

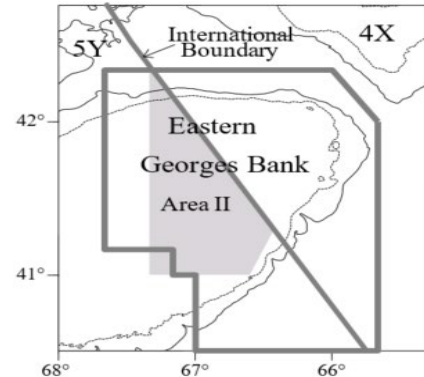


Transboundary Resources Assessment Committee

Status Report 2022/02

EASTERN GEORGES BANK COD

[5Zjm; 551,552,561,562]



Summary

- Combined Canada/United States of America (USA) catches of eastern Georges Bank (EGB) Cod in 2021 were 487 mt, including 11 mt of discards.
- The 2021 National Marine Fisheries Service (NMFS) fall survey swept area biomass value for EGB Cod has decreased from 2019, while the 2022 NMFS spring survey increased from 2021. The swept area abundance increased for both the 2022 spring and the 2021 fall surveys, but remains below the recent time series mean.
- Cod length frequency of the 2022 NMFS spring survey catch is comparable to last year, while that of the 2021 NMFS fall survey is characterized by an unusually large peak at 43 cm (17 in), representing one year old fish.
- Cod condition remains below the long-term mean for the Fisheries and Oceans Canada (DFO) spring survey and above the long-term mean for the NMFS fall and spring surveys.
- Preliminary analyses indicate an improvement in growth of young Cod on eastern Georges Bank, while older fish continue to grow slowly.
- Only aggregate landings and discards were available from the USA commercial fishery. The length and age composition information is not currently available for the 2020 or 2021 USA fishery. Full data from the 2022 DFO spring survey are not yet available pending the availability of a new vessel conversion factor.
- Available survey and fishery indicators generally remained consistent with the previous years, indicating that productivity of the stock remains low and there is no notable change in the state of the stock.

- Given that the biological assumptions going into Data Limited Methods tool (DLMtool) are maintained, the simulated operating models remain appropriate. Based on the approved Management Procedure selected by the Transboundary Management Guidance Committee (TMGC), the Transboundary Resource Assessment Committee (TRAC) catch advice for EGB Cod for 2023 is 520 mt and remains appropriate. There is a need to continue annual evaluation of whether the assumptions made in the projections of the DLMtool remain realistic, particularly if further evidence of higher than assumed growth emerges.
- The current application of the DLMtool is only intended as a short-term solution and should be replaced or supplemented with at least one functioning population model as soon as possible. The TRAC strongly recommends a benchmark for this stock.

Fishery

Combined Canada/USA catches of eastern Georges Bank (EGB) Cod in 2021 were 487 mt, including 11 mt of discards, with a quota of 635 mt (**Error! Reference source not found.**). Historically, catches averaged 17,200 mt between 1978 and 1993, peaking at 26,463 mt in 1982. Catches declined to 1,683 mt in 1995, then fluctuated at about 3,000 mt until 2004, and have subsequently declined (Table A1).

Canadian catches increased from 377 mt in 2020, which was the lowest in the time series, to 431 mt in 2021 (Table A1). Discards of Cod were estimated at 6 mt from the groundfish fleet and 5 mt from the Canadian scallop fishery in 2021. The landings occurred primarily during the third and fourth quarter, using mobile (40%) and fixed (60%) gears (Figure A1).

USA catches decreased from 67 mt in 2020 to 56 mt in 2021 (Table A1). Estimated discards of Cod for 2021 were 0.6 mt. At the time of this status update, only the aggregate landing and discard data from the USA fishery were available for the 2020 and 2021 fishing years.

The **size composition** of the 2021 Canadian fishery EGB Cod catches (landings and discards) were derived from the pooled port samples and at-sea samples from all principal gears and seasons (Table A2). Catches in 2021 peaked at 64 cm (25 in) for the Canadian fishery representing a slight increase from the 2020 fishing season (Figure A2).

The age composition since 2020 is summarized for the Canadian fishery only, but will be updated for the combined fishery removals once the USA data become available. The 2017 age class at age 4 Cod was a major contributor to the Canadian 2021 fishery catch (34% of the fish by number), followed closely by the 2018 year class at age 3 (32% by number), and distantly by the 2019 year class at age 2 (16% by number) (Figure 3; Figure 4). In 2021, fish ages 8+ accounted for less than 1% of the individuals caught in the Canadian fishery.

Harvest Strategy and Reference Points

The Transboundary Management Guidance Committee (TMGC) has adopted a strategy to maintain a low to neutral risk of exceeding the fishing mortality limit reference, $F_{ref}=0.18$ (TMGC 2003). When stock conditions are poor, fishing mortality rates should be further reduced to promote rebuilding. With the rejection of the 2013 Benchmark models and the implementation of the Data Limited Methods tool (DLMtool) simulation framework, an estimate of fishing mortality can no longer be calculated.

Data Limited Methods Tool Application

Following the rejection of the EGB Cod stock assessment models in 2018, the Transboundary Resource Assessment Committee (TRAC) applied the Data Limited Methods Tool (DLMtool) to

identify a simple, simulation tested method of providing catch advice for EGB Cod until a Benchmark can be held for this stock. Prior to completion of this application, the TRAC was asked to examine survey and fishery indicators and determine if there is a need to revisit the 2018 TRAC advice of 650 mt, resulting in a carry-over of that advice in each year (TRAC 2018, TRAC 2020). On April 22nd, 2021, the outputs of the simulation were presented at a TMGC Intercessional (see Andrushchenko et al. 2021), with the TMGC selecting two Management Procedures (MP) to provide interim advice: status quo (650 mt) and status quo minus 20% (520 mt). In 2022, the TMGC revised their decision to only select the status quo minus 20% (520 mt) MP. Given the simulated low productivity state for this stock, none of the MPs considered are expected to substantially change the current state of the EGB Cod stock, as long as conditions of low productivity persist.

The application of DLMtool to EGB Cod required several assumptions about the current biological metrics of the stock, namely weight, growth and maturity (see Andrushchenko et al. 2021). The outputs of the simulation testing remain valid as long as these biological assumptions hold. The DLMtool uses empirical data up to 2018 as the basis for these assumptions, which leaves room to test whether these assumptions hold when additional years of information become available. This year, the weight-at-age, growth, and maturity assumptions were compared to empirical survey data from the available National Marine Fisheries Service (NMFS) and Fisheries and Oceans Canada (DFO) surveys since 2019. Note that the 2020 NMFS spring and fall surveys were cancelled due to COVID-19 restrictions and are therefore absent from the analysis. In addition, the 2021 NMFS spring ages were not available in time for the 2021 TRAC assessment, so the current document includes updated information for the 2021 NMFS spring survey and newly presented 2022 data.

The updated data showed no major departure from the range used for the assumptions of weight-at-age, growth, and maturity, although the growth parameters are progressively moving towards the outer limits of the assumed range (Figures A5, A6, A7). A change in the growth rate of younger fish can cause a true increase in the K parameter, simultaneously causing the growth curve asymptote (S_{inf}) to fluctuate and creating uncertainty around whether S_{inf} has actually changed in recent years. The cohorts experiencing high growth are currently incomplete, making it difficult to model growth beyond the young ages in recent years. If the young cohorts (2019+) continue to exhibit better growth as their contribution to the population increases, the growth parameters assumed in the projections of DLMtool may move outside of the bounds in the upcoming years.

State of the Resource

Without an assessment model, the state of the resource is described by summarizing relevant survey trends. Biomass and abundance indices for the 2022 DFO spring survey will not be available until comparative fishing is complete. The survey **swept area biomass** was 1,114 mt for the 2021 NMFS fall survey, and 3,686 mt for the 2022 NMFS spring survey (Table A4; Figure A8). The 2021 NMFS fall survey swept area biomass value represents a decrease from 2019, while the NMFS spring value represents an increase from 2021 (Table A4; Figure A8). The **swept area abundance** from the NMFS fall survey increased slightly from 638,000 in 2019 to 653,000 in 2021, but remains below the recent series mean (1994–2019, 1.1 million fish) (Table A5c); for the NMFS spring survey, it increased from 1.5 million fish in 2020 to 1.8 million fish in 2021, but also remains below the recent series mean (2.8 million fish, 1994-2021). The DFO spring survey data are not ready for analysis, as a new vessel conversion factor has not yet been calculated.

Total mortality (Z) is calculated by two age groups (ages 4–5 and ages 6–8) using the NMFS spring survey abundance indices only, fitted with a LOESS smooth to help track trends (Figure A10). Total mortality trends from the NMFS spring survey based on catch curves began to break down over the past decade. The increasing occurrence of year and age combinations with no Cod observed in the surveys, particularly for the older ages, is problematic for these simple calculations of survey Z. For recent years where the calculation is functioning, total mortality on older fish is higher than on younger fish (Figure A10). Two additional years of data continue to show intermittent presence of older fish. In combination with missing surveys, this creates numerous gaps in the time series. Although the time series only provides intermittent glimpses into the level of total mortality, the absence of older fish from the survey catch confirms that high mortality on older fish continues. The total mortality calculation using the Sinclair (2001) approach also appears to have broken down for the NMFS spring survey, but the exact cause was not investigated due to time limitations (Figure A11).

Productivity

The **spatial distributions** of Cod in the 2021 NMFS fall surveys and 2022 DFO and NMFS spring surveys remained comparable to the previous years. The DFO data are provided without conversion only to illustrate the location of catches and not catch size. For the NMFS spring and fall surveys, large survey sets recorded along the northeastern edge of Georges Bank in the previous ten years were absent in the most recent year (Figure A12). The catches from the DFO spring survey were distributed across the Canadian portion of the bank, while the NMFS spring catches were broadly distributed across the American portion of eastern Georges Bank, particularly near the Hague Line. The NMFS fall catches were confined to the northeast edge of the Canadian portion of the bank. Given the comparable magnitude of catches for the USA spring survey in the past two years, the accompanying coefficients of variation were relatively low (Figure A9).

The 2021 TRAC recommended exploration of **distribution indices** to help characterize the visual interpretation of changes in the spatial distribution of Cod on eastern Georges Bank. Consequently, the geographic range (D95) and the core area (D50) indices derived from the design-weighted area of occupancy (DWA0) were calculated for all three survey data sources (Figure A16). This method was initially developed for use in American Plaice assessments (Swain and Morin 1996, Busby et al. 2007) and applied most recently in Ricard (2022) to a wide range of species.

Long-term changes in the geographic range and the core area of Cod on eastern Georges Bank tend to be generally consistent by data source. The DFO survey shows a decrease in D95 post-1990s, while the D50 remains relatively constant over the time period (Figure A16). The trends in the NMFS spring survey are less pronounced, but also appear to show a slight constriction of both the D50 and the D95 in the 1990s (Figure A16). The NMFS fall survey shows a similar constriction of the D95 in the mid-1990s, while trends in the D50 are difficult to discern due to a large number of missing points (Figure A16). This is the consequence of a small number of sets that contain a large proportion of the catch.

It was noted that if the area surveyed is invariable over time the DWA0 can detect a shrinkage or expansion in the spatial distribution of a species, but is generally imperceptive to a spatial migration of the species within the surveyed area (i.e. NMFS Spring 2022). In addition, the variability in the area surveyed over time in the NMFS surveys can confound the DWA0's ability to detect trends, indicating that other indices may be more appropriate to use in the future (e.g., Gini).

The **length frequency** of the survey catch in the 2022 NMFS spring survey peaked at 58 cm (23in), while the 2021 NMFS fall survey catch is characterized by an unusually large peak at 43 cm (17 in), representing one-year old fish (Figure A13).

Fulton's **condition factor** (K) was updated for all three surveys (Figure A14). The surveys showed a downward trend throughout the series until 2009, when K either stabilized or began to increase for all three surveys (Figure A14). With the most recent data, Cod condition remains below the long-term mean for the DFO spring survey and above the long-term mean for both the NMFS fall and spring surveys.

The most recent data update indicated an improvement in **growth** of young Cod on eastern Georges Bank, while older fish continue to grow slowly. The effect is most pronounced on fish aged 1 through 5 (Figure A17), is evident across various data sources (Canadian fishery and surveys) and ageing labs (NMFS and DFO), and persists when time of year is taken into account. In general, it appears as though young fish sampled in 2021 and 2022 all grow as well as the faster growing fish sampled in previous years (Figure A17), comparable to the level of growth seen prior to 1994 (Figure A18). An initial examination of growth by cohort indicated that the growth rate of the 2019, 2020 and 2021 cohorts is among the highest in the recent time period (Figure A19). The current analysis is preliminary and was done under a tight timeline in preparation for the 2022 TRAC meeting; further examination of growth rates and investigation into likely causes should take place as resources permit, particularly in preparation for a benchmark.

Outlook

Available survey and fishery indicators generally remained consistent with previous years (Table A6), indicating that productivity of the stock remains low and there is no notable change in the state of the stock.

Given that the biological assumptions going into DLMtool are maintained, the simulated operating models remain appropriate. Based on the approved Management Procedure selected by the TMGC, the TRAC catch advice for EGB Cod for 2023 is 520 mt and remains appropriate. There is a need to continue annual evaluation of whether the assumptions made in the projections of the DLMtool remain realistic, particularly if further evidence of higher than assumed growth emerges. The current application of the DLMtool is only intended as a short-term solution and should be replaced or supplemented with at least one functioning population model as soon as possible. The TRAC strongly recommends a benchmark for this stock.

Special Considerations

Estimated removals in recent years in USA EGB Cod catches are a source of uncertainty. Further investigation is needed into the ecological role of Cod and the potential implications of these changes on the recent productivity trends of Cod. In addition, investigation into the recent levels of natural mortality on eastern Georges Bank is recommended.

The USA commercial fishery data processing system is undergoing a change. The new system is called the Catch Accounting and Monitoring System (CAMS). Due to delays in implementation, the 2020 and 2021 USA commercial fishery data could not be processed in time for this meeting. The USA fishery data presented in this report were provided courtesy of Jamie Cournane (New England Fishery Management Council), Spencer Talmage and Dan Caless (NOAA Fisheries Greater Atlantic Regional Fisheries Office).

The NMFS and DFO ageing labs assume a different birth date for EGB Cod, with NMFS labs assuming fish are all born on January 1st and DFO labs assuming fish are all born on February 1st. For analyses using integer ages (i.e., whole age), the impact of this difference is limited to only fish sampled in the month of January; calculations of partial age are impacted regardless of month sampled.

Apparent improvement in growth of young fish and their relatively high abundance compared to the recent years in 2021 NMFS fall survey must be monitored to see if the signal persists as the fish age and increase their contribution to the population.

The USA is conducting a research track assessment on Atlantic Cod and an update was provided at this meeting. The TRAC anticipates another update next year. The current application of the DLMtool was only intended as a short-term solution and should be replaced with at least one functioning population model as soon as possible, particularly in light of apparent changes in growth of incoming year classes and the need by both Canada and the USA for science advice on stock status, reference points, etc.

Source Documents

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Correct Citation

TRAC. 2022. Eastern Georges Bank Cod. TRAC Status Report 2022/02.

APPENDIX

Table A1. Catches (mt) of Cod from eastern Georges Bank, 1978 to 2021. USA landings, Discards and Total Catch are reported for Fishing Year (May 1 – April 30). All other values, including Total Allowable Catch (TAC) are reported for calendar year (Jan 1 – Dec 31). The Combined Catch is the sum of USA Fishing Year Total Catch and Canadian Calendar Year Total Catch.

| Year | Canada | | | | | USA | | | | Combined | |
|------|----------|------------------|---------------------|-------------|-----|----------|----------|-------------|-----|----------|-------|
| | Landings | Discards Scallop | Discards Groundfish | Total Catch | TAC | Landings | Discards | Total Catch | TAC | Catch | TAC |
| 1978 | 8,777 | 98 | - | 8,875 | - | 5,502 | - | 5,502 | - | 14,377 | - |
| 1979 | 5,979 | 103 | - | 6,082 | - | 6,408 | - | 6,408 | - | 12,490 | - |
| 1980 | 8,066 | 83 | - | 8,149 | - | 6,418 | - | 6,418 | - | 14,567 | - |
| 1981 | 8,508 | 98 | - | 8,606 | - | 8,092 | - | 8,092 | - | 16,698 | - |
| 1982 | 17,827 | 71 | - | 17,898 | - | 8,565 | - | 8,565 | - | 26,463 | - |
| 1983 | 12,131 | 65 | - | 12,196 | - | 8,572 | - | 8,572 | - | 20,769 | - |
| 1984 | 5,761 | 68 | - | 5,829 | - | 10,558 | - | 10,558 | - | 16,387 | - |
| 1985 | 10,442 | 103 | - | 10,545 | - | 6,641 | - | 6,641 | - | 17,186 | - |
| 1986 | 8,504 | 51 | - | 8,555 | - | 5,696 | - | 5,696 | - | 14,251 | - |
| 1987 | 11,844 | 76 | - | 11,920 | - | 4,793 | - | 4,793 | - | 16,713 | - |
| 1988 | 12,741 | 83 | - | 12,824 | - | 7,645 | - | 7,645 | - | 20,470 | - |
| 1989 | 7,895 | 76 | - | 7,971 | - | 6,182 | 84 | 6,267 | - | 14,238 | - |
| 1990 | 14,364 | 70 | - | 14,434 | - | 6,414 | 69 | 6,483 | - | 20,917 | - |
| 1991 | 13,467 | 65 | - | 13,532 | - | 6,353 | 112 | 6,464 | - | 19,997 | - |
| 1992 | 11,667 | 71 | - | 11,738 | - | 5,080 | 177 | 5,257 | - | 16,995 | - |
| 1993 | 8,526 | 63 | - | 8,589 | - | 4,019 | 57 | 4,077 | - | 12,665 | - |
| 1994 | 5,277 | 63 | - | 5,340 | - | 998 | 5 | 1,003 | - | 6,343 | - |
| 1995 | 1,102 | 38 | - | 1,140 | - | 543 | 0.2 | 544 | - | 1,683 | - |
| 1996 | 1,924 | 56 | 0.0 | 1,980 | - | 676 | 1 | 677 | - | 2,657 | - |
| 1997 | 2,919 | 58 | 428 | 3,405 | - | 549 | 6 | 555 | - | 3,960 | - |
| 1998 | 1,907 | 92 | 273 | 2,272 | - | 679 | 7 | 686 | - | 2,959 | - |
| 1999 | 1,818 | 85 | 253 | 2,156 | - | 1,195 | 9 | 1,204 | - | 3,360 | - |
| 2000 | 1,572 | 69 | 0.0 | 1,641 | - | 772 | 16 | 788 | - | 2,429 | - |
| 2001 | 2,143 | 143 | 0.0 | 2,286 | - | 1,488 | 146 | 1,634 | - | 3,920 | - |
| 2002 | 1,278 | 94 | 0.0 | 1,372 | - | 1,688 | 9 | 1,697 | - | 3,069 | - |
| 2003 | 1,317 | 200 | - | 1,528 | - | 1,851 | 85 | 1,935 | - | 3,463 | - |
| 2004 | 1,112 | 145 | - | 1,257 | NA | 1,006 | 57 | 1,063 | NA | 2,321 | 1,300 |
| 2005 | 630 | 84 | 144 | 859 | NA | 171 | 199 | 370 | NA | 1,228 | 1,000 |
| 2006 | 1,096 | 112 | 237 | 1,445 | NA | 131 | 94 | 226 | NA | 1,671 | 1,700 |
| 2007 | 1,108 | 114 | 0.0 ¹ | 1,222 | NA | 234 | 279 | 513 | NA | 1,735 | 1,900 |

¹ Discards for the Mobile Fleet were calculated to be 0. Discards for the Fixed Gear fleet were not calculated due to low observer coverage.

| Year | Canada | | | | | USA | | | | Combined | |
|------|----------|---------------------|------------------------|----------------|-------|----------|----------|----------------|-------|----------|-------|
| | Landings | Discards Scallop | Discards Groundfish | Total Catch | TAC | Landings | Discards | Total Catch | TAC | Catch | TAC |
| 2008 | 1,390 | 36 | 103 | 1,529 | 1,633 | 224 | 20 | 244 | 667 | 1,774 | 2,300 |
| 2009 | 1,003 | 69 | 137 | 1,209 | 1,173 | 433 | 147 | 580 | 527 | 1,789 | 1,700 |
| 2010 | 748 | 44 | 48 | 840 | 1,012 | 357 | 97 | 454 | 338 | 1,294 | 1,350 |
| 2011 | 702 | 29 | 13 | 743 | 850 | 267 | 20 | 287 | 200 | 1,030 | 1,050 |
| 2012 | 395 | 42 | 31 | 468 | 612 | 96 | 52 | 148 | 63 | 616 | 675 |
| 2013 | 385 | 18 | 21 | 424 | 504 | 24 | 16 | 40 | 96 | 464 | 600 |
| 2014 | 430 | 15 | 13 | 458 | 546 | 114 | 2 | 116 | 154 | 574 | 700 |
| 2015 | 472 | 13 | 7 | 492 | 526 | 111 | 5 | 116 | 124 | 608 | 650 |
| 2016 | 428 | 9 | 3 | 440 | 488 | 92 | 5 | 97 | 136 | 537 | 624 |
| 2017 | 474 | 7 | 7 | 488 | 584 | 34 | 4 | 38 | 146 | 526 | 730 |
| 2018 | 510 | 5 | 2 | 517 | 694 | 47 | 2 | 48 | 257 | 565 | 951 |
| 2019 | 388 | 5 | 3 | 396 | 461 | 30 | 1 | 31 | 189 | 428 | 650 |
| 2020 | 362 | 11 | 4 | 377 | 461 | 64 | 3 | 67 | 189 | 444 | 650 |
| 2021 | 420 | 5 | 6 | 431 | 444.5 | 55 | 1 | 56 | 190.5 | 487 | 635 |
| Min | 362 | 5 | 0 | 377 | | 377 | 24 | 0 | | 428 | |
| Max | 17,827 | 200 | 428 | 17,898 | | 17,898 | 10,558 | 279 | | 26,463 | |
| Ave | 4,541 | 66 | 72 | 4,647 | | 4,647 | 2,747 | 54 | | 7,796 | |

Table A2. Length and age samples from the United States of America (USA) and Canadian fisheries on eastern Georges Bank. For Canadian fisheries, at-sea observer samples are included since 1990. The first quarter age samples are supplemented with USA fishery age samples from 5Zjm for 1978–1986 and Fisheries and Oceans Canada survey age samples for 1987–2021; the numbers are shown in brackets. The highlighted numbers include samples from western Georges Bank. “-” indicates commercial data from the USA fishery that is not available for 2020 or 2021.

| Year | USA | | Canada | |
|------|---------|-------|---------|---------------|
| | Lengths | Ages | Lengths | Ages |
| 1978 | 2,294 | 384 | 7,684 | 1,364 |
| 1979 | 2,384 | 402 | 3,103 | 796 (205) |
| 1980 | 2,080 | 286 | 2,784 | 728 (192) |
| 1981 | 1,498 | 455 | 4,147 | 897 |
| 1982 | 4,466 | 778 | 4,705 | 1,126 (268) |
| 1983 | 3,906 | 903 | 3,822 | 754 (150) |
| 1984 | 3,891 | 1,130 | 1,889 | 1,243 (858) |
| 1985 | 2,076 | 597 | 7,031 | 1,309 (351) |
| 1986 | 2,145 | 643 | 5,890 | 991 (103) |
| 1987 | 1,865 | 524 | 9,133 | 1,429 (193) |
| 1988 | 3,229 | 797 | 11,350 | 2,437 (510) |
| 1989 | 1,572 | 347 | 8,726 | 1,561 |
| 1990 | 2,395 | 552 | 31,974 | 2,825 (1,153) |
| 1991 | 1,969 | 442 | 27,869 | 1,782 |
| 1992 | 2,048 | 489 | 29,082 | 2,215 (359) |
| 1993 | 2,215 | 569 | 31,588 | 2,146 |
| 1994 | 898 | 180 | 27,972 | 1,268 |
| 1995 | 2645 | 14 | 6,660 | 548 |
| 1996 | 4,895 | 1,163 | 26,069 | 828 |
| 1997 | 1,761 | 82 | 31,617 | 1,216 |
| 1998 | 1,301 | 338 | 26,180 | 1,643 |
| 1999 | 726 | 228 | 26,232 | 1,290 (410) |
| 2000 | 500 | 121 | 20,582 | 1,374 |
| 2001 | 1,434 | 397 | 19,055 | 1,505 |
| 2002 | 1,424 | 429 | 16,119 | 1,252 |
| 2003 | 1,367 | 416 | 19,757 | 1,070 |
| 2004 | 1,547 | 517 | 18,392 | 1,357 |
| 2005 | 297 | 65 | 23,937 | 1,483 (697) |
| 2006 | 446 | 151 | 44,708 | 1,460 (648) |
| 2007 | 589 | 183 | 141,607 | 1,647 (456) |
| 2008 | 972 | 295 | 64,387 | 1,709 (495) |
| 2009 | 1,286 | 326 | 48,335 | 1,725 (246) |

| Year | USA | | Canada | |
|------|---------|-------|---------|--------------------------|
| | Lengths | Ages | Lengths | Ages |
| 2010 | 1,446 | 333 | 30,594 | 1,455 (433) |
| 2011 | 1,203 | 213 | 40,936 | 1,655 (536) |
| 2012 | 598 | 746 | 49,447 | 1,115 (216) |
| 2013 | 2,951 | 842 | 75,275 | 1,334 (319) |
| 2014 | 547 | 85 | 50,501 | 1,141 (184) |
| 2015 | 4,677 | 1,049 | 74,028 | 970 (202) |
| 2016 | 715 | 149 | 76,869 | 990 (282) |
| 2017 | 4,120 | 1,150 | 50,902 | 1,039 (334) ¹ |
| 2018 | 1,695 | 412 | 54,609 | 1,254 (309) ¹ |
| 2019 | 1,180 | 288 | 60,851 | 1,401 (190) |
| 2020 | - | - | 45,567 | 1,199 (259) |
| 2021 | - | - | 34,430 | 1,144 (151) |

¹ Survey ALK used to supplement quarter 1 age and length data for scallop discards only

Table A4. Swept area biomass (mt) for eastern Georges Bank Cod from the Fisheries and Oceans (DFO), National Marine Fisheries Service (NMFS) spring and fall surveys. Conversion factors to account for vessel and trawl door changes have been applied. The biomass conversion factor used for the Henry B. Bigelow since 2009 is 1.58 ($B_{survey} = B_{bigelow} / 1.58$). “-” indicates no data available.

| Year | NMFS Fall | NMFS Spring | DFO |
|------|-----------|-------------|--------|
| 1970 | 5,054 | 7,801 | - |
| 1971 | 5,287 | 10,435 | - |
| 1972 | 3,947 | 13,779 | - |
| 1973 | 11,697 | 82,311 | - |
| 1974 | 2,741 | 27,269 | - |
| 1975 | 5,246 | 23,503 | - |
| 1976 | 5,082 | 10,354 | - |
| 1977 | 9,509 | 9,335 | - |
| 1978 | 12,213 | 22,731 | - |
| 1979 | 13,050 | 12,831 | - |
| 1980 | 4,494 | 20,520 | - |
| 1981 | 7,256 | 18,568 | - |
| 1982 | 2,216 | 172,300 | - |
| 1983 | 2,449 | 20,376 | - |
| 1984 | 7,018 | 4,808 | - |
| 1985 | 2,390 | 23,190 | - |
| 1986 | 2,174 | 12,532 | 18,633 |
| 1987 | 2,634 | 7,615 | 8,824 |
| 1988 | 6,764 | 9,294 | 19,452 |
| 1989 | 5,145 | 12,104 | 14,547 |
| 1990 | 5,121 | 10,828 | 56,665 |
| 1991 | 435 | 9,391 | 25,068 |
| 1992 | 1,734 | 6,113 | 14,581 |
| 1993 | 606 | 6,598 | 16,545 |
| 1994 | 1,734 | 1,294 | 13,140 |
| 1995 | 1,220 | 10,113 | 8,118 |
| 1996 | 1,790 | 6,613 | 32,173 |
| 1997 | 1,875 | 4,051 | 11,004 |
| 1998 | 2,970 | 12,267 | 5,006 |
| 1999 | 1,044 | 5,308 | 9,178 |
| 2000 | 895 | 7,374 | 32,298 |
| 2001 | 1,159 | 3,721 | 18,037 |
| 2002 | 11,525 | 4,432 | 20,333 |
| 2003 | 608 | 6,405 | 6,218 |

| Year | NMFS Fall | NMFS Spring | DFO |
|-------------|------------------|--------------------|------------|
| 2004 | 8,347 | 21,080 | 5,661 |
| 2005 | 1,446 | 4,407 | 26,200 |
| 2006 | 2,165 | 7,331 | 12,546 |
| 2007 | 424 | 6,066 | 11,228 |
| 2008 | 792 | 5,327 | 13,657 |
| 2009 | 1,203 | 4,343 | 23,180 |
| 2010 | 732 | 3,587 | 26,352 |
| 2011 | 2,304 | 1,724 | 8,437 |
| 2012 | 609 | 4,864 | 2,449 |
| 2013 | 2,566 | 9,616 | 11,113 |
| 2014 | 1,376 | 3,254 | 2,409 |
| 2015 | 3,570 | 1,748 | 3,594 |
| 2016 | 5,438 | 3,579 | 3,656 |
| 2017 | 653 | 13,479 | 14,566 |
| 2018 | 2,549 | 3,097 | 7,198 |
| 2019 | 1,621 | 9,228 | 4,059 |
| 2020 | - | - | 4,214 |
| 2021 | 1,114 | 2,819 | 1,821 |
| 2022 | - | 3,686 | - |

Table A5a. Indices of swept area abundance (thousands) for eastern Georges Bank Cod from the Fisheries and Oceans Canada (DFO) survey, 1986–2021. Data from the 2022 survey are not yet available.

| Year/Age | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ | Total |
|----------|----|------|-------|-------|-------|-------|-------|-------|-----|-----|-----|----|----|----|----|----|-----|--------|
| 1986 | 0 | 770 | 3,538 | 3,204 | 331 | 692 | 445 | 219 | 35 | 66 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 9,311 |
| 1987 | 0 | 48 | 1,791 | 642 | 753 | 162 | 89 | 181 | 89 | 13 | 13 | 0 | 13 | 16 | 0 | 0 | 0 | 3,812 |
| 1988 | 0 | 148 | 450 | 5,337 | 565 | 838 | 95 | 79 | 179 | 18 | 12 | 4 | 0 | 16 | 0 | 0 | 0 | 7,741 |
| 1989 | 0 | 350 | 2,169 | 764 | 1,706 | 258 | 332 | 42 | 85 | 112 | 5 | 32 | 8 | 5 | 0 | 0 | 0 | 5,868 |
| 1990 | 20 | 106 | 795 | 3,471 | 1,953 | 4,402 | 535 | 1,094 | 144 | 157 | 289 | 65 | 52 | 37 | 0 | 0 | 5 | 13,125 |
| 1991 | 0 | 1198 | 1,019 | 1,408 | 1,639 | 882 | 1195 | 148 | 249 | 38 | 45 | 30 | 12 | 5 | 8 | 0 | 0 | 7,876 |
| 1992 | 0 | 48 | 2,049 | 1,221 | 409 | 643 | 451 | 300 | 93 | 38 | 0 | 3 | 3 | 18 | 0 | 0 | 0 | 5,276 |
| 1993 | 0 | 31 | 355 | 1,723 | 622 | 370 | 754 | 274 | 268 | 51 | 31 | 0 | 20 | 6 | 0 | 0 | 0 | 4,504 |
| 1994 | 0 | 13 | 629 | 691 | 1,289 | 477 | 182 | 363 | 84 | 119 | 12 | 0 | 0 | 0 | 8 | 5 | 0 | 3,871 |
| 1995 | 0 | 32 | 187 | 1,240 | 757 | 520 | 186 | 44 | 67 | 28 | 18 | 8 | 6 | 0 | 0 | 0 | 0 | 3,093 |
| 1996 | 0 | 90 | 203 | 1,744 | 4,337 | 1,432 | 1034 | 445 | 107 | 149 | 39 | 4 | 0 | 0 | 5 | 0 | 0 | 9,590 |
| 1997 | 0 | 30 | 376 | 568 | 1,325 | 1,262 | 216 | 50 | 35 | 23 | 17 | 0 | 3 | 0 | 0 | 0 | 0 | 3,905 |
| 1998 | 0 | 6 | 582 | 831 | 322 | 317 | 238 | 56 | 29 | 7 | 8 | 3 | 4 | 0 | 0 | 0 | 0 | 2,402 |
| 1999 | 0 | 3 | 156 | 1,298 | 1,090 | 449 | 317 | 190 | 10 | 28 | 5 | 9 | 0 | 3 | 0 | 0 | 0 | 3,561 |
| 2000 | 0 | 0 | 423 | 1,294 | 4,967 | 2,157 | 1031 | 510 | 317 | 20 | 23 | 12 | 0 | 0 | 0 | 0 | 0 | 10,754 |
| 2001 | 0 | 3 | 37 | 802 | 519 | 1,391 | 645 | 334 | 224 | 225 | 36 | 24 | 7 | 0 | 0 | 0 | 0 | 4,248 |
| 2002 | 0 | 0 | 118 | 477 | 2,097 | 694 | 1283 | 458 | 188 | 63 | 76 | 7 | 0 | 0 | 0 | 0 | 0 | 5,462 |
| 2003 | 0 | 0 | 8 | 200 | 510 | 867 | 194 | 219 | 69 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,078 |
| 2004 | 0 | 427 | 40 | 246 | 381 | 422 | 353 | 59 | 108 | 25 | 5 | 0 | 3 | 0 | 0 | 0 | 0 | 2,069 |
| 2005 | 0 | 25 | 1,025 | 1,398 | 7,149 | 1,766 | 816 | 743 | 60 | 87 | 8 | 4 | 0 | 0 | 0 | 0 | 0 | 13,082 |
| 2006 | 0 | 0 | 41 | 1,500 | 673 | 1,779 | 757 | 217 | 216 | 83 | 34 | 10 | 15 | 0 | 0 | 0 | 0 | 5,325 |
| 2007 | 0 | 18 | 130 | 549 | 2,606 | 379 | 653 | 119 | 81 | 53 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 4,591 |
| 2008 | 0 | 12 | 147 | 1,027 | 755 | 2,978 | 194 | 392 | 41 | 4 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 5,569 |
| 2009 | 0 | 11 | 51 | 2,487 | 2,261 | 519 | 2,955 | 0 | 82 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 8,384 |

| Year/Age | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ | Total |
|----------|---|-----|-----|-------|-------|-------|-----|-------|-----|----|----|----|----|----|----|----|-----|-------|
| 2010 | 0 | 5 | 92 | 956 | 4,105 | 1,781 | 703 | 1,828 | 65 | 84 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 9,623 |
| 2011 | 0 | 193 | 271 | 766 | 952 | 1,324 | 256 | 67 | 112 | 14 | 8 | 2 | 0 | 0 | 0 | 0 | 0 | 3,965 |
| 2012 | 0 | 9 | 149 | 327 | 315 | 195 | 158 | 7 | 18 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,182 |
| 2013 | 0 | 0 | 431 | 3,754 | 2,173 | 285 | 81 | 52 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,786 |
| 2014 | 0 | 76 | 9 | 360 | 538 | 169 | 35 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,213 |
| 2015 | 0 | 0 | 476 | 152 | 598 | 439 | 97 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,770 |
| 2016 | 0 | 8 | 197 | 1,004 | 199 | 273 | 147 | 16 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,848 |
| 2017 | 0 | 5 | 52 | 1,660 | 5,897 | 194 | 270 | 188 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,266 |
| 2018 | 0 | 39 | 149 | 520 | 1,060 | 1,610 | 77 | 50 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,512 |
| 2019 | 0 | 9 | 269 | 1,005 | 574 | 389 | 284 | 0 | 0 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 2,542 |
| 2020 | 0 | 32 | 466 | 1,753 | 620 | 330 | 49 | 20 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,274 |
| 2021 | 4 | 62 | 189 | 297 | 394 | 101 | 43 | 6 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,124 |

Table A5b. Indices of swept area abundance (thousands) for eastern Georges Bank Cod from the National Marine Fisheries Service (NMFS) spring survey, 1970–2022. Conversion factors to account for vessel and trawl door changes have been applied. During 1973–1981 a Yankee-41 net was used rather than the standard Yankee-36 net. There was no NMFS spring survey in 2020.

| Year/Age | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ | Total |
|----------|-----|-------|--------|--------|--------|-------|-----|-------|-----|-----|-----|----|----|----|----|----|-----|--------|
| 1970 | 0 | 354 | 1,115 | 302 | 610 | 73 | 263 | 48 | 0 | 71 | 24 | 0 | 48 | 0 | 0 | 0 | 0 | 2,907 |
| 1971 | 0 | 185 | 716 | 503 | 119 | 326 | 124 | 257 | 227 | 40 | 40 | 79 | 0 | 0 | 0 | 0 | 0 | 2,615 |
| 1972 | 56 | 1,578 | 1,856 | 2,480 | 393 | 114 | 136 | 60 | 88 | 73 | 18 | 14 | 0 | 0 | 14 | 0 | 0 | 6,879 |
| 1973 | 0 | 665 | 37,880 | 5,474 | 6,109 | 567 | 467 | 413 | 0 | 163 | 231 | 0 | 0 | 0 | 95 | 0 | 0 | 52,064 |
| 1974 | 0 | 461 | 5,877 | 4,030 | 759 | 2,001 | 360 | 91 | 267 | 45 | 48 | 54 | 0 | 0 | 0 | 0 | 0 | 13,991 |
| 1975 | 0 | 0 | 467 | 3,061 | 4,348 | 446 | 960 | 79 | 0 | 122 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,483 |
| 1976 | 84 | 1,733 | 1,111 | 620 | 444 | 759 | 0 | 167 | 35 | 0 | 0 | 0 | 0 | 48 | 0 | 0 | 0 | 5,001 |
| 1977 | 0 | 0 | 2,358 | 736 | 354 | 307 | 334 | 22 | 35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,145 |
| 1978 | 373 | 187 | 0 | 2,825 | 615 | 916 | 153 | 787 | 62 | 43 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 6,001 |
| 1979 | 71 | 339 | 1,332 | 122 | 1,430 | 543 | 176 | 91 | 130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,234 |
| 1980 | 0 | 11 | 2,251 | 2,168 | 169 | 1,984 | 410 | 78 | 48 | 31 | 0 | 47 | 0 | 0 | 0 | 0 | 0 | 7,197 |
| 1981 | 283 | 1,956 | 1,311 | 2,006 | 1,093 | 43 | 453 | 197 | 59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7,399 |
| 1982 | 44 | 455 | 6,642 | 13,614 | 12,667 | 9,406 | 0 | 3,088 | 992 | 120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47,027 |
| 1983 | 0 | 389 | 2,017 | 3,781 | 779 | 608 | 315 | 106 | 98 | 0 | 70 | 0 | 0 | 0 | 0 | 0 | 35 | 8,197 |
| 1984 | 0 | 103 | 117 | 344 | 483 | 92 | 182 | 74 | 18 | 105 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,518 |
| 1985 | 58 | 36 | 2,032 | 633 | 1,061 | 1,518 | 328 | 217 | 213 | 83 | 116 | 34 | 23 | 0 | 0 | 0 | 0 | 6,352 |
| 1986 | 97 | 619 | 339 | 1,132 | 298 | 427 | 536 | 20 | 109 | 142 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,719 |
| 1987 | 0 | 0 | 1,194 | 247 | 568 | 0 | 152 | 148 | 30 | 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,394 |
| 1988 | 138 | 320 | 243 | 2,795 | 274 | 461 | 51 | 5 | 67 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 4,364 |
| 1989 | 0 | 174 | 1,238 | 338 | 1,685 | 234 | 396 | 99 | 12 | 36 | 48 | 24 | 0 | 0 | 0 | 0 | 0 | 4,284 |
| 1990 | 24 | 45 | 360 | 1,687 | 586 | 634 | 152 | 164 | 19 | 0 | 0 | 24 | 0 | 0 | 0 | 0 | 0 | 3,696 |
| 1991 | 217 | 725 | 620 | 514 | 903 | 460 | 382 | 44 | 17 | 0 | 24 | 53 | 0 | 0 | 0 | 0 | 0 | 3,957 |
| 1992 | 0 | 81 | 666 | 349 | 103 | 261 | 152 | 159 | 27 | 52 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,850 |
| 1993 | 0 | 0 | 462 | 1,284 | 262 | 46 | 182 | 46 | 43 | 46 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 2,382 |

| Year/Age | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ | Total |
|----------|-----|-----|-------|-------|-------|-------|-------|-----|-----|----|----|----|----|----|----|----|-----|-------|
| 1994 | 38 | 54 | 194 | 152 | 185 | 44 | 11 | 33 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 720 |
| 1995 | 384 | 70 | 294 | 927 | 495 | 932 | 191 | 253 | 0 | 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,614 |
| 1996 | 0 | 139 | 300 | 990 | 1,343 | 121 | 94 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,016 |
| 1997 | 271 | 54 | 218 | 48 | 402 | 519 | 53 | 126 | 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,747 |
| 1998 | 54 | 0 | 1,040 | 1,985 | 995 | 983 | 609 | 30 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,729 |
| 1999 | 22 | 22 | 145 | 673 | 624 | 370 | 172 | 107 | 34 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,176 |
| 2000 | 36 | 0 | 304 | 643 | 1,348 | 492 | 138 | 52 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,032 |
| 2001 | 0 | 0 | 64 | 889 | 96 | 350 | 109 | 0 | 12 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,530 |
| 2002 | 36 | 0 | 121 | 470 | 1,081 | 175 | 214 | 61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,158 |
| 2003 | 0 | 0 | 125 | 287 | 812 | 1,154 | 135 | 78 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,599 |
| 2004 | 0 | 549 | 10 | 838 | 2,091 | 2,105 | 1,351 | 239 | 382 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7,595 |
| 2005 | 36 | 15 | 345 | 70 | 747 | 287 | 190 | 131 | 34 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,855 |
| 2006 | 0 | 37 | 73 | 952 | 411 | 1,007 | 340 | 151 | 79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,050 |
| 2007 | 0 | 0 | 369 | 308 | 2,258 | 239 | 291 | 47 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,540 |
| 2008 | 43 | 37 | 112 | 675 | 372 | 1,385 | 51 | 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,741 |
| 2009 | 0 | 61 | 86 | 875 | 408 | 219 | 377 | 24 | 12 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,078 |
| 2010 | 0 | 25 | 126 | 367 | 667 | 168 | 44 | 147 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,556 |
| 2011 | 0 | 88 | 164 | 164 | 266 | 144 | 56 | 9 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 914 |
| 2012 | 3 | 3 | 450 | 749 | 834 | 209 | 127 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,389 |
| 2013 | 0 | 0 | 653 | 3,864 | 1,202 | 129 | 64 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,926 |
| 2014 | 0 | 55 | 64 | 568 | 922 | 109 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,746 |
| 2015 | 0 | 9 | 165 | 71 | 222 | 331 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 820 |
| 2016 | 4 | 4 | 179 | 1,454 | 173 | 168 | 82 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,074 |
| 2017 | 0 | 43 | 54 | 469 | 2,681 | 808 | 502 | 165 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,274 |
| 2018 | 0 | 99 | 149 | 607 | 550 | 346 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,770 |
| 2019 | 9 | 110 | 1,157 | 1,042 | 1,982 | 834 | 213 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,355 |

| Year/Age | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ | Total |
|----------|----|----|-----|-----|-----|----|----|----|---|---|----|----|----|----|----|----|-----|-------|
| 2020 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2021 | 47 | 41 | 336 | 616 | 370 | 81 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,500 |
| 2022 | 4 | 85 | 398 | 886 | 315 | 95 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,810 |

Table A5c. Indices of swept area abundance (thousands) for eastern Georges Bank Cod from the National Marine Fisheries Service (NMFS) fall survey, 1970-2021. Conversion factors to account for vessel and trawl door changes have been applied. There was no NMFS fall survey in 2020.

| Year/Age | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ | Total |
|----------|-------|-------|-------|-------|-------|-----|-----|----|----|----|----|----|----|----|----|----|-----|-------|
| 1970 | 348 | 1,416 | 836 | 208 | 412 | 11 | 0 | 0 | 5 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,261 |
| 1971 | 203 | 1,148 | 900 | 181 | 232 | 130 | 142 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,951 |
| 1972 | 1,110 | 3,299 | 614 | 667 | 24 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,753 |
| 1973 | 46 | 2,435 | 2,947 | 997 | 979 | 93 | 0 | 25 | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7,584 |
| 1974 | 77 | 196 | 399 | 622 | 54 | 31 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,394 |
| 1975 | 414 | 660 | 177 | 414 | 764 | 27 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,501 |
| 1976 | 0 | 8,260 | 362 | 144 | 0 | 91 | 0 | 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,904 |
| 1977 | 51 | 0 | 3,475 | 714 | 184 | 156 | 178 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,760 |
| 1978 | 113 | 1,519 | 58 | 3,027 | 417 | 58 | 63 | 77 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,330 |
| 1979 | 182 | 1,704 | 1,695 | 116 | 1,522 | 243 | 48 | 20 | 11 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,557 |
| 1980 | 315 | 782 | 409 | 649 | 22 | 184 | 14 | 17 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,412 |
| 1981 | 360 | 2,352 | 1,208 | 933 | 269 | 15 | 29 | 0 | 0 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 5,220 |
| 1982 | 0 | 549 | 718 | 54 | 59 | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,406 |
| 1983 | 948 | 73 | 267 | 567 | 24 | 8 | 8 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,917 |
| 1984 | 29 | 1,805 | 120 | 690 | 1,025 | 23 | 32 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,734 |
| 1985 | 1,245 | 209 | 993 | 161 | 18 | 5 | 9 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 2,645 |
| 1986 | 119 | 3,018 | 56 | 198 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,396 |
| 1987 | 156 | 129 | 845 | 121 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 1,357 |
| 1988 | 95 | 561 | 177 | 1,182 | 163 | 206 | 0 | 30 | 41 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,464 |
| 1989 | 318 | 570 | 1,335 | 222 | 607 | 78 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,154 |
| 1990 | 198 | 403 | 442 | 831 | 120 | 204 | 20 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,232 |
| 1991 | 0 | 158 | 60 | 71 | 10 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 322 |
| 1992 | 0 | 205 | 726 | 154 | 0 | 37 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,134 |
| 1993 | 0 | 81 | 104 | 158 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 362 |

| Year/Age | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ | Total |
|----------|-----|-----|-------|-------|-------|-----|-----|-----|----|----|----|----|----|----|----|----|-----|-------|
| 1994 | 10 | 78 | 282 | 220 | 143 | 13 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 771 |
| 1995 | 223 | 28 | 122 | 304 | 66 | 29 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 779 |
| 1996 | 10 | 291 | 76 | 293 | 211 | 53 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 961 |
| 1997 | 0 | 161 | 394 | 181 | 58 | 84 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 907 |
| 1998 | 0 | 171 | 684 | 480 | 65 | 109 | 0 | 0 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,538 |
| 1999 | 0 | 15 | 14 | 249 | 124 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 434 |
| 2000 | 30 | 55 | 204 | 68 | 89 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 493 |
| 2001 | 25 | 74 | 106 | 257 | 38 | 75 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 598 |
| 2002 | 122 | 110 | 635 | 712 | 2,499 | 170 | 211 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,476 |
| 2003 | 76 | 0 | 24 | 100 | 70 | 17 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 293 |
| 2004 | 108 | 422 | 68 | 840 | 385 | 545 | 436 | 103 | 30 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 2,969 |
| 2005 | 21 | 29 | 508 | 114 | 251 | 43 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 976 |
| 2006 | 0 | 146 | 123 | 530 | 37 | 263 | 16 | 16 | 16 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,162 |
| 2007 | 60 | 22 | 136 | 7 | 69 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 302 |
| 2008 | 0 | 74 | 170 | 55 | 15 | 98 | 15 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 442 |
| 2009 | 54 | 37 | 194 | 280 | 39 | 18 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 633 |
| 2010 | 434 | 27 | 79 | 74 | 121 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 755 |
| 2011 | 58 | 323 | 362 | 248 | 177 | 110 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,309 |
| 2012 | 0 | 14 | 188 | 90 | 13 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 324 |
| 2013 | 162 | 51 | 565 | 554 | 226 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,559 |
| 2014 | 98 | 144 | 47 | 145 | 223 | 28 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 697 |
| 2015 | 42 | 223 | 1,208 | 94 | 162 | 131 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,859 |
| 2016 | 2 | 9 | 219 | 2,123 | 50 | 143 | 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,597 |
| 2017 | 43 | 73 | 76 | 66 | 91 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 348 |
| 2018 | 24 | 322 | 212 | 275 | 294 | 191 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,319 |
| 2019 | 17 | 80 | 171 | 163 | 82 | 63 | 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 638 |

| Year/Age | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ | Total |
|----------|----|-----|----|----|----|----|---|---|---|---|----|----|----|----|----|----|-----|-------|
| 2020 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2021 | 13 | 457 | 71 | 63 | 36 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 653 |

Table A6. Summary of change in fishery and survey indicators from 2021 to 2022 Transboundary Resource Assessment Committee (TRAC).
 CDN=Canada. USA=United States of America. DFO=Fisheries and Oceans Canada. NMFS=National Marine Fisheries Service.

| Indicators | 2020 TRAC | 2021 TRAC | 2022 TRAC | Summary |
|-------------------------|---|---|--|--|
| Fishery Catch | Landings= 418 mt Discards= 9 mt | Landings = 426 mt Discards = 18 mt | Landings = 505 mt Discards = 11 mt | Increase in landings Decrease in discards |
| Fishery Catch at Length | CDN: 58 cm (23 in) USA: 60 cm (24 in) | CDN: 61 cm (24 in) USA: NA | CDN: 64 cm (25 in) USA: NA | CDN fishery: Slight Increase USA fishery: NA |
| Fishery Catch at Age | 2016 (26% by number), 2017 (23%), and 2015 (22%) year classes | Only Canadian data: 2017 year class (43% by number) | Only Canadian data: 2017 (34% by number) and 2018 year classes (32% by number) | Pulled by two year classes, versus one in the previous year (**Based only on Canadian data) |
| Survey Catch at Length | DFO: 52 cm (20.5 in) NMFS spring: NA NMFS fall: multiple peaks (34 and 64 cm) | DFO: 61 cm (24 in) NMFS spring: 55 cm (22 in) NMFS fall: NA | DFO: NA NMFS spring: 58 cm (23 in) NMFS fall: 43cm (17 in) peak | DFO: NA NMFS spring: Slight Increase NMFS fall: One large peak, rather than two in 2019. |

| Indicators | 2020 TRAC | 2021 TRAC | 2022 TRAC | Summary |
|----------------------|--|---|--|---|
| Survey Catch at Age | DFO: Dominated by 2017 yc NMFS spring: NA NMFS fall: No dominant age class | DFO: Multiple contributing ycs NMFS spring: Multiple contributing ycs NMFS fall: NA | DFO: NA NMFS spring: Multiple contributing ycs NMFS fall: 2020 year class (70% by number) | DFO: NA NMFS spring: No Change NMFS fall: One dominant year class at Age 1 |
| Swept Area Abundance | DFO: 3.3 million NMFS spring: NA NMFS fall: 638 000 | DFO: 1.1 million NMFS spring: 1.5 million NMFS fall: NA | DFO: NA NMFS spring: 1.8 million NMFS fall: 653 000 | DFO: NA NMFS spr : Increase NMFS fall: Slight increase from 2020 |
| Biomass | DFO: 4,214 NMFS spring: NA NMFS fall: 1,621 | DFO: 1,821 NMFS spring: 2,819 NMFS fall: NA | DFO: NA NMFS spring: 3,686 NMFS fall: 1,114 | DFO: NA NMFS spr : Increase NMFS fall: Decrease from 2020 TRAC |
| Distribution (NEW) | | | D95 and D50 fluctuate since mid 1990s. DFO: Mostly east of Hague Line. NMFS spring: Mostly west of Hague Line NMFS fall: NE tip of EGB. | D95 or D50 continue fluctuating. Conflicting results from NMFS spring and DFO for centroid. |

| Indicators | 2020 TRAC | 2021 TRAC | 2022 TRAC | Summary |
|-------------------------------|---|---|--|---|
| Condition | DFO: < long term mean NMFS spring: NA NMFS fall: > long term mean | DFO: < long term mean NMFS spring: > long term mean NMFS fall: NA | DFO: < long term mean NMFS spring: > long term mean NMFS fall: >long term mean | DFO: No change NMFS spr : No change NMFS fall: No change since 2020 |
| Total Mortality on older ages | DFO: high NMFS spring: NA | DFO: high NMFS spring: NA | DFO: NA NMFS spring: NA | DFO: NA NMFS spring: NA |
| Growth (NEW) | | | Improved growth on young fish. Slow growth continues on old fish. | Improved growth on young fish. Slow growth continues on old fish. |

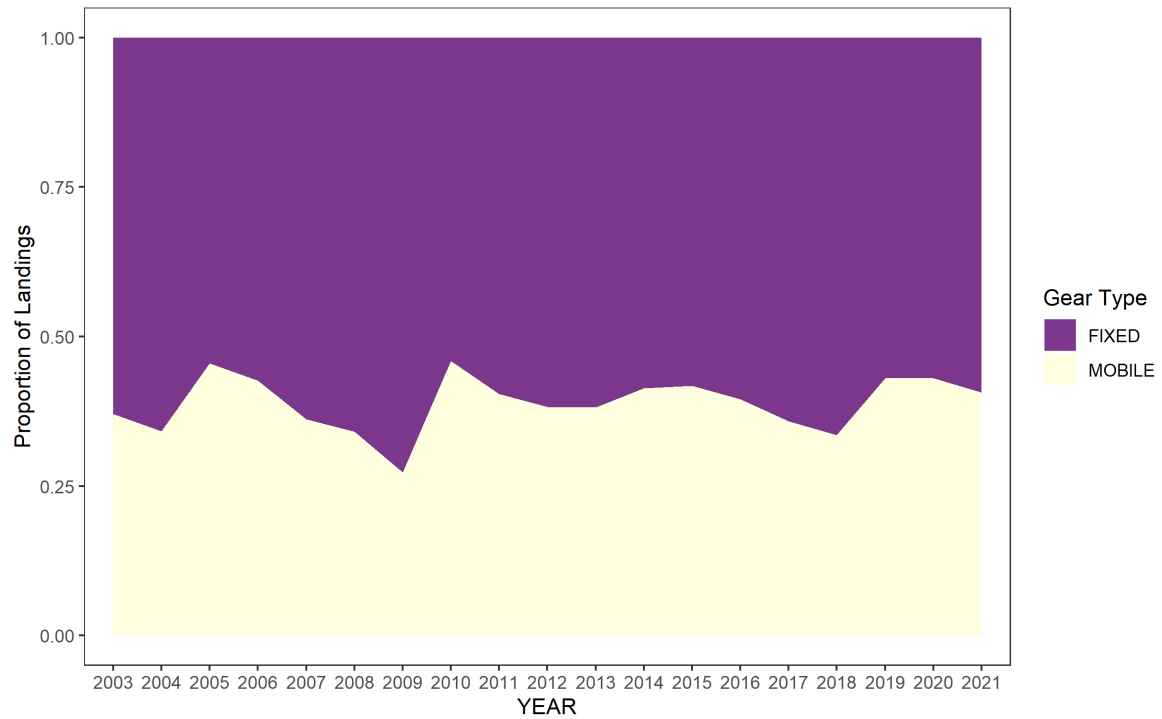


Figure A1. Proportional landings of Cod by major gear type from eastern Georges Bank for Canada (2002–2021). Commercial data from the United States of America fishery were not available for the 2020 or 2021 fishing years.

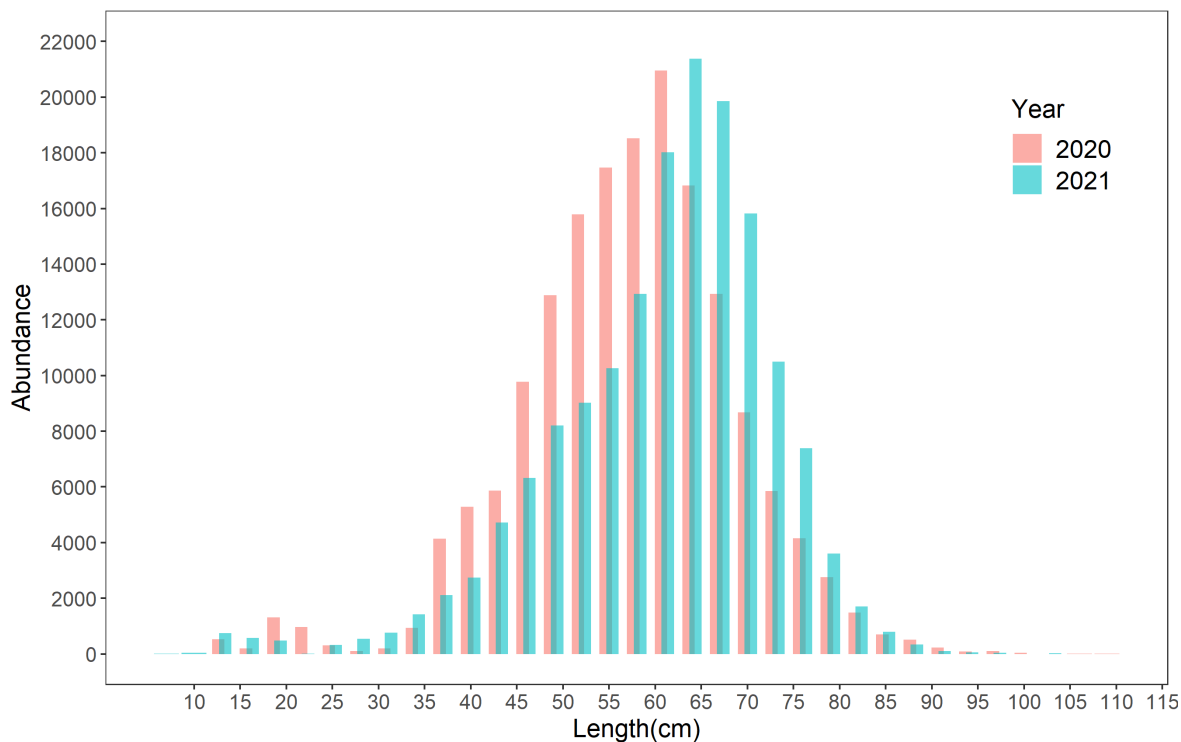


Figure A2. Length frequency of Cod catch (landings and discards) from the 2020 and 2021 Canadian fisheries on eastern Georges Bank. Commercial data from the USA fishery were not available for the 2020 or 2021 fishing years.

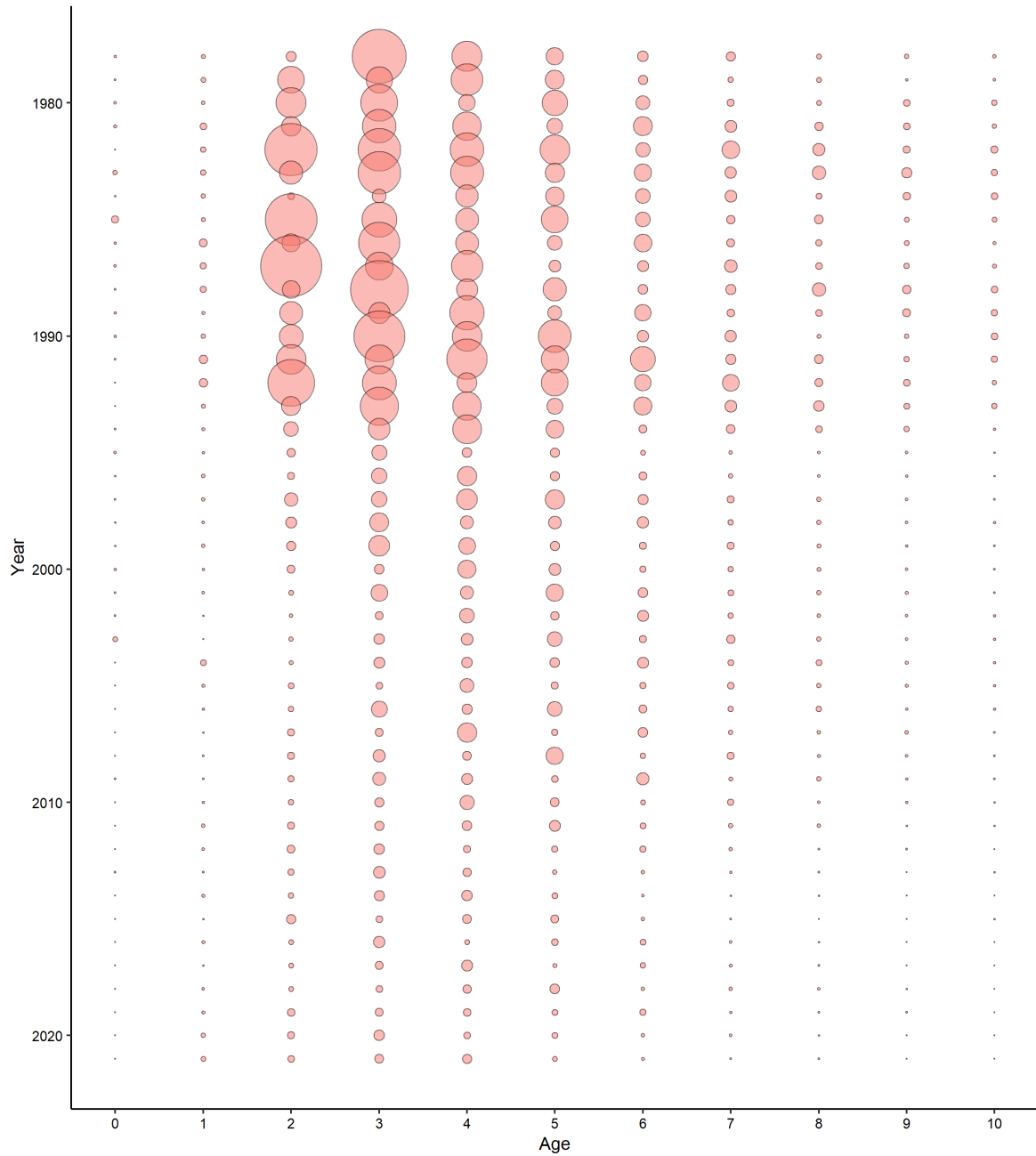


Figure A3. Fishery catch-at-age abundance for the Canadian fishery, updated through until 2021. Size of bubbles is representative of abundance.

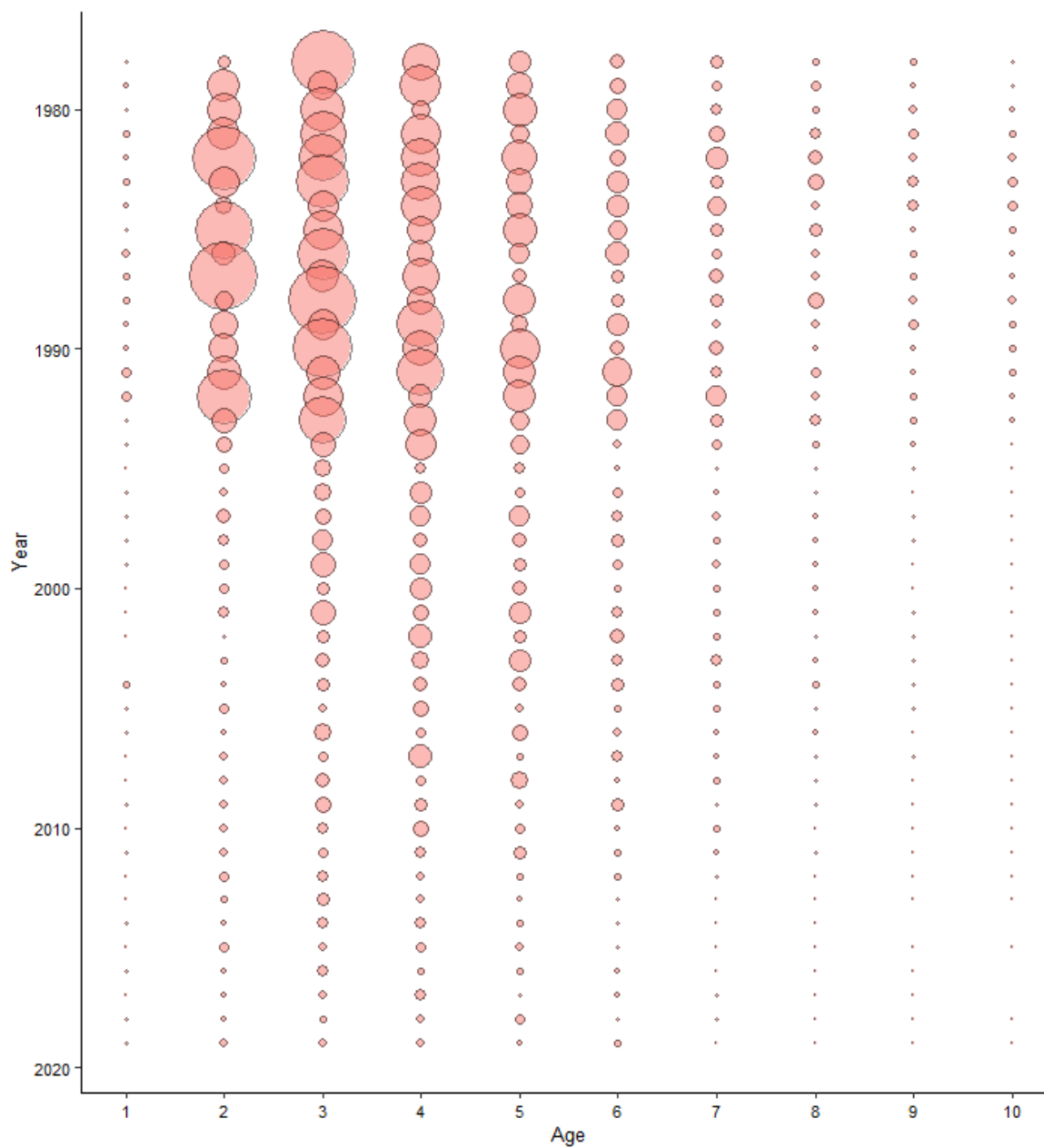


Figure A4. Combined Canada and United States of America fishery catch at age abundance for eastern Georges Bank Cod, updated to 2019. Size of bubbles is representative of abundance.

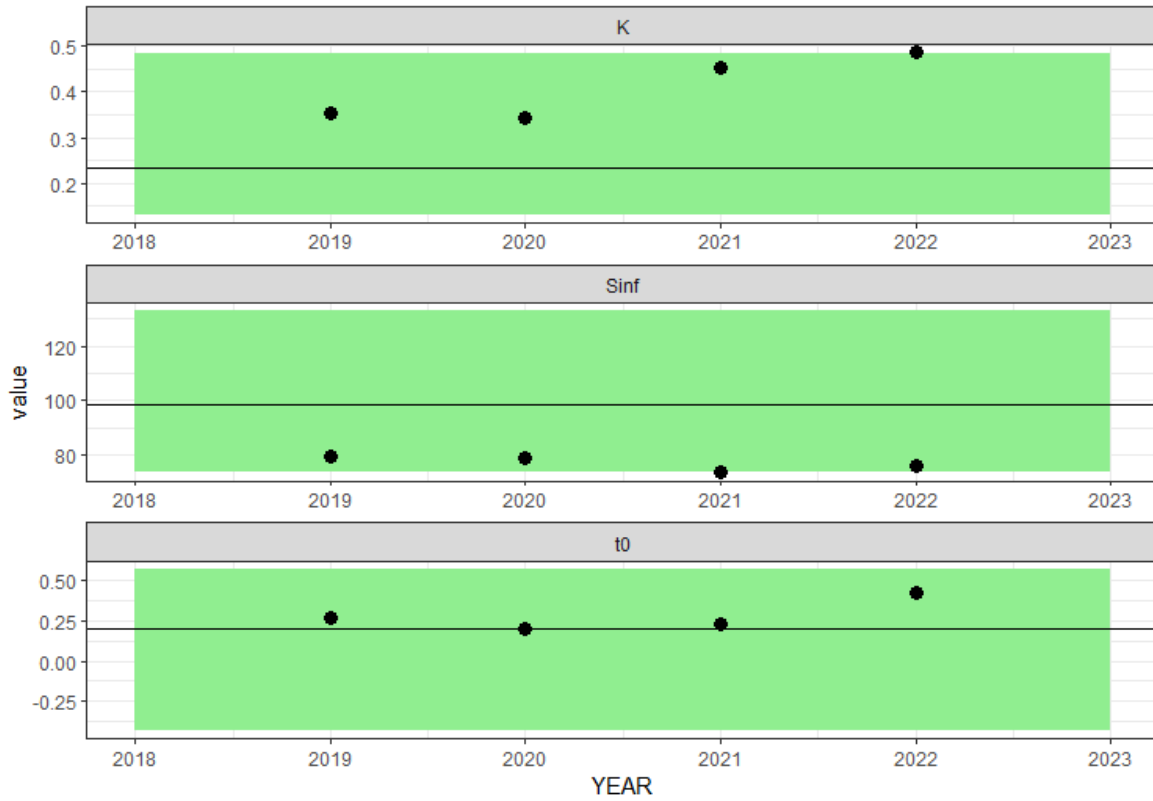


Figure A5. Temporal trends in von Bertalanffy growth parameters fit to survey data, for years 2019–2022. Points are annual growth curve fits, horizontal lines are growth curve fits spanning time period used in the Data Limited Methods tool (DLMtool) projection assumptions (2003-2019), and green rectangles indicate quantiles (0.01% and 99.9%) of that time period.

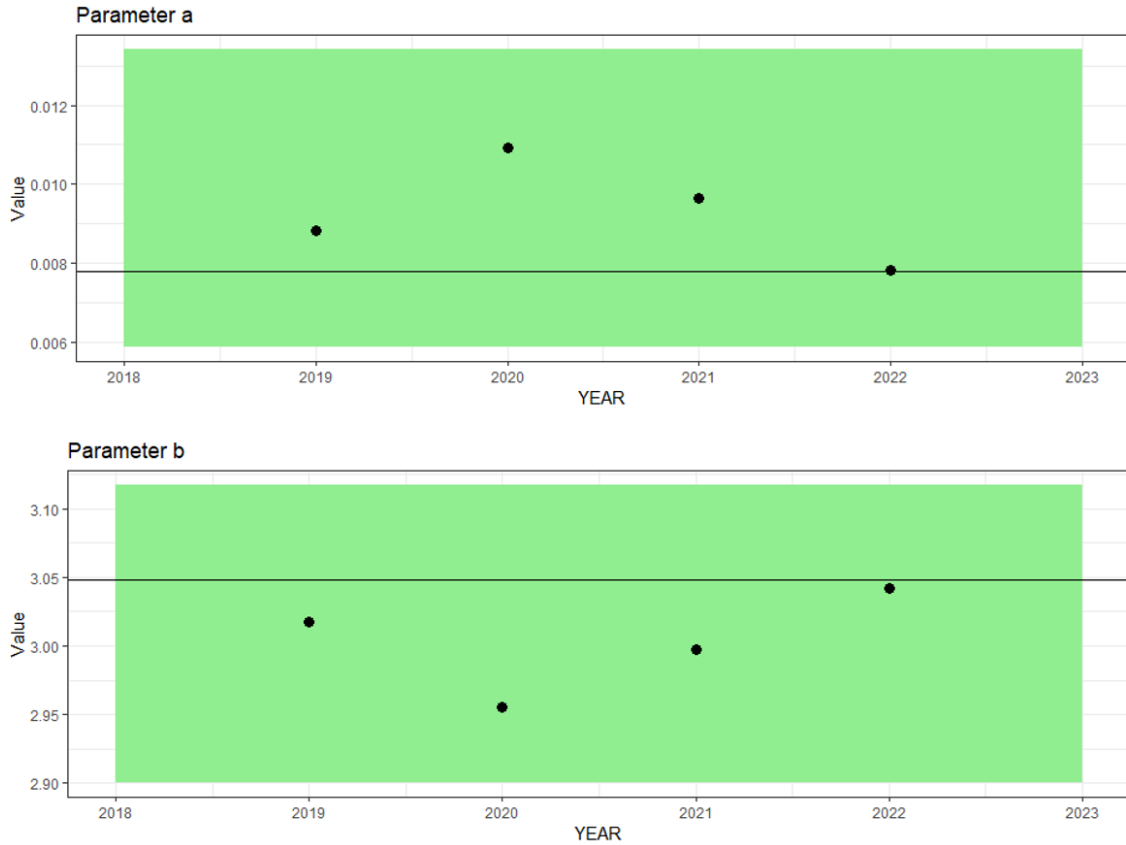


Figure A6. Trend in length-weight parameters for years 2019–2022. Horizontal lines indicate *a* (0.007812815) and *b* (3.048425056) values used in the projection assumptions in the Data Limited Methods tool (DLMtool), based on the complete time series (1980–2018). Green rectangles indicate quantiles (0.01% and 99.9%) for the complete time series (1980–2018).

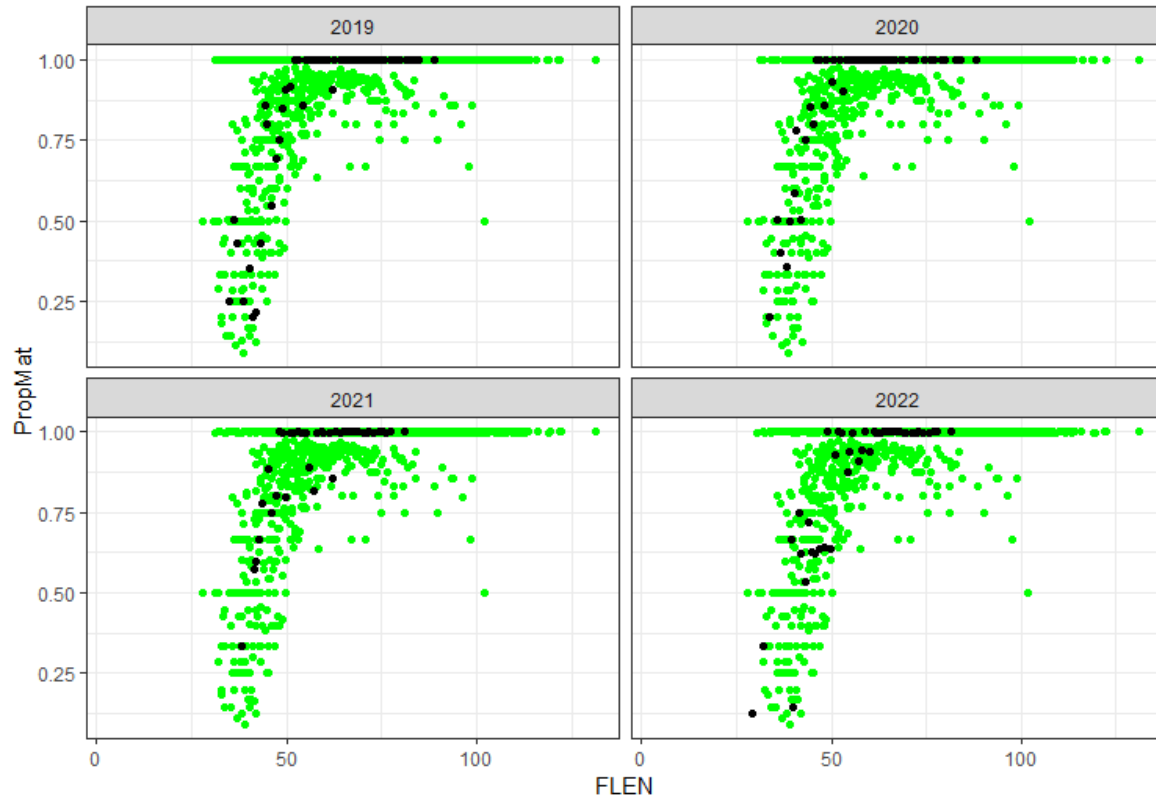


Figure A7. The pooled National Marine Fisheries Service (NMFS) and Fisheries and Oceans Canada (DFO) spring survey length-at-maturity data from 2000–2018 used to inform the L50–L95 assumptions for Data Limited Method tool (DLMtool) projections (green). The black points indicate the data available since then from the NMFS spring (2019, 2021 and 2022) and DFO spring (2019–2022) surveys.

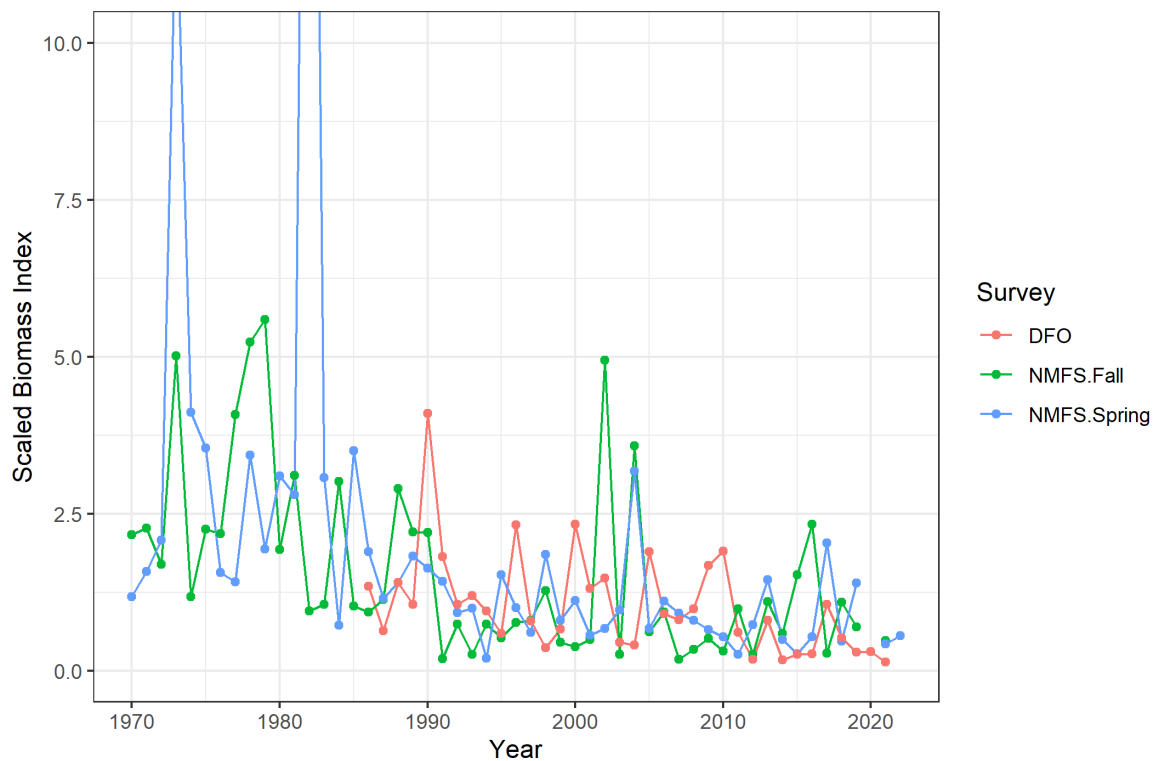


Figure A8. Survey biomass indices (ages 1+) for eastern Georges Bank Cod from the National Marine Fisheries Service (NMFS) spring (2021) and NMFS fall (2020) surveys scaled to their respective time series means. Data from the Fisheries and Oceans Canada (DFO) spring (2022) survey are missing pending calculation of a vessel conversion factor.

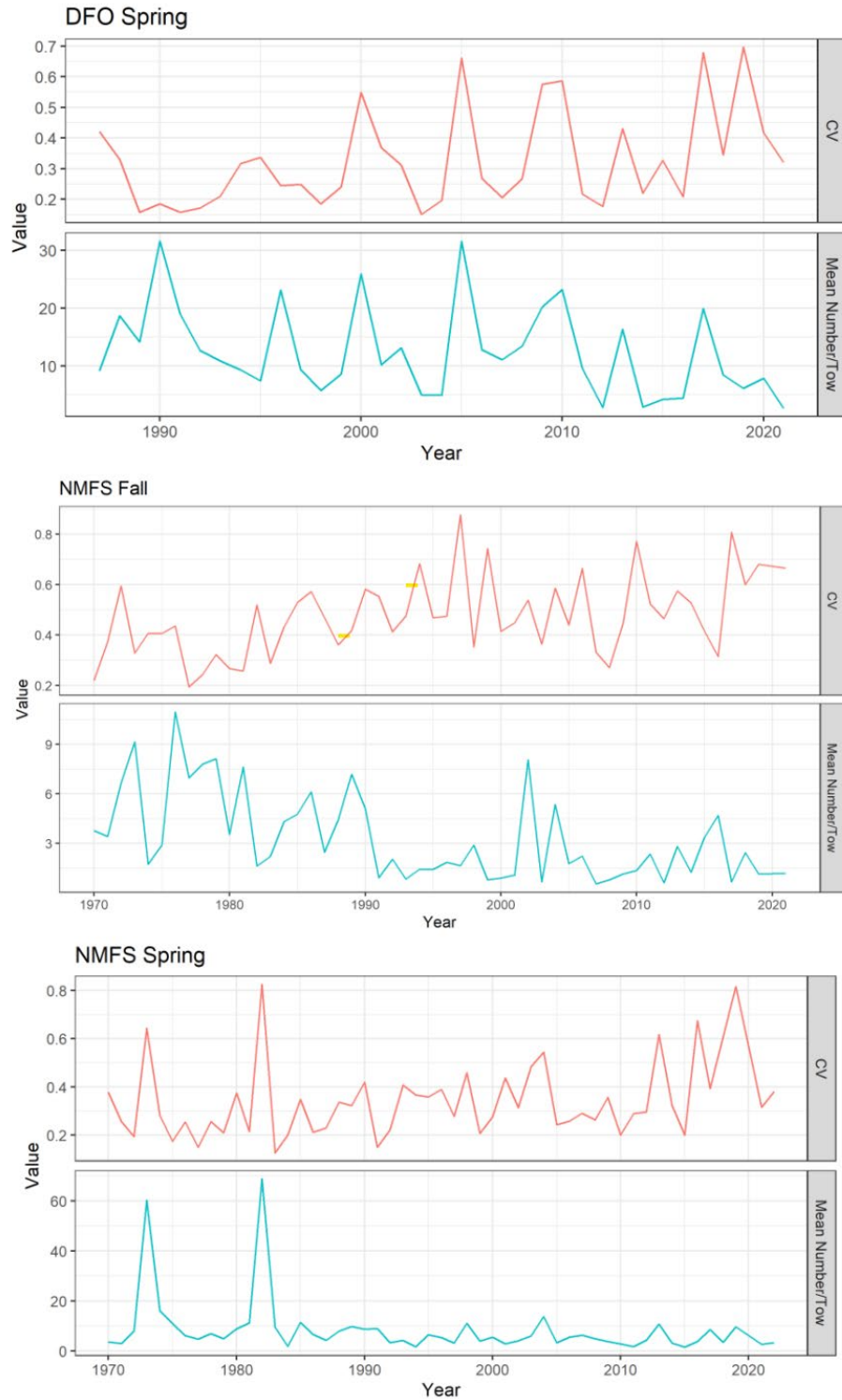


Figure A9. Stratified mean number-per-tow and coefficient of variation (CV) for Fisheries and Oceans Canada (DFO; top) and National Marine Fisheries Service (NMFS) fall (middle) and spring (bottom) survey catches of eastern Georges Bank Cod. DFO Spring 2022 data are missing pending calculation of a vessel conversion factor .

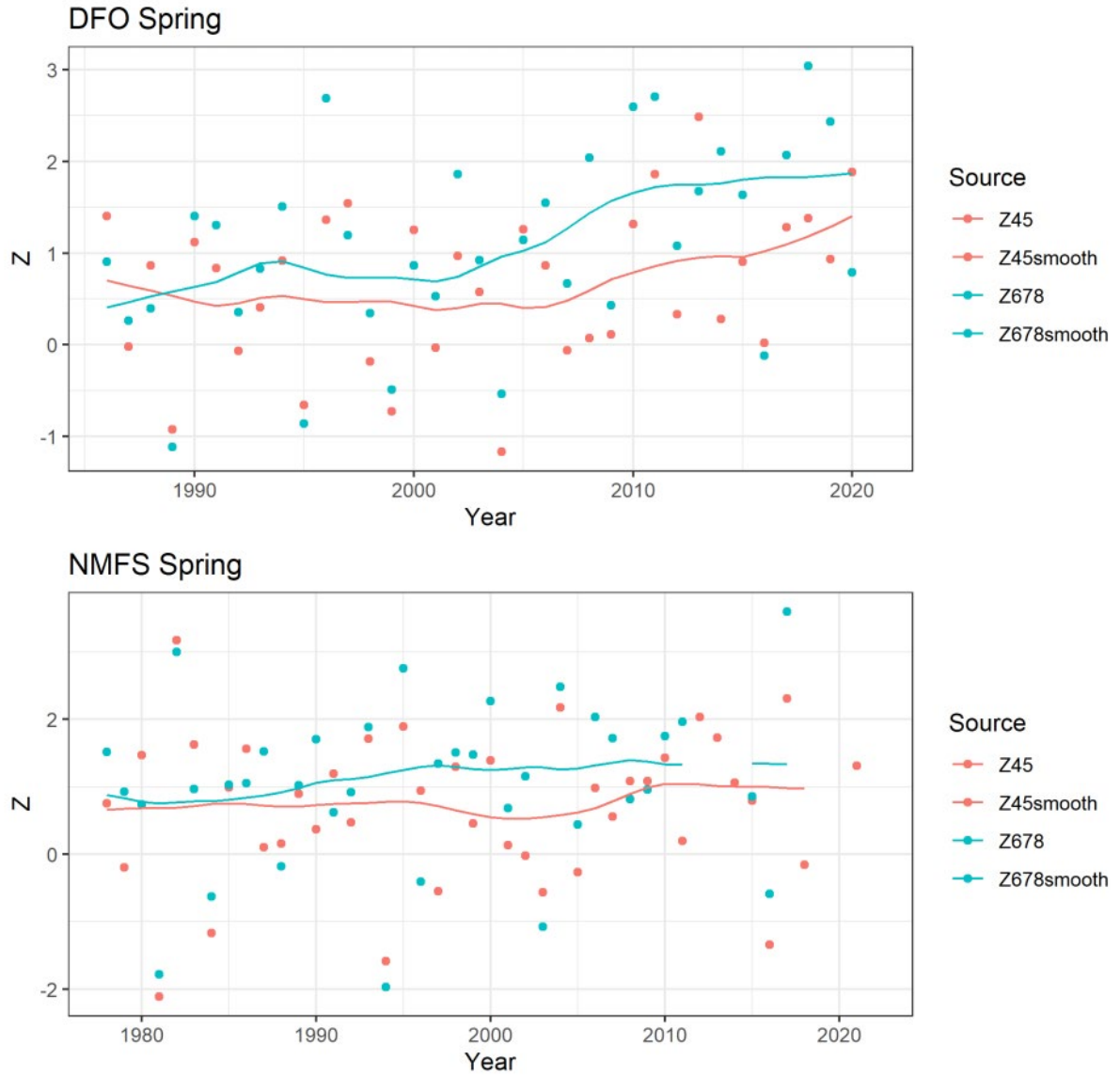


Figure A10. Total mortality (Z) calculated using the Fisheries and Oceans Canada (DFO) spring survey data and National Marine Fisheries Service (NMFS) spring survey data for eastern Georges Bank Cod. Note that the DFO time series only has data up until 2021. Colour of the points refers to the age-group the mortality was calculated for (Z45 - ages 4 and 5; Z678 - ages 6, 7 and 8). Line is a smoother applied to the point data.

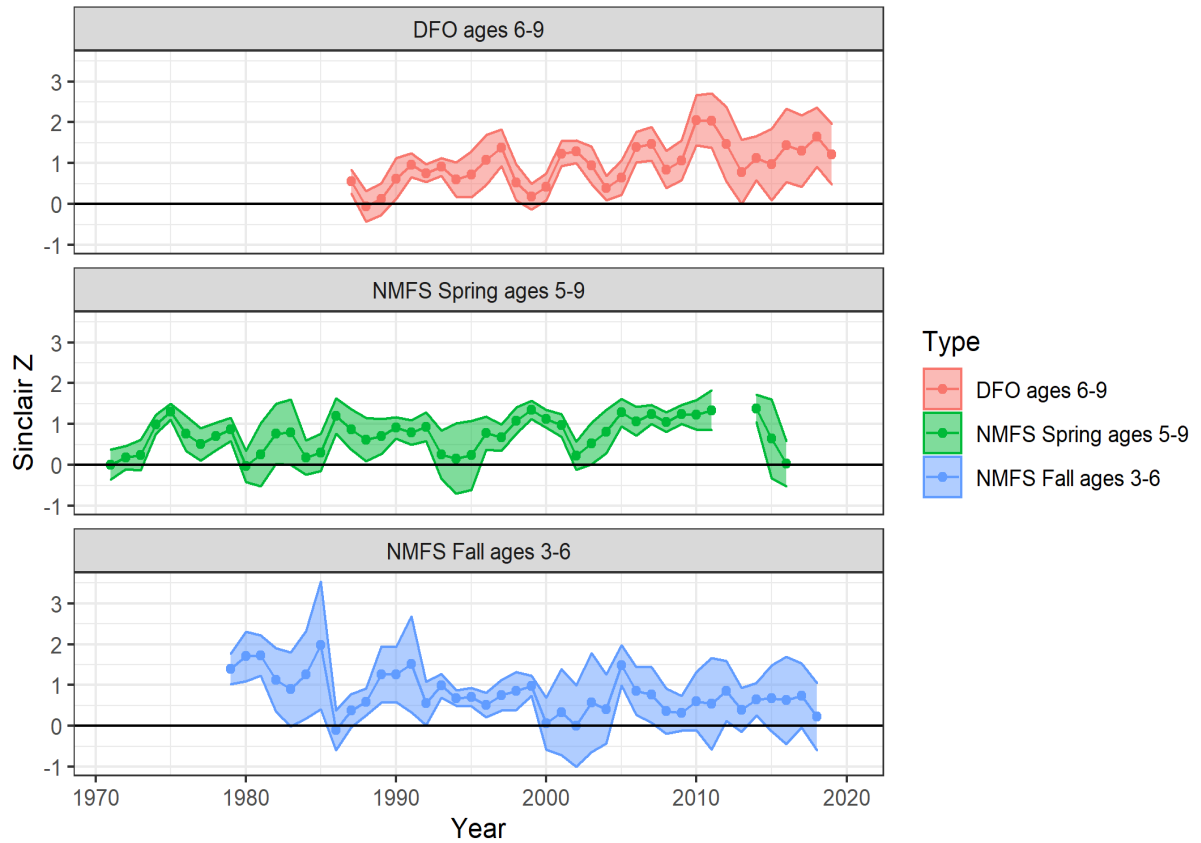
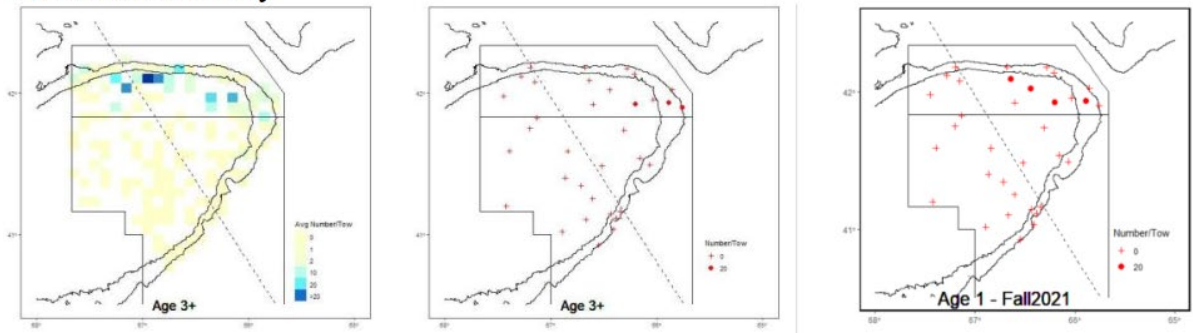
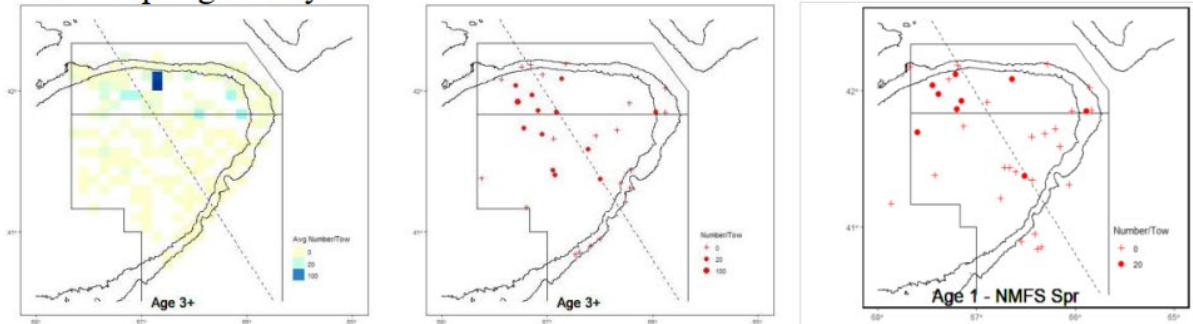


Figure A11. Empirical estimate of total mortality for the Fisheries and Oceans Canada (DFO; ages 6–9) spring survey and the National Marine Service (NMFS) fall (ages 3-6) and spring (ages 5-9) surveys. Calculation in recent years is breaking down.

NMFS Fall Survey



NMFS Spring Survey



DFO Spring Survey

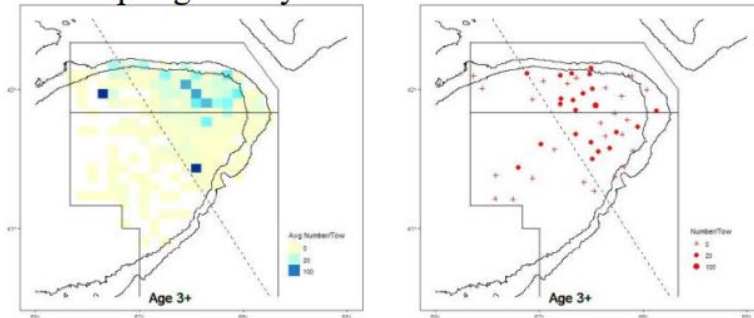


Figure A12. Spatial distribution of age 3+ Cod on eastern Georges Bank from the National Marine Fisheries Service (NMFS) fall survey for 2021 (top right) compared to the average for 2012–2021 (top left), and from the NMFS spring survey for 2022 (centre right) compared to the average for 2011–2020 (centre left). Although a new vessel conversion factor has not yet been calculated and applied, spatial distribution of 3+ Cod on eastern Georges Bank from the Fisheries and Oceans Canada (DFO) spring survey 2022 (bottom right) compared to the average for 2012-2021 (bottom left) is included to illustrate the distribution of catches.

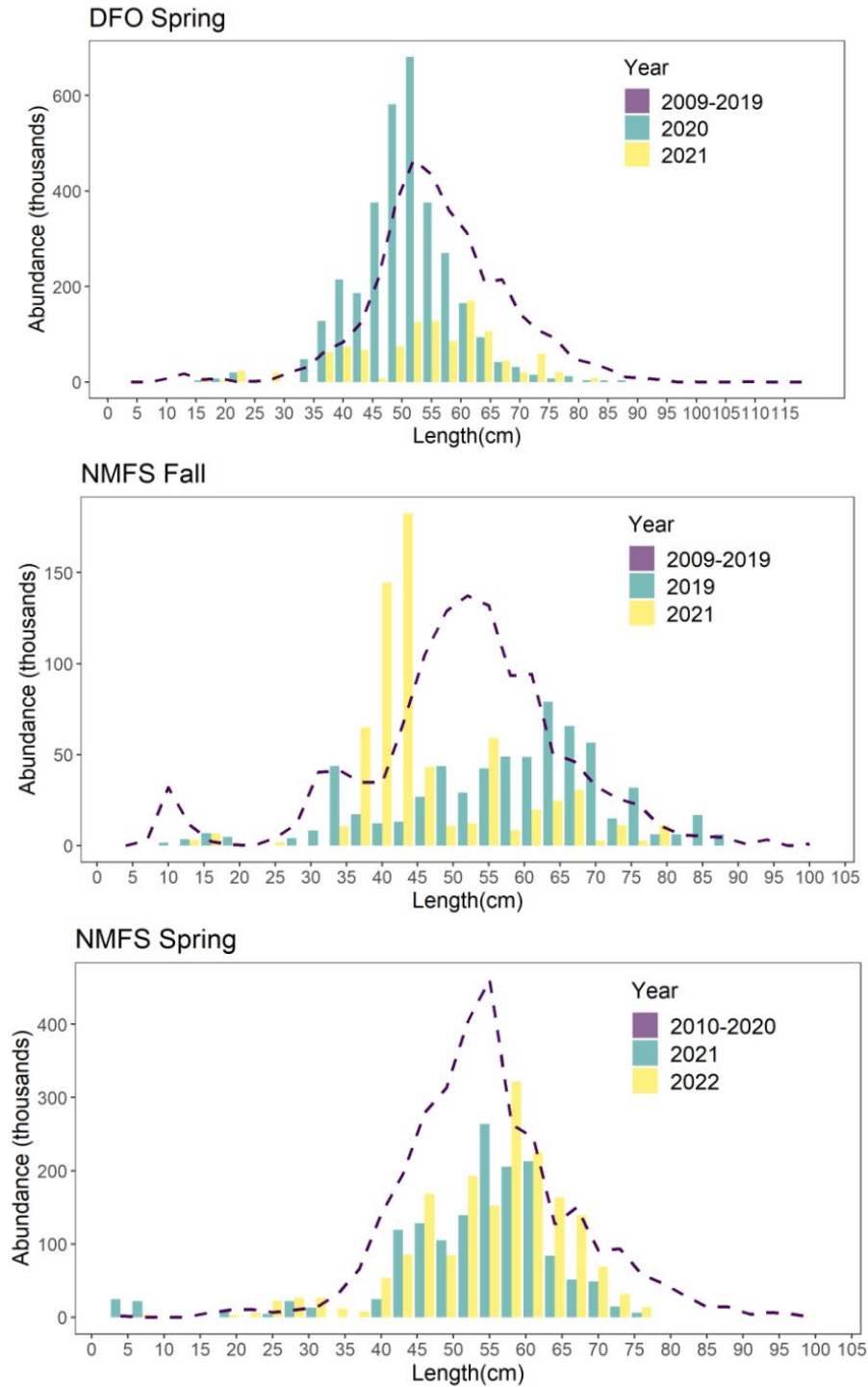


Figure A13. Length frequency distribution of the Fisheries and Oceans Canada (DFO) spring survey (2020 and 2021) and the National Marine Fisheries Service (NMFS) spring (2021 and 2022) and fall (2019 and 2021) surveys. Bars represent the most recent two years and the dashed line shows the average distribution from the previous ten years (2010-2020 for NMFS fall; 2011–2021 for NMFS spring). The NMFS fall survey plot compares 2019 and 2021 because there was no NMFS fall or spring survey in 2020.

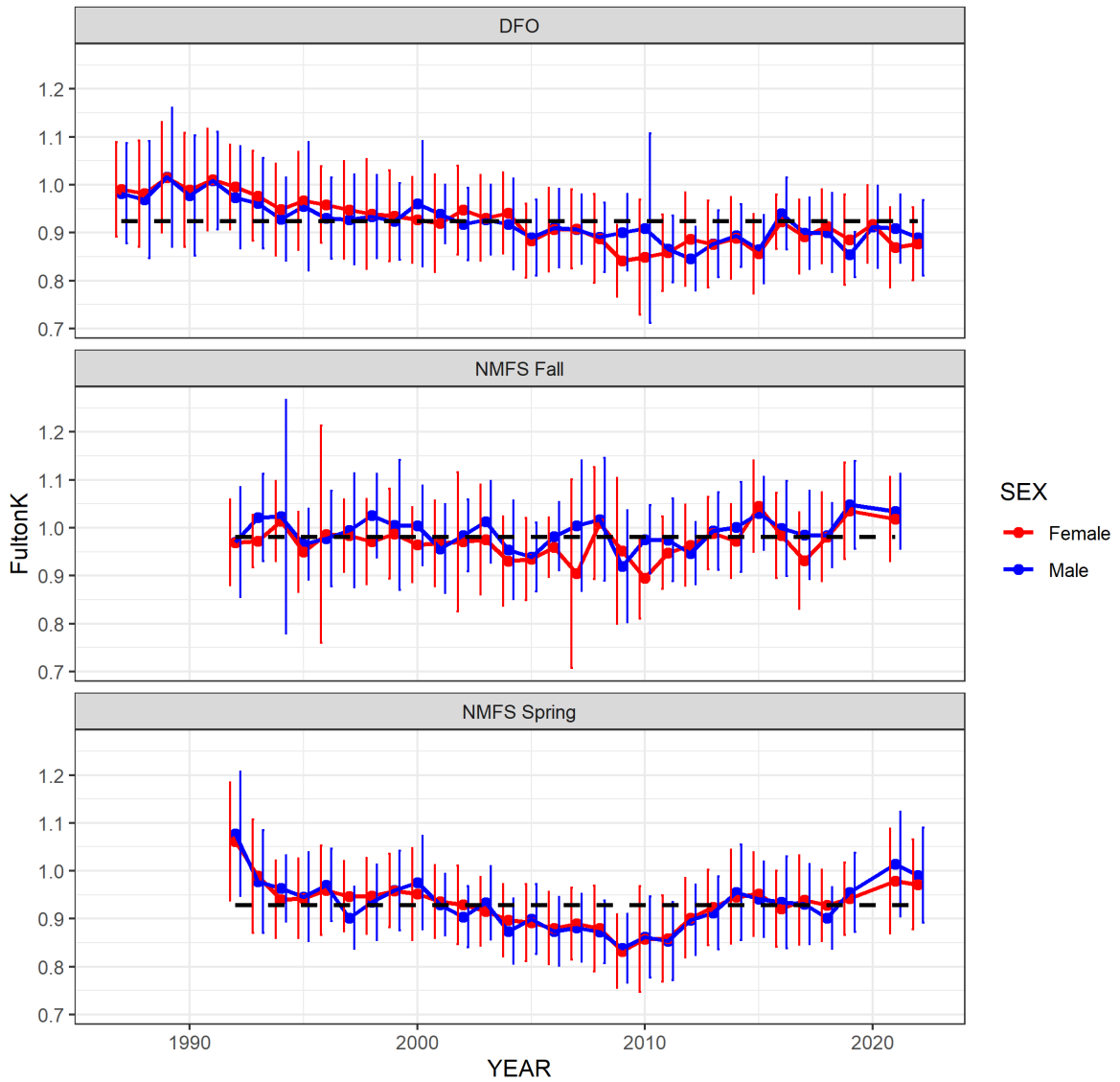


Figure A14. Fish condition (Fulton's *K*) of post-spawning Cod for eastern Georges Bank from the 2021 National Marine Fisheries Service (NMFS) fall survey and the 2022 Fisheries and Oceans Canada (DFO) and NMFS spring surveys. The dashed lines shows the time series mean.

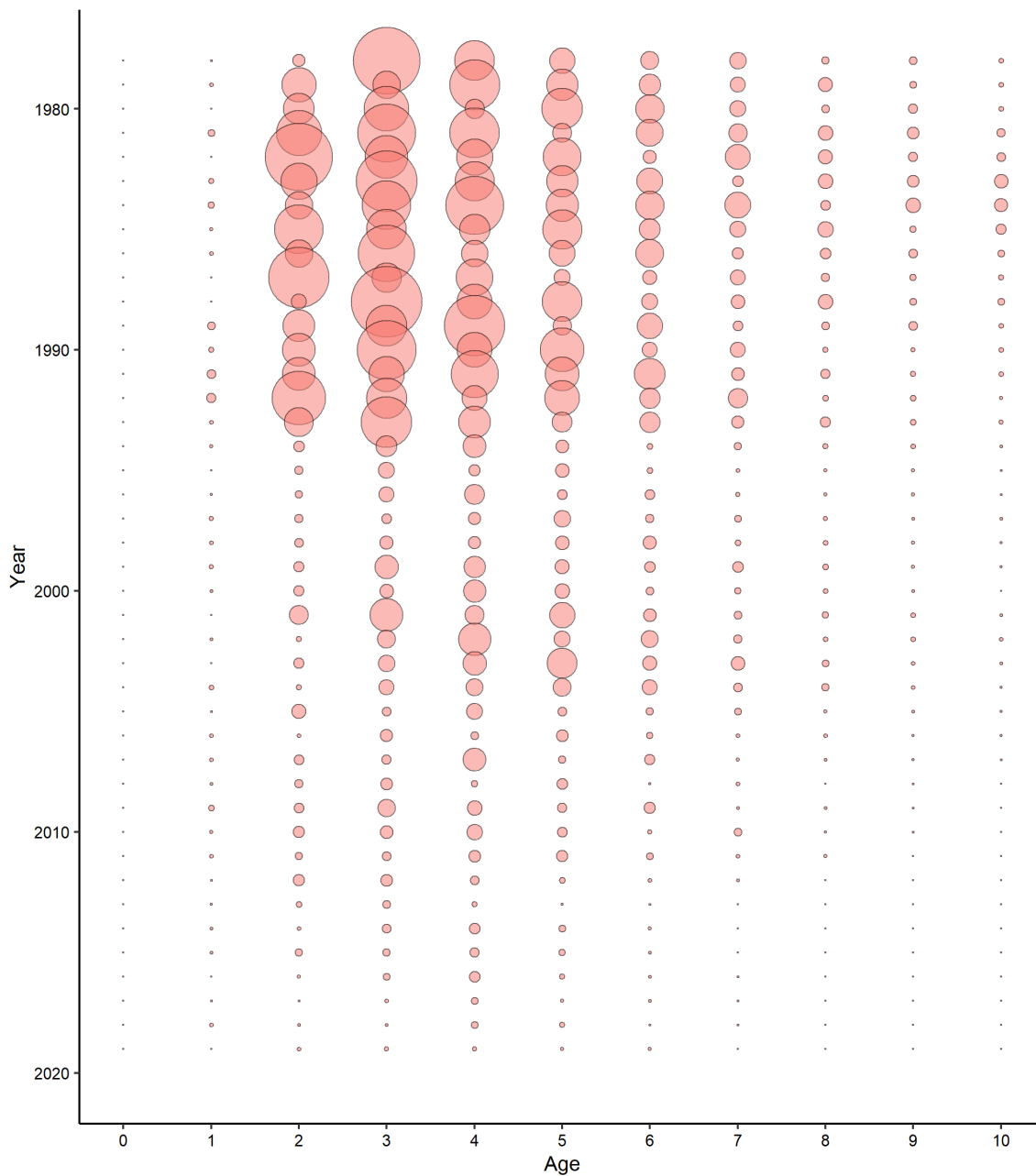


Figure A15. Fishery catch at age abundance for the United States of America fishery, updated until 2019. Size of bubbles is representative of abundance.

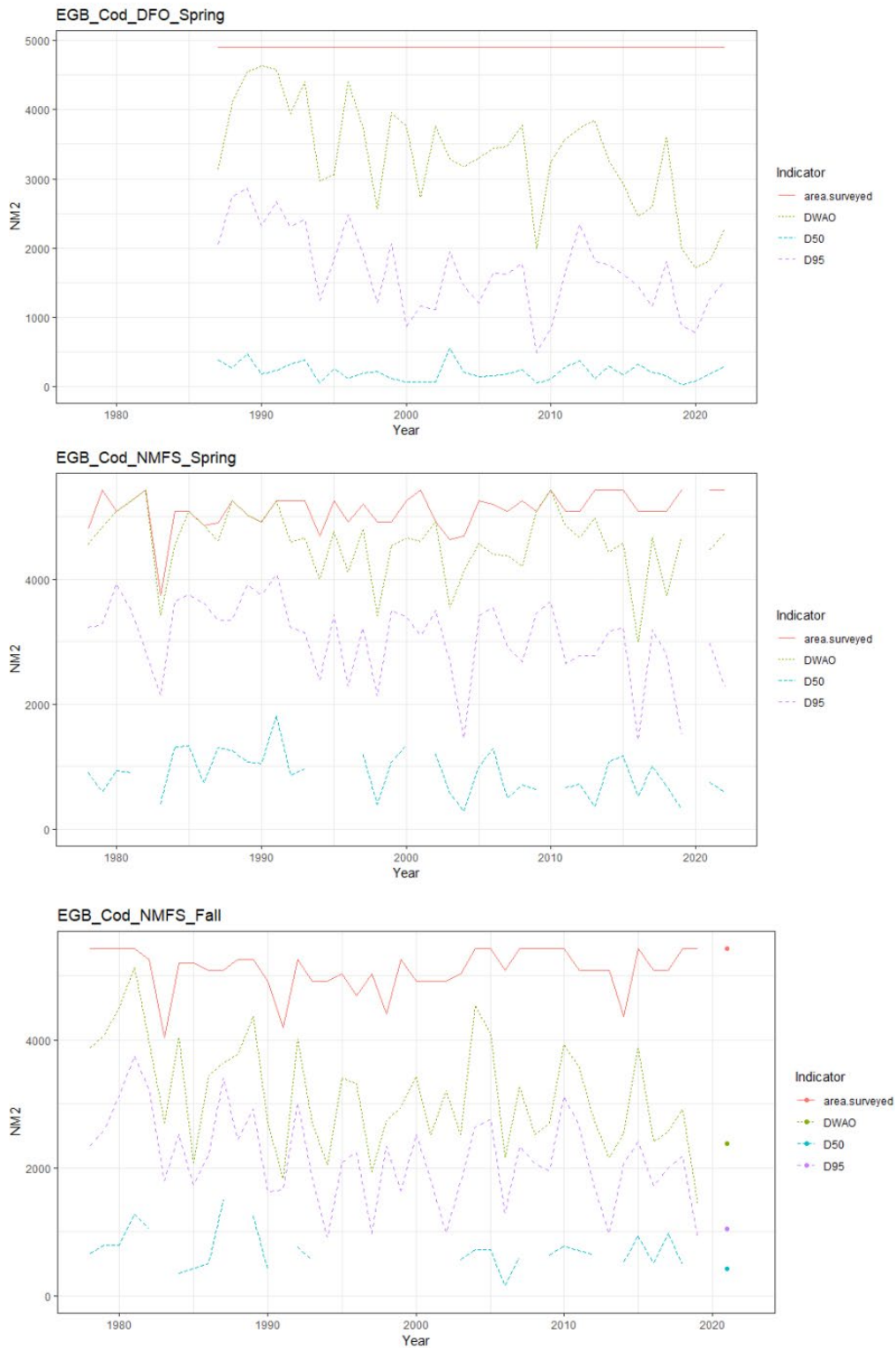


Figure A16. Distribution indices (square nautical miles) calculated for Cod on eastern Georges Bank (EGB) for each of the three surveys. The EGB NMFS fall plot (bottom) shows the 2021 survey data as points instead of lines so the values show up following the break in 2020 due to the missing survey. NMFS=National Marine Fisheries Service.

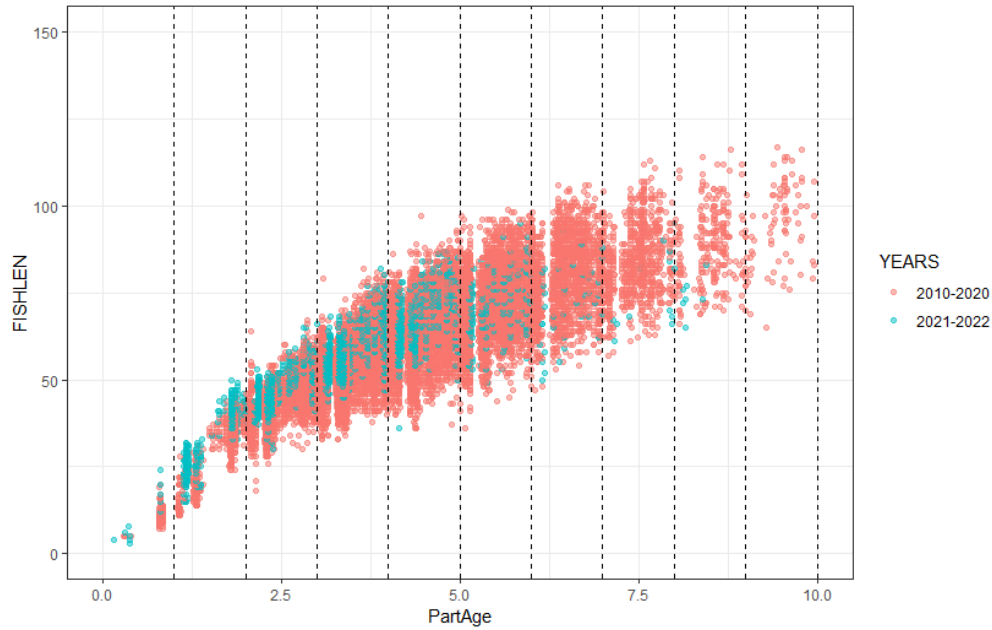


Figure A17. Growth of Cod sampled from the Canadian fishery, the National Marine Fisheries Service (NMFS) spring survey, the Fisheries and Oceans Canada (DFO) spring survey, and the NMFS fall survey data sets. Age has been adjusted to partial age based on the date of capture (surveys) or date sampled (fishery) for each fish. Partial age takes into account the birthdate assigned by the ageing lab where the fish was aged.

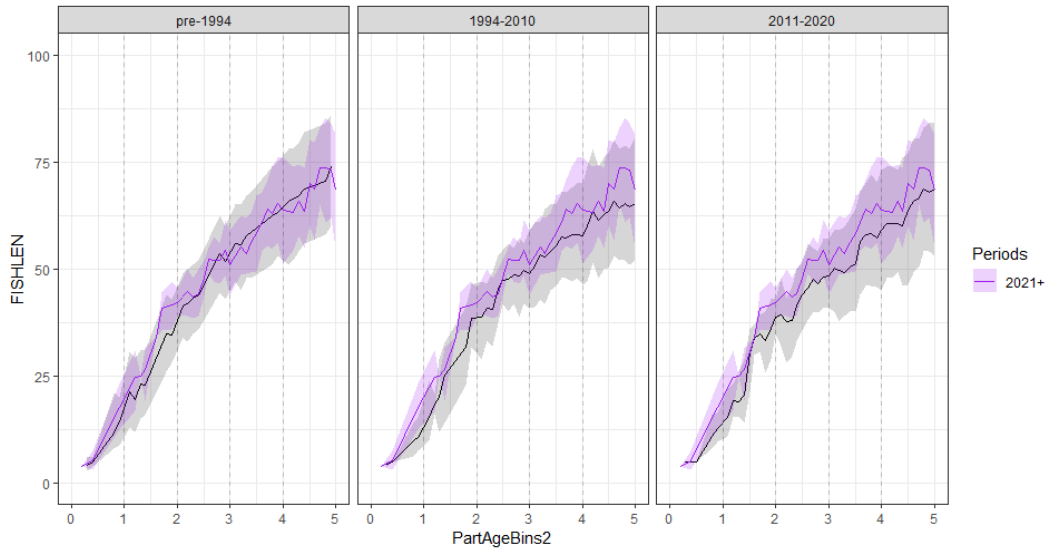


Figure A18. Mean growth (line) and 90% distribution (ribbons) of growth data from three time periods (facets) the Canadian fishery, the National Marine Fisheries Service (NMFS) spring survey, the Fisheries and Oceans Canada (DFO) spring survey, and the NMFS fall survey data sets. The purple line and ribbons show the data for 2021 and 2022, and repeat on every facet. Age has been adjusted to partial age based on the date of capture (surveys) or date sampled (fishery) for each fish. Partial age takes into account the birthdate assigned by the ageing lab where the fish was aged.

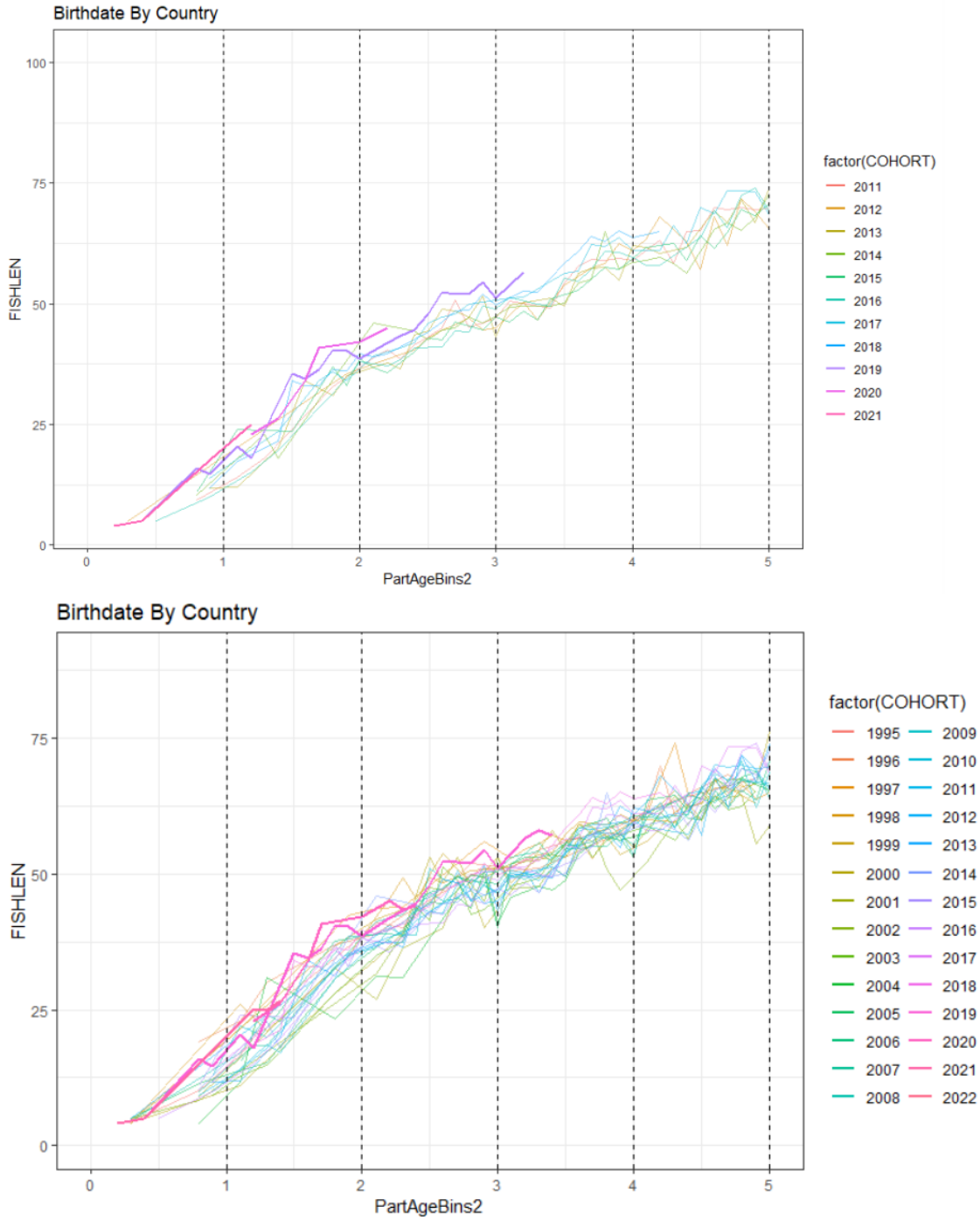


Figure A19. Growth by cohort of Cod sampled from the Canadian fishery, the National Marine Fisheries Service (NMFS) spring survey, the Fisheries and Oceans Canada (DFO) spring survey, and the NMFS fall survey since the 2010 cohort (upper panel) and since the 1995 cohort (bottom panel). Age has been adjusted to partial age based on the date of capture (surveys) or date sampled (fishery) for each fish. Partial age takes into accounts the birthdate assigned by the ageing lab where the fish was aged.