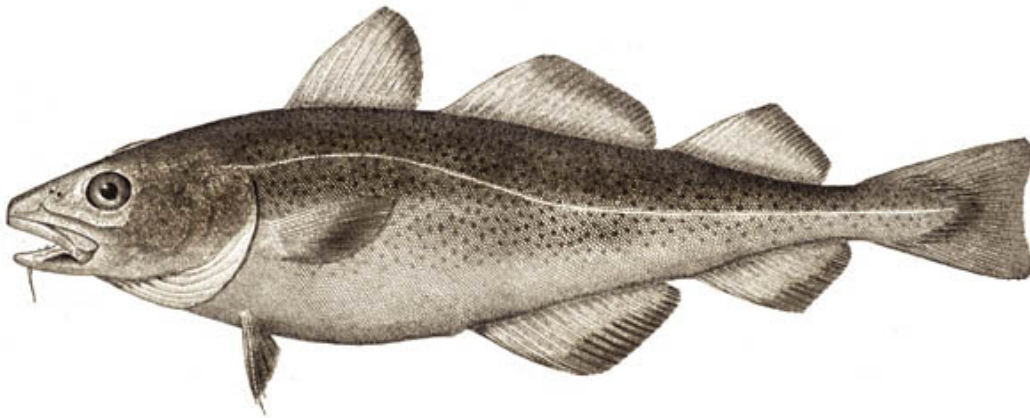




Atlantic cod

Gadus morhua



2J3KL (Northern stock)

Newfoundland and Labrador, Canada

Handline and bottom gillnet

January 2018

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Disclaimer: Ocean Wise® strives to have all assessments reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science and aquaculture. Scientific review, however, does not constitute an endorsement of the Ocean Wise seafood program or its recommendations on the part of the reviewing scientists. Ocean Wise is solely responsible for the conclusions reached in this report.

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About Ocean Wise Seafood

The Ocean Wise® seafood program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the Canadian marketplace. Ocean Wise 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. Ocean Wise makes its science-based recommendations available to the public in the form of reports that are available to view on our mobile app and download from www.ocean.org/seafood. Ocean Wise also works directly with restaurants, markets, and seafood suppliers to ensure they have the most up to date scientific information regarding sustainable seafood. The options are highlighted on their menus and display cases with the Ocean Wise symbol, making it easier for consumers to make informed seafood choices.

Sustainability recommendations are supported by assessments that synthesise and analyse the most current ecological, fisheries and ecosystem science on a species, then evaluate this information against the programs conservation ethic to arrive at a recommendation. In producing the assessments, Ocean Wise 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. Ocean Wise Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, 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, Ocean Wise' sustainability recommendations and the underlying assessments will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Ocean Wise assessments in any way they find useful.

Recommendation Policy

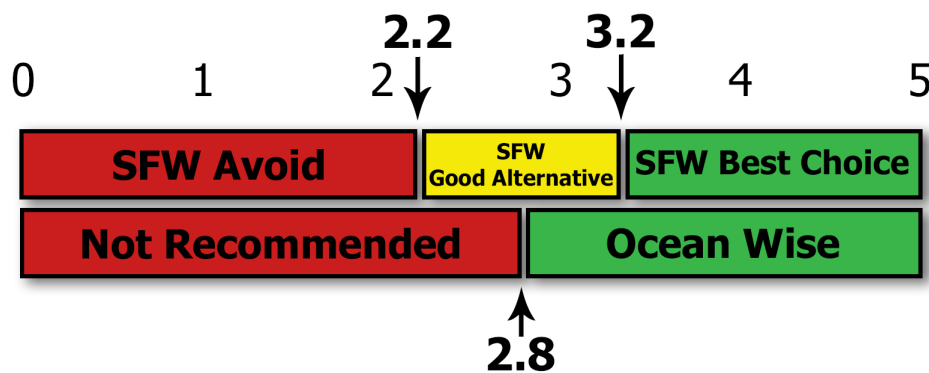
Ocean Wise recommendations are generated from assessments using the Monterey Bay Aquarium's Seafood Watch (SFW) program methodology. Following the [Seafood Watch Standard for Fisheries](#), each assessment synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic and four criteria:

1. Impacts of the fishery on the stock in question
2. Impacts of the fishery on other species
3. Effectiveness of management
4. Impacts on habitat and ecosystem

Unlike the Seafood Watch three-tiered traffic light system of Red, Yellow, Green, Ocean Wise Seafood's classification system is based on two categories: sustainable (Ocean Wise Recommended) or unsustainable (Not Recommended).

Using the Seafood Watch Standard for wild capture fisheries, Ocean Wise requires that fisheries score ≥ 2.8 (out of 5) and no more than 1 criterion scoring ≤ 2.2 to be recommended.



A comparison between the Seafood Watch and Ocean Wise scoring is depicted in the figure below:



Full Ocean Wise Recommendation Policy can be found here. <http://seafood.ocean.org/seafood-guide/how-we-grade/>

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

Table of Conservation Concerns and Overall Recommendations

Stock/fishery	Impacts on the stock	Impacts on other spp.	Management	Habitat and Ecosystem	Overall Seafood Watch score	Ocean Wise recommendation 
Atlantic cod (2J3KL) – handline	Yellow 2.236	Green 5.0	Yellow 3.0	Green 3.873	Good alternative 3.376	
Atlantic cod (2J3KL) - gillnet	Yellow 2.236	Red 1.0	Red 2.0	Yellow 3.0	Avoid 1.914	Not recommended

Summary

This report uses the [Seafood Watch Standard for Fisheries](#) (v. 3.2) to assess the sustainability of the Atlantic cod (*Gadus morhua*) bottom gillnet and handline small-scale (a.k.a. 'stewardship') fisheries operating in the NAFO 2J3KL region; landings from these fisheries currently represent about 40% of the cod landed in Newfoundland and Labrador.

Atlantic cod is one of the most iconic fish in the world and the fishery for this species has a long, complex (and, at times, highly contentious) history in Canada. Fished since the late 1400s, landings reached a high of 800,000 t in 1968. Only a decade later, however, landings had declined by over 80% and, in the early 1990s, Canada's cod collapsed. This collapse is attributed to a decline in environmentally-favourable conditions for cod, as well as overfishing and the associated shortcomings of the domestic management body, Fisheries and Oceans Canada (DFO), which did not effectively curtail fishing effort or implement a proactive harvest strategy in the face of declining catches.

Following the collapse, a moratorium was put on cod in 1992 but for the 2J3KL stock, an inshore stewardship fishery has been permitted to operate since 2007. While spawning stock biomass has increased substantially in recent years, it is still only 34% of B_{lim} , and thus population biomass remains in the 'critical' zone, in accordance with the Canadian precautionary approach framework for fisheries developed as part of guidance on stock rebuilding. At the same time, fishing mortality is estimated to be very low at present (i.e., 0.014 for cod aged 5-14) and is not preventing the stock from recovering.

Handlining is an active fishing gear and when the hooks used are size specific to the target species, it can be highly selective. Negligible bycatch occurs with this gear in the 2J3KL cod fishery. Conversely, studies have shown that substantial numbers of small cetaceans, pinnipeds, leatherback turtles and marine birds die from entanglement in bottom gillnets, and that this gear has a noticeable impact on the population health of some avian species.

The management of the stewardship fishery is the responsibility of Fisheries and Oceans Canada (DFO). Several objectives for stock rebuilding are outlined in a Maritime-wide cod recovery plan and an additional plan specific to 2J3KL is currently in development. Overall, the stock appears to be recovering slowly, however long-term precaution by management is warranted to ensure this can happen. With regard to bycatch, DFO also lacks a protocol or strategy for protecting marine wildlife vulnerable to entanglements.

Handlines have a minimal impact on bottom structure, but bottom gillnets come into direct contact with the sea floor and may encounter sensitive bottom habitat in this region. Currently, some spatial protection exists in the 2J3KL region to protect sensitive areas and this is part of a larger national plan to protect 10% of Canadian waters by 2020.

Introduction

1) Scope of the analysis and ensuing recommendation

This report assesses the sustainability of the small-scale Atlantic cod (*Gadus morhua*) bottom gillnet and handline fisheries operating off Newfoundland and Labrador in the NAFO 2J3KL region (also referred to synonymously as the 'northern stock'). Over 75% of cod fishing here is undertaken using bottom gillnets and 18% with handlines. Some fishing for cod also occurs using traps (aka. pots) as well as trawl gears and longlines but landings from these gear types are currently small (~5% collectively) and are not covered in this assessment. In 2015, landings from the 2J3KL fishery represented about 40% of the cod landed in Newfoundland and Labrador region (Rouxel 2017); the proportion is likely higher for recent years given increased catches.

2) Overview of the species

With a body shape similar to haddock or pollock, Atlantic cod are often mottled olive green or yellow-brown in colour, have a white lateral line, and a distinctive barbell (hair-like projection) on their chin (Cohen et al. 1990). A demersal gadid, this species inhabits the colder (0-5 °C) coastal and offshore waters of the Arctic and north Atlantic Oceans (COSEWIC 2010); in the western Atlantic, its range extends from Ungava Bay north of Quebec, Canada southward along the North American coast to Cape Hatteras, North Carolina, U.S. Atlantic cod are also found in the waters off Greenland and Iceland and, in the eastern Atlantic from the Barents Sea northward along the coast to Bay of Biscay and southward to the coast of Brittany, France (Kaschner et al. 2016). Cod of the 2J3KL stock complex inhabit an area of roughly 400,000 km² from the Grand to Hamilton Banks (Fig 1).

Cod are broadcast spawners, yet research has shown complex mating interactions and behaviours including non-random mate selection by females and competition among males for access to females during spawning times (Hutchings et al 1999). As a result of over-exploitation, all cod stocks on the Atlantic coast of Canada have phenotypic and genetic changes to life history traits, including a lower age at maturity (Hutchings 2004). The present age at maturity for northern cod (6 years) is now slightly younger than in the 1980s. Although these cod grow faster, this decrease in age at maturity is also reflected in a smaller size at maturity, which has negative implications for fecundity and, by extension, stock recruitment and population growth.

Prior to the 1990s, much of the 2J3KL stock was highly migratory, with individuals spending winter farther offshore near the continental shelf before returning to near-shore waters and the plateau of the Grand Bank in the summer months (DFO 2013). During the mid-2000s, this migration pattern became less apparent, and tagging studies have shown that some parts of the northern stock undergo extensive migrations and intermingle with other stocks (such as 3Ps off southern Newfoundland), while others migrate along the coast or do not migrate at all (DFO 2016c). Research on the distribution and movement of cod is ongoing.

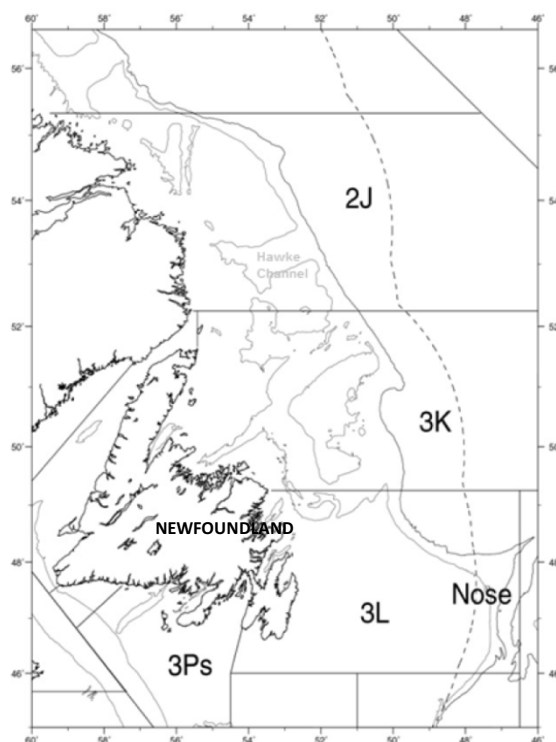


Figure 1. Stock area of northern cod (2J3KL). The dashed line indicates Canada's 200 nautical mile Exclusive Economic Zone (EEZ). Source: DFO 2016c.

Historically, the most important food source for northern cod was capelin, although at differing life stages they also feed on other fish and shellfish species including herring, flounder, shrimp, and crab (DFO 2013, DFO 2015); stomach content analyses suggest cod eat a wide array of other species and are not overly discerning predators (COSEWIC 2010). Nowadays, it is believed that northern shrimp are also a key prey source for cod as the proportion of this species in the diet of Atlantic cod has increased since the 1990s (Simms 2017). As DFO (2016) explains, “during the 1985-2007 period, capelin availability was found to be a significant driver of Northern cod biomass dynamics and the trends in cod, capelin, and cod diet composition in recent years further support the importance of capelin availability in cod rebuilding.” There has been no stock assessment for capelin since early 2015 but DFO suggests capelin are at their lowest numbers in five years (Kinsella 2017).

3) History and management of the fishery

Atlantic cod is one of the most iconic fish in the world and the fishery for this species has a long, complex (and, at times, highly contentious) history in Canada. Recorded evidence of the size of the cod population in Maritime waters dates back to the 1497, when John Cabot first reached North American waters. The subsequent establishment of European settlements by colonists in

Newfoundland is largely attributable to this resource and even in the late 1800s the fish remained so abundant that the famous French novelist Alexandre Dumas posited, “that if no accident prevented the hatching of the eggs and each egg reached maturity, it would take only three years to fill the sea so that you could walk across the Atlantic dryshod on the backs of cod” (Pringle 1997). Although some hyperbole may have been injected into the population size of these fish, written and photographic evidence from the 18th and 19th century suggests they were indeed one of the world’s greatest natural resources and the spawning stock was estimated at 2.5 million fish as recently as the 1960s (COSEWIC 2010).

As technological enhancements improved the efficiency of commercial fisheries, the catch remained substantial through the 1960s and reached a high of 800,000 t in 1968 (DFO 2016c; Fig 2a). Only a decade later, however, landings had declined by over 80% and, in the early 1990s, Canada’s cod collapsed. This collapse is largely attributed to overfishing and the associated shortcomings of the domestic management body, Fisheries and Oceans Canada (DFO), which did not effectively curtail fishing effort or implement a proactive harvest strategy in the face of declining catches and stock health (Hutchings and Myers 1994; Myers et al. 1997; Hutchings and Reynolds 2004; COSEWIC 2010). As detailed in *Northern Cod: a Failure of Canadian Fisheries Management* (Wappel 2005), the Canadian House of Commons Standing Committee on Fisheries and Oceans Canada following a study on Northern Cod in 2017, concluded that that, although DFO failed to act responsibly, at the same time, it was “often under pressure from fishermen, coastal communities, unions, and politicians to provide opportunities” (Simms 2017). In addition, changes in the ecosystem—notably shifts in capelin availability during the 1980s—as well as climate related water temperature changes likely also played a role (Rose 2004). A recently-developed stock assessment model specific to northern cod (NCAM) attributes stock decline more to natural factors more than fishing, although this is controversial (DFO 2016b).

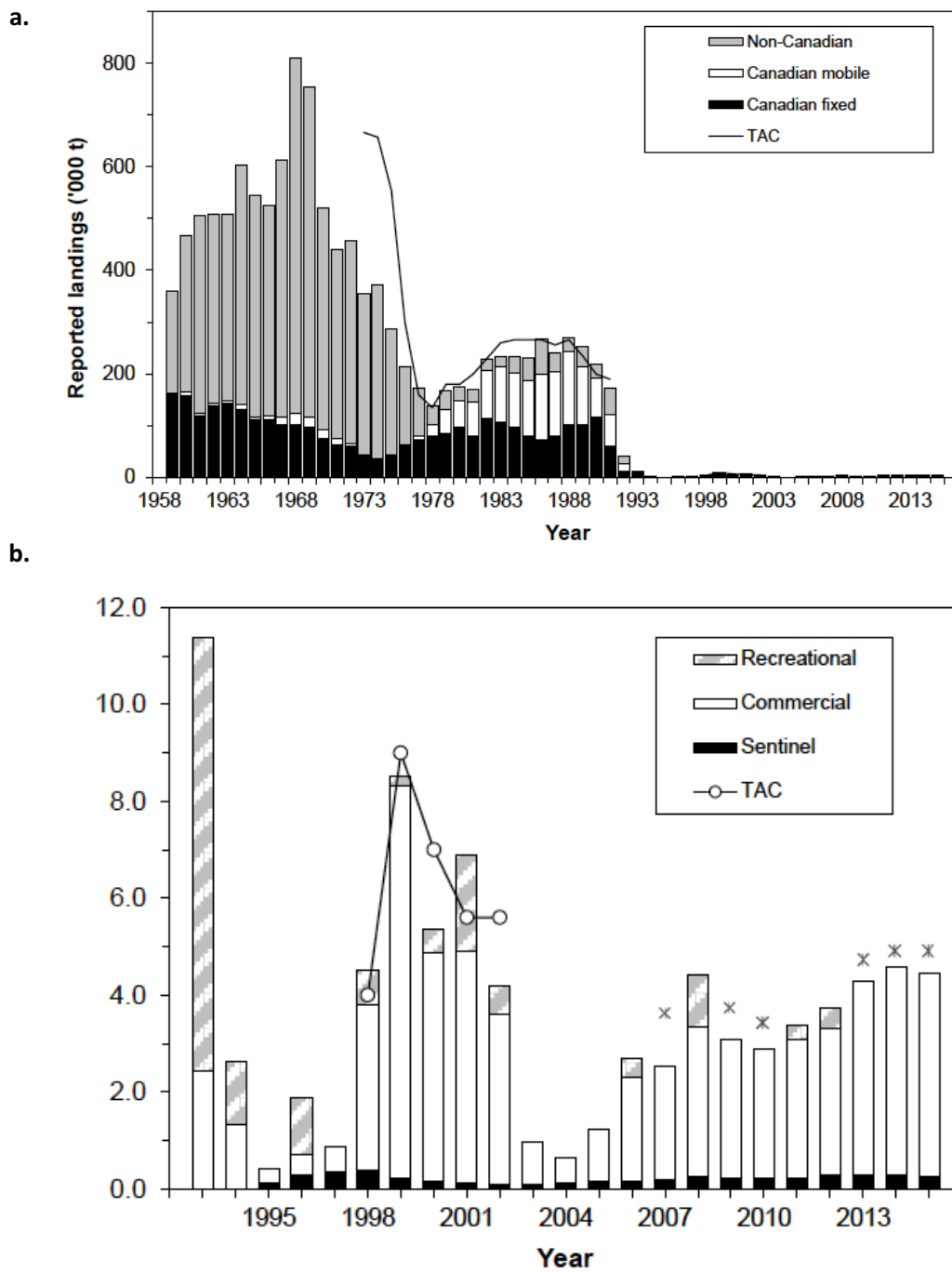


Figure 2. a) Total Allowable Catches (TACs) and landings (thousands of tonnes) from 1959-2015 and b) from 1993-2015. Asterisks indicate that recreational catches in 2007, 2009-10, and 2013-15 were not directly estimated. (From DFO 2016c).

Within Canadian waters, cod continues to be managed by DFO both at the federal level (through the *Fisheries Act* and *Oceans Act*) and regionally (the 2J3KL stock falls under the jurisdiction of the Newfoundland and Labrador Region). Following the collapse, a moratorium was put on cod in 1992, which has prevented any offshore industrial-scale commercial fishing; scientific research and monitoring is ongoing (DFO 2016c). For the 2J3KL stock, an inshore small-scale fishery has been permitted to operate since 2007. Based on information provided by DFO, roughly 30,000 fishers are involved in the fishery and the division of effort is roughly 77% bottom gillnet, 18% handline, and 5% other (pots, trawls, and longlines); the 3K area is the most actively fished (56%), followed by 3L (42%) and 2J (2%) (DFO pers. comm. 2017). Landings from this fishery were around 4,000 t annually between 2013-2015 (DFO 2016c; Fig 2b) and in 2016, the catch from this fishery was 9,875 t (DFO 2017e). Presently, the total amount of cod caught by recreational fisheries is not well known yet tagging data suggests they have amounted to an annual average of 30% of the small-scale fishery landings in the last decade.

Cod is also still often caught as bycatch in other fisheries for demersal species and in the 3KL division, upward of 600 t were inadvertently caught by the winter flounder (*Pseudopleuronectes americanus*) fishery in 2004-05 (DFO 2016c). Outside of the Canadian Exclusive Economic Zone (EEZ), the Scientific Council of the Northwest Atlantic Fisheries Organization (NAFO) has reported annual landings of Atlantic cod ranging from 61 t to 292 t between 2000-2015 (DFO 2016c).

4) Importance to the U.S./North America

Most, if not all, of the 2J3KL catch remains in the North America market. Fish from the handline fishery are almost always sold fresh to restaurants or high-end retailers in eastern Canada, with a very small percentage entering the U.S. market.

5) Common and market names

In North America, the species in this assessment is referred to as Atlantic cod or cod. Often it is also grouped with other demersal species (e.g., haddock, pollock) and sold under the generic term 'whitefish'. It may also be identified by its Spanish name: *bacalao*.

6) Primary Product forms

Like many whitefish, Atlantic cod is typically sold as a fresh or frozen fillet. This species is highly versatile and is a common ingredient in fish and chips as well as soups and chowders. Atlantic cod from other parts of the world (i.e., UK, Europe) is used as a common ingredient in fish sticks and other processed or value-added products.

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Criteria for Fisheries, available at <http://www.seafoodwatch.org>.

Criterion 1: Impact on the Species Under Assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

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

Criterion 1 Summary

Stock/ fishery	1.1 Stock status	1.2 Fishing mortality	Subscore
Atlantic cod (2J3KL) – handline	1.0 (High concern)	5.0 (Low concern)	2.236 (Moderate concern)
Atlantic cod (2J3KL) - gillnet	1.0 (High concern)	5.0 (Low concern)	2.236 (Moderate concern)

Criterion 1 Assessment

Factor 1.1 Abundance

Scoring Guidelines

- *5 (Very Low Concern)—Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern)—Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) —Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern)—Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

ATLANTIC COD (2J3KL) – HANDLINE AND GILLNET

Key relevant info: The most recent full stock assessment for 2J3KL Atlantic cod estimated spawning stock biomass (SSB) at 300,000 t in 2015 (DFO 2016c). While SSB has increased substantially in recent years, it is still only 34% of B_{lim} , the defined Limit Reference Point (LRP). As such, population biomass remains in the 'critical' zone for this stock. Furthermore, due to population collapse in the early 1990s, the 2J3KL cod stock (along with other stocks in Canada) was listed as 'Endangered' by the Committee on the Status of Endangered Wildlife in Canada in 2010 (COSEWIC 2010). For these reasons, it receives a score of 'high concern' for this criterion.

Detailed rationale: Unfavorable environmental conditions and overfishing (by both foreign and domestic fleets) resulted in the collapse of the northern cod stock (along with the other cod stocks of Atlantic Canada) in 1992. The 2J3KL population biomass is believed to have declined by 99% relative to the 1960s; for this main reason, it was listed as an 'Endangered' species in Canada (COSEWIC 2010). A moratorium on industrial-scale commercial fishing since the collapse has limited the amount of fish caught and, over the last decade, the stock has shown signs of slowly rebuilding (Fig 3). A Limit Reference Point (B_{lim}) of 900,000 t (which refers to the average SSB during the 1980s) was set in 2010 (Simms 2017). Overall abundance has been increasing (i.e., from 3% of B_{lim} in 2005 to 34% in 2015) and there appears to be an increase in larger, older fish (Simms 2017; DFO 2016c). Still, no other stock target or reference points have

been defined for biomass and although current signs are encouraging, these levels show that “the stock is considered to have suffered serious harm and the ability to produce good recruitment is seriously impaired” (DFO 2016c).

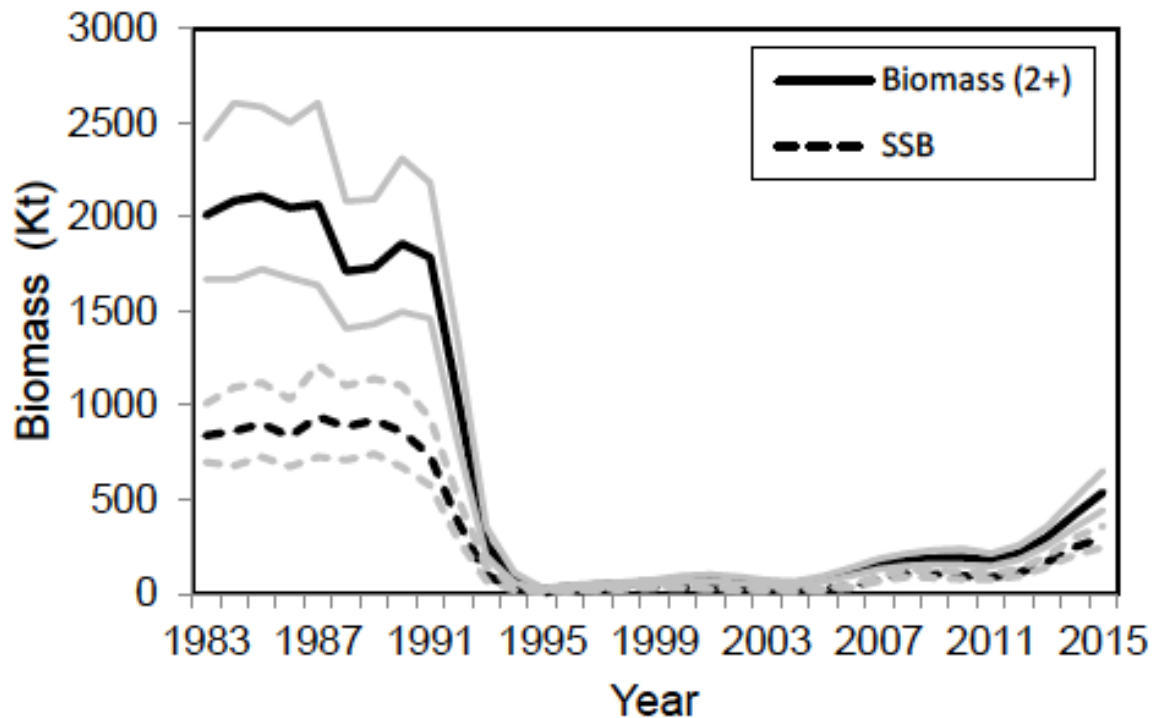


Figure 3. Abundance of 2J3KL Atlantic cod over time. Following stock collapse in 1992, biomass has been slowly increasing since the early 2000s and, for 2015, the stock was at 34% of the LMR. Source: DFO 2016c.

Factor 1.2 Fishing mortality

Scoring Guidelines

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern)— Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern)—Probable that fishing mortality from all source is above a sustainable level.*

FACTOR 1.2 – Fishing mortality

Key relevant info: No target reference points (i.e., F_{MSY}) currently exist for this stock but fishing mortality for the 2J3KL stock in 2015 was estimated at 0.014 for cod aged 5-14, which represents < 5% of total mortality for mature adults. This value was based on an estimated total

catch of 6,900 t in 2015 (reported and estimated landings). Overall, the exploitation rate is very low at present and is not preventing the stock from recovering. As such, this criterion receives a score of ‘low concern’.

Detailed rationale: Prior to the collapse of the stock, fishing mortality was fluctuating around 0.20 for age 5-14 year old fish and around 0.40 for 7-9 year olds (Fig 4). As DFO (2016) explains, “directed inshore fisheries for cod have continued throughout most of the post-moratorium period. Fishing mortality (ages 5-14) was low (0.05) during 1995-97 when inshore fishing was highly restricted, but increased rapidly reaching close to pre-moratorium values ($F=0.15$ to 0.20) when a directed inshore fishery for cod was reopened in 1998-2002. Closure of the directed inshore fishery in 2003-2005 resulted in a substantial reduction in F to 0.04 . More recently, F has been low and declined further, from 0.04 in 2006 to 0.01 in 2015 in spite of increased inshore catches during the ongoing directed inshore commercial and recreational fisheries”.

Although the current stock assessment model accounts for commercial landings, recreational catch has been highly uncertain in recent years and direct estimates are unavailable for 2006, 2008, 2013-15. The total catch in 2016 (all sources) was 13,500 t, with roughly 15% of this coming from recreational sources; recreational landings averaged 30% between 2006-2015 (DFO 2015c). Despite the total increase in landings from 2015 to 2016 there is a very low risk (< 4%) of SSB declining below the 2015 level when stock projections to 2018 were performed with catches ranging from zero to five times the 2015 catch (Table 1; DFO 2016c).

Table 1. Results of the three-year projections for catch multipliers from 0 (no catch) to 5 times the estimated catch in 2015. Source: DFO 2016c.

Projections	Catch Multiplier 0	Catch Multiplier 1	Catch Multiplier 2	Catch Multiplier 3	Catch Multiplier 4	Catch Multiplier 5
Risk (in %) of SSB declining below 2015 value	1.0	1.3	1.7	2.1	2.6	3.3
Probability (in %) of exceeding B_{lim} in 2018	7.9	7.1	6.5	5.9	5.3	4.8
SSB in 2018 relative to B_{lim}	0.66	0.65	0.64	0.62	0.61	0.60

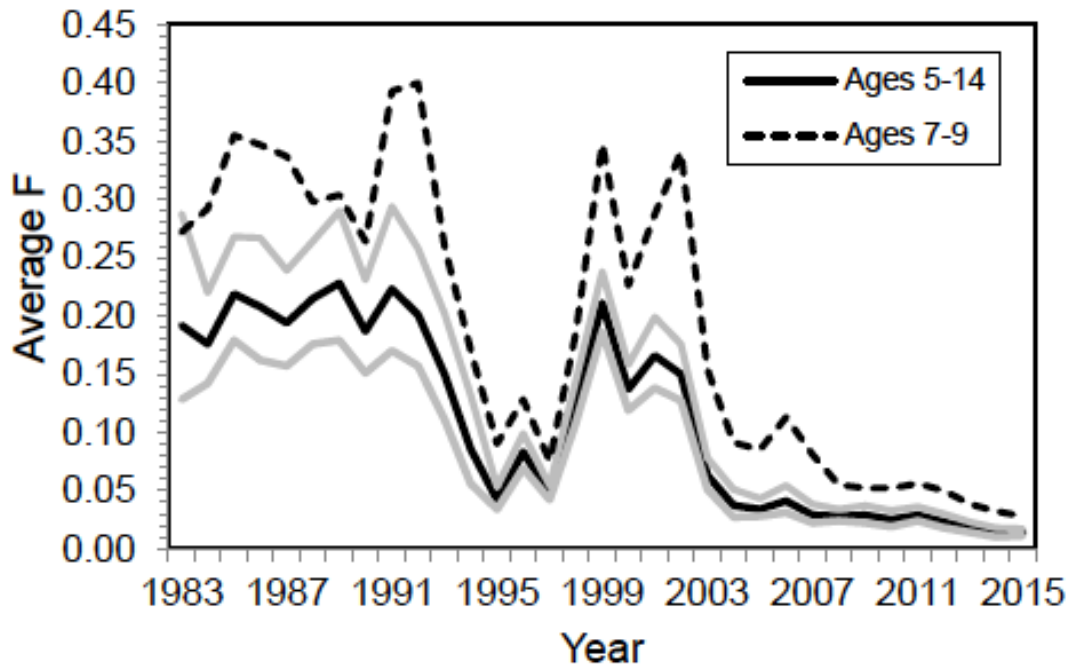


Figure 4. Fishing mortality of 2J3KL Atlantic cod (by age) over time. Source: DFO 2016c.

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch® defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

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

Criterion 2 Summary

Handlining is an active fishing gear and when the hooks used are size specific to the target species, it can be highly selective. Almost no bycatch occurs with this gear in the 2J3KL cod fishery. The only reported bycatch was a mako shark in 2016 (DFO pers. comm. 2017), although a porbeagle shark was accidentally hooked that year as well (Bird 2016). The incidental catch of one short-horned sculpin during a recent study was observed (Rouxel 2017) but based on the available information, there are no species that meet the criteria for inclusion in Criterion 2.

Depending on mesh size and where/when they are deployed, bottom gillnets can pose a substantial risk to other marine life. The mesh size used in the 2J3KL gillnet fishery must be no less than 5.5 in (14 cm) and no greater than 6.5 in (16.5 cm) (DFO 2017b). As a passive gear, DFO (2017b) states that gillnets may be left for up to 30 hours, and they are less discriminatory than most gears when it comes to the species they ensnare. Unlike handlines, there is a high incidence of mortality from drowning, entanglement, and/or suffocation and most bycatch cannot be released alive.

Fisher logbooks in the gillnet fishery report a variety of incidentally caught species in the 2J3KL gillnet fishery between 2012-2016: American plaice, Greenland halibut, Atlantic herring, mackerel, redfish, yellowtail flounder, greysole, skate, squid, pollock, hake, monkfish, winter flounder, spider crab and sculpin (DFO pers. comm. 2017). From these data, Greenland halibut accounts for 90% of all reported bycatch but based on logbook information total bycatch in the gillnet fishery averaged only 18 t annually (< 1% of the total catch) between 2012-2016. This low bycatch rate is similar to that amount of discards reported by the Greenland halibut bottom gillnet fishery (Fuller 2008). Although this

information pertains mostly to fish species, a recent study suggests a high encounter rate (i.e., observed in 67% of tests) of benthic invertebrates (i.e., green sea urchin, sea scallop, blue mussel, northern and basket sea stars) in the gillnet fishery as well (Rouxel 2017).

The findings of several studies over the last decade suggest that DFO records are incomplete when it comes to recording the bycatch of the gillnet fisheries, especially incidentally trapped seabirds and marine mammals. Substantial numbers of small cetaceans, pinnipeds, and marine birds die from entanglement (Benjamins et al. 2007, 2008; Zydels et al. 2013), and that this gear has a noticeable impact on the population health of some avian species (Regular et al. 2013). Leatherback turtles also spend the summer months off the coast of Newfoundland and Labrador and are prone to entanglement in gillnet gears (Whale Release and Strandings, n.d.; O’Boyle 2012). Although incidental catch of these species as a percentage of the total catch could not be calculated based on volume, the high incidence of interaction and mortality justifies their inclusion in Criterion 2 for the gillnet fishery.

The Unknown Bycatch Matrices (UBMs) were used according to the Seafood Watch Standard to identify the susceptibility of the different identified species (and groups) to bottom gillnet gears and, if inclusion was justified (i.e., ≤ 3.5), scored accordingly. The lowest scoring species and driver of the Criterion 2 score are the seabirds and leatherback turtle.

ATLANTIC COD (2J3KL) – HANDLINE

Species	2.1 Stock status	2.2 Fishing mortality	2.3 Modifying factor	Subscore
No significant bycatch	-	-	1.0	5.0

FACTOR 2.1 – Abundance

Key relevant info: No significant bycatch.

FACTOR 2.2—Fishing mortality

Key relevant info: No significant bycatch.

FACTOR 2.3 – Modifying factor: discards and bait use

Key relevant info: In order to attract cod to the line, most fishers use both artificially baited hooks and natural bait (usually squid) (Rouxel 2017). Estimates of bait use are not available for this fishery but it is unlikely that it is substantial relative to total target landings.

Detailed rationale: NA

ATLANTIC COD (2J3KL) – GILLNET

Species	2.1 Stock status	2.2 Fishing mortality	2.3 Modifying factor	Subscore
Seabirds	1.0	1.0	1.0	1.0
Marine mammals	1.0	1.0	1.0	1.0
Leatherback turtle	1.0	1.0	1.0	1.0
Benthic invertebrates	2.33	3.0	1.0	2.644

SEABIRDS

FACTOR 2.1 – Abundance

Key relevant info: Several species of seabirds are incidentally caught by the bottom gillnet fishery and this group receives a susceptibility score of 3 using the Unknown Bycatch Matrix for Northwest Atlantic gillnets. Since seabirds are a highly vulnerable taxa, this criterion scores ‘high concern’.

Detailed rationale: Studies on the Newfoundland cod gillnet fishery report the incidental catch of great shearwaters (*Puffinus gravis*), gannets, double crested cormorants (*Phalacrocorax auritus*), murrelets (*Uria aalge* and *U. lomvia*), and Atlantic puffins (*Fratercula arctica*). Other similar gillnet fisheries in the area report the catch of these species as well as others, including: loons (*Gavia* spp.), northern fulmars (*Fulmarus glacialis*), sooty shearwaters (*Puffinus griseus*), Cory’s shearwaters (*Calonectris diomedea*), common eiders (*Somateria mollissima*), razorbills (*Alca torda*), black guillemots (*Cepphus grylle*) and dovekies (*Alle alle*) (Benjamin et al. 2008). Of the species caught in the cod fishery, the Atlantic puffin has the lowest IUCN rating (‘Vulnerable’). The overall trend of the west Atlantic population is unknown but “populations are suspected to be declining rapidly through the combined impact of predation by invasive species, pollution, food shortages caused by the depletion of fisheries and adult mortality in fishing nets” (BirdLife International 2017).

FACTOR 2.2 – Fishing mortality

Key relevant info: Seabirds receive a susceptibility score of 3 for Northwest Atlantic bottom gillnet fisheries using the Unknown Bycatch Matrix and with no additional information, this would result in a fishing mortality score of ‘moderate concern’. However, due to recent research that shows gillnet fisheries in Atlantic Canada have a demonstrable effect on the abundance of certain bird populations in the area, this criterion has been scored ‘high concern’.

Detailed rationale: Between 2001-2003, an estimated 2,000-7,000 murrens and >2000 shearwaters were trapped in Newfoundland's gillnet fisheries; several other species (see above) were also caught in numbers ranging from tens to hundreds (Benjamins et al. 2008). Another recent study showed that due to decreased bycatch during the large-scale cod fishery closure in the 1990s, the breeding populations of auks and gannets increased from pre-closure levels and that there was "a positive population response of common murrens to reduction in gillnet fishing within its foraging range" (Regular et al. 2013).

MARINE MAMMALS

FACTOR 2.1 – Abundance

Key relevant info: Marine mammals are highly susceptible to interactions with gillnets and trap/pot fisheries in nearly all regions and with trawls and drift longlines in most regions. This taxa receives a susceptibility score of 1 using the Unknown Bycatch Matrix for Northwest Atlantic gillnets. Since marine mammals are a highly vulnerable taxa, this criterion scores 'high concern'.

Detailed rationale: The harbor porpoise (*Phocoena phocoena*) is frequently caught by the nearshore cod bottom gillnet fishery. In the west Atlantic Ocean, an estimated 75,000 harbour porpoises live in the Gulf of Maine/Upper Bay of Fundy and an additional 27,000 live in the Gulf of St. Lawrence. The total global population of this species is estimated at about 700,000 individuals but the overall population trend is unknown (Hammond et al. 2008).

FACTOR 2.2—Fishing mortality

Key relevant info: Marine mammals receive a susceptibility score of 1 for Northwest Atlantic bottom gillnet fisheries using the Unknown Bycatch Matrix and with no additional information, this would result in a fishing mortality score of 'moderate concern'. However, due to the significant and seemingly disproportionate impact of the cod bottom gillnet fishery on mortality of this species, this criterion has been scored 'high concern'.

Detailed rationale: Between 2001-2003, an estimated 4,518 harbour porpoises were caught in Newfoundland gillnet fisheries (mostly for cod) (Benjamins et al 2007). Assuming these porpoises are associated with the St Lawrence population (see above), this suggests an annual observed mortality of roughly 16%. Most of the recorded entanglements occurred during the summer months (July-September), which coincides with the current opening time of the fishery. Although the IUCN does not list this species as threatened globally, it does state that, "the most significant threat in most areas is incidental catches in fishing gear, primarily gillnets" (Hammond et al. 2008). Furthermore, the most recent harbor porpoise assessment by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lists this species as 'Special Concern' in the northwest Atlantic specifically stating that "susceptibility of harbour porpoises to bycatch in fishing gear represents an incipient threat" (COSEWIC 2006).

LEATHERBACK TURTLE

FACTOR 2.1 – Abundance

Key relevant info: The Atlantic population of leatherback turtles (*Dermochelys coriacea*) is listed as ‘Endangered’ under Canada’s Species At Risk Act (SARA 2017). As such, it scores ‘high concern’ for this criterion.

Detailed rationale: There is no direct estimate of stock abundance for leatherback turtles on either coast of Canada. The most recent estimate for the North Atlantic is between 34,000-94,000 adults but current data are insufficient to determine population trends (COSEWIC 2012).

FACTOR 2.2—Fishing mortality

Key relevant info: According to the SFW Unknown Bycatch Matrix, sea turtle susceptibility to northwest Atlantic bottom gillnets is 3, therefore ‘moderate concern’. However, gillnet fisheries in Atlantic Canada have been identified as a main threat to leatherback turtles, which spend the summer months off the coast of Newfoundland and Labrador. For this reason, this criterion has been upgraded to ‘high concern’.

Detailed rationale: Since turtles become entangled at-depth, this gear likely poses a high risk of mortality from these interactions due to drowning. Encounters with groundfish gillnet gear since 1976 represented 44% of all interactions (75) recorded and “this fishery represents a high potential source of interaction, especially off Newfoundland” (O’Boyle 2012). Recorded interactions are dependent on observer data (for which coverage was less than 2% in 3K and 3L during the study period), and logbook information (which may be subject to fisher error or under-reporting). As such, these estimates may be lower than reality.

BENTHIC INVERTEBRATES

FACTOR 2.1 – Abundance

Key relevant info: Benthic invertebrates were included based on a susceptibility score of 3 for bottom gillnet fisheries using the Unknown Bycatch Matrix. None of the species incidentally caught are from highly vulnerable taxa, therefore this criterion scores ‘moderate concern’.

Detailed rationale: Although logbook information only identifies some bycatch of squid (*Illex* spp.) and toad crab (*Hyas araneus* and *H. coarctatus*), a recent study on Newfoundland cod fishery bycatch found benthic invertebrates in 67% of their bottom gillnet sets (Rouxel 2017). Trapped species included toad crab, green sea urchin (*Strongylocentrotus droebachiensis*), sea scallop (*Placopectin magellanicus*), common whelk (*Buccinum undatum*), blue mussel (*Mytilus edulis*), basket star (*Gorgonocephalus eucnemis*), northern sea star (*Asterias vulgaris*), lion’s mane jellyfish (*Cyanea capillata*), moon jellyfish (*Aurelia aurita*), red soft coral (*Gersemia rubiformis*) and northern red anemone (*Urticina felina*).

FACTOR 2.2—Fishing mortality

Key relevant info: Benthic invertebrates were included based on a susceptibility score of 3 for bottom

gillnet fisheries using the Unknown Bycatch Matrix. Therefore, this criterion scores 'moderate concern'.

Detailed rationale: NA

FACTOR 2.3 – Modifying factor: discards and bait use

Key relevant info: This fishery does not use bait and based on logbook information, there were no dead discards between 2012-2016. Due to low observer coverage, this information could not be verified. However, it is unlikely that the amount of dead discards relative to total landings exceeds 100%.

Detailed rationale: NA

Criterion 3: Management Effectiveness

Five subfactors are evaluated: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either ‘highly effective’, ‘moderately effective’, ‘ineffective,’ or ‘critical’. The final criterion 3 score is determined as follows:

- *5 (Very Low Concern)—Meets the standards of ‘highly effective’ for all five subfactors considered.*
- *4 (Low Concern)—Meets the standards of ‘highly effective’ for management strategy and implementation’ and at least ‘moderately effective’ for all other subfactors.*
- *3 (Moderate Concern)—Meets the standards for at least ‘moderately effective’ for all five subfactors.*
- *2 (High Concern)—At minimum, meets standards for ‘moderately effective’ for Management Strategy and Implementation and Bycatch Strategy, but at least one other subfactor is rated ‘ineffective.’*
- *1 (Very High Concern)— Management Strategy and Implementation and/or Bycatch Management are ‘ineffective.’*
- *0 (Critical)—Management Strategy and Implementation is ‘critical’.*

The Criterion 3 rating is determined as follows:

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

Rating is Critical if Management Strategy and Implementation is Critical.

Criterion 3 Summary

Stock/fishery	3.1 Management strategy	3.2 Bycatch strategy	3.3 Scientific research and monitoring	3.4 Enforcement of management regulations	3.5 Stakeholder inclusion	Subscore
Atlantic cod (2J3KL) – handline	Moderately effective	Highly effective	Moderately effective	Moderately effective	Moderately effective	3.0
Atlantic cod (2J3KL) – gillnet	Moderately effective	Moderately effective	Ineffective	Moderately effective	Moderately effective	2.0

Criterion 3 Assessment

ATLANTIC COD (2J3KL) – HANDLINE

FACTOR 3.1 – Management strategy and implementation

Key relevant info: Several objectives for the management of the stewardship fishery were outlined in a Maritime-wide cod recovery plan (DFO 2005) and an additional stock-specific rebuilding plan is currently in development. A short-term “stock growth” (i.e., increased abundance, although not to historic levels) rebuilding timeline of 5-10 years was included in the original recovery plan (DFO 2005). Research by DFO as well as independent researchers suggests abundance is increasing and the population is rebuilding (Rose and Rowe 2015; DFO 2016c). However, more recent preliminary data suggest the comeback may have stalled (Rose and Rowe, 2017). Scientists have advised that “removals should be kept to the lowest possible level” to promote stock growth (DFO 2016c) and although catch limits have increased in recent years, the current mortality from fishing remains in a low risk zone (see Table 1, Criterion 1.2). Nonetheless, increased fishing could impact the rate of recovery and a highly cautious approach to management is essential (Bailey 2017; Rowe and Rose 2017). For these reasons, this criterion is scored as ‘moderately effective’.

Detailed rationale: In 2003, the Governments of Canada and Newfoundland and Labrador formed the Canada-Newfoundland and Labrador Action Team for Cod Recovery. In 2005, this Action Team released a variety of recommendations for the recovery of cod stocks off Newfoundland and Labrador. The main objective of this strategy was to “prevent further declines in the biological status of these stocks and to contribute to the recovery and sustainable management of the stocks over the longterm” (DFO 2005).

The harvest plan for the 2J3KL fishery is updated annually and the following information was obtained from the 2017 version (DFO 2017b). Participation in the fishery is limited to fishers living in a port within in the 2J3KL area. The fishing season runs from mid-June to the end of November, but fishing is prohibited during the entire month of July. There is no total allowable catch (TAC) for the areas but weekly catch limits/quotas are set independently for the 2J and 3KL regions (Fig 5). While these levels of catch are not believed to pose a risk to the recovery of the stock (see Criterion 1.2) no information was available regarding how these limits were determined and this is inconsistent with the recommendation in the recovery plan (i.e., adopt TAC decision rules).

	Weekly Limit (lbs/week) by NAFO Division	
	2J	3KL
June 12 – 30	4000	4000
July	0	0
August	4000	2000
September	5000	3000
October	5000	5000
November	5000	5000

Figure 5. Weekly catch limits for each area per license in the 2J3KL cod stewardship fishery. (From DFO 2017b.)

Fishers may only employ one gear type per day and for handlines, a maximum of six hooks per line is permitted. Additional measures include a minimum catch size (fish must equal or exceed 45 cm in length) and areas are closed when the number of cod less than 45 cm exceeds 15% of the area's total. Discarding at sea is prohibited and all fishers are required to report their landings (both targeted and bycatch) in their logbooks.

FACTOR 3.2—Bycatch strategy

Key relevant info: Fishery is believed to have very low (<5%) bycatch therefore it scores 'highly effective' for this criterion.

Detailed rationale: NA

FACTOR 3.3 -- Scientific research and monitoring

Key relevant info: In recent years, DFO has conducted a stock assessment for 2J3KL cod every three years and, from 2018 onward, these assessments will happen on an annual basis. However, despite the frequency of assessments, some landings are not adequately accounted for (and, thus, this metric is not as accurate as possible). Although there appears to be sufficient data collection with regard to targeted catch in the commercial fishery, unreported recreational catch is a key factor in model uncertainty and "accurate monitoring of deaths resulting from both commercial and recreational fisheries should be considered a management priority" (DFO 2016b). A further lack of bycatch data retention warrants a score of "moderately effective" for this criterion.

Detailed rationale: Stock assessments are based on an integrated state-space model developed specifically for northern cod and include information from trawl and gillnet surveys, fishery landings, and tagging studies (DFO 2016b). However, since the recreational catch has been estimated in six of the last ten years, this has been identified as key source of uncertainty in the stock assessment model (DFO 2016c).

Although bycatch is likely insignificant given the active and targeted nature of handlining, bycatch data are not kept for vessels <35 ft due to privacy concerns. Furthermore, high grading of under-sized cod may occur given fish length restrictions and the warning of closure if undersized catch limits are reached. This would additionally result in under-reported catches yet it is unclear how these are accounted for in the stock assessment model.

Due to a recommendation by the Canadian House of Commons Standing Committee on Fisheries and Oceans and the 2+3KLNO Groundfish Advisory Committee, DFO will start conducting stock assessments every year for the next five years, beginning in winter 2018 (DFO 2017a).

FACTOR 3.4 – Enforcement of management regulations

Key relevant info: Enforcement and monitoring measures exist, although their effectiveness is uncertain. For this reason, this criterion scores 'moderately effective'.

Detailed rationale: Fishers must land their catch at designated ports and dockside monitoring/ catch validation is 100% (Oceana 2017). For vessels that exceed 40 ft in length, the use of VMS is mandatory but at-sea observer coverage is very low for many fisheries in Atlantic Canada (Fuller et al. 2008; DFO 2016a; Oceana 2017) and thus not all fishing activities may be overseen or accurately observed.

FACTOR 3.5— Stakeholder inclusion

Key relevant info: Despite past conflicts over management decisions, there is a constructive relationship between DFO, scientists, and fishermen. However, current management decisions for northern cod appear to be weighted most heavily by input from certain industry members more than others. For this reason, this criterion scores ‘moderately effective’.

Detailed rationale: The most recent stock assessment included participation by and discussion between DFO scientists and managers, academics, representatives from the industry including Fish, Food and Allied Workers (FFAW), Groundfish Enterprise Allocation Council (GEAC), First Nations, and non-governmental organizations (DFO 2016b). That said, the 2017 harvest strategy was “based on a proposal submitted by Newfoundland and Labrador Groundfish Industry Development Council (NL-GIDC), collaboration between the Fish Food and Allied Workers Union (FFAW) and various Newfoundland and Labrador seafood processors” (DFO 2017d). As such, it is possible that the interests of certain parties were weighed more heavily than others and no information was available on how conflict is addressed in this fishery.

In March 2017, the Canadian House of Commons Standing Committee on Fisheries and Oceans released the report, *Newfoundland and Labrador’s Northern cod fishery: Charting a new sustainable future* (Simms 2017). This report was a follow-up to *Northern Cod: a Failure of Canadian Fisheries Management* (Wappel 2005). The new report includes the Committee’s findings as a result of consultation with all of the aforementioned groups and it includes ten recommendations regarding management directives and best practices for the fishery going forward (including the recommendation of more regular stock assessments (see Criterion 3.2). Historically, cod management has been a highly contentious issue in Canada, particularly with regard to the collapse in the early 1990s. Although differences in opinion remain (especially between fishers and DFO scientists when it comes to observations of stock health), collaboration since this time is highly encouraging for the future of the fishery.

ATLANTIC COD (2J3KL) – GILLNET

FACTOR 3.1 – Management strategy and implementation

Key relevant info: Several objectives for the management of the stewardship fishery were outlined in a Atlantic-wide cod recovery plan (DFO 2005) and an additional stock-specific rebuilding plan is currently in development. A short-term “stock growth” (i.e., increased abundance, although not to historic levels) rebuilding timeline of 5-10 years was included in the original recovery plan (DFO 2005). Research by DFO as well as independent researchers suggests abundance is increasing and the

population is rebuilding (Rose and Rowe 2015; DFO 2016c). However, more recent preliminary data suggest the comeback may have stalled (Rose and Rowe, 2017). Scientists have advised that “removals should be kept to the lowest possible level” to promote stock growth (DFO 2016c) and although catch limits have increased in recent years, the current total catch remains in a low risk zone (see Table 1, Criterion 1.2). Nonetheless, increased fishing could impact the rate of recovery and a highly cautious approach to management is essential (Bailey 2017; Rowe and Rose 2017). For these reasons, this criterion is scored as ‘moderately effective’.

Detailed rationale: In 2003, the Governments of Canada and Newfoundland and Labrador formed the Canada-Newfoundland and Labrador Action Team for Cod Recovery. In 2005, this Action Team released a variety of recommendations for the recovery of cod stocks off Newfoundland and Labrador. The main objective of this strategy was to “prevent further declines in the biological status of these stocks and to contribute to the recovery and sustainable management of the stocks over the long-term” (DFO 2005).

The harvest plan for the 2J3KL fishery is updated annually and the following information was obtained from the 2017 version (DFO 2017b). Participation in the fishery is limited to fishers living in a port within in the 2J3KL area. The fishing season runs from mid-June to the end of November, but fishing is prohibited during the entire month of July. There is no total allowable catch (TAC) for the entire season but weekly catch limits/quotas are set independently for the 2J and 3KL regions (Fig 5). While these levels of catch are not believed to pose a risk to the recovery of the stock (see Criterion 1.2) no information was available regarding how these limits were determined and this is inconsistent with the recommendation in the recovery plan (i.e., adopt TAC decision rules).

	Weekly Limit (lbs/week) by NAFO Division	
	2J	3KL
June 12 – 30	4000	4000
July	0	0
August	4000	2000
September	5000	3000
October	5000	5000
November	5000	5000

Figure 5. Weekly catch limits for each area per license in the 2J3KL cod stewardship fishery. (From DFO 2017b.)

Fishers may only employ one gear type per day and for gillnets, a maximum of six nets per vessel is permitted in June, August and September (up to 9 may be onboard during October and November). The length of a gillnet may not exceed 50 fathoms, mesh size must be 5.5-6.5 inches wide and all gillnets must be tagged. Additional measures include a minimum catch size (fish must equal or exceed 45 cm in length) and areas are closed when the number of cod less than 45 cm exceeds 15% of the area’s total landings. Discarding at sea is prohibited and all fishers are required to report their landings (both targeted and bycatch) in their logbooks.

FACTOR 3.2—Bycatch strategy

Key relevant info: Certain landing limits and handling measures are in place for incidentally caught fish species, however there is no bycatch strategy nor mitigation measures for other commonly encountered marine species (i.e., seabirds, marine mammals). For this reason, this criterion scores ‘moderately effective’.

Detailed rationale: The current harvest plan for the cod stewardship fishery states that fishers are restricted to 10% of 200lbs incidental bycatch (whichever is greater) and for Greenland halibut, bycatch may not exceed 5% or 200 lbs daily when the Greenland halibut fishery is open. When this fishery is closed, all Greenland halibut must be returned to the water “in a manner that causes the least harm”. Species other than Greenland halibut, including any Northern or Spotted wolffish (which are listed under the Canadian Species At Risk Act) must also be released.

Independent research has concluded that Newfoundland gillnet fisheries (including those for cod) are responsible for the mortality of thousands of seabirds as well as hundreds of marine mammals (including pinnipeds and cetaceans) annually (Benjamins et al. 2007, 2008; Regular et al. 2013; Zydulis et al. 2013; Rouxel 2017). However, there are no explicit management measures in place aimed at reducing the impacts of this gear type on any of these species outside of designated Marine Protected Areas (see Criterion 4).

FACTOR 3.3 -- Scientific research and monitoring

Key relevant info: In recent years, DFO has conducted a stock assessment for 2J3KL cod every three years and, from 2018 onward, these assessments will happen on an annual basis. However, despite the frequency of assessments, some landings are not adequately accounted for (and, thus, this metric is not as accurate as possible) and only one stock reference point has been set.

In relation to bycatch, the bottom gillnet fisheries of Newfoundland are known to be responsible for the death of thousands of marine animals each year yet these interactions are not included in DFO bycatch records. While bycatch data are collected from logbooks, the degree to which analysis of these data occurs is unclear. Thus, the monitoring and assessment of bycatch appears to be insufficient given the potential impact of the fishery on many species. For this reason, this criterion scores ‘ineffective’.

Detailed rationale: Stock assessments are based on an integrated state-space model developed specifically for northern cod and include information from trawl and gillnet surveys, fishery landings, and tagging studies. However, since the recreational catch has been estimated in six of the last ten years, this has been identified as key source of uncertainty in the stock assessment model (DFO 2016c). Due to a recommendation by the Canadian House of Commons Standing Committee on Fisheries and Oceans and the 2+3KLNO Groundfish Advisory Committee, DFO will start conducting stock assessments every year for the next five years, beginning in winter 2018 (DFO 2017a).

As discussed in Criterion 2, research suggests that DFO bycatch records are incomplete when it comes to quantifying the incidental capture of gillnet fisheries, especially for seabirds and marine mammals (see Benjamins et al. 2007, 2008; Regular et al. 2013; Zydulis et al. 2013; Rouxel 2017). More vessel

monitoring as well as targeted research on the impacts of the cod gillnet fishery is required as current management measures and oversight are clearly insufficient for protecting certain types of marine wildlife. With regard to cetaceans, COSEWIC (2006) states “the lack of porpoise bycatch monitoring and mitigation in many of the relevant fisheries are reasons for concern”.

FACTOR 3.4 – Enforcement of management regulations

Key relevant info: Enforcement and monitoring measures exist, although their effectiveness is uncertain. For this reason, this criterion scores ‘moderately effective’.

Detailed rationale: Fishers must land their catch at designated ports and dockside monitoring/ catch validation is 100% (Oceana 2017). For vessels that exceed 40 ft in length, the use of VMS is mandatory but at-sea observer coverage is very low for many fisheries in Atlantic Canada (Fuller et al. 2008; DFO 2016a; Oceana 2017) and thus not all fishing activities may be overseen or accurately observed.

FACTOR 3.5— Stakeholder inclusion

Key relevant info: Despite past conflicts over management decisions, there is a constructive relationship between DFO, scientists, fishermen and local ENGOs. However, current management decisions for northern cod appear to be weighted most heavily by input from certain industry members more than others. For this reason, this criterion scores ‘moderately effective’.

Detailed rationale: The most recent stock assessment included participation by and discussion between DFO scientists and managers, academics, representatives from the industry including Fish, Food and Allied Workers (FFAW), Groundfish Enterprise Allocation Council (GEAC), First Nations, and non-governmental organizations (DFO 2016b). Local ENGOs now also attend fishery advisory meetings and stock assessment meetings. That said, the 2017 harvest strategy was “based on a proposal submitted by Newfoundland and Labrador Groundfish Industry Development Council (NL-GIDC), collaboration between the Fish Food and Allied Workers Union (FFAW) and various Newfoundland and Labrador seafood processors” (DFO 2017d). As such, it is possible that the interests of certain parties were weighed more heavily than others and no information was available on how conflict is addressed in this fishery.

In March 2017, the Canadian House of Commons Standing Committee on Fisheries and Oceans released the report, *Newfoundland and Labrador’s Northern cod fishery: Charting a new sustainable future* (Simms 2017). This report was a follow-up to *Northern Cod: a Failure of Canadian Fisheries Management* (Wappel 2005) The new report includes the Committee’s findings as a result of consultation with all of the aforementioned groups and it includes ten recommendations regarding management directives and best practices for the fishery going forward (including the recommendation of more regular stock assessments (see Criterion 3.2). Historically, cod management has been a highly contentious issue in Canada, especially with regard to the collapse in the early 1990s. Although differences in opinion remain (especially between fishers and DFO scientists when it comes to observations of stock health), collaboration since this time is highly encouraging for the future of the fishery.

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 and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

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

Criterion 4 Summary

Stock/ fishery	4.1a Impact on substrate	4.1b Mitigation of fishing gear impacts	4.2 EBFM	Subscore
Atlantic cod (2J3KL) – handline	4.0	+1.0	3.0	3.873
Atlantic cod (2J3KL) - gillnet	2.0	+1.0	3.0	3.0

Criterion 4 Assessment

Factor 4.1a Physical 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)—Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 (Moderate)—Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 (High)—Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*

- 0 (Very High)—Dredge or 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.

ATLANTIC COD (2J3KL) – HANDLINE

FACTOR 4.1a – Impact of fishing gear on the substrate

Key relevant info: Although they likely have a minimal impact on bottom structure, handlines are vertical lines that occasionally contact the seafloor when fishing for demersal species such as cod. When applying the Seafood Watch standard to this gear type, this criterion scores ‘low concern’.

Detailed rationale: NA

ATLANTIC COD (2J3KL) – GILLNET

FACTOR 4.1a – Impact of fishing gear on the substrate

Key relevant info: Although they are a passive gear, bottom gillnets must be weighed down in order to sink to the depth of the targeted species. The anchors, as well as the nets themselves come into direct contact with the sea floor. When considering the local bottom structure that may be impacted, this criteria scores ‘high concern’ based on the Seafood Watch criteria.

Detailed rationale: Gillnet weights will contact the seafloor and lead ropes and/or the net itself may interact with the bottom as well. No information regarding the bottom composition of exact fishing sites was available but different habitat types have been identified in the coastal waters of Bonavista Bay, Newfoundland (part of the 2J3KL region). These habitat types include: mud, loose gravel, gravel, rock, sparse algae/cobble, macro-algae, high relief/deep cobble, and wood chips; rock was identified as the dominant type in this area (Anderson et al. 2002). Sampling surveys using Atlantic cod gillnets also report catching a variety of benthic invertebrates (see Criterion 2) as well as the northern red anemone (*Urticina felinai*) and red soft coral (*Gersemia rubiformis*) (Rouxel 2017).

Factor 4.1b Modifying factor: Mitigation of gear impacts

Scoring Guidelines

- +1 (Strong Mitigation)—>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery’s footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of ‘moderate’ mitigation measures.
- +0.5 (Moderate Mitigation)—At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery’s footprint is

prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.

- *0 (No Mitigation)—No effective measures are in place to limit gear impacts on habitats.*
- *0 (Not Applicable) – Not applicable because gear used is benign and received a score of 5 in 4.1*

ATLANTIC COD (2J3KL) – HANDLINE AND GILLNET

FACTOR 4.1b – Modifying factor: mitigation of fishing gear impacts

Key relevant info: Fishing for cod is limited to coastal waters up to 12 nautical miles offshore (DFO 2017b). Thus, due to the small spatial footprint of the stewardship fishery for cod relative to the total 2J3KL area, and the short fishing season (i.e., limited to four months annually) there is no reason to believe this fishery poses an above minimal risk to the benthic environment. As such, it receives a score of ‘strong mitigation’.

Detailed rationale: NA

Factor 4.2 Ecosystem-based Fisheries Management

Scoring Guidelines

- *5 (Very Low Concern)—Policies that have been shown to be effective are in place to protect species’ ecological roles and ecosystem functioning (e.g. catch limits that ensure species’ abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 (Low Concern)—Policies are in place to protect species’ ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 (Moderate Concern)— Policies are not in place to protect species’ ecological roles and ecosystem functioning but detrimental food web impacts are not likely.*
- *2 (High Concern)— Policies are not in place to protect species’ ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 (Very High Concern)—Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

ATLANTIC COD (2J3KL) – HANDLINE AND GILLNET

FACTOR 4.2 – Ecosystem based fisheries management

Key relevant info: Currently, some spatial protection exists in the 2J3KL region (applicable to all fisheries, not only cod) to protect sensitive areas and this is part of a larger national plan to protect 10% of Canadian waters by 2020. However, as a result of the overexploitation of cod in the past, the Canadian Atlantic ecosystem is believed to have shifted dramatically. Due to the uncertainty around how a recovered cod stock may once again alter species interactions and the local environment as well as the current situation of the capelin stock, this criterion was scored ‘moderate concern’.

Detailed rationale: The collapse of Canada’s Atlantic cod stocks had substantial impacts on the biodiversity of the local ecosystem in terms of species abundance, diversity, richness and evenness (McCain et al 2016). Thus, the stability of this system is likely still uncertain and as cod stocks recover under the current management regime, the increase in abundance of this benthic predator will likely cause shifts in the community composition and structure once more (and the implication of this increase on both the ecosystem and its fisheries remains unknown). Recent declines in capelin abundance—a key food source for cod—warrant increased attention by management and consideration of a comprehensive ecosystem approach, based on the productive capacity of the eco-region.

At a broader scale, Canada seeks to meet a target of 10% MPA coverage for its waters by 2020 (DFO 2017d). Within the 2J3KL region are three MPAs where fishing is prohibited: Gilbert Bay, Round Island, and Duck Island (DFO 2017b). Compared to the 2J3KL area as a whole, these MPAs are small and research is ongoing to monitor their effectiveness (DFO 2014). Many of the management conditions pertaining to the stewardship fishery as well as fishing licensing protocols for Newfoundland and Labrador extend beyond the cod fishery to other species and regions in an effort to ensure all of the fisheries in the area are managed holistically (DFO 2017b,c).

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