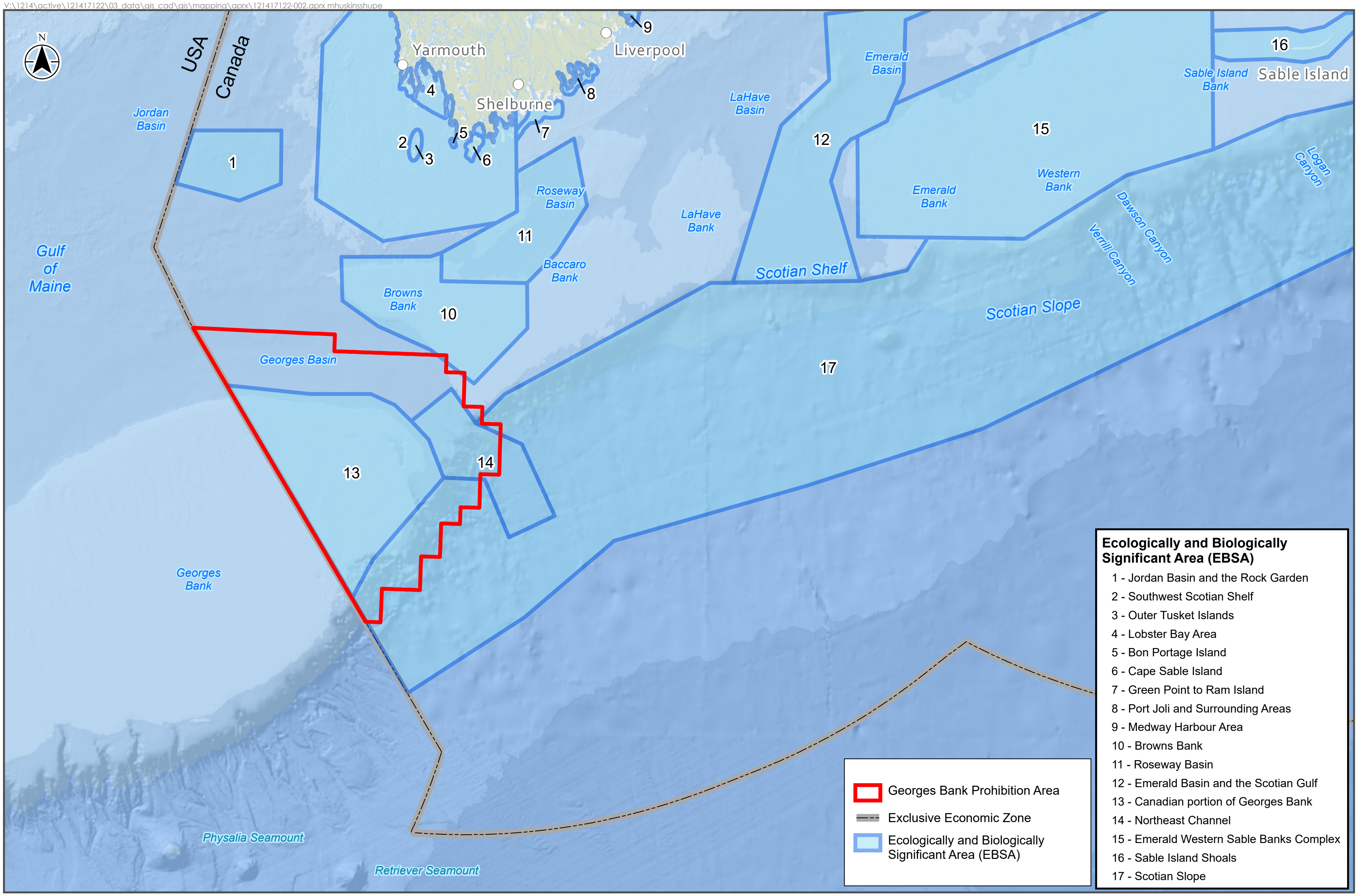
This *Oceans Act* AOI is comprised of two geographically separate areas. The component to the west is centered on Georges Basin, while the more eastern component is located in the Fundian Channel and includes a portion of Brown's Bank. The eastern portion is much larger than the western component. This area was identified in 2018 because of its diverse and sensitive benthic habitat. This is an important area for corals and sponges, which provide habitat for depleted groundfish species, including Atlantic cod, Atlantic wolffish, winter skate, thorny skate, and white hake (DFO 2021b). The Fundian Channel/Browns Bank AOI is also used by blue whales as for foraging. The Fundian Channel acts as a migratory corridor for many marine species, as it is the largest entrance into the Gulf of Maine (DFO 2021b).

Corsair and Georges Canyons Conservation Area

This conservation area was established by DFO in 2016 to protect the sensitive corals and sponges that occur in this area. Corsair and Georges Canyons are deep, steep-sided submarine canyons located south of Georges Bank. These canyons contain high densities of gorgonian corals, including *Paragoria arborea* (DFO 2017). Bottom fisheries are closed in this conservation area, except for two small, limited fishing zones where red crab fishing is permitted (DFO 2017).

Ecologically and Biologically Significant Areas

EBSAs are areas of particularly high ecological or biological importance relative to other areas in a region (DFO 2004; King et al. 2016). Although EBSAs don't have legal status, they are identified by DFO to help support integrated, ecosystem-based management (Doherty and Horsman 2007). Considerable work has been done over the past decade to identify EBSAs in the Scotian Shelf Bioregion which includes the Scotian Shelf, the offshore Canadian portions of the Gulf of Maine and Georges Bank, the Scotian Slope, and the deep waters beyond the slope (King et al. 2016). Additional EBSAs have been identified in the Atlantic coastal region of Nova Scotia (Hastings et al. 2014). Several EBSAs occur in or near the Georges Bank Prohibition Area; these are listed in Table 2.7, and shown in Figure 2.3.



Basemap Sources: Canada Nova Scotia Offshore Petroleum Board, Government of Canada, Fisheries and Oceans Canada.
EBSA Data Sources: Fisheries and Oceans Canada Open Government Portal
(https://open.canada.ca/data/en/dataset/d2d6057f-d7c4-45d9-9fd9-0a58370577e0)
Service Layer Credits: World Ocean Base: CHS, Esri, GEBCO, DeLorme, NaturalVue

NAD 1983 UTM Zone 20N

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Ecologically and Biologically Significant Areas (EBSA)

Stantec

Figure 2.3

Table 2.7 Ecologically and Biologically Significant Areas

EBSA	Description / Features[1]
Jordan Basin and the Rock Garden	• Contains a complex bedrock outcrop referred to as the 'Rock Garden', which supports a diverse benthic community • Contains a high species richness of fish and invertebrates • Provides important habitat for white hake, spiny dogfish, redfish and cusk • Contains important seabird habitat
Southwest Scotian Shelf	• Inshore EBSA, more productive than most of coastal Nova Scotia • High lobster productivity and density • Supports a haddock nursery and a herring spawning ground • Abundant whales
Outer Tusket Islands	• Contains a complex shoreline and many islands • Hosts colonies of Common Eider, Great Black-backed Gull and Herring Gull • This is one of the few areas in Nova Scotia with Atlantic Puffins nest • Supports significant aggregations of several seabird function guilds • Contains two inshore Grey Seal breeding colonies
Lobster Bay Area	• Inshore EBSA with high kelp productivity • Unique topography and upwelling area • High diversity of birds and fish • Abundant lobster, wolffish population, groundfish and lobster
Bon Portage Island	• Contains globally significant numbers of Leach's Storm-petrel • Supports colonies of Great Black-backed Gull, Herring Gull and Great Blue Heron • Migratory stopover site for waterfowl, shorebirds, songbirds and raptors • Surrounded by rich marine algae beds
Cape Sable Island	• Highly productive inshore area • Cape Sable Island and Outer Bird Island are Important Bird Areas • A variety of rare birds occur here • Winter/spring area for many species of migrating waterfowl • South Cape Island has productive eel grass beds
Green Port to Ram Island	• Common eider molting area from July to late August/early September • Supports a mixed colony of double-crested and great cormorants
Port Joli and Surrounding Areas	• Intertidal areas, subtidal areas, and undeveloped shoreline on southwestern Nova Scotia • Contains salt marshes, eelgrass areas and important bird habitat • Piping plover and Harlequin duck (both endangered species) occur in this area
Roseway Basin	• Relatively shallow basin that represents an important habitat component for the endangered North Atlantic right whale • North Atlantic Right Whales feed, socialize, and may mate in this EBSA • Other at-risk whale species, including blue whales and fin whales, also occur in this area • High biologically productivity, and high levels of surface chlorophyll, krill and Calanus • Important habitat for redfish, smooth skate, American plaice, Atlantic cod, Atlantic wolfish and cusk • Important seabird habitat

Table 2.7 Ecologically and Biologically Significant Areas

EBSA	Description / Features[1]
Canadian Portion of Georges Bank	• Strong current and steep topography result in an upwelling of nutrients in this area • Primary production in this area is estimated to be approximately 40% higher than surrounding shelf regions • Provides spawning and nursery grounds for cod and haddock • Provides spawning and settling area for scallops • Provides summer residence for deep water lobster
Northeast Channel	• Contains the densest known aggregations of large gorgonians gorgonian corals (*Paragorgia arborea* and *Primnoa resedaeformis*) in Atlantic Canada and also contains *Acanthogorgia armata* corals • Includes the “Hell Hole” where there are aggregations of pelagic species • High diversity of whales and dolphins • Swordfish aggregation area
Scotian Slope	• Unique geography • High finfish diversity, including demersal, mesopelagic and large pelagic fishes • Migratory route for endangered leatherback turtles • Migratory route for whales and large pelagic fish • Seabird feeding and overwintering area
Browns Bank	• Highly productive area with a known concentration of large lobsters including brood stock and adult lobsters • Important spawning and nursery area for Atlantic cod and haddock • Important habitat for herring, Atlantic wolffish and winter skate • Important seabird habitat • Includes the Fundy Moraine that may serve as a natural refuge
Sources: Doherty and Horsman 2007; Hastings et al. 2014; King et al. 2016	

2.3 SOCIO-ECONOMIC SETTING

Socio-economic analyses contained in this report have been conducted by Gardner Pinfold Consulting Limited. The approach to reviewing the socio-economic issues related to Georges Bank has been multifaceted with a focus on changes in the Georges Bank fisheries and general economy of the Southwest Nova Scotia region since the 2010 Review.

The analysis of fisheries updates includes an assessment of commercial fish stocks, landings data, and harvesting practices. Key data sources for the socio-economic review include the following:

- DFO stock status reports and management plans
- DFO landings data
- Anecdotal information from fishery industry participants
- Census/Statistics Canada data
- Professional knowledge related to industry economic research and the regional fisheries

2.3.1 Economic Profile of Southwest Nova Scotia

The colonial history of southwest Nova Scotia is one of over 300 years of close association with the sea. The French (Acadian) established settlements in the area early in the 17th century. For many years, the principal economic activities - fishing, trapping, logging and farming - were carried out largely on a subsistence basis. Consequently, the number of settlements remained small and the area sparsely populated.

Nova Scotia entered a period of sustained prosperity late in the 18th century. The main economic activities were fishing, shipbuilding, and trade. The ports of Halifax and Yarmouth became important commercial centres. Numerous manufacturing and service operations evolved to supply and support the expanding fishing and shipbuilding industries. The region's main exports were fish, fish oil, lumber and ships.

In more recent economic history, many areas in the province have moved out of the mainstream of industrial development and the service economy has gained importance. Southwest Nova Scotia is one region that has become increasingly dependent on the fishery, although the service economy has also gained importance. This dependence on the fishery for employment and income continues to this day with modernized facilities and vessels to add value to products and to enhance prices received. This is taking place across all fisheries.

Statistics Canada's 2016 Census data (most recent available) has been used to prepare the economic profile of the Southwest Nova Scotia region, supported by Gardner Pinfold's knowledge of industry trends based on a range of consulting assignments in the fishery, forest sector and tourism industry.

The five counties in Southwest Nova Scotia (Lunenburg, Queens, Shelburne, Yarmouth, and Digby) share several common features, and many of the key economic statistics are very similar now to what was reported in the 2010 Review.

The region has felt the impact of several economic events that have hurt the economy, not all of which have had an observable impact in the economic statistics taken from the 2016 Census. The Bowater Pulp Mill located in Queens County closed in 2012 leading to job losses and impacts on the demand for primary forest harvesting operations. Sawmills were also impacted and a large mill at Oakland Lunenburg County owned by Bowater closed permanently. Mink farm production, a major contributor to the agricultural sector and largely based in Digby County, has virtually shut down. COVID-19 has also impacted the economy at large due to the various lockdowns. COVID-19 has particularly impacted the tourism sector virtually eliminating visitation from the United States and other important foreign markets. Bay Ferries "The Cat" has not sailed between Yarmouth and Bar Harbour since 2018. Labour force recruitment challenges are being reported in the fishery and in the hospitality/tourism sectors. Some fish processing plants are accessing foreign workers to help meet their requirements. Key observations based on the 2016 Census are presented below:

- The fishing industry continues to be the largest source of industrial employment and income, both the harvesting and processing sector contribute to this.

- Labour force participation rates continue to drop; they were 4.8% lower than the provincial average in 2016.
- Official unemployment rates are 0.7 percentage points higher than the provincial average; this is slightly less than in the late 1990s, but remains among the lowest in the province.
- Average incomes for Southwest Nova Scotia ($37,064) are over 11% lower than the provincial average ($41,479); this difference is larger today than in the late 1990s to late 2000s, where average incomes were 5-10% lower.
- Population is concentrated in coastal communities, a legacy of the close association with the fishery.
- Population decline continues to be a factor due mainly to high rates of out-migration of persons at the prime age for household formation. This, in turn, leads to the elderly forming a higher proportion of the total population than is the case in Nova Scotia generally.

Though the region today is characterized by a more diversified economy than 50 years ago, there continues to be a greater dependence on the primary industries – principally fishing and forestry – than in the economy of Nova Scotia generally. The region is facing many economic challenges.

2.3.1.1 Employment by Industry

The Southwest Nova Scotia region's relative dependence on the fishery is best illustrated by the proportion of those employed in the "agriculture, forestry, primary fishing and hunting" industry classification – about 11.3% of total employment. This compares with just under 4.0% for the province (Table 2.8). A further indication of the importance of the fishing industry may be found in employment in manufacturing (where fish processing is included): proportionately roughly twice as many are employed in this sector in the region than in the province (14% compared to 7%). In the past 10 to 20 years, the number employed in fish processing has declined, overall. Some caution should also be used in comparing these data since they include all manufacturers. In the Southwest Nova Scotia region, this includes Michelin and remaining sawmills.

A summary of labour force by industry within the Southwest Nova Scotia region and Nova Scotia as a whole are presented for 2008 and 2016 in Table 2.8 and Table 2.9, respectively.

Table 2.8 2008 Labour Force by Industry, Southwest Nova Scotia Region Compared to Nova Scotia

	Nova Scotia (000s)	%	Southwest Nova Scotia (000s)	%
Total employed, all industries	453.2	100	56.8	100
Goods-producing sector	92.6	20	19	33
Agriculture	6.4	1	1.7	3
Forestry, fishing, mining, oil and gas	12.7	3%	5.2	9%
Utilities	3.1	1	X	X
Construction	31.3	7	4.2	7
Manufacturing	39.1	9	7.6	13

Table 2.8 2008 Labour Force by Industry, Southwest Nova Scotia Region Compared to Nova Scotia

	Nova Scotia (000s)	%	Southwest Nova Scotia (000s)	%
Services-producing sector	360.6	80	37.8	67
Trade	79.2	17	9.2	16
Transportation and warehousing	18.6	4	1.4	2
Finance, insurance, real estate and leasing	22.3	5	1.8	3
Professional, scientific and technical services	21.3	5	1.6	3
Business, building and other support services	25.9	6	2.4	4
Educational services	33.9	7	3.3	6
Health care and social assistance	60.5	13	8	14
Information, culture and recreation	19.8	4	2.4	4
Accommodation and food services	29.4	6	3.3	6
Other services	19.4	4	2.1	4
Public administration	30.3	7	2.4	4

Note:
Data presented for the forestry, fishing, mining and oil/gas industries are combined due to confidentiality.
Source: Statistics Canada, Table 282-0061.

Table 2.9 2016 Labour Force by Industry, Southwest Nova Scotia Region Compared to Nova Scotia

	Nova Scotia 000s	%	Southwest Nova Scotia 000s	%
Total employed, all industries	465.3	100	53.8	100
Goods-producing sector	4.0	0.9	0.2	0.5
Agriculture, forestry, fishing, and hunting	17.8	3.8	6.1	11.3
Utilities	2.9	0.6	0.2	0.4
Construction	33.6	7.2	3.7	6.8
Manufacturing	32.4	7.0	7.4	13.8
Services-producing sector	9.3	2.0	0.7	1.3
Trade	72.9	15.7	8.3	15.5
Transportation and warehousing	19.7	4.2	1.6	2.9
Finance, insurance, real estate and leasing	22.1	4.8	1.6	3.0
Professional, scientific and technical services	26.1	5.6	2.0	3.6
Business, building and other support services	22.9	4.9	2.1	3.9
Educational services	35.5	7.6	3.3	6.2

Table 2.9 2016 Labour Force by Industry, Southwest Nova Scotia Region Compared to Nova Scotia

	Nova Scotia 000s	%	Southwest Nova Scotia 000s	%
Health care and social assistance	64.4	13.8	7.4	13.7
Information, culture and recreation	9.4	2.0	0.9	1.7
Accommodation and food services	33.1	7.1	3.6	6.6
Other services	19.2	4.1	2.3	4.3
Public administration	40.2	8.6	2.5	4.7

Note:
Data presented for the agriculture, forestry, fishing, and hunting industries are combined due to confidentiality.
Source: Statistics Canada.

2.3.1.2 Average Income

Average income in Nova Scotia was $41,479 in 2016, while in Southwest Nova Scotia it was $37,064, or 11.2% is lower than the provincial average; all counties in the region showed lower income levels. However, as shown in Table 2.10, average income for all counties increased in comparison to the provincial average from 2006 to 2016, except for Queens County.

Table 2.10 Southern Region, Average Income ($), 2006 and 2016

	Average Income 2006 ($)	% of Provincial Average	Average Income 2016 ($)	% of Provincial Average
Digby	25,549	80.3	34,000	82.0
Lunenburg	28,998	91.2	38,336	92.4
Queens	27,159	85.4	34,728	83.7
Shelburne	26,770	84.2	39,323	94.8
Yarmouth	27,740	87.2	36,481	88.0
Nova Scotia	31,795	100	41,479	100

Note:
* of population 15 years and over.
Source: Statistics Canada.

2.3.1.3 Labour Force Characteristics

The participation rate (the percentage of working age people in the labour force), taken in conjunction with employment growth, are important indicators of economic activity. Both indicators show significant decreases in Southwest Nova Scotia from 2008 to 2016, with the participation rate decreasing from 60.5% to 56.5%, and total employment decreasing by 13.8%. While the unemployment rate in Southwest Nova Scotia remains higher than the provincial average, the unemployment rate in Southwest Nova Scotia increased by 15.1% (up to 10.7% from 9.3%), which was a less significant increase than the provincial average, where the rate increased by 29.9%, up to 10% from 7.7% (see Table 2.11). Nova Scotia's unemployment rate has since decreased to 8.4% by July 2021, while Western Nova Scotia experienced an unemployment rate of 13.1% during that month. Western Nova Scotia is a regional geographic unit used by Statistics Canada. Southwest Nova Scotia has been defined in this report as the counties of Lunenburg, Queens, Shelburne, Yarmouth and Digby. The Statistics Canada region of Western Nova Scotia is larger than the unit of Southwest Nova Scotia used in this report.).

In 2016, the Nova Scotia labour participation rate was 4.81 percentages points higher than the average for Southwest Nova Scotia, while the unemployment rate was 0.7 percentage points lower. These differences reflect stronger employment creation in the province as a whole. The number employed in Nova Scotia increased by 5.7% between 2008 and 2016, while the decrease in Southwest Nova Scotia was 13.8%.

Table 2.11 Labour Force Activity for Southwest Nova Scotia Region Compared to Nova Scotia (2008 and 2016)

	2008		2016	
	Southwest NS	Nova Scotia	Southwest NS	Nova Scotia
Population (000)	103.5	768.6	113.2	923.6
Total labour force (000)	62.6	491	54.8	474.6
Total employment (000)	56.8	453.2	49.0	427.3
Full-time employment (000)	45.8	370.3	25.9	252.8
Part-time employment (000)	11	82.9	33.1	247.6
Unemployment (000)	5.8	37.8	5.8	47.3
Not in labour force (000)	40.9	277.6	42.3	300.2
Unemployment rate (%)	9.3	7.7	10.7	10.0
Participation rate (%)	60.5	63.9	56.5	61.3
Employment rate (%)	54.9	59	50.5	55.2
Source: Statistics Canada.				

2.2.1.5 Population

The overall population of Southwest Nova Scotia has been decreasing each decade from 1986 to 2016. By contrast, the overall population of the province increased steadily every decade over that same period (Table 2.12). Only Lunenburg County experienced some positive growth relative to 1986 levels, while all other counties in the region have registered steady population decreases. Each county experienced a population decline over the 2006-2016 period.

Table 2.12 Southwest Nova Scotia Region Population, 1986-2016

	1986	1996	2006	2016
Digby County	21,852	20,500	18,995	17,323
Lunenburg County	46,483	47,561	47,150	47,126
Queens County	13,125	12,417	11,215	10,351
Shelburne County	17,516	17,002	15,540	13,966
Yarmouth County	27,073	27,310	26,275	24,419
Southern Region	126,049	124,790	119,175	113,185
Nova Scotia	873,199	909,282	913,465	923,598
Source: Statistics Canada.				

2.3.2 Economics of the Georges Bank Fisheries

This section examines the socio-economic significance of the Georges Bank fisheries to communities in southwest Nova Scotia in consideration of quantity and value of landings, number of vessels, employment and income at sea and on shore. This review focuses on the period 1999-2020.

This section covers the major commercial fisheries that occur on Georges Bank (Northwest Atlantic Fisheries Organization [NAFO] zone 5ZE). Changes in landings, landed value, stock health, and management of specific commercial species are provided in Appendix A.

2.3.2.1 Overview of Recent Changes in the Georges Bank Fishing Industry

By generating employment and income on vessels, in plants and in support services, the Georges Bank fisheries have helped to sustain the economies of fishing communities in Southwest Nova Scotia and southern New Brunswick for over 150 years. The scale of the contribution has fluctuated over the years, responding to the frequent shifts in resource conditions, technology, and markets. The mix of communities supported by the fisheries has also changed with time, responding to the rise and fall of certain fish stocks, fleet rationalizations and consolidation and investment by the fishing industry.

In trying to assess the economic significance of Georges Bank, or any fishing area for that matter, it is important to maintain an historical perspective. Relying on a single year's data, or data covering only a brief period, could produce misleading conclusions.

In 1998, the Georges Bank Review Panel noted that Georges Bank was widely regarded as one of the world's most productive fishing grounds (NRCan and NSPD 1999). The significant role played by Georges Bank in Canadian fisheries history can be traced at least as far back as the mid-1800s, and it continues to support a very diversified and valuable fishery to this day. The Canadian Georges Bank fishery in 1997 provided employment for approximately 1,000 people at sea harvesting, generating direct income of $32 million, and 650 people in processing ashore, with direct income of $6 million. Support services were also provided for the 180 active vessels and the processing sector. The value to the regional economy, the product value, has ranged from $57 million to $148 million annually in the period

1990 – 97 (Gardner Pinfold 1998). Overall, the Panel concluded that, “Georges Bank has a significant and fully-exploited fishery and is heavily used”.

This current review of the socio-economic circumstance associated with the fishery in Georges Bank leads to the same conclusions the Panel made in 1999.

The fishing industry has evolved in terms of fishing technology and a modern management approach leading to improved enterprise economics. Although fewer fishers and vessels are active on Georges Bank now than was the case in 1998, the overall importance of the Georges Bank fishery is as important to the economy of Southwest Nova Scotia today as it was in 1999 and 2010 as documented in the 2010 Review.

The 2010 Review documented the fishing industry as the single largest source of industrial employment and income in Southwest Nova Scotia. This remains the case today. Fish products have consistently been the single largest source of private sector export earnings for Nova Scotia. Fish harvesting and processing sectors in Nova Scotia lead all other private sector industries in employment and economic contribution and the sector continues to invest in new facilities, vessels, and fish handling equipment. To assess changes related to the importance of Georges Bank, it is important to provide an accurate profile of the fishing industry that relies on various Georges Bank resources. The Georges Bank fishery for purposes of this report includes landings from the Canadian portion (5ZE).

Presently, there are several Integrated Fisheries Management Plans (IFMPs) and Rebuilding Plans that include commercial fisheries within or along Georges Bank. Groundfish are managed by the 5VWX5 groundfish – Maritimes Region IFMP (DFO 2018a), which has been in effect since 2018. Two other groundfish species are managed by Rebuilding Plans: the Rebuilding Plan for Atlantic cod – NAFO Division 5Z (DFO 2018b), and the Rebuilding Plan for yellowtail flounder – NAFO Division 5Z (DFO 2018c). Additional IFMPs exist for herring (DFO 2020b), Atlantic swordfish and other tunas (DFO 2016), lobster and Jonah crab (DFO 2019c), and scallop (DFO 2018d).

Table 2.13 highlights changes in the Georges Bank fishery from 2008 to 2020 as described in greater detail below.

Table 2.13 Summary of Changes in the Georges Bank Fishery from 2008 to 2020

Fishery	Highlights
Shellfish (mainly scallop)	• Most important fishery in 2020 at 85% of landed value of all fisheries. This is up from 76% of total value in 2008. • Fleet configuration has been changing with introduction of freezer scallop vessels. These vessels are state-of-the-art and now account for a high percentage of landings. The introduction of these vessels has resulted in lower employment. • Variation in total allowable catch (TAC) for scallops do occur depending on year class recruitment to the fishery. • Offshore lobster fishery has very steady in terms of landings from year to year. Partial ownership of this fleet was sold by Clearwater Seafoods Incorporated to Membertou First Nation in September 2020. The entirety of Clearwater Seafoods was purchased by a coalition of First Nation groups and Premium Brand Holdings Corporation in November 2020.

Table 2.13 Summary of Changes in the Georges Bank Fishery from 2008 to 2020

Fishery	Highlights
Groundfish (haddock, cod and yellowtail)	• Groundfish fleet operates in a similar manner to how it operated in 2008. • Quota is distributed among various vessel classes. • In 2020 groundfish accounted for almost 22% of total value from Georges Bank. • Groundfish landings have fluctuated from about 20,000 megatonnes (MT) in 2009/10 to a low of 6,000 MT in 2013.The stocks have rebounded to the range of 12-15,000 MT over the past five years. Haddock is the highest value groundfish species.
Pelagic and other (mainly pelagic herring, swordfish and tuna also includes offshore lobster)	• In terms of value, the pelagic fishery continues to be relatively small. In 2008 it accounted for less than 6% of total; by 2020 this had dropped further to about 3%.

2.3.2.2 Value of Landings

In 2020 the Georges Bank fishery landed catch of all species was valued at $140.6 million. This total value includes all commercial landings and those related to Aboriginal commercial licenses. Due to confidentiality, the Aboriginal commercial fishery cannot be separately reported. If there are any Food Social and Ceremonial (FSC) landings from Georges Bank these are not recorded as commercial landings and would therefore not be included in the total.

The shellfish fishery accounted for over 85% of landed value followed by groundfish at 22%. The pelagic fishery accounted for the remainder at about 3%. Over the period 2002 to 2020, total value peaked in 2014 at $142.6 million. Table 2.14 shows that 2020 has been among the top three best years since 2002.

From 2002 to 2020, wide swings in fishing activity on Georges Bank have led to substantial shifts in the impact on the regional economy. These swings, as reflected in the quantity and value of landings, are presented in Table 2.14. The data show that annual landed value can swing from $64.4 million to $142.6 million, depending on resource and market conditions. This pattern serves to illustrate the point that fluctuation continues to be one of the few constants in the fishery.

The landed value data in Table 2.14 are based on information provided by DFO. These values reflect DFO’s best estimate of market value with adjustments to reflect the integrated nature of some of the fisheries. Some prices are those agreed to between vessel-owners and buyers. Where vessel-owners and buyers are the same (e.g., integrated companies), the significance of price is related to determining crew incomes; prices do not necessarily reflect competitive conditions (they are generally lower, thus the need to adjust to market prices).

Table 2.14 Value ($) of Georges Bank Fishery (2002-2020) by Major Species Groups[1]

Year	Groundfish ($)	Value		
		Large Pelagic, Estuarial, Mollusc, and Crustacean (excl. Scallop) (Round MT) ($)	Offshore Scallop (Round MT) ($)	Total ($)
2002	19,112,859	3,684,216	76,785,224	99,582,300
2003	18,643,854	4,335,971	75,979,421	98,959,246
2004	14,783,787	4,080,269	49,895,342	68,759,399
2005	21,954,619	8,058,346	34,347,063	64,360,028
2006	22,814,619	5,962,856	53,741,880	82,519,355
2007	20,487,263	6,082,809	54,483,119	81,053,191
2008	22,748,416	5,786,844	76,813,792	105,349,052
2009	24,969,477	5,085,201	77,333,054	107,387,732
2010	25,406,493	7,495,016	60,507,427	93,408,935
2011	23,481,331	6,039,797	75,026,582	104,547,710
2012	15,133,935	5,675,937	75,260,768	96,070,639
2013	9,167,214	6,506,020	109,786,117	125,459,350
2014	19,237,874	3,954,287	119,386,235	142,578,396
2015	25,455,200	6,903,385	108,101,971	140,460,557
2016	22,233,227	3,157,428	68,957,937	94,348,593
2017P[2]	15,610,838	4,878,371	77,605,131	98,094,340
2018P	15,739,551	2,723,533	104,085,836	122,548,920
2019P	18,250,689	3,109,799	112,983,750	134,344,237
2020P	17,184,575	3,748,016	119,691,215	140,623,805

Notes:
[1]The landed value data are based on information provided by DFO. These values reflect DFO's best estimate of market value with adjustments to reflect the integrated nature of some of the fisheries.
[2]"P" denotes preliminary data.
Source: DFO Fisheries Management – Commercial Fisheries 2021. Personal communications.

Landings for groundfish, scallop and pelagics have fluctuated over the past 20 years. Offshore scallop landings were at their peak from 2000 – 2003 (Table 2.15; Table A.2, Appendix A).

Groundfish landings have fluctuated over the same period, more than doubling from 9,106 t in 1998 to 19,322 t in 2009, then dropping to a 20-year low of 6,242 t in 2013, before more than doubling again in 2014 to 14,763 t and remaining above 12,000 t ever since (Table 2.15).

For Georges Bank in 2020, groundfish represented 12% of the total landed values of all commercial fisheries, and offshore scallop represented 85% (Table 2.15).

On Georges Bank, groundfish landings decreased from a 20-year high of 19,322 t in 2009 to 12,445 t in 2020, with a 20-year low of 6,242 t in 2013 (Table 2.15). Fewer than 25% of the 2,517 groundfish licences in the Maritimes Region were active in 2015. Since 2009, the most valuable groundfish species in terms of regional landed value are halibut and haddock (DFO 2018a).

Table 2.15 Quantity of Georges Bank Landings 2002-2020 by Major Species Groups

Year	Quantity				
	Groundfish – Round MT	Large Pelagic, Estuarial, Mollusc, & Crustacean (Excl Scallop) (Round MT)	Offshore Scallop (Round MT)	Total (Round MT)	Offshore Scallop Meat (Round MT)
2002	13,288	2,031	55,641	70,960	6,704
2003	12,775	2,205	51,687	66,667	6,227
2004	13,782	448	31,185	45,415	3,757
2005	17,535	776	22,449	40,760	2,705
2006	14,676	616	34,014	49,306	4,098
2007	13,872	558	36,566	50,996	4,406
2008	16,802	676	48,616	66,094	5,857
2009	19,322	655	48,033	68,010	5,787
2010	19,232	862	44,491	64,585	5,360
2011	14,205	696	37,513	52,414	4,520
2012	7,468	640	33,599	41,706	4,048
2013	6,242	675	42,388	49,306	5,107
2014	14,763	357	46,454	61,574	5,597
2015	16,759	561	36,645	53,964	4,415
2016	14,232	233	28,613	43,079	3,447
2017P	15,028	408	30,796	46,232	3,710
2018P	14,160	184	34,580	48,924	4,166
2019P	15,362	234	43,792	59,389	5,276
2020P	12,445	381	43,683	56,509	5,263
Source: DFO Fisheries Management – Commercial Fisheries 2021. Personal communications.					

2.3.2.3 Economic Impact of the Georges Bank Fishing Industry

Table 2.16 shows that the final product value of Georges Bank processed fish in 2020 is $218 million.

Table 2.16 Final Product Values in Millions of Dollars for the Four Major Fisheries that Operate in NAFO Zone 5Z[1]

Year	Shellfish (million $)	Groundfish (million $)	Pelagic (million $)	Other (million $)	Total (million $)
1998	143.45	34.15	2.28	0.02	179.90
1999	128.65	36.97	1.49	0.03	167.15
2000	198.90	45.54	1.21	0.03	245.67
2001	161.47	48.31	5.29	0.01	215.08
2002	141.44	43.33	2.46	0.02	187.24
2003	135.84	41.71	3.53	0.01	181.09
2004	89.94	32.22	1.97	0.00	124.13
2005	63.16	46.82	4.75	0.00	114.74
2006	88.73	47.66	3.43	0.00	139.82
2007	89.25	41.99	2.96	0.00	134.20
2008	129.58	45.23	4.53	0.00	179.34
2009	96.78	49.94	3.67	0.00	150.39
2010	91.06	50.6	4.85	0.00	146.52
2011	103.25	47.18	2.71	0.00	153.14
2012	104.19	30.27	2.94	0.00	137.4
2013	168.48	18.33	3.12	0.00	189.94
2014	179.74	38.47	0.48	0.00	218.7
2015	170.21	50.82	3.02	0.00	224.05
2016	107.51	44.56	0.44	0.00	152.5
2017P	108.84	30.57	2.72	0.00	142.13
2018P	161.24	30.88	0.79	0.00	192.91
2019P	170.78	36.79	1.89	0.00	209.46
2020P	183.27	34.46	0.95	0.00	218.69

Notes:
[1] Processing typically adds 50-100% to landed value at the wholesale level, though the figure could be higher in some market conditions. This varies by species, ranging from 70-100% for scallops and lobster to as little as 50% for some groundfish products. DFO has provided their best estimates of product value for the Georges Bank fishery over the 1998 – 2020 period. It is understood that industry participants believe the DFO estimates of product value are understated. A comprehensive database is not available to confirm this observation.
Source: DFO Fisheries Management – Commercial Fisheries 2021. Personal communications.

"Landed value" is the value of fish landed at the wharf - usually the price paid to fishers by buyers. "Product value" or "commercial value" is the value of the fish products as it leaves processing plants or for fresh product could reflect mark-up by buyers. Analysts use these terms to try to distinguish between the primary value of the resource (landed value) and the value added by processing (product value). Product value does not reflect retail pricing.

Tables 2.17 through 2.19 show provincial summaries of economic impacts for both the fish processing industry and the commercial fisheries (harvesting sector). While the focus is on 2019, the impacts in 2008 and 2011 are shown for reference. As can be seen in Table 2.19, fish processing in 2019 accounts for 7,000 person-years of direct employment, with spin-off jobs adding an additional 10,150 person-years of employment. Many people working in fish processing have seasonal jobs, which would mean employment levels would be higher than suggested by the person-year estimates. Table 2.19 also shows that fish harvesting accounts for 6,430 person-years in direct employment with an additional 4,051 in spin-off jobs. The seasonality of work is also a characteristic of the harvesting sector.

There has not been any recent economic impact analysis of the fishing sector in Nova Scotia. The most recent was based on a 2014 study (Gardner Pinfold 2014) that presented impacts for 2011. The 2014 analysis has been updated to 2019 noting that the results are meant to be indicative as opposed to conclusive. This approach provides a reasonable degree of accuracy for the purposes of describing the economic importance of the sector.

For landed value, Georges Bank landings were $134 million in 2019, accounting for 9% of provincial industry totals. The ratio of Georges Bank to total provincial data for both landed value and commercial production is indicative of the economic value of the Georges Bank fishery.

Table 2.17 Economic Impact of the Provincial Fishing Industry - 2008

	Direct	Spin-off[1]	Total
Fish Processing			
Gross Domestic Product (GDP) ($000s)	153,143	351,519	504,662
Employment (P-Y)	3,242	5,466	8,709
Household Income ($000s)	117,638	225,179	342,818
Fish Harvesting			
GDP ($000s)	332,054	205,191	539,628
Employment (P-Y)	3,462	3,685	7,172
Household Income ($000s)	232,427	125,573	359,668

Note:
[1] Includes impact on fishing industry.
Source: Gardner Pinfold 2007

Table 2.18 Economic Impact of the Provincial Fishing Industry - 2011

	Direct	Spin-off[1]	Total
Fish Processing			
GDP ($000s)	158,900	589,600	748,500
Employment (P-Y)	5,985	8,680	14,665
Household Income ($000s)	168,900	395,325	564,200
Fish Harvesting			
GDP ($000s)	411,520	348,130	759,650
Employment (P-Y)	6,480	4,120	10,600
Household Income ($000s)	334,000	199,900	533,900

Note:
* Includes impact on fishing industry.
Source: Gardner Pinfold 2014

Table 2.19 Economic Impact of the Provincial Fishing Industry 2019

	Direct	Spin-off[1]	Total
Fish Processing			
GDP ($000s)	275,202	1,017,000	1,292,500
Employment (P-Y)	7,000	10,150	17,150
Household Income ($000s)	291,500	670,450	961,950
Fish Harvesting			
GDP ($000s)	840,895	706,351	1,547,246
Employment (P-Y)	6,430	4,051	10,481
Household Income ($000s)	681,124	408,674	1,089,798

Notes:
[1]Includes impact on fishing industry.
Impacts estimated by Gardner Pinfold solely for the purpose of this analysis.

Table 2.20 compares key economic data related to the fishery between 1997, 2007 and 2019. At-sea employment has dropped from 1,055 to 556 persons (fewer vessels active in both scallop and groundfish). However, onshore employment has increased mainly due to groundfish processing.

Table 2.20 Comparison of Key Economic Data Related to Georges Bank Fishery, 1997, 2007 and 2019

	1997	2007	2019
Employment - at Sea:			
Person-Years*	n/a	720	378
Persons	1,000	1,055	556
Employment - Onshore Processing:			
Person-Years[1]	650	375	414
Persons[2]	n/a	575	636
Income at Sea	$40 million	$33.55 million	$56.3 million
Processing Income	$7.5 million	7.4 million	$11.2 million
Number of Vessels	180	226	95

Notes:
[1] Estimate derived by Gardner Pinfold for this study based on fishing activity by month.
[2] Person-Years to Persons ratio for fish processing and fish harvesting taken from Gardner Pinfold 2007 and Gardner Pinfold 2014; 2019 estimated by Gardner Pinfold solely for the purpose of this analysis.

2.3.3 Changes in Employment and Income from Georges Bank Fisheries

2.3.3.1 Number of vessels

Prior to 1998 Gardner Pinfold reported that as many as 300 vessels participated annually in one or more of the Georges Bank fisheries (NRCan and NSPD 1999). Changes in stock abundance and access arrangements caused the fleet mix to change from year to year, and also led to a general decline in the number of trips made. But the decline in the overall number of active vessels has continued. DFO estimated that 226 vessels were active in 2007, down to 95 active vessels in 2020 (Table 2.21). From 2007 to 2020, the estimated number of employed individuals in NAFO Zone 5ZE fisheries declined by roughly half, from 1,055 to 556 (Table 2.21). In 2008, there were 21 active shellfish vessels in 5ZE, down to 12 in 2020. Groundfish and pelagic vessels decreased from 102 and 103 to 49 and 40 respectively, from 2008 to 2020 (Table 2.21).

Table 2.21 shows the number of vessels active on Georges Bank in 2020 as compared to 2008. Most landings occur in Southwest Nova Scotia. In total, 215 vessels were active in 2008; this has dropped to 95 in 2020, representing a percentage decrease of over 55%.

Table 2.21 Number of Vessels Active in 5Z in 2008 Compared to 2020

Year	Shellfish	Groundfish	Pelagic	Total
2008	21	102	103	215
2020P	12	49	40	95
% change	-42.86%	-51.96%	-61.17%	-55.81%

Notes:
Totals may not appear to sum correctly as vessels can fish in multiple fisheries; “P” denotes preliminary data.

2.3.3.2 Harvesting Employment and Income

The Georges Bank fisheries provided harvesting employment for an estimated 1,055 persons in Southwest Nova Scotia in 2007, and down by 50% to 556 persons in 2020 (Table 2.22). The work is year-round for many (those on scallop and lobster vessels and in associated onshore activities) and contributes to year-round or seasonal employment for many others involved in the groundfish and swordfish fisheries. DFO has estimated the income earned from fishing by the 1,055 persons crew in 2007 to be $33.5 million. In 2020, a smaller 556 persons crew earned $56.3 million in total income.

The total income figures presented in Sections 2.2.3.2 and 2.2.3.3 of this report are minimum values. In addition to personal income, the fishery generates profits for many enterprises and companies. It is not possible to develop accurate profit measures because operating cost data at the enterprise level are unavailable; the addition of operating costs would add several million dollars to total income for both harvesting and processing.

Table 2.22 Estimated Number of Individuals Employed in Select NAFO Zone 5ZE Fisheries in 2007 and 2020

Fishery	Number of Specialist Vessels	Average Crew Size	Estimated Employed Individuals
2007			
Shellfish (2007)	21	21	440
Groundfish (2007)	117	3	351
Pelagic (2007)	88	3	264
Total (2007)	**226**		**1,055**
2020			
Shellfish (2020P)	11	27	299
Groundfish (2020P)	48	3	144
Pelagic (2020P)	36	3	113
Total (2020P)	**95**		**556**

Note:
"P" denotes preliminary data.
Source: DFO Fisheries Management – Commercial Fisheries 2021. Personal communications.

Table 2.23 Estimated Total Income in Millions of Dollars Generated by Vessels Fishing in NAFO Zone 5ZE in 2007 and 2020

Fishery	Estimated Employed Individuals	Estimated Vessel Crew Income (million $)
Shellfish (2007)	440	23.4
Groundfish (2007)	351	9.23
Pelagic (2007)	264	0.92
Total (2007)	**1,055**	**33.55**
Shellfish (2020P)	299	6.9
Groundfish (2020P)	144	49
Pelagic (2020P)	113	0.4
Total (2020P)	**556**	**56.3**
Note: “P” denotes preliminary data.		

Depending on the fishery and the vessel in question, the duration of employment may range from a few days to year-round. For most offshore scallop fishers (who represent about 40% of the total involved), the season is roughly ten months, though some of the time is spent on Browns Bank where in a typical year 20-30% of the offshore scallop catch is taken.

Fishing effort for groundfish and swordfish is highly seasonal for the fishers involved. The fishery is concentrated in the June-August period, with limited activity after October. The lobster fishery is less seasonal, though landings tend to be concentrated in the April to June period, and in the November to January period.

Georges Bank remains an important fishing location for all participating vessels and fishers. Given that all fisheries on the east coast are presently at their full commercial capacity, shifting to alternative fishing grounds is not possible, even if new licences were permitted.

2.3.3.3 Processing Employment and Income

The value to the regional economy is based not just on landed value, but on the value of the final product. Adding value through processing and shipping contributes to regional employment, and individual and corporate income. Table 2.24 shows the estimated employment associated with seafood processing of select fishery landings caught in NAFO Zone 5Ze in 2019.

Table 2.24 Estimated Number of Full-time, Full-year Equivalent Employment Positions Associated with Seafood Processing of Select Fishery Landings Caught in NAFO Zone 5Ze in 2019

Fishery	Annual Landings (t)	Processing Rate (t/h)	Annual Processing Hours (h)	Annual Full-time Employment Equivalent (Person-Years)
Sea Scallops	5,276	0.04	131,900	73
Offshore Lobster	N/A	0.05	N/A	N/A
Groundfish	15,362	0.025	614,480	341
Swordfish	N/A	0.045	N/A	N/A
Total	**20,638**		**746,380**	**414**

Note:
The number of hours an average employee works per year was assumed to be 1800.
Estimated by Gardner Pinfold solely for the purpose of this analysis.

DFO has estimated the processing sector employment and income impacts associated with the Georges Bank fishery. The results of their work are shown in Table 2.25. Fish landed from Georges Bank is processed in plants throughout the five counties in Southwest Nova Scotia. The form and extent of processing, and hence employment, vary by species.

- Scallop: The major part of processing – shucking – occurs at sea and is included in vessel employment. It is this sector that has undergone the greatest transformation with the advent of freezer vessels. Onshore processing for some of the landings still involves washing, freezing and packing. Product is sold fresh or frozen, with the bulk shipped mainly to the US.
- Lobster: On-shore processing involves grading, storage and packing. Product is sold live, with the bulk shipped to the US. Some processing (meat extraction) is also included.
- Groundfish: The catch is generally headed and gutted at sea. Further processing on shore involves one or more of the following: packing for the dressed fish market; filleting; splitting and salting (cod); or, further processing into products such as sticks, portions and entrées. There is a trend to more processed products such as fresh and frozen fillets compared with ten years ago. This could suggest the processing hours used in this study are underestimated. There has also been some investment in freezing capacity at sea by groundfish vessels. Several processing plants have invested in their processing facilities to take advantage of the high-quality haddock being landed from Georges Bank. Major investments at processing plants are occurring in both Pubnico and Digby.
- Swordfish: The catch is generally sold whole fresh to retail outlets or restaurants, but may be processed into steaks before shipping.
- New industry wide data and analysis not available. In general it is understood that operations are investing in efficiency and better product for higher product prices.

Table 2.24 shows the annual full time employment equivalents for the processing of Georges Bank landing to be 414 persons in 2019. This compares to 375 person-years estimated in 2007. These estimates are based on labour requirements by species provided by industry. Data are presented in full-time equivalents (FTE) to allow comparisons with annual measures.

The processing income attributable to Georges Bank fisheries is estimated to have generated about $7.5 million in 2007 (Table 2.25) compared to $11.2 million in direct payment to plant workers in 2019 (Table 2.26).

Table 2.25 Estimated Total Annual Income Earned in Seafood Processing of Select Fishery Landings Caught in NAFO Zone 5Ze in 2007

Fishery	Annual Processing Hours (h)	Labour Wage (h)	Total Annual Income Earned ($000)
Scallops	110,000	11.00	1,200
Offshore Lobster	5,120	11.00	56
Groundfish	555,360	11.00	6,100
Swordfish	4,978	11.00	55
Total	**675,458**		**7,411**
Note: The hourly wage for labour was assumed to be $11.00.			

Processing typically adds 50-100% to landed value at the wholesale level, though the figure could be higher in some market conditions. This varies by species, ranging from 70-100% for scallops and lobster to as little as 50% for some groundfish products. DFO has provided their best estimates of product value for the Georges Bank fishery over the 1998 –2020 period. Their estimate indicates that in the best year (2000), the Georges Bank fisheries contributed as much as $245 million to the local economy; in the poorest year (2012), the contribution was as low as $137 million (Table 2.16). Most recently, in 2020, the value was $219 million. It is understood that industry participants believe the DFO estimates of product value are understated. A comprehensive database is not available to confirm this observation.

Table 2.26 Estimated Total Annual Income Earned in Seafood Processing of Select Fishery Landings Caught in NAFO Zone 5ZE in 2019

Fishery	Annual Processing Hours (h)	Labour Wage (h)	Total Annual Income Earned ($000)
Scallops	131,900	15.00	$1,978
Offshore Lobster	N/A	15.00	N/A
Groundfish	614,480	15.00	$9,217
Total	**746,380**		**$11,195**
Note: The hourly wage for labour was assumed to be $15.00. Estimated by Gardner Pinfold solely for the purpose of this analysis.			

2.3.3.4 Regional Dependence on Georges Bank

Vessels active on Georges Bank land catches in several ports in southwest Nova Scotia. These communities are not the only ones to benefit from the Georges Bank fisheries, but they are the most obvious ones. Others include communities where vessel crews and plant workers live, and where processing plants are located. These are not necessarily the same as the ports of landing.

Landings data by community are not available for all ports because confidentiality restrictions prohibit publication where particular enterprises could be identified. For this reason, data are aggregated to the county level.

In 2007, Georges Bank accounted for 25% and 13% of the total value of landings for Shelburne County and Yarmouth County, respectively. In 2020, Georges Bank accounted for 26% of the total landings for Shelburne and 10% for Yarmouth. In 2007, Georges Bank accounted for 40% of the total value of landings for Lunenburg County and Queens County combined, which rose to 47% in 2020 (see Table 2.27).

Table 2.27 Georges Bank Landed Values by County, 2007 and 2020

County	Total From NAFO Zone 5Ze	District Total	%
2007			
Shelburne (2007)	$37,449,470	$152,760,900	25%
Yarmouth (2007)	$18,289,614	$143,106,508	13%
Lunenburg-Queens (2007)	$20,891,222	$52,157,974	40%
Other (2007)	$4,422,886	-	-
Total (2007)	$81,053,192	-	-
2020			
Shelburne (2020P*)	$61,119,765	$237,301,797	26%
Yarmouth (2020P)	$20,372,596	$198,806,606	10%
Lunenburg-Queens (2020P)	$51,622,222	$110,768,260	47%
Other (2020P)	$1,678,203	-	-
Total (2020P)	$134,792,786	-	-

Note:
*"P" denotes preliminary data.
Source: DFO Fisheries Management – Commercial Fisheries 2021. Personal communications.

2.3.4 Aboriginal Fisheries

Overview

The Regional Fisheries Management Program of DFO Maritime Region is responsible for managing the regional fisheries resources, including Aboriginal fisheries, in marine and inland waters.

Aboriginal rights to fish were affirmed by the Supreme Court of Canada's 1999 Marshall decision. In response to this decision and the resulting government obligation to manage the fisheries with the objective of increased self-reliance for First Nations, DFO has initiated various programs and initiatives aimed at increasing Aboriginal communities' participation in the Atlantic commercial fishery. Aboriginal communities became active in the present Georges Bank groundfish fishery in 2003 when, according to DFO quota reports, a quota allocation for both cod and haddock on Georges Bank was designated for the Aboriginal fishery. While Aboriginal participation in the commercial fishery occurred before the 1999 R. v. Marshall Decision, the Aboriginal mobile gear fleet was established as its own unique commercial fleet, featuring licences restricted to mobile gear vessels under 65 feet in length operating under an Enterprise Allocation System. As recently as 2020, the Aboriginal mobile gear fleet was allocated quota of 19 tonnes of cod and 1,098 tonnes of haddock for Georges Bank (see Table A-5 in Appendix A).

Fisheries Agreements with the majority of First Nations have been established in the Scotia-Fundy region through the *Atlantic Integrated Commercial Fisheries Initiative.* This has resulted in increased First Nations access to commercial fisheries in the region, including Georges Bank, through communal commercial fisheries.

DFO received a federal mandate in 2017 to negotiate *Rights Reconciliation Agreements* for fisheries with Mi’kmaq and Maliseet First Nations in Atlantic Canada, and to date none have been signed for fisheries in Nova Scotia (DFO 2021c).

Commercial Communal Fisheries

In 1999, the value of Aboriginal commercial communal landings in the Maritimes region was $3 million, which increased to $140 million by 2018. According to DFO, First Nations fishing enterprises currently employ roughly 1,700 people, 1,300 of which are fish harvesters (DFO, 2021A). In 2016, the total market value of all commercial fisheries landings in Eastern Canada (Quebec and east) was valued at $2,160 million, $122 million (6%) of which was landed by commercial communal fisheries (Coates 2019). Table 2.28 shows the number of commercial communal licences issued in NAFO 5Ze for 2019.

Table 2.28 Commercial Communal Fishery Licence and Landing Information for NAFO 5Ze

Fishery	Number of Commercial Communal Licences (2019)	Number of Commercial Communal Licences with Landings (2019)
Groundfish (all gear)	12	*
Swordfish (DFO Maritimes)	14 (all large pelagics)	0
Bluefin tuna (DFO Maritimes)	14 (all large pelagics)	*
Albacore tuna, bigeye tuna, yellowfin tuna, blue marlin, white marlin, mahi mahi (DFO Maritimes)	14 (all large pelagics)	0
Mackerel (DFO Maritimes)	32	0

Note:
*: To protect confidentiality, landings totals are denoted by an asterisk (*) in instances where less than five separate license holders have been active
Source: CNSOPB 2021a

In 2007, there were 12 vessels fishing 10 Aboriginal licenses in NAFO Unit Area 5Ze with a total landed value of approximately $1.72 million for groundfish. In 2015, 3 of the 11 Aboriginal mobile gear licences were actively fished in the 4VWX5 region, with an approximate landed value of $1.5 million (DFO 2018a). In 2008, the Aboriginal fishery’s quota allocation for cod and haddock was 69 tonnes and 1,154 tonnes, respectively. In 2020, the Aboriginal fishery’s quota allocation for cod and haddock was 30 tonnes and 529 tonnes, respectively (see Table 2.29).

Table 2.29 2008 and 2020 groundfish quota allocations on Georges Bank by fleet sector (t)

Fleet sector	Cod	Haddock	Yellowtail
Aboriginal fishery (2008)	69	1,154	
Fixed gear <45’ (2008)	791	2,824	
Fixed & mobile gear ITQ/Enterprise Allocation Fleet (2008)	577	10,378	
By-catch reserve (2008)	196	150	550
Reserve (2008)		444	
TOTAL (2008)	**1,633**	**14,950**	**550**
Aboriginal fishery (2020)	19	1,098	
Fixed gear <45’ (2020)	224	2,686	
Fixed & mobile gear ITQ/Enterprise Allocation Fleet (2020)	See notes		
Fixed Gear 45-65’ (2020)	30	529	
Mobile Gear <65’ (2020)	108	5,839	
Fixed Gear 65-100’ (2020)	4	137	
Mobile Gear 65-100’ (2020)	4	137	
Vessels >100’ (2020)	18	3,232	
By-catch reserve (2020)	55	142	42
Reserve (2020)		n/a	
TOTAL (2020)	**462**	**13,800**	**42**

Note:
Fixed & Mobile Gear ITQ/Enterprise Allocation Fleet no longer exists – this was a pilot project that ended in 2011 at which time the fleets within received individual allocations these have been outlined as such.

In 2007, there were 12 vessels fishing 10 Aboriginal licenses in NAFO Unit Area 5ZE with a total landed value of approximately $1.72 million for groundfish. In 2015, three of the 11 Aboriginal mobile gear licences were actively fished in the 4VWX5 region, with an approximate landed value of $1.5 million (DFO 2018a). In 2008, the Aboriginal fishery’s quota allocation for cod and haddock was 69 tonnes and 1,154 tonnes, respectively. In 2020, the Aboriginal fishery’s quota allocation for cod and haddock was 30 tonnes and 529 tonnes, respectively (Table 2.30).

In 2018, there were 2,300 commercial herring licences issued in the Maritimes region. Of those, 29 were Aboriginal Commercial Communal licences using fixed gear, two of which were active in 2018 (DFO 2020b).

First Nations note the money generated from the fishing enterprises goes directly to those actively fishing, including captains and crews, but also as salaries to those managing and maintaining the fleets. After operational costs are removed from the income generated for each year, the profits are then returned to each community where the Band Administration decides on how to best benefit the community.

Moderate Livelihood Fisheries

The Supreme Court of Canada ruled in the September 17, 1999 R. v. Marshall Decision that there is a Treaty right for First Nations peoples to hunt, fish and gather in pursuit of a “moderate livelihood”. These Treaty rights stem from the Peace and Friendship Treaties of 1760 and 1761. As a result of this Supreme Court decision, DFO implemented its Marshall Response Initiative in 2000, a regional variation of the Aboriginal Fisheries Strategy. The Marshall Response Initiative was extended in 2007. Through the Marshall Response Initiative and the Atlantic Integrated Commercial Fisheries Initiative, as well as the Rights Reconciliation Agreements process, DFO has provided over $550 million to First Nations Communities, increasing Aboriginal participation in commercial fisheries while contributing “to the pursuit of a moderate livelihood” (DFO 2021c).

In June 2021, the Potlotek First Nation and DFO reached an “interim agreement”, enabling the First Nation to operate the first authorized moderate livelihood fishery in Nova Scotia, with authorization from DFO to fish up to 700 commercial lobster traps. DFO states that while fished as a “moderate livelihood fishery”, Potlotek’s traps are fished under pre-existing licences without adding additional fishing effort to the regions they are allowed to fish.

In October 2021, four Mi’kmaq bands launched moderate livelihood fisheries with DFO approval through another interim agreement. The four First Nations—Acadia, Annapolis Valley, Bear River, and Glooscap—modeled the Kespukwitk District Netukulimk Livelihood Fisheries Plan based on the Potlotek First Nation’s moderate livelihood fishery launched in June 2021. Through this partnership, the four First Nations will manage a total of 3,500 commercial lobster traps, with a limit of 70 traps per harvester. Fishing will predominantly occur in Saint Mary’s Bay and will occur during the pre-existing commercial fishing season.

In 2020, the Sipekne'katik First Nation launched its own self-regulated “moderate livelihood” lobster fishery in Southwest Nova Scotia. While the federal Fisheries Minister stated that they would enforce the rules regarding seasonality, the Sipekne'katik First Nation asserted its Treaty rights to fish outside the commercial Lobster Fishing Area (LFA) 34 season if they choose to do so. DFO has yet to reach an agreement with Sipekne'katik First Nation, citing that the fishery occurs outside of the DFO-regulated season.

At this time no moderate livelihood agreements include fisheries on Georges Bank, although this could change in the future.

Aboriginal Food, Social and Ceremonial (FSC) Fishery

Aboriginal FSC fishing is considered a cultural and sustenance activity in Georges Bank. DFO negotiates agreements for FSC fishing, through which licences are issued with specific restrictions regarding the location, method, gear type, and time frame of when a FSC fishery can occur. In 2016/17, there were 12 FSC licences issued to organizations to fish within the Maritimes Region for groundfish (DFO 2018a). Although most FSC fishing occurs in tidal or inland waters, some species of interest may migrate through offshore waters (e.g., Atlantic salmon, American eel).

Purchase of Commercial Licences and Quota by First Nations

Clearwater Seafoods, the largest shellfish producer in Canada, was purchased in 2020 by a coalition of seven Mi'kmaq First Nations along with Premium Brands, a British Columbia-based multinational company. While Clearwater is North America's single largest producer of shellfish and owns Canadian commercial fishing licences for species such as lobster, scallop, crab, and offshore clams, none of the quota or licences acquired in this purchase is officially classified as Aboriginal. Lobster and scallops from Georges Bank are important sources of revenue for Clearwater Seafoods.

3.0 ECONOMIC BENEFITS AND OPPORTUNITIES ASSOCIATED WITH THE OFFSHORE PETROLEUM INDUSTRY

3.1 GENERAL OPPORTUNITIES FOR ECONOMIC BENEFITS

Offshore activity is typically divided into four phases:

- Exploration (seismic surveying, exploration drilling)
- Development (engineering, design and construction of production facilities and export mechanisms)
- Production
- Decommissioning and Abandonment

Opportunities for local interests to participate in offshore activities arise during each phase, with the development and production phases offering the most economic opportunities for local supply chains. Opportunities fall into three general categories:

- employment
- services
- materials and equipment

Of the three, employment and services hold the greatest potential. Materials and equipment also represent significant expenditures. Examples of various materials and equipment used in various stages of offshore oil and gas are presented in Table B-1 in Appendix B. Requirements tend to be highly specialized, with capability in eastern Canada having increased markedly due to the establishment of the offshore oil and gas industry in both Newfoundland and Labrador and Nova Scotia.

Given the uncertainties surrounding the scale and timing of any offshore activity, it is difficult to do much more than list the general categories of opportunity (Table 3.1). Each category would contain specific occupations and business opportunities.

What seems clear from the experience in Nova Scotia and Newfoundland and Labrador is that seizing these opportunities requires initiative. In the case of jobs, it also requires the right mix of skills, specialized training and abilities. In the case of services, it also requires an ability to produce a product to meet industry standards of quality, price and delivery. Developing joint ventures with established companies has proven to be an effective strategy for entrepreneurs wishing to enter the industry. Nova Scotia and its workforce has project experience based on industry activities that have taken place over the past 20 plus years.

A 12-year Retrospective of Natural Gas Production in Nova Scotia was completed in 2009 (Stantec 2010c). This report provides a summary of economic benefits attributable to the existing industry and, on a case study basis, documents many business success stories. Any potential development on Georges Bank will benefit from the industry experience established in the province through the existing projects. This experience would likely also likely result in higher rates of provincial benefits. This study has not been updated; however, its findings and conclusions remain relevant at this time. An important conclusion of the Stantec report is as follows:

“Nova Scotia’s experiences in the offshore to-date can be used to continue to succeed in this competitive industry, both here and abroad. The amassed knowledge and experience is a benefit and a value that cannot be quantified, but that will surely continue to be used to operate and compete successfully in the offshore industry around the world.”

Table 3.1 Offshore Oil and Gas Employment and Service Opportunities

	Exploration	Development	Production	Abandonment
Employment	• seismic vessel crew • support vessel crew • drill rig crew • shore base staff • catering staff	• support vessel crew • drill rig crew • shore base staff • catering staff • project mgt staff • engineers/consultants • divers • fabrication trades – plate/pipe fitters – welders – instrument fitters – electricians – construction trades – fitters – welders – electricians – civil trades • barge/crane crews	• project administration staff • offshore platform staff • gas plant staff • shore base staff • support vessel crew • well maintenance	• barge/crane crews • support vessel crew • fabrication trades – plate/pipe fitters – welders • divers

Table 3.1 Offshore Oil and Gas Employment and Service Opportunities

	Exploration	Development	Production	Abandonment
Services	• marine transportation • air transportation • drilling services • catering • vehicle leasing • equipment rental • warehousing • consulting • wholesale trade • retail trade	• engineering • fabrication • construction • transportation • maintenance • marine transportation • air transportation • catering • vehicle leasing • equipment rental • warehousing • consulting • wholesale trade • retail trade	• office services • well services • transportation • marine transportation • air transportation • catering • warehousing	• marine transportation • fabrication

Source: Stantec Consulting Ltd. 2010c

Specific examples of how employment and service opportunities could potentially benefit the Southwest Nova Scotia region are discussed in Section 3.4.

3.2 CANADA-NOVA SCOTIA OFFSHORE PETROLEUM INDUSTRY

The assessment of the overall value of the Georges Bank region associated with the petroleum industry is hypothetical as there is currently no industry activity due to the moratorium, currently in place until December 31, 2022. In this section, the potential scale of value of petroleum activity drawing on past Nova Scotia offshore energy projects is demonstrated, and potential opportunities and economic benefits to the region are considered in hypothetical terms.

The offshore petroleum industry has no operations based in Southwest Nova Scotia. The analysis of economic value of petroleum resource exploration and development is based on experience in the province over the past 20 years.

3.2.1 Overview of Nova Scotia Offshore Energy Projects

In the history of petroleum activity in the Canada-Nova Scotia Offshore Area, there have been three production projects, all of which were located in the Sable Subbasin approximately 500 km northeast of Georges Bank: Cohasset-Panuke Project, Sable Offshore Energy Project (SOEP), and Deep Panuke Offshore Gas Development Project (Deep Panuke).

Cohasset-Panuke Project

The Cohasset-Panuke Project was Canada's first offshore oil project and operated from June 1992 to December 1999 on the Scotian Shelf. Operating 14 production wells from two fields (Cohasset and Panuke), facilities included two steel jackets at Cohasset and Panuke connected by a subsea pipeline, and a modified jack-up drilling and production unit. Light crude oil was transferred by pipeline to a storage tanker moored at a calm buoy near the production platform, and shuttle tankers would periodically offload oil for transport to market. Production from the Cohasset-Panuke Project was permanently shut-in in 1999 and decommissioning and abandonment was completed in 2006 (CNSOPB 2021b). This facility produced 7.1 million cubic metres of oil during its life span.

Sable Offshore Energy Project (SOEP)

SOEP was formed by a consortium of five companies:

- ExxonMobil Canada Properties Ltd
- Shell Canada Limited
- Imperial Oil Resources
- Pengrowth Energy Trust (Emera Inc.)
- Mosbacher Operating Limited

Following regulatory approval in 1998, SOEP undertook the development of natural gas production from discoveries near Sable Island. Production began in late 1999 in what is referred to as the Tier I gas fields which included Thebaud, Venture and North Triumph. Subsequently, Tier II saw the development of the Alma Field in late 2003 and South Venture in late 2004. December 2018 marked the last production from the SOEP, at which time production was permanently shut-in. From 1999 to 2018, SOEP produced 59.9 billion cubic meters of natural gas.

SOEP constructed an export pipeline to bring natural gas from the Thebaud central processing and compression facility near Sable Island to Goldboro, NS, and the pipeline began operating in 1999. A natural gas processing plant was constructed at Goldboro to prepare the raw gas for market, and Maritime and Northeast Pipeline (M&NP) constructed an onshore pipeline to carry natural gas to the principal consumer market in the northeast US, with laterals to Point Tupper, Halifax, Amherst and Saint John, New Brunswick.

Over the course of the project, a total of 21 production wells were drilled in five fields, with each field having a satellite platform. Raw gas was transported from satellite platforms via subsea flowlines to a central offshore processing facility for preliminary processing before being transported through a 198 km subsea pipeline to the Goldboro processing facility. In late 2017, ExxonMobil Canada Ltd. began the plugging and abandonment of the 21 production wells and in 2019 activities for the decommissioning and removal of offshore platforms began. All offshore facilities were removed by November 2020, with the exception of the subsea export pipeline (flushed and filled with seawater) which remains in place (CNSOPB 2021c).

Deep Panuke

In 1999, the natural gas was discovered below the former Panuke oil field. The Deep Panuke project received regulatory approvals in 2007. The Deep Panuke offshore production facility (Production Field Centre or PFC) processed the produced sour gas to “sweet” market gas which was transported to Goldboro in a separate 172 km subsea pipeline that is adjacent to the existing SOEP pipeline. The offshore pipeline was connected to the M&NP onshore pipeline through a metering station at Goldboro for market distribution. The Deep Panuke project began production in August 2013, and eventually produced 4.17 billion cubic meters of natural gas from four production wells. All Deep Panuke production was permanently shut-in in May 2018.

Deep Panuke used a jack-up type offshore production platform which was tied back to the four subsea production wells by subsea flow lines. Decommissioning was completed in 2020 (CNSOPB 2021d). As was done for the Sable Offshore Energy Project, the subsea export pipeline (flushed and filled with seawater) remains in place.

Exploration Activity

In 2012 and 2013, following Call for Bids NS11-1 and NS12-1 administered by the Canada-Nova Scotia Offshore Petroleum Board (CNSOPB), Shell Canada Limited (Shell) was issued six deepwater exploration licences (ELs) on the Scotian Slope and two shallow water exploration licences on the Scotian Shelf. A 3D seismic survey was conducted in 2013 to inform a deepwater exploratory drilling program which commenced in 2015. Between 2015 and 2016 Shell drilled two deepwater exploratory wells in the Shelburne Basin 250 km off the coast of Southwest Nova Scotia. In 2017 Shell announced it would not be proceeding with further exploration or development on their exploration licences.

Similarly, in 2013, following Call for Bids NS 12-1, BP was issued four exploration licences on the Scotian Slope, with non-operating partners Hess Canada Oil and Gas ULC and Woodside Energy International (Canada) Limited and acquired 3D seismic data in 2014. After drilling one deepwater exploration well on the Scotian Slope in 2018, the well was plugged and abandoned. Between January 2019 and January 2021 BP posted a series of escalating drilling deposits to extend Period 1 of their exploration licence to the full nine years permitted by legislation. BP’s exploration licence (EL 2434R) will expire in January 2022. Exploration licences located adjacent to the Georges Bank Prohibition Area were awarded to Equinor Canada Ltd. (formerly Statoil Canada Ltd.) in 2015, although to date, Equinor has not filed any applications for authorizations to conduct offshore activities on these licences. Unless a drilling deposit is posted, Equinor’s exploration licences will expire in January 2022.

In May 2019, the CNSOPB announced that no bids were submitted for Call for Bids NS18-3. In May 2021, the CNSOPB issued Call for Bids NS21-1, which includes two primarily deepwater parcels. Call for Bids NS21-1 closes on November 3, 2021.

The Government of Nova Scotia notes that there may be up to 3.4 trillion cubic meters of natural gas and 8 billion barrels of oil remaining to be extracted in Nova Scotia’s offshore waters (Nova Scotia Department of Energy and Mines, n.d.). As of October 2021, the only current offshore oil and gas activities are for the post-abandonment monitoring programs associated with decommissioning and abandonment of the SOEP and Deep Panuke projects.

3.2.2 Economic Benefits of Offshore Petroleum Activity in Nova Scotia

In Gardner Pinfold's 2009 study on the "Economic Impact of the Ocean Sector in Nova Scotia", the impacts associated with offshore oil and gas industry were documented for 2006. This analysis was updated in 2014 to reflect 2011 statistics.

Tables 3.2 to 3.4 show the impacts for both development and production activities that took place in 2008, 2011 and 2017. The 2017 analysis is not as robust as that done for 2008 and 2011; an estimate has been prepared using various factors and information on the project activity. The data presented in these tables were derived using similar methodology as used for the fishing industry in this report and permits comparison of the relative economic scales of the two industries.

Table 3.2 Economic Impact of the Canada-Nova Scotia Offshore Oil and Gas Industry (2008)

	Direct	Spin-off	Total
Development			
GDP ($000s)	4,296	12,421	16,717
Employment (person-years [P-Y])	67	222	289
Household Income ($000s)	3,232	8,130	11,362
Production			
GDP ($000s)	1,166,618	206,771	1,373,388
Employment (P-Y)	614	3,392	4,006
Household Income ($000s)	42,939	137,399	180,338

Table 3.3 Economic Impact of the Canada-Nova Scotia Offshore Oil and Gas Industry (2011)

	Direct	Spin-off	Total
Development			
GDP ($000s)	17,332	12,376	29,709
Employment (P-Y)	194	143	337
Household Income ($000s)	12,554	7070	19,624
Production			
GDP ($000s)	289,720	42,180	331,900
Employment (P-Y)	288	560	848
Household Income ($000s)	19,885	27,400	47,285
Source: Gardner Pinfold 2014			

Table 3.4 Economic Impact of the Offshore Oil and Gas Industry (2017)

	Direct	Spin-off	Total
Development			
GDP ($000s)	-	-	-
Employment (P-Y)	-	-	-
Household Income ($000s)	-	-	-
Production			
GDP ($000s)	98,010	14,224	112,325
Employment (P-Y)	100	140	240
Household Income ($000s)	6,861	9,605	16,466
Note: Impacts estimated by Gardner Pinfold solely for the purpose of this analysis.			

Cumulative expenditures and hours of employment for SOEP and Deep Panuke have been calculated through various CNSOPB benefit reports (as reported by operators) and are summarized in Table 3.5. Appendix B provides additional details on project expenditures.

Table 3.5 Cumulative Expenditures and Hours of Employment for SOEP and Deep Panuke (2007-2019)

	SOEP	Deep Panuke
Cumulative Expenditure ($)		
Nova Scotia	3,281.8 million	
Total	7,961.1 million	1,953.9 million
Cumulative Person Hours of Employment		
Nova Scotia	27.05 million	7.88 million
Total	40.96 million	9.25 million
Source: CNSOPB benefits reports		

3.3 ENTITLEMENT TO ECONOMIC BENEFITS FOR THE OFFSHORE

Offshore energy projects generate economic benefits to the provincial economy. These benefits include employment, service supply opportunities and royalties to the province. Federal legislation requires parties that wish to undertake offshore gas or oil related work or activity to submit development plans for approval. These development plans must contain Canada-NS benefits plans with provisions for the Accord Acts:

- The employment of Canadians, especially members of the provincial labour force
- A program shall be carried out and expenditures made to promote education and training in the province in relation to offshore petroleum resource activities

- Giving first consideration to services provided from within NS and to goods manufactured in the province, where those services and goods are competitive in terms of fair market price, quality and delivery

Nova Scotia has an Offshore Petroleum Royalty Regime that is based on revenues and profits associated with energy projects.

In the fiscal year 2011–2012, the province received close to $286 million in royalties alone. Total offshore revenues received by the province from 2003 to 2013 is over $3.4 billion (most recent information available) (NSDEM undated).

Appendix B provides more detail on past projects and how rates might be set for future projects. These rates would be based on the Nova Scotia Offshore Royalty Regime which uses a generic formula that reflects revenue, profits and risks.

Industrial benefits are the economic benefits and opportunities that arise from petroleum resource activities in the Canada-Nova Scotia Offshore Area. The Accord Acts require an Operator to have an approved Canada-Nova Scotia Benefits Plan prior to the authorization of any work or activity or the approval of any development plan.

There is a direct economic benefit for the people of Nova Scotia when companies hire Nova Scotians as workers, and use our expert engineering, fabrication, and supply services.

3.4 ACTIVITIES THAT COULD GENERATE POTENTIAL ECONOMIC BENEFITS TO SOUTHWEST NOVA SCOTIA

Petroleum exploration and production activities can offer potential economic benefits to Southwest Nova Scotia in the form of employment and business opportunities realized from the range of services required in the support of offshore operations. Geographic location and proximity to infrastructure are key elements of support activities related to both the exploration and production phases of petroleum sector development.

In the 12-Year Retrospective of Natural Gas Production (Stantec 2010c), Stantec identifies key economic elements of the petroleum industry which play a significant role in the province's economy. Among these elements, Nova Scotia firms have demonstrated economic benefits through supporting offshore operations in the areas of marine expertise, ship building and repair, port and harbour operations, transportation and the provision of other services and expertise required to sustain personnel and equipment operating 24-hours per day, seven days per week in remote locations.

Economic benefits to the region would include employment opportunities, provision of services including transportation services and vessel maintenance, increased demand for accommodation and hospitality services and an enhanced commercial tax base. These services have a regional focus as support operations are time dependent and reducing time for logistics operations can lead to significant cost savings and enhanced safety. This can be illustrated through particular linkages between shore-based supply operations, helicopter support services and offshore operations.

Shorebase Support Operations

In the case of operations on Georges Bank, a marine supply base near the site would likely be established to reduce travel times and offer quick turn around on materials supply. For the Sable and Deep Panuke projects shorebase support services were provided out of Halifax as the closest shipping port and airport to the production areas. The relatively long transit time for vessels out of Halifax to Georges Bank would provide a case to establish a marine supply base in southwest Nova Scotia.

The requirements for shore-based operations for exploration include several key facilities. The wharf must be suitable for the supply vessels and dock must have sufficient area and strength to handle a heavy crane for loading and offloading the vessels and place containers and equipment loads. Typically, an area for bulk tanks for the storage of fuel, barite and other consumables used in drilling operations is located near the wharf where these materials can be pumped onto the supply vessels. The offshore supply base would require a lay down area nearby for the storage of drill pipe and casing which could easily be moved to the wharf for load out to the drilling operation. Office space for supply-base personnel and communications equipment would be required at the wharf. The base operation requires sufficient power for the electric pumps used in bulk materials transfer, office services, security lighting and shore power for supply vessel when in port. A supply of freshwater is typically purchased from the local municipality to support both drilling operations and crew needs on the offshore platform and vessels. The supply base relies on highway transportation of bulk products and therefore road transport is an important element of regional infrastructure.

With some consideration to the specific needs of the petroleum industry, many of these services are similar to the services required by the fishing industry which is well established in the region. As a major fishing centre, Southwest Nova Scotia has a number of ports with facilities which could meet these requirements.

Air Services

There are potential economic benefits to the region related to increased air transportation services. Air services to support offshore operations include requirements for personnel and cargo transport. The transportation of crew is typically by fixed wing carrier service to the supporting airport and helicopter service from this airport to the offshore platform. The helicopter services are provided by a private company under contract to the oil company. The fixed wing service is typically provided by a commercial air carrier.

Crews rotate on a routine basis and with limited seating capacity on the aircraft, a number of helicopter flights are required for each change. Offshore personnel come from diverse geographic regions and therefore, commercial flights are usually between the supporting airport and a hub terminal such as Halifax Stanfield International Airport.

The transport of cargo by air to offshore operations is typically for specialized instruments or repair parts needed on a rush basis for specialized services during drilling or production. Limitations of the carrying capacity of helicopters and the high cost of helicopter flight time require that transportation of equipment by air is only done when there is an urgent need. Nonetheless, connection with air transport carriers is an important part of air services required by the offshore industry.

Land Transportation Services

There are potential benefits to the region in the transportation sector. The offshore industry relies heavily on road transportation for many of the consumables used in offshore operations. Drill pipe, well casing, barite and fuel oil are just some of the important bulk commodities routinely consumed by offshore drilling programs which are transported by truck to the supply base. The demand by the offshore industry for these services could provide increased opportunities for direct employment in trucking and indirect employment in supply service to this sector in the region.

Ship Building and Repair

Offshore petroleum activity in the region could increase the demand for vessel repair and maintenance service to the supply vessel fleet. The proximity of these services to the operations site can provide an advantage in reduce travel times and fuel costs for supply vessel operators which may be an important factor due to strong competition with other yards in the province.

Hospitality Services

Petroleum development would increase the number of people coming into the area and requiring services from the hospitality sector. Shore-based petroleum workers would require long term housing and accommodation and could be expected to consume goods and services thereby providing an economic stimulus to the region. Offshore workers, travelling to and from the offshore platform would stimulate demand for temporary accommodations and food services in local hotels and motels and restaurants. This increase in demand may provide employment opportunities in this sector which has shown a decline in the region in recent years.

Summary

In summary, based on experiences from other offshore petroleum projects in Nova Scotia, there are various potential regional economic benefits which could be realized if oil and gas activities were permitted to occur on Georges Bank.

4.0 UPDATES IN KNOWLEDGE AND ENVIROMENTAL MANAGEMENT OF OFFSHORE PETROLEUM ACTIVITIES

This section provides an overview of potential offshore petroleum activities including key environmental interactions, issues and concerns, and applicable research updates and/or environmental management measures that may have evolved since the 2010 Review. Key sources of information for this discussion include the Western Scotian Shelf and Slope SEA (CNSOPB 2021a) and the Regional Assessment of Offshore Oil and Gas Exploratory Drilling East of Newfoundland and Labrador (IAAC 2021). This section is intended to provide context to Section 5 where potential effects on commercial and traditional fisheries are presented.

4.1 SEISMIC EXPLORATION AND OTHER GEOPHYSICAL PROGRAMS

4.1.1 Activity Description

Seismic surveys are generally the first step in petroleum exploration. Sound waves are used to develop an image of subsurface strata and structure features to understand geological features and confirm the possible presence or absence of petroleum. High-energy sound sources (airguns) are towed behind a survey vessel while it travels along a track line in a prescribed grid crossing known or suspected seabed areas with hydrocarbon accumulations. Reflections of sound waves are recorded by hydrophones (streamers) also towed behind the survey vessel (C-NLOPB 2014; CNSOPB 2021a). The reflected sound is then processed to map possible hydrocarbon accumulations (C-NLOPB 2014).

Two-dimensional (2D) surveys typically involve one air gun array and one seismic streamer and are used in frontier exploration areas to produce a general understanding of geological structure (CNSOPB 2021a). Three-dimensional (3D) surveys involve multiple air source arrays and streamers, producing data sets that can be processed to reveal 3D geometry at high resolutions. 3D seismic surveys are usually focused on areas with known geological targets (CNSOPB 2021a). In the last decade, wide-azimuth (WAZ) seismic surveys have also been conducted offshore Nova Scotia. WAZ surveys involve multiple towed streamers/recording devices and source vessels (whereas conventional 3D involves a single vessel towing both a source and receiver array), providing a broader range of horizontal coverage, and thus resulting in enhanced data quality and capacity to resolve complex geological features (CNSOPB 2021a). Depending on the spatial scale of the survey area, the duration of seismic programs can vary from a few weeks to a few months.

Other geophysical programs may involve seabed surveys (e.g., sub-bottom profiling, multibeam surveys, sidescan sonar, and electromagnetic surveys) undertaken to detect potential hazards and characterize surficial geology and bedforms in the immediate vicinity of targeted drilling locations. The duration of these surveys would typically be in the range of a few days to a few weeks.

Vertical seismic profiling (VSP) is another type of geophysical survey used during exploration. During exploration drilling, once the well has been completed, a VSP survey is conducted to correlate drilling data to seismic data. VSP involves placing geophones inside the well with a seismic source suspended from the drilling unit or another offset vessel. The seismic source is similar to a seismic survey array, although generally with a smaller output and shorter time frame (e.g., one to three days).

4.1.2 Key Issues and Concerns

Key issues and concerns associated with seismic exploration and other geophysical surveys relate primarily to underwater sound and physiological and behavioural effects on marine life and potential interference with fishing activities (e.g., through effects on fisheries resources and/or space conflict issues including potential damage to gear).

There are no new emerging issues or concerns related to seismic exploration that were not previously identified in the 1999 Panel Review or 2010 Review.

4.1.3 Updates in Knowledge and/or Environmental Management

The 2010 Review summarized key findings of studies on the physiological and behavioural effects of seismic noise on invertebrates and fish larvae and marine mammals and provided an overview of key mitigation measures as outlined in the Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP) (DFO 2007). Marine mammal monitoring techniques were identified, with vessel-based monitoring identified as the most common form of monitoring for seismic programs in Atlantic Canada. Passive acoustic monitoring (PAM) was acknowledged as a monitoring technique primarily reserved for research and development with limited industrial application.

Seismic sound has been the focus of much research in the last decade, including in Atlantic Canada where the Environmental Studies Research Fund (ESRF) program has supported several research projects in recent years on this topic. Recent ESRF research projects completed in Atlantic Canada related to seismic noise have focused on modelling (Deveau et al. 2018; Warner et al. 2018) and monitoring (Delarue et al. 2018; Smith et al. 2019) seismic sound and assessing potential risks to fisheries resources (Payne et al. 2015; Cote et al. 2020; Morris et al. 2021; ESRF project 2018-01S in progress). Delarue et al. (2018) contributed considerable new information on the occurrence of several species of marine mammals and the characterization of the underwater soundscape in Atlantic Canadian waters. Their findings suggest that there is potential for noise effects of anthropogenic activities on marine mammals in areas of overlap, primarily in the form of communication masking or habitat displacement.

The 2010 Review summarized several studies examining effects of seismic on commercial finfish and invertebrate species and concluded there was little to no evidence of fish mortality effects upon exposure to seismic sound under field operating conditions; however, variable short-term behavioural responses for certain fish species was noted. Behavioural effects on fisheries species and corresponding potential adverse effects on catch rates remains a concern for fish harvesters. In response to concerns raised by snow crab harvesters about potential impacts of seismic surveying on catch rates near commercial fishing areas, an ESRF study was undertaken between 2015 and 2017 to assess impacts on snow crab to exposure from industry seismic vessels on the Grand Banks of Newfoundland (Morris et al. 2019). The researchers confirmed there was no evidence of physical injury to snow crabs but indicated effects of seismic exposure on snow crab movement could not be ruled out completely (Cote et al. 2020; Morris et al. 2020). However, given the high natural variability in catch rates, potential changes in observed behaviour appear subtle and not a prominent threat to the fishery (Cote et al. 2020).

Sound exposure guidelines have been developed for fish (Popper et al. 2014), marine mammals (NMFS 2018; Southall al. et al. 2019; NOAA n.d) and sea turtles (Popper et al. 2014) to help predict the relative risk to marine animals potentially experiencing mortality, hearing impairment and behavioural effects from exposure to impulsive (e.g., seismic) and non-impulsive sound in the marine environment.

Predictive modelling results can then be compared to these guidelines to help predict zones of influence of effects in environmental assessments. Despite ongoing research efforts and advancements in developing sound exposure guidelines, there remain considerable gaps in the understanding of anthropogenic sound on fish and invertebrates, particularly in understanding particle motion as a stimulus (IAAC 2021) and cumulative effects of anthropogenic sound (DFO 2020a).

The SOCP remains a key mitigation for seismic surveys. In 2020, DFO's Canadian Science Advisory Secretariat completed a review of the SOCP and identified several potential modifications and additions for consideration if/when an update to the SOCP occurs (DFO 2020a). These recommendations for potential future updates to the mitigation measures in the SOCP relate to:

- Additional protection(s) for critical and important habitat for marine mammals and sea turtles
- Protocols for enhancing marine mammal and sea turtle impact mitigation and monitoring
- Acoustic modelling to determine the appropriate size of the safety zone and in-field verification to validate zone size
- More specific guidance and protocols for marine mammal observers (MMO) and PAM
- Data collection, data sharing, and reporting requirements

Since 2010, there have been few seismic programs conducted in the Canada-Nova Scotia Offshore Area. Shell Canada Limited and BP Exploration (Canada) Limited each completed large 3D WAZ seismic programs over their deepwater exploration licences on the Scotian Slope in 2013 and 2014, respectively. Underwater sound modelling was conducted as part of the EA process and sound source verification monitoring was conducted during the seismic survey, along with marine mammal monitoring. Both seismic programs employed visual and acoustic (PAM) monitoring techniques.

4.2 DRILLING

4.2.1 Activity Description

Drilling is conducted to confirm the presence of petroleum hydrocarbons within a targeted geological structure (exploration drilling), delineate the extent of the resource (delineation drilling) and/or increase accessibility to the resource during production (development drilling). Depending on water depth, oceanographic conditions and rig availability, wells may be drilled by a jack-up rig, drillship, or semi-submersible rig. All of these drilling units have been used in drilling programs offshore Nova Scotia.

Wells are drilled in successive stages (sections), with each section becoming narrower in diameter as it reaches deeper into the seafloor. Drilling fluids (also referred to as drilling muds) can be water-based or synthetic-based, and are used to lubricate the drill bit, help maintain pressure against reservoir fluids, and carry rock cuttings through a riser (conduit) back up to the rig for processing. During the drilling of the initial hole sections for the well, before a drilling riser has been installed, the cuttings and associated drilling muds are released onto the seafloor. Water-based muds are used for these initial hole sections. After the initial well section has been drilled and a drilling riser is installed, water-based or synthetic-based muds can be used for drilling hole sections. Cuttings are carried through the riser back to the rig where they are separated from the drilling muds so the drilling muds can be recovered and reused in the process. In Atlantic Canada, cuttings associated with water-based mud use may be disposed overboard during the drilling process whereas cuttings associated with synthetic-based mud must first be treated to reduce oil concentration on cuttings before they are permitted for offshore disposal. Spent drilling fluids and contaminated cuttings not permitted for offshore disposal are brought back to shore for treatment and disposal.

Once an exploration well has been drilled to its target depth, a series of well evaluation programs (e.g., VSP survey) may be completed. Following this, the exploration well is plugged using cement and/or mechanical barriers at different intervals within the wellbore and abandoned. The wellhead may be removed from the secured wellbore or, as was the case in the most recent exploration drilling programs conducted offshore Nova Scotia between 2014 and 2018, approval is sought to leave the wellhead in place on the seafloor. Exploration wells are not used for producing hydrocarbons.

Development drilling generally involves drilling several wells (resulting in increased quantities of drilling discharges within a concentrated area) and requires additional infrastructure such as different and/or more drilling platforms, pipelines and/or flowlines (Oak 2020) (Section 4.3).

Depending on water depth and geological conditions (including depth of intended target), drilling an offshore well can take anywhere from 30 days to more than 120 days. During the drilling program, helicopters and vessels are used to transport personnel and supplies between a shorebase and drilling location.

4.2.2 Key Issues and Concerns

Key issues and concerns related to routine drilling activities include burial and toxicity effects to benthic species from discharges of drilling muds and cuttings; marine and migratory bird attraction to artificial lighting on drilling rigs and incineration during flaring/well testing; and impacts of underwater sound on fish, marine mammals and sea turtles including communication masking and displacement from important habitats (e.g., spawning, feeding and nursery areas) (CNSOPB 2021a). Vessel traffic associated with supply and servicing in drilling programs represent a relatively minor contribution to existing vessel traffic (e.g., fisheries vessels, cruise ships, tankers, container ships) offshore Nova Scotia but can contribute to adverse effects on the marine environment through ship-source pollution and wastes, underwater sound and risk of collisions with marine mammals and sea turtles. If wellheads are left in place on the seafloor at the end of a drilling program, they may become colonized by benthic invertebrates and can potentially represent a snagging hazard if located in shallower waters. However, abandoned wellheads are marked on nautical charts and are only approved to remain in place if they do not represent a hazard to fisheries. Safety zones are maintained around drilling rigs for the duration of the drilling program and exclude non-project vessels (e.g., fishing vessels) within a specified radius (usually 500 m).

There are no new emerging issues or concerns related to exploration drilling that were not previously identified in the 1999 Panel Review or 2010 Review.

4.2.3 Updates in Knowledge and/or Environmental Management

While no new issues or concerns have emerged in the last decade, there have been notable advancements in regulatory oversight, knowledge of effects and mitigative requirements pertaining to drilling.

Regulatory Oversight

With the implementation of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and successive legislation in 2019, the *Impact Assessment Act (IAA)*, federal environmental assessment requirements and associated regulatory oversight for offshore exploratory drilling programs have changed. Reviews are occurring over longer time periods and involving considerably more Indigenous and stakeholder engagement than ever before.

In 2019, a Regional Assessment of Exploratory Drilling East of Newfoundland and Labrador was initiated. Shortly after its publication in 2020, a Ministerial Regulation was issued, exempting exploratory drilling within a defined study area from undergoing a project-specific impact assessment under the IAA (although still subject to regulatory review by the C-NLOPB under the Accord Acts). In contract, exploratory drilling programs conducted outside the Regional Assessment study area (i.e., future drilling offshore Nova Scotia) are still required to be assessed under the IAA in addition to the Accord Acts.

During this time period, there have also been changes in regulatory oversight of drilling operations under the Accord Acts. In December 2010, the National Energy Board (now the Canadian Energy Regulator), C-NLOPB and CNSOPB updated the Offshore Waste Treatment Guidelines (NEB et al. 2010), which reinforced minimum performance targets for drilling related emissions and discharges and emphasized the importance of project-specific Environmental Protection Plans (EPPs) for environmental management. Although use of oil-based muds (OBM) is not prohibited, the Offshore Waste Treatment Guidelines indicate that that OBM would only be approved for use in exceptional circumstances. In August 2017, the C-NLOPB and CNSOPB also updated the Drilling and Production Guidelines (C-NLOPB and CNSOPB 2017), which assist in understanding the requirements of the *Drilling and Production Regulations*, recognized as goal- or performance-based regulations. Additional regulatory updates pertaining to accidental events during drilling are discussed in Section 4.4.

Environmental Mitigation and Monitoring

With an emphasis on operator accountability, there has been an increased focus on data collection and environmental monitoring during drilling programs to better understand and mitigate potential effects. Attraction to artificial lighting on offshore drilling and production platforms has long been understood as a potential pathway of direct mortality or injury for marine birds. Long-term monitoring studies have shown Leach's storm-petrel to be the most common species stranded on vessels in Atlantic Canada (Davis et al. 2017). This species has experienced significant declines in the last few decades in Atlantic Canada and elsewhere (Hedd et al. 2018; Rodrĩguez et al. 2019; Wilhelm et al. 2019). Although it is recognized that the potential for interactions and effects is greater for production platforms than drilling rigs, operators conducting exploratory drilling programs are expected to adapt similar monitoring and mitigation procedures.

Pelagic seabird monitoring programs have become more scientifically rigorous, with updated data collection protocols (e.g., Eastern Canada Seabirds at Sea [ECSAS] standardized protocol for pelagic seabird surveys from moving and stationary platforms [Gjerdrum et al. 2012]). Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada (ECCC 2016) were developed, with the expectation that operators would document interactions with marine and migratory birds and mitigate accordingly to reduce injury and/or mortality events. Flaring during exploration drilling is not a common activity, but if it is planned to occur during testing, operators are expected to try to avoid periods of migratory bird vulnerability and provide advance notice to the CNSOPB with plans to prevent harm to or killing of migratory birds (CNSOPB 2021a).

In recent years, there has also been an increased focus on mitigating effects of drilling in areas with defined benthic conservation objectives (e.g., Sensitive Benthic Areas), particularly in the Canada-Newfoundland and Labrador Offshore Area, where exploration licences were issued within an area that was subsequently designated as a marine refuge to protect corals and sponges (Northeast Newfoundland Slope Closure). Recommendations for mitigation measures in areas with defined benthic conservation objectives related to discharges (exploration and production) include reinjection of cuttings, the establishment of setbacks/buffer zones based on detailed dispersion modelling, and habitat delineation with high-resolution mapping (DFO 2019b).

Environmental effects monitoring (EEM) programs associated with development drilling at various producing fields in the eastern Canada-Newfoundland and Labrador Offshore Area continue to validate environmental assessment predictions and contribute to an understanding of drilling effects on the marine benthos and marine fish. EEM programs conducted for the four existing production projects on the Grand Banks of Newfoundland (Hibernia, Terra Nova, White Rose, and Hebron) have confirmed drilling effects on the marine benthos are relatively localized. Synthetic-based mud appears to have relatively low toxicity with effects confined to tens of metres from cuttings piles (Whiteway et al. 2014; Suncor Energy 2019; Husky Energy 2019; HMDC 2019) and little to no evidence of adverse effects on benthic abundance, biomass, richness and diversity extending beyond 2 km (Neff et al. 2014; Suncor Energy 2019).

Since the 2010 review, there have been two exploratory drilling programs conducted in the Canada-Nova Scotia Offshore Area. Shell Canada Limited and BP Canada Energy Group ULC each conducted deepwater drilling programs on the Western Scotian Shelf. As part of the Shelburne Basin Venture Exploration Drilling Project, Shell drilled two deepwater wells between 2015 and 2016. BP Canada Energy Group ULC drilled a single well in 2018 for the Scotian Basin Exploration Drilling Project. Both drilling programs were subject to environmental assessment under the Accord Acts and CEAA 2012.

Regulatory approval conditions for both drilling programs were considerably more specific than those issued for drilling programs in the previous decade and included additional consultation and engagement, and monitoring and follow-up programs to validate predictions of drilling discharges and underwater sound emissions presented in their respective environmental impact statements. Both operators were required to conduct benthic video surveys at each wellsite prior to and following the drilling programs to characterize the benthic habitat and validate predictions on drill waste deposition. Visual surveys verified the zone of drill waste deposition to be generally consistent with predictive modelling evidence of sediment deposition observed out to approximately 325 m from the wellhead (Stantec 2019). Most visible evidence of deposition occurred within 30 m (Stantec 2019) to 75 m (Stantec 2017) from the wellhead. For both exploration drilling projects, the distribution, species types, and relative numbers of macrofauna observed during post-drill surveys were similar to those observed during pre-drill surveys (Stantec 2016, 2017, 2019). If the pre-drill surveys identified any habitat-forming corals or sponges, or other environmentally sensitive features, the operators were required to move the drilling unit to avoid affecting them, or consult with the CNSOPB to determine an appropriate course of action (Minister of Environment 2015; Minister of Environment 2018).

Speed restrictions were also identified for supply vessels to reduce risk of collisions with marine mammals and sea turtles. Both operators were also required to conduct acoustic monitoring during their respective drilling programs, to help validate acoustic modelling and effects predictions. All three deepwater wells received approval to leave abandoned wellheads on the seafloor, following consultation and engagement with Indigenous and commercial fishers.

4.3 DEVELOPMENT AND PRODUCTION

4.3.1 Activity Description

If commercial quantities of hydrocarbons are discovered during exploration drilling, an operator may apply to have it declared a commercial discovery and apply to the CNSOPB for a production licence for the opportunity to produce petroleum for commercial use. Development includes infrastructure planning and drilling of development wells, while production is the subsequent period during which a field and its associated infrastructure are used to produce oil or gas (Oak 2020). Depending on the size of the reservoir, it may be developed from one or two wells or may have several production wells linked through subsea flowlines back to a central facility. In the offshore environment, oil and gas are typically produced at fixed platforms with subsea pipelines to transport product to shore or floating production storage and offloading (FPSO) facilities. Where FPSO facilities are used, crude oil is offloaded into large shuttle tankers for shipment.

When the field is exhausted, the wells are plugged and abandoned, and production infrastructure is decommissioned (Oak 2020). As with exploration drilling programs, helicopters and vessels are used to transport personnel and supplies between a shorebase and the offshore production facility. Given the larger size and longer timeframe of production projects, additional staff and service providers are required and shorebase facilities are generally more extensive.

4.3.2 Key Issues and Concerns

Environmental interactions and effects on the marine environment for development and production are similar to those associated with exploration drilling (Section 4.2), albeit generally with larger footprints and longer timeframes (years instead of months). Production projects require additional wells and infrastructure (e.g., platforms, flowlines, pipelines), presenting increased impacts to benthic species and habitats.

Production also usually results in the discharge of large quantities of produced water and other marine discharges, increasing exposure of benthic species and habitats to low concentrations of contaminants (Oak 2020). Produced water, comprised of inorganic salts, metals, radioisotopes, production chemicals (e.g., biocides and emulsion breakers), and a wide variety of organic chemicals (e.g., organic acids, petroleum hydrocarbons, and phenols) represents the largest volume (up to 80%) waste stream in oil and gas production operations (DFO 2011).

Another differentiating factor between effects of exploration and production is the long-term presence of production infrastructure (e.g., wellheads, flowlines, pipelines) which introduces hard substrate in the water column and on the seafloor. This introduced “hardscape” supports sessile epifauna and attracts fish and invertebrates, creating an artificial reef effect (Oak 2020).

With the transport of crude oil through pipelines or tankers, production projects introduce another potential pathway for oil spills that does not exist during exploration drilling programs.

There are no new emerging issues or concerns related to development and production that were not previously identified in the 1999 Panel Review or 2010 Review. However, as noted in Section 4.3.3, there has been an increased focus on GHG emissions and climate change in the last decade.

4.3.3 Updates in Knowledge and/or Environmental Management

Many updates in knowledge and/or environmental management related to drilling (Section 4.2.3) would also apply to development and production including updates to the Offshore Waste Treatment Guidelines (NEB et al. 2010) and Drilling and Production Guidelines (C-NLOPB and CNSOPB 2017). The key difference in environmental impacts between exploration and production projects is the difference in spatial and temporal footprints and differences in marine (e.g., produced water) and atmospheric (GHG) discharges and potential for spills during transport of crude oil (Section 4.4).

With the decommissioning of the SOEP and Deep Panuke projects in Nova Scotia, there has been less attention on development and production in the province. Learnings from production projects on the Grand Banks of Newfoundland are particularly helpful in improving an understanding of environmental effects. Production projects generally extend over longer timeframes and are required to conduct EEM programs to validate effects predictions and mitigation effectiveness. A summary of EEM results pertaining to drilling and effects on sediment quality is presented in Section 4.2.3. A summary of EEM results pertaining to produced water discharges is presented below.

Produced Water

In general, EEM results have confirmed that produced water dilutes rapidly once it is discharged. EEM results for Terra Nova and Hibernia have confirmed effects on water quality are limited to near the point of discharge (i.e., less than 50 m) (Suncor Energy 2019; HMDC 2019). White Rose EEM results reported low levels of some produced water constituents were detected at near-field stations, approximately 300 m from the *SeaRose* FPSO, although an analysis of general trends in seawater chemistry does not indicate any project effects on water quality at the White Rose field (Husky 2019). Produced water discharges were not continuous for the Hebron project in 2018 and therefore water quality testing was not part of the 2018 EEM (ExxonMobil Canada Properties 2021).

With respect to commercial fish study components, EEM reports for the various projects indicate detection of minor differences between study and reference areas, but little evidence of adverse effects on commercial fish and no evidence of tainting. Hibernia EEM results of the fish health surveys and body burden analyses reveal that, in general, there are no significant differences observed between fish collected from project areas (Hibernia Platform or Hibernia Southern Extension) compared to those collected from reference sites 50 km away (HMDC 2019). For the Terra Nova project, Suncor Energy (2019) reported no effects on American plaice; while some tissue contamination was found in Iceland scallop, this contamination has been found to be decreasing over time and has never translated into tainting of the resource. Husky's White Rose 2016 EEM reported that analyses of tissue chemistry, taste and fish health has revealed no compelling evidence of effects of project activities (including produced water discharges) on commercial fish (Husky 2019). EEM results for the Hebron Project indicated minor differences in commercial fish between the study and reference areas, including larger fish at the Hebron platform, but that fish from either sampling area were indistinguishable in the taint (taste) tests (ExxonMobil Canada Properties 2021).

Climate Change and GHG Reduction

One of the most important issues that has received the greatest attention in the past decade on a global scale is that of climate change. Recognizing the importance of reducing GHG emissions to help reduce climate change impacts, the Government of Canada has established GHG emission reduction targets and committed to achieve a net-zero emissions economy by 2050, through the introduction of the *Canadian Net-Zero Emissions Accountability Act* (ECCC 2021). This legislation follows the Pan-Canadian Framework on Clean Growth and Climate Change introduced by the Government of Canada in 2016. Objectives of this Framework include, among other objectives, reducing of methane emissions from oil and gas by 40-45% below 2012 levels by 2025 (Government of Canada 2016). To help fulfill this commitment, in 2020, the Government of Canada introduced the *Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector) in 2020* These regulations provide a flexible approach for operators to plan and implement strategic solutions to reduce emissions and establish operating, inspection and maintenance standards to address unintentional emissions.

In addition to the various federal policies and regulations, provincial regulatory instruments are also being used to regulate and reduce GHG emissions to help achieve national and provincial targets. In Nova Scotia, the *Sustainable Development Goals Act* was introduced in 2019 which sets GHG emission targets and mandates the creation of a Climate Change Plan for Clean Growth. *Cap-and-Trade Program Regulations*, which came into effect in 2019, set annual allowances for GHG emissions from certain activities in the province. Although 75% of Nova Scotia's GHG emissions in 2016 came from electricity and heat generation and transportation, the Regulations apply to a wide range of activities, including oil and gas sector related activities (which contributed approximately 3% of provincial totals in 2016) such as petroleum and natural gas production and natural gas processing; operation of equipment related to the transmission, storage and transportation of natural gas; and natural gas distribution (Province of Nova Scotia 2019). In October 2021, the newly elected provincial Conservative government introduced legislation entitled the *Environmental Goals and Climate Change Reduction Act*. The Act establishes 28 new environmental, emissions reduction and economic development goals, and will be supported by the Climate Change Plan for Clean Growth containing specific measures to achieve these goals.

Technological advances by the oil and gas industry to reduce emissions during production include reduction of flaring, process heat optimization, thermal insulation, and fugitive emission leak detection and repair management programs. In 2020, the IMO's amendment to Annex VI of the International Convention for the Prevention of Pollution from Ships (known as "IMO 2020") came into effect, substantially reducing allowable sulphur content in fuel oil for ships operating outside designated emission control areas (IMO 2020). Emissions from burning fuel compliant to IMO 2020 will not only reduce air pollution but may also result in reduction of GHG emissions as cleaner fuels like natural gas are used to fuel ships and/or onshore power supply and when ships are berthing.

Although there is currently no existing offshore petroleum production project in Nova Scotia, future projects would be required to predict annual GHG emissions and demonstrate conformance with federal and provincial regulatory requirements, amidst increasing social and political pressures to achieve a cleaner and more sustainable energy future for the province.

4.4 ACCIDENTAL RELEASES (SPILLS AND BLOWOUTS)

4.4.1 Activity Description

Accidental events could occur during seismic exploration, exploration drilling, and development and production activities and result in unplanned and unauthorized releases to the marine environment. The CNSOPB defines "spills to the sea" as any discharge of petroleum or any other refined petroleum product that enters the sea in the offshore area as result of oil and gas activities, other than one that is authorized under the Accord Acts. An "unauthorized discharge" is when a substance or mixture is discharged from a production or drilling installation in an amount or concentration in excess of the limits described in an operator's EPP, or the substance or manner of discharge is not described in the EPP (C-NLOPB and CNSOPB 2018).

Batch spills of petroleum or unauthorized discharges of other substances are the most the common type of unplanned release associated with petroleum operations in Atlantic Canada (CNSOPB 2021a; IAAC 2021). These types of accidental releases are generally of short duration (may be instantaneous) and are generally the result of equipment failures or human error (IAAC 2021). An example of a recent accidental discharge in the Canada-Nova Scotia Offshore Area was the unauthorized release of approximately 136 m^3 of synthetic-based mud during the drilling of exploratory well Aspy D-11 by BP Canada Energy Group in June 2018. An investigation into the incident concluded the cause of the incident was a failed connection in the mud boost line that was fastened to the marine riser and that the discharge did not result in significant adverse environmental effects (CNSOPB 2019).

A blowout represents an uncontrolled, continuous release of hydrocarbons from a well and can occur underwater (generally at the seabed) or at the surface (at the drilling equipment on the installation) during drilling. There have been two well blowouts offshore Nova Scotia since the first well was drilled in 1967: a surface blowout at an exploratory gas well in 1984, and a subsurface blowout in 1985 (no release to the environment). There have been no blowouts in the Canada-Newfoundland and Labrador Offshore Area.

Spills may also occur during transport of hydrocarbons (e.g., from a tanker or pipeline). The largest spill from an offshore oil and gas operation in Canadian history occurred on November 16, 2018 when approximately 250,000 litres of crude oil leaked from a subsea flow line associated with the White Rose Oil Development Project (C-NLOPB 2018). Large spills from tanker incidents in Canadian waters are rare but have occurred in the past, including the 1970 grounding of the *Arrow* offshore Nova Scotia which remains the largest oil spill in Canada. The tanker hauling 9,500 tonnes of Bunker C fuel oil ran aground near Port Hawkesbury, Nova Scotia spilling most of its cargo and contaminating 75 miles of shoreline (Lee et al. 2015).

Between 2010 and 2020, the CNSOPB reports there have been 77 spill incidents in the Canada-Nova Scotia Offshore Area, with 53 (69%) of those spill incidents being less than 1 L in volume (CNSOPB 2021a; CNSOPB 2021e). As presented in 2010 Review (Stantec 2010a), the number of spills reported by the CNSOPB in the previous decade (1999-2009) was 161 with 59 (37%) of spill incidents being less than 1 L in volume. A comparison of spill frequency and volumes over the last two decades shows a decreasing trend.

4.4.2 Key Issues and Concerns

The risk and consequence of an oil spill is the greatest environmental concern associated with oil and gas exploration and production activities. The environmental consequences of an accidental spill or release can vary considerably depending on various circumstances (e.g., chemical properties, spill volume, environmental and oceanographic conditions, time of year, sensitivity of receptors), although even small amounts of hydrocarbons can have detrimental effects on marine wildlife, particularly for marine birds. Effects on fisheries can also vary and can include biological effects on fisheries resources, loss of access (e.g., restrictions in fishing areas), damage (e.g., fouling) to gear, and reduced marketability of seafood due to actual or perceived quality issues.

Predictive modelling conducted during environmental assessments and/or oil spill contingency planning processes is used to predict the fate and behaviour of spilled hydrocarbons, including the spatial extent of a surface slick or in-water plume, potential duration of exposure, and probability of shoreline interaction. This information can then be used to predict adverse environmental effects and inform spill response measures.

DFO (2011) summarized oil spill trajectory modelling for a hypothetical spill (summer conditions) on the Northeast Peak of Georges Bank. It suggested that under light wind conditions, trajectories would likely be influenced by the residual current and slicks would generally move to the south and southeast. Under storm conditions, surface water movement would be more likely driven by the winds and the slick would move in the direction of the prevailing wind. In either case, given the distance between Georges Bank and the shoreline, as well as the residual current, it is expected that a large portion of the slick would evaporate and disperse during transit, with a low probability of shoreline oiling. DFO (2011) also presented potential residence time of passive particles on Georges Bank with the objective to assess fate of marine spills introduced to the Bank and various influences on retention and dispersion and dilution processes. Recognizing that there are temporal and seasonal variations, including the location on Georges Bank and the occurrence of storms and other point source events, the general residence time of passive particles attributed to a gyre circulation range from 20 to 80 days. This estimate was based on drifter and model studies (DFO 2011).

In the observational and modeling studies conducted by the U.S. GLOBEC program on Georges Bank and described in DFO (2011), the near-surface drift patterns and residence time estimates at 10 m water depth revealed a clockwise gyre around the Bank with typical residence times of 40 days in winter to 90 days in summer. The residence time for the potential effects from any oil spill on Georges Bank, however, would need to consider such factors as the type of hydrocarbon product spilled, emulsification and weathering of the product for example, which would require project-specific oil spill modelling with spatial and seasonal considerations.

Since the 2010 Deepwater Horizon Oil Spill in the Gulf of Mexico, there have been considerable advancements in the understanding and mitigation of oil spill effects (Section 4.4.3). In response to this event, however, new concerns emerged with respect to effects of oil spill response, most notably effects of dispersant use on marine life. Updates in knowledge and environmental management of spills (including dispersant use) are described below in Section 4.4.3.

4.4.3 Updates in Knowledge and/or Environmental Management

In general, the frequency of large oil spills worldwide has decreased significantly over the past few decades (API 2009). During the 1990s, total inputs of oil from anthropogenic sources (e.g., spills, urban runoff, vessel and facility operations) in coastal areas of Eastern Canada have averaged 9,000 barrels (bbl) annually, and in offshore areas, 2,700 bbl annually, for a total of 11,700 bbl. Spill volumes off Eastern Canada have decreased significantly in the last decade to about 600 bbl (BHP Canada 2020). Occasional tanker spills have provided the greatest threat to the region in the past.

According to data from the International Tanker Owners Pollution Federation (ITOPF 2020), the average number of tanker spills per year (worldwide) in the 1970s was about 79 and decreased by over 90% to an average of 6 spills per year in the 2010s. In the year 2020, the number of oil spills recorded was less than the annual average recorded for the previous decade.

The largest accidental oil spill in U.S. history occurred on April 21, 2010 when a loss of well control and subsequent explosion and fire on the *Deepwater Horizon* oil rig occurred in the Gulf of Mexico. Although the 2010 Review acknowledged the Deepwater Horizon oil spill, the significance of this event and how it would affect future drilling operations and spill contingency planning were not fully understood at that time. In the years that followed, considerable knowledge has been gained which has changed the way operators, regulators and scientists predict, evaluate, and respond to oil spills. These include, but are not limited to: technological advancements in oil spill trajectory modelling; remote sensing of oil slicks and oil spill response technology; new research and assessment developments (e.g., oil toxicity science, natural resource damage assessments); and regulatory improvements. There were also lessons learned around effects on fisheries from the Deepwater Horizon oil spill which have resulted in updates in the Atlantic region, such as technological advancements, research and assessment, regulatory improvements and specific lessons learned for fisheries.

Technological Advancements

Subsea dispersant injection (SSDI) and the invention of a specialized piece of equipment (well capping stack) used to “cap” the well flow are two examples of technological innovation which occurred during Deepwater Horizon oil spill. SSDI involves adding spill-treating agents directly to the fluid releasing from the well with the intent to limit the formation of a surface oil slick (thereby reducing interaction with surface receptors including marine birds and response workers) and optimizing the potential for microbial biodegradation in the water column. This approach to dispersant application had not previously been used during previous well control events. A capping stack, which temporarily stops or redirects the well flow while work is undertaken to permanently kill the well (e.g., through drilling a relief well), was also invented as a well control measure during the Deepwater Horizon oil spill. Subsea well capping stacks are now staged in strategic locations around the world for deployment in the event of a well control incident. Operators proposing drilling programs in the Canada-Nova Scotia Offshore Area must include, as part of their Activity Authorization application, a well containment plan which outlines the resources and logistics associated with mobilizing and installing a capping stack in the event of a loss of well control.

Research and Assessment

The Deepwater Horizon oil spill provided an unprecedented opportunity for research collaboration and development of innovative solutions. Wildlife rescue efforts, natural resource damage assessments and ongoing monitoring programs have provided an improved understanding for assessing impacts of oil spills on benthic ecosystems, marine mammals, sea turtles and birds This information is being used to help inform protection and restoration of wildlife during future oil spills (e.g., Guidelines for Assessing Exposure and Impacts of Oil Spills on Marine Mammals [Sullivan et al. 2019]). Unprecedented remediation and restoration efforts funded by a historic environmental damage settlement have advanced the understanding of ecosystem level effects and resiliency, with ongoing restoration and monitoring programs continuing to contribute to this field for years to come.

Although not necessarily directly linked to the Deepwater Horizon oil spill, the Government of Canada has made a considerable investment in recent years in research and assessment pertaining to oil spills and response. In 2015, the Royal Society of Canada (RSC) Expert Panel was established in response to a request from the Canadian Energy Pipeline Association (CEPA) and the Canadian Association of Petroleum Producers (CAPP) because of widespread recognition of the knowledge gaps related to accidental spills of crude oil in aquatic ecosystems and the need for research to inform policies, regulations and practices related to spill prevention and response. Although the scope of the RSC Expert Panel review extended beyond accidental spills from offshore oil and gas exploration and production, the learnings and critical research areas identified in the Panel's *Report on Behaviour and Environmental Impacts of Crude Oil Released into Aqueous Environments* (Lee et al. 2015), are applicable and advance research discussions which can serve to inform future spill response planning.

Aligned with the recommendations in the RSC Expert Panel Report (Lee et al. 2015), the Multi-Partner Research Initiative (MPRI) was established under Canada's Oceans Protection Plan in 2017. Led by DFO, the goal of MPRI is to build a research network that brings together scientific expertise in oil spill research to advance scientific knowledge to support decision making on oil spill response and remediation strategies and enhance Canada's response "toolkit" (DFO 2021d). As of spring 2021, over $35 million in grants and contributions have been awarded to 40 projects and partnerships involving over 240 researchers from 60 institutions and 12 countries (DFO 2021d).

Regulatory Improvements

Parallel to advancements in science and technology, regulatory improvements have also occurred since the Deepwater Horizon oil spill. In Canada, regulatory changes were made to strengthen the safety and security of offshore oil exploration and production with the implementation of the *Energy Safety and Security Act* in 2015. This Act amended the Accord Acts and the *Canada Oil and Gas Operations Act* with the intent of improving oil spill prevention, response, and accountability and established a legal framework to permit the safe use of spill-treating agents (e.g., dispersants) in specific circumstances. Subsequently, in 2016, the federal Minister of Environment released the *Regulations Establishing a List of Spill-treating Agents*, allowing the CNSOPB to authorize the use of one or more of the spill-treating agent products listed in Schedule 1 of the Regulations.

As a result of these regulatory changes, operators who are proposing drilling programs are now required to conduct a spill impact mitigation assessment (SIMA) (also referred to as a net environmental benefit analysis or NEBA) as part of their oil spill response planning process. The SIMA/NEBA is a tool used to assess the impacts of spill response methods to help inform decision making on which response tools should be used under a particular set of circumstances with the goal of minimizing overall harm once a spill has occurred. For example, the consequences of using spill-treating agents to move the oil into the water column as part of a spill response are evaluated against potential impacts of leaving the oil on the water surface. Operators are also required to conduct oil spill trajectory modelling and emergency response drills and exercises to help assess and improve emergency response plans.

Lessons Learned for Fisheries

Following the Deepwater Horizon oil spill, there were no documented cases of fish-kills in offshore waters but many fisheries were closed intermittently due to increased potential for oil contamination of pelagic seafood species (Beyer et al. 2016). Monitoring found little evidence of significant seafood contamination (Ylitalo et al. 2012), yet there was a consumer perception that seafood from the Gulf of Mexico posed a health risk to consumers (McKendree et al. 2013). Studies examining the effects of the Deepwater Horizon oil spill on commercial fisheries in the Gulf of Mexico found substantial short-term losses to fisheries but a high degree of resiliency and quick recovery after closures were ended (Fiore et al. 2020).

One Ocean is an inter-industry liaison organization that was developed in Newfoundland and Labrador to facilitate effective communication between the offshore fishing and petroleum sectors. Although a similar organization does not exist in Nova Scotia, the learnings and tools developed by One Ocean may be useful for future application in Nova Scotia as appropriate. Following the Deepwater Horizon oil spill, One Ocean organized an inter-industry delegation tour to the Gulf of Mexico in October 2010 to better understand lessons learned from that incident and the potential applicability of those findings to the Newfoundland and Labrador environment. Five key findings from the study tour were as follows (One Ocean 2017a):

- The fishing industry played a vital role in oil spill response
- The compensation process and procedure was not understood
- The fishing industry was negatively impacted by the spill
- The oil and gas industry did not have the infrastructure or equipment on hand for response
- Communication was a major issue

In the years that followed, One Ocean worked with fishing and petroleum industry organizations to better understand the applicability of these findings and suggest improvements to avoid similar outcomes should a large spill event occur in Newfoundland and Labrador (which could also be applicable to some extent in the future for Nova Scotia). Examples of advancements that have occurred relative to the findings are as follows:

- Enhanced participation of the fishing industry in industry-led spill response exercises
- Updates to the Compensation Guidelines (C-NLOPB and CNSOPB 2017)
- Industry investment in additional spill response equipment and enhanced response capability
- Development of the One Ocean Spill Communication Protocol (One Ocean 2017b) and the One Ocean Protocol for Exploratory Drilling (One Ocean 2021)

A key outstanding issue identified by One Ocean which requires further attention is compensation programs, processes and procedures. One Ocean is working on developing recommendations for compensation program best practices, with the aim that in the future, operators would adopt these recommendations as part of their oil spill plans for all offshore activities (One Ocean 2017a). As noted above, while One Ocean does not apply to the Canada-Nova Scotia Offshore Area, in absence of similar resources in the province, these tools and resources developed by One Ocean may be adopted as appropriate.

5.0 UPDATED ASSESSMENT OF POTENTIAL EFFECTS ON COMMERCIAL AND TRADITIONAL FISHERIES

Offshore petroleum activities (routine and accidental events) can interact with commercial and traditional fisheries directly through displacement from fishing areas or damage to fishing gear and equipment, and indirectly, through effects on fisheries species. These interactions could change the availability of fisheries resources and/or increase level of fishing effort and result in financial consequences for fisheries interests. In the event of an oil spill, estimates of loss in fisheries are dependent on the combination of the initial mortality of fish species, length of fisheries closures, and marketability of seafood (e.g., public perceptions of seafood safety and the degree of tainting (visible, taste, smell) of seafood) (Sumaila et al. 2012). It is difficult to quantify potential socio-economic impacts associated with these potential effects without discrete scenarios. Instead, pathways of effects on commercial and traditional fisheries are described below, focusing on updates since 2010 and outstanding issues of concern pertaining to potential petroleum activities on Georges Bank.

5.1 CHANGE IN ABUNDANCE, DISTRIBUTION AND/OR QUALITY OF FISHERIES RESOURCES

Underwater sound emissions and marine discharges as well as accidental releases associated with seismic, drilling programs, development and production projects may interact with marine fish resulting in sublethal effects and /or behavioural effects on fish. This could affect the abundance, distribution and/or quality of fisheries resources thereby resulting in impacts on commercial and traditional fisheries.

5.1.1 Residual Issues Identified in 2010

Key residual issues identified in the 2010 Review that could relate to a potential change in abundance, distribution and/or quality of fisheries resources include the following:

- Potential sublethal effects of seismic noise on individual fish, particularly for commercially-important fish species and species at risk
- Persistence of synthetic-based drilling mud and biological impact of drilling materials on benthic organisms
- Potential chronic and/or cumulative effects of produced water contaminants on the marine ecosystem
- Effects of spill countermeasures including the biodegradation of hydrocarbon compounds and bioavailability of toxic components in dispersants

5.1.2 Updates

Updates in knowledge and environmental management related to seismic and geophysical programs (Section 4.1.3), drilling (Section 4.2.3), development and production (Section 4.3.3), and accidental releases (Section 4.4.3) provide further insight to the understanding of, but do not eliminate the residual issues identified in 2010. Research studies continue to focus on sublethal effects of fish due to underwater noise and marine discharges as well as effects of spills and response measures.

EEM studies on the Grand Banks of Newfoundland examining effects of offshore production projects White Rose (Husky Energy 2019), Hibernia (HMDC 2019) and Terra Nova (Suncor Energy 2019) on fish health have generally shown no evidence of effects of project activities on commercial fish species. EEM results for the Hebron Project indicated minor differences in commercial fish between the study and reference areas, including larger fish at the Hebron platform (ExxonMobil Canada Properties 2021). There was limited evidence of tissue contamination for some species for some projects; however, none of the EEM studies for the four development projects have shown evidence of taint (taste) of test species (e.g., American plaice, Iceland scallop, snow crab) (ExxonMobil Canada Properties 2021; HMDC 2019; Husky Energy 2019; Suncor Energy 2019).

Based on local experience in Atlantic Canada, including EEM results and fisheries operations, there is no evidence that offshore petroleum activities are having an adverse effect on the abundance, distribution and/or quality of fisheries resources.

5.1.3 Outstanding Issues

In consideration of the limited evidence of effects on fish abundance, distribution and/or quality from routine oil and gas operations, key outstanding issues relate primarily to effects from a potential oil spill. The severity of a spill and effects on fish depends on various circumstances including chemical properties, spill volume, environmental and oceanographic conditions, time of year, and sensitivity of species. Recent improvements in spill prevention and response technology and procedures, and compensation and communication protocols will help reduce impacts on commercial and traditional fisheries that could occur as a result of effects on fisheries resources.

5.2 LOSS OF ACCESS AND/OR CROWDING

Safety zones established around oil and gas infrastructure to prevent damage to infrastructure and maintain safety and security of personnel exclude fishing activity within specific areas. Depending on the nature of the petroleum installation, this safety (exclusion) zone can remain in place for several weeks or several years. Safety zones associated with the SOEP and Deep Panuke Project were established around producing wells and platforms but were not extended to the export pipelines to shore. These safety zones are no longer in place with the decommissioning of the projects in 2020.

In the case of seismic exploration, a specific safety zone may not be delineated, but fisheries vessels are essentially excluded from active survey areas as enforced through fisheries liaison officers who are hired by seismic operators to communicate with fisheries interests while the survey is ongoing to avoid space conflicts. In other cases (e.g., subsea infrastructure such as pipelines), fishers avoid certain areas to reduce risk of gear loss or damage (Section 5.3), effectively creating unofficial exclusion zones.

5.2.1 Residual Issues Identified in 2010

The 1999 Review Panel and 2010 Review recognized potential conflict of space issues associated with the petroleum industry and other ocean users and expressed concerns that the displacement of vessels from Georges Bank would result in overcrowding in other areas. The 2010 Review identified no specific residual issues with respect to loss of access and exclusion of fisheries that would require additional research and consideration and concluded that successful coexistence of fisheries and petroleum interest requires effective consultation and coordination of activities.

5.2.2 Updates

Loss of access remains a valid issue of concern in the event that petroleum activities were permitted to occur on Georges Bank, however, it is unlikely that the implementation of safety zones around oil and gas infrastructure and associated exclusion of fishing activity in certain areas would "potentially result in socio-economic effects such as decreased landings and production values, increased cost of production to fishing industry, downward pressure on fishing industry employment and/or social welfare losses associated with lower tax revenues and increased social transfers" as characterized in the 2010 Review. Safety zones remain an important safety measure to help protect infrastructure and personnel, although the use of fisheries liaison officers and established communication protocols help to mitigate adverse effects on fisheries. Socio-economic effects associated with loss of access due to offshore petroleum activities have not historically been observed in the Canada-Nova Scotia Offshore Area. Given there are no production installations remaining and no seismic or exploration drilling programs are proposed in the Canada-Nova Scotia Offshore Area, the potential for cumulative effects associated with multiple safety (exclusion) zones is low.

5.2.3 Outstanding Issues

Loss of access and/or crowding could be a potential issue of concern depending on the location and extent of offshore petroleum activity. As indicated in the 1999 Panel Review and 2010 Review, successful coexistence of fisheries and petroleum interest will require effective consultation and coordination of activities. Of greater concern would be the implementation of fisheries closures in the event of a spill, particularly if the closure affected key fishing grounds and/or fishing seasons. At the peak of fisheries closures following the Deepwater Horizon oil spill, approximately 229,270 square kilometres (nearly 37% of federal waters in the Gulf of Mexico) were off-limits to fishing, although most closure areas were re-opened less than a year after the spill (Upton 2011). Fisheries closure under these circumstances are necessary to help protect human health and safety, including safety of harvesters and of seafood consumers, and also help prevent damage to gear. However, adverse effects associated with fisheries closures can be reduced through effective communication and compensation protocols. A large spill on Georges Bank could also result in fisheries closures although the extent and duration of such closures would depend on the type of hydrocarbon product spilled, location of the spill on the bank, seasonal effects of dispersion and fate of the spill, and potential overlap with fishing activities.

5.3 GEAR LOSS OR DAMAGE

Loss of or damage to fishing gear could occur from petroleum-fishery interactions during routine operations (e.g., entanglement) or in the event of a spill (e.g., gear fouling).

5.3.1 Residual Issues Identified in 2010

The 1999 Review Panel and 2010 Review acknowledged risk of gear loss or damage. At the time of the 1999 Panel Review, the Canadian Association of Petroleum Producers (CAPP) and fishing industry representatives were still negotiating a voluntary compensation regime for damages from petroleum-related activities. and the existence of compensation guidelines. The 2010 Review acknowledged advancements in mitigation such as the *Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity* developed jointly by the CNSOPB and C-NLOPB in 2002 and the Canadian East Coast Offshore Operators Non-attributable Fisheries Damage Compensation Program developed by CAPP in 2007. It was acknowledged that fisheries compensation remained an important issue, particularly with regard to compensation for restricted access or lost opportunity.

5.3.2 Updates

There is no publicly available data on incidents of fishing gear loss or damage due to interactions with petroleum industry in the Canada-Nova Scotia Offshore Area. Rouse et al. (2020) examined records of fisheries losses suffered by United Kingdom (UK) vessels interacting with oil and gas infrastructure within UK waters. Between 1989 and 2016, there were a total of 1590 incidents that resulted in a financial loss, vessel abandonment, or an injury/fatality for UK commercial fishers, although the data also showed a 98.6% reduction of annual recorded instances over this period. Most recorded incidents were associated with single otter trawlers and oil and gas production-related debris. Data was not provided for claims categorized as loss of fishing grounds, gear or access. A key finding of the study was that the offshore petroleum and fisheries industries should enhance data sharing practices to improve risk models and reduce the frequency and severity of incidents.

In February 2016, a revised 'polluter pays' regime came into effect through legislative amendments (e.g., updates to the Accord Acts), strengthening the liability regime in relation to the drilling for or development or production of petroleum or other petroleum-related work or activities. In 2017, the CNSOPB and C-NLOPB released the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity (CNSOPB and C-NLOPB 2017) to update the 2002 guidelines and provide guidance to parties adversely affected by authorized petroleum related work or activity. The legislative amendments and updated Compensation Guidelines recognize the risk of damage to the environment, the property, and the economic interests of third parties working and living in and adjacent to areas affected by authorized petroleum-related work or activities in the respective jurisdictions of the offshore Boards (CNSOPB and C-NLOPB 2017). The updated Compensation Guidelines define actual loss or damage eligible for compensation to include "income, including future income, and, with respect to any Aboriginal peoples of Canada, loss of hunting, fishing and gathering opportunities" (CNSOPB and C-NLOPB 2017). These updates undoubtedly represent mitigative improvements for fish harvesters, and through the expanded definition of losses and damages, highlight the need to include the full spectrum of potential losses in impact assessments.

5.3.3 Outstanding Issues

As indicated in Section 5.2, effective consultation and coordination of activities is important to reduce risk of gear loss or damage. Advancements in the compensation process to be implemented in the unlikely event of gear loss or damage represents a positive update since 2010. Nonetheless, gear loss or damage remains a potential issue of concern. Fisheries closures implemented in the event of a spill require further consideration regarding a compensation arrangement.

6.0 CONCLUSIONS

There have been considerable fluctuations in fisheries landings and values, with approximately half the number of active fishers and vessels on Georges Bank now than was the case over twenty years ago, yet the key species of importance remain the same (groundfish, lobster, and scallop) and the overall importance of the Georges Bank fishery is as important to the economy of southwest Nova Scotia today as it was in 1999. Total value of landings from Georges Bank have increased from about $90 million to $145 million in 2020. On a county-by-county basis in Southwest Nova Scotia the value of Georges Bank landings as a percentage of total fish landings within the county range between 10 and 47%. Fishery sector employment in the region account for over 11% of total employment.

The last decade has also seen a large change in offshore petroleum activity offshore Nova Scotia, with two (now inactive) production projects and two exploration drilling projects occurring on the Scotian Shelf and Slope. These projects contributed substantial socio-economic benefits to the province while they were active, with direct and indirect employment opportunities and expenditures, and in the case of production projects, significant royalty payments (e.g., approximately $3.4 billion between 2003 and 2013).

Since the 2010 Review, there have been several updates in knowledge and/or environmental management, including regulatory updates, that have improved our understanding and management of potential environmental effects of offshore petroleum activities. However, several key issues, including potential interactions with commercial and traditional fisheries which were raised in 1999 and again in 2010, remain relevant today.

These issues include:

- Physical and behavioural effects on marine species from seismic noise
- Drill muds and cuttings
- Produced water
- Accidental discharges (spills and blowouts)
- Greenhouse gas emissions and climate change
- Transportation issues (pipelines and tankers)

Environmental effects monitoring programs associated with recent and/or ongoing exploration and production projects offshore Nova Scotia and Newfoundland and Labrador, as well as collaborative research programs such as the Environmental Studies Research Fund and the Multi-Partner Research Initiative have resulted in additional knowledge and insight to many of these topics, informing effects assessments and key mitigation measures.

Two key factors which have had a strong influence in advancing science and technology and shaping regulatory policy and investment on a global scale with respect to offshore petroleum activities over the last decade are climate change and the Deepwater Horizon oil spill.

In the last decade, scientific evidence of climate change effects has become more widely accepted, world leaders have committed to achieving ambitious targets to achieve a low carbon energy future and the transition from fossil fuels to renewables has gained momentum. The focus of the oil and gas sector has advanced from GHG emissions accounting and reduction to striving to achieve net-zero carbon emissions. Although demand for fossil fuels remains relatively high, oil and gas operators are expanding their business strategies to include renewable energy sources. Future oil and gas exploration and development, if it were permitted to occur on Georges Bank, would need to be structured to support provincial and federal objectives and commitments regarding climate change.

The Deepwater Horizon oil spill, while a tragic event, provided an unprecedented opportunity for research collaboration and development of innovative solutions related to oil spill prevention and response. Considerable knowledge has been gained since the spill event in 2010 including technological advancements in well control, oil spill trajectory modelling and response technology, oil toxicity science, and natural resource damage assessments. In addition to advancing science and technology related to offshore oil and gas operations, this event also served as a catalyst for offshore regulatory updates here in Canada.

Since the 2010 Review, advances in scientific knowledge, mitigation, and regulatory requirements have improved performance and understanding of effects of the offshore oil and gas sector. Despite concerns, successful co-existence of fisheries and petroleum activities has been demonstrated offshore Nova Scotia, with both industries contributing substantially to the provincial economy.

7.0 REFERENCES

API (American Petroleum Institute). 2009. Analysis of U.S. Oil Spillage. Regulatory and Scientific Affairs Department. API Publication 356. August 2009 Prepared by Dagmar, Schmidt Etkin, Environmental Research Consulting.

Archibald, D. and James, MC. 2016. Evaluating inter-annual relative abundance of leatherback sea turtles in Atlantic Canada. Marine Ecology Progress Series. 547. 10.3354/meps11648.

Beyer, J., Trannum, H.C., Bakke, T., Hodson, P.V. and T.K. Collier. 2016. Environmental Effects of the Deepwater Horizon Oil Spill: A Review. Marine Pollution Bulletin, 110, 28-51.

Bernier, R.Y., Jamieson, R.E., and Moore, A.M. (eds.) 2018. State of the Atlantic Ocean Synthesis Report. Can. Tech. Rep. Fish. Aquat. Sci. 3167: iii + 149 p.

BHP Canada. 2020. BHP Canada. Exploration Drilling Project. Available at: rpt_ (iaac-aeic.gc.ca)

Bolduc, F., F. Rosseu, C. Gjerdrum, D. Fifield, and S. Christin. 2018. Atlas of Seabirds at Sea in Eastern Canada 2006 - 2016. Environment and Climate Change Canada, Canadian Wildlife Service, https://open.canada.ca/data/en/dataset/f612e2b4-5c67-46dc-9a84-1154c649ab4e Accessed: 23 April 2019.

Byrne, M. and S. Fitzer. 2019. The impact of environmental acidification on the microstructure and mechanical integrity of marine invertebrate skeletons. Conservation Physiology. 7: 1-21.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board) and CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). 2017. Drilling and Production Guidelines.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board) and CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). 2018. Incident Reporting and Investigation Guideline.

CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). 2019. Unauthorized Discharge of Drilling Mud Incident Summary Report. BP Canada Energy Group ULC Scotian Basin Exploration Project. Aspy D-11 Exploration Well. November 2019. Available at: https://www.cnsopb.ns.ca/sites/default/files/resource/bp_sbm_incident_summary_report.pdf

CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). 2021a. Western Scotian Shelf and Slope Strategic Environmental Assessment. March 2021. Prepared by Stantec Consulting Ltd.

CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). 2021b.Cohasset Panuke. Available at: https://www.cnsopb.ns.ca/offshore-activity//legacy-production-projects/cohasset-panuke.

CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). 2021c. Sable Offshore Energy Project. Available at: https://www.cnsopb.ns.ca/offshore-activity/current-activity/sable-offshore

CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). 2021d. Available at: https://www.cnsopb.ns.ca/offshore-activity/current-activity/sable-offshore

CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). 2021e. Spills to the Sea April 1-December 31, 2020. Available at: https://www.cnsopb.ns.ca/sites/default/files/resource/spills_to_the_sea_quarterly_april012020_dec312020.pdf

Coates. 2019. The Marshall Decision at 20. Two Decades of Commercial Re-Empowerment of the Mi'kmaq and Maliseet. Accessible at: 20191015_Marshall_Decision_20th_Coates_PAPER_FWeb.pdf (macdonaldlaurier.ca)

COSEWIC. 2010. COSEWIC assessment and status report on the Spiny Dogfish Squalus acanthias, Atlantic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 50 pp. Available at: (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. 2011. COSEWIC assessment and status report on the Atlantic Sturgeon Acipenser oxyrinchus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiii + 49 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

COSEWIC. 2014. COSEWIC assessment and status report on the Red-necked Phalarope *Phalaropus lobatus* in Canada. Available at: Red-necked Phalarope,Phalaropus lobatus (publications.gc.ca)

COSEWIC. 2019. COSEWIC assessment and status report on the Shortfin Mako. Isurus oxyrinchus, Atlantic Canada Population in Canada. Available at:https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/cosewic/Sr-RequinTaupeBleuShortfinMako-v00-2019-Eng.pdf

Cote, D., Morris, C.J., Regular, P.M., and Piersiak, M.G. 2020. Effects of 2D seismic on snow crab movement behavior. Fisheries Research 230:105661.

Curran, K. and K. Azetsu-Scott. 2012. State of the Scotian Shelf Report - Ocean Acidification. 28 p. Fisheries and Oceans Canada.

Davis, R.A., Lang, A.L. and B. Mactavish. (2017) Study of Seabird Attraction to the Hebron Production Platform: A Proposed Study Approach. Rep. No. SA1190. Prepared by LGL Limited, St. John's NL for Hebron Project, ExxonMobil Properties Inc. St. John's, NL. 30 p + appendices.

Delarue, J., K.A. Kowarski, E.E. Maxner, J.T. MacDonnell, and S.B. Martin. 2018. Acoustic Monitoring Along Canada's East Coast: August 2015 to July 2017. Document Number 01279, Environmental Studies Research Funds Report Number 215, Version 1.0. Technical report by JASCO Applied Sciences for Environmental Studies Research Fund, Dartmouth, NS, Canada. 120 pp + appendices.

Deveau, T.J., J. Delarue, S.B. Martin, and K. Lucke. 2018. Transmission Loss Modelling of Seismic Airgun Sounds: Predicted Received Levels, with Frequency Weighting, off Atlantic Canada. Document Number 01620, Environmental Studies Research Funds Report Number 217, Version 2.0. Technical report by JASCO Applied Sciences for Environmental Studies Research Fund, Dartmouth, NS, Canada. 43 pp + appendices.

DFO (Fisheries and Oceans Canada). 2004. Identification of ecologically and biologically significant areas. DFO Can. Sci. Advis. Sec. Ecosys. Stat. Rep. 2004/006.

DFO (Fisheries and Oceans Canada).2007. Statement of Canadian Practice with Respect to Mitigation of Seismic Sound in the Marine Environment. Available at: Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment (dfo-mpo.gc.ca)

DFO (Fisheries and Oceans Canada). 2011. The Marine Environment and Fisheries of Georges bank, Nova Scotia: Consideration of the Potential Interactions Associated with Offshore Petroleum Activities. Can. Tech. Rep. Fish. Aquat. Sci. 2945: xxxv + 492pp.

DFO (Fisheries and Oceans Canada). 2015. Mapping areas of high phytoplankton biomass in the offshore component of the Scotian Shelf Bioregion: A remotely-sensed approach. Canadian Science Advisory Secretariat (CSAS) Research Document 2015/036, Maritimes Region. 40 p.

DFO (Fisheries and Oceans Canada). 2016. Integrated Fisheries Management Plan. Canadian Atlantic Swordfish and other Tunas. Available at: https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/swordfish-espadon/NEW-swordfish-2013-espado-eng.html

DFO (Fisheries and Oceans Canada). 2017. Coral and Sponge Conservation Measures in the Maritimes. Available at: Coral and Sponge Conservation Measures in the Maritimes (dfo-mpo.gc.ca)

DFO (Fisheries and Oceans Canada). 2018a. Fisheries and Oceans Technical Paper 347. 4VWX5 Groundfish. Maritimes Region. Available at: https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/groundfish-poisson-fond/groundfish-poisson-fond-4vwx5-eng.html

DFO (Fisheries and Oceans Canada). 2018b. Rebuilding Plan for Atlantic Cod. NAFO. Division 5Z. Available at: https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/cod-morue/cod-morue-2019-eng.html

DFO (Fisheries and Oceans Canada). 2018c. Rebuilding Plan for Yellowtail Flounder. NAFO. Division 5Z. Available at: https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/flounder-limande/2018/index-eng.html

DFO (Fisheries and Oceans Canada). 2018d. Integrated Fisheries Management Plan. Offshore Scallop. Maritimes Region. Available at: https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/scallop-petoncle/2018/index-eng.html

DFO (Fisheries and Oceans Canada). 2018e. What is Ocean Acidification? Available at: https://www.dfo-mpo.gc.ca/oceans/publications/soto-rceo/2012/page02-eng.html#a2

DFO (Fisheries and Oceans Canada). 2019a. Northeast Channel Coral Conservation Area (Restricted Bottom Fisheries Zone). Available at: Northeast Channel Coral Conservation Area (Restricted Bottom Fisheries Zone) (dfo-mpo.gc.ca). Accessed August 2021.

DFO (Fisheries and Oceans Canada). 2019b. Assessment of the Effectiveness of Mitigation Measures in Reducing the Potential Impacts of Oil and Gas Exploration and Production on Areas with Defined Benthic Conservation Objectives. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2019/025.

DFO (Fisheries and Oceans Canada). 2019c. Integrated Fisheries Management Plan. Offshore Lobster and Jonah Crab. Maritimes Region. Available at: https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/lobster-crab-homard/2019/index-eng.html

DFO (Fisheries and Oceans Canada). 2020a. Review of the Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment. Canadian Science Advisory Secretariat Science Advisory Report, 2020/005. Available at: https://waves-vagues.dfo-mpo.gc.ca/Library/40875751.pdf

DFO (Fisheries and Oceans Canada). 2020b. Integrated Fisheries Management Plan. Atlantic Herring. Maritimes Region. Available at: https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/herring-hareng/2020/index-eng.html

DFO (Fisheries and Oceans Canada). 2020c. Maritimes Region Fisheries Atlas: Catch Weight Landings Mapping (2014–2018) on a Hexagon Grid. Can. Tech. Rep. Fish. Aquat. Sci. 3373: vi + 68 p.

DFO (Fisheries and Oceans Canada). 2021a. Physical Oceanographic Conditions on the Scotian Shelf and in the Gulf of Maine during 2019. DFO Can. Sci. Advis. Sec. Res. Doc. 2021/040. iv + 58 p.

DFO (Fisheries and Oceans Canada). 2021b. Fundian Channel-Browns Bank Area of Interest (AOI). Available at: Fundian Channel-Browns Bank Area of Interest (AOI) (dfo-mpo.gc.ca)

DFO (Fisheries and Oceans Canada). 2021c. Our Response to the *Marshall* Decisions. Publication. Available at: https://www.dfo-mpo.gc.ca/publications/fisheries-peches/marshall-1999-eng.html

DFO (Fisheries and Oceans Canada). 2021d. Multi-partner Research Initiative; Improving Oil Spill Response Technology in Canada. Spring 2021 Issue 1.

Doherty, P., and Horsman, T. 2007. Ecologically and biologically significant areas of the Scotian Shelf and environs: A compilation of scientific expert opinion. Can. Tech. Rep. Fish. Aquat. Sci. 2774: xii + 57 p.

ECCC (Environment and Climate Change Canada) 2016. Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada.

ECCC (Environment and Climate Change Canada). 2021 Canadian Environmental Sustainability Indicators: Progress towards Canada's greenhouse gas emissions reduction target. Available at: https://www.canada.ca/content/dam/eccc/documents/pdf/cesindicators/progress-towards-canada-greenhouse-gas-reduction-target/2021/progress-ghg-emissions-reduction-target.pdf

ExxonMobil Canada Properties. 2021. Hebron 2018 EEM Report. Volume 1 – Interpretation Prepared by Wood Environment & Infrastructure Solutions. March 2021.

Fiore, J., Bond, C., and S. Nataraj. 2020. The Impact of the Deepwater Horizon Oil Spill on Commercial Blue Crab Landings. February 5, 2020. RAND Corporation Working Paper Series. DOI: https://doi.org/10.7249/WR1290-1.

Fisher, J.A.D., Frank, K.T., Kostylev, V.E., Shackell, N.L., Horsman, T., and Hannah, C.G. 2011. Evaluating a habitat template model's predictions of marine fish diversity on the Scotian Shelf and Bay of Fundy, Northwest Atlantic. ICES J. Mar. Sci. 68: 2096-2105.

Gardner Pinfold. 2007. Economic Impact of the Ocean Sector in Nova Scotia, 2002 – 2006.

Gardner Pinfold. 2014. Economic Value of the Ocean Sector in Nova Scotia: 2007-2011. Submitted to Nova Scotia Department of Economic and Rural Development and Tourism. March 2014.

Gjerdrum, C., D.A. Fifield, and S.I. Wilhelm. 2012. Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. Canadian Wildlife Service Technical Report Series No. 515. Atlantic Region. vi + 37 pp.

Government of Canada. 2016. Pan-Canadian Framework on Clean Growth and Climate Change.

Harrington, A.M and H.J. Hamlin. 2019. Ocean acidification alters thermal cardiac performance, hemocyte abundance, and hemolymph chemistry in subadult American lobsters Homarus americanus H. Milne Edwards, 1937 (Decapoda: Malcostraca: Nephropidae). Journal of Crustacean Biology. 39(4): 468-476.

Hastings, K., M. King, and K. Allard. 2014. Ecologically and biologically significant areas in the Atlantic coastal region of Nova Scotia. Can. Tech. Rep. Fish. Aquat. Sci. 3107: xii + 174 p.

Hedd, A., Pollett, I.L., Mauck, R.A., Burke, C.M., Mallory, M.L., McFarlane Tranquilla, L.A., Montevecchi, W.A., Robertson, G.J., Ronconi, R.A., Shutler, D., Wilhelm, S.I., and Burgess, N.M. (2018). Foraging areas, offshore habitat use, and colony overlap by incubating Leach's storm-petrels Oceanodroma leucorhoa in the Northwest Atlantic. PLoS One. 13(5): e0194389. https://doi.org/10.1371/journal.pone.0194389.

HMDC (Hibernia Management Development Company). 2019. Hibernia Platform (Year 10) and Hibernia Southern Extension (Year 3) Environmental Effects Monitoring Program (2016). Volume 1 – Interpretation. April 2019.

Husky Energy. 2019. White Rose Environmental Effects Monitoring Program 2016. January 2019.

IAAC (Impact Assessment Agency of Canada). 2021. Regional Assessment of Offshore Oil and Gas Exploratory Drilling East of Newfound and Labrador. Available at: https://nloffshorestudy.iciinnovations.com/mapviewer/

IMO (International Maritime Organization). 2020. IMO 2020 – Cutting Sulphur Oxide Emissions. Available at: https://www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx

ITOPF (International Tanker Owners Pollution Federation). 2020. Oil Tanker Spill Statistics 2020. Available at: https://www.itopf.org/fileadmin/uploads/itopf/data/Documents/Company_Lit/Oil_Spill_Stats_publication_2020.pdf

James, M., and E. Bond. 2018. Chapter 3.6: Sea Turtles. In: Bernier, R.Y., Jamieson, R.E., and Moore, A.M. (eds.) 2018. State of the Atlantic Ocean Synthesis Report. Can. Tech. Rep. Fish. Aquat. Sci. 3167: iii + 149 p.

Kennedy, E., L. Bennett, S. Campana, K. Clark, P. Comeau, M. Fowler, C. Gjerdrum, F. Grégoire, C. Hannah, L. Harris, G. Harrison, M. James, I. Jonsen, C. Johnson, B. Law, W.K.W. Li, G. Melvin, T. Milligan, S. Paul, D. Pezzack, J. Sameoto, J. Simon, K. Smedbol, P. Smith, H. Stone, D. Themelis, J. Tremblay, L. Van Eeckhaute, J. Wade, Y. Wang, and T. Worcester. 2011. The Marine Ecosystem of Georges Bank. DFO. Can. Sci. Advis. Sec. Res. Doc. 2011/059: xiv + 232pp. (Erratum: October 2011).

King, M., Fenton, D., Aker, J. and Serdynska, A. 2016. Offshore Ecologically and Biologically Significant Areas in the Scotian Shelf Bioregion. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/007. viii + 92 p.

Koning, T. 2011. The East Georges Bank Basin, Offshore Nova Scotia: An Undrilled Basin with Significant Oil and Gas Potential. Search and Discovery Article #10299 (2011). Adapted from poster presentation at AAPG Annual convention and Exhibition, New Orleans, Louisiana April 11-14, 2010.

LeBris, A., Mills, K.E., Wahle, R.A., Chen, Y., Alexander, M.A., Allyn, A.J., Schuetz, J.G., Scott, J.D. and A.J. Pershing. 2018. Climate vulnerability and resilience in the most valuable North American fishery. Proceedings of the National Academy of Sciences. 115(8): 1831-1836.

Lee, K, S.L. Armsworthy, S.E. Cobanli, N.A. Cochrane, P.J. Cranford, A. Drozdowski, D. Hamoutene, C.G. Hannah, E. Kennedy, T. King, H. Niu, B.A. Law, Z. Li, T.G. Milligan, J. Neff, J.F. Payne, B.J. Robinson, M. Romero, and T. Worcester. 2011. Consideration of the Potential Impacts on the Marine Environment Associated with Offshore Petroleum Exploration and Development Activities. DFO. Can. Sci. Advis. Sec. Res. Doc. 2011/060: xii + 134p.

Lee, K., M. Boufadel, B. Chen, J. Foght, P. Hodson, S. Swanson and A. Venosa. 2015. Expert Panel Report on the Behaviour and Environmental Impacts of Crude Oil Released into Aqueous Environments. Royal Society of Canada, Ottawa, ON. 488 pp.

McKendree, M.G., Ortega, D.L., Widmar, N.O., and H.H. Wang. 2013. Consumer Perceptions of Seafood Industries in the Wake of the Deepwater Horizon Oil Spill and Fukushima Daiichi Nuclear Disaster (No 155582). Michigan State of University, Department of Agricultural, Food and Resource Economics.

Minister of Environment. 2015. Decision Statement Issued under Section 54 of the Canadian Environmental Assessment Act, 2012 for the Shelburne Basin Venture Exploration Drilling Project. Signed by The Honourable Leona Aglukkaq on June 15, 2015. Available at: Environmental Assessment Decision Statement - Canada.ca (ceaa-acee.gc.ca)

Minister of Environment. 2018. Decision Statement Issued under Section 54 of the Canadian Environmental Assessment Act, 2012 for the Scotian Basin Exploration Drilling Project. Signed by The Honourable Catherine McKenna on January 31, 2018. Available at: 121522E.pdf (ceaa.gc.ca)

Morris, C.J., D. Cote, B. Martin, R Saunders-Lee, M. Rise, J. Hanlon., J. Payne, P.M. Regular, D. Mullowney, J. C. Perez-Casanova, M.G. Piersiak, J. Xu, V. Han, D. Kehler, J.R. Hall, S.Lehnert, E. Gonzalez, S. Kumar, I. Bradbury, N. Paddy. 2019. An assessment of the potential risks of seismic surveys to affect Snow Crab resources. St. John's, NL. 92p. Environmental Studies Research Fund Report No. 220.

Morris, C.J., D. Cote, B. Martin, D. Mullowney. 2020. Effects of 3D seismic surveying on snow crab fishery. Fisheries Research 232 (2020): 105719.

NABCI (North American Bird Conservation Initiative Canada). 2019. The State of Canada's Birds, 2019. Environment and Climate Change Canada, Ottawa, Canada. 12 pages. Available at: www.stateofcanadasbirds.org

NEB (National Energy Board), C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board), and CNSOPB (Canada-Nova Scotia Offshore Petroleum Board). (2010). Offshore Waste Treatment Guidelines.

Neff, J., K. Lee, E.M. DeBlois and G.G. Janes. 2014. Environmental Effects of Offshore Drilling in a Cold Ecosystem: A 10-year Monitoring Program at the Terra Nova Offshore Oil Development off the Canadian East Coast. Deep-Sea Research Part II. Volume 110.

New England Fishery Management Council (NEFMC) and Ecosystem Based Fishery Management Plan (FMP) Development Team. 2019. Draft Example Fishery Ecosystem Plan (eFEP) for Georges Bank. Draft, Aug. 21, 2019.

NOAA (National Oceanic and Atmospheric Administration). 2021. 2017-2021 North Atlantic Right Whale Unusual Mortality Event. Available at: 2017–2021 North Atlantic Right Whale Unusual Mortality Event | NOAA Fisheries.

Nova Scotia Department of Energy and Mines. Oil and Gas. N.D. Available at: https://energy.novascotia.ca/oil-and-gas

NRCan (Natural Resources Canada). 2018. Canada's Energy Transition – Getting to our Energy Future, Together. Generation Energy Council Report. June 2018. Available at: Canada's Energy Transition: Getting to Our Future, Together (nrcan.gc.ca)

NRCan (Natural Resources Canada) and NSPD (Nova Scotia Petroleum Directorate). 1999. Georges Bank Review Panel Report. June 1999. Available at: https://oera.ca/sites/default/files/2019-05/1999-Georges-Bank-Review-Panel-Report.pdf

NSDEM (Nova Scotia Department of Energy and Mines). Undated. Oil and Gas – Offshore – Economic Benefits. Available at: https://energy.novascotia.ca/oil-and-gas/offshore/economic-benefits

Oak, T. 2020. Oil and gas exploration and production activities in areas with defined benthic conservation objectives: a review of potential impacts and mitigation measures. Canadian Science Advisory Secretariat Research Document 2020/040. July 2020.

One Ocean. 2017a. One Ocean Oil Spill Prevention and Response Initiative: Application of the Gulf of Mexico Key Findings to the Newfoundland and Labrador Region. October 2017. Available at: http://www.oneocean.ca/pdf/2017%20GoM%20OSPR%20Final.pdf

One Ocean. 2017b. One Ocean Oil Spill Communication Protocol.

One Ocean. 2021. One Ocean Protocol for Exploratory Drilling Projects in the Newfoundland and Labrador Offshore - June 2021. Available at: http://www.oneocean.ca/pdf/2021_OOPED_June.pdf

Payne, Andrews, C.D., Hanlon, J. and J. Lawson. 2015. Effects of Seismic Air – Gun Sounds on Lobster. Available at: https://www.esrfunds.org/sites/www.esrfunds.org/files/publications/ESRF197-Payne-et-al.pdf

Popper, Hawkins, Fay, Mann, Bartol, Carlson, Coombs, Ellison, Gentry, Halvorsen, Løkkeborg, Rogers, Southall, Zeddies, Tavolga, 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. SpringerBriefs in Oceanography, Volume ASA S3/SC1.4 TR-2014. ASA Press

Proctor, R.M., Taylor, G.C., and J. A. Wade. 1984. Oil and natural gas resources of Canada – 1983. Geological Survey of Canada Paper 83-31. 59 p.

Province of Nova Scotia. 2019. Nova Scotia Cap and Trade Regulatory Framework. Available at: https://climatechange.novascotia.ca/sites/default/files/Nova-Scotia-Cap-and-Trade-Regulatory-Framework.pdf

Rheuban, J.E., Doney, S.C., Cooley, S.R. and D.R. Hart. 2018. Projected impacts of future climate change, ocean acidification, and management on the US Atlantic sea scallop (Placopecten magellanicus) fishery. PLOS ONE. 13(9): e0203536

Rodríguez, A., Arcos, J.M., Bretagnolle, V., Dia Maria, P., Holmes, N.D., +33 authors. 2019. Future Directions in Conservation Research on Petrels and Shearwaters. Front. Mar. Sci., 18 March 2019. https://doi.org/10.3389/fmars.2019.00094.

Siedlecki, SA., J. Salisbury, DK. Gledhill, C. Bastidas, S. Meseck, K. McGarry, CW. Hunt, M. Alexander, D. Lavoie, ZA. Wang, J. Scott, DC. Brady, I. Mlsna, K. Azetsu-Scott, CM. Liberti, DC. Melrose, MM. White, A. Pershing, D. Vandemark, DW. Townsend, C. Chen, W. Mook, and R. Morrison. 2021. Projecting ocean acidification impacts for the Gulf of Maine to 2050: New tools and expectations. Elem. Sci. Anth.,9: 1, 1-29.

Sproule. 2010. Seismic Interpretation, Identification of Petroleum Prospectivity, ad Resource Assessment of the East Georges Bank Basin Offshore Nova Scotia, Canada (As of September 30, 2010). Prepared for Offshore Energy Technical Research Association.

Stantec (Stantec Consulting Ltd.). 2010a. Preliminary Review of Environmental and Socio-economic Issues on Georges Bank. Prepared for Offshore Energy Environmental Research Association.

Stantec (Stantec Consulting Ltd.). 2010b. A Preliminary Review of Existing Technologies and their Mitigative Potential in Offshore Petroleum Developments. Prepared for Offshore Energy Environmental Research Association.

Stantec (Stantec Consulting Ltd.). 2010c. A 12-Year Retrospective of Natural Gas Production in Nova Scotia. Prepared for the Department of Energy. April 2010.

Stantec (Stantec Consulting Ltd.). 2016. Final Report: Shelburne Basin Venture Exploration Drilling Project: Cheshire L-97A Sediment Deposition Survey Report. File No. 121511210. Prepared for Shell Canada Limited. December 2016.

Stantec (Stantec Consulting Ltd.). 2017. Final Report: Shelburne Basin Venture Exploration Drilling Project: Monterey Jack E43-A Sediment Deposition Survey Report. File No. 121511210. Prepared for Shell Canada Limited. April 2017.

Stantec (Stantec Consulting Ltd.). 2019. Final Report: Scotian Basin Exploration Drilling Project: Aspy D-11A Sediment Deposition Survey Report. File No. 121413516. Prepared for BP Canada Energy Group ULC. February 2019.

Sullivan, L., T. Brosnan, T.K. Rowles, L. Schwacke, C. Simeone, and T. K. Collier. 2019. Guidelines for Assessing Exposure and Impacts of Oil Spills on Marine Mammals. NOAA Tech. Memo. NMFS-OPR-62, 82 p.

Sumaila, U.R., Cisneros-Montemayor, A.M., Dyck, A., Huang, L., Cheung, W., Jacquet, J., Kleisner, K., Lam, V., McCrea-Strub, A., Swartz, W., Watson, R., Zeller, D., and D. Pauly. 2012. Impact of the Deepwater Horizon well blowout on the economics of US Gulf fisheries. Can. J. Fish. Aquat. Sci. 69, 499–510.

Suncor Energy. 2019. Terra Nova 2017 Environmental Effects Monitoring Program Year 10 (Volume 1). Revised Submission. November 2019.

Upton, H.E. 2011. The Deepwater Horizon Oil Spill and the Gulf of Mexico Fishing Industry. Congressional Research Service. February 2011. Available at: https://sgp.fas.org/crs/misc/R41640.pdf

Warner et al. 2018. Analysis of Acoustic Particle Motion Data from the Svein Vaage Airgun Study. Available at: https://www.esrfunds.org/sites/www.esrfunds.org/files/publications/ESRF216_Warner, G_A_ et al.pdf

Whiteway, S.A., M.D. Paine, T.A. Wells, E.M. DeBlois, B.W. Kilgour, E.J. Tracy, R.D. Crowley, U.P. Williams and G.G. Janes. 2014. Toxicity Assessment in Marine Sediment for the Terra Nova Environmental Effects Monitoring Program (1997-2010). Deep-Sea Research II, 110: 26-3.

Wilhelm, S. and A.C. Smith. 2018. Chapter 3.7 Seabirds. In: Bernier, R.Y., Jamieson, R.E., and Moore, A.M. (eds.) 2018. State of the Atlantic Ocean Synthesis Report. Can. Tech. Rep. Fish. Aquat. Sci. 3167: iii + 149 p.

Wilhelm, S., Hedd, A., Robertson, G., Mailhiot, J., Regular, P., Ryan, P., and E. Richard. 2019. The world's largest breeding colony of Leach's Storm-petrel *Hydrobates leucorhous* has declined. Bird Conservation International. 1-18. 10.1017/S0959270919000248.

Ylitalo, G.M., Krahn, M.M., Dickhoff, W.W., Stein, J.E., Walker, C.C., Lassitter, C.L., Garrett, E.S., Desfosse, L.L., Mitchell, K.M., Noble, B.T., Wilson, S., Beck, N.B., Benner, R.A., Koufopoulos, P.N., and R.W. Dickey. 2012. Federal seafood safety response to the Deepwater Horizon oil spill. Proc. Natl. Acad. Sci. U. S. A. 109, 20274–20279.

APPENDIX A

Overview of Georges Bank Fisheries

A.1 SCALLOPS

The scallop fishery on Georges Bank is the most important fishery in terms of landed value with $119.7 million in landings in 2020. This fishery accounts for 85% of total landed value of all fishing activity on Georges Bank, compared to 75% in 2008. The offshore scallop fishery is responsible for approximately 75% of all scallop landed value in the Maritimes Region, and 10% of the total landed value of all commercial fisheries in the Maritimes Region[1].

Industry Structure

The commercial scallop fishery in Georges Bank for fishing vessels greater than 65' in length is managed through the Offshore Scallop – Maritimes Region Integrated Fisheries Management Plan (IFMP). Scallop grounds in Georges Bank are contained in Scallop Fishing Area (SFA) 27 and is broken into two sections, Georges Bank (A) and Georges Bank (B).

There are six companies active in the offshore scallop fishery[2]. The offshore scallop fishery is entirely commercial and is managed based on an enterprise allocation (EA) system, where each of the companies receives a percentage of the annual total allowable catch (TAC) for reach Scallop Fishing Area they operate in. In 2006, the six offshore scallop licence holders consolidated their EA shares, which remains the case today.

Prior to 1986, a large fleet of inshore vessels also fished on Georges Bank. As a result of an agreement reached in 1986, the fishing grounds are formally divided into exclusive offshore and inshore areas, with the inshore fleet now confined essentially to the Bay of Fundy. In 1986, companies held licences for 76 offshore scallop vessels, roughly 90% of which were active. By 2017, there were only 12 active vessels, out of a total of 76 eligible vessels[3].

As of 2016, the Canadian offshore scallop fleet consists of five freezer trawlers and seven wetfish trawlers. This is down from six freezer trawlers and 10 wetfish trawlers in 2011. Freezer vessels typically have a crew of 25 to 32, while wetfish vessels have a crew of 17 to 19[4]. In March of 2021 the Atlantic Destiny a 39 metre scallop freezer trawler sank on Georges Bank and vessel replacement plans are unknown.

Following the Canada-US boundary delimitation in 1984, the new management regime is total allowable catch (TAC and a system of individual company quotas termed enterprise allocations. The enterprise allocations eliminated competitive fishing and the incentive for companies to operate large fleets to maximize shares of the overall TAC. The fleet continues to adjust to the size needed to harvest the available resource efficiently.

---

[1] DFO. (2018). *Offshore scallop – Maritimes region*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/scallop-petoncle/2018/index-eng.html#toc1
[2] Ibid.
[3] Ibid.
[4] Ibid.

The fleet operates from a few main ports in southwest Nova Scotia including:

- Lunenburg;
- Riverport/LaHave;
- Saulnierville;
- Liverpool;
- Lockeport; and
- Shelburne.

By 2016, nearly half the offshore scallop quota was held by one company, Clearwater Seafoods Limited Partnership (see Table A-1 below). Clearwater's 43.86% of the offshore scallop quota was reported to be fished by just three vessels out of 35 eligible vessels in 2016[5].

Table A-1 Offshore Scallop Licence Holders and EA Shares (as of January 2016)

Company Name	% Share of TAC
Clearwater Seafoods Limited Partnership	43.86
Ocean Choice International L.P.	16.77
Comeau's Sea Foods Limited	16.68
Adams and Knickle Limited	9.77
Mersey Seafoods Limited	7.00
LaHave Seafoods Limited	5.92

The market for Canadian sea scallops has been diversified into Europe and Asia from a primarily North American market.

Innovations introduced by industry, bottom imaging technology and vessel tracking systems, have provided the industry and DFO with the ability to better understand the resource and has permitted the harvest of quota more efficiently (e.g., the ability to identify particular beds of sea scallops and to target harvesting operations more specifically). This technology also permits identification of areas where the sea scallops are not at full maturity to allow operators to defer harvesting in those areas. Technology has remained fairly consistent over the past ten years.

Resource Access

Access to the scallop resource is through enterprise allocations. Each company's enterprise allocation is based on the percentage share of the TAC negotiated in 1986. These in turn are based on each of the original participant's historic share of total landings. The distribution of enterprise allocations still reflect these shares as adjusted by the consolidation of companies. Under the enterprise allocation rules, the sale of a company and its entire enterprise allocation holding is allowed, though permanent transfers of a portion of an enterprise allocation are not permitted (temporary in-season transfers are permitted). No single company may hold more than 50% of the TAC for any specific scallop stock. Consolidation has

[5] DFO. (2018). *Offshore scallop – Maritimes region*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/scallop-petoncle/2018/index-eng.html#toc1

continued; in 2017 there were12 vessels fishing TAC held by six companies (latest year information available).

It is the stated objective of the enterprise allocation approach that each company should invest in the number, size and type of vessel needed to harvest its allocation in the most economically effective manner possible. This has resulted in the move toward freezer trawler utilization and the corporate consolidation of the fishing fleet. This objective is constrained only by a vessel replacement restriction that specifies the maximum and minimum allowable length. The minimum length criterion is to maintain a clear distinction between the inshore and offshore sectors.

The enterprise allocation program is intended to remain in place indefinitely.

Management

Prior to 1998, Georges Bank area was managed as one unit; since then, it has been managed as two zones. Zone ‘a’ is the traditional scallop fishing ground and a more productive area than zone ‘b’, which is marginal scallop habitat.

Landings data by zone from 1998 to 2020 are shown in Table A-2. Landings on an annual basis have fallen in the range of 3,000 - 5,000- tonnes. In 2010 approximately 5,200 tonnes were landed with the low end of the range occurring in 2016. Landings in 2020 reported at 4,700 tonnes; this is more consistent with landings over the period 2008 and 2010.The low was 2016 at 3,500 and the peak was 5,600 tonnes in 2014.

Table A-2 Georges Bank Scallop TAC and Catch (Meat MT), 1998 to 2020

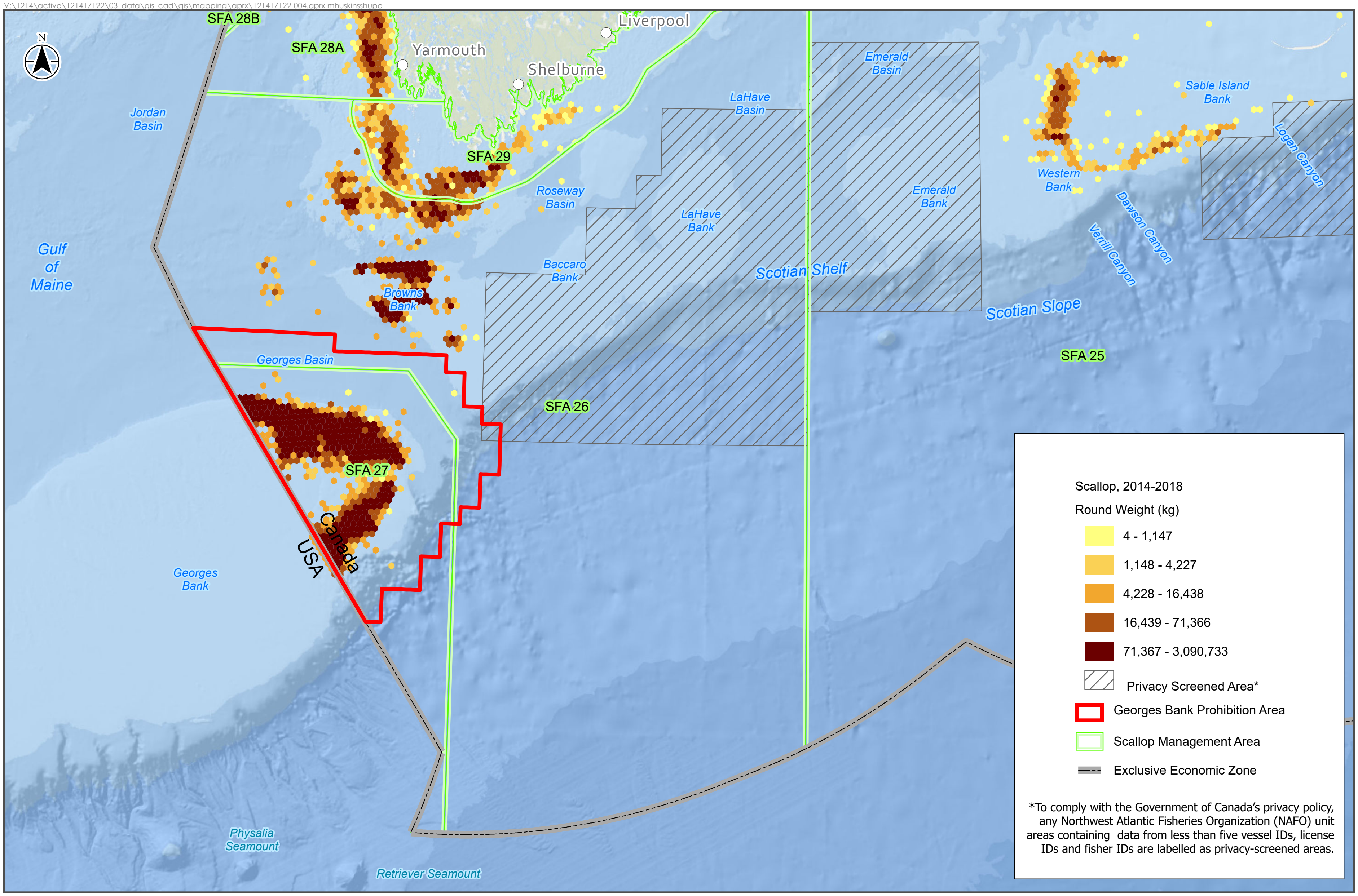
Year	Catch (t)		TAC (t)	
	Zone ‘a’	Zone ‘b’	Zone ‘a’	Zone ‘b’
1998	3,191	800	3,200	800
1999	2,503	1,196	2,500	1,200
2000	6,212	601	6,200	600
2001	6,480	395	6,500	400
2002	6511	192	6,500	200
2003	6028	199	6,000	200
2004	3557	200	3,500	200
2005	2504	201	2,500	200
2006	3936	162	4,000	200
2007	4005	400	4,000	400
2008	5500	358	5,500	400
2009	5527	260	5,500	350
2010	5294	66	5,500	200
2011	4520	0	4,500	0

Table A-2 Georges Bank Scallop TAC and Catch (Meat MT), 1998 to 2020

Year	Catch (t)		TAC (t)	
	Zone ‘a’	Zone ‘b’	Zone ‘a’	Zone ‘b’
2012	4001	47	4,000	50
2013	4999	108	5,000	100
2014	5406	191	5,500	200
2015	4017	398	4,000	200
2016	3053	394	3,000	400
2017P	3510	201	3,500	200
2018P	3405	762	3,400	750
2019P	4494	783	4,500	800
2020P	4705	558	5,000	900
“P” denotes preliminary data				

In March 2010, the Eastern Canada Sea Scallop Fishery achieved Marine Stewardship Council (MSC) certification as a sustainable well managed fishery and was the first MSC certified scallop fishery in North America. The fishery was recertified in June of 2015 and again in December of 2020.

V:\1214\active\121417122\03_data\gis_cad\gis\mapping\aprx\121417122-004.aprx mhuskinsshupe



Sources: Base Data - Canada Nova Scotia Offshore Petroleum Board, Government of Canada, Fisheries and Oceans Canada.
Service Layer Credits: World Ocean Base: CHS, Esri, GEBCO, DeLorme, NaturalVue

NAD 1983 UTM Zone 20N

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

0 50 100 150 200
Kilometres

Stantec

Scallops Landings Composite
Landings (kg) per 10 km2 hexagon

SCIENCE AND SOCIO-ECONOMIC REVIEW OF THE GEORGES BANK PROHIBITION AREA 2010-2021

121417122-004

Figure A-1

Changes to Management

The commercial scallop fishery in Georges Bank is managed under DFO's 2018 IFMP, *Offshore scallop – Maritimes region*.

Since November 2004, the offshore scallop industry has implemented voluntary fishery closure areas on Georges Bank to improve commercial yield of large aggregations of juvenile scallops. Three voluntary closures were put in place by the industry in December 2007. The voluntary closure coordinates were modified in October 2008 as a result of available information on size distribution of scallops in the voluntary closed areas and surrounding areas. As of 2018, there continue to be two voluntary area closures on Georges Bank, including one that occurs for seven weeks from February to March to protect spawning cod, and one over the month of June to protect spawning yellowtail flounder. These voluntary area closures are controlled through annual DFO Variation Orders.

The TAC for Georges Bank (A) was at its highest—6,500 tonnes—in 2001 and 2002, while the TAC for Georges Bank (B) was at its highest—1,200 tonnes—in 1999. In 2021, the offshore scallop commercial fishery TAC for Georges Bank (A) was 4,000 tonnes, down from 5,000 tonnes in 2020, while Georges Bank (B) was 500 tonnes, down from 900 tonnes in 2020. In 2021, the total TAC for Georges Bank was 4,500 tonnes, down from 5,900 tonnes in 2020[6]. In 2020, the catch in Georges Bank (A) was 4,705 tonnes, while the catch for Georges Bank (B) was 558 tonnes. Complete TAC and catch data for Georges Bank from 1998 to 2020 are shown in Table A-2.

DFO-Industry Survey / Recent Conclusions and Advice from DFO

A joint DFO – industry survey takes place annually on Georges Bank, covering both zones. Joint industry-DFO Science annual surveys continue to occur for all offshore scallop fishing areas in the Maritimes region. A biomass-based population model is employed to evaluate commercial fisheries impacts and determine future catch levels for Georges Bank (A). Georges Bank (B) future catch levels are determined by survey trends and commercial catch rates from previous years[7].

Fully-recruited biomass for Georges Bank A was estimated to be 36,757 t in 2019, well above the long-term media of 18,107 for 1986 to 2018, and up from 28,831 t in 2018[8].

Fully recruited (commercial) biomass has been above 10,000 t since 2000. This is due to a combination of several large recruit cohorts, including 2009, and 2010, a shift by industry to generally lower exploitation rates, and adoption of an industry-implemented protocol on a minimum landed scallop size from 1995 onward. The exploitation rates are generally higher than the levels expected due to growth discounted for natural mortality.

---

[6] DFO. (2021). *2021 offshore scallop fishery in the Maritimes region – Scallop Fishing Areas 10-12, 25-27.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/decisions/fm-2021-gp/atl-11-eng.html

[7] DFO. (2018). *Offshore scallop - Maritimes region.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/scallop-petoncle/2018/index-eng.html#toc4

[8] DFO. (2020). *Stock status update of Georges Bank 'A' scallops (*Placopecten magellanicus*) for the 2020 fishing season.* Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/40950098.pdf

As of the current IFMP, the target exploitation rate for Georges Bank (A) is 0.25, under which the stock is expected to remain in the Health Zone. A TAC of 5,000—the TAC for 2020—results in an exploitation rate of 0.11. Even at a theoretical TAC of 7,500, the exploitation rate would be 0.17.

Fishing Patterns

In 2020, commercial fishing effort was highest in the months of January, March, May, June, and July, with comparatively little fishing occurring in December.

Table A-3 Monthly Scallop Landings 2008 & 2020[9]

Month	Round Weight (kg)	Meat Weight (kg)
January, 2008	2,262,841	272,631
February, 2008	3,030,100	365,072
March, 2008	4,685,148	564,476
April, 2008	5,513,266	664,249
May, 2008	5,286,805	636,964
June, 2008	4,508,094	543,144
July, 2008	5,447,913	656,375
August, 2008	5,952,821	717,207
September, 2008	2,856,183	344,118
October, 2008	4,846,872	583,961
November & December, 2008	4,212,335	507,510
January, 2020P	4,173,625	502,846
February, 2020P	3,224,421	388,484
March, 2020P	4,207,391	506,915
April, 2020P	3,870,555	466,332
May, 2020P	5,284,478	636,684
June, 2020P	4,957,083	597,239
July, 2020P	4,862,011	585,784
August, 2020P	3,306,664	398,393
September, 2020P	2,989,900	360,229
October, 2020P	2,883,115	347,363
November, 2020P	3,330,715	401,291
December, 2020P	592,970	71,442

[9] Source: DFO. Note: Data for Nov & Dec 2008 were grouped to maintain participant confidentiality.

A.2 LOBSTER AND JONAH CRAB

Industry Structure

There are currently eight offshore lobster licences and eight offshore Jonah crab licences for LFA 41, all of which were owned by Clearwater Seafoods Limited Partnership up to September of 2020. At that time two of the licences were sold to Membertou First Nation. The TAC for both offshore lobster and Jonah crab is evenly allocated at 12.5% of the TAC per licence

Management

As of 2019, the offshore commercial lobster fishery continues to be managed under an IFMP for both lobster and Jonah crab. The fishery is open 12 months a year. Unlike the inshore lobster fishery, there are no trap number limits or trap dimension limits for the offshore lobster fishery. The offshore commercial lobster fishery is the only lobster fishery in Canada managed with a TAC[10]. The TAC for lobster in LFA 41 was 720 t in 2021 and has remained the same since 1985[11].

The TAC for Jonah Crab in LFA 41 was 270 t, down from 540 t in 2014. There has been no directed fishing for Jonah Crab in LFA since 2008, with its TAC being limited to by-catch when fishing for lobster[12].

Presently, the offshore lobster and Jonah crab fisheries are managed by several key management measures, including:

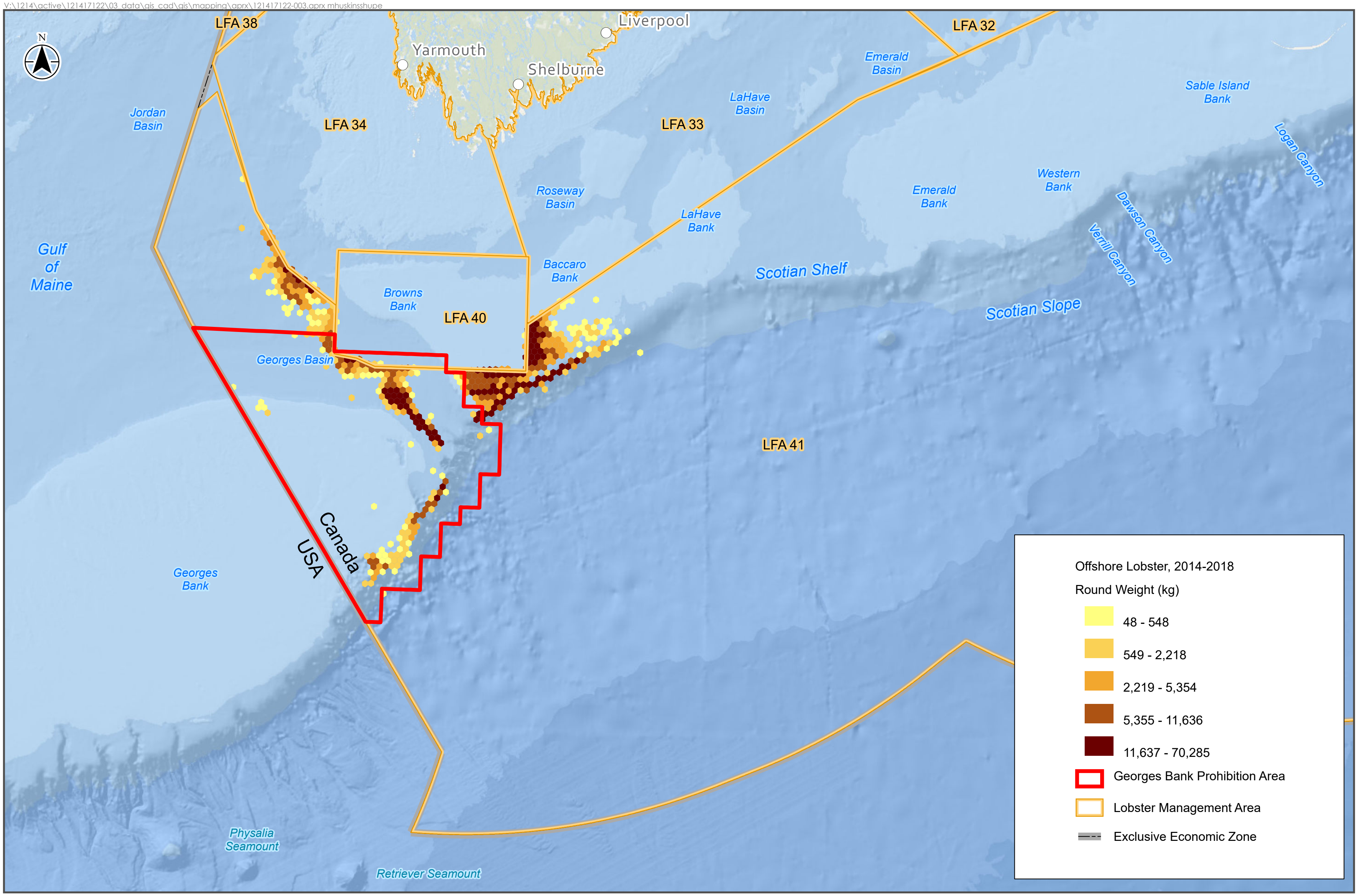
- The use of an annual TAC to limit the amount of lobster and Jonah crab that can be caught.
- A minimum lobster carapace length and minimum Jonah crab carapace length (for males).
- The requirement to release egg-bearing and v-notched female lobsters.
- A limit to the number of licenced vessels.

The offshore lobster fishery achieved MSC certification in 2010 and was recertified in 2015, but Clearwater made the decision not to recertify in 2020.

---

[10] DFO. (2021). *Proceedings of the regional peer review of the stock assessment of American lobster in Lobster Fishing Area (LFA) 41.* Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/40975356.pdf
[11] DFO. (2021). *2021 offshore lobster (Maritimes region) – Lobster Fishing Area 41*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/decisions/fm-2021-gp/atl-02-eng.html
[12] DFO. (2015). *Assessment of the Canadian LFA 41 offshore lobster (*Homarus americanus*) fishery (NAFO Divisions 4X 5Zc)*. Retrieved from http://waves-vagues.dfo-mpo.gc.ca/Library/362141.pdf

V:\1214\active\121417122\03_data\gis_cad\gis\mapping\aprx\121417122-003.aprx mhuskinsshupe



Sources: Base Data - Canada Nova Scotia Offshore Petroleum Board, Government of Canada, Fisheries and Oceans Canada.
Service Layer Credits: World Ocean Base: CHS, Esri, GEBCO, DeLorme, NaturalVue

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

NAD 1983 UTM Zone 20N

0 50 100 150 200
Kilometres

Offshore Lobster Landings Composite
Landings (kg) per 10 km2 hexagon

Stantec

SCIENCE AND SOCIO-ECONOMIC REVIEW OF THE GEORGES BANK PROHIBITION AREA 2010-2021

121417122-003

Figure A-2

Fishing Patterns

Offshore vessels are permitted to fish in the Offshore Lobster Fishing District, an area lying beyond 50 nautical miles of the coast of Nova Scotia between the Laurentian Channel in the north and the mouth of the Bay of Fundy in the south. This line was established in 1971 to separate the inshore and offshore fisheries. Prior to the sale of the two licenses all eight licences were fished by one fishing vessel[13].

The number of active fishing vessels in the commercial offshore lobster fishery has changed since it was first established. The original share of the quota was designed to be broken down to each of eight vessels. When Enterprise Allocation was established in the mid-1980s, the number of vessels was reduced. By 2007, there were only four vessels fishing lobster and Jonah crab in LFA 41. This number was reduced to two by 2010, and all TAC has been exclusively fished by one vessel since 2012[14].

The fishery was concentrated initially on western and southeastern Browns Bank and southern Georges Bank. Effort shifted to the southwest and southeast edges of Browns when the Bank itself it was closed to lobster fishing in 1977. Effort also shifted to the northeastern part of Georges Bank as better grounds were discovered closer to port. When the International Court of Justice set the maritime boundary in 1984, American fishing effort was eliminated in Crowell and Georges Basins in the Gulf of Maine, and the Canadian vessels moved into these areas.

While a year-round fishery, landings tend to peak in late spring. Limited fishing effort occurs in late summer, primarily due to low catch rates and softer shell conditions of freshly moulted lobster[15].

Resource Status and Prospects

The most recent stock status update was completed in November 2016, and a new stock framework was developed for the fishery in January 2017[16]. In the 2016 stock status update, it was found that abundance indicators for the 2016 trawl-based three-year mean and at-sea sample medians were both above the upper boundary, and that when following the 2013 framework, the offshore commercial lobster fishery was determined to be in the healthy zone[17].

DFO notes that the exploitation rate for lobsters in LFA 41 has not been estimated but assumes it to be low because landings have remained constant while abundance has steadily increased. Abundance indicators are based on the mean number per tow figures from DFO Maritimes Region RV trawl surveys,

---

[13] DFO. (2015). *Assessment of the Canadian LFA 41 offshore lobster (*Homarus americanus*) fishery (NAFO Divisions 4X 5Zc)*. Retrieved from http://waves-vagues.dfo-mpo.gc.ca/Library/362141.pdf
[14] DFO. (2015). *Assessment of the Canadian LFA 41 offshore lobster (*Homarus americanus*) fishery (NAFO Divisions 4X 5Zc)*. Retrieved from http://waves-vagues.dfo-mpo.gc.ca/Library/362141.pdf
[15] DFO. (2015). *Assessment of the Canadian LFA 41 offshore lobster (*Homarus americanus*) fishery (NAFO Divisions 4X 5Zc)*. Retrieved from http://waves-vagues.dfo-mpo.gc.ca/Library/362141.pdf
[16] DFO. (2021). *Proceedings of the regional peer review of the stock assessment of American lobster in Lobster Fishing Area (LFA) 41.* Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/40975356.pdf
[17] DFO. (2017). *Lobster (*Homarus americanus*) in Lobster Fishing Area 41 (4X + 5Zc): 2016 stock status update.* Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/4062433x.pdf

and these figures have been increasing since the mid-1990s, with the most recent stock assessment in 2014 demonstrating all-time high abundance indicators in a 30-year time series[18].

Nova Scotia lobsters take 8-10 years to reach 82.5 mm carapace length (CL), the legal minimum size in LFA 41. Mature lobsters seasonally migrate to shallower waters in summer and deeper waters in winter. Over most of the lobster's range these movements amount to few kilometers; however, in the Gulf of Maine, the offshore regions of the Scotian Shelf and off New England, lobsters can undertake long distance migrations of tens to hundreds of kilometers.

The lobster stock structure in the Gulf of Maine is not fully understood and is viewed as a stock complex, which means that there may be a number of sub-populations linked in various ways by movements of larvae and adults.

The number and distribution of the subpopulations are uncertain. Lobster concentrations are highest in coastal regions and lower concentrations are associated with the offshore Banks of Browns and Georges. Lobsters are found in higher concentrations on the banks migrate to deeper water in winter.

Georges Bank (Corsair Canyon and the slope east of it) has been fished since 1972. There is little area for expansion on Georges Bank as the US lobster fishery lies to the south, and once lobsters move onto the banks they disperse. This is also an area where significant mobile gear activity would interfere with lobster fishing.

Based on the current indicators of abundance, fishing pressure and production, the current TAC of 720 t (in place since 1985) does not appear to have had negative impacts on the lobster in LFA 41 overall and is considered to represent an acceptable harvest strategy at this time.

A.3 GROUNDFISH

Industry Structure

The groundfish fleet operating on Georges Bank is the largest and most diverse of any of the fisheries.

Virtually all inshore vessels are under 19.8 m (65'), though a very few fall into the 19.8-30.5 m (65-100') category (Table A-4). There are several hundred vessels of varying length and gear type in the inshore groundfish fleet in southwest Nova Scotia. In 2008, 102 different groundfish vessels participated in the Georges Bank groundfish fishery; this dropped to 49 in 2020.

Inshore vessels tend to be owner-operated. With the shift towards newer management systems including enterprise allocations and individual transfer quotas (ITQs), an increasing proportion of the mobile gear fleet has become integrated into inshore processing companies.

---

[18] DFO. (2015). *Assessment of the Canadian LFA 41 offshore lobster (*Homarus americanus*) fishery (NAFO Divisions 4X 5Zc)*. Retrieved from http://waves-vagues.dfo-mpo.gc.ca/Library/362141.pdf

The *Policy for Preserving the Independence of the Inshore Fleet in Canada's Atlantic Fisheries* (PIIFCAF) was introduced in 2007, with an objective of ensuring that inshore fish harvesters remain independent, and the benefits of fish harvested under their licences remained with the fisher and their respective communities. However, only the <45' fixed gear fleet is currently subject to the PIIFCAF[19].

The Marine Stewardship Council, an international non-profit organization established to monitor and promote sustainable fisheries, has certified two commercial groundfish fisheries in the Maritimes Region, including one that occurs on Georges Bank established in October 2010 for haddock[20].

In 1998, a new commercial fishing fleet was created when 45'-65' fixed gear licence holders separated from <45' fixed gear licence holders, marking a shift to an ITQ system[21].

The groundfish fishery in Georges Bank is predominantly a commercial fishery, although there are also recreational and First Nations FSC components. Groundfish stocks harvested through the commercial groundfish fishery are accounted for under a TAC or bycatch limit. For the commercial fishery, there are three fleets with their own licences: <65' aka "inshore", 65'-100' aka "midshore", and >100' aka "offshore".

The 1999 R. v. Marshall Decision led to the establishment of a separate Aboriginal <65' mobile gear fleet, which currently operates under an enterprise allocation system, allowing various vessels to fish the same licence. The Aboriginal mobile gear fleet currently fishes under the MG <65' Conservation Harvesting Plan[22].

Table A-4 Groundfish Licences by Fleet Sector for 2015/2016[23]

Licence Type	Fleet Sector	Allocation Scheme	Licences	Active Licences	Fishing Area
Inshore	Fixed gear <45'	Community quotas	2,099	439	4T, 4Vn, 4VsW, 4X5Y
	Fixed gear 45'-65'	ITQ	57	37	3NO, 4VWX5
	Mobile gear <65'	ITQ	299	69	4VWX5
	Aboriginal mobile gear	Enterprise allocation	11	3	4VWX5
Midshore	Fixed gear 65'-100'	Enterprise allocation	4 (10)	2	Atlantic-wide
	Mobile gear 65'-100'	Enterprise allocation	6 (10)	5	Atlantic-wide
Offshore	>100' fleet	Enterprise allocation	15 (25)	8	Atlantic-wide

[19] DFO. (2010). *Policy for preserving the independence of the inshore fleet in Canada's Atlantic fisheries*. Retrieved from https://www.dfo-mpo.gc.ca/reports-rapports/regs/piifcaf-policy-politique-pifpcca-eng.htm
[20] DFO. (2018). *5VWX5 groundfish – Maritimes region.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/groundfish-poisson-fond/groundfish-poisson-fond-4vwx5-eng.html
[21] DFO. (2018). *5VWX5 groundfish – Maritimes region.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/groundfish-poisson-fond/groundfish-poisson-fond-4vwx5-eng.html
[22] DFO. (2018). *5VWX5 groundfish – Maritimes region.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/groundfish-poisson-fond/groundfish-poisson-fond-4vwx5-eng.html
[23] DFO. (2018). *5VWX5 groundfish – Maritimes region.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/groundfish-poisson-fond/groundfish-poisson-fond-4vwx5-eng.html

Resource Access

TACs are set for each fish major stock and then allocated through quotas to the different fleet and gear sectors licensed to fish those stocks. All vessels gain access to the resource either through enterprise allocations (offshore vessels) or ITQs (inshore mobile gear vessels). Enterprise allocations and ITQs are set by DFO based on historic landings. Shares for the inshore fixed gear fleets are set by associations to which DFO has delegated responsibility for certain aspects of management. These associations account for just over 90% of the fixed gear allocation on Georges Bank.

Three species of groundfish have allocations specific to Georges Bank (NAFO division 5ZE): cod, haddock and yellowtail flounder. Other groundfish species are caught on Georges, but none is subject to specific allocations. The allocations on Georges Bank by fleet sector in 2008 and 2020 are shown in Table A-5.

Table A-5 2008 and 2020 Groundfish Quota Allocations on Georges Bank (5Ze) by Fleet Sector (t)[24]

Fleet Sector 2008	Cod	Haddock	Yellowtail Flounder
Aboriginal fishery (2008)	69	1,154	
Fixed gear <45’ (2008)	791	2,824	
Fixed & mobile gear ITQ/Enterprise Allocation Fleet (2008)	577	10,378	
By-catch reserve (2008)	196	150	550
Reserve (2008)		444	
2020			
Aboriginal fishery (2020)	19	1098	
Fixed gear <45’ (2020)	224	2686	
Fixed & mobile gear ITQ/Enterprise Allocation Fleet (2020)*	See notes		
Fixed Gear 45-65’	30	529	
Mobile Gear <65’	108	5839	
Fixed Gear 65-100’	4	137	
Mobile Gear 65-100’	4	137	
Vessels >100’	18	3232	
By-catch reserve (2020)	55	142	42
Reserve (2020)		n/a	

Joint management of the transboundary groundfish stocks on Georges Bank (cod, haddock and yellowtail flounder) has been a challenge.

[24] *: Fixed & Mobile Gear ITQ/Enterprise Allocation Fleet no longer exists – this was a pilot project that ended in 2011 at which time the fleets within received individual allocations.

For its part, in 1985 Canada set a quota for its fishers as though the whole 5ZE stock were within its jurisdiction. The US adopted a similar approach (though quotas were not used). For much of the next decade, fishing pressure was up to four times higher than the level which would have been consistent with a conservative fishing strategy (generally referred to as F0.1).

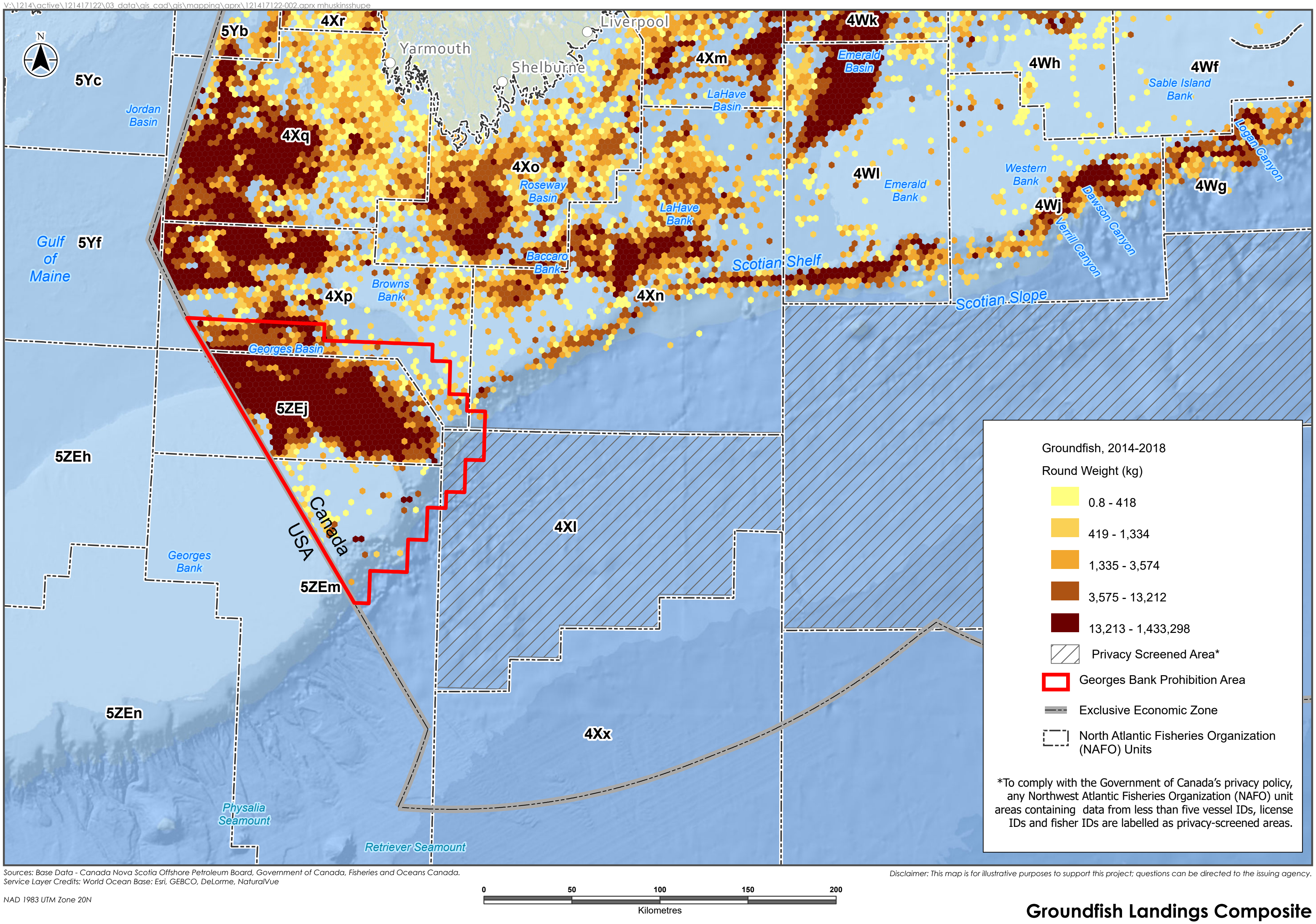
Not until 1995, with a year-round closure on the US side of the line and a substantial reduction in the Canadian quota, did the exploitation rate drop to an acceptable level.

Canada has faced considerable difficulty managing transboundary groundfish stocks on Georges Bank (cod, haddock and yellowtail flounder). Before 1977, the area was an international fishery and stocks were heavily over-fished as national quotas tended to be ignored. In 1978, Canadian quotas were set subject to negotiations with the US. From 1979 until the boundary settlement in 1984, the TACs and quotas were also set subject to negotiations with the US; the quotas were essentially based on the Canadian shares of the 5ZE TACs as set out in an unratified 1979 Fisheries Agreement.

Canada altered its approach in 1985 as the parties were unable to make any progress on an agreement for joint management. Both countries abandoned the practice of sharing the stock according to the Fisheries Agreement. For its part, Canada set a quota for its fishers as though the whole 5ZE stock were within its jurisdiction. The US adopted a similar approach (though quotas were not used). For much of the next decade, fishing pressure was up to four times higher than the level which would have been consistent with a conservative fishing strategy (generally referred to as F0.1). Not until 1995, with a year-round closure on the US side of the line and a substantial reduction in the Canadian quota, did the exploitation rate drop to an acceptable level.

The overfishing contributed to a sharp decline in stock abundance. From a peak of 25,000 t in 1985, the Canadian quota for cod declined to just 1,000 t in 1995 (reducing it to a by-catch fishery). Similarly, from a 12,000 t peak in 1982, the haddock quota declined to 2,500 t in 1995.

As of 2003, the *Canada-US Transboundary Resource Understanding* holds Canada and the US jointly responsible for accounting for all fishing mortality for yellowtail flounder, cod, and haddock.



Sources: Base Data - Canada Nova Scotia Offshore Petroleum Board, Government of Canada, Fisheries and Oceans Canada.
Service Layer Credits: World Ocean Base: Esri, GEBCO, DeLorme, NaturalVue

NAD 1983 UTM Zone 20N

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Groundfish Landings Composite
Landings (kg) per 10 km2 hexagon

Stantec

SCIENCE AND SOCIO-ECONOMIC REVIEW OF THE GEORGES BANK PROHIBITION AREA 2010-2021

121417122-002

Figure A-3

Fishing Patterns

The fishery is dominated by draggers and long-liners. Some 120 (down from 145 in 1998) vessels are estimated to be active, though more are eligible to fish based on historic participation. For many vessels, the individual quotas are too low to make the trip economic, so they trade or lease their quotas to others.

Fishing for cod and haddock ranges over the Bank, depending on the location of stocks in any particular year.

Table A-6 Canadian Groundfish Landings from Georges Bank

Year	Weight (round; MT)
1998	9,106
1999	9,205
2000	12,058
2001	14,851
2002	13,288
2003	12,775
2004	13,782
2005	17,535
2006	14,676
2007	13,872
2008	16,802
2009	19,322
2010	19,232
2011	14,205
2012	7,468
2013	6,242
2014	14,763
2015	16,759
2016	14,232
2017P	15,028
2018P	14,160
2019P	15,362
2020P	12,445
Note: "P" denotes preliminary data	

Total Canadian groundfish landings from Georges Bank peaked in 2009 at 19,322 t and hit a 20-year low of 6,242 t in 2013, with figures remaining above 12,000 t since 2014 (Table A-6).

The TAC for Eastern Georges Bank haddock (5Zjm) was 13,000 t in 2020, and down to 7,614 t in 2021. The TAC for Eastern Georges Bank Atlantic cod (5Zjm) was 461.5 t in 2020, and down to 444.5 t in 2021. The TAC for Georges Bank yellowtail flounder (5Zhjmn) is reserved to bycatch only and was increased from 42 t in 2020 to 45 t in 2021[25].

Resource Status and Prospect

Resource status and prospect information was collected from cod, haddock and yellowtail flounder Georges Bank Assessments completed by the Transboundary Resources Assessment committee.

Cooperation on fisheries science and management between Canada and the US has improved over the past few years. Stock assessment information is shared, and each country takes the other's catch expectations into consideration in developing management strategies. The management objective for both is to implement restrictive measures to allow stocks to re-build.

Eastern Georges Bank Cod

The 5Z cod stock once supported a significant directed fishery, but recent significant decreases in stock biomass and low quota levels have significantly restricted directed fishing. The TAC for Eastern Georges Bank cod dropped from 964 t in 2018, to 461.5 t in 2019 and 2020, and down to 444.5 t in 2021[26].

Atlantic cod is a groundfish species managed under a new 2017 DFO mixed groundfish IFMP, the *4VWX5 Groundfish Integrated Fisheries Management Plan*[27] as well as the 2019 *Rebuilding plan for Atlantic cod – NAFO division 5Z*[28]. Eastern Georges Bank cod are considered a transboundary resource and are managed collaboratively with the US.

As of 2018, the fleet share of 5Z cod is primarily composed of fixed gear under 45' (48.4%), mobile gear over 65' (23.3%), and a bycatch reserve of 12%. The Aboriginal Enterprise Allocation fleet (mobile gear over 65') has 4.2% of the fleet share.

There have only been three notable recruitment events for Eastern Georges Bank cod since 1992: 2003, 2010, and 2013. However, these recruitment events remained significantly below the pre-1990 average of 10 million fish per year. A combination of high total mortality, lower weights at age throughout the population, and ongoing poor recruitment have all led to a lack of rebuilding for the Eastern Georges Bank cod stock[29].

---

[25] DFO. (2021). *2021 groundfish (Maritimes region) – 5Z.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/decisions/fm-2021-gp/atl-01-eng.html
[26] DFO. (2021). *2021 groundfish (Maritimes region) – 5Z.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/decisions/fm-2021-gp/atl-01-eng.html
[27] DFO. (2018). *4VWX5 groundfish – Maritimes region*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/groundfish-poisson-fond/groundfish-poisson-fond-4vwx5-eng.html
[28] DFO. (2019). *Rebuilding plan for Atlantic cod – NAFO division 5Z.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/cod-morue/cod-morue-2019-eng.html
[29] DFO. (2019). *Rebuilding plan for Atlantic cod – NAFO division 5Z.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/cod-morue/cod-morue-2019-eng.html

Adult population biomass (ages 3+) declined from about 50,000 t in 1990 to below 10,000 t in 1995, where it has remained since.

Recruitment has not been above 10 million fish per year since the late 1980s. Resource productivity is currently poor due to low recent recruitment and low weights-at-age.

Average weight at length, used to reflect condition, has been stable, but declines in length and weight at age have hampered biomass rebuilding. Resource productivity is currently poor due to low recent recruitment and low weights at age compared to the 1980s.

While management measures have resulted in decreased exploitation rates since 1995, adult biomass has fluctuated without any appreciable rebuilding. The continuing poor recruitment since the early 1990s is an important factor for this lower productivity.

Cod and haddock are often caught together in groundfish fisheries, although they are not necessarily caught in proportion to their relative abundance because their catchabilities to the fisheries differ. Due to the higher haddock quota, discarding of cod may be high and should be monitored. Modifications to fishing gear and practices, with enhanced monitoring, may mitigate these concerns. Eastern Georges Bank haddock quota has increased since 2013 alongside stock increases, but cod quota availability to account for bycatch while directing for haddock remains a limiting factor for the haddock fishery[30].

Eastern Georges Bank Haddock

The Transboundary Management Guidance Committee (TMGC) has adopted a strategy to maintain a low to neutral risk of exceeding the fishing mortality limit reference. When stock conditions are poor, fishing mortality rates should be further reduced to promote rebuilding.

Improved recruitment since 1990, lower exploitation and reduced capture of small fish in the fisheries allowed the adult population biomass (ages 3+) to increase from near an historical low of 9,100 t in 1993 to 81,900 t in 2003. Adult biomass decreased to 57,800 t in 2005 and subsequently increased to 155,600. In 2010, the spring survey biomass index was at 50,800 t and the fall biomass survey index was at 51,300 t. Both figures increased significantly in 2015 through 2017, before decreasing again in 2018 and 2019. Exceptional year classes have been noted in 2000, 2003, 2010, 2013, and 2016, with 2013 being the largest ever recorded in the time series[31].

DFO has noted that there has been a decline in weight-at-age for Eastern Georges Bank haddock since the late 1990s[32].

---

[30] DFO. (2019). *Rebuilding plan for Atlantic cod – NAFO division 5Z.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/cod-morue/cod-morue-2019-eng.html
[31] DFO. (2020). *Eastern Georges Bank haddock*. Retrieved from https://s3.amazonaws.com/nefmc.org/5e_TSR_2020_EGB-Haddock_FINAL.pdf
[32] DFO. (2020). *Eastern Georges Bank haddock*. Retrieved from https://s3.amazonaws.com/nefmc.org/5e_TSR_2020_EGB-Haddock_FINAL.pdf

With current fishing practices and catch ratios, the achievement of rebuilding objectives for cod may constrain the harvesting of haddock. Modifications to fishing gear and practices, with enhanced monitoring, may mitigate these concerns.

The TAC for Eastern Georges Bank haddock dropped from 15,000 t in 2019, to 13,800 t in 2020, and to 7,614 t in 2021[33]. This drop in TAC can be attributed to the fact that the population remains below the time-series average biomass while weight-at-age remains lower than normal. As of 2020, the Transboundary Resources Assessment Committee (TRAC) believes the stock condition of Eastern Georges Bank haddock is not poor but gave a range of quota advice for 2021 in the 2,635 t to 14,117 t range[34].

Canadian catches increased from 12,222 t to 14,168 t in 2019. Catches were as low as 4,621 t in 2013 but have remained above 11,000 t since 2014. TMGC has been responsible for setting quota for Eastern Georges Bank haddock since 2004, and the quota has never been fully taken. In 2009, 2010, and 2011, 66%, 63%, and 58% of the quota was caught. The percentage of quota caught in 2014 was 53%, 28% in 2017, and 49% in 2019[35].

Combined American and Canadian catches for Eastern Georges Bank haddock were 14,762 t in 2019. In 2019, the fishery age composition was dominated by the 2013 year-class. There was a significant decrease (75%) in swept area biomass during the fall survey in 2018 to 2019, dropping from 25,304 t to 6,292 t. The spring survey also demonstrated a significant decrease (66%) in swept area biomass, dropping from 96,905 t in 2019 to 32,765 t in 2020[36].

Georges Bank Yellowtail Flounder

Georges Bank yellowtail flounder is considered a transboundary resource and is managed collaboratively with the United States. Combined Canada and USA catches in 2008 were 1,275 t, and down to 87 t in 2018. In 2012, the TAC for a by-catch in Canada was 586 t. By 2021, the TAC has decreased to only 45 t. Historically, yellowtail was an important commercial species, but overfishing has significantly impacted the fishery, and the Georges Bank stock is currently in the critical zone. Commercial exploitation of Georges Bank yellowtail flounder began in the mid-1930s via the US trawler fleet, with catches increasing from 400 t in 1935 to an average of 17,500 t from 1963 to 1976. A directed Canadian fishery only began on Georges Bank in 1993, and the stock began being managed as a transboundary resource in 2001. Catches and quotas have been consistently decreasing since 2004. Since 2004, most yellowtail flounder landings have occurred as by-catch from trips directed for haddock.

---

[33] DFO. (2021). *2021 groundfish (Maritimes region) – 5Z.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/decisions/fm-2021-gp/atl-01-eng.html
[34] DFO. (2020). *Eastern Georges Bank haddock*. Retrieved from https://s3.amazonaws.com/nefmc.org/5e_TSR_2020_EGB-Haddock_FINAL.pdf
[35] DFO. (2020). *Eastern Georges Bank haddock*. Retrieved from https://s3.amazonaws.com/nefmc.org/5e_TSR_2020_EGB-Haddock_FINAL.pdf
[36] DFO. (2020). *Eastern Georges Bank haddock*. Retrieved from https://s3.amazonaws.com/nefmc.org/5e_TSR_2020_EGB-Haddock_FINAL.pdf

Efforts are now being made to rebuild the stock, including DFO's 2018 *Rebuilding plan for yellowtail flounder*[37]. Yellowtail flounder is a groundfish species managed under a new 2017 DFO mixed groundfish IFMP, the *4VWX5 Groundfish Integrated Fisheries Management Plan*[38]. Declines in stock biomass and low quota levels have resulted in Georges Bank yellowtail flounder to be strictly managed as a by-catch only species.

As of 2018, the fleet share for 5Z yellowtail flounder was 0.7% for the Aboriginal fleet, 4.9% for vessels over 100', and 64.4% for mobile gear (trawlers) below 65'. The remaining 30% in fleet shares have been set aside as a "bycatch reserve", with the assumption that 100% of yellowtail flounder caught incidentally in the offshore scallop fishery do not survive when discarded[39].

A.4 PELAGIC FISHERIES

The total landed value of pelagic species, which include swordfish, tunas, and herring, captured in Georges Bank was $2.28 million in 1998 and $0.95 million in 2020. In that time series, the total landed value of pelagic species reached a high of $5.29 million in 2001 and a low of $0.44 in 2016 (see Table 5.5).

Swordfish

Industry Structure

The Atlantic Canada swordfish fleet is composed mainly of long-line vessels, all of which also hold groundfish licenses. In 2012, there were 77 longline and harpoon swordfish licences in Atlantic Canada, 56 of which were active, and 1,203 harpoon-only licences, 34 of which were active[40].

Resource Access

The fishery operates on a competitive basis (i.e., all license-holders compete to maximize their share of the Canadian quota). The Canadian quota has declined sharply since the 1960s when it shifted from a harpoon fishery to primarily a longline fishery, peaking at 8,000 t, before dropping from 3,500 t in the late 1980s to just 1,100 t in 1998. The Canadian quota increased to 1,431 in 2008 before going back down to 1,348 in 2009 and 2010 (this quota is not Georges Bank specific). As of 1992, entry to the swordfish fishery is limited to the currently existing licences. This commentary is based on latest published information.

---

[37] DFO. (2019). *Rebuilding plan for yellowtail flounder – NAFO division 5Z.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/flounder-limande/2018/index-eng.html
[38] DFO. (2018). *4VWX5 groundfish – Maritimes region*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/groundfish-poisson-fond/groundfish-poisson-fond-4vwx5-eng.html
[39] DFO. (2019). *Rebuilding plan for yellowtail flounder – NAFO division 5Z.* Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/flounder-limande/2018/index-eng.html
[40] DFO. (2016). *Canadian Atlantic swordfish and other tunas*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/swordfish-espadon/NEW-swordfish-2013-espado-eng.html#toc1

Management

Swordfish is a highly-migratory species. The North Atlantic stock is under the jurisdiction of the International Commission for the Conservation of Atlantic Tunas (ICCAT). The Canadian fishery is managed by DFO that controls it within the quota assigned by ICCAT. Management measures include limited entry licensing, at-sea observers, logbook reporting and dockside monitoring.

Fishing Patterns

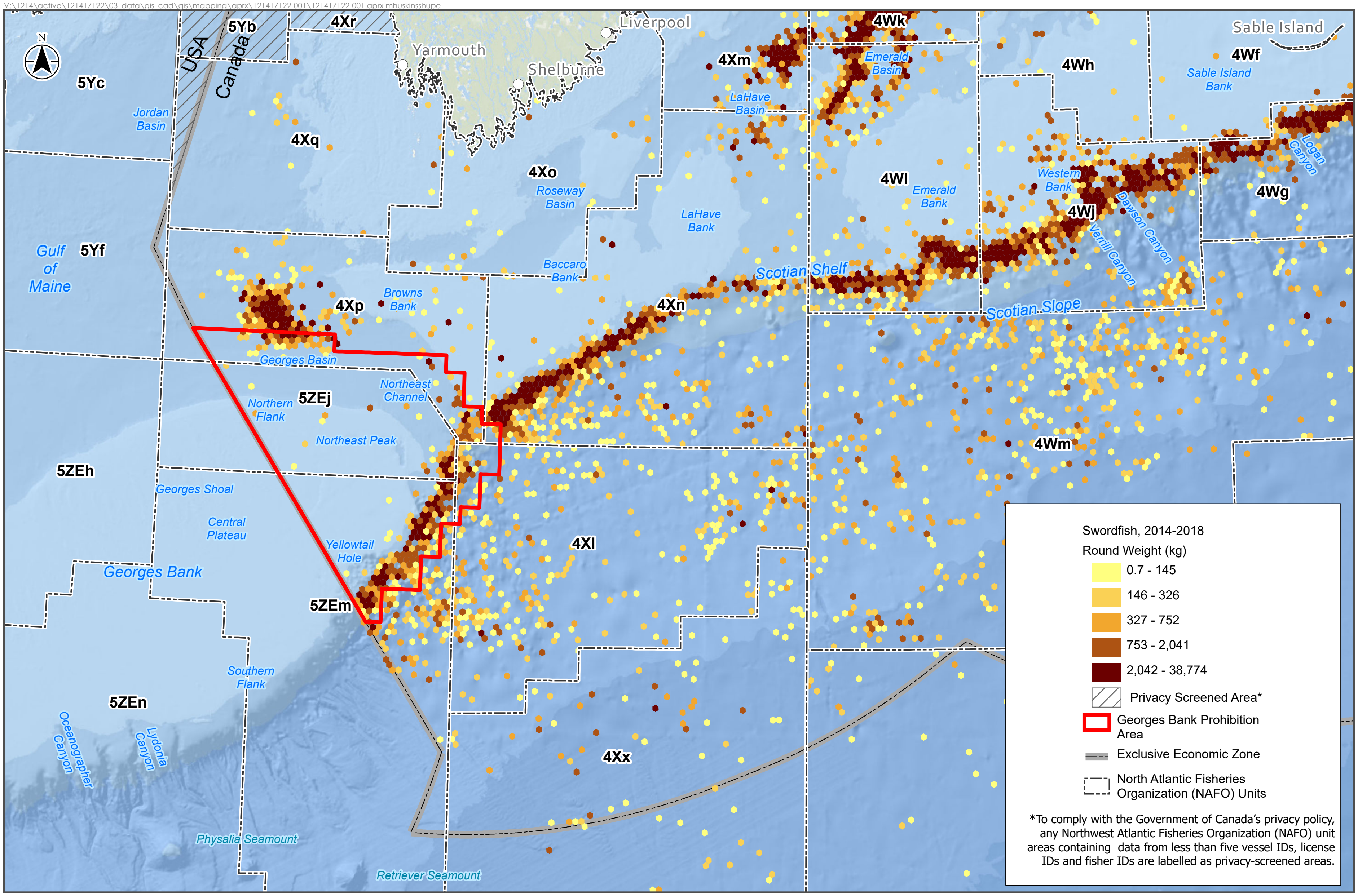
The swordfish season on Georges Bank opens on August 1 and extends through September and into October as the stock makes its way through its northern range. About 50 longline vessels are active. Swordfish are found on the edge and slope of the Banks, where there is a distinct thermocline (where water depth drops sharply from shallow to deep). They are found throughout the water column but are caught mainly at night during their migration to feed in surface waters (Figure A-4). Longlines extend some 65 km. It is the understanding of the Study Team that in recent years swordfish have been harpooned right across Georges Bank.

Resource Status and Prospects

Stocks have declined over the past decade, and further declines are expected. The TAC (and national quotas) is expected to be reduced in the next few years to promote stock re-building.

The longline swordfish fishery was certified by MSC in April 2012 and renewed in May 2020. The harpoon swordfish fishery was certified by MSC in June 2010 and renewed in April 2020.

V:\1214\active\121417122\03_data\gis_cad\gis\mapping\aprx\121417122-001\121417122-001.aprx mhuskinsshupe



Sources: Base Data - Canada Nova Scotia Offshore Petroleum Board, Government of Canada, Fisheries and Oceans Canada.
Service Layer Credits: World Ocean Base: Esri, GEBCO, DeLorme, NaturalVue

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

NAD 1983 UTM Zone 20N

0 50 100 150
Kilometres

Swordfish Landings Composite
Landings (kg) per 10 km2 hexagon

Stantec

SCIENCE AND SOCIO-ECONOMIC REVIEW OF THE GEORGES BANK PROHIBITION AREA 2010-2021

121417122-001

Figure A-4

Tuna

The tuna fishery conducted in waters off Nova Scotia is based on a TAC set by the International Commission for the Conservation of Atlantic Tunas (ICCAT). Tuna are broken down into two categories: bluefin tuna and "other tuna". Other tuna includes albacore, bigeye, skipjack, and yellowfin. The fish are very valuable, and landings are strictly monitored. Licence holders must purchase tags in advance of catching tuna. All tuna landed, both by directed fishing and by-catch must have a valid tag attached. The "Hell Hole", the northeast channel off Georges Bank, is the most important area for Nova Scotia tuna landings. Tuna catch data for Georges Bank is not available from DFO.

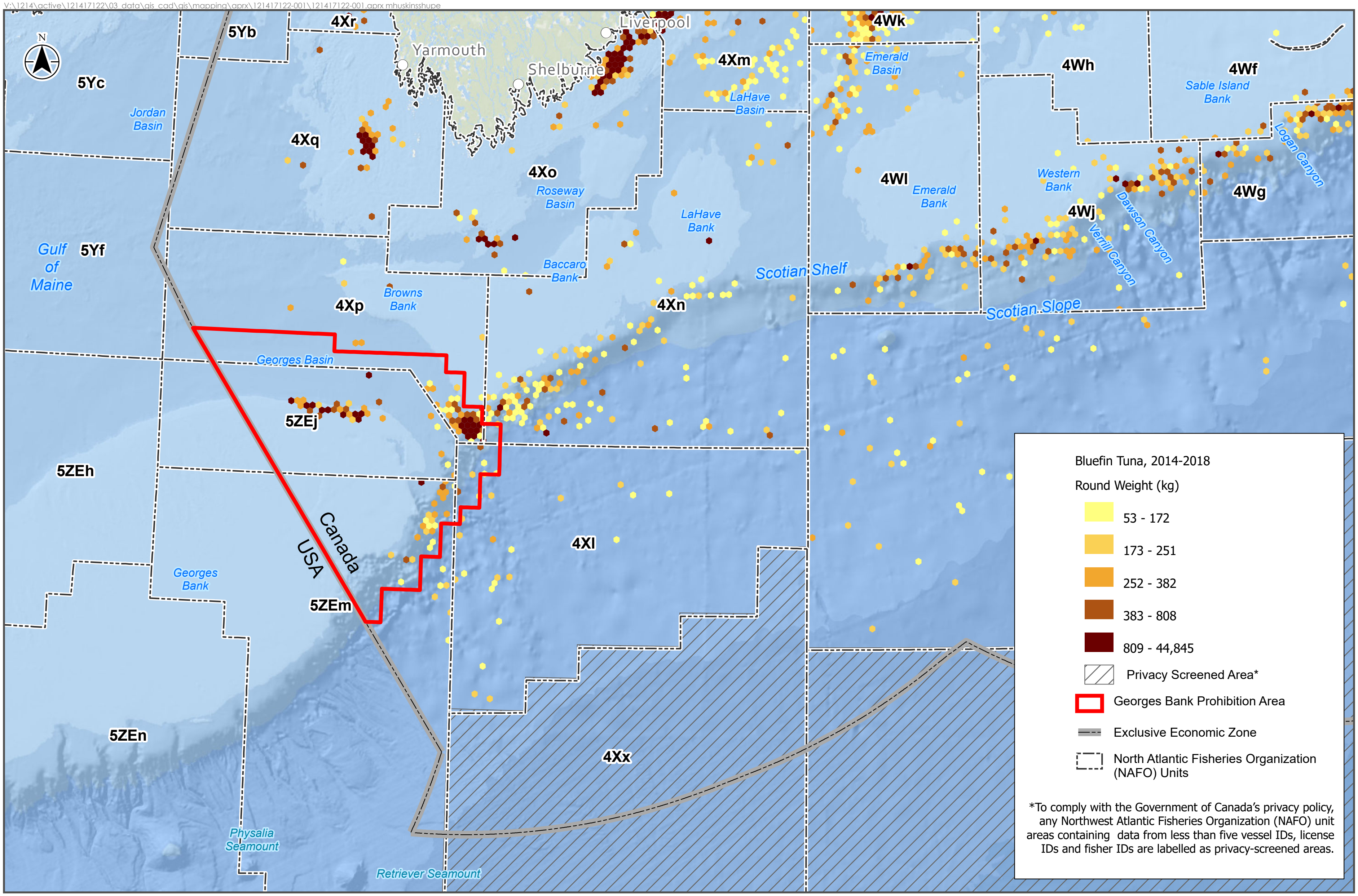
As of 2017, Canada's Atlantic bluefin tuna fishery is managed by DFO's Canadian Atlantic Bluefin Tuna IFMP. In 2017, there was a total of 846 licences for tuna in Atlantic Canada, 77 of which were commercial communal licences[41]. The commercial bluefin tuna fishing season is open year-round, but most directed fishing occurs from late July to mid-November. There are several fleets fishing bluefin tuna in Atlantic Canada. The Southwest Nova Scotia fleet consisted of 32 licences in 2017, six of which were held by Aboriginal organizations.

The Southwest Nova Scotia fleet has 21.7% of Canadian quota, and traditionally fishes off Southwest Nova Scotia, including Georges Bank. Most of the Southwest Nova Scotia fleet operates under an ITQ system, and the fishery is managed under an equal share per individual licence agreement. The number of tags a Southwest Nova Scotia fleet licence holder can get per year is based on the initial fleet allocation of the fleet, and generally does not exceed 15 tags per year[42].

Canadian quota for Western bluefin tuna was 452.57 t in from 2015 to 2017 and 530.59 t from 2018 to 2020. In 2017, the Southwest Nova Scotia fleet reported landings of 75.8 t in "traditional waters" and 14.5 t of landings outside its traditional sector fishing area, or 90.1 t in total. Bluefin tuna landed prices averaged $15.84/kg from 2011 to 2015[43] Using this price, the Southwest Nova Scotia fleet landed $1.43 million in bluefin tuna in 2017, $1.2 million of which would have been in their traditional waters, which includes Georges Bank.

---

[41] DFO. (2019). *Canadian Atlantic bluefin tuna (*Thunnus thynnus*) – NAFO fishing areas 3KLNOP, 4RSTVWX and 5YZ – 2017*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/bluefin-tuna-thon-rouge/bluefin-tuna-thonrouge2017-eng.html
[42] DFO. (2019). *Canadian Atlantic bluefin tuna (*Thunnus thynnus*) – NAFO fishing areas 3KLNOP, 4RSTVWX and 5YZ – 2017*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/bluefin-tuna-thon-rouge/bluefin-tuna-thonrouge2017-eng.html
[43] DFO. (2019). *Canadian Atlantic bluefin tuna (*Thunnus thynnus*) – NAFO fishing areas 3KLNOP, 4RSTVWX and 5YZ – 2017*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/bluefin-tuna-thon-rouge/bluefin-tuna-thonrouge2017-eng.html



Sources: Base Data - Canada Nova Scotia Offshore Petroleum Board, Government of Canada, Fisheries and Oceans Canada.
Service Layer Credits: World Ocean Base: CHS, Esri, GEBCO, DeLorme, NaturalVue

NAD 1983 UTM Zone 20N

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Bluefin Tuna Landings Composite
Landings (kg) per 10 km2 hexagon

Stantec

SCIENCE AND SOCIO-ECONOMIC REVIEW OF THE GEORGES BANK PROHIBITION AREA 2010-2021

121417122-001

Figure A-5

Herring

Industry Structure

Atlantic herring is managed under the 2020 *Atlantic herring in the Maritimes Region* IFMP[44], which includes Georges Bank. The herring fleet with access to Georges Bank is primarily composed of purse seine vessels, though only a few have been active in the fishery since it re-opened in 1993. The purse seine fleet had numbered over 40 vessels until the early 1990s, with many vessels independently owned. There were nine active purse seine licences in the Maritimes region in 2018 (Table A-7). The purse seine fleet was responsible for 81 to 99% of all herring landings in the Maritimes region from 1981 to 2018.

Table A-7 Number of Issued and Active Herring Licences by Licence and Gear Type, 2018

Licence Type	Gear Type	Issued Licences (# that are CC Licences)	Active Licences
Fixed gear	Weir	180 (5)	30
	Shut-off (beach / drag / bar seine)	42	22
	Trap net	18	4
Vessel-based	Gillnet (set and fixed)	1483 (24)	110
	Gillnet (drift)	397	94
Exempted vessel-based	Purse seine	32	9
	Mid water trawl	1	-
Recreational	Gillnet	67	-
Bait	Gillnet (set or fixed)	1291 (42)	116
Transport	-	81	7
Total	-	3592 (71)	392

Declining stocks have led to fleet rationalization. The remaining vessels are now largely company-owned.

Resource Access

The fishery on Georges Bank is open to all licensed vessels on a competitive basis.

Combined Canada and USA herring landings (not isolated to Georges Bank) increased from 106,000 t in 2005, to 116,000 t in 2006, then declined to 90,000 t in 2008 and 52,000 t by 2012, before increasing to 62,600 t in 2016. Landed weight has been below 120,000 t since 1994 and below 100,000 t since 2005.

[44] DFO. (2020). *Atlantic herring in the Maritimes region*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/herring-hareng/2020/index-eng.html

In 2016, a total of 160 active fixed gear licences secured a landed value of approximately $5.44 million, while 11 active mobile gear licences secured a landed value of approximately $19.68 million, or $25.12 million for the Maritimes region in total.

Management

The Georges Bank fishery is managed using a variety of measures set out in the “1997 Scotia-Fundy Fisheries Integrated Herring Management Plan, NAFO Sub-divisions 4WX, 4VN, and 5Z”. Canadian and US scientists are making efforts to develop a joint management approach. A rebuilding plan for the Southwest Nova Scotia / Bay of Fundy herring stock was completed by DFO in 2013.

Georges Bank is considered one of the three spawning grounds for the herring stock that occupies the Gulf of Maine to Georges Bank area, with the Georges Bank spawning ground responsible for 85 to 90% of the stock complex[45].

According to the most recent IFMP for herring in the Maritimes region, industry and DFO have agreed on an initial Canadian allocation of 20,000 tonnes for 5Z herring on Georges Bank[46].

Resource Status and Prospects

According to the most recent IFMP for herring in the Maritimes region, little is known about the status of offshore herring in the Maritimes region. Stock status reports have consistently demonstrated a need to rebuild herring stocks in the region for almost two decades, and the stock is presently considered to be in the “critical zone” [47].

[45] DFO. (2020). *Atlantic herring in the Maritimes region*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/herring-hareng/2020/index-eng.html
[46] DFO. (2020). *Atlantic herring in the Maritimes region*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/herring-hareng/2020/index-eng.html
[47] DFO. (2020). *Atlantic herring in the Maritimes region*. Retrieved from https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/herring-hareng/2020/index-eng.html

APPENDIX B

Detailed Analysis of the Sable Offshore Energy Project and Deep Panuke – Nova Scotia Royalty Regime Offshore Oil and Gas

A detailed assessment of the economic value of a petroleum industry development on Georges Bank can only be done in the abstract. To further illustrate the type and rate of economic benefits that can occur on an annual basis of an offshore development, we have assembled annual economic data for Deep Panuke and SOEP and have presented our findings in a summary table (See Table B-2).

By reviewing this table, the reader can gain an appreciation for annual economic activity associated with such a development. The data is not available to distinguish between pure project development and operational impacts. However, in the first column we show the key activities taking place each year. The greatest impacts associated with the project occur during years the greatest activity related to development was taking place. For instance, in 1999 for SOEP, $510 million of project expenditures took place in the province of Nova Scotia. The peak employment occurred in the same year in terms of person-hours worked by Nova Scotians. At peak in 1999, 955 different people were working on the project. Following 1999, development continued with work related to Tier II activity; however the economic activity was occurring at a lower rate than occurred in 1999. Total head count in employment stayed quite consistent between 1999 and 2004 with numbers ranging between 828 and 1,082.

Table B-1 Examples of Materials and Equipment Required for Various Stages of Offshore Oil and Gas Drilling and Development

Drilling & completions	Subsea, export pipelines, & tie-in	Mobile Offshore Production Unit (MOPU) & RFO – Electrical & HVAC	MOPU & RFO – Instrumentation, Safety, and Loss Control	MOPU & RFO – Mechanical	MOPU & RFO – Piping Structural, Architectural, Telecoms, and First Fills
• Production casings and tubulars • Casing accessories (float equipment, centralizers, etc.) • Conductors • Safety equipment • Subsurface safety valve & accessories • Liner hangers • Packers, PBRs and seal assemblies • Downhole press / temp gauges and accessories • Flow control equipment • External casing packers • Drill bits	• Concrete mattresses • Sand bags • Anodes • Subsea isolation valve • Flowlines • Umbilicals • Wellheads and XMAS trees • Subsea control equipment • Line pipe • Flanges and fittings • Pipe bends • Concrete mattresses • Anodes	• Power Distribution System, Switchgear, MCCs, Transformers, and Panelboards • UPS / Rectifiers & Battery Chargers / Banks • Navigational Aids • Power, Control & Instrument Cables • Cable Glands • Cable Tray • Junction Boxes • Lighting Fixtures • Miscellaneous Electrical Bulks • Heat Tracing • Air Handling Units • Miscellaneous Fans • Fire Dampers • Electric Heaters	• Control System (DCS / ESD / Fire & Gas) • Metering Equipment • Production Information Management System • Analyzers • Flow Indicators and Flow Switches • Instrument Housings and Enclosures • Instrument Tube and Fittings • Level Instruments – Transmitters / Switches / Indicators • Pressure & Temperature Gauges / Switches • Choke Valves • Control & Regulating Valve • Actuated On/Off Valves • Breathing Air Package • Deluge Skids • Life Saving Equipment (SCUBA, Life Rafts, Safety Showers, Eye Wash, etc. • Fire Fighting Equipment and Containers • Life Boats and Stations (Evacuation Systems) • Spill Equipment • Safety Signs	• Gas Compressors • Compressors – Acid Gas • Compressors – Stabilizer O/H • Main Power Generation • Emergency / Essential Power Generation • Printed Circuit Heat Exchangers • Double Pipe and MultiTube Exchangers • Plate Exchangers • Shell & Tube Heat Exchangers • Pedestal Cranes • Stabilizer Feed Filters & Coalescers • Open Drain Polishers • Filters & Filter Coalescers • Amine Gas Sweetening System • Chemical / Methanol Injection System • Condensate Stabilizer Package • Electrochlorination / Hypochlorite Package • Flare Package incl. Flare Tips • Fuel Gas Package • TEG Gas Dehydration System • Aviation Fuel Package • Plant / Instrument Air System • Inert Gas System • Pig Launchers / Receivers • Potable Water (Seawater Conversion Unit) • Produced Water Package • Seawater Filtration Package • Sewage Treatment Package • Seawater Pumps • Condensate Re-injection Pumps • Centrifugal Pumps • Fire Water Pumps • Positive Displacement Pumps • Sump Pumps • Atmospheric Tanks • Knockout Drums • Vessels – Carbon Steel • Production Separator Vessels • Scrubber Vessels • Steam Generators • Mechanical Handling Equipment • Workshop Equipment	• Carbon Steel Pipe, Fittings, and Flanges • 316, Duplex & Super Duplex, and Alloy 625 Stainless Steel Pipe, Fittings, and Flanges • Titanium Pipe, Fittings, and Flanges • CUNI Pipe, Fittings, and Flanges • Studbolting • Gaskets • Strainers • Flame Arrestors • Ball Valves • Butterfly Valves • Gate, Globe, and Check Valves • Modular Valves • Safety Relief Valves (PSV's) • Valve Interlocks • Steel Plate • Steel Tubulars • Structural Rolled Sections • Cathodic Protection Anodes • External Blast Walls, Fire Walls, and Doors • Platform and Architectural Signs • Met / Ocean System • Radar Monitor • Communications System (Onshore / Offshore) • Public Address System • Radio / Video / Communication System • Security and Surveillance System • Lubes / Oils • Chemicals

Source: EnCana, 2006

Table B-2 Summary Table of Annual Activity Associated with the Sable Offshore Energy Project and Deep Panuke Showing Annual Expenditures and Employment Levels

Year	Sable Offshore Energy Project Activity	Deep Panuke Activity	Total Expenditure (millions)		Total NS Expenditure (millions)		Total Employment (million person hours)		Total NS Employment (million person hours)		Head Count NS (at Dec 31)	
			Sable	Deep Panuke	Sable	Deep Panuke	Sable	Deep Panuke	Sable	Deep Panuke	Sable	Deep Panuke
1998	• Tier 1 Project Development – 60% complete • Increased onshore activity at Sheet Harbour pipe coating, Goldboro gas plant, and Point Tupper fractionation. • Thebaud, Venture, and North Triumph platforms progressing. • Drilling conducted at Venture Field.	• Not active.	$1,081	-	$242	-	5.4	-	2.4	-	1,895	-
1999	• Construction, installation, and commissioning of all platforms, pipelines, and plants. • Received regulatory approval to operate all facilities.	• Not active.	$1,347	-	$510	-	6.1	-	3.5	-	955	-
2000	• Drilling work wound down as 10th well was completed. • Natural gas production began through Maritimes and Northeast Pipeline.	• Not active.	$443	-	$209	-	2.7	-	2.3	-	828*	-
2001	• Completion of second full year of production. • ExxonMobil becomes operator of SOEP. • Preliminary engineering on Tier II gas fields.	• Not active.	$330	-	$166	-	1.4	-	1.7	-	953	-
2002	• Project achieves highest average monthly sales and daily production. • Construction and upgrades complete at Goldboro plant. • Tier II development on two fields progresses. • Compression Project preliminary engineering completed.	• Not active.	$510	-	$205	-	1.8	-	0.98	-	900	-
2003	• Upgrades at Point Tupper and Goldboro complete. • Tier II production at Alma field authorized and underway. • Tier II construction on Venture platform continues. • Compression project contracts awarded.	• Not active.	$610	-	$240	-	3.0	-	1.9	-	974	-
2004	• Improvements to Goldboro and Point Tupper initiated. • Production license granted for Tier II South Venture field. • Tier II drilling at SV commences. • First gas at SV achieved in December. • Compression Project ongoing.	• Not active.	$560	-	$199	-	2.5	-	1.6	-	1,082	-
2005	• Additional SV wells brought into production. • Upgrades to Thebaud, Venture, North Triumph cranes completed. • Drilling of Venture V-7 completed. • Tier II modifications to Thebaud initiated. • Compression project ongoing.	• Not active.	$490	-	$153	-	2.3	-	1.0	-	733	-

Table B-2 Summary Table of Annual Activity Associated with the Sable Offshore Energy Project and Deep Panuke Showing Annual Expenditures and Employment Levels

Year	Sable Offshore Energy Project Activity	Deep Panuke Activity	Total Expenditure (millions)		Total NS Expenditure (millions)		Total Employment (million person hours)		Total NS Employment (million person hours)		Head Count NS (at Dec 31)	
			Sable	Deep Panuke	Sable	Deep Panuke	Sable	Deep Panuke	Sable	Deep Panuke	Sable	Deep Panuke
2006	• Drilling activities completed on Alma 3 well. • Commissioning and startup of Compression Project. • Tier II Thebaud modifications ongoing. • Tie-ins brownfield work initiated.	• Not active.	$486	-	$186	-	2.2	-	1.4	-	697	-
2007	• Marks decade of continuous operation. • Production from North Triumph platform re-established. • Commissioning of Thebaud compression platform continued. • Compression facilities operating.	• Project granted approval by CNSOPB and National Energy Board in March. • Project approval granted by EnCanaa's Board of Directors in October.	$249	$32.8	$110	N/A	1.2	0.16	1.1	0.11	411	N/A
2008	• Drill rig secured and materials ordered for Alma 4 well. • Internal inspections of two pipelines completed. • No new project development work occurred. • Planning of a maintenance campaign scheduled for the summer of 2009.	• Approval of pipeline route by National Energy Board to connect with Goldboro construction. • Completion of offshore pipeline coating process at Sheet Harbour. • Preparation for export pipeline in 2009. • Geotechnical survey to investigate production field centre (PFC) site location.	$197	$238.6	$106	N/A	0.94	0.31	0.86	0.28	336	N/A
2009	• Successful completion of maintenance campaigns at both the onshore and offshore facilities. • Drilling of the Alma 4A development well.	• Installation and trenching of export pipeline for Deep Panuke to Goldboro. • Installation of wellhead protection structures at 5 offshore wells. • Preparation for drilling.	$381.3	$371	$168.4	N/A	1.47	0.61	1.3	0.5	320	N/A
2010	• Ongoing operations and maintenance.	• Drilling of disposal well. • Installation of subsea flowlines to connect 4 production wells and acid gas disposal well to PFC site. • Installation and trenching of 3-km of pipeline.	$176.0	$305	$106.6	N/A	0.84	1.36	0.76	1.18	218	N/A
2011	• Ongoing operations and maintenance.	• Arrival and installation of PFC; start of hook-up and commissioning activities for PFC. • Completion of subsea program to prepare facilities offshore for first gas. • Gas export pipeline prepared to accept natural gas from project in Golboro.	$143.3	$169	$74.8	N/A	0.57	0.85	0.54	0.74	212	N/A
2012	• Ongoing operations and maintenance.	• Project begins operations phase.	$146.6	$55	$77.6	N/A	0.65	0.9	0.61	0.78	251	N/A
2013	• Ongoing operations and maintenance.	• First gas and full production achieved. • Project fully into operations phase.	$168.8	$100.5	$91.2	N/A	0.66	0.85	0.59	0.73	265	N/A
2014	• Ongoing operations and maintenance.	• Ongoing operations and maintenance.	$217.2	$123	$111.1	N/A	0.80	0.89	0.69	0.71	406	N/A
2015	• Ongoing operations and maintenance.	• Ongoing operations and maintenance. • Shift to focus on winter production to account for higher demand.	$179.5	$121	$98.8	N/A	0.73	0.88	0.66	0.73	444	N/A
2016	• Ongoing operations and maintenance.	• Ongoing operations and maintenance.	$148.5	$109	$88.9	N/A	0.75	0.8	0.64	0.65	354	N/A

Table B-2 Summary Table of Annual Activity Associated with the Sable Offshore Energy Project and Deep Panuke Showing Annual Expenditures and Employment Levels

Year	Sable Offshore Energy Project Activity	Deep Panuke Activity	Total Expenditure (millions)		Total NS Expenditure (millions)		Total Employment (million person hours)		Total NS Employment (million person hours)		Head Count NS (at Dec 31)	
			Sable	Deep Panuke	Sable	Deep Panuke	Sable	Deep Panuke	Sable	Deep Panuke	Sable	Deep Panuke
2017	• Ongoing operations and maintenance. • Commencement of early decommissioning planning, regulatory, and procurement activities.	• Ongoing operations and maintenance. • Commencement of early decommissioning planning, regulatory, and procurement activities.	$172.4	$104	$91.3	N/A	0.96	0.71	0.82	0.62	564	N/A
2018	• Decommissioning activities in full effect. • Production ceases.	• Decommissioning activities in full effect. • Production ceases.	$322.8	$98	$159.8	N/A	1.4	0.51	1.0	0.44	461	N/A
2019	• Decommissioning activities.	• Decommissioning activities.	$306.5	$127	$145.0	N/A	1.1	0.45	0.83	0.36	413	N/A
Cumulative (to end of 2019)			$7,961.1	$1,953.9	$3,281.8	N/A	41	9.25	27.1	7.88	-	-

Nova Scotia Offshore Royalty Regime

Overview

Nova Scotia has an Offshore Petroleum Royalty Regime that is based upon revenues and profits. The regime is designed to recognize the inherent risks involved in offshore oil and gas exploration and production. The regime provides arrangements for the currently producing Sable Offshore Energy Project and the Deep Panuke Project which is currently under development, as well as a generic formula for future projects. The generic royalty regime is explicitly designed to encourage risk-taking by offering lower royalties for the first project in a new area - a so called "high risk project".

Authority

The authority for the Government to put in place regulations that set royalty levels for oil and gas projects in the offshore Nova Scotia area comes from the Offshore Petroleum Royalty Act. The Act also provides for royalty agreements to be put in place between offshore production license holders and the government of Nova Scotia. In July of 1999, the government of Nova Scotia signed formal royalty agreements with each interest owner of the Sable Offshore Energy Project, and in June 2006 signed an Offshore Strategic Energy Agreement (OSEA) with Encana Corporation concerning the Deep Panuke Project. Generic royalty regulations will apply to future offshore oil and gas projects. Each of the royalty regimes stipulate that royalty will be a function of both the value of petroleum leaving a project boundary as well as profits associated with the operation of a project. Royalty is initially set as an increasing percentage of gross revenues before it switches to increasing percentages of net revenues. Royalty rates increase with project profitability. Once net revenue royalty levels are reached, royalty cannot be less than a specified level of gross revenues.

Royalty Terminology

Gross Revenues (GR): The value of petroleum leaving the boundary of an offshore project.

LTBR: Long Term Government of Canada Bond Rate (10 year).

Net Revenue (NR): The gross revenue of a project less the costs associated with getting the petroleum to the project boundary.

Return Allowance (RA): A percentage of unrecovered project costs. Once simple payout is achieved, the return allowance ceases to be calculated.

Simple Payout: The point at which project revenues first reach or exceed the sum of allowed exploration costs, capital costs, operating costs and royalties paid. Corporate income tax is not an allowed cost for royalty purposes.

Sable Offshore Energy Project Royalty Regime

Gross Revenue Royalty	
Tier 1	1% GR, 36 month period
Tier 2	2% GR, until simple payout RA based on 5% + LTBR
Tier 3	5% GR, until simple payout RA based on 12.5% + LTBR
Net Revenue Royalty	
Tier 4	30% NR, until simple payout RA based on 45% + LTBR *
Tier 5	35% NR *

*** minimum of 1% or 5% of GR payable depending on average gas price.**

Deep Panuke Project Royalty Regime

Gross Revenue Royalty	
Tier 1	2% GR, until simple payout RA based on 5% + LTBR
Tier 2	5% GR, until simple payout RA based on 12.5% + LTBR
Net Revenue Royalty	
Tier 3	20% NR, until simple payout RA based on 25% + LTBR *
Tier 4	32.5% NR *

*** minimum of 5% GR payable.**

Generic Royalty Regime
Base Regime

Gross Revenue Royalty	
Tier 1	2% GR, until simple payout RA based on 5% + LTBR
Tier 2	5% GR until simple payout RA based on 20% + LTBR
Net Revenue Royalty	
Tier 3	20% NR until simple payout RA based on 45% + LTBR *
Tier 4	35% NR *

Small Oil

Gross Revenue Royalty	
Tier 1	2% GR until later of 2 years or simple payout RA based on 5% + LTBR
Tier 2	5% GR until later of 3 years or simple payout RA based on 20% + LTBR
Net Revenue Royalty	
Tier 3	Same as Tier 3 of BASE REGIME *
Tier 4	Same as Tier 4 of BASE REGIME *

High Risk

Gross Revenue Royalty	
Tier 1	Same as Tier 1 of BASE REGIME
Tier 2	Same as Tier 2 of BASE REGIME
Net Revenue Royalty	
Tier 3	20% NR *

*** Minimum of 5% GR payable.**

For projects that fall under the Base Regime, only successful finding costs are allowed costs for royalty purposes. For projects that fall under the Small Oil or High Risk regimes, in addition to successful exploration costs, unsuccessful exploration costs associated with the project may be allowed costs for royalty purposes.