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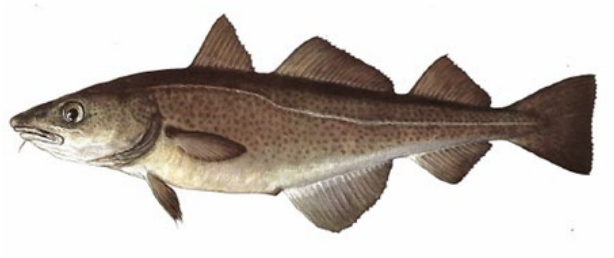
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat
Quebec Region **Science Advisory Report 2019/032**

ASSESSMENT OF THE NORTHERN GULF OF ST. LAWRENCE (3PN, 4RS) ATLANTIC COD STOCK IN 2018



Atlantic cod (Gadus morhua) by E. Klimoff, Vladykov, 1955.

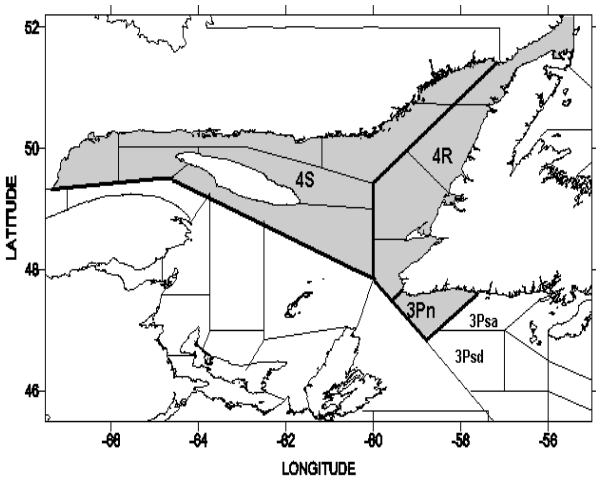


Figure 1. Cod stock management area in the Northern Gulf of St. Lawrence (3Pn, 4RS).

Context

The first total allowable catch (TAC) of the Northern Gulf of St. Lawrence Atlantic cod stock (NAFO subdivision 3Pn and divisions 4R and 4S; Figure 1) was 55,000 t in 1977. It reached a maximum of 100,000 t between 1983 and 1985. This fishery was then placed under two moratoriums (1994 to 1996 and 2003). Between 1974 and 1993, this stock was fished by Canadian fleets using fixed and mobile gears, as well as by some foreign fleets using mobile gear. Since 1997, landings have been carried out by the Canadian fleet and mostly by fixed gear (gillnets, longlines and handlines). A recreational fishery is conducted on this stock and its harvest was estimated only in 2006 and 2008.

The Northern Gulf cod spawning stock biomass has been in the critical zone, well below the limit reference point, since 1990. In 2010, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the Laurentian North (3Pn, 4RS and 3Ps) cod population, part of which consists of Northern Gulf of St. Lawrence (3Pn, 4RS) cod, as endangered, based essentially on the extent of the decline (78–89%) in adult abundance over three generations (30 years).

This resource is managed mainly by an annual total allowable catch (TAC). Several other management measures (number and types of gear, area closures during spawning and in winter (3Pn), observers, dockside monitoring, minimum size, bycatch monitoring, rules for the recreational fishing, etc.) are also enforced. Since 1999, the management year has started on May 15 of the current year and ended on May 14 of the following year.

This stock is assessed every two years using mainly data from commercial fisheries, sentinel programs (fixed and mobile gear) and DFO research survey. This Science Advisory Report is from the February 21 and 22, 2019 meeting on the assessment of northern Gulf of St. Lawrence (3Pn, 4RS) cod. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- Starting in 2017-2018, the total allowable catch increased from 1,500 t to 3,185 t, which corresponds to a fishing allocation of 2,769 t. The preliminary landings totaled 2,670 t in 2017-2018 and 2,515 t in 2018-2019.
- In 2018, there were 39 recreational fishing days between June and September. This fishery's catches are unknown.
- In 2017, the commercial longline fishery performance index remained above the series average, while it declined and was situated at the average level for the gillnet fishery. The performance index of the commercial longline fishery in Quebec has remained above the series average since 2015.
- The standardized catch rates of the longline and gillnet sentinel fishing programs declined in the last two years. In 2018, the longline index was below the series average and the gillnet index was close to the average.
- DFO's research survey abundance index was above average from 2014 to 2016 and decreased in 2017. In 2018, it increased slightly and was comparable to the series average. In 2018, the sentinel trawl survey abundance index was the second lowest value since 1995.
- The spawning stock biomass (SSB) estimated from the Virtual Population Analysis (VPA) model declined the past two years to the lowest values in 20 years (11,774 t in 2019). This decrease would be attributable to high total mortality.
- Natural mortality estimated by the VPA is increasing, it had a value of 0.7 for 2014-2018. The empirical estimate of total realized mortality, independently from the model, using DFO and sentinel surveys corroborates trends in increasing estimates of fishing mortality and natural mortality estimated by the VPA. Causes of this mortality include unrecorded fishing mortality and predation by Grey and Harp seals, but their importance is unknown.
- The estimated exploitation rates from the VPA and the tagging program doubled since the last evaluation in 2016. In 2018, they were 0.18 and 0.21, respectively.
- For 2020 and 2021, projections of annual harvests of 300 t and 1,500 t indicate a slight decrease in SSB with a probability greater than 75% and 85%, respectively. These estimates are greatly influenced by that of natural mortality estimate.
- The SSB estimate for January 2019 is situated in the critical zone and represents only 10% of the limit reference point. According to the precautionary approach, harvests from all sources should be as low as possible to promote spawning biomass recovery.

BACKGROUND

Biology

In summer, 3Pn and 4RS Atlantic Cod are distributed throughout the Gulf of St. Lawrence at depths of 50 to 200 meters. In winter, the fish gather off southwestern (3Pn) and southern (3Psa and 3Psd) Newfoundland at depths of 300 to 500 m.

Hypoxic conditions can affect cod metabolism, with the primary impact typically being movement to more oxygenated areas. Oxygen levels below 30% represent a major challenge (reduced physiological capacity; digestion, growth, fertility, condition) for this species.

Age at 50% maturity has varied over time for this stock and is currently between four and five years. Spawning takes place mainly in April and May at depths of 200 to 250 metres. The main spawning area

is found off Port au Port (west coast of Newfoundland). After spawning, the eggs and larvae are pelagic and disperse with the currents over a period of two to three months. The ideal temperature for larval survival is 7°C to 14°C. Juveniles (30 to 60 mm in length) subsequently seek out demersal areas, where they appear to prefer habitats with cobble, grass beds, and sponges.

Cod diet varies with fish size: smaller cod feed mainly on small prey (zooplankton, crustaceans), while larger cod feed on capelin (*Mallotus villosus*), herring (*Clupea harengus*), redfish (*Sebastes spp.*), flatfish, cod, and crab. Cod diet data in the Northern Gulf indicate that these fish have a diverse diet which is not dependent on a single prey item.

Cod are preyed on by various species (Northern shortfin squid (*Illex illecebrosus*), grey seal (*Halichorus grypus*), harp seal (*Pagophilus groenlandicus*), Atlantic halibut (*Hippoglossus hippoglossus*), Atlantic Mackerel (*Scomber scombrus*), herring) during the different stages of their life cycle. Predation can have a major impact on cod population status. A number of studies conducted in the southern Gulf of St. Lawrence (4T) are currently reporting high predation by grey seals on cod, preventing the recovery of that stock. This pressure is likely also responsible for changes in cod distribution showing a shift to deeper waters.

Overview of oceanographic conditions and the ecosystem

The Gulf of St. Lawrence ecosystem has been undergoing significant changes in recent decades. Surface waters and deep waters are warming and becoming depleted in oxygen, particularly at the heads of channels. The water volume in the cold intermediate layer (CIL) in summer has been decreasing since 2007, while the CIL temperature index shows some inter-annual variability, although an upward trend has been observed since 2000.

In the northern Gulf, changes observed at lower trophic levels and in zooplankton composition could affect energy transfer to higher trophic levels.

In recent years, the oxygen concentration has decreased significantly in some areas of the Gulf of St. Lawrence, particularly at the head of deep channels. The annual DFO survey conducted in August shows that cod are not found in the hypoxic (< 30%) waters located at the heads of channels. However, in summer, cod are not typically found at great depths in the Gulf of St. Lawrence. In 2016, the dissolved oxygen level at cod wintering sites was 45%.

In recent years, the Atlantic redfish (*Sebastes mentella*) population in the Northern Gulf of St. Lawrence has grown considerably. The abundance estimates of commercial-sized and pre-recruit Atlantic halibut derived from the DFO survey in 2017 and 2018 are among the highest in the historical series. Among invertebrates, a decrease has been noted in biomass indexes for most shrimp species, while an upward trend has been noted for Northern shortfin squid, a southern, seasonal pelagic species, and for some amphipod species. Although there is currently no capelin biomass index for the Gulf of St. Lawrence, biological indexes, calculated from commercial samples and scientific surveys, show that the average size and condition of capelin have declined over the past several years.

The Canadian Northwest Atlantic grey seal population has been increasing since 1960 (more than 420,000 individuals in 2016). Grey seal numbers in the Gulf of St. Lawrence vary from season to season: in the northern Gulf, for example, their abundance in summer may be twice that in winter.

The harp seal population is very abundant (more than 7 million individuals in 2012). A portion of this population arrives in the Gulf of St. Lawrence in the fall, and returns to the waters of the Canadian Arctic and Greenland in April and May.

The components of the St. Lawrence ecosystem and the changes observed in it could have effects on cod, such as impacts on productivity, and changes in the occurrence and intensity of interspecific interactions (predation, competition). However, the magnitude of these effects is unknown. The fact

remains, however, that an increase in predator (grey seal and harp seal) populations or a decrease in food availability could have a negative impact on the Northern Gulf cod stock.

Fishery

Cod total allowable catch (TAC) and landings declined steadily between 1984 and 1993 in the Northern Gulf of St. Lawrence (Figure 2). Average landings for the 2012–2016 period were 1,285 t with a TAC of 1,500 t (Table 1). Beginning in 2017–2018, the TAC increased to 3,185 t, which corresponds to an available fishing allocation of 2,769 t. Preliminary landings totalled 2,670 t in 2017–2018 and 2,515 t in 2018–2019. Catches in the commercial fishery in recent years have been made up mainly of five- to 10-year-old cod.

In 2016, the recreational fishery season increased from 32 to 46 days. In 2018, there were 39 recreational fishing days between June and September. No catch data are available for this fishery.

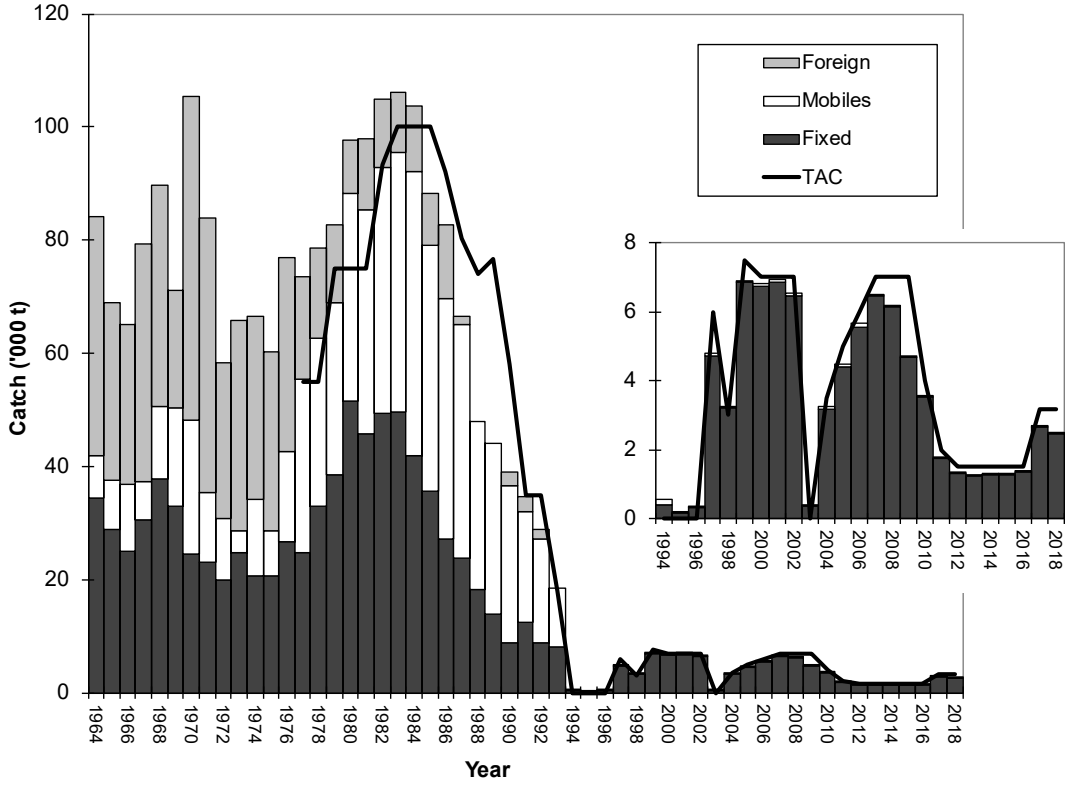


Figure 2. Annual landings and total allowable catch (TAC) by management year. (1964-1998: management by calendar year; 1999: TAC from January 1, 1999, to May 14, 2000; 2000 to 2018 TAC from May 15 to May 14 of the following year).

Table 1. Cod landing (t) by fleet and TAC for Subdivision 3Pn and Divisions 4RS. Average per period and annual values from 2017-2018.

	Fleet				
Period	Fixed	Mobil	Foreign	Total	TAC
1964-1976	26,878	11,814	36,333	75,026	-
1977-1986	28,893	33,531	9,613	70,341	70,420
1987-1993	13,445	25,315	2,092	39,956	53,820
1994-1996	293	53	0	346	Moratorium
1997-2002	5,804	60	0	5,865	6,250
2003	354	35	0	389	Moratorium
2004-2011[1]	4,459	49	0	4,508	5,188
2012-2016	1,279	6	0	1,285	1,500
2017-2018[2]	2,661	10	0	2,671	3,185
2018-2019[2]	2,453	10	0	2,463	3,185

[1] Includes 75 t from the recreational fishery in 2006 and 67 t in 2008
[2] Preliminary data, December 31th 2018

Commercial fishery performance index taken from logbook data for fixed gear fleets (gillnet and longline, Newfoundland vessels under 35 feet, and Quebec vessels under 45 feet) show an increase in catches per unit effort (CPUE) after the 2003 moratorium until 2006, and then a decrease until 2009. CPUEs increased between 2009 and 2016 (Figure 3). In 2017, the performance index for the commercial longline fishery remained above the series average, but decreased to the average value for gillnet fishing. The performance index for the commercial longline fishery (Quebec Region) has remained above the series average since 2015 (Figure 4).

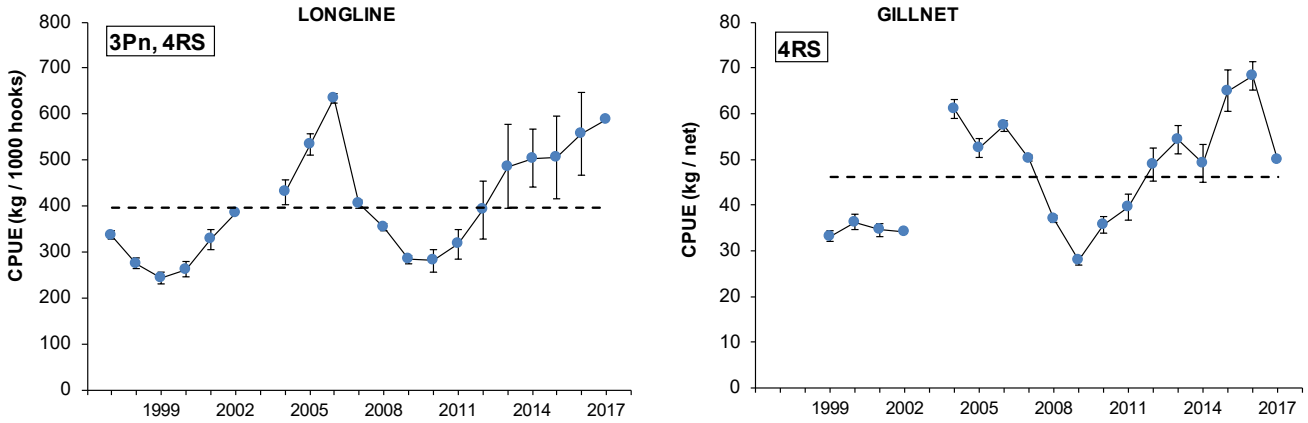


Figure 3. Catch per unit effort (CPUE) ± 95% confidence interval calculated from commercial fishery logbooks for Quebec vessels (< 45 feet) and Newfoundland (< 35 feet). The dotted line represents the series average (1997 or 1999 to 2016). Note that the data for the 2018-2019 season were not available for this evaluation.

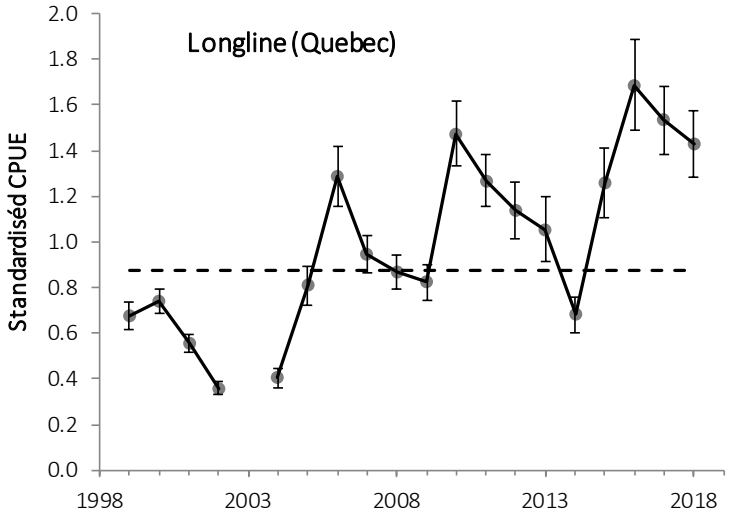


Figure 4. Catch per unit effort (CPUE) ± 95% confidence interval calculated from commercial fishery logbooks for Quebec longliners (> 45 feet). The dotted line represents the series average (1998 to 2017).

Since 2004, more than 85% of cod landings have come from the directed cod fishery. Cod bycatch landings are low (around 200 t/year) and mainly occur in the directed fisheries for Atlantic halibut and Greenland halibut (*Reinhardtius hippoglossoides*).

Cod is a bycatch that is not accounted for in the landing statistics for the Northern shrimp (*Pandalus borealis*) fishery. Analysis of the at-sea observer database indicates that cod is caught in slightly more than 20% of trawl tows. These catches account for 1 kg or less per tow, and captured cod are small, i.e. under 30 cm (1–2 years). Overall, these catches represent less than 1% of the estimated biomass of that size of cod (under 30 cm), according to the DFO survey.

ASSESSMENT

Sources of information

The status of cod stock in the Northern Gulf of St. Lawrence was assessed using data from commercial fisheries (landings, number at age), a tagging program (exploitation rate), an abundance index calculated from DFO research survey (bottom trawl) (4RS, 1990 to 2018), abundance indixes from the fixed gear sentinel program (gillnets, 4RS, 1995 to 2018 and longlines, 3Pn, 4RS, 1995 to 2018), an abundance index derived from the mobile gear sentinel program (bottom trawl) (3Pn, 4RS, 1995-2018), biological data (including fecundity and maturity) from annual surveys dating back to 2002 (except 2003 and 2017) and cod condition data collected annually (DFO survey since 1990 and fixed gear sentinel program since 1998).

Biological data

The monitoring of cod physical condition, conducted as part of the sentinel program, shows an annual cycle. The condition index is lower in spring before spawning and then increases from summer to fall when it peaks. In 2017 and 2018, the Fulton's condition index (K) values were lower than the 1998 to 2016 mean for fish 45 and 55 cm long, but close to the mean for fish 35 and 65 cm long. This index derived from DFO survey (August) is estimated using total mass, which is inevitably influenced by stomach fullness and gonad development. The index values had been declining in recent years; in 2018, they were generally higher than the series average (1990–2016). In 2017 and 2018, the

hepatosomatic index (HSI), which more closely follows recent fish feeding success, shows the same trends over an annual cycle. The observed values for these indexes represent acceptable condition levels.

DFO survey

Cod abundance in terms of mean number per tow was generally below the series average for 1992–2012. It increased above the average from 2014 to 2016. In 2017 and 2018, it was estimated to a value near the average (Figure 5). In 2017, cod abundance under 44 cm was generally comparable to the series average for 1990–2017, while in 2018 cod abundance was higher than this average. In both years, the cod abundance over 44 cm was below the series average. For 2018, a mode at 7 cm was observed (2018 cohort), which is uncommon for this survey (Figure 6).

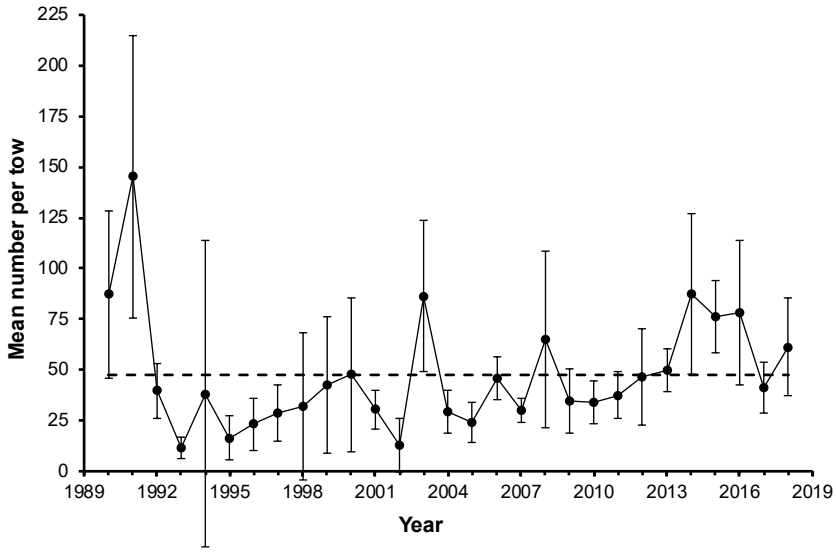


Figure 5. Mean number of cod per tow from DFO survey in 4RS. The error bars indicate the 95% confidence interval. The dotted lines indicate the average for the 1990–2017 period.

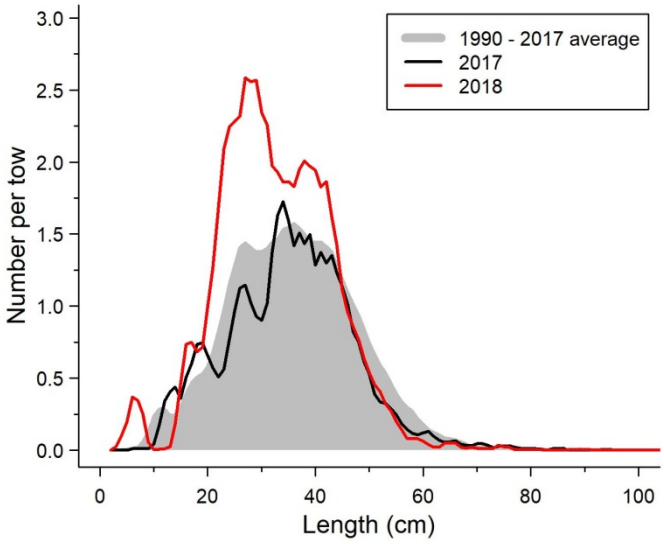


Figure 6. Length frequency distributions (mean number per 15 minutes tow) observed during DFO survey for cod in 4RS.

Cod distribution along the west coast of Newfoundland (4R) remained consistent from 1990 to 2018, while in the western Gulf, cod biomass gradually declined between 1990–1994 and 2000–2004. Beginning in 2005–2009, cod spatial distribution extended into Division 4S, especially north and west of Anticosti Island. Finally, recent cod distribution (2010–2014 and 2015–2018) was similar to that observed in the early 1990s (1990–1994) (Figure 7).

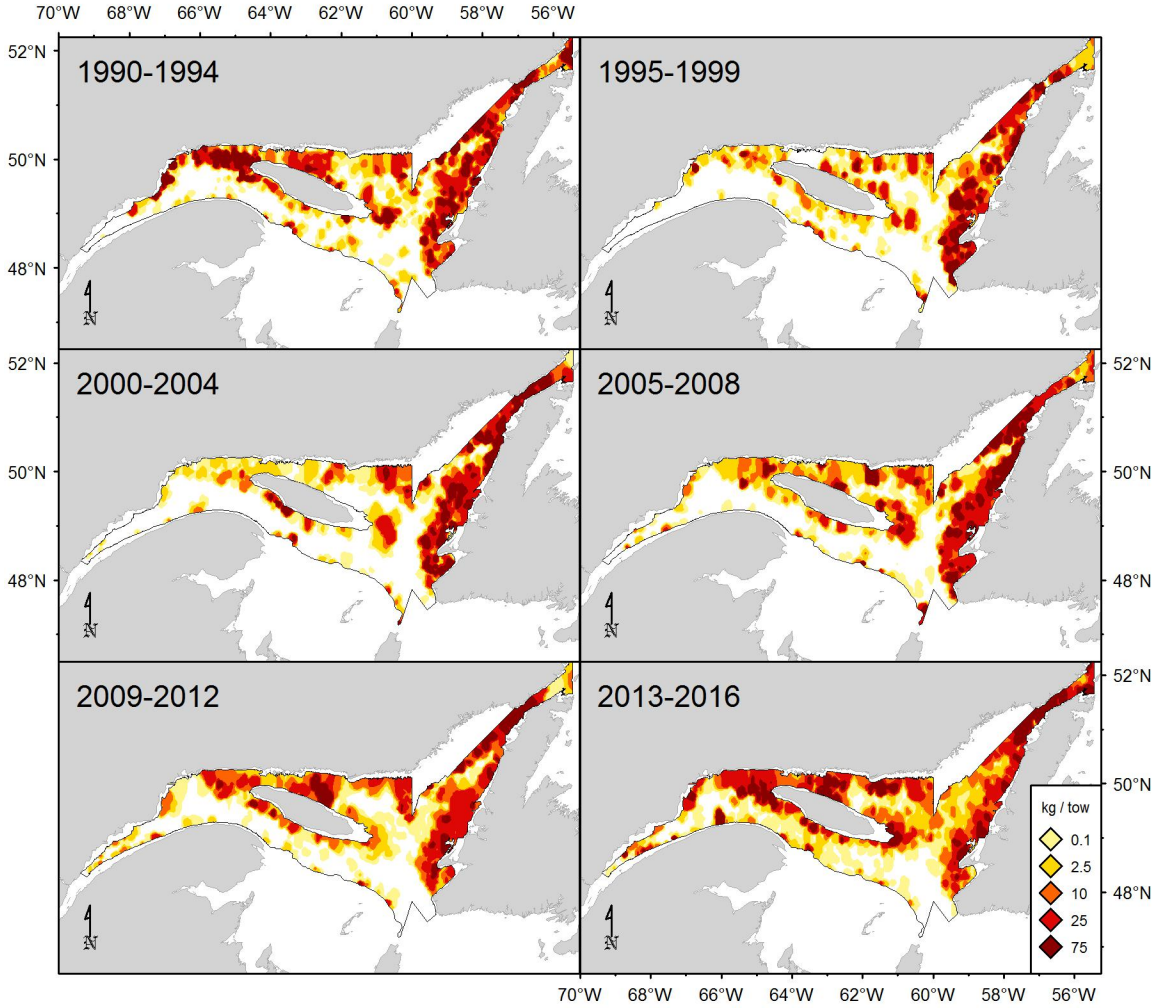


Figure 7. Distribution of cod catch rates (kg/15-minutes tow) in DFO survey in 4RS.

Mobil gear (bottom trawl) sentinel fishery program

The index calculated from the sentinel fisheries program using a bottom trawl is based on stratified random surveys conducted in July throughout areas 3Pn, 4R, and 4S. It includes two periods: 1995–2002, involving depth strata of at least 20 fathoms exclusively; and from 2003 onward, when three 10- to 20-fathom strata were added to those previously sampled. The series for these two periods cannot be directly compared or combined. The index does not show any clear trend for either series (Figure 8). In 2018, the abundance index derived from the sentinel fishery program trawl survey was the second-lowest value observed since 1995.

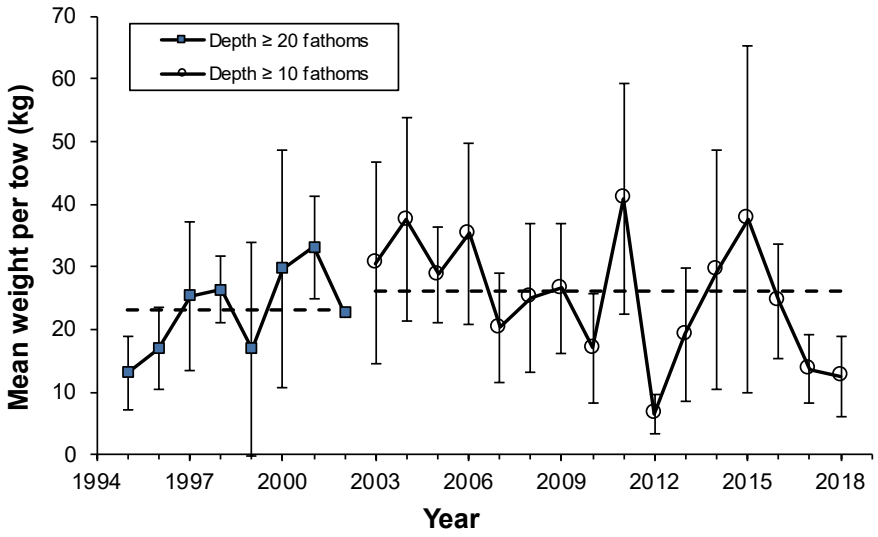


Figure 8. Mean number of cod per 30-minutes tow (±95% confidence interval) during the July mobile gear sentinel fisheries program. The dotted lines represent the averages for each series (1995-2002, 20 fathoms or more; 2003-2016, 10 fathoms or more).

Fixed gear (longline and gillnet) sentinel fishery program

Standardized CPUEs in the fixed gear sentinel fishery program (longline and gillnet) have been used as abundance indexes in cod assessments since 1998. Data are collected at 24 sites along the coast in 4R, 4S, and 3Pn. The longline index has fluctuated over the years. After increasing between 1995 and 2006, it decreased until 2010 before increasing again until 2016. The longline index then decreased over the past two years and, in 2018, fell below the 1995–2016 series average. The gillnet index shows a similar pattern, with 2017 and 2018 values near the series average (Figure 9).

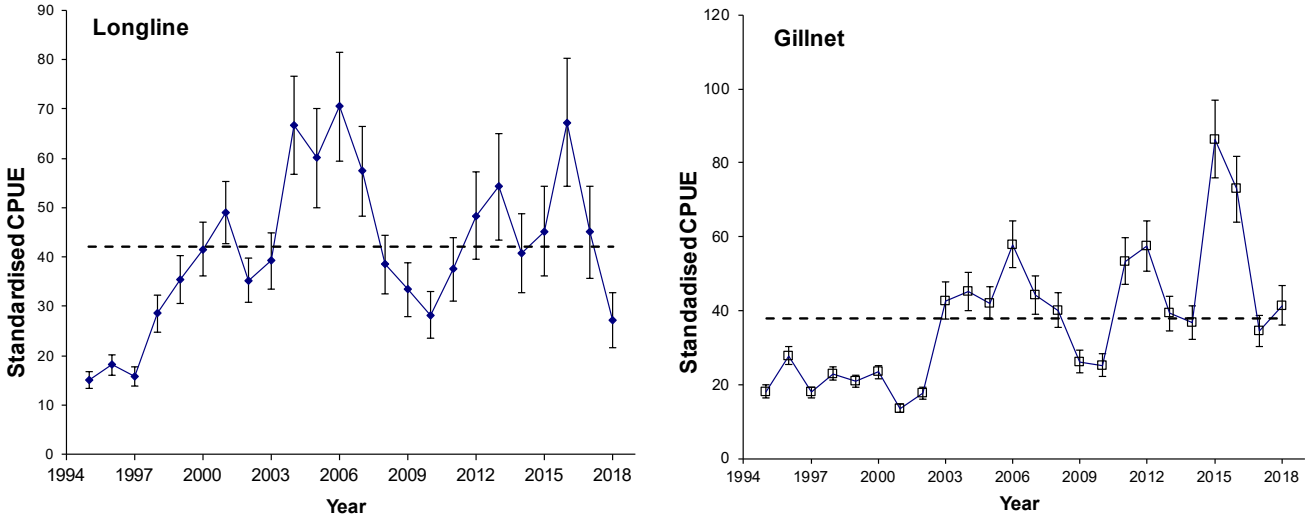


Figure 9. Standardized catch per unit effort (CPUE) for the fixed gear sentinel fisheries program. The dotted line represents the 1995–2016 series average. The error bars indicate the 95% confidence interval.

Virtual population analysis

A virtual population analysis (VPA), conducted using NFT ADAPT, was used to estimate several Northern Gulf of St. Lawrence cod stock status parameters, including exploitation rate, population abundance, and spawning stock biomass (SSB). The VPA is based on catches at age in the commercial fishery, and estimated values are adjusted based on various abundance indexes: longline sentinel (1995 to 2018, ages 3 to 13+); gillnet sentinel (1995 to 2018, ages 4 to 13+); mobile sentinel ≥ 20 fathoms (1995 to 2002, ages 2 to 11); mobile sentinel ≥ 10 fathoms (2003 to 2018, ages 1 to 11); and the DFO survey (1990 to 2018, ages 1 to 11).

For the virtual population analysis (VPA), natural mortality (M) values include all potential sources of mortality that are not accounted for in catch statistics, while mortality due to these catches is included in fishing mortality (F) estimates. M values were set at 0.2 from 1974 to 1985, 0.4 from 1986 to 1996, and 0.2 from 1997 to 2003. M values were subsequently estimated using VPA in five-year blocks for ages 3 to 12. The estimated values were: M=0.4 for 2004 to 2008, M=0.5 for 2009 to 2013 and M=0.7 for 2014 to 2018. Possible causes for the apparent increase in natural mortality, particularly beginning in 2004, are predation by grey seals and harp seals and unaccounted fishing mortality, such as recreational fishing, although their importance is unknown.

Cod population (ages 3+) biomass, which was very high in the late 1980s, decreased in the early 1990s. It then remained low and stable until 2010 before increasing slightly from 2012 to 2015, and then declining again in recent years (Figure 10). The spawning stock biomass (SSB) estimated using VPA has declined in the past two years to the lowest values in 20 years (11,774 t in 2019). Spawning stock biomass falls in the critical zone according to the precautionary approach and represents only 10% of the limit reference point (Blim of 116,000 t) (Figure 10).

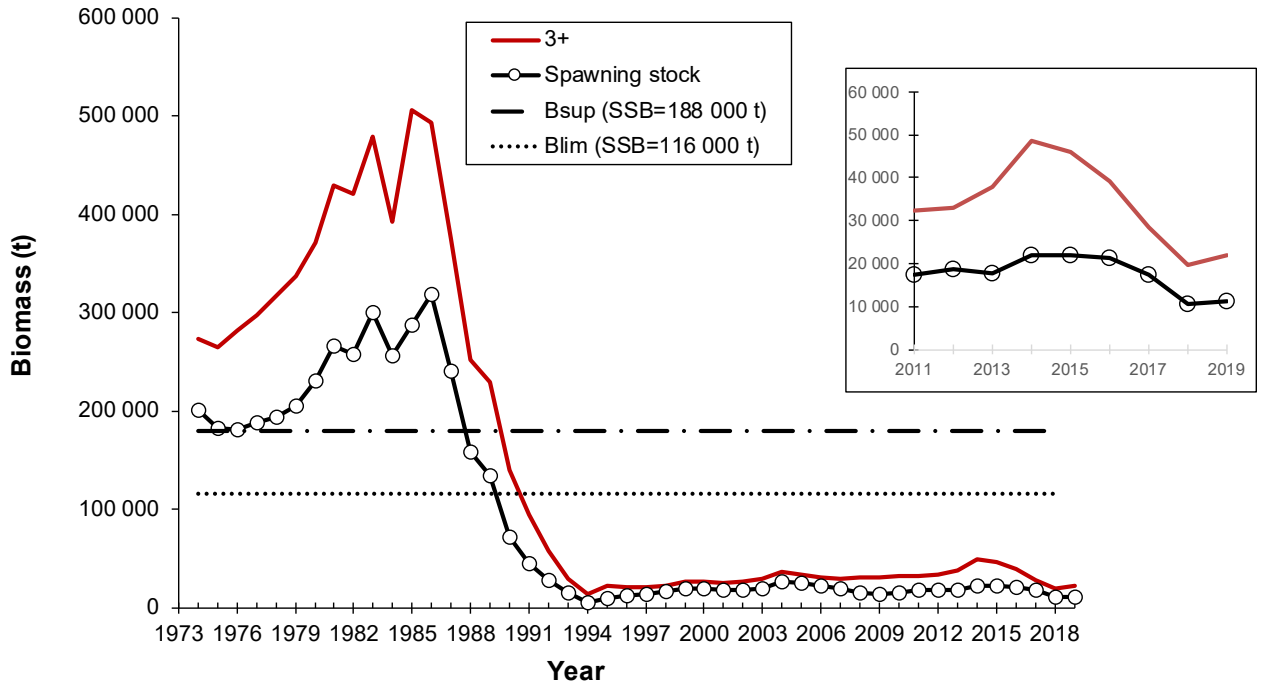


Figure 10. Biomass of fish over 3 years of age and spawning stock biomass (SSB). The upper reference points (Bsup) and the limit reference point (Blim) defined according to the precautionary approach are also represented.

Recruitment abundance at age 3, estimated by VPA beginning in 1990, was higher in 2014 and 2015 (2011 and 2012 cohorts). The recruitment rate increased between 1994 and 2014 before declining in subsequent years (Figure 11).

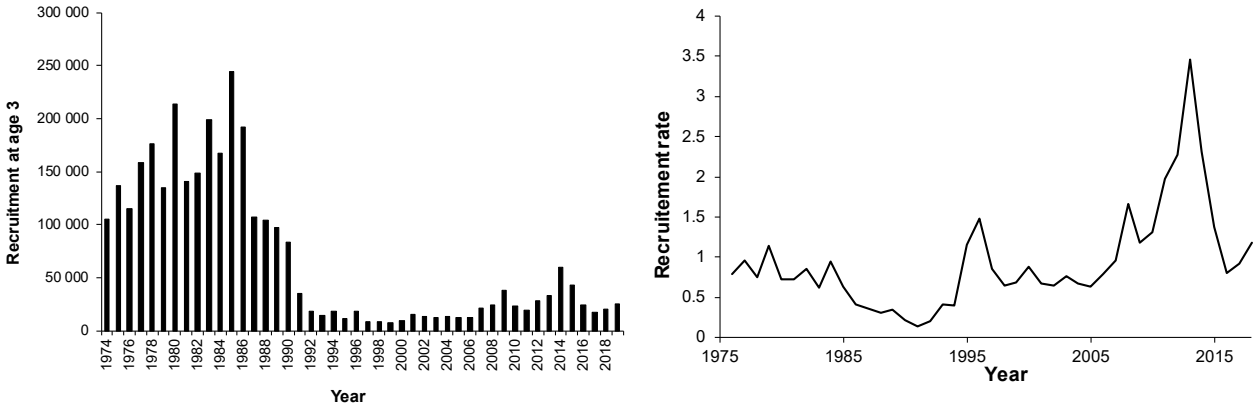


Figure 11. Estimate of the number of recruits aged 3 years by the VPA and the recruitment rate calculated by the number of recruits at 3 years divided by the spawning stock biomass in the recruitment year of these fish.

The exploitation rate for seven- to nine-year-old cod, estimated by the VPA, was high from 1997 to 2002, as well as in 2008, 2009, and 2010. It then decreased significantly from 2011 to 2016 before increasing again in 2017 with an increase in landings. The estimate for 2018 was 0.18 (Figure 12).

Tagging

In the Northern Gulf of St. Lawrence, a total of 94,934 cod were tagged between 1995 and 2018 as part of a tagging program aimed partly at estimating the exploitation rate. Of this number, 7,885 tags were returned by fishers, nearly 90% of which were from areas 4R, 4S, and 3Pn. The exploitation rate estimated from this tagging program increased from 2003 to 2007 before dropping to lower levels between 2011 and 2016. It has since doubled, reaching 0.21 in 2018, which is comparable to the estimate calculated using VPA (Figure 12).

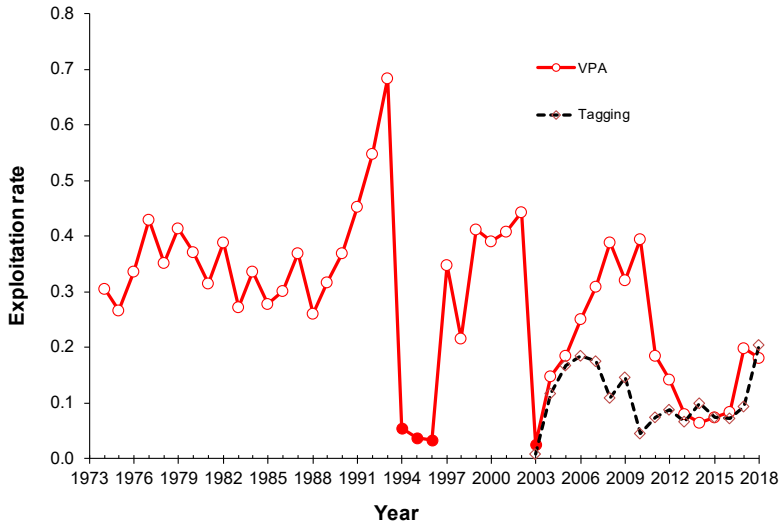


Figure 12. Exploitation rate estimated by VPA for seven- to nine-year-old cod and by the tagging program for fish measuring 40 to 80 cm. The solid symbols represent the moratorium years.

Total mortality estimates

An empirical estimate of total mortality (*Z*) was calculated without using VPA on the basis of catch at age indicators derived from DFO and sentinel fishery programs. The estimates from these analyses represent the mean *Z* for cod at selected ages during the previous and subsequent two-year periods (Figure 13).

The analyses show that *Z* was high (> 1.5) in the early 1990s when the stock collapsed and then declined to around 0.7 in 1994–1996 during the first moratorium. Since virtually no fishing took place during that time, this *Z* value reflects the natural mortality rate. *Z* subsequently increased to about 0.85 in 2000, and then to between 0.2 and 0.4 in 2003 during the second moratorium. In 2004, after the moratorium was lifted, the value increased with increasing fishing activity. From 2008 to 2011, *Z* estimates differed between the mobile gear surveys (DFO and bottom trawl sentinel program) and the fixed inshore gear (longline and gillnet) sentinel program. The latter produced high estimates (*Z* > 1.2) comparable to values observed during the stock collapse in the early 1990s Surveys with fixed inshore gear sample sites that are closer to the coast and capture larger cod on average compared to mobile surveys. Therefore, these estimates may represent values for older cod (gear selectivity) or for cod in coastal waters, where these surveys are conducted.. Consistent trends between surveys after 2012 suggest that Z decreased to around 0.7 in 2014. Since fishing allocations were very low during this period, this suggests that natural mortality, which includes unaccounted fishing mortality and predation, was high. Estimated *Z* has increased to about 1.0 in recent years, which is consistent with the recent increase in fishing allocations.

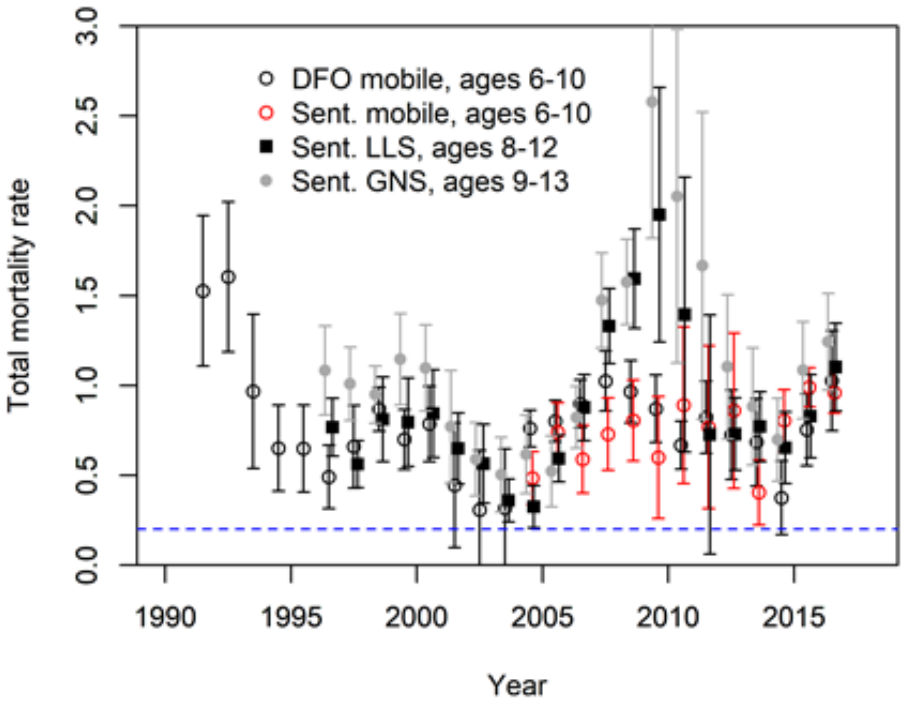


Figure 13. Estimates of total mortality rate (Z) using a modified catch-curve analysis applied to each of four fishery-independent surveys (distinguished by plot symbols): DFO mobile trawl survey and sentinel program mobile trawl, longline (LLS), and gillnet (GNS) surveys. The ages included in the analysis differed among surveys and are indicated in the legend. The dashed blue line indicates a total mortality rate of 0.2, the assumed baseline natural mortality for the stock.

Outlook

The NFT AGEPRO model was used to make spawning stock biomass projections for 2020 and 2021 from the VPA results. The projections indicate that, with an annual harvest of 300 t and 1,500 t, a slight decrease in the SSB compared to that estimated for January 2019, with a probability of 75% and 85%, respectively. These estimates are greatly influenced by natural mortality estimates.

Sources of uncertainty

The model used (VPA) requires exhaustive catch data, but there are no catch estimates for the recreational fishery.

Natural mortality estimates calculated using VPA play an important role in estimating the spawning stock biomass, particularly when deriving projections. If natural mortality is incorrectly estimated or changes over the coming years, the projection estimates will be inaccurate.

According to DFO survey, cod abundance is similar between divisions 4R and 4S. The tagging project was carried out only in 4R. Differences between divisions could bias the estimate of the exploitation rate.

CONCLUSION

This assessment indicates that Northern Gulf of St. Lawrence cod stock remains in the critical zone according to the precautionary approach and well below the estimated limit reference point of 116,000 t. The 2019 estimate is only 10% of the limit reference point. According to the precautionary approach, harvests from all sources should be as low as possible in order to promote spawning stock biomass recovery .

Assessment schedule

This stock is assessed every two years and the next full assessment will be conducted in the winter of 2021. In interim years, key resource indicators are updated to provide an overview of the most recent stock status to Fisheries Management. The indicators used for this stock status update are the commercial fishery landings, abundance indexes derived from the DFO research survey (4RS), as well as the fixed (longlines and gillnets) and mobile gears sentinel programs (4RS and 3Pn).

LIST OF MEETING PARTICIPANTS

Name	Affiliation	February 21	February 22
Benoit, Hugues	DFO - Science	x	x
Bernier, Denis	DFO - Science	x	
Bourdages, Hugo	DFO - Science	x	x
Brassard, Claude	DFO - Science	x	x
Cerqueira, Andy	MAPAQ	x	x
Chabot, Denis	DFO - Science	x	
Couillard, Jean-Pierre	ACPG	x	
Cyr, Charley	DFO - Science	x	
Denis, Marcel	ACPG	x	x
Dennis, Bill	FLR – Prov. of NL	x	x
Desgagnés, Mathieu	DFO - Science	x	x
Dubé, Sonia	DFO - Science	x	x
Dufresne, Yvon	DFO - Science	x	x
Duplisea, Daniel	DFO - Science	x	x
Emond, Kim	DFO - Science	x	x
Folliot, Benjamin	Dalhousie University	x	x
Gauthier, Johanne	DFO - Science	x	x
Huard, Georges	ACPG	x	
Hurtubise, Sylvain	DFO - Science	x	
Karbowski, Chelsey	Oceans North Canada	x	x
Lubar, John	DFO – Resource Management	x	x
Lussier, Jean-François	DFO - Science	x	x
Méthot, Chantal	DFO – Science	x	
Nadeau, Paul (tél)	APBCN	x	x
Nozères, Claude	DFO - Science	x	x
Ouellette-Plante, Jordan	DFO - Science	x	x
Parent, Geneviève	DFO - Science		x
Plourde, Stéphane	DFO - Science	x	x
Roux, Marie-Julie	DFO - Science	x	
Sandt-Duguay, Emmanuel	AGHAMM	x	x
Senay, Caroline	DFO - Science	x	x
Simms, Jason	DFO – Resource Management	x	x
Spingle, Jason	FFAW/UniFor	x	x
Trottier, Steve	DFO - Resource Management	x	x
Van Beveren, Elisabeth	DFO - Science	x	x
Vascotto, Kris	AGC	x	x

SOURCES OF INFORMATION

This Science Advisory Report is from the February 21 and 22, 2019 meeting on the assessment of the Northern Gulf of St. Lawrence (3Pn, 4RS) cod. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada Science Advisory Schedule as they become available.

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Aussi disponible en français:

MPO. 2019. Évaluation du stock de morue franche du nord du golfe du Saint-Laurent (3Pn, 4RS) en 2018. Secr. can. de consult. sci. du MPO, Avis sci. 2019/032.