

# Seafood Assessment



## Sea Scallop

*Placopecten magellanicus*



(from SeafoodWatch Report)

## Atlantic Canada

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## **About Sea Choice® and Seafood Assessments**

The Sea Choice® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the Canadian marketplace. Sea Choice® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Sea Choice® makes its science-based recommendations available to the public in the form of a pocket guide, Canada's Seafood Guide, that can be downloaded from the Internet ([www.seachoice.org](http://www.seachoice.org)) or obtained from the Sea Choice® program directly by emailing a request to us. The program's goals are to raise awareness of important ocean conservation issues and empower Canadian seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on Canada's Seafood Guide is supported by a Seafood Assessment by Sea Choice or a Seafood Report by Monterey Bay Aquarium; both groups use the same assessment criteria. Each assessment synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic/sustainability criteria to arrive at a recommendation of "Best Choices", "Concerns" or "Avoid". The detailed evaluation methodology is available on our website at [www.seachoice.org](http://www.seachoice.org). In producing Seafood Assessments, Sea Choice® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and scientific reviews of ecological sustainability. Information used to evaluate fisheries and aquaculture practices for assessments regularly comes from ecologists, fisheries and aquaculture scientists, members of industry and conservation organizations. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Sea Choice's sustainability recommendations and the underlying Seafood Assessments will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Assessments in any way they find useful, with acknowledgement. For more information about Sea Choice® and Seafood Assessments, please contact the Sea Choice® program via e-mail and telephone information available at [www.seachoice.org](http://www.seachoice.org)

Sea Choice® and Seafood Assessments are made possible through a grant from the David and Lucile Packard Foundation.

## **Executive Summary**

Important Canadian sea scallop fisheries are conducted by inshore fishermen in the Gulf of St. Lawrence and the Bay of Fundy off Digby, Nova Scotia. The offshore fishery occurs on Georges Bank off the southwestern tip of Nova Scotia. Depending on the area, scallop fishing can be conducted on a year-round basis. Fishermen harvesting inshore sea scallops use vessels of about 18 m which tow drags equipped with large wire-mesh bags over the ocean bottom. Larger, more powerful vessels (about 30 m in length) are used to harvest the offshore scallops. The landed value of scallops in Eastern Canada in 2005 was over \$ 88 million, which makes it the fourth most valuable fishery in Atlantic Canada after lobster, snow crab and shrimp.

Sea scallops (*Placopecten magellanicus*) exhibit a high intrinsic population growth rate, high individual growth rate, low age at first maturity, and high fecundity, and are thus ranked inherently resilient to overfishing.

Despite of a long fishing record, offshore sea scallops stocks in Canada seem currently healthy. The targeted biomass of scallops (> 100 mm shell height) has decreased since 2002, but ranges above the long-term average of 1981-2005. Sea scallops are not considered overfished on Canadian offshore banks. Knowledge of the overall population abundances of Canadian wild scallop stocks remains fragmentary because DFO's stock assessment reports cover only one region at a time, and stocks and data are not always reported in the same fashion in different reports, increasing the difficulty of comparison between fishing areas and between in- and offshore scallop fisheries. Therefore, the status of sea scallop stocks is considered moderate.

Quantitative bycatch data from observers are hard to come by. Bycatch reports exist for groundfish (such as yellowtail flounder and monkfish) and benthic invertebrates (lobster and Icelandic scallops). Bycatch of all groundfish species, except monkfish, must be returned to the water. Monkfish have accounted for approximately 85% of the groundfish bycatch landed by offshore scallop vessels. Lobster bycatch is considered minimal. Canada has no reported bycatch of endangered sea turtles or barndoor skates. It must be stressed that a complete picture of the bycatch problem is lacking. Increasing observer coverage and reporting of observer data will help alleviate this problem. DFO has taken measures to address the yellowtail flounder bycatch problem.

Scallop dredging has severe impacts on benthic populations, communities, and habitats. Some fishing areas, such as Georges Bank may recover from short-term impacts of scallop dredging. The long-term impacts from scallop fishing gear must be considered a serious conservation concern, because of potential effects on the benthic community including reduction of species densities, shifts in the spatial distributions of macrofaunal populations, removal of epifauna, reduction of habitat complexity, redistribution of grain sizes in sediments and increases in water column silt load. The offshore scallop fishery industry conducts sea-bed mappings, which has allowed fishers and scientists to determine the exact location of scallops, enabling the industry to fish more efficiently and decrease disturbance to the ocean floor.

Canadian management has been faulted for ignoring scientific advice on managing the Bay of Fundy scallop fishery, but, overall, has implemented strong management practices such as

limited entry, gear restrictions, the establishment of fishing areas and seasons, and meat counts. Catches are monitored through an industry-funded dockside monitoring program, and vessels are required to carry “black boxes”, or vessel monitoring systems. The industry also participates in and funds the research vessel surveys, collects data through a port sampling program and conducts sea-bed mapping to determine the exact locations of scallops, thus decreasing overall disturbance to the ocean floor by focusing catch effort on areas with high biomass.

*Justification for Reassessment*

For a more comprehensive review, focusing on the US fishery see [Sea Scallop Seafood Watch Report](#) (available online:

[http://www.mbayaq.org/cr/cr\\_seafoodwatch/content/media/MBA\\_SeafoodWatch\\_SeaScallopsReport.pdf](http://www.mbayaq.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_SeaScallopsReport.pdf)


The criteria analyzed in the assessment for seas scallops, *Placopecten magellanicus*, from eastern Canada result in the following overall recommendation: AVOID

**Table of Sustainability Ranks**

Sustainability Criteria	Conservation Concern			
	Low	Moderate	High	Critical
Inherent Vulnerability	√			
Status of Stocks		√		
Nature of Bycatch			√	
Habitat Effects			√	
Management Effectiveness		√		

**Overall Seafood Recommendation:**

Sea Scallops

Best choice 

Some Concerns 

**Avoid **

**About the Overall Seafood Recommendation:**

- A seafood product is ranked **Avoid** if two or more criteria are of High Conservation Concern (red) OR if one or more criteria are of Critical Conservation Concern (black) in the table above.
- A seafood product is ranked **Some Concerns** if the five criteria “average” to yellow (Moderate Conservation Concern) OR if the “Status of Stocks” and “Management Effectiveness” criteria are both of Moderate Conservation Concern.
- A seafood product is ranked **Best Choice** if three or more criteria are of Low Conservation Concern (green) and the remaining criteria are not of High or Critical Conservation Concern.

## **Introduction**

### **Biology**

Sea scallops, *Placopecten magellanicus*, occur from Cape Hatteras, North Carolina, USA to the north shores of the Gulf of St. Lawrence and Newfoundland, Canada. They typically occur in waters 20-110 meters (m) depth, although they can range from 2-384 m depth (NEFSC 1991). Due to their sensitivity to high water temperatures, scallops become increasingly restricted to deeper waters in the southern portion of their range (Brand 1991). This assessment does not comprehensively cover the fishery for the Iceland scallop (*Chlamys islandica*) which overlaps in range with the sea scallop in the Gulf of St. Lawrence.

Unlike many commercial scallop species, the sea scallop has separate sexes. Male scallops develop a white gonad in the summer months, while female gonads are bright red. Eggs and sperm are released into the water and fertilization takes place in the sea. Spawning begins in late August to early September, and the larvae drift in the water for almost a month before settling to the bottom in October (DFO 2006).

### **Fishery**

The Canadian sea scallop fishery is conducted in inshore and offshore waters. The main type of fishing gear used is the Digby dredge, although there is a small diving fishery off Lunenburg, Nova Scotia as well as limited seeding of scallop beds in the Gulf of St. Lawrence.

#### *(1) Offshore Fishery*

Canada maintains an offshore fleet of boats over 88 feet in length. Boats participating in the offshore fishery must fish south of 44° 40' latitude and more than 12 miles offshore and occurs on Georges Bank, the Scotian Shelf (including the Middle Grounds, Western Bank, Sable Island Bank, German Bank and Browns Bank), as well as off Newfoundland on St. Pierre Bank. Because scallops occur at shallower depths in northern waters, it is possible for the Canadian fishery to spatially separate smaller and larger boats. The bulk of Canadian landings, 72%, are exported to the US (DFO 2004).

#### *(2) Bay of Fundy / Southwest Nova Scotia (inshore)*

The inshore scallop fleet has traditionally fished in the Bay of Fundy, particularly off Digby and near the island of Grand Manan (Figure 1). Fishing has generally been concentrated off Digby, but also extends into the Inner Bay of Fundy and as stocks have been depleted, vessels have been granted access to inshore areas off Yarmouth.

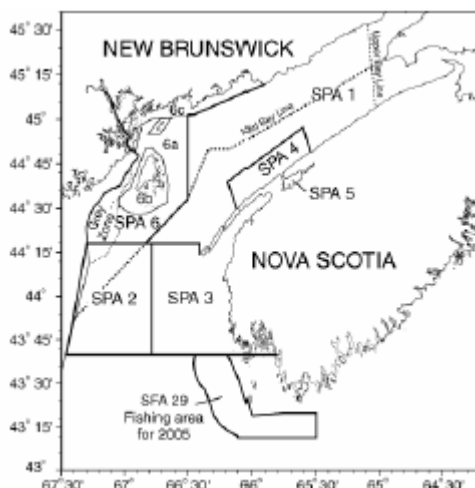


Figure 1. Location of inshore scallop areas in the Bay of Fundy and off southern Nova Scotia (image from DFO 2006c).

Recent re-opening of the inshore fishery off Yarmouth to the Full Bay Fleet has caused controversy among fishermen and fisheries managers. Scallop Fishing Area (SFA) 29 encompasses a very large inshore area inside the 12-mile territorial sea from the south of Yarmouth to Cape North in Cape Breton. Prior to 1986, the Full Bay Scallop Fleet fished in this area. Following the 1986 inshore/offshore scallop fishing agreement, fishing by the Full Bay Fleet was restricted to north of latitude 43°40'N. A limited fishery by the Full Bay Fleet was granted from 1996–98. Access was again granted to this fleet in 2001 with a full at-sea monitoring program and with a condition of a post-season industry-funded survey.

SFA 29 is within Lobster Fishing Area 34 and, as a result, scallop fishers consulted with lobster fishers in the area to deal with potential conflicts. Lobster fishermen have expressed concern about the impacts of scallop fishing as LFA 34 is one of the best lobster fishing areas in Atlantic Canada. Lobster by-catch was minimal in 2001 despite high scallop catch rates. The impact on the lobster fishery is measured only by lobster bycatch, which continues to be monitored in this fishery.

In 2002, the Minister of Fisheries and Oceans approved access to this area by the Full Bay Fleet and inshore east of Baccaro licence holders who are eligible to fish in SFA 29 west of longitude 65°30'W. SFA 29 inshore scallop licenses were historically restricted to east of Baccaro (east of longitude 65°30'W). A joint project agreement was signed with the fishing fleets, Natural Resources Canada, and Fisheries and Oceans Canada with all parties providing funds to conduct multi-beam acoustic mapping of the seafloor and other scientific work. A map showing bottom features for the entire area has been prepared and was distributed to the fishermen for the 2004 fishery. Work continues on analyzing surficial geology and the spatial distribution of scallops. Advice on TACs for this area has been provided annually and is based on tracking the response of survey estimates of abundance to catches in the previous year. There is no framework or reference points for the fishery in SFA 29 at this time.

### (3) Inshore fishery Quebec

The inshore commercial scallop fishery in Quebec began in the late 1960s targets two species indiscriminately, the sea scallop (*Placopecten magellanicus*) and Iceland scallop (*Chlamys islandica*). The sea scallop is faster growing than the Iceland scallop, which matures at age 8. These two species are found mainly on gravel, shell or rocky bottoms, generally at depths of 20 to 60 metres. Iceland scallops occur along the North Shore, around Anticosti Island and off the north coast of the Gaspé Peninsula, but are virtually absent from the southern Gulf. In contrast, sea scallops are found primarily in the southern Gulf, including the Magdalen Islands and Chaleur Bay, and occasionally along the Lower North Shore. There is also some scallop aquaculture in the Magdalen Islands.

The Digby drag is widely used. Over the years, there has been a substantial increase in fishing effort, primarily as a result of the fleet's increased capacity and efficiency. Catches are landed mostly as meat (muscle), but the proportion landed in the shell has been growing since the late 1990s. This is in contrast to the other scallop fisheries in Atlantic Canada, where the muscle is the primary meat landed. Whole scallops are eaten more frequently in Quebec.

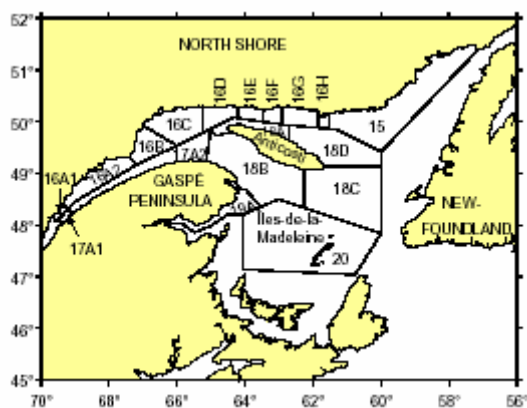


Figure 2. Inshore scallop fishing areas in Quebec (DFO 2005c)

The region is divided into 18 management units with 79 permanent fishing licences and 10 exploratory licences as of 2005 (figure 2). Fishing effort is controlled in all units, and most units on the North Shore and around Anticosti Island are governed by quotas, as well. The North Shore region has posted the largest scallop landings in Quebec since 1985 (DFO 2005c)

In 2004, landings totalled more than 127 t of meat, down by 21% from 2003. The North Shore accounted for 82% of the landings, followed by the Magdalen Islands with 14%, and the Gaspé with 4%. Fishing effort also decreased by 34% in 2004 (DFO 2005c).

#### **Economic Importance**

Scallops are important to the Atlantic Canadian economy. In 2005, sea scallops were the 4<sup>th</sup> most important Atlantic fishery in Canada, with over \$88 million Canadian in landings.

**Scope of the analysis and the ensuing recommendation:**

This analysis covers the sea scallop fishery in Atlantic Canadian waters, and discusses both the inshore fishery and offshore fishery. Because of concerns about bycatch and the impacts of scallop dredges on the sea floor, coupled with depleted stocks in some areas, the overall recommendation for this species is: AVOID.

**Availability of Science**

Science is readily available and accessible in the form of regular stock assessments. Regional Advisory Processes (RAPS) are held periodically. There are assessments available from 2005 and 2006 for all fisheries reviewed in this analysis. Unlike US stock assessments, Canadian stock status reports do not necessarily include FMSY or BMSY, which makes comparison to US stocks difficult. In the offshore fishery, industry funds much of the science, including mapping of the sea floor. There has been some independent science done on the impacts of the scallop fishery on the sea floor. More research is required to fully assess impacts of these extensively used gears. Some data on bycatch are in government reports, but are generally limited or not consistently released. Observer data is not easily accessible. Previous reliance on logbooks has resulted in poor historical data, but increases in observer coverage are improving data collection.

**Market Availability**

**Common and market names:** Scallop, sea scallop, digby scallop, pétoncles

**Seasonal availability:** Available year round. In North American, only the adductor muscle is eaten.

**Product forms:** Scallops come fresh or frozen. In Quebec, whole scallops can be purchased, but the majority of the seafood product is the adductor muscle.

## **Analysis of SeaChoice® Sustainability Criteria for Wild-caught Species**

### **Criterion 1: Inherent Vulnerability to Fishing Pressure**

The commercial value of the scallop fishery as well as its relatively sedentary lifestyle has resulted in significant research on assessing life history characteristics relevant to fisheries management. There is information on growth parameters, reproductive potential, and recruitment. Less attention has been paid to intrinsic rates of increase or maximum age for sea scallop; however there are estimates for both. Research on juveniles and habitat preferences has also been conducted (ref). Difficulties in assessment of juveniles makes year class estimates difficult.

Sea scallops have separate sexes and spawn by releasing gametes into the water to be fertilized. Other benthic invertebrates with this mode of reproduction have been shown to be vulnerable to the Allee effect, where reproduction is reduced or eliminated below a certain population density, although this has not been directly observed in sea scallops. Similarly, higher population densities would be expected to enhance recruitment, as fertilization success increases, but evidence for strong stock-recruitment relationships is equivocal. McGarvey (1993) documented an exponential increase in recruitment of sea scallops with stock size. In contrast, more recent data analyzed by NEFSC found little indication of recruitment driven by biomass (NEFSC 2003). A better understanding of stock-recruitment relationships is necessary to more precisely determine density and population size effects on recruitment at both high and low densities.

Sea scallops grow quickly, reaching maturity at age 2, even though individuals less than 5 years of age may contribute little to the population gamete pool (McGarvey et al. 1993). Scallops continue to grow quickly during their first few years of life, increasing in length by 50-80% between 3-5 years of age. Females may release 14-66 million eggs, but only approximately 1-6% of those eggs will be fertilized, survive the planktonic larval phase, and reach 2 years of age (Barber and Blake 1991; McGarvey et al. 1992). This estimate is highly variable, and reflects the density dependent stock-recruitment relationship. Scallops are relatively long lived; estimates on life-span range from 18-29 years (Bricelj and Shumway 1991). (Information taken from Halpin 2005). Scallops prefer a sandy, gravel bottom which is not limited in the North Atlantic (DFO 2006).









**Table 1.** Life history characteristics of the sea scallop (*Placopecten magellanicus*)

<b>Age at Maturity</b>	<b>Growth Rate/Max. Size</b>	<b>Maximum Age</b>	<b>Fecundity</b>	<b>Species Range</b>	<b>Special Behaviors</b>
Median age at maturity (years for female/male): 2 years	R=0.48	18-29	14-16million eggs	North Atlantic, from Virginia to Labrador	Adults tend to aggregate, patchy in distribution

### **Synthesis**

Scallops exhibit characteristics of a species inherently resilient to fishing pressure, namely high intrinsic population growth rate, high individual growth rate, low age at first maturity, and high fecundity. Additionally, the species is relatively widespread across the northwest Atlantic, and

while adults travel only small distances, a 5-week planktonic phase allows for widespread larval dispersal. Characteristics that could undermine the species’ resilience include a moderately long life span and a life history potentially vulnerable to the Allee effect, but overall sea scallops rank inherently resilient to fishing pressure.

<b>Criterion 1: Inherent Vulnerability to Fishing Pressure</b>	
<b>Primary Factors to Evaluate</b>	<b>Ranking</b>
Intrinsic rate of increase ‘r’	
Age at first maturity	
von Bertalanfy growth coefficient ‘k’	
Maximum Age	
Reproductive potential (fecundity)	
<b>Secondary Factors to Evaluate</b>	
Species range	
Special behaviours or requirements	
Quality of habitat (non-fishery impacts)	

**Inherent Vulnerability Rank:**

**Low (Resilient)** 

Moderate 

High (Vulnerable) 

**Criterion 2: Status of Wild Stocks**

**Factors 1 & 2: Management classification status & Abundance thresholds**

The Canadian offshore scallop fishery began on Georges Bank as early as the mid 1940s (DFO 2000). This area has been fished more or less year round by the Canadian offshore scallop fleet, with a regulated TAC since 1986 (DFO 2006d). The Georges Bank scallop fishery is managed in two zones, one designated as ‘a’ which are the traditional scallop grounds and zone ‘b’, a more marginal production area. On Georges Bank, the targeted biomass of scallops > 100 mm shell height (generally 4-7 years of age) ranges above the long-term average of 1981-2005, but has decreased since 2002 (DFO 2006). Up until 2002, the offshore fleet fished primarily fresh scallop products, but since that time the fleet has incorporated freezer trawlers. In the first year of fishing the freezer-trawlers landed nearly 10% of the TAC. In 2005, the freezer-trawlers have landed 57% of catches from zone ‘a’ and 58% of catches from zone ‘b’ (DFO 2006d).

In 2005, the TAC for zone ‘a’ was set at 2500T and 200 t for zone ‘b’. Reported landings for each area met the TAC, with 2484 t reported for zone ‘a’ and 201 t for zone ‘b’. Landings for zone ‘a’ are at the lowest levels since 1998 while zone b landings have remained at 200T since 2002 (Figure 3). Fishery targeted biomass is estimated at 15000t for zone ‘a’ in 2005.

Survey catch rates for scallops in zone ‘a’ for both recruits (age 4+) and pre-recruits (age 3) peaked in 2000. The age 4+ number per tow declined since 2000, with a slight recovery in 2005 to above the long-term average. The age 3 number per tow declined from 2000 to 2003 and has increased during the last two years to above the long-term average.

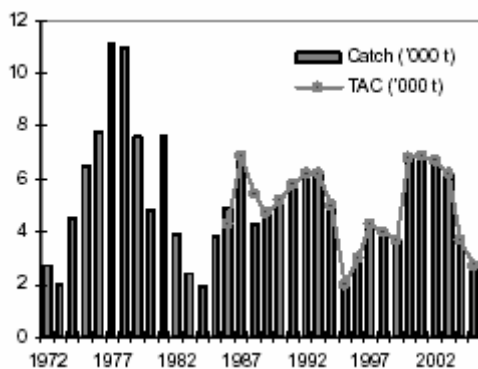


Figure 3. Catch and TAC of scallops from 1972-2004 on Georges Bank (DFO 2006d)

Generally, the Canadian stock assessment process does not specify stock status in terms of  $B_{MSY}$ . The overall population abundance of Canadian wild scallop stocks are largely unknown because DFO's stock assessment reports cover only one region and stock at a time. Biomass values for certain areas and stocks are available for the fishery targeted age groups (4-7 years for scallops) only. In addition, data are not always reported in the same fashion in different reports, increasing the difficulty of comparison between fishing areas. Commercial catch rates reached historical high levels during 2000 - 2002 and have since declined to average levels.

In the Bay of Fundy, scallop landings peaked in the mid 1980's and declined until 1997. Catches increased again, but failed to reach the set TAC in 2003. At that time, the TAC was decreased. Research surveys have been conducted annually since 1981, with similar trends in abundance, to those detected through catch rates (DFO 2004).

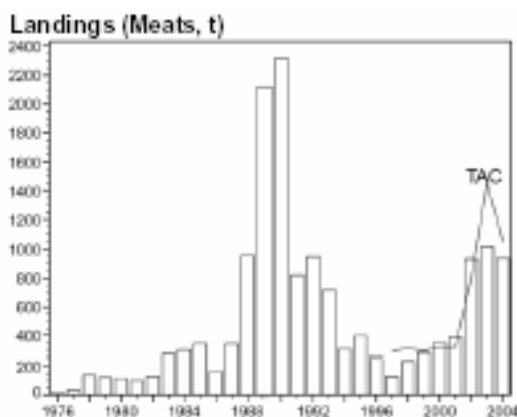


Figure 4. Scallop landings in the Bay of Fundy from 1976 to 2004 (Source: DFO 2004).

Landings in the inshore fishery in Quebec peaked in the early 1970s, and again in 1990 and have declined throughout the region since that time. Catches in 2004 were the lowest in more than a decade (Figure 5).

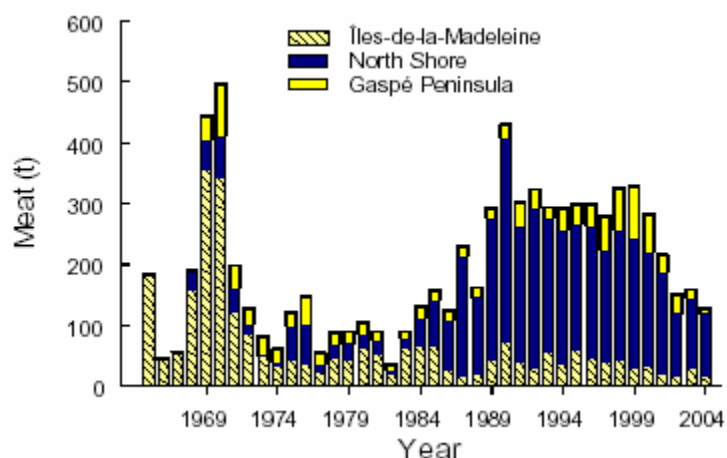


Figure 5. Scallop landings in the inshore fishery in Quebec. Landings include sea scallop and the Iceland scallop (Figure from DFO 2005c).

### Factor 3: Occurrence of Overfishing

The scallop fishery is not assessed according to reference points that would characterize it as overfished or whether overfishing was occurring.

### Factor 4: Overall degree of uncertainty in status of stock

Because of the availability of long term fishery-dependent data for Georges Bank scallops (DFO 2006), Bay of Fundy scallops (DFO 2005a), Scallop Fishing Area (SFA) 29 (DFO 2005b), Quebec scallops (DFO 2005c) as well as assessments for previous years, there is relatively little uncertainty in stock status. Fishery independent data is also collected for the inshore fishery in the Bay of Fundy and the Gulf of St. Lawrence fishery. Scientific surveys are completed in the offshore through cooperation with industry.

### Factors 5 & 6: Long-term and short-term trends in abundance

Commercial catch rates (CPUE) for the offshore fishery on Georges Bank are available from 1981. Catch rates reached historical high levels during 2000-2002 and have since declined to average levels (DFO 2006). Survey catch rates for scallops in zone 'a' for both recruits (age 4+) and pre-recruits (age 3) peaked in 2000. The age 4+ number per tow have declined since 2000, with a slight recovery in 2005 to above long-term average. The age 3 number per tow declined from 2000 to 2003 and has increased during the last two years to above the long-term average (DFO 2006).

For Bay of Fundy scallops (DFO 2005a), CPUE for scallops in Scallop Production Area (SPA) 1A declined from a high in the late 1980s to a low in 1997. With the large 1998 year-class recruiting to SPA 1A, it peaked again in 2002, and is now declining. CPUE for scallops in SPA

1B has declined in the last two years, but is still above the median level. CPUE for scallops in SPA 3 averaged 16.7 kg/h in 2005, compared to 22.1 kg/h in 2004 and were just above the median catch rate for the series (14.5 kg/h). CPUE for scallops in SPA 4 in 2004/2005 (21.8 kg/h) declined from 2003/2004 (38.6 kg/h) and was near the median over the whole time series (21.3 kg/h). Mean catch rates in October 2005 (12.2 kg/h) were less than half the mean for October 2005 (27 kg/h). CPUE for scallops in SPA 5 in 2005 (26.1 kg/h) was lower than in 2004 (32.1 kg/h) but still above the median for the 1977 to 2005 series (21 kg/h). CPUE for scallops in SPA 6 has been fluctuating with low effort for the Full Bay fleet. CPUE for the Mid Bay Fleet is fluctuating at a lower rate or above the 1993-2005 median level. For Quebec scallops, see DFO 2005c. For SFA 29, average catch rate for the Full Bay Fleet was 41.8 kg/h in 2005 compared to 54.4 kg/h in 2004 (DFO 2005b).

In the Quebec region, catches have fallen with the exception of the North Shore, where they have remained stable since 1998. Fishing effort has also fallen, and as the majority of population information is obtained through fishery dependent data, true population estimates are unknown (DFO 2005b).

#### **Factor 7: Current age, size, or sex distribution**

Dredging alters the size and age structure of fished scallop populations (Stokesbury et al. 2004).

**Synthesis**

Stock status is dependent on the area. The offshore fishery has reduced its effort considerably in the last decade, but maintained high catch levels, particularly when there is a good year class. The inshore fishery in the Bay of Fundy is in decline, and vessels have moved into new areas, that have not been heavily fished for the last 20 years. In Quebec, stocks are considered low, with the exception of the North Shore area where catches have remained constant. In all areas, catches have declined from when the fisheries first began. Overall, stock status is considered to be in moderate condition, with stocks low in some areas and considered healthy in others.

<b>Criterion 2: Status of Wild Stocks</b>			
<b>Primary Factors to Evaluate</b>	<b>Rankings</b>		
	<b>Offshore (Georges Bank, Scotian Shelf)</b>	<b>Inshore (Bay of Fundy)</b>	<b>Inshore (Quebec / GSL Region)</b>
Management classification status	■	■	■
Current population abundance relative to $B_{MSY}$	■	■	■
Occurrence of overfishing	■	■	■
Overall degree of uncertainty in status of stock	■	■	■
Long term trend in abundance	■	■	■
Short term trend in abundance	■	■	■
Current age, size, or sex distribution	■	■	■

**Conservation Concern: Overall Status of Wild Stocks**



**Criterion 3: Nature and Extent of Bycatch**

*Bycatch is defined as species that are caught but subsequently discarded (injured or dead) for any reason. Bycatch does not include incidental catch (non-targeted catch) if it is utilized, accounted for and/or managed in some way.*

**Factor 1: Quantity & Composition of Bycatch**

The Canadian scallop fishery has reported bycatch of groundfish (such as yellowtail flounder and monkfish) and benthic invertebrates (lobster and Icelandic scallops) (DFO 2000). In the Lower Bay of Fundy scallop fishery, over 150 additional species have been recorded from dredge hauls (Fuller et al 1998). The majority of these were not commercial species, but benthic fauna including sponges, hydroids, tunicates and bryozoans, all of which form structural habitat on the sea floor. In some areas, horse mussel beds were also impacted.

Several commercial species are caught in scallop dredges. Monkfish have accounted for approximately 85% of the groundfish bycatch landed by offshore scallop vessels (DFO 2000). Bycatch of all groundfish species, except monkfish, must be returned to the water. Lobster bycatch occurs in Scallop Fishing Area 29 (DFO 2005b). Lobster bycatch was considered minimal in 2001 despite high scallop catch rates. Lobster bycatch is regularly monitored by onboard observers. Bycatch of barndoor skate and loggerhead turtles is of concern in the US Northeast scallop fishery (Halpin 2005 and references therein) but are not considered a bycatch problem in Canada (Greg Stevens pers. comm.). A complete picture based on quantitative bycatch data is lacking. Increasing observer coverage and reporting of observer data will help alleviate this problem. Indirect mortality of both target and non target species should also be estimated.

**Factor 2: Population Consequence of the Bycatch**





A complete picture of bycatch effects in the Canadian scallop fishery is lacking. The idea that barndoor skate bycatch may not be a problem in Canada because it has already been driven to low abundances is discussed by Halpin (2005 and references therein). According to DFO, there is no barndoor skate bycatch in the Canadian scallop fishery (Greg Stevens, pers.comm.). Analyses of bycatch have not been properly done. Fishermen note the gradual extension of “lemonweed”, the bryozoan *Flustra foliacea*, from the Upper Bay to off Yarmouth, and suggest that this change is a result of the scallop fishery (Fuller and Cameron 1998).

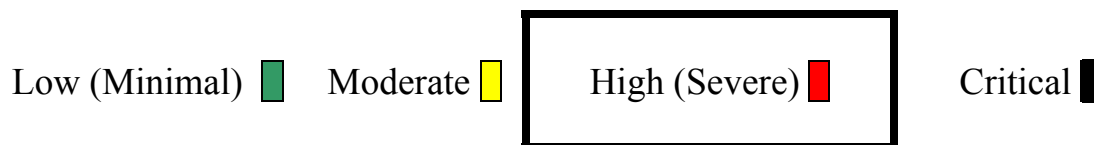
**Factor 3: Trends in Interaction Bycatch Rates**

Because of the lack of long term and / or systematic research in bycatch, there is no information for bycatch interaction rates.

**Synthesis**

While scallop dredges catch many other species, in addition to the target species, there has been little long term or systematic analysis in the Canadian fishery. Bycatch species include habitat forming species on the sea floor, as well as commercial species such as monkfish and lobster. Significant changes in the sea floor fauna have been documented in Canadian waters. Because of the lack of research, concern about the impacts on lobsters and seafloor habitat, bycatch is rated as “high” concern.

<b>Criterion 3: Bycatch</b>	
<b>Primary Factors to Evaluate</b>	<b>All Areas</b>
Quantity & composition of bycatch	
Population consequence of bycatch	
Trends in bycatch interaction rates	
<b>Secondary factors</b>	
Ecosystem impacts	

**Nature of Bycatch Rank:****Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems****Factors 1-3: Habitat Effects**

Scallop dredges have impacts on benthic populations, communities, and habitats by damaging or reducing structural biota and habitat complexity and by altering seafloor structure and large habitat features (DFO 2006b). Scallop dredging may impact the benthic community by reducing densities and shifting spatial distribution of macrofaunal populations (Langton et al. 1987, Langton and Robinson 1990, Thrush et al. 1985, Kenchington 2000, Bradshaw et al. 2002) by removing colonial epifauna and reducing habitat complexity (Dayton et al. 1995, Auster et al. 1996, Collie et al. 1997, Collie and Escanero 2000, Hall-Spencer and Moore 2000, Stokesbury and Harris 2006) and by redistributing grain size of sediments and increasing silt in the water column (Caddy 1989, Mayer et al. 1991, Grant 2000, MacDonald 2000). In the lower Bay of Fundy, scallop dredging has been shown to have altered the seafloor community, with a marked shift from sessile, longer lived species to mobile, fast growing species (Kenchington et al in prep).

On the offshore banks, scallops of e.g. Georges Bank prefer a sandy, gravel bottom in depths of 35-120 m (DFO 2006). Stokesbury and Harris (2006) suggest that a limited short-term sea scallop fishery on Georges Bank alters the epibenthic community less than the natural dynamic environmental condition. Lindholm et al. (2004) suggests that sand habitats on Georges Bank exposed to natural disturbance may recover from fishing gear impact in a relatively short period of 1 year. Both investigations were conducted in a high energy area. They stress the importance of closed areas to allow recovery from fishing impacts, but are not representative of all scallop fishing areas.






**Factors 4 & 5: Ecosystem Effects**

Offshore scallop fisheries are conducted on Georges Bank, the Eastern Scotian Shelf, Browns Bank, German Bank, and St. Pierre Bank. The offshore scallop fleet consists of wet fish vessels and freezer-trawlers, ranging from 27-46 m length. Generally, these vessels simultaneously fish two New Bedford offshore rakes or drags, 4-6.1 m width, one on each side of the vessel (DFO 2006). The inshore scallop fishing vessels in the Bay of Fundy are between 30' to 65'. The gear width limit is 5.5 m with ring size of not less than 82 mm inside diameter (DFO 2005a). New areas have recently been opened to the inshore vessels, particularly in the Lobster Fishing Area 29. While catches of lobsters in scallop gear are not alarming, it is the impacts on the sea floor that are not recorded. There has been considerable concern by fishermen in this area, and the issue has been brought to the attention of scallop managers.

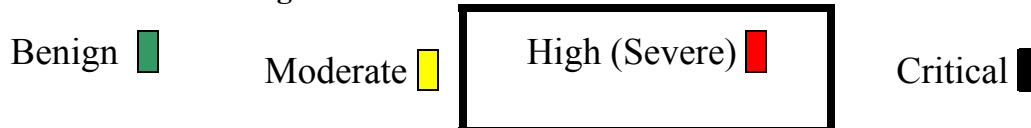
In the Bay of Fundy, research has shown a change in the benthic ecosystem from one dominated by sessile, long lived species to domination by mobile, short lived species (Kenchington et al in prep). This study compared bycatch in the scallop dredge between 1967 and 1997. In the Gulf of St. Lawrence, little impact was found (Archambault get ref), however this study was completed 40 years after the scallop fishery began and it is likely that any changes would not be noticeable because there are few control areas.

### **Synthesis**

Scallop dredges impact habitat. Ecosystem effects have been detected, however there are few studies that have adequate controls where an impacted area is compared to an area that has never been fished. Dredging can also impact the populations of scallops, and results in indirect mortality of the target species, altering size structure and resilience of the species

<b>Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems</b>	
<b>Factors to Evaluate</b>	<b>Ranking</b>
Impacts of Fishing Gear on Habitat	
Resilience of the Habitat	
Spatial Extent of the Impact	
Disruption of food webs from target species removal	
Changes in ecosystem state	

**Overall Effects of Fishing Practices Rank:**



**Criterion 5: Effectiveness of the Management Regime**

**Factor 1: Stock Assessments**

DFO produces periodic scientific assessments of scallop stocks, including recommendations for fishery management (e.g. DFO 2006, 2005a, b, c). These are peer reviewed by DFO internal and external scientists.

**Factor 2: Scientific Monitoring**

The two key management measures in the offshore scallop fishery are TACs (Total Allowable Catches) and meat counts. To ensure the integrity of the TACs, the industry is required to fund an independent dockside monitoring program (DMP). Currently, 100% of landings are monitored with catch data from each landing being transferred directly from the monitoring company to DFO. Commencing in 1997, consistent with Fisheries and Oceans Canada's (DFO's) approach in other Enterprise Allocation (EA) fisheries, all scallops landed from offshore scallop vessels must be monitored by a dockside observer and be recorded against the EA of the appropriate company. The past practice where crews were permitted to take small, predetermined quantities of scallops ashore without the benefit of dockside monitoring and without having the weights attributed to EA quotas, was prohibited by license condition effective January 1, 1997. Real time electronic monitoring is now provided by all offshore scallop vessels regardless of the area being fished. The inshore scallop fishery fleets also participate in dockside monitoring and meat sampling programs (DFO 2004a). In addition, the fleets of inshore scallop fishing area 29 are required to financially contribute to a sea-bed mapping project in the area (DFO 2004a). There is little monitoring of bycatch species or changes in bycatch over time.

**Factor 3: Scientific Advice**

Scientific advice is provided annually and includes information from fishery independent trawl surveys for the inshore fishery. Surveys for the offshore fishery are done on commercial vessels (check).

#### **Factor 4: Management Plans to Control Bycatch**

The offshore scallop fishery has a bycatch management plan in place. Since bycatch data are not accessible it is not clear if the plan is effective. Additionally, the bycatch management plan addresses bycatch of commercial species, but not of non-commercial or habitat forming species. (CHECK this plan)

#### **Factor 5: Management Plans to Control Habitat Impacts from Fishing Practices**

For the offshore scallop fishery, the industry conducts sea-bed mappings to focus fishery activities into exploitable areas. It has allowed fishers and scientists to determine the exact location of scallops, enabling the industry to fish more efficiently and decrease disturbance to the ocean floor (DFO 2004a, Greg Stevens pers comm). Conversely, this has also allowed exploitation of brood stocks and has enabled the fishery to target areas that were previously inaccessible as fishing gear would get caught in rough grounds.

In the Quebec region, conservation measures have been suggested, primarily to protect spawning grounds and reduce the impacts of scallop dredging on new recruits and larval settlement. As scallops spawn in late summer, and juveniles settle on the seabed in the fall. A halt in fishing during the spawning and settlement periods (August to November) would limit the adverse effects of dragging on the substrate and favour the survival of young scallops. A rotational fishing strategy would also reduce the mortality rate of pre-recruits (DFO 2005c). While these measures have been proposed, they have not been implemented to date.

#### **Factor 6: Catch Monitoring and Enforcement**








To ensure compliance with meat count regulations, fishery officers routinely conduct meat counts and quantities of scallop landings. In addition, scallop fishing vessels have observer coverage.

#### **Factor 7: Management Track Record**

Offshore scallop fishery on Georges Bank has maintained a long-term stock productivity (DFO 2006). The inshore fishery has had to close areas and has had to shift fishing areas to maintain catches. In the Quebec region, some areas have not been able to reach the TAC. Overall, there has been a reduction in fishing effort and a maintained level of catch, primarily due to fleet rationalization in the offshore.

## Synthesis

Canada does routine stock assessments with fishery dependent and fishery independent data. Management has implemented good management practices such as limited entry, gear restrictions, establishment of fishing areas and seasons, and meat counts. Catches are monitored through an industry-funded dockside monitoring program, and offshore vessels are required to carry “black boxes”, or vessel monitoring systems. Canadian management has been faulted for ignoring scientific advice on managing the Bay of Fundy scallop fishery, and in failing to address habitat impacts on lobsters in the Northumberland Strait. There is little in place to address bycatch of commercial and non-commercial species. Seabed mapping has occurred, through industry / DFO cooperation, which has led to a decreased footprint of the dredge fishery, but has also allowed vessels to target older brood stocks and access areas previously protected because of the potential for gear hang ups.

<b>Criterion 5: Effectiveness of the Management Regime</b>	
<b>Factors to Evaluate</b>	<b>Ranking</b>
Stock Assessments	
Scientific Monitoring	
Scientific Advice	
Bycatch	
Fishing Practices	
Catch Monitoring and Enforcement	
Management Track Record	

### Overall Effectiveness of the Management Regime:

Highly effective  **Moderate**  Ineffective  Critical 

### Overall Evaluation and Seafood Recommendation


Scallops are relatively resilient to fishing pressure, although there is concern about the indirect impacts of fishing on natural populations. Stock status is variable throughout the Atlantic Region, with pulsed reproduction resulting in strong year classes, and peaks and troughs in catches. There are concerns about bycatch and impacts of the fishery on the marine ecosystem. The numbers of species caught as bycatch are high and impacts on commercial and non-commercial species have received little study in Atlantic Canada. Scallop dredges are known to be one of the most destructive gear types. Management practices have been reasonably effective as overall area that is impacted by scalloping, particularly on the offshore has been reduced. However, little has been done to reduce bycatch or mitigate impacts on habitat. Scallop vessels have moved into areas that have not been fished regularly, resulting in concern for lobster habitat and bycatch. Scallops are therefore given a recommendation of “avoid”.

**Table of Sustainability Ranks**

Sustainability Criteria	Conservation Concern			
	Low	Moderate	High	Critical
Inherent Vulnerability	√			
Status of Stocks		√		
Nature of Bycatch			√	
Habitat Effects			√	
Management Effectiveness		√		

**Overall Seafood Recommendation:**

Scallop (dredge)

Best choice 

Good alternative 

**Avoid **

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