

The Safina Center  
at Stony Brook University

(formerly Blue Ocean Institute)

and



Monterey Bay Aquarium  
**Seafood Watch**

**White Hake**

*Urophycis tenuis*

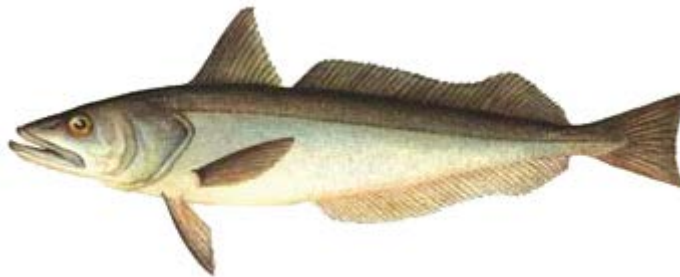


Image © B. Guild Gillespie/www.chartingnature.com

**Canada**

Bottom longline, bottom gillnet, and bottom trawl

June 10, 2014

Blue Ocean Institute Seafood Analysts

## **About The Safina Center**

The Safina Center (formerly Blue Ocean Institute) creates an original blend of science, art and literature that inspires a deeper connection with nature, especially the sea. Our books, films and educational programs instill hope, enlighten personal choices and build a larger constituency for conservation. From Alaskan fishing villages to Zanzibar's shores, we witness firsthand how nature is changing, then explain what these changes mean for wildlife and for people. The Safina Center translates science into language people can understand. Our goal is to be a unique voice of hope, guidance and inspired change. Our work is disseminated through major, mainstream outlets such as the PBS television network, *The New York Times*, Huffington Post, NationalGeographic.com and CNN.com plus other established print, television and online media.

Founded in 2003 by conservation pioneer and MacArthur "genius" award winner Dr. Carl Safina, The Safina Center builds on three decades of his field research, policy work, acclaimed books and other writing.

### **The Safina Center's *From Sea to Table* Program**

The Safina Center's founders created the first seafood guide in 1998. The Safina Center online seafood guide now encompasses over 160-wild-caught species. Our peer-reviewed seafood reports are transparent, authoritative, easy to understand and use. All rankings and full reports are available on our website in the *Seafood Choices* section. *From Sea to Table* helps consumers, retailers, chefs and health professionals discover the connection between human health, a healthy ocean, fishing and sustainable seafood.

- Our online guide to sustainable seafood is based on our scientific rankings for more than 160 wild-caught seafood species and provides simple guidelines.
- We partner with Whole Foods Market (WFM) to help educate their seafood suppliers and staff, and provide our scientific seafood rankings for WFM stores in the US and UK.
- Through our partnership with Chefs Collaborative, we created *Green Chefs/Blue Ocean*, a free, interactive, online sustainable seafood course for chefs and culinary professionals.
- Our website features tutorials, videos, blogs, links and discussions of the key issues such as mercury in seafood, bycatch, overfishing, etc.

Check out our Fellows Program, Scientific Collaborations and Carl Safina's current work at <http://safinacenter.org/>.

The Safina Center is a 501 (c) (3) nonprofit organization based in the School of Marine & Atmospheric Sciences at Stony Brook University, Long Island, NY. <http://safinacenter.org/> admin@safinacenter.org | 631.632.3763

#### Disclaimer

Seafood Watch and The Safina Center strive to ensure that all our Seafood Reports and recommendations contained therein are accurate and reflect the most up-to-date evidence available at the time of publication. All our reports are peer-reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science or aquaculture. Scientific review, however, does not constitute an endorsement of the Seafood Watch program or of The Safina Center or their recommendations on the part of the reviewing scientists. Seafood Watch and The Safina Center are solely responsible for the conclusions reached in this report. We always welcome additional or updated data that can be used for the next revision. Seafood Watch and Seafood Reports are made possible through a grant from the David and Lucile Packard Foundation and other funders.

## **About Seafood Watch®**

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch® 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. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from [www.seafoodwatch.org](http://www.seafoodwatch.org). The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices," "Good Alternatives" or "Avoid." The detailed evaluation methodology is available upon request. In producing the Seafood Reports, Seafood Watch® 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 other scientific reviews of ecological sustainability. Seafood Watch® Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch®'s sustainability recommendations and the underlying Seafood Reports 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 Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling 1-877-229-9990.

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## Guiding Principles

The Safina Center and Seafood Watch define sustainable seafood as originating from sources, whether fished<sup>1</sup> or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

Based on this principle, Seafood Watch and The Safina Center have developed four sustainability **criteria** for evaluating wild-catch fisheries for consumers and businesses. These criteria are:

- How does fishing affect the species under assessment?
- How does the fishing affect other, target and non-target species?
- How effective is the fishery's management?
- How does the fishing affect habitats and the stability of the ecosystem?

Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and **rating**

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide and The Safina Center's online guide:

**Best Choice/Green:** Are well managed and caught in ways that cause little harm to habitats or other wildlife.

**Good Alternative/Yellow:** Buy, but be aware there are concerns with how they're caught.

**Avoid/Red:** Take a pass on these for now. These items are overfished or caught in ways that harm other marine life or the environment.

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<sup>1</sup> "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates.

## Summary

This report provides analysis and recommendation for the White Hake (*Urophycis tenuis*) fishery in two regions of Northeast Canada, the Maritimes and Newfoundland and Labrador. White Hake is a bottom-dwelling fish species (or 'groundfish') typically found in the Atlantic Ocean from Cape Hatteras to southern Labrador and are primarily caught using three types of gear; bottom longline, bottom trawl, and bottom gillnet.

White Hake in Northeast Canada are at a low abundance, and despite low fishing levels in recent years, White Hake do not seem to be recovering. There has been no directed fishery for White Hake in the Maritimes region since 1999; White Hake are only permitted to be caught as bycatch in fisheries for other groundfish species. A directed fishery for White Hake still exists in the Newfoundland and Labrador region.

The fisheries that catch White Hake also catch numerous other species, some of which are overfished, threatened, or endangered. Several measures strategies are in place, such as annual catch limits, to regulate fishing for White Hake and other species caught in Canada's groundfish fisheries, but they have only been moderately effective.

Bottom longlines and gillnets cause a low amount of damage to the mud and sand habitats where White Hake live, while bottom trawls cause moderate habitat damage. Fishing impacts on the overall ecosystem are of moderate concern.

All Canadian White Hake fisheries are rated red or avoid.

## Table of Conservation Concerns and Overall Recommendations

Species / Fishery	Criterion 1 Impacts on the Species Under Assessment	Criterion 2 Impacts on other Species	Criterion 3 Management Effectiveness	Criterion 4 Impacts on Habitat and Ecosystem	Overall Recommendation
White hake Newfoundland and Labrador North Atlantic - Trawl, Bottom	Red (1.53)	Red (1.53)	Yellow (3.00)	Yellow (2.60)	<b>Red/Avoid (2.064)</b>
White hake Newfoundland and Labrador North Atlantic - Gillnet, Bottom	Red (1.53)	Red (0.95)	Yellow (3.00)	Yellow (3.12)	<b>Red/Avoid (1.920)</b>
White hake Newfoundland and Labrador North Atlantic - Longline, Bottom	Red (1.53)	Red (1.45)	Yellow (3.00)	Yellow (3.12)	<b>Red/Avoid (2.134)</b>

White hake Maritimes North Atlantic - Gillnet, Bottom	Red (1.53)	Red (0.95)	Yellow (3.00)	Yellow (3.12)	<b>Red/Avoid (1.920)</b>
White hake Maritimes North Atlantic - Trawl, Bottom	Red (1.53)	Red (1.00)	Yellow (3.00)	Yellow (2.60)	<b>Red/Avoid (1.857)</b>
White hake Maritimes North Atlantic - Longline, Bottom	Red (1.53)	Red (0.95)	Yellow (3.00)	Yellow (3.12)	<b>Red/Avoid (1.920)</b>

### Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

- **Best Choice/Green** = Final Score >3.2, **and** no Red Criteria, **and** no Critical scores
- **Good Alternative/Yellow** = Final score >2.2, **and** neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern<sup>2</sup>, **and** no more than one Red Criterion, **and** no Critical scores, **and** does not meet the criteria for Best Choice (above)
- **Avoid/Red** = Final Score ≤2.2, **or** either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern **Error! Bookmark not defined.**, **or** two or more Red Criteria, **or** one or more Critical scores.

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<sup>2</sup> Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

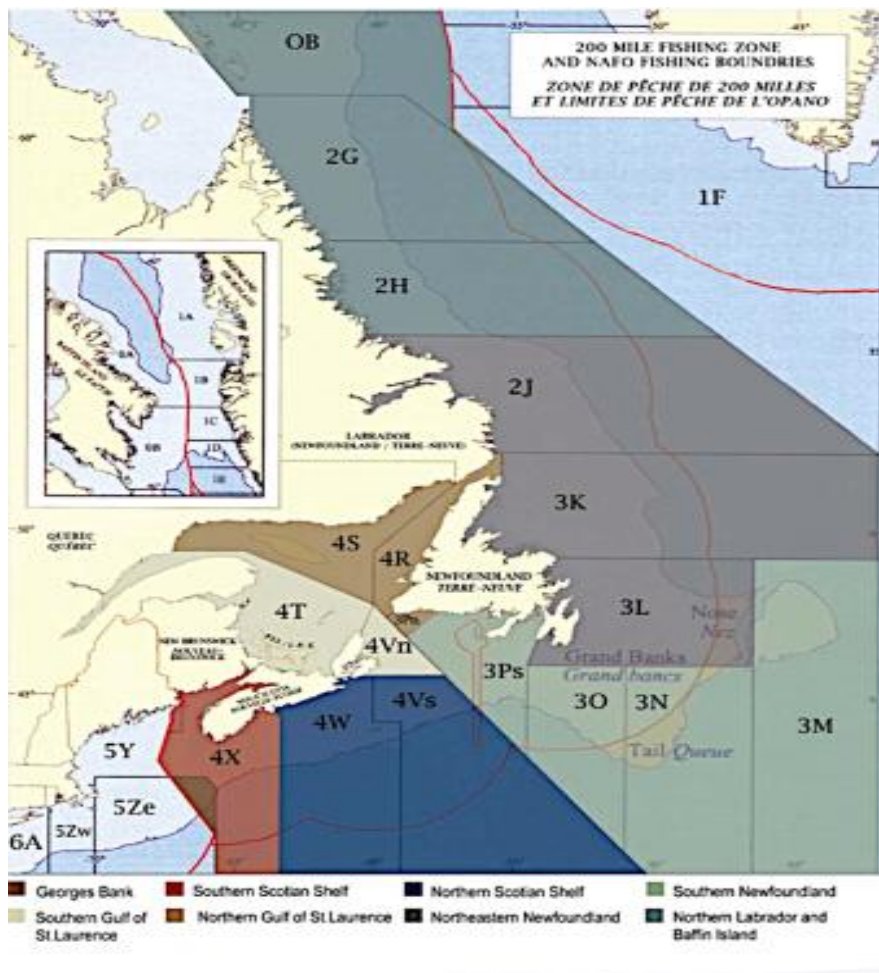
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## Introduction

### Scope of the Analysis and Recommendation

This report evaluates white hake (*Urophycis tenuis*) caught with bottom longlines, bottom gillnets, and bottom trawls in two regions of Northeast Canada; the Maritimes and Newfoundland and Labrador. White Hake are caught in fisheries throughout the Maritimes region (NAFO Divisions 4VWX and 5), but most are caught on the southern Scotian Shelf/Bay of Fundy (Division 4X). In the Newfoundland and Labrador region, white hake fisheries only occur in southern Newfoundland (Divisions 3N, 3O, and Subdivision 3Ps) (Figure 1). White hake caught in the Gulf of St. Lawrence were not considered in this assessment since there are very minimal commercial catches of white hake in this area.



Source: DFO, Communications Branch and Economic Analysis and Statistics.

Figure 1. Map of the NAFO management areas. (DFO 2011-Canadian Fisheries Statistics 2008).

### Overview of the Species and Management Bodies

White hake (*Urophycis tenuis*) is a fast-growing, bottom dwelling fish species (or 'groundfish') that inhabits the North Atlantic waters, favoring temperatures between 3°C and 10°C and depths of 50 to



400 m. Though white hake is typically found from Cape Hatteras to southern Labrador it has been reported as far north as the Icelandic waters and as far south as the deep waters off Florida. White hake can live for more than 20 years, and reach sexual maturity between 2 and 5 years old. They can grow up to 135 cm long and weigh up to 22 kg. Depending on their age, white hake prey on a variety of species including, shrimps, polychaetes, crustaceans, krill, Atlantic herring, Atlantic cod, haddock, longfin hake, redfish, Atlantic mackerel, northern sand lance, winter flounder, and smaller white hake (DFO 2013d). In return, they are preyed on by Atlantic cod, grey seals, harp seals, and other fish. Out of all the commercial groundfish species, white hake are the most fertile; a single female can produce several million eggs at each spawning.

White hake have been exploited throughout their geographical range. Historically, the white hake fishery was the third or fourth most important groundfish fishery in the southern Gulf of St. Lawrence (DFO, 2013d). However, due to a decline of white hake in this area, there has been a fishing moratorium for white hake in the southern Gulf of St. Lawrence since 1995. Today, white hake are primarily caught on the Scotian Shelf (Maritimes region) and off of southern Newfoundland.

In the Maritimes region, white hake is managed by the Department of Fisheries and Oceans Canada (DFO). Directed fishing for white hake is not permitted in this region but they are allowed to be caught in fisheries for other groundfish species, like cod, halibut, redfish, and pollock. Targeted fishing for white hake occurs in the Newfoundland and Labrador region. Fisheries in this region are managed by both the Department of Fisheries and Oceans Canada and the Northwest Atlantic Fisheries Organization (NAFO).

### **Production Statistics**

In the Maritimes region, catches of white hake were highest in 1986 and 1987 (around 8,000 t), and remained relatively high (around 5,000 t) into the mid-1990's. Catch restrictions were introduced in the mid-late 1990's, and since then catches have been at or below 2100 t annually. In Newfoundland and Labrador, catches of white hake peaked in three periods, the mid 1970's, the late 1980's, and the mid-2000's. Each peak was around 8,000 t annually. Recent catches have been less than 1000 t (COSEWIC 2013d).

Canadian reported catches of White Hake in 2013 were 1,070 t, with 354 t caught in Newfoundland and Labrador, 700 t caught in the Maritimes, and 16 t in the Gulf of St. Lawrence (DFO 2014b). On average, bottom longlines take 41% of the catch, bottom gillnets 33% of the catch, and bottom trawls 26% of the catch (DFO 2005a).

### **Importance to the US/North American Market**

The National Marine Fisheries Service Fisheries Statistics and Economics Division records all imports of hake species together. In 2012, the U.S. imported just under 12,500 t of hake from 17 countries. Sixty-five percent of the hake imports or 8,148 t were from Canada (NMFS 2013). U.S. catches of all Atlantic hake species (white hake, red hake, silver hake, offshore hake) were around 11,000 t in 2012.

**Common and Market Names**

Other common names for white hake include codling, squirrel hake, ling, steakfish, mud hake, and merluche blanche (French)(Simpson et al. 2012a).

**Primary Product Forms**

White hake is sold fresh, frozen, and smoked.

## Assessment

This section presents relevant information on the fishery and details how the fishery is scored relative to the Seafood Watch Fisheries Criteria, available at <http://www.seafoodwatch.org>.

### Criterion 1: Impacts on the species under assessment

*This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown.*

*The final Criterion 1 Score is determined by taking the geometric mean of the abundance and fishing mortality scores. Rating is based on the score as follows:*

- $>3.2$ =Green or Low Concern
- $>2.2$  and  $\leq 3.2$ =Yellow or Moderate Concern
- $\leq 2.2$ =Red or High Concern.

*Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.*

#### Criterion 1 Summary

WHITE HAKE				
Region / Method	Factor 1.1 Inherent Vulnerability	Factor 1.2 Abundance Score	Factor 1.3 Fishing Mortality Score	Criterion 1 Score
Maritimes North Atlantic Gillnet, Bottom	Medium Vulnerability	1.00:Very High Concern	2.33:Moderate Concern	<b>Red (1.526)</b>
Maritimes North Atlantic Longline, Bottom	Medium Vulnerability	1.00:Very High Concern	2.33:Moderate Concern	<b>Red (1.526)</b>
Maritimes North Atlantic Trawl, Bottom	Medium Vulnerability	1.00:Very High Concern	2.33:Moderate Concern	<b>Red (1.526)</b>
Newfoundland and Labrador North Atlantic Gillnet, Bottom	Medium Vulnerability	1.00:Very High Concern	2.33:Moderate Concern	<b>Red (1.526)</b>
Newfoundland and Labrador North Atlantic Longline, Bottom	Medium Vulnerability	1.00:Very High Concern	2.33:Moderate Concern	<b>Red (1.526)</b>
Newfoundland and Labrador North Atlantic Trawl, Bottom	Medium Vulnerability	1.00:Very High Concern	2.33:Moderate Concern	<b>Red (1.526)</b>

## Criterion 1 Assessment

### WHITE HAKE

#### Factor 1.1 - Inherent Vulnerability

##### Scoring guidelines

- *Low = FishBase vulnerability score for species 0-35 OR species exhibits life history characteristics that make it resilient to fishing, e.g., early maturing (<5 years), short lived (< 10 years), small maximum size, and low on food chain.*
- *Medium = FishBase vulnerability score for species 36-55 OR life history characteristics that make it neither particularly vulnerable or resilient to fishing, e.g. moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain.*
- *High = FishBase vulnerability score for species 56-100 OR life history characteristics that make it particularly vulnerable to fishing, e.g. long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator.*

*Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g. schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

#### **Medium Vulnerability**

The FishBase vulnerability score for white hake is 72 out of 100, which suggests white hake have a high inherent vulnerability to fishing (Froese and Pauly 2013). However, the life history characteristics of white hake indicate they only have a medium inherent vulnerability to fishing. White hake mature at around 42-45 cm (~4 years old). They can live up to 20 years old and reach a length of 135 cm (DFO 2005a). White hake are broadcast spawners and can produce several million eggs during each spawning. Within the food chain, they are a high-level predator species. We have rated this factor "medium" based on this species' life history attributes.

#### **Rationale:**

Table 1: Results from Seafood Watch fish vulnerability rubric (SFW criteria document, pg. 4). Attribute scores can range from 1-3 with higher scores signifying more resilient life history attributes.

Vulnerability attribute	Category	Score
Average age at maturity	< 5 years	3
Average maximum age	10-25 years	2

Fecundity	>100 eggs	N/A
Average max size	100-300 cm	2
Average size at maturity	40-200 cm	2
Reproductive strategy	Broadcast spawner	3
Trophic level	>3.25	1
<b>Average Score</b>	<b>Medium Vulnerability</b>	<b>2.17</b>

Species with average attribute scores between 1.80 and 2.43 are deemed to have a 'medium vulnerability'.

## Factor 1.2 – Abundance

### Scoring guidelines

- 5 (Very Low Concern) = Strong evidence that population is above target abundance level (e.g. biomass at maximum sustainable yield, BMSY) or near virgin biomass
- 4 (Low Concern) = Population may be below target abundance level, but it is considered not overfished/depleted.
- 3 (Moderate Concern) = Abundance level is unknown and species has a low or medium inherent vulnerability to fishing
- 2 (High Concern) = Population is overfished, depleted, or a species of concern OR Abundance is unknown and species has a high inherent vulnerability to fishing.
- 1 (Very High Concern) = Population is listed as threatened or endangered.

### Maritimes North Atlantic, Gillnet, Bottom

### Maritimes North Atlantic, Longline, Bottom

### Maritimes North Atlantic, Trawl, Bottom

### Newfoundland and Labrador North Atlantic, Gillnet, Bottom

### Newfoundland and Labrador North Atlantic, Longline, Bottom

### Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### 1.00 Very High Concern

The Committee on the Status of Endangered Wildlife (COSEWIC) in Canada identified two distinct populations of white hake in Canada; the Southern Gulf of St. Lawrence population and the Atlantic and Northern Gulf of St. Lawrence population. They recently determined that the Southern Gulf of St. Lawrence population is "endangered" and the Atlantic and Northern Gulf of St. Lawrence population is "threatened" (COSEWIC 2013d). The Atlantic and Northern Gulf of St. Lawrence population includes white hake found in both the Maritimes and Newfoundland and Labrador regions. It was estimated that adult abundance of this white hake population declined by 70% over the last ~30 years. Most of this decline occurred prior to the mid 1990's. Since the mid-1990's abundance has remained fairly stable. Much of the decline in white hake abundance is estimated to have occurred in the Maritimes region and Northern Gulf of St. Lawrence (COSEWIC 2013d). Abundance in the Newfoundland and Labrador region has fluctuated but is currently considered low (NAFO 2013b). The threatened determination by COSEWIC means white hake will now be considered for formal listing under Canada's Species At Risk Act; if listed they will be given federal protection. Since the most recent scientific assessment of white

hake indicates they are threatened in these regions, we have rated this factor "very high concern".

**Rationale:**

There is some suggestion of population separation between white hake in the Maritimes and white hake in Newfoundland and Labrador (Roy et al. 2012). However, scientists also found significant migration of white hake between these areas and the life history characteristics of white hake in these two areas are similar; therefore the Committee on the Status of Endangered Wildlife in Canada considered them to be of the same population (COSEWIC 2013d). The bodies that manage white hake, however, assess and manage white hake in these two areas separately.

In the Maritimes region, white hake is assessed and managed by the Department of Fisheries and Oceans Canada (DFO). The last formal assessment for white hake in the Maritimes region was completed in 2005 (Bundy and Simon 2005). At that time, abundance on the northern Scotian Shelf was considered low and it was noted that the white hake in this area required rebuilding (DFO 2005a). Abundance on the southern Scotian Shelf/Bay of Fundy was also decreasing and it was noted that catches at the current level could cause abundance to decrease further if recruitment (the amount of new fish entering the population each year) did not improve (Bundy and Simon 2005, DFO 2005). In 2013, the abundance of white hake in the Maritimes was reviewed. This update assessment showed that abundance has continued to remain low since 2005. Overall, abundance of immature individuals on the entire Scotian Shelf was estimated to have declined by 60% since the 1980's, although current estimates of abundance are similar to abundance estimates seen in the 1970s. Abundance of adult fish has decreased overall by 56% since 1970 and by 77% since the 1980's (Simon and Cook 2013).

In the Newfoundland and Labrador region, white hake are assessed and managed by the Department of Fisheries and Oceans Canada and the Northwest Atlantic Fisheries Organization (NAFO). Abundance of white hake in the region has fluctuated. High abundance of white hake was recorded in the early 2000's, primarily due to high levels of new fish entering the population. Since 2004 abundance has declined to levels observed in the mid-1990's (Simpson and Miri 2013). Current abundance of white hake relative to their abundance prior to the mid-1990's is uncertain. Abundance estimates of white hake from surveys conducted in this region prior to 1996 are not directly comparable to the abundance estimates from the survey conducted since 1996 because the surveys used different gears with different catch efficiencies (COSEWIC 2013d). There are no abundance goals/targets for white hake in this region, but due to low numbers of new fish entering the population over the last decade, current abundance is considered low (NAFO 2013b).

**Factor 1.3 - Fishing Mortality**

*Scoring guidelines*

- *5 (Very Low Concern) = Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY) OR fishery does not target species and its*

*contribution to the mortality of species is negligible ( $\leq 5\%$  of a sustainable level of fishing mortality)*

- *3.67 (Low Concern) = Probable (>50% chance) that fishing mortality is at or below a sustainable level, but some uncertainty OR fishery does not target species and does not adversely affect species, but its contribution to mortality is not negligible OR fishing mortality is unknown, but the population is healthy and the species has a low susceptibility to the fishery (low chance of being caught)*
- *2.33 (Moderate Concern) = Fishing mortality is fluctuating around sustainable levels OR fishing mortality is unknown and species has a moderate-high susceptibility to the fishery, and if species is depleted, reasonable management is in place.*
- *1 (High Concern) = Overfishing is occurring, but management is in place to curtail overfishing OR fishing mortality is unknown, species is depleted and no management is in place*
- *0 (Critical) = Overfishing is known to be occurring and no reasonable management is in place to curtail overfishing.*

#### **Maritimes North Atlantic, Gillnet, Bottom**

#### **Maritimes North Atlantic, Longline, Bottom**

#### **Maritimes North Atlantic, Trawl, Bottom**

##### **2.33 Moderate Concern**

Overfishing on white hake in the Maritimes in the 1980's through the mid 1990's likely led to the large decline in white hake abundance in this area. In the late 1990's, targeted fishing for white hake was prohibited and fisheries for other groundfish species were restricted to catching a certain amount of white hake. Since this time, fishing mortality on white hake has been low and below the long-term mean (Bundy and Simon 2005)(Simon and Cook 2013). The last formal assessment for white hake in the Maritimes region in 2005 and an updated review of white hake in 2013, estimated fishing mortality on white hake to be relatively low compared to total mortality. Total mortality of white hake on the Scotian Shelf is high and increasing in recent years and its causes are unknown (Simon and Cook 2013). Total mortality of white hake in the Bay of Fundy is variable without trend (DFO 2005a). Because no fishing mortality targets have been established for white hake, it is hard to determine if current fishing levels are low enough to allow white hake to recover. We have therefore rated this factor "moderate concern".

#### **Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

#### **Newfoundland and Labrador North Atlantic, Longline, Bottom**

#### **Newfoundland and Labrador North Atlantic, Trawl, Bottom**

##### **2.33 Moderate Concern**

In 1988, Canada commenced a directed fishery for white hake in southern Newfoundland. The fishery in international waters (Divisions 3NO) has been managed through annual catch limits set by the Northwest Atlantic Fisheries Organization (NAFO) since 2004. The catch limit is divided between Canada, the European Union, and Russia (Simpson et al. 2011). The catch limit was set at 8,500 t from 2004-2010, which was well above average catch levels, then reduced to 6,000 t in 2011 and 5,000 t in 2012.

Since 2013 the catch limit has been set at 1,000 t, though there is a mechanism that could increase the catch limit to 5,000 t if there is a sudden spike in abundance (NAFO 2013b). There is no catch limit for the fishery in Subdivision 3Ps in Canada's national waters. This fishery is managed by Fisheries and Oceans Canada. Catches for the entire 3NOPs area have only been around 350 t in recent years. Fishing mortality is considered low and has been declining, but no formal fishing mortality targets have been defined (Simpson and Miri 2013)(NAFO 2013b). Because of the low white hake abundance in recent years, fisheries scientists have recommended that catches should not exceed current levels (NAFO 2013b). Although current fishing levels likely pose a low threat to white hake in this region (COSEWIC 2013d), due to a lack of proper management controls to ensure catches do not increase, we have rated fishing mortality as "moderate concern".



## **Criterion 2: Impacts on other species**

All main retained and bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. Seafood Watch® defines bycatch as all fisheries-related mortality or injury other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing.

To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch. Rating is based on the score as follows:

- >3.2=Green or Low Concern
- >2.2 and <=3.2=Yellow or Moderate Concern
- <=2.2=Red or High Concern.

Rating is Critical if Factor 2.3 (Fishing Mortality) is Critical.

### **Criterion 2 Summary**

Only the lowest scoring main species is/are listed in the table and text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix A.

<b>White hake</b>				
<b>Region / Method</b>	<b>Factors 2.1-2.3</b>		<b>Factor 2.4 Multiplier ((Discards+ Bait)/ Retained Catch)</b>	<b>Criterion 2 Score</b>
	<b>Lowest Scoring of Other Species</b>	<b>Lowest Species Subscore</b>		
<b>Maritimes North Atlantic, Gillnet, Bottom</b>	Atlantic cod and leatherback turtle	1.00	0.95 (20-40%)	Red (0.95)
<b>Maritimes North Atlantic, Longline, Bottom</b>	Atlantic cod and cusk	1.00	0.95 (20-40%)	Red (0.95)
<b>Maritimes North Atlantic, Trawl, Bottom</b>	Atlantic cod	1.00	1.00 (<20%)	Red (1.00)
<b>Newfoundland and Labrador North Atlantic, Gillnet, Bottom</b>	Leatherback turtle	1.00	0.95 (20-40%)	Red (0.95)
<b>Newfoundland and Labrador North Atlantic, Longline, Bottom</b>	Atlantic cod, northern wolffish, spotted wolffish	1.526	0.95 (20-40%)	Red (1.450)
<b>White hake: Newfoundland and Labrador North Atlantic, Trawl, Bottom</b>	Atlantic cod, northern wolffish, spotted wolffish	1.526	1.00 (<20%)	Red (1.526)

The bycatch and retained species that were analyzed in this assessment were chosen based on the percent of catch they make up in the overall groundfish fisheries in the Maritimes and Newfoundland and Labrador regions or if they were listed as "endangered", "threatened", or "special concern" {MSC

2010}{MSC 2013}. White Hake are caught in a directed fishery in the Newfoundland and Labrador region and in both the Maritimes and Newfoundland and Labrador, they are caught as bycatch in fisheries for other groundfish species, like cod, halibut, redfish, and pollock. The gears used to catch white hake (gillnets, longlines, and trawls) all catch numerous other species, some of which are endangered, threatened, or depleted. In all fisheries bycatch of Atlantic cod, a species that is considered "endangered" by the Committee on the Status of Endangered Wildlife in Canada, is of high concern, especially in the Maritimes regions where overfishing of Atlantic cod is still occurring. Other sensitive species that are caught include leatherback turtles (gillnet fisheries), marine mammals (gillnet fisheries), cusk (longline fisheries), wolffish, and skates.

## Criterion 2 Assessment

### ATLANTIC COD

#### Factor 2.1 - Inherent Vulnerability

*Scoring guidelines – Same as Factor 1.1 above*

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom

Newfoundland and Labrador North Atlantic, Longline, Bottom

Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### High Vulnerability

The FishBase vulnerability score for Atlantic cod is 71 out of 100, which indicates Atlantic cod have a high inherent vulnerability to fishing (Froese and Pauly 2013). Atlantic cod reach sexual maturity between 5 and 8 years old and at a length of 45-60 cm. They are prolific spawners; each female can lay several million eggs at each spawning. The biggest Atlantic cod on record weighed 96 kg and was more than 180 cm long. Atlantic cod older than 15 years are uncommon; however, a 27 year old cod is on record (DFO 2013b). Within the food chain, they are a high-level predator species.

#### Factor 2.2 – Abundance

*Scoring guidelines – Same as Factor 1.2 above*

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

1.00

#### Very High Concern

In 2003, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determined that the Atlantic cod population in the Maritimes region was a species of "special concern". In 2010, Atlantic cod was re-assessed and the Maritimes region was split into two populations, the Laurentian South

population and the Southern population. Both populations were considered "endangered" due to a decline in abundance and an increase in natural mortality (COSEWIC 2010a)(DFO 2011d). Atlantic cod are currently being considered for listing under Canada's Species at Risk Act (Government of Canada 2014). For this reason, the abundance of Atlantic cod in the Maritimes region was scored "very high concern".

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

**1.00 Very High Concern**

Atlantic cod in the Newfoundland and Labrador region (includes 2GH, 2J3KL and 3NO) was determined to be "endangered" in 2003 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). In 2010, COSEWIC re-assessed the status of this population and confirmed the "endangered" status (COSEWIC 2010a). They also determined that the Laurentian North population, which includes part of the southern Newfoundland area (subdivision 3Ps) and the northern Gulf of St. Lawrence (3Pn4RS), is "endangered". Currently, Atlantic cod are being considered for listing under Canada's Species at Risk Act (Government of Canada 2014). Atlantic cod were previously considered for listing under Canada's Species at Risk Act in 2006, but were not listed. The species was not listed because the government felt that although cod abundance was depleted in many places, abundance was highly variable among areas and that listing the species would have severe socioeconomic impacts (Government of Canada 2006).

In southern Newfoundland where the white hake fisheries occur, abundance of Atlantic cod has been increasing. In Division 3NO abundance of Atlantic cod has doubled since 2010, but still remains well below the limit/overfished abundance reference point (NAFO 2013b). Abundance of Atlantic cod in division 3Ps is estimated to have greatly increased over 2009-2012 and is now above the defined limit abundance reference point (DFO 2013o). The limit abundance reference point is based on the lowest estimated abundance from which cod were able to rapidly recover. A target abundance goal has not been defined. Although cod abundance varies among areas, because of the "endangered" determinations for the Atlantic cod populations, we have rated this factor "very high concern".

**Factor 2.3 - Fishing Mortality**

*Scoring guidelines – Same as Factor 1.3 above*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

**1.00 High Concern**

Although fishing mortality on Atlantic cod drastically decreased in the 1990's, fishing mortality on Atlantic cod in the Maritimes has still remained above the established fishing target level of 0.2. In 2008, the fishing mortality was estimated to be 0.3 (DFO 2011d). Management measures have been set into place to try to reduce the catches of Atlantic cod and the precautionary approach is applied to any

management decisions. In 2003, a Canada-Maritimes cod action team was established to develop a long-term management strategy for cod (DFO 2012e). Because overfishing is considered to be occurring on Atlantic cod but management is in place, fishing mortality was rated "high concern".

#### Newfoundland and Labrador North Atlantic, Gillnet, Bottom

#### Newfoundland and Labrador North Atlantic, Longline, Bottom

#### Newfoundland and Labrador North Atlantic, Trawl, Bottom

### 2.33 Moderate Concern

Fishing mortality on Atlantic cod in Division 3NO is very low, and is estimated to be well below the fishing mortality target level, indicating fishing is sustainable. There is no directed fishery for Atlantic cod in Division 3NO; it is only caught as bycatch. At current fishing levels abundance is projected to continue to increase but still remain below the limit abundance level in 2016 (this would be the case even if fishing mortality was zero) (NAFO 2013b). Fishing mortality on Atlantic cod in Subdivision 3Ps is unknown, but estimates of total mortality were high (DFO 2012d)(DFO 2013o). Over the last decade, many fishing mortality management measures have been implemented to promote the recovery of Atlantic cod. These measures include, conservation harvesting plans, limited entry licenses, seasonal limits and bycatch protocols for other directed fisheries, geographic restrictions, and protecting small fish and spawning fish (DFO 2005c). Because fishing levels are unknown in some parts of Newfoundland and Labrador (Subdivision 3Ps), but management measures are in place to promote the recovery of Atlantic cod, we have rated this factor "moderate concern".

## CUSK

### Factor 2.1 - Inherent Vulnerability

*Scoring guidelines – Same as Factor 1.1 above*

#### Maritimes North Atlantic, Longline, Bottom

### High Vulnerability

The FishBase vulnerability score for cusk is 65 out of 100, which indicates that this species has a high inherent vulnerability to fishing. Cusk can live up to 20 years and grow to over 100 cm long. They reach sexual maturity at a length of 50 cm (5-6 years old). Spawning occurs between April and July and the eggs are pelagic (COSEWIC 2003a). Cusk typically feed on fish and crustaceans and are considered a high-level predator species within the food chain (COSEWIC 2003b)(Froese and Pauly 2013).

### Factor 2.2 - Abundance

*Scoring guidelines – Same as Factor 1.2 above*

#### Maritimes North Atlantic, Longline, Bottom

### 1.00 Very High Concern

In May 2003, cusk was determined to be "threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2003b). Cusk were considered for listing under the Species at Risk Act, but

were not listed due to concerns about the methods used to estimate cusk abundance, socioeconomic implications, and because new management measures were recently implemented for cusk to help protect them. However, in November 2012, the Committee on the Status of Endangered Wildlife in Canada re-assessed cusk using additional scientific information and considered the species "endangered" (COSEWIC 2012d). The new assessment indicated that cusk abundance has declined continuously since 1970. Therefore, the abundance of cusk was given a rating of "very high concern".

### **Factor 2.3 - Fishing Mortality**

*Scoring guidelines – Same as Factor 1.3 above*

#### **Maritimes North Atlantic, Longline, Bottom**

**1.00 High Concern**

Fishing mortality on cusk is unknown. Although there has not been a directed commercial fishery for cusk since 1999, fishing still remains the biggest threat to cusk populations. Cusk is caught as a bycatch species in other groundfish fisheries, particularly the longline fisheries. There are annual bycatch catch limits in place for cusk but despite management efforts cusk abundance has continued to decline (DFO 2008a)(COSEWIC 2012d). Since cusk is considered "endangered" by Committee on the Status of Endangered Wildlife in Canada and fishing mortality remains their biggest threat, the fishing mortality for the cusk population was rated "high concern".

## **LEATHERBACK TURTLE**

### **Factor 2.1 - Inherent Vulnerability**

*Scoring guidelines – Same as Factor 1.1 above*

#### **Maritimes North Atlantic, Gillnet, Bottom**

#### **Maritimes North Atlantic, Longline, Bottom**

#### **Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

#### **Newfoundland and Labrador North Atlantic, Longline, Bottom**

#### **High Vulnerability**

Sea turtles are considered to have a "high" inherent vulnerability to fishing.

### **Factor 2.2 – Abundance**

*Scoring guidelines – Same as Factor 1.2 above*

#### **Maritimes North Atlantic, Gillnet, Bottom**

#### **Maritimes North Atlantic, Longline, Bottom**

#### **Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

#### **Newfoundland and Labrador North Atlantic, Longline, Bottom**

**1.00 Very High Concern**

The leatherback sea turtle was considered "Endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in April 1981 (COSEWIC 2012a). Their status has been re-examined in 2001

and 2012 and confirmed. The species is also listed as "Endangered" under Canada's Species At Risk Act (SARA). It is estimated that the global population of leatherback sea turtles has declined 70%. The abundance of the leatherback sea turtle is deemed "very high concern".

### **Factor 2.3 - Fishing Mortality**

*Scoring guidelines – Same as Factor 1.3 above*

#### **Maritimes North Atlantic, Gillnet, Bottom**

#### **Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

##### **1.00 High Concern**

There have been no reported interactions between leatherback turtles and the Canadian groundfish gillnet fishery since 2001, however observer coverage in the fishery has been very low (less than 2%). In 2005, two leatherback turtle interactions were reported in logbooks in the Newfoundland and Labrador region, and since 1976, leatherback turtle encounters with groundfish gillnet gear represented the highest number (33) of the 75 records reported to the Whale Release and Strandings in Newfoundland and Labrador. This suggests that the potential for interaction in this fishery may be greater than suggested by the observer data (DFO 2012a). Further data is required. In a recent assessment of worldwide fisheries bycatch impacts on sea turtles, net gears (which includes gillnets) were determined to have a high impact on leatherback turtles in the northwest Atlantic (Wallace, B. P et al. 2013). Leatherback turtles are protected under Canada's Species At Risk Act (SARA) and a recovery strategy is in place. Because of the potential for high interactions with leatherback turtles in the groundfish gillnet fishery, this factor has been rated "high concern".

#### **Maritimes North Atlantic, Longline, Bottom**

#### **Newfoundland and Labrador North Atlantic, Longline, Bottom**

##### **5.00 Very Low Concern**

There have been no reported interactions between the groundfish longline fishery and leatherback turtles in the fishery observer database since 2001 (DFO 2012a). At-sea observer coverage in the fishery has ranged from 2–30% depending on the area. There have been three reports in fisher logbooks from the Quebec Region and ten reports of encounters with groundfish longline gear have been made to Whale Release and Strandings since 1976. These reports indicate that the risk of interaction from this fishery may be greater than suggested by the observer database (DFO 2012a). Further studies are required to determine whether the risk of interaction with the groundfish longline fishery is increasing or decreasing. However, fishing impacts from the groundfish longline fishery are likely less than the pelagic longline fishery. In the pelagic longline fishery, observers (coverage has ranged from 5-30%) documented 102 interactions from 2001 to 2005 and 36 interactions from 2006-2010 (DFO 2012a). A recent study on the global impacts of sea turtle bycatch rated longline gear as having a low impact on the Northwest Atlantic leatherback sea turtle population (Wallace, B. P et al. 2013). Because longline fisheries overall are having a low impact on leatherback sea turtle population in the Northwest Atlantic, and bottom longlines are less of a threat to sea turtles than pelagic longlines, we have rated this factor "very low concern".

## **NORTHERN WOLFFISH**

### **Factor 2.1 - Inherent Vulnerability**

*Scoring guidelines – Same as Factor 1.1 above*

Newfoundland and Labrador North Atlantic, Gillnet, Bottom  
Newfoundland and Labrador North Atlantic, Longline, Bottom  
Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### **High Vulnerability**

The FishBase vulnerability score for northern wolffish is 78 out of 100, which puts it in the high inherent vulnerability category. Northern wolffish can reach a maximum length of 180 cm and live to around 20 years old (COSEWIC 2012c)(Simpson et al. 2012c). According to one study, they reach sexual maturity at 5-6 years old and at a length of 54 cm (Simpson et al. 2012c). However, other studies, indicate a higher size and age at sexual maturity and state that the information is limited (Kulka et al. 2007)(COSEWIC 2012c), The fecundity of northern wolffish is considered low for its size; a study done in the Barents Sea reported fecundity rates of 23,380-23,485 eggs for a female between 112 and 134 cm (Simpson et al. 2012c). They lay demersal eggs. Northern wolffish typically prey on pelagic fish, jellyfish, echinoderms, crustaceans, and molluscs and are considered a high-level predator species within the food chain (COSEWIC 2012c)(Froese and Pauly 2013).

### **Factor 2.2 – Abundance**

*Scoring guidelines – Same as Factor 1.2 above*

Newfoundland and Labrador North Atlantic, Gillnet, Bottom  
Newfoundland and Labrador North Atlantic, Longline, Bottom  
Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### **1.00 Very High Concern**

Northern wolffish is considered "threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and under Canada's Species At Risk Act (SARA). The abundance of this species declined greatly during the 1980's (by more than 90%) and there was also a decline in their range of distribution (Kulka et al. 2007). However since 2002, there have been small increases in their abundance and range size (COSEWIC 2013b). This species is found in the highest densities on the northeast Newfoundland and southern Labrador shelves (DFO 2013g). It is rare in the Maritimes region. The abundance of northern wolffish is ranked "very high concern".

### **Factor 2.3 - Fishing Mortality**

*Scoring guidelines – Same as Factor 1.3 above*

Newfoundland and Labrador North Atlantic, Gillnet, Bottom  
Newfoundland and Labrador North Atlantic, Longline, Bottom  
Newfoundland and Labrador North Atlantic, Trawl, Bottom

### 2.33 Moderate Concern

There are no estimates of fishing mortality on the northern wolffish. From 1995-2002, the index of exploitation (catch/relative biomass), which represents a maximum estimate of the proportion of the wolffish population that was removed, is low, 6.3% (Kulka et al. 2007). In 2008, under a requirement of the Species at Risk Act (SARA), a joint recovery strategy/management plan was published for the northern, spotted, and Atlantic wolffish. To stay under compliance with SARA, the Department of Fisheries and Oceans Canada (DFO) must submit progress reports every five years until the objectives of the recovery strategy are achieved (DFO 2013g). Any northern wolffish that are caught must be released back to sea. Since fishing mortality on northern wolffish is uncertain, but appropriate management is in place, the fishing mortality for northern wolffish is ranked "moderate concern".

## SPOTTED WOLFFISH

### Factor 2.1 - Inherent Vulnerability

*Scoring guidelines – Same as Factor 1.1 above*

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

#### High Vulnerability

The FishBase vulnerability score for spotted wolffish is 80 out of 100, which puts it in the high inherent vulnerability category (Froese and Pauly 2013). Spotted wolffish can grow up to 150 cm and live for longer than 21 years. They reach sexual maturity at around 7 years old and a length of 75-80 cm (DFO 2009d)(Kulka et al. 2007). Spawning occurs during summer months and the eggs are deposited in large clusters on the sea bottom (Kulka et al. 2007). Within the food chain, they are considered a high-level predator species (Froese and Pauly 2013).

### Factor 2.2 – Abundance

*Scoring guidelines – Same as Factor 1.2 above*

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

### 1.00 Very High Concern

In May 2001, the Canadian spotted wolffish population was considered "threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The status of spotted wolffish was re-examined and confirmed in November 2012. This species is also listed as "threatened" under Canada's Species At Risk Act (SARA). The population of spotted wolffish declined by 90% from the late 1970's-mid 1990's and the range this species is found over also declined (Kulka et al. 2007). Abundance has increased in many areas since the mid-1990's, but still remains low relative to historical levels. Spotted wolffish has its highest densities in northern Newfoundland and southern Labrador. It is rare in the Maritimes region (COSEWIC 2012e). The abundance of spotted wolffish is ranked "very high concern".



**Factor 2.3 - Fishing Mortality**

*Scoring guidelines – Same as Factor 1.3 above*

Newfoundland and Labrador North Atlantic, Gillnet, Bottom

Newfoundland and Labrador North Atlantic, Longline, Bottom

Newfoundland and Labrador North Atlantic, Trawl, Bottom

**2.33**

**Moderate Concern**

Spotted wolffish are taken as bycatch in the Canadian Atlantic groundfish fisheries. There is currently no estimate of fishing mortality relative to sustainable fishing mortality targets, but an exploitation index (catch/relative abundance) was calculated to be 2.2% in 2002 (Kulka et al. 2007). In 2008, under a requirement of the Species At Risk Act (SARA), a joint recovery strategy/management plan was published for the northern, spotted, and Atlantic wolffish. To stay under compliance with SARA, Fisheries and Oceans Canada (DFO) must submit progress reports every five years until the objectives of the recovery plan are achieved (DFO 2013g). Any spotted wolffish that are caught must be released back to sea. Since fishing mortality on spotted wolffish is uncertain, but appropriate management strategies are in place, this factor is deemed "moderate concern".

**ALL SPECIES****Factor 2.4 – Modifying Factor: Discards and Bait Use***Scoring Guidelines*

*The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.*

<b>Ratio of bait + discards/landings</b>	<b>Factor 2.4 score</b>
<20%	1
20-40%	0.95
40-60%	0.9
60-80%	0.85
80-100%	0.8
>100%	0.75

Maritimes North Atlantic, Gillnet, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom

**0.95**

**20-40%**

Information on discards (fish thrown back to sea) was not available for the Newfoundland and Labrador

groundfish fisheries. In the Maritimes region some discard data is available from at-sea observer programs, but the amount of fishery catches sampled is very low (0-2% during 2002-2006), leading to uncertainties in the data. The most recent data for this fishery is for 2005. In 2005 it was estimated that 1,136 t of fish were discarded and 3,237 t of fish were retained (landed) in the gillnet groundfish fishery on the southern Scotian Shelf and the Gulf of Maine (Divisions 4X5Y). The ratio of discards to landings was approximately 35%. Two percent of the fishery catches in Divisions 4X5Y were sampled in 2005. This is the main area where the Canadian gillnet fishery takes place and the only area in the Maritimes region with observer coverage in 2005 (Gavaris et al. 2010). In Northwest Atlantic U.S. groundfish gillnet fisheries, a similar but slightly higher discard to landings ratio of 46.8% was estimated (NMFS 2011).

#### **Maritimes North Atlantic, Longline, Bottom**

#### **Newfoundland and Labrador North Atlantic, Longline, Bottom**

**0.95**

**20-40%**

Information on discards (fish thrown back to sea) was not available for the Newfoundland and Labrador groundfish fisheries. In the Maritimes region some discard data is available from at-sea observer programs, but the amount of fishery catches sampled is very low (2-4%), leading to uncertainties in the data. The most recent data is for 2006. The ratio of discards to retained catches (landings) in the Maritimes region was approximately 38.7% for the longline groundfish fishery in 2006. An estimated 3,845mt of fish were discarded and 9,944mt of fish were retained/landed (Gavaris et al. 2010). In previous years (2003-2005), the estimated discards to landings ratio was lower, around ~15%. In the similar U.S. Northwest Atlantic longline groundfish fishery, the bycatch to landings ratio is 27.7% (NMFS 2011).

#### **Maritimes North Atlantic, Trawl, Bottom**

#### **Newfoundland and Labrador North Atlantic, Trawl, Bottom**

**1.00**

**< 20%**

Information on discards (fish thrown back to sea) was not available for the Newfoundland and Labrador groundfish fisheries. In the Maritimes region some discard data is available from at-sea observer programs. The amount of fishery catches that have been sampled in this region ranged from 5-17% during 2002-2006. The most recent data is for 2006 (Gavaris et al. 2010). Seventeen percent of the catches were sampled in 2006. An estimated 1,410mt of fish were discarded and 16,359mt was retained (landed) in the groundfish bottom trawl fishery in 2006. The ratio of discards to retained catches/landings is approximately 8.6%.

## **Criterion 3: Management effectiveness**

Management is separated into management of retained species (harvest strategy) and management of non-retained species (bycatch strategy).

The final score for this criterion is the geometric mean of the two scores. Rating is based on the score as follows:

- $>3.2$  = Green or Low Concern
- $>2.2$  and  $\leq 3.2$  = Yellow or Moderate Concern
- $\leq 2.2$  or either the Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern.

Rating is Critical if either or both of Harvest Strategy (Factor 3.1) and Bycatch Management Strategy (Factor 3.2) are Critical.

### **Criterion 3 Summary**

Region / Method	Factor 3.1 Harvest Strategy Score	Factor 3.2 Bycatch Strategy Score	Criterion 3 Score
Maritimes North Atlantic Gillnet, Bottom	3.000: Moderate Concern	3.000: Moderate Concern	Yellow(3.000)
Maritimes North Atlantic Longline, Bottom	3.000: Moderate Concern	3.000: Moderate Concern	Yellow(3.000)
Maritimes North Atlantic Trawl, Bottom	3.000: Moderate Concern	3.000: Moderate Concern	Yellow(3.000)
Newfoundland and Labrador North Atlantic Gillnet, Bottom	3.000: Moderate Concern	3.000: Moderate Concern	Yellow(3.000)
Newfoundland and Labrador North Atlantic Longline, Bottom	3.000: Moderate Concern	3.000: Moderate Concern	Yellow(3.000)
Newfoundland and Labrador North Atlantic Trawl, Bottom	3.000: Moderate Concern	3.000: Moderate Concern	Yellow(3.000)

### **Factor 3.1: Harvest Strategy**

#### *Scoring Guidelines*

Seven subfactors are evaluated: Management Strategy and Implementation, Recovery of Species of Concern, Scientific Research and Monitoring, Record of Following Scientific Advice, Enforcement of Regulations, Management Track Record, and Stakeholder Inclusion. Each is rated as 'ineffective', 'moderately effective', or 'highly effective'.

- 5 (Very Low Concern) = Rated as 'highly effective' for all seven subfactors considered
- 4 (Low Concern) = Management Strategy and Recovery of Species of Concern rated 'highly effective' and all other subfactors rated at least 'moderately effective'.
- 3 (Moderate Concern) = All subfactors rated at least 'moderately effective'.
- 2 (High Concern) = At minimum meets standards for 'moderately effective' for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated 'ineffective'.
- 1 (Very High Concern) = Management exists, but Management Strategy and/or Recovery of Species of Concern rated 'ineffective'
- 0 (Critical) = No management exists when a clear need for management exists (i.e., fishery catches threatened, endangered, or high concern species) OR there is a high level of Illegal, Unregulated, and Unreported Fishing occurring.

### Factor 3.1 Summary

Factor 3.1: Harvest Strategy								
Region /Method	Subfactor 3.1.1. Management Strategy and Impl.	Subfactor 3.1.2 Recovery of Species of Concern	Subfactor 3.1.3 Scientific Research & Monitoring	Subfactor 3.1.4 Record of Following Scientific Advice	Subfactor 3.1.5 Enforcement of Regs.	Subfactor 3.1.6 Track Record	Subfactor 3.1.7 Stakeholder Inclusion	Factor 3.1 Score
Maritimes North Atlantic Gillnet, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Moderately Effective	3.000: Moderate Concern
Maritimes North Atlantic Longline, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Moderately Effective	3.000: Moderate Concern
Maritimes North Atlantic Trawl, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Moderately Effective	3.000: Moderate Concern
Newfoundland and Labrador North Atlantic Gillnet, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Moderately Effective	3.000: Moderate Concern
Newfoundland and Labrador North Atlantic Longline, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Moderately Effective	3.000: Moderate Concern
Newfoundland and Labrador North Atlantic Trawl, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Moderately Effective	3.000: Moderate Concern

### Factor 3.1 Assessment

#### Subfactor 3.1.1 - Management Strategy and Implementation

*Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? To achieve a Highly Effective rating,*

*there must be appropriate management goals and evidence that the measures in place have been successful at maintaining/rebuilding species.*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

**Moderately Effective**

White hake in the Maritimes is managed by the Department of Fisheries and Oceans Canada (DFO) as part of the mixed groundfish fishery. Since 1999, there has been no directed fishery for white hake in the Maritimes region. White hake is caught as bycatch in longline, gillnet, and bottom trawl fisheries targeting other groundfish species and has been managed through incidental catch limits. Separate catch limits have been set for the fixed gears fleets (longlines and gillnets) and the mobile gear (trawls) fleets since 2001. The catch limits for white hake have varied from year to year, but the current catch limits are 1,790t for fixed gear vessels <45 ft, 200t for fixed gear vessels >45 ft, and 200t for mobile gear. The fixed gear catch limits are further divided up and allocated to specific divisions; most of the catch limit is given to the southern Scotian shelf/Bay of Fundy division (Simon and Cook 2013).

Catch limits have been set for other groundfish species as well. Much of the management of the Canadian mixed groundfish fishery revolves around the protection of Atlantic cod. Catch limit reconciliation guidelines have also been established for the groundfish fishery. This ensures that any overharvest of the catch limit in one year will be accounted for in the next fishing year (DFO 2013j). Management decisions follow guidelines outlined in the Sustainable Fisheries Framework and use the Precautionary Approach (DFO 2009c). Despite this, some groundfish species, including white hake and cod, remain severely depleted. Therefore, the management strategy for the Maritimes region is deemed "moderately effective".

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

**Moderately Effective**

In this region, white hake and other groundfish are managed by the Northwest Atlantic Fisheries Organization (NAFO) in international waters (Division 3NO) and by the Department of Fisheries and Oceans Canada (DFO) in Canada's national waters (Subdivision 3Ps). The Northwest Atlantic Fisheries Organization manages fisheries through total allowable catch limits and closed areas, following the Precautionary Approach and an Ecosystem Approach (NAFO 2013a). A white hake directed fishery in Division 3NO was commenced in 1988. The Northwest Atlantic Fisheries Organization (NAFO) established the first total allowable catch limit for white hake in 2005. The catch limit was set well above average catch levels at 8,500 t for 2005-2009. In 2010 and 2011, a reduction of the catch limit to 1,000 t was suggested, but the catch limit was only reduced to 6,000 t (Kulka and Miri 2007)(Simpson et al. 2011). The catch limit for 2012 was further reduced to 5,000 t and the catch limit for 2013 was reduced to 1,000 t, though there is a mechanism that could allow the catch limit to be increased to 5,000 t if the population was deemed to have increased (NAFO 2013b). The Department of

Fisheries and Oceans Canada has not set a catch limit for white hake in the 3Ps subdivision, but total catches of white hake in the Newfoundland and Labrador region (inclusive of 3Ps) have been well below established catch limits set by NAFO. The Department of Fisheries and Oceans Canada has established catch limits for several other groundfish species (cod, redfish, witch flounder, skate, and American plaice) (DFO 2013p). Catch limit reconciliation guidelines have been established to ensure that any fish removals over the allowed catch limits are rectified the following year (DFO 2013j).

Despite the low fishing levels for white hake, abundance has remained low since 2000. No abundance or fishing mortality goals/reference points have been established for white hake. Due to the low abundance it has been recommended that catches of white hake remain at the current low levels (NAFO 2013b), but management regulations do not seem to be precautionary enough to ensure catches do not increase. Management success of other retained groundfish species has been mixed, with some populations being sustained at healthy levels, while other species are still struggling to recover. For these reasons, the management strategy was deemed "moderately effective".

### **Subfactor 3.1.2 - Recovery of Species of Concern**

*Considerations: When needed, are recovery strategies or management measures in place to rebuild overfished/threatened/endangered species or to limit fishery's impact on these species? What is their likelihood of success? To achieve a Highly Effective rating, rebuilding strategies that have a high likelihood of success in an appropriate timeframe must be in place when needed, as well as measures to minimize mortality for any overfished/threatened/endangered species.*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

#### **Moderately Effective**

The Atlantic and Northern Gulf of St. Lawrence white hake population, which includes white hake in the Maritimes, has recently been determined to be "threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2013d). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) consists of an independent body of scientific advisors who perform species assessments and recommend species for listing under Canada's Species At Risk Act (Simpson et al. 2012a). The Species at Risk Act was established in 2003 to conserve, protect and help recover threatened and endangered species. Once a species is listed, recovery strategies and action plans must be created (DFO 2013k). Unfortunately, the Canadian Government does not always follow the recommendations by COSEWIC and often chooses not to list fish species under the Species at Risk Act because of socioeconomic concerns (Government of Canada 2006)(Government of Canada 2010)(Waples et al. 2013). It remains to be seen if white hake will be listed under the Species at Risk Act.

In the Maritimes, management measures, including incidental catch limits, have been put in place to try to reduce fishing mortality on white hake. Although fishing levels have remained relatively low, natural mortality of white hake has remained high, and the species is not yet recovering (Simon and Cook

2013).

Other species of concern retained in the mixed groundfish fishery include cod and cusk, both of which are considered endangered by the Committee on the Status of Endangered Wildlife in Canada but are not listed under Canada's Species at Risk Act. Management measures, like catch limits are in place to protect these species, but fishing still remains a prominent threat (DFO 2008a)(DFO 2011d). This factor is deemed "moderately effective".

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

**Moderately Effective**

The Atlantic and Northern Gulf of St. Lawrence white hake population, which includes white hake in Newfoundland and Labrador, has recently been determined to be "threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2013d). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) consists of an independent body of scientific advisors who perform species assessments and recommend species for listing under Canada's Species At Risk Act. The Species at Risk Act was established in 2003 to conserve, protect and help recover threatened and endangered species. Once a species is listed, recovery strategies and action plans must be created (DFO 2013k). Unfortunately, the Canadian Government does not always follow the recommendations by COSEWIC and often chooses not to list fish species under the Species at Risk Act because of socioeconomic concerns (Government of Canada 2006)(Government of Canada 2010)(Waples et al. 2013). It remains to be seen if white hake will be listed under the Species at Risk Act.

The catch limit for white hake in international waters of the Newfoundland and Labrador region (3NO) has been reduced to 1,000t for the 2013 fishing season, but there remains a mechanism to allow for an increase in the catch limit to 5,000 t if abundance was determined to have increased (NAFO 2013b). No catch limit is currently in place for the fishery in Canada's national waters (3Ps).

Several other depleted species also retained in the groundfish fisheries in this region, including Atlantic cod, American plaice, and skates. Catch limits are in place for these species to limit fishery catches (DFO 2013p). In addition, the Northwest Atlantic Fisheries Organization (NAFO) has established rebuilding strategies for cod and American plaice in Division 3NO. Both cod and American Plaice are under a directed fishing moratorium in Division 3NO (NAFO 2013a). American plaice are also under a fishing moratorium in subdivision 3Ps, which is managed by the Department of Fisheries and Oceans Canada (DFO) (DFO 2013p). Despite the regulations in place, several species have remained at low abundances, and thus this factor is rated "moderately effective".

### **Subfactor 3.1.3 - Scientific Research and Monitoring**

*Considerations: How much and what types of data are collected to evaluate the health of the population and the fishery's impact on the species? To achieve a Highly Effective rating, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

#### **Moderately Effective**

The Department of Fisheries and Oceans (DFO) monitors groundfish fisheries through the At-sea Observer Program, the Dockside Monitoring Program (DMP) and Vessel Monitoring System (VMS). These programs help monitor fishing activities, collect scientific data, provide positional information of vessel activity, and monitor industry compliance with fishing regulations and license conditions (DFO 2012h)(DFO 2013q). Fishers are also required to fill out logbooks to record information about their fishing catch and effort (DFO 2012i). Scientific research surveys and industry surveys are regularly conducted to monitor the abundance of white hake and other groundfish species. These surveys also provide information on predator/prey relationships, diets, area of occupancy, and size classes (Simon and Cook 2013). The latest population assessment for white hake in the Maritimes region was completed in 2005 (DFO 2005a). However, a review on white hake in the Maritimes for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was completed in 2013, which provided updates on the abundance of white hake (Simon and Cook 2013). The latest population assessment for white hake in the Newfoundland and Labrador region was completed in June 2013 (Simpson and Miri 2013). Even though there is up-to-date data available for white hake in this region, no abundance and fishing mortality targets have been established so the current data may be insufficient to rebuild white hake populations. Overall, the scientific research/monitoring factor is deemed "moderately effective".

### **Subfactor 3.1.4 - Management Record of Following Scientific Advice**

*Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g., do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

#### **Moderately Effective**

Scientific advice is provided to managers at the Division of Fisheries and Oceans Canada by the Canadian Science Advisory Secretariat. Currently, there is no evidence indicating that scientific advice is not



followed when setting catch limits for groundfish including, cod, haddock and pollock (NAFO 2013d); however in the past, it is believed that catch limits for groundfish were set too high, which may be one reason some groundfish populations have yet to recover (Shelton et al. 2007). The latest scientific advisory report for white hake in the Maritimes region was completed in 2005. Fisheries management requested that this report be written in order for them to determine an appropriate catch limit for white hake. The report concluded that white hake abundance was at low levels and required rebuilding (DFO 2005a). There has been no scientific advice given on white hake since 2005. Because managers have not always followed scientific advice, this factor is deemed "moderately effective".

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

**Moderately Effective**

Scientific advice is provided to managers at the Division of Fisheries and Oceans Canada by the Canadian Science Advisory Secretariat. Currently, there is no evidence indicating that scientific advice is not followed when setting catch limits for groundfish including, cod, haddock and pollock (NAFO 2013d); however in the past, it is believed that catch limits for groundfish were set too high, which may be one reason some groundfish populations have yet to recover (Shelton et al. 2007). Scientific reports and advice are also produced for the Northwest Atlantic Fisheries Organization (NAFO), the body responsible for management in international waters of the Newfoundland region. During 2002-2003, a combination of heavy fishing pressure and low recruitment caused a drastic decline of white hake in the Newfoundland and Labrador region (Kulka and Miri 2007). As a result, the Northwest Atlantic Fisheries Organization adopted a total allowable catch limit (TAC) for white hake in 2004 but it did not regulate fishing until 2005. The total allowable catch limit was set at 8,500 t, which was far too large to effectively sustain the population. The catch limit was only reduced to 6,000 t for the 2010 and 2011 years even though scientific advice recommended a catch limit of 1,000 t (Simpson et al. 2011). The catch limit was reduced to 5,000 t in 2012 and to 1,000 t for the 2013 fishing season, though there is a mechanism that could allow the catch limit to be increased to 5,000 t if it is determined that the availability of white hake has increased (NAFO 2013a). Because managers have not always followed scientific recommendations when setting catch limits for white hake and other groundfish, this factor is deemed "moderately effective".

**Subfactor 3.1.5 - Enforcement of Management Regulations**

*Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

### Highly Effective

The Department of Fisheries and Oceans Canada (DFO) is responsible for enforcing the Fisheries Act as well as other regulations and legislation set in place. Fishery officers throughout Canada regularly monitor fishing activity through air surveillance, at-sea inspections, and patrolling on land (DFO 2013f). Modern technologies such as, vessel monitoring systems, video monitoring, and radar and satellite surveillance are used to detect and deter illegal activities. In addition, at-sea observer and dockside monitoring programs help monitor compliance (DFO 2013r). DFO also encourages the general public to report violations through "Observe, Record, Report" programs (DFO 2013r).

In the Maritimes region, there is a strong fisheries enforcement presence with 140 officers. About 40% of these offices are dedicated solely to enforcing regulations for groundfish fisheries that catch white hake and other species. In 2008, there were a total of 16,124 "enforcement hours" in which 114 violations were discovered. Besides enforcement, the Department of Fisheries and Oceans Canada also promotes compliance with the law through education and awareness activities (MSC 2010). Fishermen have been known to report non-compliance of their peers to authorities and there is no evidence of systematic non-compliance. The Northwest Atlantic Fisheries Organization (NAFO) is responsible for compliance and enforcement in part of the Newfoundland and Labrador region. NAFO has several programs and activities in place to ensure and maintain a high level of compliance. These programs include vessel monitoring systems and an observer program (NAFO 2013e). Also, contracting parties provide inspection vessels and/or inspection aircrafts to monitor the activities of the fishing vessels. During inspection, the inspectors check for illegal gear, illegal fishing activities, mis-recording of catches, interference with the vessel monitoring systems, etc (NAFO 2013e). Since regulations are regularly enforced, this factor is rated "highly effective".

### Subfactor 3.1.6 – Management Track Record

*Considerations: Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels? A Highly Effective rating is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

### Moderately Effective

Many management measures, including fishing gear restrictions, area and time closures, and catch limits, have been enacted to manage Canada's groundfish fisheries. Management success has been mixed, with some populations being sustained at healthy levels, while some populations have not yet recovered from depleted states. Management of white hake in the Maritimes region began in 1996, when the first catch limit was introduced. White hake have been managed as a bycatch fishery with incidental catch limits since 1999. Despite these management efforts to sustain the population, there are very few large white hake left compared to the 1980s (DFO 2005a). However, the main reason why

the white hake population is not rebounding is because of high natural mortality; fishing mortality is relatively low. This factor was given a score of "moderately effective".

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

**Moderately Effective**

Many management measures, including fishing gear restrictions, area and time closures, and catch limits, have been put in place to manage Canada's groundfish fisheries. Management success has been mixed, with some populations being sustained at healthy levels, while some populations have not yet recovered from depleted states. A directed fishery for white hake in international waters of the Newfoundland and Labrador region began in 1988; however regulations on catch limits were not put in place until 2005. Until 2013, the catch limits have been minimally effective due to the fact that they were set too large to allow the species to recover (Kulka and Miri 2007)(Simpson et al. 2011)(NAFO 2013b). It is uncertain if current management efforts are enough to allow for the recovery of white hake. This factor is deemed "moderately effective".

**Subfactor 3.1.7 - Stakeholder Inclusion**

*Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent and includes stakeholder input.*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

**Moderately Effective**

The Department of Fisheries and Oceans Canada (DFO) provides opportunities for all interested and affected parties to be involved in the fisheries management process. DFO works with a diverse range of stakeholder groups and individuals including local communities, fishery biologists, enforcement personnel, international organizations, aboriginal groups with fishing and resource rights, commercial aquaculture and wild fishery organizations, companies, and provincial counterparts with shared resource management responsibilities (DFO 2013s). Stakeholder involvement is established through regular consultation with the large number of representative organizations and through public meetings (MSC 2010). However, it is unclear how the opinions of stakeholders are used in the decision making process. This factor is deemed "moderately effective".

### Factor 3.2: Bycatch Management Strategy

#### Scoring Guidelines

Four subfactors are evaluated: Management Strategy and Implementation, Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.' Unless reason exists to rate Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations differently, these ratings are the same as in 3.1.

- 5 (Very Low Concern) = Rated as 'highly effective' for all four subfactors considered.
- 4 (Low Concern) = Management Strategy rated 'highly effective' and all other subfactors rated at least 'moderately effective.'
- 3 (Moderate Concern) = All subfactors rates at least 'moderately effective.'
- 2 (High Concern) = At minimum, meets standards for 'moderately effective' for Management Strategy but some other factors rated 'ineffective.'
- 1 (Very High Concern) = Management exists, but Management Strategy rated 'ineffective.'
- 0 (Critical) = No bycatch management even when overfished, depleted, endangered or threatened species are known to be regular components of bycatch and are substantially impacted by the fishery.

#### Factor 3.2 Summary

Factor 3.2: Bycatch Management Strategy					
Region / Method	Subfactor 3.2.1 Management Strategy and Impl.	Subfactor 3.2.2 Scientific Research and Monitoring	Subfactor 3.2.3 Record of Following Scientific Advice	Subfactor 3.2.4 Enforcement of Regs.	Factor 3.2 Score
Maritimes North Atlantic Gillnet, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	3:000: Moderate Concern
Maritimes North Atlantic Longline, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	3:000: Moderate Concern
Maritimes North Atlantic Trawl, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	3:000: Moderate Concern
Newfoundland and Labrador North Atlantic Gillnet, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	3:000: Moderate Concern
Newfoundland and Labrador North Atlantic Longline, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	3:000: Moderate Concern
Newfoundland and Labrador North Atlantic Trawl, Bottom	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	3:000: Moderate Concern

## Factor 3.2 Assessment

### Subfactor 3.2.1 - Management Strategy and Implementation

*Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and how successful are these management measures? To achieve a Highly Effective rating the primary bycatch species must be known and there must be clear goals and measures in place to minimize the impacts on bycatch species (e.g., catch limits, use of proven mitigation measures, etc.).*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

#### **Moderately Effective**

The Canadian Atlantic groundfish fishery has management strategies to help mitigate the fishing impacts on incidentally caught species. Under Canadian regulations, all groundfish must be retained and landed regardless of the gear being used. However, there are some exceptions; dogfish, sculpin, lumpfish, and skate may be discarded. Also, under the "Small Fish Protocol" the release of undersized fish species is required. As well, an area is subject to a temporary closure (minimum of 10 days) to a specific fleet sector if the number of undersized fish reaches or exceeds 15% of the catch (DFO 2013e). Conservation Harvesting Plans designate the total bycatch of species that can be taken on each trip in percentage terms relative to the total catch. Any species caught that is classified under the Species at Risk Act (SARA) as "threatened" or "endangered" must be released from where it was taken and if alive, in a manner that causes the least harm (DFO 2013n). As well, recover strategies must be developed for species listed under the SARA. Species listed under the SARA include wolffish, leatherback sea turtle, and some marine mammals. Some gear modifications have also been tested and introduced to Canadian fisheries including circle hooks on longlines to reduce turtle bycatch, acoustic "pingers" or alarms on gillnets to reduce cetacean bycatch, and separator panels on otter trawls to reduce cod bycatch (Baer et al. 2010)(Fuller et al. 2008). Despite these various management strategies, there is not enough data available to know how effective these strategies are. Therefore, this factor is deemed "moderately effective".

### Subfactor 3.2.2 - Scientific Research and Monitoring

*Considerations: Is bycatch in the fishery recorded/documented and is there adequate monitoring of bycatch to measure fishery's impact on bycatch species? To achieve a Highly Effective rating, assessments must be conducted to determine the impact of the fishery on species of concern, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are being met.*

**Maritimes North Atlantic, Gillnet, Bottom**

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom

Newfoundland and Labrador North Atlantic, Longline, Bottom

Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### **Moderately Effective**

In order to monitor catch and fisheries data, Canada has set up programs such as the At-Sea Observer program and dockside monitoring. The fishing industry is 100% responsible for the cost of the national At-Sea Observer program (DFO 2013a). The At-Sea Observer Program puts certified private-sector observers aboard fishing vessels to monitor fishing activities and collect scientific data, including data on fisheries bycatch and discards (DFO 2013a). However, at-sea observer coverage levels for principal Canadian fisheries are too low and intermittent to have a high degree of confidence in the bycatch/discard data collected. For instance from 2002-2006, the level of observer coverage in the groundfish trawl fishery ranged from 0-3% for the Scotian Shelf, Bay of Fundy and Gulf of Maine areas (Divisions 4VWX5Y) and from 8-33% in Georges Bank (Division 5Z) (Gavaris et al. 2010). In the groundfish longline and gillnet fisheries observer coverage has been 1% or less for the Scotian Shelf/Gulf of Maine and around 10% in Georges Bank (Gavaris et al. 2010). Because information on bycatch and discards in the Canadian groundfish fisheries is collected, but data collection is limited, this factor is deemed "moderately effective".

#### **Subfactor 3.2.3 - Management Record of Following Scientific Advice**

*Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g., do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.*

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom

Newfoundland and Labrador North Atlantic, Longline, Bottom

Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### **Moderately Effective**

Managers only sometimes follow scientific advice. See Factor 3.1 Harvest Strategy for details.

#### **Subfactor 3.2.4 - Enforcement of Management Regulations**

*Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.*

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom  
Newfoundland and Labrador North Atlantic, Longline, Bottom  
Newfoundland and Labrador North Atlantic, Trawl, Bottom

**Highly Effective**

Enforcement of fishery regulations is considered "highly effective". See Factor 3.1 Harvest Strategy for details.

## **Criterion 4: Impacts on the habitat and ecosystem**

*This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment.*

*The final score is the geometric mean of the impact of fishing gear on habitat score (plus the mitigation of gear impacts score) and the Ecosystem Based Fishery Management score. Rating is based on the score as follows:*

- >3.2=Green or Low Concern
- >2.2 and <=3.2=Yellow or Moderate Concern
- <=2.2=Red or High Concern.

*Rating cannot be Critical for Criterion 4.*

### **Criterion 4 Summary**

<b>Region / Method</b>	<b>Factor 4.1 Impact of Gear on Habitat Score</b>	<b>Factor 4.2 Mitigation of Gear Impacts Modifier</b>	<b>Factor 4.3 Ecosystem Based Fisheries Management Score</b>	<b>Criterion 4 Score</b>
<b>Maritimes North Atlantic Gillnet, Bottom</b>	3.00:Low Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	<b>Yellow (3.123)</b>
<b>Maritimes North Atlantic Longline, Bottom</b>	3.00:Low Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	<b>Yellow (3.123)</b>
<b>Maritimes North Atlantic Trawl, Bottom</b>	2.00:Moderate Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	<b>Yellow (2.598)</b>
<b>Newfoundland and Labrador North Atlantic Gillnet, Bottom</b>	3.00:Low Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	<b>Yellow (3.123)</b>
<b>Newfoundland and Labrador North Atlantic Longline, Bottom</b>	3.00:Low Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	<b>Yellow (3.123)</b>
<b>Newfoundland and Labrador North Atlantic Trawl, Bottom</b>	2.00:Moderate Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	<b>Yellow (2.598)</b>

### **Criterion 4 Assessment**

#### **Factor 4.1 – Impact of Fishing Gear on the Habitat/Substrate**

*Scoring Guidelines*



- 5 (None) = Fishing gear does not contact the bottom
- 4 (Very Low) = Vertical Line Gear
- 3 (Low) = Fishing gear contacts the bottom, but is not dragged along the bottom (e.g., bottom gillnet, bottom longline, trap) and fishing does not occur on sensitive habitats. Bottom seine gear fished on resilient mud/sand habitats. Midwater trawl gear that is known to contact bottom occasionally (<25% of the time) or purse seine gear known to commonly contact bottom
- 2 (Moderate) = Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Bottom seine fished on habitats other than mud/sand
- 1 (High) = Dredge or bottom trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)
- 0 (Very High) = Dredge or bottom trawl fished on biogenic habitat (e.g., deep-sea corals, eelgrass and maerl)

*Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive plausible habitat type*

#### Maritimes North Atlantic, Gillnet, Bottom

#### Newfoundland and Labrador North Atlantic, Gillnet, Bottom

**3.00**      **Low Concern**

Bottom gillnets are a passive gear that hang vertically in the water column with anchors on each end (Fuller et al. 2008)(Baer et al. 2010)(NOAA 2002). Gillnets are made up of three components: a leadline, a wepline or mesh, and a floatline. The mesh size depends on the size of the fish that is being targeted. Typically, 5-15 nets are attached to each other and each net is usually 300 feet in length. Results from several studies on the impact of bottom gillnets on the habitat vary greatly, from minimal impacts to high impacts, depending on factors such as substrate type and fishing frequency (Baer et al., 2010). Overall, bottom gillnets contact the seafloor but their areal impact is less than that of bottom trawls and dredges. Because white hake are typically found in bottom habitats with substrates of mud or fine-grained sand (NOAA 1998), which tend to be resilient to fishing gear damage, this factor was rated "low concern".

#### Maritimes North Atlantic, Longline, Bottom

#### Newfoundland and Labrador North Atlantic, Longline, Bottom

**3.00**      **Low Concern**

Bottom longlines consist of a single mainline that holds together hundreds of shorter lines with hooks. Bottom longlines are anchored to the seafloor and are shown to have an effect of the surrounding habitat, particularly when they are hauled in, as the line and hooks can snag rocks, coral, and other bottom structures or organisms in its path (Baer et al. 2010). Habitat damage from bottom longlines depends on several factors: number of hooks used, weights, type of line, hauling speed, technique, and bottom type (Fuller et al. 2008). White hake are typically found in habitats with substrates of mud or fine-grained sand (NOAA 1998), which tend to be resilient to damage caused by fishing gears, therefore, this factor is ranked "low concern".

**Maritimes North Atlantic, Trawl, Bottom****Newfoundland and Labrador North Atlantic, Trawl, Bottom****2.00****Moderate Concern**

Bottom trawls consists of large nets that are dragged along the seafloor (Fuller et al. 2008). Bottom trawls can have direct and indirect effects on the bottom habitat but the severity of these effects depend upon that habitat being fished (NOAA 2002). These effects include sediment resuspension, the removal or destruction of structure forming species, and altering benthic (bottom) communities (NOAA 2002). Studies of groundfish bottom trawling in Atlantic Canada show short-term disruption of benthic communities, including reductions in the abundance and diversity of benthic organisms (Fuller et al. 2008). These habitats can recover within one to three years; however, habitats that are frequently trawled can remain in an altered state. Since white hake are typically found in habitats with substrates of mud or fine-grained sand (NOAA 1998), which tend to be resilient to fishing gear damage, this factor was ranked as "moderate concern".

**Factor 4.2 - Mitigation of Gear Impacts***Scoring Guidelines*

- *+1 (Strong Mitigation) = Examples include large proportion of habitat protected from fishing gear (>50%), fishing intensity low/limited, gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage, or an effective combination of 'moderate' mitigation measures.*
- *+0.5 (Moderate Mitigation) = 20% of habitat protected from fishing gear or other measures in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.*
- *+0.25 (Low Mitigation) = Few measures are in place to limit gear impacts on habitats (e.g., vulnerable habitats protected but other habitats not protected; some limits on fishing effort/intensity, but not actively being reduced).*
- *0 (No Mitigation) = No effective measures are in place to limit gear impacts on habitats*

**Maritimes North Atlantic, Gillnet, Bottom****Maritimes North Atlantic, Longline, Bottom****Maritimes North Atlantic, Trawl, Bottom****Newfoundland and Labrador North Atlantic, Gillnet, Bottom****Newfoundland and Labrador North Atlantic, Longline, Bottom****Newfoundland and Labrador North Atlantic, Trawl, Bottom****0.25****Minimal Mitigation**

Some initiatives to address fishing impacts of the habitat have been implemented in Canada including gear restrictions and/or modifications, area closures, and marine protected areas (MPAs). For example, area closures have been put in place to protect cold-water corals on the Scotian Shelf and a coral habitat

on the southwest slope of the Grand Banks off Newfoundland (Fuller et al. 2008). The Northwest Atlantic Fisheries Organization (NAFO), which manages white hake and other groundfish in international waters of the Northwest Atlantic, has identified 18 areas as being vulnerable to bottom contact gears. Subsequently, these areas have been closed to bottom fishing (NAFO 2013f). These closed areas account for about 5% of the bottom fishing areas in NAFO's jurisdiction (NAFO 2013g). A "minimal mitigation" score was awarded

### Factor 4.3 – Ecosystem-Based Fisheries Management

#### Scoring Guidelines

- *5 (Very Low Concern) = Substantial efforts have been made to protect species' ecological roles and ensure fishing practices do not have negative ecological effects (e.g., large proportion of fishery area protected with marine reserves, abundance is maintained at sufficient levels to provide food to predators).*
- *4 (Low Concern) = Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. If hatchery supplementation or fish aggregating devices (FADs) are used, measures are in place to minimize potential negative ecological effects.*
- *3 (Moderate Concern) = Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species. OR negative ecological effects from hatchery supplementation or FADs are possible and management is not in place to mitigate these impacts.*
- *2 (High Concern) = The fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.*
- *1 (Very High Concern) = The use of hatchery supplementation or FADs in the fishery is having serious negative ecological or genetic consequences. OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.*

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Trawl, Bottom**

**3.00**

**Moderate Concern**

The continental shelf of Atlantic Canada and New England is one of the most productive marine ecosystems and fishing grounds in the world. Due to an increase in fishing pressure in the last fifty years, species abundances and species composition have been dramatically altered. Total fish biomass has been greatly reduced in this region (Fogarty and Murawski 1998), and the Atlantic Canadian fishery now relies on invertebrate species such as lobster, crab, scallop and shrimp (Fuller et al. 2008). In addition to fishing impacts, natural and anthropogenic environmental impacts (e.g., temperature shifts) may also be

resulting in changes to the ecosystem. Separating the effects of fishing and the effects of environmental changes may be close to impossible.

In order to protect the whole ecosystem and create sustainable fisheries, an ecosystem based management approach is increasingly being applied through fisheries management plans in Canada. A policy and legal framework to protect the marine environment currently exists in Canada and new policies for fisheries management that will revolve around an Ecosystem Approach to Fisheries are being developed. The Strategic Program for Ecosystem-Based Research and Advice (SPERA) participate in research projects that support national priorities for managing ecosystems in Canada (DFO 2013h). Also, a new Ecosystem Science Framework in support of Integrated Management was developed to create a better understanding of the cumulative impacts of human activities in Canadian waters and to provide a framework for integrating science activities. An ecosystem approach in Canada requires increased collaboration between a number of sectors in order to provide decision-makers with integrated scientific advice (DFO 2013i).

The Northwest Atlantic Fisheries Organization, which manages white hake and other groundfish in international waters of the Newfoundland and Labrador region, has also been working on implementing an Ecosystem Based Approach to Fisheries Management since 2007. Efforts that have been made to protect the ecosystem include the closure of 18 bottom habitat areas to fishing to protect vulnerable species and habitats, and placing fishing moratoriums on key food web species, like capelin, which are prey for many large fish. They are working to understand ecological interactions among species, determine fishing encounter thresholds for corals and sponges, and on identifying key vulnerable species and habitats in the region (NAFO 2014).

While scientific assessment and efforts to account for species' ecological roles are underway by the Northwest Atlantic Fisheries Organization, since the Ecosystem Approach to fisheries in Canada is mostly in its planning stage, this factor is ranked "moderate concern".

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## **Appendix A: Main Species Considered in the Assessment**

Summary of all main species considered in the assessment

<b>White hake: Maritimes North Atlantic, Gillnet, Bottom</b>				
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>
ATLANTIC COD	High	1.00: Very High Concern	1.00: High Concern	<b>1.000</b>
LEATHERBACK TURTLE	High	1.00: Very High Concern	1.00: High Concern	<b>1.000</b>
HARBOR PORPOISE	High	2.00: High Concern	1.00: High Concern	<b>1.414</b>
NORTH ATLANTIC RIGHT WHALE	High	1.00: Very High Concern	2.33: Moderate Concern	<b>1.526</b>
WINTER SKATE	High	1.00: Very High Concern	2.33: Moderate Concern	<b>1.526</b>
ATLANTIC WOLFFISH	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
SPINY DOGFISH	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
THORNY SKATE	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
ATLANTIC POLLOCK	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>

<b>White hake: Maritimes North Atlantic, Longline, Bottom</b>				
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>
ATLANTIC COD	High	1.00: Very High Concern	1.00: High Concern	<b>1.000</b>
CUSK	High	1.00: Very High Concern	1.00: High Concern	<b>1.000</b>
WINTER SKATE	High	1.00: Very High Concern	2.33: Moderate Concern	<b>1.526</b>
ATLANTIC WOLFFISH	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
SPINY DOGFISH	High	2.00: High	2.33:	<b>2.159</b>



		Concern	Moderate Concern	
<b>THORNY SKATE</b>	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
<b>LEATHERBACK TURTLE</b>	High	1.00: Very High Concern	5.00: Very Low Concern	<b>2.236</b>
<b>HADDOCK</b>	Medium	4.00: Low Concern	2.33: Moderate Concern	<b>3.053</b>
<b>ATLANTIC HALIBUT</b>	High	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>

<b>White hake: Maritimes North Atlantic, Trawl, Bottom</b>				
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>
<b>ATLANTIC COD</b>	High	1.00: Very High Concern	1.00: High Concern	<b>1.000</b>
<b>WINTER SKATE</b>	High	1.00: Very High Concern	2.33: Moderate Concern	<b>1.526</b>
<b>ACADIAN REDFISH</b>	Medium	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
<b>ATLANTIC WOLFFISH</b>	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
<b>SPINY DOGFISH</b>	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
<b>THORNY SKATE</b>	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
<b>ATLANTIC POLLOCK</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>HADDOCK</b>	Medium	4.00: Low Concern	2.33: Moderate Concern	<b>3.053</b>
<b>SILVER HAKE</b>	Medium	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>

White hake: Newfoundland and Labrador North Atlantic, Gillnet, Bottom				
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
LEATHERBACK TURTLE	High	1.00: Very High Concern	1.00: High Concern	1.000
HARBOR PORPOISE	High	2.00: High Concern	1.00: High Concern	1.414
ATLANTIC COD	High	1.00: Very High Concern	2.33: Moderate Concern	1.526
NORTH ATLANTIC RIGHT WHALE	High	1.00: Very High Concern	2.33: Moderate Concern	1.526
NORTHERN WOLFFISH	High	1.00: Very High Concern	2.33: Moderate Concern	1.526
SPOTTED WOLFFISH	High	1.00: Very High Concern	2.33: Moderate Concern	1.526
ATLANTIC WOLFFISH	High	2.00: High Concern	2.33: Moderate Concern	2.159
THORNY SKATE	High	2.00: High Concern	2.33: Moderate Concern	2.159
WINTER SKATE	High	2.00: High Concern	2.33: Moderate Concern	2.159
HADDOCK	Medium	3.00: Moderate Concern	2.33: Moderate Concern	2.644
ATLANTIC HALIBUT	High	5.00: Very Low Concern	5.00: Very Low Concern	5.000

White hake: Newfoundland and Labrador North Atlantic, Longline, Bottom				
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
ATLANTIC COD	High	1.00: Very High Concern	2.33: Moderate Concern	1.526
NORTHERN WOLFFISH	High	1.00: Very High Concern	2.33: Moderate Concern	1.526
SPOTTED WOLFFISH	High	1.00: Very High Concern	2.33: Moderate	1.526

			Concern	
<b>ATLANTIC WOLFFISH</b>	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
<b>THORNY SKATE</b>	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
<b>LEATHERBACK TURTLE</b>	High	1.00: Very High Concern	5.00: Very Low Concern	<b>2.236</b>
<b>ATLANTIC HALIBUT</b>	High	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>

<b>White hake: Newfoundland and Labrador North Atlantic, Trawl, Bottom</b>				
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>
<b>ATLANTIC COD</b>	High	1.00: Very High Concern	2.33: Moderate Concern	<b>1.526</b>
<b>NORTHERN WOLFFISH</b>	High	1.00: Very High Concern	2.33: Moderate Concern	<b>1.526</b>
<b>SPOTTED WOLFFISH</b>	High	1.00: Very High Concern	2.33: Moderate Concern	<b>1.526</b>
<b>ACADIAN REDFISH</b>	Medium	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
<b>AMERICAN PLAICE</b>	High	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
<b>ATLANTIC WOLFFISH</b>	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
<b>THORNY SKATE</b>	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
<b>WITCH FLOUNDER</b>	High	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
<b>YELLOWTAIL FLOUNDER</b>	Medium	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>

## Assessment of Main Species Not Included in Body of Report

### ACADIAN REDFISH

#### Factor 2.1 - Inherent Vulnerability

Maritimes North Atlantic, Trawl, Bottom

Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### Medium Vulnerability

The FishBase vulnerability score for acadian redfish is 44 out of 100, which suggests this species has a medium inherent vulnerability to fishing. Acadian redfish are a slow growing, long-lived species, with a low fecundity (DFO 2010a). They can live up to 40 years old and grow to 45 cm in length (DFO 2012b). They reach sexual maturity between 8 and 10 years of age and at a length of approximately 22 cm (DFO 2010a)(Froese and Pauly 2013). Acadian redfish exhibit internal fertilization and females bear live young (DFO 2010a). Within the food chain, they are an intermediate species.

#### Factor 2.2 – Abundance

Maritimes North Atlantic, Trawl, Bottom

1.00

#### Very High Concern

There are several different management units for acadian redfish in Canada. For the Scotian Shelf management unit in the Maritimes, formal target abundance reference points, like the biomass needed to produce the maximum sustainable catch/yield (BMSY) could not be determined, so the average abundance for acadian redfish over the period 1970-2010 was used as a proxy for BMSY. The limit abundance reference point for Acadian redfish was set at 40% of the average abundance or the BMSY proxy (DFO 2012b). Abundance of acadian redfish on the Scotian Shelf declined from 1970 until 2000, but has increased since, and has remained above the limit abundance reference point for the entire time, suggesting the species is not depleted. Current abundance is also above the BMSY proxy and the therefore managers consider redfish on the Scotian Shelf to be healthy (DFO 2012b). However, it is uncertain if the defined abundance reference points represent true sustainable abundance levels.

For the Gulf of St. Lawrence and Laurentian Channel redfish management unit, which includes a small part of the Maritimes area, the abundance of acadian redfish is well below the limit/overfished abundance reference point and only at 17% of the target abundance level (BMSY, the biomass at maximum sustainable yield) (DFO 2012b)(McAllister and Duplisea 2012).

The Committee on the Status of Endangered Wildlife in Canada considers acadian redfish in the Maritimes area to be part of a larger Atlantic redfish population that includes the Newfoundland and Labrador and Gulf of St. Lawrence areas, since genetic differences among Acadian redfish in these different areas are small. They determined that the Atlantic acadian redfish population is "threatened" (COSEWIC 2010c). Redfish are now being considered for formal listing under Canada's Species at Risk Act (Government of Canada 2014). We have therefore rated this factor "very high concern".

### Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### 1.00 Very High Concern

In the Newfoundland and Labrador region, the acadian redfish is often assessed and managed with the deepwater redfish (*S.mentella*) because the species are not distinguished in the catches. Redfish in Division 3LN has been increasing since 2000 and abundance is estimated to above the target abundance goal/reference point, which is the biomass at maximum sustainable yield (BMSY). In Division 3O, no abundance goals/targets have been defined, however, abundance of redfish in this area has also been increasing since 2000 (NAFO 2013b). Abundance of acadian redfish in the Gulf of St. Lawrence and Laurentian Channel, which includes part of the 3Ps subdivision, is currently at a critically low level, at only 17% of the target abundance level (the biomass at maximum sustainable yield). The population has been growing in recent years, but is expected to take a long time to rebuild to a healthy level (DFO 2012b)(McAllister and Duplisea 2012). The abundance of deepwater redfish in this area is considered critically low as well.

The Committee on the Status of Endangered Wildlife in Canada considers acadian redfish in the Newfoundland and Labrador area to be part of a larger Atlantic redfish population that includes the Maritimes and Gulf of St. Lawrence areas, since genetic differences among Acadian redfish in these different areas are small. They determined that the Atlantic acadian redfish population is "threatened" (COSEWIC 2010c). The Committee on the Status of Endangered Wildlife in Canada considers deepwater redfish "endangered" in the Gulf of St. Lawrence and Laurentian Channel and "threatened" in the remainder of Newfoundland and Labrador (COSEWIC 2010c). Redfish are now being considered for formal listing under Canada's Species at Risk Act (Government of Canada 2014). We have therefore rated this factor "very high concern".

## Factor 2.3 - Fishing Mortality

### Maritimes North Atlantic, Trawl, Bottom

#### 3.67 Low Concern

No fishing mortality targets have been established for acadian redfish in the Maritimes region (DFO 2012b). However, management strategies like, minimum landing size, annual catch limits, and area closures have been set into place to regulate fishing on acadian redfish (DFO 2000)(DFO 2010a). These strategies appear to be effective, since abundance of acadian redfish has been increasing and has doubled since 2000. We have therefore rated fishing mortality as "low concern".

### Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### 3.67 Low Concern

In Division 3LN of the Newfoundland and Labrador region, fishing levels on redfish are estimated to below the fishing mortality at maximum sustainable yield (FMSY), indicating fishing is sustainable. In Division 3O, the fishing mortality at maximum sustainable yield has not been determined for redfish but fishing levels in this area are low and thought to be sustainable (NAFO 2013b). In the Laurentian Channel

which includes part of Subdivision 3Ps, the fishing level in relation to the fishing mortality at maximum sustainable yield is also unknown. An average of 3% of the exploitable redfish abundance was commercially caught in the Laurentian Channel between 2000-2007 and catches have been well below established total allowable catch limits (DFO 2010a)(McAllister and Duplisea 2012). Because fishing levels appear to be low in all regions and redfish abundance has generally been increasing in recent years, we have rated this factor "low concern".

## **AMERICAN PLAICE**

### **Factor 2.1 - Inherent Vulnerability**

#### **Newfoundland and Labrador North Atlantic, Trawl, Bottom**

##### **High Vulnerability**

The FishBase vulnerability score for American plaice is 66 out of 100 which indicates that this species has a high inherent vulnerability to fishing. American Plaice are a slow growing and moderately long-lived species that exhibit sexual dimorphism; females grow faster and are larger than the males. In general, females sexually mature at about 7-9 years old (30-40 cm) and males at 4-4.5 years old (16-21 cm) (DFO 2011a). They can live up to 30 years and reach a length of 83 cm (Froese and Pauly 2013). The relative fecundity of American plaice ranges from 78 to 1077 eggs and the eggs are released in batches every few days (DFO 2011a). American plaice are a high-level predator species within the food chain.

### **Factor 2.2 – Abundance**

#### **Newfoundland and Labrador North Atlantic, Trawl, Bottom**

##### **1.00 Very High Concern**

The abundance of American plaice has declined over its entire range (DFO 2011a). In April 2009, the Newfoundland and Labrador population was examined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and was considered "threatened". The population met the criteria for "endangered" but was only considered "threatened" because its distribution has remained stable and the present abundance suggests it is unlikely they will go extinct within 5 generations (COSEWIC 2009). The latest assessments for the populations in southern Newfoundland (Div. 3LNO and 3Ps) indicate that abundance remains very low and below the limit abundance reference point (DFO 2012j)(Dwyer et al. 2012). American plaice are now being considered for formal listing under Canada's Species at Risk Act (Government of Canada 2014). This factor was deemed "very high concern".

### **Factor 2.3 - Fishing Mortality**

#### **Newfoundland and Labrador North Atlantic, Trawl, Bottom**

##### **3.67 Low Concern**

There has been a moratorium on directed fishing for American plaice since 1993, but the species is still taken as bycatch in fisheries for other groundfish. Bycatch of American plaice increased to over 1,000 t in the early 2000s. However, catches have since declined with only 402 t and 273 t caught in 2010 and 2011, respectively. The current fishing mortality of American plaice in Subdivision 3Ps is estimated to be 64% of the limit fishing mortality reference point (Flim) and the probability of being above Flim is relatively low (20%), indicating fishing levels are likely sustainable (DFO 2012f). Since 1992, the abundance of American plaice in this division has been increasing (DFO 2012f). Based on the latest assessment of American plaice in Division 3LNO, fishing levels for this population are also below sustainable levels and abundance is increasing (Dwyer et al. 2012). However, because American Plaice in this region are still struggling to recover, even after decades of low fishing, we have rated fishing mortality as "low concern" rather than very low concern.

## **ATLANTIC HALIBUT**

### **Factor 2.1 - Inherent Vulnerability**

**Maritimes North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

#### **High Vulnerability**

The FishBase vulnerability score for Atlantic halibut is 88 out of 100, which indicates this species has a high inherent vulnerability to fishing (Froese and Pauly 2013). Atlantic halibut is the largest of the flatfishes; they can live up to 40 years and reach a length of 470 cm. Females reach sexual maturity at 11-12 years of age and around 120 cm (DFO 2011c). Males reach maturity at 7-8 years old and a length of 80 cm. Atlantic halibut are broadcast spawners and females can lay up to 7 million eggs (COSEWIC 2011). Within the food chain, they are a high-level predator species.

### **Factor 2.2 – Abundance**

**Maritimes North Atlantic, Longline, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Longline, Bottom**

**5.00**

#### **Very Low Concern**

Since the 1970's, the abundance of Atlantic halibut has varied considerably. However, in the last 10 years, there has been an increase in abundance of Atlantic halibut in all areas in Canada (COSEWIC 2011). Also, recruitment (i.e., amount of new fish entering the population) has been above average since 2002 (DFO 2011c). Currently, Atlantic halibut is listed as "endangered" under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. However, this listing is dated (1996) and may not be relevant to the populations in Canadian waters. According to a 2011 assessment and status report, Atlantic halibut in Canada are not at risk (COSEWIC 2011). In 2009, the mature fish abundance or

spawning stock biomass (SSB) of Atlantic halibut on the Scotian Shelf (Maritimes region) and southern Newfoundland was estimated to be well above the target level (BMSY, the biomass at maximum sustainable yield), which means their abundance is in a healthy zone (DFO 2011c). Therefore, abundance of Atlantic halibut was deemed "very low concern".

### Factor 2.3 - Fishing Mortality

Maritimes North Atlantic, Longline, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom

Newfoundland and Labrador North Atlantic, Longline, Bottom

**5.00**      **Very Low Concern**

With few natural predators, overfishing is the main potential threat to Atlantic halibut. However, current management efforts (e.g., catch limits and size limits) have reduced the threat of overfishing to a minimum (COSEWIC 2011). In 2009, fishing mortality on Atlantic halibut on the Scotian Shelf and southern Newfoundland was estimated to be below the fishing mortality at maximum sustainable yield/catch (FMSY), meaning the population is being fished sustainably. The probability that the limit removal reference point will be exceeded is less than 1 percent (DFO 2012c). Therefore, fishing mortality is ranked as "very low concern".

## ATLANTIC POLLOCK

### Factor 2.1 - Inherent Vulnerability

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Trawl, Bottom

**Medium Vulnerability**

The FishBase vulnerability score for Atlantic pollock (*Pollachius virens*) is 59 out of 100, which is considered a high inherent vulnerability to fishing (Froese and Pauly 2013). However, the life history characteristics of Atlantic pollock suggest a medium inherent vulnerability rating is more appropriate. As well, there is no indication that Atlantic pollock is at risk of depletion. For these reasons the inherent vulnerability is ranked as "medium" based on the life history method. Atlantic pollock can live up to 23 years and grow up to 110 cm in length. They can reach sexual maturity at 3-4 years of age and at a length of 45-50 cm. Pollock spawn between November and February and have several spawning sites throughout Canadian waters (DFO 2009a). Within the food chain, they are a high level predator species.

### Factor 2.2 – Abundance

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Trawl, Bottom

**3.00**      **Moderate Concern**



The last full assessment for Atlantic pollock in the Maritimes region was completed in 2009 (DFO 2009a). The assessment found that in the eastern area of the Maritimes region the abundance of Atlantic pollock has varied but showed a declining trend from the 1980s to 2006. Since then, abundance has increased. In the western area, the abundance of Atlantic pollock showed an increasing trend from 2002-2009 (DFO 2009a)(Stone et al. 2009). A recent update of abundance in the western area, indicates an apparent sharp decrease in abundance in 2010; the reason for this is uncertain (DFO 2011f).

In 2012, abundance conservation targets/goals were developed for Atlantic pollock in the eastern area. They used the average abundance/biomass estimate from a period of high productivity (1984-1993) as a proxy for the biomass at maximum sustainable yield (BMSY). This equaled 50,200 t. The limit abundance reference point was set at 40% of this BMSY proxy or 20,100 t. Based on abundance estimates from surveys of pollock, the abundance of pollock has only been above the limit abundance reference point five times since 1994, with 4 of those times occurring since 2006. This suggests the status of pollock is improving (Stone 2012). However, until these newly established abundance reference points are used in a formal population assessment, the status of pollock remains uncertain.

Since the abundance of Atlantic pollock is uncertain and they have a medium inherent vulnerability to fishing, this factor was ranked "moderate concern".

### Factor 2.3 - Fishing Mortality

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Trawl, Bottom

2.33

**Moderate Concern**

Relative fishing mortality (catches/survey abundance) of pollock for the eastern population was estimated to be low in the last population assessment, at 3% and 2% for 2007 and 2008, respectively. However, there are no defined fishing mortality targets. For the western population, fishing mortality rates on pollock increased to high levels in the 1990s and remained high until the early 2000s. Since 2006 though, fishing mortality rates for pollock ages 6-9 have been below the established fishing mortality target/reference level ( $F_{ref}$ ) of 0.2 due to reduced catch limits. However, total fishing mortality on all age groups remains uncertain (DFO 2009a). A new management strategy for western pollock began in 2012, which defines how the catch limits will be set based on the abundance estimates of pollock (DFO 2011f). There was some concern by scientists as to whether the management strategy was conservative enough (DFO 2011e). Due to uncertainties about whether fishing levels on pollock are sustainable, we have rated this factor "moderate concern".

### ATLANTIC WOLFFISH

#### Factor 2.1 - Inherent Vulnerability

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom

Newfoundland and Labrador North Atlantic, Longline, Bottom

Newfoundland and Labrador North Atlantic, Trawl, Bottom

### High Vulnerability

The Atlantic wolffish has a FishBase vulnerability score of 67 out of 100, which indicates Atlantic wolffish have a high inherent vulnerability to fishing (Froese and Pauly 2013). The Atlantic wolffish can reach a maximum length of 150 cm and live over 22 years (Simpson et al. 2012c)(Keith and Nitschke 2010). Atlantic wolffish reach sexual maturity at 5-6 years old and approximately 60 cm long. Reproduction begins with internal fertilization. Adults undergo inshore spawning migrations in the spring and summer months. A female can lay up to 35,320 eggs, depending on their size, depositing them on the ocean floor (Simpson et al. 2012c). Atlantic Wolffish feed primarily on crabs and echinoderms and are a middle level species within the food chain (Simpson et al. 2012c)(Froese and Pauly 2013).

## Factor 2.2 – Abundance

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom

Newfoundland and Labrador North Atlantic, Longline, Bottom

Newfoundland and Labrador North Atlantic, Trawl, Bottom

2.00

### High Concern

Atlantic wolffish were considered a species of "special concern" by the Committee on the Status of Endangered Wildlife in Canada in 2000 and this status was confirmed in 2012 (COSEWIC 2012). The species is also listed as "special concern" under Canada's Species at Risk Act (Government of Canada 2013). Abundance of this species declined greatly from the 1980's until the mid 1990's, but since then abundance has increased in many areas, particularly in Newfoundland and Labrador waters, which has historically been the area of greatest concentration for this species. These abundance increases are likely at least partly due to reduced fisheries catches. Despite this, abundance still remains low compared to levels in the early 1980's. In the Maritimes region, where historically there were fewer Atlantic wolffish, abundance has continued to decline (COSEWIC 2012) (Simpson et al. 2013)(DFO 2013g). Abundance conservation targets have not been established for Atlantic wolffish. Because this species has been designated as "special concern" and because it has a high vulnerability to fishing, abundance is rated "high concern".

## 2.3 - Fishing Mortality

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom  
 Newfoundland and Labrador North Atlantic, Longline, Bottom  
 Newfoundland and Labrador North Atlantic, Trawl, Bottom

**2.33 Moderate Concern**

There is no direct measure for fishing mortality on the Atlantic wolffish. Between 1995-2002, the index of exploitation (catch/relative biomass) of Atlantic wolffish was very low, around 1 percent (Kulka et al. 2007). Wolffish catches have generally not been specified by species so catches of Atlantic, northern, and spotted wolffish are all lumped together. However, currently only Atlantic wolffish is allowed to be retained. Retained catches of wolffish have declined considerably since the 1980's, and this has likely contributed to the observed abundance increases in some areas. However, large numbers of wolffish may be discarded at sea and not reported (COSEWIC 2012)(Simpson et al. 2013). Survival of discarded Atlantic wolffish is thought to be high (DFO 2013t). Atlantic wolffish are protected under Canada's Species at Risk Act (SARA). In 2008, as a requirement from the Species at Risk Act, a joint recovery strategy/management plan was published for northern, spotted, and Atlantic wolffish. Under the Species at Risk Act, there are also monitoring and reporting requirements for the implementation of management plans (DFO 2013g). Because fishing mortality on Atlantic wolffish is uncertain, but management measures to protect this species are in place, we have awarded a score of "moderate concern".

## **HADDOCK**

### **Factor 2.1 - Inherent Vulnerability**

Maritimes North Atlantic, Longline, Bottom  
 Maritimes North Atlantic, Trawl, Bottom  
 Newfoundland and Labrador North Atlantic, Gillnet, Bottom

**Medium Vulnerability**

The FishBase vulnerability score for haddock is 47 out of 100, which indicates haddock have a medium inherent vulnerability to fishing. Haddock reach sexual maturity by age 3 and grow to an average of 40 cm by age 4. After age 4, their growth slows and Haddock reach only about 46 cm by age 10 (DFO 2012g). Haddock can live up to 20 years and grow to a maximum length of 112cm (Froese and Pauly 2013). A female haddock can produce up to 3 million eggs each year and peak spawning occurs in April/May (DFO 2012g).

### **Factor 2.2 – Abundance**

Maritimes North Atlantic, Longline, Bottom  
 Maritimes North Atlantic, Trawl, Bottom

**4.00 Low Concern**

Haddock in the Maritimes region are primarily caught in the southern Scotian Shelf/Bay of Fundy and in

eastern Georges Bank. The southern Scotian Shelf/Bay of Fundy population was last assessed in 2011. Mature fish abundance or the spawning stock biomass (SSB) has remained relatively stable over the past two decades. Recent recruitment (= amount of new fish entering population) has been variable, with poor year classes during 2007 and 2008 and large year classes in 2009 and 2010. The spawning stock biomass at maximum sustainable yield (SSBMSY) was estimated to be 52,000 t (DFO 2012g). A limit abundance reference point (LRP) of 40% of SSBMSY (20,800 t) and upper abundance reference point (USR) of 80% of SSBMSY (41,600 t) were suggested (DFO 2012g). The current abundance of Haddock in the southern Scotian Shelf/Bay of Fundy area is somewhat uncertain, but is considered to likely be in the "cautious zone", in between the limit and upper abundance reference points. In eastern Georges Bank, abundance of haddock has overall increased since the early 2000's and is currently estimated to be at its highest level in the time series (1969-2012). No abundance conservation goals/reference points have been established for this population but fishing levels are adequately controlled and adjusted based on haddock abundance (TRAC 2013). This factor is ranked "low concern".

#### Newfoundland and Labrador North Atlantic, Gillnet, Bottom

##### 3.00 Moderate Concern

The last population status report for haddock in the Newfoundland and Labrador region was completed in 2001 (DFO 2001a)(DFO 2001b). The abundance of haddock was low from 1972 to 1982, then peaked in 1984. During the 1999, 2000, and 2001 surveys, the haddock encountered were predominately small, immature fish (DFO 2001a). Since no abundance targets/reference points were given and no recent assessments of haddock in the Newfoundland and Labrador region have been completed, abundance is considered "unknown". Since haddock have a medium inherent vulnerability to fishing, this factor is ranked "moderate concern".

### Factor 2.3 - Fishing Mortality

#### Maritimes North Atlantic, Longline, Bottom

#### Maritimes North Atlantic, Trawl, Bottom

##### 2.33 Moderate Concern

Haddock is caught as part of a multi-species fishery in the Maritimes region, with most catches occurring on the southern Scotian Shelf/Bay of Fundy and eastern Georges Bank. The total allowable catch (TAC) for Haddock in the southern Scotian Shelf/Bay of Fundy was 7,000 t from 2006 to 2009, lowered to 6,000 t for 2010 and 2011 and to 5,100 t in 2012 (DFO 2012g)(DFO 2014a). Catches have been lower than the catch limit, averaging approximately 5,700 t since 2005. A target fishing mortality reference point of 0.25 has been suggested but further review is required (DFO 2012g). Catch limits are also set for the eastern Georges Bank population, which is managed jointly with the U.S.. Catch limits are set to ensure a low to neutral risk of exceeding the established fishing mortality reference level of 0.26. Current fishing levels are below the established reference level and have been below the reference level for most years since 1996 (TRAC 2013). Due to uncertainties about the current fishing mortality for the southern Scotian Shelf/Bay of Fundy, this factor is ranked "moderate concern".

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom****2.33 Moderate Concern**

There is currently no directed fishery for haddock in the Newfoundland and Labrador region (DFO 2001a)(DFO 2001b). They are caught as bycatch in fisheries for other groundfish species. No fishing mortality targets have been defined for haddock in the Newfoundland and Labrador region so the fishing mortality is considered "unknown". Therefore, this factor was ranked "moderate concern".

**HARBOR PORPOISE****Factor 2.1 - Inherent Vulnerability****Maritimes North Atlantic, Gillnet, Bottom****Newfoundland and Labrador North Atlantic, Gillnet, Bottom****High Vulnerability**

Marine mammals are considered to have a "high" inherent vulnerability to fishing.

**Factor 2.2 – Abundance****Maritimes North Atlantic, Gillnet, Bottom****Newfoundland and Labrador North Atlantic, Gillnet, Bottom****2.00 High Concern**

Currently, there are no range-wide estimates of the abundance of harbor porpoises in eastern Canada. However, the northwest Atlantic population of harbor porpoise is considered a species of "special concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2006). The harbor porpoise is also included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which regulates the trade of species that may be threatened (DFO 2008b). Therefore, abundance of harbor porpoise was ranked as "high concern".

**Factor 2.3 - Fishing Mortality****Maritimes North Atlantic, Gillnet, Bottom****Newfoundland and Labrador North Atlantic, Gillnet, Bottom****1.00 High Concern**

The most important threat to the harbor porpoise population in eastern Canada is bycatch in fishing gear, particularly gillnet gear that targets groundfish, like white hake (COSEWIC 2006). However, since the 1990's the threat has decreased due to the depletion of groundfish species and the subsequent reduction in fishing effort (COSEWIC 2006). In the Bay of Fundy/Gulf of Maine (Maritimes region), harbor porpoise bycatch in the groundfish gillnet fishery has been reduced from the thousands to a few hundred (COSWEIC 2006). In 1996, a Harbor Porpoise Conservation Strategy was developed to limit the annual bycatch to 110 porpoises. Time-area closures have also been implemented to reduce porpoise

bycatch, and other measures such as, the use of acoustic deterrents or modified gear are being investigated (DFO 2008b). Acoustic deterrents are used in the US gillnet fisheries in the Gulf of Maine. In the Newfoundland and Labrador region, bycatch of harbor porpoises has declined, likely due to reduced fishing effort, but a few thousand harbor porpoises may still be caught in the region. In 2002, it was estimated that 1,500-3,000 harbor porpoises were caught in the nearshore gillnet cod fishery (COSWEIC 2006). Fewer management measures have been implemented in the Newfoundland and Labrador region to reduce harbor porpoise bycatch and there remains considerable uncertainty about the total magnitude of harbor porpoises caught in the region (COSWEIC 2006). Because groundfish gillnet fisheries remain a significant potential threat to harbor porpoises and all available management measures to reduce harbor porpoise bycatch are not being used, we have ranked fishing mortality as "high concern".

## **NORTH ATLANTIC RIGHT WHALE**

### **Factor 2.1 - Inherent Vulnerability**

**Maritimes North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

#### **High Vulnerability**

The North Atlantic right whale is considered to have a "high" inherent vulnerability to fishing.

### **Factor 2.2 – Abundance**

**Maritimes North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**1.00 Very High Concern**

The North Atlantic right whale was considered "endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1980. The status of the species has been re-examined in 1985, 1990, and 2003 and has remained "endangered". The species is also listed as "endangered" under Canada's Species At Risk Act (SARA). The estimated population size is 322 whales and the mean time to extinction was estimated to be 208 years (COSEWIC 2003a). For these reasons, abundance was ranked "very high concern".

### **Factor 2.3 - Fishing Mortality**

**Maritimes North Atlantic, Gillnet, Bottom**

**Newfoundland and Labrador North Atlantic, Gillnet, Bottom**

**2.33 Moderate Concern**

Commercial whaling for the North Atlantic right whale has been illegal since the 1930's, and this species is protected under Canada's Species At Risk Act. Despite being legally protected, ship strikes and entanglement of fishing gear is an immediate threat to the recovery of the population (COSEWIC 2003a). Between 1970 and 2007, of the 75 document whale deaths, 11% were traced to entanglements, 37% to

ship strikes, 28% to unknown causes, and 24% to neonatal mortality (Environment Canada 2010). Actual total deaths due to human activities are unknown, but are almost certainly greater than the amount observed. Entanglements often cannot be identified to a specific fishery, but fixed gears, like gillnets and pot gear, are thought to account for most entanglements (Environment Canada 2010). Because of the very low population size of this species, any human-caused mortality is harmful. Management strategies have been set in place to reduce fishing mortality and ship strikes of the North Atlantic right whale in Canadian waters. A recovery strategy has been developed and critical habitats have been designated to reduce vessel traffic in those areas (DFO 2010c). Training on disentanglements has also been provided to fishery officers by the Department of Fisheries and Oceans Canada (DFO) (DFO 2010c). Since the North Atlantic right whale is "endangered" but management efforts are in place to reduce its mortality from fishing, this factor was rated "moderate concern".

## **SILVER HAKE**

### **Factor 2.1 - Inherent Vulnerability**

#### **Maritimes North Atlantic, Trawl, Bottom**

##### **Medium Vulnerability**

The FishBase vulnerability score for silver hake is 54 out of 100, which indicates that this species has a moderate inherent vulnerability to fishing (Froese and Pauly 2013). Silver hake can live up to 12 years old and grow to a length of 76 cm (DFO 2013m). They reach sexual maturity at around 2 years old and a length of 23 cm (DFO 2013m). Silver hake move to shallow waters to spawn from July to September. They are broadcast spawners, with each female capable of releasing up to three batches of eggs in a single spawning period (NOAA 2006). Silver hake typically prey on fish (80%), crustaceans (10.2%), and squid (9.2%) (Lock and Packer 2004). Young silver hake prey mostly on krill while the food of adult silver hake consists mostly of fishes, including smaller silver hake (DFO 2010d). They are preyed on by monkfish, pollock, Atlantic halibut, cod, and seals (DFO 2013m).

### **Factor 2.2 – Abundance**

#### **Maritimes North Atlantic, Trawl, Bottom**

**5.00**

##### **Very Low Concern**

The last population assessment of silver hake in the Maritimes region was completed in 2012. Based on surveys, the abundance of silver hake has increased to levels observed in the 1980's. According to the 2012 assessment the current abundance of silver hake (120,000 t) is well above the target level, the biomass at maximum sustainable yield (BMSY = 59,000 t). Abundance of silver hake can be highly variable from year to year because of varying annual recruitment (amount of new fish entering the population). Abundance is projected to decline in 2013 and 2014, but at current catch levels there is a very low probability (<15%) of abundance falling below 80% of BMSY, which is considered the upper

abundance reference point (DFO 2013m). The abundance of silver hake has been above the upper abundance reference point since 1993, with the exception of a few years in the early 2000's. Since the current abundance of silver hake is above the target level, we have rated this factor "very low concern".

### Factor 2.3 - Fishing Mortality

#### Maritimes North Atlantic, Trawl, Bottom

**5.00**      **Very Low Concern**

Since 2003, there has been a total allowable catch limit (TAC) for silver hake in the Maritimes region of 15,000 t, but actual catches have been lower, averaging 11,100 t (DFO 2013m). According to the 2012 assessment of silver hake, fishing mortality on silver hake is currently well below the fishing mortality at maximum sustainable yield (FMSY) and has been below FMSY since 1993 (DFO 2013m). Since it is highly likely that fishing mortality is below a sustainable level this factor is deemed "very low concern".

## SPINY DOGFISH

### Factor 2.1 - Inherent Vulnerability

#### Maritimes North Atlantic, Gillnet, Bottom

#### Maritimes North Atlantic, Longline, Bottom

#### Maritimes North Atlantic, Trawl, Bottom

#### High Vulnerability

The FishBase vulnerability score for spiny dogfish is 69, which indicates it has a high inherent vulnerability to fishing. Spiny dogfish have internal fertilization and a gestation period of 18-24 months. They give birth to an average of 6 pups. In the Atlantic, 50 percent of females mature at age 16 and a length of 82 cm; males mature at 63.6 cm and 10 years of age (COSEWIC 2010b). The lifespan of a spiny dogfish is 31 years (DFO 2007). They are a high-level predator species within the food-chain.

### Factor 2.2 – Abundance

#### Maritimes North Atlantic, Gillnet, Bottom

#### Maritimes North Atlantic, Longline, Bottom

#### Maritimes North Atlantic, Trawl, Bottom

**2.00**      **High Concern**

In April 2010, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determined that the spiny dogfish is a species of "special concern". In Canadian waters, spiny dogfish are abundant, but low fecundity, long generation time (23 years), uncertainty regarding abundance of mature females, and demonstrated vulnerability to overfishing in adjacent U.S. waters are causes for concern (COSEWIC 2010b). There are no abundance reference points/ conservation goals for this species. Because spiny dogfish are considered a species of "special concern" and have a high



vulnerability to fishing, we have ranked this factor as "high concern".

### Factor 2.3 - Fishing Mortality

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

#### 2.33 Moderate Concern

Spiny dogfish are caught in both target fisheries and as bycatch in fisheries for groundfish species. Total allowable catches have been established for spiny dogfish in Canadian waters. On the Atlantic coast, the current total allowable catch is 2500 t for fixed gear (e.g. longlines, gillnets) vessels <45 ft in length and there are bycatch caps of 5 t for fixed gear 45'-65 ft in length and 25 t for mobile gear vessels <65 ft (MSC 2013). There are no restrictions on discarding spiny dogfish at sea. It has been estimated that discards contribute to around 24% of the overall fishing mortality for this species. Fishing in Canadian waters does not appear to be having a detectable impact on the spiny dogfish population (COSEWIC 2010b). However, without a formal population assessment it is hard to determine whether fishing levels are sustainable or not. For this reason, the fishing mortality factor is ranked "moderate concern".

## THORNY SKATE

### Factor 2.1 - Inherent Vulnerability

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom

Newfoundland and Labrador North Atlantic, Longline, Bottom

Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### High Vulnerability

The FishBase vulnerability score for thorny skate is 70 out of 100, which indicates thorny skate have a high inherent vulnerability to fishing. The thorny skate can live for 16-20 years and grow upwards of 100 cm. The average age at sexual maturity is 11 years old. They can lay 6-40 eggs per year (COSEWIC 2012b). Within the food chain, they are a high-level predator species.

### Factor 2.2 – Abundance

Maritimes North Atlantic, Gillnet, Bottom

Maritimes North Atlantic, Longline, Bottom

Maritimes North Atlantic, Trawl, Bottom

Newfoundland and Labrador North Atlantic, Gillnet, Bottom

Newfoundland and Labrador North Atlantic, Longline, Bottom

**Newfoundland and Labrador North Atlantic, Trawl, Bottom****2.00 High Concern**

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determined that the thorny skate is a species of "special concern" in May 2012 (COSEWIC 2012b). They are also designated as "vulnerable" globally on the International Union for the Conservation of Nature Red List of Threatened Species. The latest population assessment for thorny skate in the Newfoundland and Labrador region was completed in 2012. Abundance of thorny skate declined in the 1980s and has remained stable at low levels from 1996-2012 (Simpson et al. 2012b)(DFO 2013c). There are no abundance conservation targets/goals for thorny skate in Canadian waters. Because this species has a high vulnerability to fishing and is considered a species of "special concern", abundance was deemed a "high concern".

**Factor 2.3 - Fishing Mortality****Maritimes North Atlantic, Gillnet, Bottom****Maritimes North Atlantic, Longline, Bottom****Maritimes North Atlantic, Trawl, Bottom****Newfoundland and Labrador North Atlantic, Gillnet, Bottom****Newfoundland and Labrador North Atlantic, Longline, Bottom****Newfoundland and Labrador North Atlantic, Trawl, Bottom****2.33 Moderate Concern**

Currently the only directed fishery for thorny skate is on the Grand Banks in the Newfoundland and Labrador region. This fishery is managed under a catch limit by the Northwest Atlantic Fisheries Organization (NAFO) and the Department of Fisheries and Oceans Canada (DFO). A mixed fishery for thorny skate and winter skate on the eastern Scotian Shelf (Maritimes region) is currently under moratorium. Thorny skate are also taken as bycatch in trawl, gillnet, and longline groundfish fisheries throughout their range. Catches in Canadian waters have declined since the mid-1990's (COSEWIC 2012b)

Relative fishing mortality (catch/relative biomass) for thorny skate in Newfoundland and Labrador Shelf area has remained at approximately 10% since 1985 (COSEWIC 2012b). In the 3Ps division, relative fishing mortality has typically remained below 5% since 1985. In Div. 3LNO, fishing mortality has been decreasing. Relative fishing mortality peaked at 29% in 1997, then decreased to approximately 17% from 1998-2004, and since 2005 has averaged 6% annually (Simpson et al. 2012b).

No estimate of fishing mortality is available for the Maritimes region, but since 2013 all thorny skates caught must be released (MSC 2013).

Commercial fishery catches likely contribute to the decline in thorny skate, however, no direct link has been shown (COSEWIC 2012b). The fishing mortality factor is deemed a "moderate concern".

## **WINTER SKATE**

### **Factor 2.1 - Inherent Vulnerability**

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

#### **High Vulnerability**

The winter skate has a FishBase vulnerability score of 62 out of 100, which indicates it has a high inherent vulnerability to fishing. Winter skate are slow growing, reaching lengths of 110 cm and living up to 30 years. They reach sexual maturity between the ages of 7 and 13 years and at a length of 50 to 75 cm. Winter skate spawn in late summer/early fall and can lay between 6 and 50 eggs/year (COSEWIC 2005). Within the food chain, they are a high-level predator species.

### **Factor 2.2 – Abundance**

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

**1.00**

#### **Very High Concern**

In 2005, the Western Scotian Shelf population of winter skate was determined to be a species of "special concern" and the Eastern Scotian Shelf population of winter skate was determined to be "threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The abundance of mature individuals on the Eastern Scotian Shelf is estimated to have declined by more than 90% since the early 1970's and is now at a historically low level (COSEWIC 2005). Since the mid-1980's, the area occupied by winter skate appears to have declined significantly. Despite these large abundance declines, the Government of Canada chose not to list this species under the federal Species at Risk Act, primarily due to socioeconomic concerns (Government of Canada 2010). There is no updated information on winter skate abundance. Since the latest scientific information suggests the Eastern Scotian Shelf population is threatened, this factor is deemed "very high concern".

### **Factor 2.3 - Fishing Mortality**

**Maritimes North Atlantic, Gillnet, Bottom**

**Maritimes North Atlantic, Longline, Bottom**

**Maritimes North Atlantic, Trawl, Bottom**

**2.33**

#### **Moderate Concern**

Commercial catches of winter skate are regulated by the Department of Fisheries and Oceans in Canadian waters. There used to be a directed fishery for winter skate in Canada on the eastern Scotian Shelf, but now all winter skate catch is limited to bycatch. There have been no direct studies on the causes of winter skate mortality, however, bycatch in groundfish fisheries and fisheries for invertebrates

is a primary threat in Canadian waters (COSEWIC 2005). The fishing mortality of winter skate as bycatch in groundfish fisheries has been reduced in recent years due to dramatic reductions in fishing effort. Bycatch of winter skate on the eastern Scotian Shelf from 2000-2005 averaged 74 t (DFO 2005e). Slightly more recent estimates of winter skate bycatch estimates indicated that between 2002 and 2006 an estimated 48 t was discarded from the groundfish longline fishery and 281 t were discarded from the groundfish bottom trawl fishery (Gavaris et al. 2010). There have been no recent assessments of winter skate to determine if current fishing levels on winter skate are sustainable or not. Due to a lack of information, the fishing mortality factor is deemed "moderate concern".

## **WITCH FLOUNDER**

### **Factor 2.1 - Inherent Vulnerability**

#### **Newfoundland and Labrador North Atlantic, Trawl, Bottom**

##### **High Vulnerability**

The FishBase vulnerability score for witch flounder is 68 out of 100, which indicates this species has a high inherent vulnerability to fishing (Froese and Pauly 2013). Witch flounder is a long-lived, slow growing species and can live for over 20 years, reaching a maximum length of 78 cm (Froese and Pauly 2013; DFO 2013I). They reach sexual maturity at approximately 30 cm in length and a age of 6 or 7 years for males and females respectively (DFO 2013I)(Kennedy and Steele 1971). Witch Flounder are broadcast spawners and each female can produce over 500,000 eggs during each spawning (Burnett et al. 1992). Spawning usually takes place from March to July in very deep water (500-700m) (DFO 2013I). Witch flounders have small mouths which limits their prey to small animals such as marine worms and small crustaceans and shellfish (DFO 2013I). Within the food chain they are an intermediate species (Froese and Pauly 2013).

### **Factor 2.2 – Abundance**

#### **Newfoundland and Labrador North Atlantic, Trawl, Bottom**

**2.00**

##### **High Concern**

Most catches of witch flounder in the groundfish fisheries occur in Subdivision 3Ps. The last population assessment for witch flounder in this area was completed by the Department of Fisheries and Oceans Canada (DFO) in 2005 (DFO 2005d). There are no abundance targets/goals for this population; however mean abundance during 1996-2005 was estimated to be at about 80% of the abundance during the 1983-1990 period. Abundance appears to have remained relatively stable from 2000 onward (DFO 2005d). In neighboring international waters (Division 3NO), witch flounder is considered depleted (Brodie et al. 2011). Since witch flounder have a high inherent vulnerability to fishing, current abundance levels in Subdivision 3Ps are uncertain, and the species is depleted in other areas in this region, this factor is rated "high concern".

## Factor 2.3 - Fishing Mortality

### Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### 2.33 Moderate Concern

Most catches of witch flounder in the groundfish fisheries occur in Subdivision 3Ps. Since the early 1970's, annual catches of witch flounder in Subdivision 3Ps generally fluctuated between 300 and 1000 t. From 1986-93, catches were relatively stable averaging around 1000 t annually. During the early 2000s, annual catches averaged just over 500 t (DFO 2005d). No fishing mortality targets have been established for this population. The last assessment of this species, in 2005, concluded that considering the apparent stability in distribution, survey abundance and recruitment observed over many years, it is likely that fishing of witch flounder at current levels is not harmful to the population (DFO 2005d). However, no update assessment has been conducted since then. In 2012, the catch of witch flounder was 228 t, well below the established catch limit (DFO 2014a). In neighboring international waters (Divisions 3NO), there has been a fishing moratorium on directed fishing for witch flounder since 1995 (Brodie et al. 2011). This factor is deemed a "moderate concern".

## YELLOWTAIL FLOUNDER

### Factor 2.1 - Inherent Vulnerability

#### Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### Medium Vulnerability

The FishBase vulnerability score for yellowtail flounder is 37 out of 100, which indicates it has a medium inherent vulnerability to fishing (Froese and Pauly 2013). Yellowtail flounder can live up to 12 years old and grow to a length of 60 cm. They reach sexual maturity between 4 and 6 years of age and at a length of around 30cm. Spawning occurs on or near the sea floor from May-July. Females release 350,000-4,570,000 eggs in batches and they are fertilized externally by the males. The fertilized eggs float to the surface layers where they drift during development (DFO 2009b). Yellowtail flounder prey on polychaete worms and amphipods and are preyed upon by skates, monkfish, bluefish, Atlantic halibut, fourspot flounder, cod, spiny dogfish, and grey seals (DFO 2009b). Within the food chain, they are an intermediate species (Froese and Pauly 2013).

### Factor 2.2 – Abundance

#### Newfoundland and Labrador North Atlantic, Trawl, Bottom

#### 5.00 Very Low Concern

The Newfoundland and Labrador yellowtail flounder population was last assessed by the Northwest Atlantic Fisheries Organization (NAFO) in 2011. Abundance surveys show an increase in abundance of yellowtail flounder since the moratorium on directed fishing was declared in 1994. The 2007 and 2008 Canadian survey abundance estimates were the highest in the series (Parsons et al. 2011). Yellowtail

flounder abundance is estimated to be high and above the biomass at maximum sustainable yield (BMSY) (Parsons et al. 2011). Therefore, abundance is deemed "very low concern".

### Factor 2.3 - Fishing Mortality

#### Newfoundland and Labrador North Atlantic, Trawl, Bottom

**5.00**      **Very Low Concern**

Yellowtail flounder in the Newfoundland and Labrador region have been under total allowable catch (TAC) regulation since 1973. The current TAC is set at 17,000t (Parsons et al. 2013). Current fishing mortality is estimated to be less than the fishing mortality at maximum sustainable yield (FMSY), indicating fishing levels are sustainable (Parsons et al. 2011) (Parsons et al. 2013). Therefore, this factor is deemed "very low concern."