Yellowtail Flounder Research Track Working Group Report

TABLE OF CONTENTS

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Affiliation Key

GARFO = Greater Atlantic Regional Fisheries Office
GMRI = Gulf of Maine Research Institute
MADMF = Massachusetts Division of Marine Fisheries
NEFMC = New England Fisheries Management Council
NEFSC = Northeast Fisheries Science Center
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ACKNOWLEDGEMENTS

Larry Alade and Alex Hansell served as assessment lead scientists for the Cape Cod/Gulf of Maine (CCGOM) and Georges Bank (GB) stocks, respectively. Cameron Hodgdon joined the NEFSC in fall 2023 and took over as assessment lead scientist for the Southern New

England/Mid Atlantic (SNEMA) stock. All working group (WG) members provided valuable input across all Terms of Reference (TOR). Jessie Kittel and Cole Carrano assisted with modeling (TOR4) for GB yellowtail. Tim Miller provided assistance with WHAM. Leona Burgess (NEFSC) provided assistance with the STOCKEFF database and outputs. Cole Carrano, Tara Dolan, Jessie Kittel and Scott Schaffer served as WG meeting rapporteurs. Michele Traver and Alex Dunn provided administrative support.

WORKING GROUP PROCESS

The yellowtail flounder research track (RT) WG was formed in August 2022. Unless otherwise noted, WG meetings were conducted virtually on the following dates:

1. October 4, 2022
2. November 1, 2022
3. January 20, 2023 – TOR1 subgroup
4. February 6, 2023
5. March 9, 2023 – Stakeholder engagement
6. June 7, 2023
7. August 28, 2023
8. October 2, 2023
9. October 20, 2023
10. October 31, 2023
11. December 1, 2023
12. January 10, 2024
13. April 29, 2024 – Hybrid meeting
14. May 1, 2024
15. May 29, 2024
16. July 17, 2024
17. August 21, 2024
18. September 11, 2024
19. September 30, 2024

The WG reviewed all data and model decisions during meetings and reviewed draft report sections. WG members also participated in modeling worktime meetings to give updates on progress.

INTRODUCTION

Assessment history

Cape Cod/Gulf of Maine stock

Prior to 2002 (NEFSC 2003), Cape Cod and northern Gulf of Maine yellowtail flounder stocks were assessed separately. Cape Cod assessments initially relied on descriptive summaries and modeling, indicating a stable stock from the 1940s to the 1960s (Royce et al. 1959, Lux 1964). However, from the early 1970s, increased fishing effort led to declining catch rates and high fishing mortality (Parrack 1974; Howe 1975). Despite a brief period of stability in the mid-1970s (McBride and Sissenwine 1979), the stock experienced high mortality and a truncated age structure by the late 1970s (McBride et al. 1980). Although the 1987 year class contributed to some rebuilding, the stock was deemed overexploited by the 1990s (Rago 1994), and that year class may have included immigrants to the Cape Cod stock area from the dominant 1987 yearclass in Southern New England (Goethel et al. 2015). Age-based assessments from 1985 to 1997 indicated high fishing mortality and low biomass compared to BMSY (Cadrin et al. 1999).The Stock Assessment Workshop (SAW) 28 in 1999 used Virtual Population Analysis (VPA) on this stock, finding biomass levels since the early 1990s had been below MSY, with 1997 biomass at only 44% of BMSY. Although fishing mortality declined in the mid-1990s, the stock remained overfished and was subject to overfishing. Updates in 1999 and 2000 showed some reduction in fishing mortality (Cadrin and King 2000; Cadrin 2001a). For the northern Gulf of Maine, no analytical assessment had been conducted before SAW 36 (NEFSC 2003), though historical data indicated increased landings from the 1940s to the 1970s, with limited survey information (Royce et al. 1959; Lux 1964; McBride and Sissenwine 1980).

In 2002, SAW 36 considered a proposal by the Southern Demersal Working Group (SDWG) to define three stock units: Cape Cod/Gulf of Maine (CCGOM), Georges Bank (GB) and Southern New England/Mid-Atlantic (SNEMA), based on life history differences and distribution patterns. The SAW 36 model for CCGOM was a VPA of commercial landings and discards at age, assuming a natural morality, *M*, of 0.2. Indices of recruitment and stock abundance were obtained from Northeast Fisheries Science Center (NEFSC) and Massachusetts Division of Marine Fisheries (MADMF) bottom trawl surveys. The VPA calibration was revised to group older ages (5+) into a single class, offering a new perspective on the stock's historical development. The assessment proposed an F_{MSY} proxy of $F_{40\%}$ = 0.17, and a spawning stock biomass (SSB) proxy of 12,600 mt. Despite revisions in data and methodology, the SAW 36 assessment findings were consistent with previous assessments, indicating that the Cape Cod component of the stock, which represents about 90% of landings, remained overfished.

In 2005 CCGOM yellowtail flounder was assessed using VPA with a 5+ age group formulation (GARM II, Mayo et al. 2005, updated from Cadrin and King 2003). This VPA formulation was considered to be sub-optimal because age 3 partial recruitment was assumed to be fully selected at 1.0. The stock exhibited high fishing mortality rates and low abundance. The proxy for F_{MSY} (F40%) was 0.17, with corresponding SSB_{MSY} and MSY values of 12,600 mt and 2300 mt, respectively. By 2004, the estimate of SSB had declined to 1100 mt, just 9% of SSB_{MSY}, while F = 0.75) was four times F_{MSY}, indicating severe overfishing and an overfished stock.

The 2008 Groundfish Assessment Review Meeting (GARM III, Legault et al. 2008; NEFSC 2008) benchmark assessment updated fishery catch estimates and survey indices through 2007-2008. The VPA used a 6+ formulation for the age groups allowing appropriate estimation of age 3 partial recruitment, resulting in better diagnostics and no retrospective pattern. The CCGOM yellowtail flounder stock remained overfished (SSB_{2007}/SSB_{MSY} = 0.25) and overfishing continued (F_{2007}/F_{MSY} = 1.73). SSB_{MSY} and MSY were estimated at 7790 mt and 1720 mt, respectively.

An assessment update was completed in 2012 (NEFSC 2012), updating catch and survey data through 2010. The CCGOM yellowtail flounder stock remained overfished and subject to overfishing, with an estimated SSB of 1680 mt and an F of 0.36. The revised biological reference points set SSB_{MSY} at 7080 mt, F_{MSY} at 0.26, and MSY at 1600 mt, indicating the stock was below its biomass target. A retrospective pattern resulted in downward adjustments to the estimate for the above-average 2005 year class and to SSB, compared to GARM III estimates. The Review Panel recommended use of the rho adjusted F and SSB values for status determination.

The next operational assessment for CCGOM yellowtail flounder updated the 2012 VPA (Legault et al. 2012) to include revised catch data, survey indices, and weights at age (NEFSC 2015). The assessment concluded the stock was overfished and subject to overfishing. The retrospective pattern worsened, leading to a rho adjusted 2014 SSB of 857 mt (16 % of the biomass target) and a rho adjusted F of 0.64 (229% of the overfishing threshold proxy F_{MSY} proxy = 0.279). Although misspecification of *M* was considered a potential cause, increasing *M* from 0.2 to 0.4 only partially mitigated the retrospective pattern.

In 2017 an operational assessment was conducted on CCGOM yellowtail flounder, updating the previous 2015 VPA assessment (Alade 2015). The 2017 assessment found the stock to be overfished with overfishing occurring. There was a major retrospective pattern. The rho adjusted SSB in 2016 was estimated to be 1191 mt, which was 26% of the biomass target (SSB_{MSY} proxy = 4640 mt). The rho adjusted 2016 fully selected F was estimated to be 0.314, which was 115% of the overfishing threshold proxy (F_{MSY} proxy = 0.273).

An operational assessment in 2019 updated the previous VPA assessment (Alade 2017) finding that the CCGOM yellowtail flounder stock was not overfished, nor subject to overfishing (NEFSC 2022). The change in status was supported by an above average estimated 2016 year class coupled with very low exploitation. Retrospective adjustments were made to the model. The rho adjusted SSB in 2018 was estimated to be 2125 mt, which was 62% of the biomass target SSB_{MSY} proxy = 3439. The 2018 fully selected F was estimated to be 0.092, which was 29% of the overfishing threshold proxy (F_{MSY} proxy = 0.32). This assessment model underwent several major changes, including new methods (Miller 2013; Miller et al. 2017a,b; Miller 2018) to estimate relative catch efficiency for rockhopper and chainsweep gear in NEFSC bottom trawl surveys, resulting in calibrated stratified swept mean numbers at length and calibrate biomass estimates.

The 2022 management track assessment for CCGOM yellowtail flounder (NEFSC 2022) was an operational assessment of the previous 2019 VPA assessment (Alade 2019). The assessment reported the stock was not overfished and overfishing was not occurring after retrospective adjustments were made to the model results. SSB in 2021 was estimated to be 3058 mt, which was 99.7% the biomass target (SSB_{MSY} proxy = 3068 mt). The 2021 fully selected fishing mortality was estimated to be 0.10, which was 32% of the overfishing threshold proxy (FMSY proxy = 0.32).

Georges Bank Stock

Early stock assessments of GB yellowtail flounder relied on catch curves, tagging experiments, and a detailed understanding of the fishing fleets operating at the time, finding high fishing mortality rates relative to natural mortality rates but little apparent impact on the stock, and identified temperature as a potential factor in stock abundance (Royce et al 1959, Lux 1964, Lux 1969). By the 1970s, decreases in catch were being associated with too much fishing pressure (Brown and Hennemuth 1971, Sissenwine 1977), which reduced somewhat in the early 1980s (Brown et al. 1980, Clark et al. 1981) although misreporting among the stock areas was noted as a problem. Increases in mesh size in 1982 and 1983 also contributed to increase in biomass (McBride and Clark 1983), but effort was still too high (Overholtz and Murawski 1985). A more comprehensive summary of early research on this stock is available in Legault and Cadrin (2014).

The first stock assessment of GB yellowtail flounder to use VPA was reviewed as part of SAW 7 (NEFSC 1989), which found high fishing mortality and low stock abundance. Subsequent VPAs found similar results (NEFSC 1991, NEFSC 1994), with SAW 18 concluding the stock had collapsed (NEFSC 1994). Canadian catch was first incorporated in the assessment in 1996, but did not change the perception of the stock (Gavaris et al. 1996). The effect of strong management measures were detected by the end of the decade, both in VPA and surplus production models (Cadrin et al. 1998).

The Transboundary Resources Assessment Committee (TRAC), a joint US-Canadian scientific body, conducted its first joint assessment of GB yellowtail flounder in 1998 using VPA (Neilson and Cadrin 1998). Retrospective patterns of overestimating SSB and underestimating fully-selected fishing mortality appeared in 2000 (NDWG 2000, Cadrin et al. 2000) and continued in the next TRAC and GARM assessments (Stone et al. 2001, NEFSC 2002, Stone and Legault 2003, Legault and Stone 2004).

A benchmark assessment for this stock was conducted in 2005 through TRAC leading to multiple VPA formulations, including one that split the survey time series in 1995 to “alias unknown mechanisms” because no changes actually occurred in the survey. This splitting of the surveys was done to address the continuing retrospective pattern. Surplus production model results diverged from all the VPA model results and were no longer considered. The base model that did not split the survey time series was never used for management advice. Only the VPA with split survey time series was used for management advice for a number of years (Legault et al. 2006, Legault et al. 2007, NEFSC 2008, Legault et al. 2009). However, the retrospective pattern re-emerged in 2010 despite this model change (Legault et al. 2010). During this period, the Canadian survey had two years, 2008 and 2009, where a single tow caught more yellowtail flounder than all the tows in all the years prior combined. This led to numerous sensitivity analyses of how to handle these unusual events in the model. The continued strengthening of the retrospective pattern in the next assessment (Legault et al. 2011) led to the use of a rho-adjustment to try to account for the retrospective pattern when providing catch advice (Legault et al. 2012, Legault et al. 2013).

The continuing problems with retrospective patterns and other model diagnostic issues led to a Diagnostic and Empirical Approach Benchmark in 2014 (O'Brien and Clark 2014). At this meeting, age-based modeling using VPA was abandoned and replaced by an approach that used the three available surveys to directly estimate population biomass and apply an exploitation rate based on recent catch/survey values to generate catch advice, called the empirical approach. This empirical approach, with some modifications to account for missing surveys, changes in estimates of survey catchability, and changes in how the exploitation rate for catch advice was derived, was used through 2020 (Legault et al. 2015, Legault and Busawon 2016, Legault and McCurdy 2017, Legault and McCurdy 2018, Legault and Finley 2019, TRAC 2020).

In 2020, due to low survey biomass and concern that the empirical approach was just chasing noise in the surveys, a new Limiter approach was suggested for use (TRAC 2020). The Limiter sets upper and lower bounds for the average survey biomass. If the most recent surveys fall within these bounds, constant catch advice is provided. In 2021, the TRAC recommended using the Limiter with a lower bound of 1000 mt, an upper bound of 7300 – 8500 mt, and catch advice of 200 mt when the survey biomass was between the bounds (TRAC 2021). The Limiter has been used to assess the stock since 2021 (TRAC 2022).

Southern New England/Mid-Atlantic Stock

The first quantitative stock assessment of yellowtail flounder focused on the Southern New England/Mid-Atlantic (SNEMA) resource. Royce et al. (1959) analyzed landings, length and age compositions, effort, and tagging data, estimating an F of approximately 0.3 in the 1940s. However, revised estimates suggested a higher F of around 0.6 during that period (Lux 1969). Lux (1964) concluded the stock was not overfished in the 1950s, but age-based mortality estimates for the 1960s were high (Lux 1967, 1969). Later assessments excluded Mid-Atlantic data, but showed rising F and declining stock size in the late 1960s (Brown and Hennemuth 1971a, 1971b; Pentilla and Brown 1973).

Starting in 1974, the Mid-Atlantic and Southern New England yellowtail resources were assessed separately, but both areas reported high mortality and low stock size in the 1970s (Parrack 1974, Sissenwine et al. 1978, McBride and Sissenwine 1979, McBride et al. 1980, Clark et al. 1981). In the early 1980s, surveys and commercial catches indicated strong recruitment, but high discard rates and F exceeding Fmax in Southern New England (McBride and Clark 1983, Clark et al. 1984, NEFC 1986). By the late 1980s, assessment methods for Southern New England yellowtail advanced to a calibrated VPA, revealing high F in the 1970s and early 1980s and a strong 1980 cohort (F=0.60-1.48; NEFC 1989). Later assessments identified another dominant cohort from 1987, but F continued to rise through the 1980s, leading to record-low biomass in the early 1990s (Conser et al. 1991, Rago et al. 1994).

The Southern New England stock was considered collapsed by 1992 (Rago et al. 1994) fishing mortality was 84%, well above the 35% exploitation rate associated with F20%, SSB declined to 1300 mt, while recruitment in the preceding three years was the poorest on record. The assessment panel recommended F be reduced to levels approaching zero, including discards. A new source of discarding began in 1994 in the sea scallop fishery due to regulations that prevented the scallop fleet from landing groundfish in excess of 500 lb.

In 1996, yellowtail flounder was assessed, along with 25 other stocks, as part of the northeast demersal complex (NEFSC 1996). The report noted that principal flounder biomass in the northeast region, including yellowtail flounder, American plaice, witch flounder, windowpane flounder and winter flounder, had declined by about 60-80% since the late 1970s. Yellowtail flounder biomass within Southern New England suffered the steepest declines; biomass declined by over 90% within that time period.

Annual updates of the 1997 VPA on Southern New England yellowtail flounder (SAW 24) from 1997 to 1999 indicated a reduction in F in the late 1990s, but little rebuilding of stock biomass (NEFSC 1997, 1998; Cadrin 2000). In 1997, biomass remained low, but increasing, as fishing mortality held below the reference point (F = 0.27). Recruitment remained poor, with all recent year classes well below the historic average. A 2000 VPA update was rejected due to inadequate sampling in 1999, forcing the subsequent assessment to rely on projections from the 1999 VPA (Cadrin 2001b, NEFSC 2002).

The first GARM (NEFSC 2002) updated the single stock VPA for southern New England yellowtail. Despite assessment uncertainties, the stock in 2001 was clearly overfished, with SSB at 1900 mt (4% of SSB_{MSY}) and overfishing was occurring (F = 0.46, 1.7 times F_{MSY}).

As was noted above (see CCGOM section), in 2002, the SDWG proposed the separation of yellowtail flounder into three stocks: CCGOM, GB and SNEMA. SAW 36 (NEFSC 2003) marked the first assessment of the combined SNEMA yellowtail flounder stock. The model, a VPA calibrated using the ADAPT algorithm for the terminal year 2001, estimated abundance from 1973-2001, adjusting for survivors in 2002 and survey catchability. *M* was set at 0.2 based on various factors, including tag returns and the age of the oldest sampled individual. Retrospective analysis revealed a pattern in which updated estimates of F increased and updated estimates of SSB decreased. The F_{MSY} proxy ($F_{40\%}$) was estimated at 0.26, with an SSB_{MSY} proxy of 69,500mt and an MSY proxy of 14,200 mt.

GARM II (Mayo and Terciero 2005) updated the SAW 36 VPA. F averaged 0.84 between 2002-2004, while SSB decreased to 695 mt by 2004. The direction of the retrospective pattern reversed from the previous pattern, with updated estimates of SSB increasing and updated estimates of F decreasing. This switch coincided with the change to using observer samples and 1131 industry-based survey samples (Table D2 in Mayo and Terceiro 2005) in addition to port sampling, prompting the Review Panel to recommend the assessment solely rely on port sampling for future assessments. As it was done in GARM I, reference points were estimated from yield and a SSB-per-recruit analysis with an assumption of constant recruitment (Cadrin 2003). The stock was determined to be severely overfished and overfishing was occurring. The estimate of 2004 F (0.99) was more than twice the F desired for the rebuilding program (0.37), and 2004 SSB was only 10% of the projected value. Despite this, a directed fishery remained for this fish into 2003.

The GARM III (NEFSC 2008) VPA revised the previous assessment, using an age-6+ formulation, instead of the previous 7+ formulation (Cadrin and Legault 2005), a change that reduced the retrospective pattern. The VPA was tuned to the winter, spring, and fall NEFSC bottom trawl survey swept area biomass indices. A two-stanza recruitment approach, where recruitment was associated with SSB either greater or less than 500 mt, was used to determine stock status. The 2007 SSB was estimated to be 3508 mt, while F was 0.41. The stock was overfished (SSB_{2007}/SSB_{MSY} = 13%) and subject to overfishing (F_{2007}/ F_{MSY} = 160%).

SAW 54 (NEFSC 2012) oversaw a change from the VPA model to a statistical catch-at-age model conducted in the Age Structured Assessment Program, ASAP (Legault and Restrepo 1999). SSB in 2011 was estimated at 3873 mt, a slight increase from previous years, while average F for ages 4-5 was 0.12. Following the advice of the GARM III Review Panel, BRP were computed using age-1 recruitment sampled from an empirical cumulative distribution function (CDF) under two recruitment scenarios. One scenario used data from 1990-2010, reflecting a potential decline in stock productivity since 1990, while the other used the full 1973-2010 time series, divided into two recruitment stanzas based on whether SSB was above or below 4319 mt. This threshold was determined from a minimum residual variance analysis relating SSB to age-1 recruitment. For both recruitment scenarios, the overfishing threshold $F_{40\%}$ was 0.316, indicating that overfishing was not occurring. However, whether the stock was overfished depended on the recruitment scenario. Under the recent recruitment scenario, SSB_{MSY} was 2995 mt, and MSY was 773 mt, suggesting the stock was not overfished and would be considered rebuilt by 2014 under the rebuilding plan. However, under the two stanza scenario, SSB_{MSY} was 22,615 mt, and MSY was 5834 mt, indicating the stock remained overfished. While both scenarios were plausible, the review panel concluded that the evidence favored the recent recruitment scenario, though uncertainty remained about whether the stock was overfished.

From 2015-2019, a series of operational assessments built upon the 2012 benchmark ASAP assessment. The 2015 Operational Assessment (terminal year 2014) concluded the stock was overfished and subject to overfishing, estimating SSB at 502 mt (26% of the biomass target SSB_{MSY} proxy = 1959 mt) and fully selected fishing mortality at 1.64 (469% of the F_{MSY} proxy = 0.35). Retrospective adjustments were not made to the model despite the strong retrospective pattern because of the large proportion of infeasible projections (assumed 2015 adjustment required F > 5).

The 2017 Operational Assessment (NEFSC 2017, terminal year 2016) found SNEMA yellowtail flounder remained overfished and subject to overfishing. SSB in the terminal year (2016) had declined to 152 mt, 8% of the biomass target (SSB_{MSY} proxy = 1860 mt). Fully selected F in 2015 was estimated at 1.09, 320% of the overfishing threshold proxy (F_{MSY} proxy = 0.341). Though the revision of 2009-2024 NEFSC survey indices reduced retrospective bias by 22% for F and 42% for SSB, a major retrospective pattern was still evident.

By the 2019 Operational Assessment (NEFSC 2022), the stock was no longer subject to overfishing, but was still overfished. SSB in 2018 was estimated to be 90 mt which is 5% of the biomass target (SSB_{MSY} proxy = 1779). The 2018 fully selected fishing mortality was estimated to be 0.259, which is 73% of the overfishing threshold proxy (F_{MSY} proxy = 0.355). The major retrospective pattern persisted in this ASAP model: The 7-year Mohn's ρ was -0.31 and 0.63, relative to F and SSB respectively. A retrospective adjustment was applied, though the magnitude of the patterns was less than in the previous assessment.

In 2022, a level 2 Management Track assessment was conducted for SNEMA yellowtail flounder. The analytical ASAP assessment model updated reference points through 2021. The stock remained overfished and was not subject to overfishing. The major retrospective pattern (Mohn's ρ 2.43 and -0.62 for SSB and F, respectively) necessitated retrospective adjustments for estimated reference points. The rho adjusted 2021 SSB was 70 mt and the rho adjusted 2021 F_{Full} 0.082. With these rho adjustments, SSB was 4% of the biomass target (SSB_{MSY} proxy = 1715 mt) and fully selected fishing mortality was at 23% of the overfishing threshold proxy. The long-term outlook for this stock was identified as a source of uncertainty. Extremely low survey catches in 2021 (2, 3, and 2 fish caught in the NEFSC spring, NEFSC fall, and larval surveys respectively), raised concerns about detectability.

Management history

New England groundfish stocks are managed under the Magnuson-Stevens Fishery Conservation and Management Act. The New England Fishery Management Council (NEFMC or Council) makes proposals, through various management actions, to the National Marine Fisheries Service (NMFS) for management of the fishery. An initial groundfish plan for cod, haddock, and yellowtail flounder was adopted in 1977 that relied on poorly enforced quotas (total allowable catches (TACs). The quota system was terminated in 1982 with the adoption of the Interim Groundfish Plan, which regulated minimum fish sizes and minimum codend mesh regulations for the Gulf of Maine and Georges Bank to control fishing mortality. The interim plan was replaced by the Northeast Multispecies Fishery Management Plan in 1986, which established biological targets in terms of maximum spawning potential and continued to rely on gear restrictions and minimum mesh size to control fishing mortality.

GB yellowtail flounder is a transboundary stock co-managed by the United States and Canada. Quotas are set and allocated to the United States and Canada annually by the Transboundary Management Guidance Committee (TMGC) based on the catch advice from the U.S. domestic stock assessment. In 2024, the Transboundary Resource Assessment Committee was discontinued. Under the new process, the U.S. solely conducts the stock assessment for the GB yellowtail flounder stock and provides scientific guidance for TMGC to consider. In Canada, the commercial fishery is managed with quotas, gear modification requirements, minimum fish sizes, bycatch restrictions and seasonal closures, and yellowtail flounder is primarily a bycatch species in the cod and haddock fisheries.

The Northeast Multispecies (Groundfish) Fishery Management Plan specifies the management measures for thirteen groundfish species off the New England and Mid-Atlantic coasts. Some of these species, like yellowtail flounder, are further subdivided into individual stocks that are attributed to different geographic areas. The Management Plan has been updated through a series of amendments and framework adjustments. The Plan included substantial increases in minimum mesh sizes in 1994 (6 in., 152 mm), 1999 (6 in., 152 mm, diamond mesh or 6.5 in., 165 mm, square mesh) and 2000 (6.5 in., 165 mm, for all trawls). Amendment 16, which became effective in 2010, adopted a broad suite of management measures to achieve the fishing mortality targets necessary to rebuild overfished stocks and meet other requirements of the Magnuson-Stevens Act. Amendment 16 adopted a process for setting annual catch limits that requires catch limits to be set in biennial specifications packages. Under this system of fisheries quotas and accountability, yellowtail flounder is managed as three independent stocks: GB, CCGOM, and SNEMA. Landings and discards from all fisheries count against the applicable catch limits, which are monitored throughout the year. If an overage occurs, an accountability measure is triggered under certain conditions.

Cape Cod/Gulf of Maine Fishery Management

Based on the 2022 assessment, CCGOM yellowtail flounder is not overfished and overfishing is not occurring (NEFSC 2022). The stock is rebuilt as of 2022. Additional measures are in place to reduce fishing mortality and protect spawning fish and habitat. The commercial fishery is subject to seasonal rolling closures, gear-specific year-round closures, and spawning closures. Year-round and seasonal closures in place in the Gulf of Maine include the Western Gulf of Maine habitat or groundfish closure areas and the Cashes Ledge habitat or groundfish closure areas. The Great South Channel Habitat Management Area is closed year-round to bottom-tending mobile gear.

Georges Bank Fishery Management

The 2024 stock assessment results for GB yellowtail flounder continue to indicate low stock biomass and poor productivity (NEFSC 2024). Recent catch is low relative to the biomass estimates and fishing does not appear to be a major driver of stock status currently. Stock status for GB yellowtail flounder is overfished, with overfishing status unknown. GB yellowtail flounder is in a rebuilding plan with a rebuilding date of 2032. In addition to the management measures outlined above, there are measures to reduce fishing mortality and to protect spawning fish and habitat. Closures in place in the Georges Bank area include the Georges Bank Dedicated Habitat Research Area, Closed Area II, and two Seasonal Spawning Closures.

In addition to the commercial groundfish fishery, two other fisheries managed by the Council receive sub-allocations of GB yellowtail flounder and are subject to accountability measures. The scallop fishery receives a sub-allocation based on a fixed percentage of 16% of the U.S. allowable catch. If the scallop fishery exceeds its allowable catch, they are subject to a gear restricted accountability measure, implemented the year following an overage. The current accountability measure is a modified dredge intended to reduce bycatch of yellowtail flounder that must be used in the GB yellowtail flounder gear restriction area. Since 2014, the scallop fishery has been prohibited from retaining yellowtail flounder. A portion of the U.S. allowable catch of GB yellowtail flounder is also allocated to small mesh fisheries (mainly targeting squid and whiting) based on a fixed percentage of 2%. If these fisheries exceed their allowable catch, a gear restricted accountability measure goes into place, typically the year following an overage, which requires small mesh fisheries to use approved selective trawl gear in the GB yellowtail flounder stock area.

Southern New England/Mid Atlantic Fishery Management

Based on the 2022 assessment, SNEMA yellowtail flounder is overfished and overfishing is not occurring (NEFSC 2022). The stock is in a rebuilding plan with a rebuilding date of 2029. The stock remains at low abundance despite low catches. There are no closures in the Southern New England/Mid-Atlantic area. There is the Southern New England Habitat Area of Particular Concern which includes the area around Cox Ledge.

In addition to the commercial groundfish fishery, the scallop fishery also receives a sub-allocation of SNEMA yellowtail flounder and is subject to accountability measures. This allocation is based on 90% of the scallop fishery projected bycatch estimate for the upcoming fishing year. If the scallop fishery catch exceeds their allocation, they are subject to the same gear restricted accountability measure described above, required for use in the SNEMA yellowtail flounder gear restricted area.

BIOLOGY

Yellowtail flounder (*Limanda ferruginea*) is a demersal flatfish whose range in United States (US) waters extends from Labrador to Chesapeake Bay, generally at depths between 40 and 70 m. The species has been described as relatively sedentary, although recent evidence from mark–recapture studies counters this classification with off bottom movements (Walsh and Morgan 2004), limited seasonal movements (Royce et al. 1959; Lux 1963), and transboundary movements (Stone and Nelson 2003; Cadrin 2010).

Spawning occurs during spring and summer, peaking in May (Cadrin 2010). Eggs are deposited on or near the bottom and float to the surface after fertilization. Larvae drift for approximately two months, then change form and settle to the bottom (Cadrin 2010). Off the northeast coast of the US, yellowtail flounder grow up to 55 cm total length and can attain weights of 1.0 kg. Growth is sexually dimorphic, with females growing at a faster rate than males (Lux and Nichy 1969; Cadrin 2010).There is little data on yellowtail flounder showing up as prey in the NEFSC Food Habits Database. It is likely that many of the yellowtail flounder seen in stomachs automatically get aggregated into higher taxa and are not identified to species level (pers. comm. Brian Smith).

Stock Identification

The scientific basis for current assessment and management units was reviewed by the 36th Northeast Regional Stock Assessment Workshop (NEFSC 2003) and the 3rd Groundfish Assessment Review Meeting (NEFSC 2008). In summary, the available information supports the continued assessment of three spatial units: 1) CCGOM, 2) GB, and 3) SNEMA. Simulation testing suggests that assessing current management units as separate stocks is generally robust to uncertainty in location of stock boundaries and movement among stocks (Goethel et al. 2015). Cadrin (WP) reviews information available since SAW36 and offers recommendations to fill information gaps (e.g., advanced analysis of genetics).

Length-weight relationship

Length weight equations are useful metrics to confirm stock delineations and for expanding lengths to weights to construct a catch at age matrix for the assessment. Length and weight data are available from the NEFSC spring and fall bottom trawl surveys. The most recent length weight equations for survey data for CCGOM and GB are from Wigley et al. (2003), which used data from 1992 – 1999. The most recent length weight equations from survey data for SNEMA are from SAW 2012, which used data from 1992– 2010. The most recent length weight equation from the commercial data are from Lux (1969). The WG updated the length weight equations for all stocks using survey data from 1999 to 2021 to confirm differences across stocks. Annual and seasonal length weight equations were calculated.

The results showed similar trends in length weight relationships between previous analyses and updated results. Results highlight significant differences between stocks and seasons. In the spring and for both seasons combined, Yellowtail flounder in SNEMA stock were heaviest at a given length, followed by GB and the CCGOM. However, in the fall updated data shows that the CCGOM stock is the heaviest at a given length followed by GB and SNEMA (Table 1; Figure 1). It is important to highlight that sample sizes are low for GB and SNEMA. Since 2015, annual sample sizes from the GB stock are less than 100 fish, while sample sizes for SNEMA are less than 35 fish, with the majority of years having less than 10 samples.

Ultimately, this work supported the current stock structure of three distinct stocks: CCGOM, GB and SNEMA. The commercial length-weight equations from Lux (1969) were used for GB and SNEMA catch expansions. CCGOM used NEFSC spring length-weight relationship as a basis for fishery weights to numbers (SAW 54). A study is currently going on to update commercial length-weight equations from the commercial fishery (Pers comm. Wigley). If sample sizes are sufficient updated equations can be used for future catch at age expansions.

Table 1: Length-weight parameters for the three stocks. Previous methods are from Wigley et al (2003) and SAW 12. Updated results are from the Research Track.

Season	Source	CCGOM		GB		SNEMA	
		alpha	beta	alpha	beta	alpha	beta
Spring	Update	-12.10689	3.113598	-12.3097	3.169349	-12.13511	3.137181
	Previous	-12.19415	3.150079	-12.6065	3.285499	-12.42864	2.970016
Fall	Update	-12.00847	3.087394	-11.3658	2.964666	-11.55703	3.175982
	Previous	-11.87475	3.064464	-11.6378	3.002981	-11.54187	2.96
Both	Update	-12.07506	3.103541	-11.8009	3.025541	-12.04101	3.107285
	Previous	-11.97647	3.090456	-12.04223	3.122622	-12.24433	3.167944

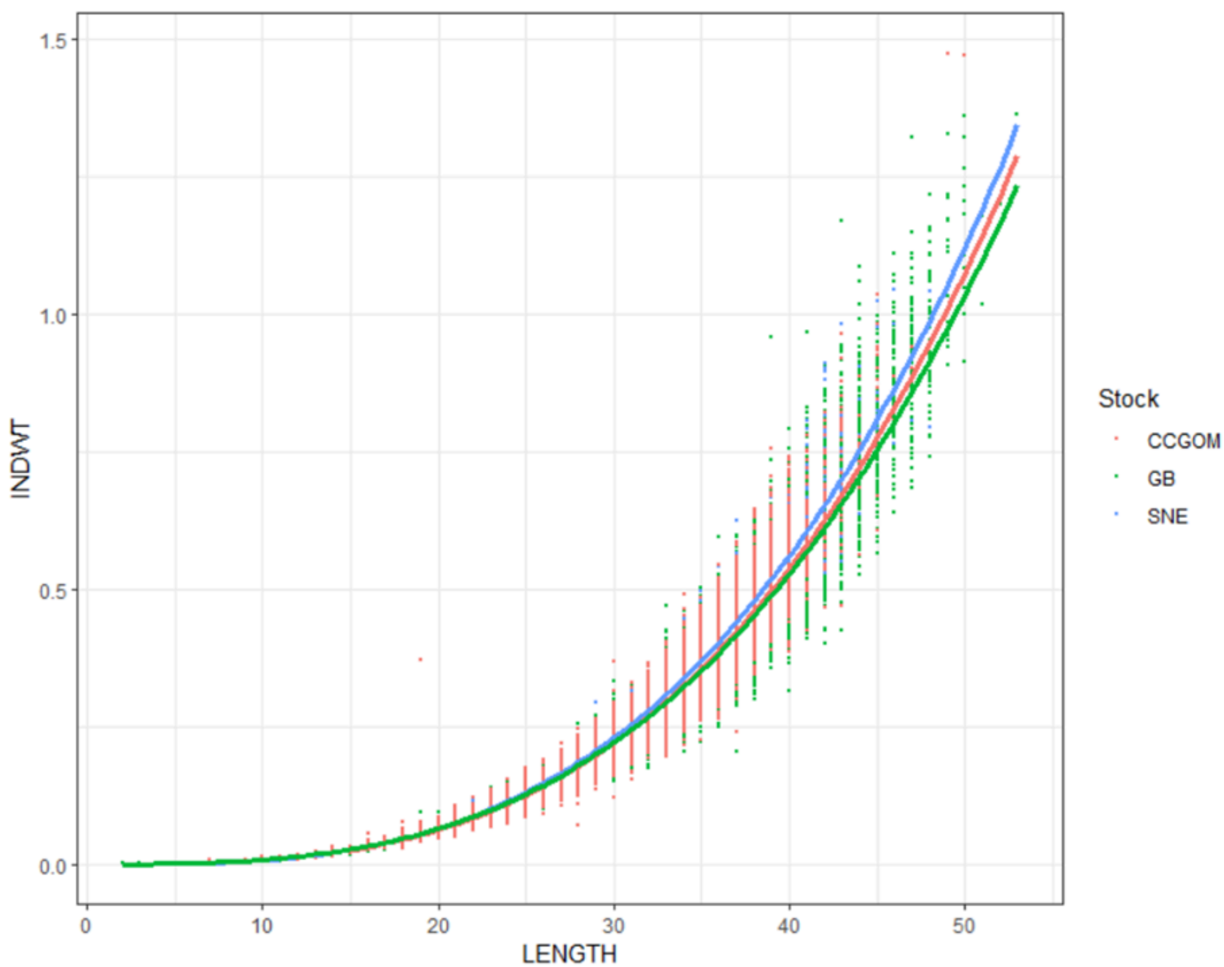


Figure 1: Updated annual length-weight relationships for the three stocks using NEFSC survey data from 2000-2021.

Growth

Growth rates were explored to investigate if different rates were present between the three stock areas. Von-Bertlanffy growth curves using data from the NEFSC surveys were last updated for all three stocks during SARC 54 using data from 1981–2010 . These results suggested that CCGOM fish are generally larger at older ages followed by GB and SNEMA. Updating the results with data from 2012–2021 display different trends. In general, there are fewer samples of older fish for all three stocks. For both the spring and fall, GB fish are larger at older ages followed by SNEMA and then CCGOM. Annual Von-Bertlanffy curves suggest similar lengths at age for GB and SNEMA, with CCGOM fish being shorter at older ages (Table 2). Updated annual curves using the entire dataset (1968–2021) suggest that GB fish are largest at older ages, followed by CCGOM and SNEMA (Figure 2). Mean length at age was explored for all three stocks from 1981–2021. In the fall, mean length at age shows variable trends for all three stocks. There is limited information on age-1 fish for all three stocks and few samples for SNEMA in recent years (Figure 3). In the spring, mean length trends show decreasing length at age for all three stocks (Figure 4). Differences in Von-Bertlanffy growth curves and mean length at age support treating CCGOM, GB and SNEMA as separate stocks. However, the relatively stable geographic differences that had been observed for decades (e.g., consistently smaller size at age in CCGOM than GB or SNEMA, Cadrin 2010) appear to have changed in the last decade (e.g., smallest size at age in SNEMA), either from changes in environmental conditions or low sample size.

Table 2. Von-Bertlanffy growth curve parameters from SAW 54 and the updated analyses conducted during the Research Track

Season	Source	CCGOM			GB			SNEMA		
		Linf	K	T0	Linf	K	T0	Linf	K	T0
Spring	Update	46.294	0.7387	-0.521	41.664	0.5921	-0.302	40.797	0.6329	-0.411
	Previous	45.057	0.4201	-0.198	41.846	0.7489	-0.545	35.723	0.9655	-0.637
Fall	Update	37.463	0.5864	-0.615	42.039	0.6073	-0.456	47.155	0.3267	-1.251
	Previous	46.294	0.4034	-0.477	42.739	0.6365	-0.253	35.611	0.8662	-0.150
Both	Update	38.073	0.477	-0.567	42.277	0.506	-0.469	42.422	0.489	-0.22
	Previous	47.663	0.311	-0.710	44.319	0.49	-0.378	36.395	0.696	-0.168

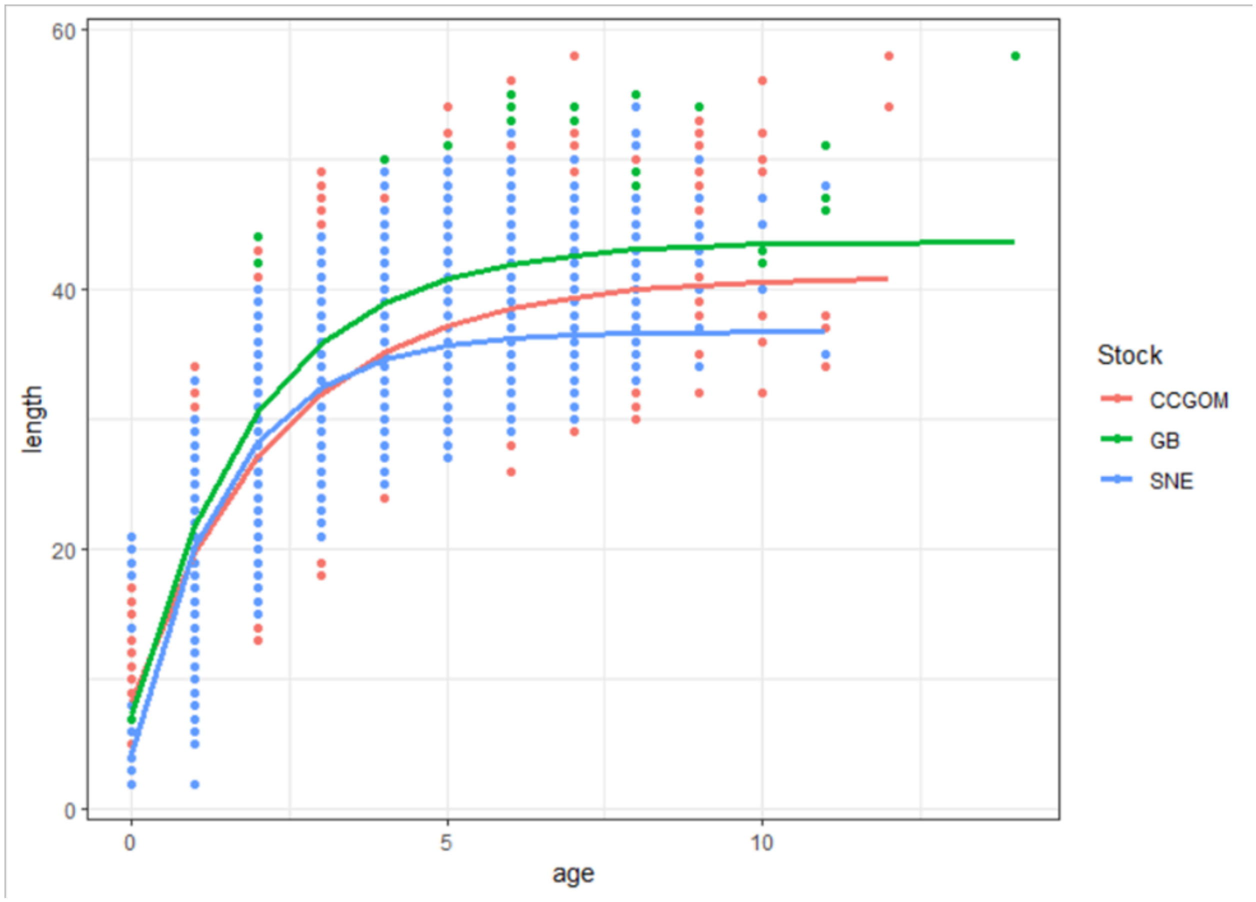


Figure 2: Annual Von-Bertlanffy growth curves for the three stocks using NEFSC survey data from 1981-2021.

Figure 3: Mean length at age from the fall NEFSC survey.

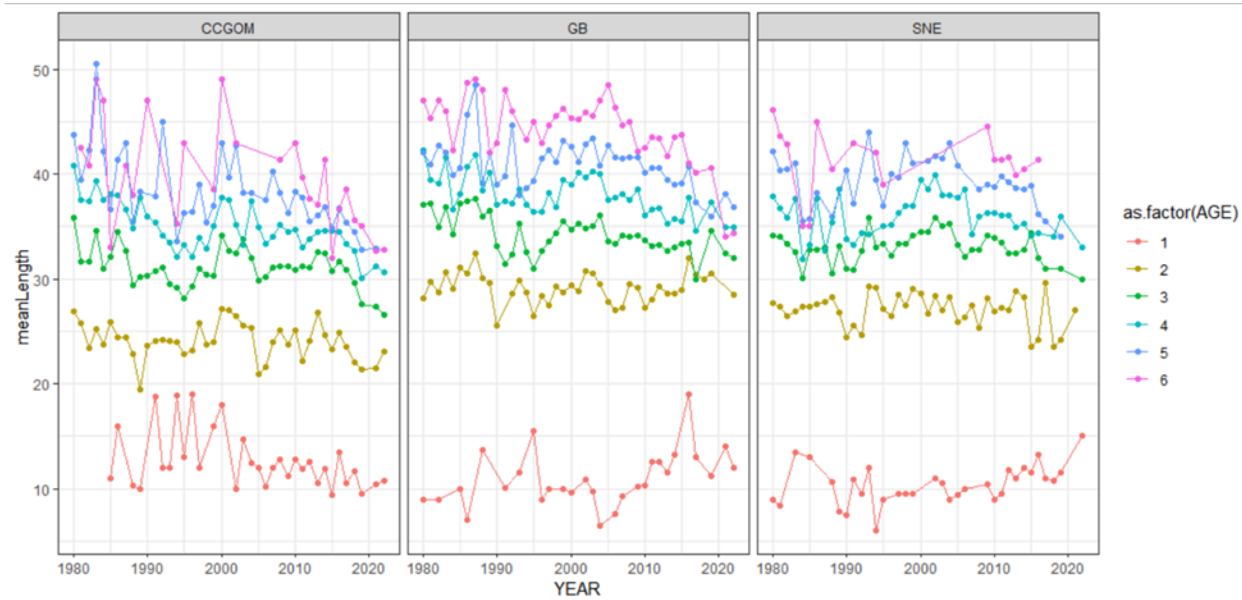


Figure 4: Mean length at age from the springNEFSC survey.

Maturity

Background
Geographic patterns in vital population parameters have historically provided a foundation for distinguishing separate management stocks, often reflecting genetic and environmental differences (Begg et al. 1999, Cadrin 2010). In the U.S., yellowtail flounder from CCGOM are generally characterized by later age and larger size at maturity compared to the GB and SNEMA stocks. These distinctions have been observed consistently for over three decades (Begg et al. 1999), supporting the use of these population characteristics for stock-specific management.

Approach
Data for this analysis were obtained from the NEFSC random stratified bottom trawl surveys, conducted in both spring and autumn between 1968 and 2022. To focus on yellowtail flounder's peak spawning period, only spring survey data (March to May) were included. In each stock area, we analyzed existing samples on fish length, sex, and maturity stage, classifying individuals as either immature or mature by grouping all stages other than immature.

We initially evaluated maturity-at-age across stock areas using both logistic regression and a direct estimation approach. However, the WG recommended caution with logistic regression due to its sensitivity to small sample sizes, which can bias parameter estimates, especially at age extremes where sample data may be sparse. This issue was most pronounced for GB and SNEMA yellowtail stocks. Consequently, we employed a direct estimation method, calculating the proportion of females mature at each age without imposing a curve. Proportion mature was evaluated across all three stocks by decade, with a variety of moving average windows to determine the most stable indicators while maintaining sensitivity to recent trends.

Summary and Recommendations

The analysis revealed variations in maturity proportions over time, notably for ages 2 and 3. Proportion mature at age increased in the CCGOM and GB stocks, while SNEMA showed a decline. Sample size constraints, particularly in recent decades for GB and SNEMA, limit the confidence in these trends and may not fully capture stock dynamics. In contrast, the relatively robust sample sizes for CCGOM enhance the reliability of observed maturity patterns in this stock area (Alade and Hansell WP).

The WG's recommendations for the 2024 RT were as follows:

- For GB and SNEMA, use a time-series average of proportion mature at age due to limited sample sizes.
- For CCGOM, apply a 3-year moving average smoother, leveraging the larger sample size for a more refined temporal resolution.

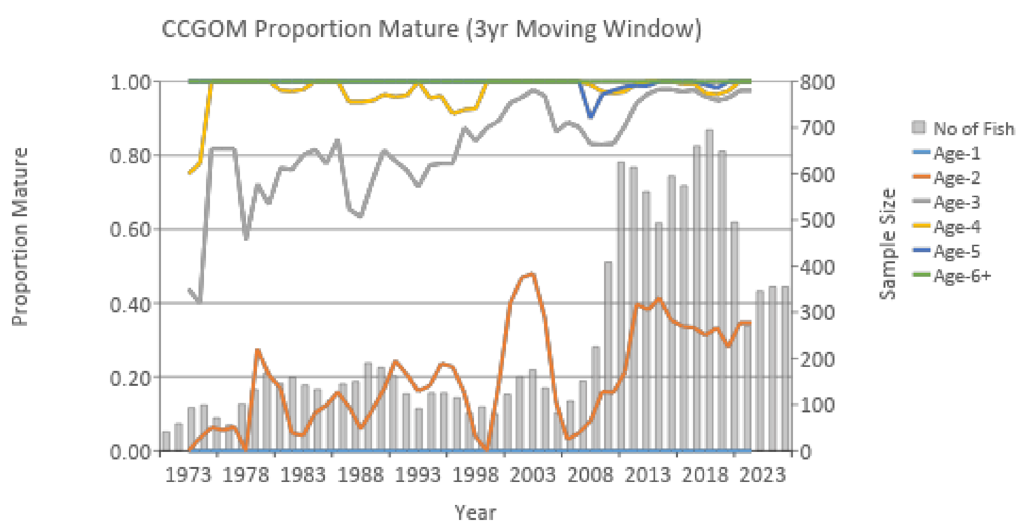


Figure 5: Sample size (bars) and proportion mature for CCGOM yellowtail from 1970-2022

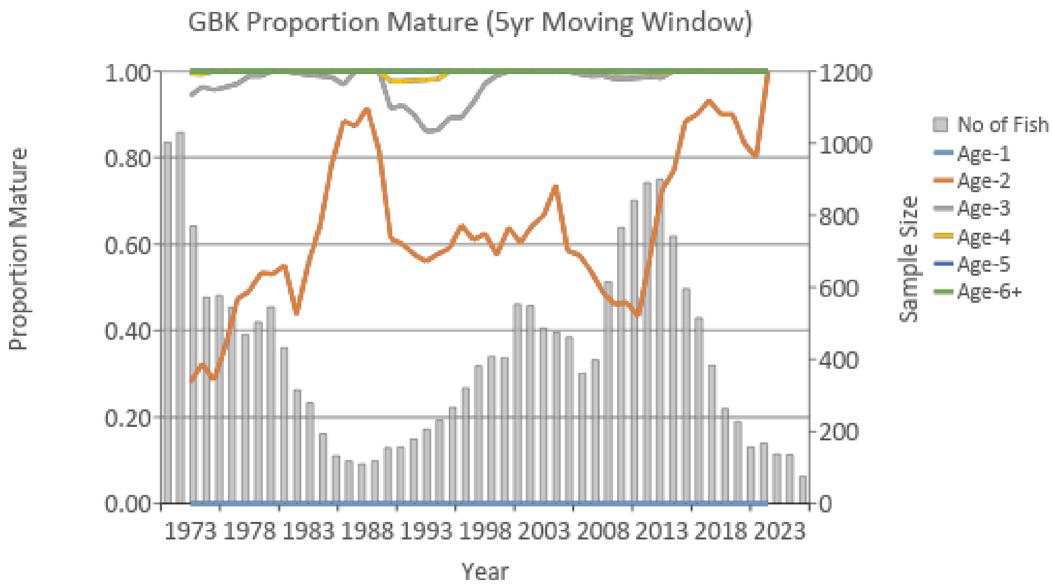


Figure 6: Sample size (bars) and proportion mature for GB yellowtail from 1970-2022

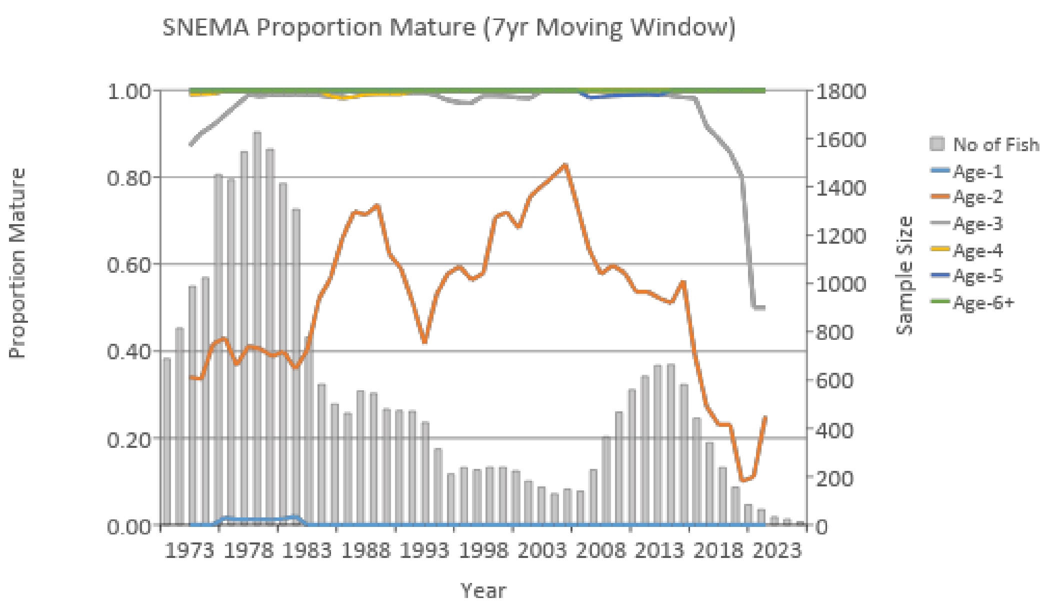


Figure 7: Sample size (bars) and proportion mature for SNEMA yellowtail from 1970-2022

Natural mortality

Life history parameters were estimated for each stock of yellowtail flounder off New England to derive approximations of natural mortality rate (Cadrin WP). Maximum age by stock was determined from fishery-independent survey data or fishery monitoring data. Spring survey data was used to derive maturity at age. Spring and fall survey data were used to estimate von Bertalanffy growth parameters. Several estimators of natural mortality derived from life history parameters produced a wide range of estimates for each stock. Estimates of instantaneous natural mortality rate derived from longevity were approximately 0.4 for the CCGOM and GB stocks and 0.4 to 0.5 for the SNEMA stock. Longevity-based estimates were intermediate to those based on growth, maturity, gonadosomatic index, or regional temperature. These approximations were used to inform natural mortality as long-term lifetime rates.

TOR1: ECOSYSTEM AND CLIMATE INFLUENCES

"Identify relevant ecosystem and climate influences on the stock. Characterize the uncertainty in the relevant sources of data and their link to stock dynamics. Consider findings, as appropriate, in addressing other TORs. Report how the findings were considered under impacted TORs."

Contributors: Jessie Kittel, Steve Cadrin, Conor McManus, Alex Hansell, Tara Dolan, Chris Legault, Charles Adams, Larry Alade, Hubert du Pontavice, Lisa Kerr, Jamie Behan, Scott Large, Abby Tyrell, Scott Schaffer

Yellowtail flounder inhabit the continental shelf of the northwest Atlantic and historically supported target fisheries off New England. However, the GB and SNEMA stocks have declined in recent decades and have not recovered despite severely restricted fisheries, suggesting that productivity may be negatively affected by climate change. Ocean waters off New England are warming faster than the global average, and decreased yellowtail flounder productivity has been associated with ocean warming in the region (Pershing et al., 2021; Stone et al., 2005). US stock assessments of yellowtail flounder have exhibited retrospective patterns, in which contemporary estimates of abundance decrease when a new year of data is added, presenting a major source of uncertainty for determining stock status and informing rebuilding plans (Legault et al. 2012, Legault et al. 2013). Retrospective patterns may result from model assumptions that do not account for environmental effects on population or fishery dynamics (Kerr et al. 2022). In the face of climate change, there is increasing exploration of climate impacts on stock dynamics in the context of stock assessments. However, incorrectly integrating climate information can contribute to model misspecification. Thus, it is important to identify significant relationships and understand mechanisms before using them in assessments.

Kittel et al. (WP) reviewed the available information on environmental drivers that may be impacting US stocks of yellowtail flounder from literature and harvesters' ecological knowledge, tested relationships between environmental indices and components of productivity (i.e., recruitment, growth, maturity, survival).

The literature review identified stock specific differences and indicated that yellowtail flounder are indeed vulnerable to climate variability, affecting their distribution, recruitment, and potentially other components of production such as natural mortality and growth. The environmental covariates identified as having the most support for further exploration include the Atlantic Multidecadal Oscillation (AMO), North Atlantic Oscillation (NAO), bottom temperature, Gulf Stream Index (GSI), and the cold pool index.

Generalized Additive Models (GAMs) were applied to explore relationships between the identified environmental variables and stock dynamics to determine what data should be explored in yellowtail flounder stock assessment models. Several potential climate impacts were identified. Recruitment of yellowtail flounder off southern New England was correlated to the Gulf Stream Index (Figure 1.1) and the Mid-Atlantic Bight Cold Pool. Recruitment of yellowtail flounder on Georges Bank was correlated with bottom temperature (Figure 1.1) and the Atlantic Multidecadal Oscillation. Recruitment indices of CCGOM yellowtail flounder was correlated with bottom temperature and AMO. Preliminary results suggest weight-at-length was larger when ocean waters were warmer.

The WG made several data and model decisions based on the literature review and statistical tests. The WG also decided to apply time-varying size at age from annual samples (or multi-annual samples if needed) for all three stocks. The WG also decided to explore environmental covariates to recruitment deviations, with SNEMA recruitment informed by lagged GSI or Cold Pool Index, GB recruitment informed by lagged bottom temperature or AMO, and CCGOM recruitment informed by lagged bottom temperature. The same environmental covariates were also recommended for exploration on time varying natural mortality.

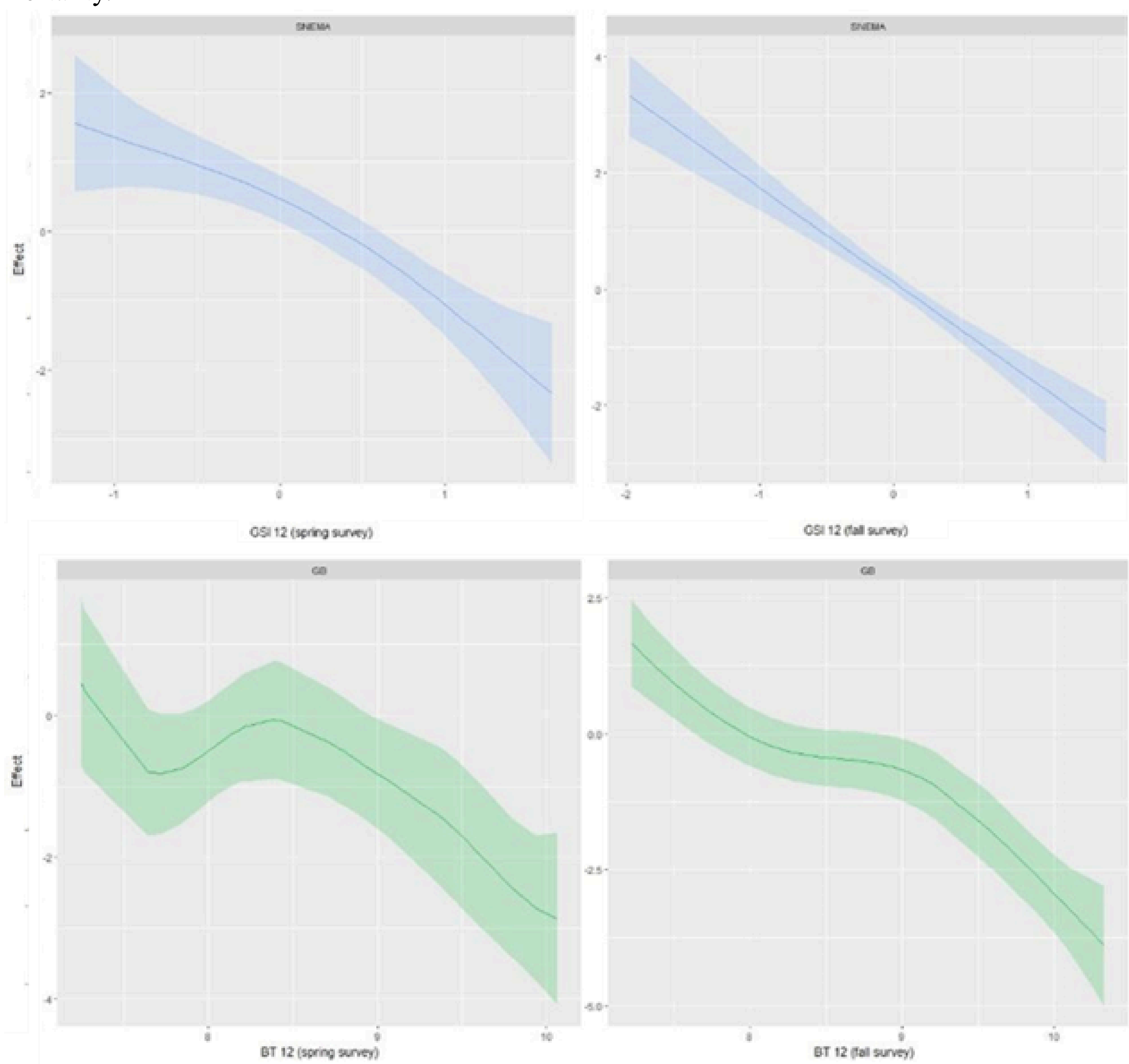


Figure 1.1. Relationships of environmental covariates of yellowtail flounder recruitment applied in stock assessment modeling. Partial effects of 12-month lagged Gulf Stream Index (GSI 12) on spring (left) and fall (right) survey indices of SNEMA recruitment (top panels) and 12-month lagged bottom temperature (BT 12) on survey indices of GB recruitment (bottom panels).

McManus and Richardson (WP) developed larval habitat suitability models for the three US yellowtail flounder stocks to determine (1) how environmental variables correspond to larval abundance, and (2) how yellowtail flounder habitat suitability has changed over time. Several environmental variables corresponded to larval abundance, including sea temperature, copepod abundance and climate oscillations. When calculating habitat suitability indices for the stocks, their trajectories were similar over time: increasing habitat suitability in the 1970s and 1980s, and declining in the 2000s. Constructed larval indices for the Southern New England-Mid Atlantic stock were compared to the stock's habitat suitability to determine whether changes in habitat have induced variability in the stock's larval production. Larval abundance and habitat suitability were significantly, but weakly correlated, suggesting that the environmental habitat conditions may not be the greatest determinant in larval production. Although the information was informative regarding prospective habitat requirements for larval yellowtail flounder and offers a mechanism for environmental effects on yellowtail flounder recruitment, the WG elected to not use the habitat indices as environmental covariates within the stocks' assessment models.

TOR2: CATCH DATA

"Estimate catch from all sources including landings and discards. Describe the spatial and temporal distribution of landings, discards, and fishing effort. Characterize the uncertainty in these sources of data."

Overview

Methodology

Statistical areas used to report yellowtail landings are shown in Figure 2.1.1. The statistical area boundaries have been in existence since the mid-1940s (Rounsefell 1948, Royce et al. 1959), although the current three-digit numerical coding scheme was not adopted until 1963 (Mayo 1977). Landings are obtained from the weighout reports of commercial dealers, and are generally considered a census of total landings. Prior to 1994, commercial landings were allocated to the three-digit statistical area according to post-trip interviews conducted by NMFS port agents (Burns et al. 1983). Since 1994, fishing vessels have been required to submit a vessel trip report (VTR) containing statistical area and effort information, which are then matched to dealer reported landings at the trip level using a multi-tiered allocation procedure (Wigley et al. 2008). Biological samples are collected dockside by NMFS port agents. Sampling protocols are designed to have consistent temporal coverage in length samples across all primary gear types that land yellowtail. Length samples (sample units are one fish tote, containing approximately 100 fish) are collected per market category, port, and gear. Since 1994, an average of 47, 52 and 36 samples have been collected annually from CCGOM, GB and SNEMA stocks, respectively. (Tables 2.1.1, 2.1.2, 2.1.3). However, in recent years due to low landings for two of the yellowtail flounder stocks (GB and SNEMA) and reduced funding, fewer length samples are available from landed fish.

Historical Fishery

A New England fishery for yellowtail flounder developed in the 1930s, coincident with a decline in winter flounder abundance (Royce et al. 1959, Lux 1964). Yellowtail flounder were historically caught in otter trawls targeting other groundfish species or scallops. United States landings were negligible prior to the mid 1930s, but fluctuated widely in the decades that followed. Landings increased to average 6,500 mt in 1948–1949 (NEFSC 1994), peaking at 31,000 mt in 1942 (Lux 1964). The fishery for yellowtail flounder was historically divided into Southern New England (south of Massachusetts and Rhode Island), Georges Bank, and Cape Cod (east and north of Cape Cod, Lux 1964). Yellowtail were historically landed in ports from New Jersey to Maine. The amount of fish landed in Connecticut, New York and New Jersey declined as early as the 1950s. By 1940, New Bedford, Massachusetts had become the principal yellowtail port because of industry infrastructure and proximity to fishing grounds. From 1940–1961 over one half of all United States yellowtail were landed in New Bedford (Lux 1964).

Catch Accounting and Monitoring System

Commercial landings and discard data from 2020 onward are sourced from the Catch Accounting and Monitoring System (CAMS). Prior to that, data was compiled from area allocation (AA) tables for stock assessment and matched via the data matching and imputation system (DMIS) for quota monitoring. The impetus for transitioning to CAMS was to provide a single comprehensive source for all Northeast US commercial catch, for quota monitoring, stock assessment, protected resources estimation, and ecosystem modeling in a fully documented relational database (NOAA, 2023). Data is consolidated at the trip or sub-trip level. Data in CAMS are stratified with more specific gear types than used in the past. There is good agreement between CAMS and the previous system for yellowtail flounder landings and discard data across the three stocks in most years (Figure 2.1.2). In the future, all catch information will be provided by CAMS..

Commercial Landings

Cape Cod/Gulf of Maine stock

From 1964 to 2022, commercial landings in CCGOM declined from a high of 5,583 mt in 1980 to a time series low of 156 mt in 2020 (Figure 2.2.1, Table 2.2.1). Commercial landings from the CCGOM stock encompass statistical areas 464–467, 511–515 and 521 (Figure 2.2.2, Table 2.2.2). The majority (56%) of landings come from statistical area 514. From 1994-2022 landings were concentrated within Massachusetts state waters north of Cape Cod (Figure 2.2.3). Yellowtail flounder are caught in the otter trawl, scallop dredge, gillnet and uncategorized fisheries. The majority (91%) of landings come from the trawl fishery, with an increase in gillnet landings from 6 to 399 mt from 1984–1998 (Figure 2.2.4, Table 2.2.3).

Georges Bank stock

GB yellowtail flounder had been a principle resource for the New England groundfish fishery, but has not been targeted in recent years, and is currently caught primarily as bycatch in other demersal fisheries. From 1964 to 2022, US commercial landings from GB declined from a high of 15,944 mt in 1980 to a time series low of 0.3 mt in 2022 (Figure 2.2.5, Table 2.2.4). Canadian landings peaked at 2913 mt in 2001 but have remained below 1 mt since 2016. Commercial landings from the GB stock encompass statistical areas 522, 525, 541-543, 551, 552, 561 and 562. The majority (56%) of landings prior to 1984 came from statistical area 524, after which no landings were recorded from that area (Figure 2.2.6, Table 2.2.5). The abrupt shift in the 1980s can be attributed to the implementation of the Hague line in 1984, delineating US and Canadian waters and splitting the former strata. After 1984, the majority of landings came from area 562 (83% in 1986) and then to 525, peaking at 86% in 2017, and finally to 522, comprising a mean of 67% of total landings since 2020. The GB stock area includes parts of Canada’s exclusive economic zone (Figure 2.2.7). Canadian landings were relatively high in the late 1990s-early 2000s, but showed similar trends to the US landings and remained a small proportion of total landings throughout the time series (Figure 2.2.8). GB yellowtail flounder are caught in the otter trawl, scallop dredge, gillnet and uncategorized fisheries, with the majority (time series mean = 98%) of landings coming from the trawl fishery (Figure 2.2.9, Table 2.2.6).

Southern New England/Mid Atlantic stock

SNEMA yellowtail flounder was also a principle resource for the New England groundfish fishery, but has not been targeted in recent years, and is currently caught primarily as bycatch in other demersal fisheries. Since their peak at (19,149 mt) in 1964 landings decreased to a relative low (1680 mt) during the late 1970s before rebounding in the mid 1980s and 1990s before entering a steady decline to 0.22 mt in 2022 (Figure 2.2.10, Table 2.2.7). The magnitude of landings has been low recently, averaging about 1.3 mt per year in the last 5 years, due to a combination of low biomass and regulatory restrictions on commercial landings.. Commercial landings encompass statistical areas 526, 533, 534, 537–539, 611–616, 621–629, and 631–639. From 1994–2022 landings were more concentrated around Block Island, Rhode Island and to the northeastern edge of the stock area adjacent to the border of the Georges Bank stock area (Figure 2.2.11). Prior to 1995, the majority (53%) of landings were from statistical area 526, whereas statistical area 539 and 537 dominate the catch to 2022 (Figure 2.2.12, Table 2.2.8). Yellowtail flounder are caught in the trawl, scallop dredge, gillnet and uncategorized fisheries.The majority of landings come from the trawl fishery, comprising a mean of 96% of landings (Figure 2.2.13, Table 2.2.9).

Landings at Length

Cape Cod/Gulf of Maine stock

The proportion from the large market category has been decreasing over the time series from 85% in 1974 to 7% in 2019 with an increase in proportion from the small market category since 2010 to 73% in 2022 (Figure 2.3.1, Table 2.3.1). There is considerable overlap in market category definitions: From 1964-2022, large market category fish ranged from 23–67 cm, 29–46 cm for medium or select, 23–48 cm for small, and 27-58 cm for unclassified (Figure 2.3.2). Lengths of kept fish, 1989–2022, averaged 36.18 cm, ranging from 23-67 cm.

Georges Bank stock

The proportion from the large market category has accounted for the majority of landings averaging 66% over the time series, with an increase in proportion from the unclassified and small market categories to 44% post 2020 (Figure 2.3.3, Table 2.3.2). Medium or select market categories are classifications only used by several ports and thus there are not records for the majority of years.(Figure 2.3.4).

Southern New England/Mid Atlantic stock

Proportion of landings in each market category has been a relatively evenly split between large (38%), small (30%) and unclassified (30%) since the beginning of classification in 1972, with medium or select making up the remaining 8%. Medium or select market category has increased from 3% in 2004 to 31% in 2022 (Figures 2.3.5 and 2.3.6; Table 2.3.3). Lengths of kept fish, 1989–2022, averaged 37 cm, ranging from 4-67 cm.

Landings at Age

Landings at age were updated for 1994–2022. Data prior to 1994 was obtained from previous assessments. When estimating landings at age, every attempt was made to maintain market category and quarter-year stratification to align with the port sampling design. However, in some years there were not samples for every market category, especially towards the end of the time series when landings were low for the GB and SNEMA stocks. If the number of samples were not sufficient for each market category in each quarter, a semi-annual stratum was used. If a semi-annual stratum was not sufficient, an annual stratum was applied. Seasonal length weight relationships were used to convert quarter and seasonal stratifications from landings to numbers at age (NAA). Annual length weight relationships were used to convert annual landings to NAA.

NAA were estimated by applying a 1 cm binned age-length key to the observed length distribution that was aggregated by quarter, semester or annual as described above. There were some length samples for all three stocks that had no corresponding age samples. These gaps were filled using a multinomial regression to predict age from length.

Cape Cod/Gulf of Maine stock

The proportion at age of CCGOM yellowtail flounder landings at age has expanded at the end of the time series with more older ages being observed in recent years (Figure 2.4.1, Table 2.4.1). From 1994–2004 commercial landings of age 3 fish made up 22% on average of the commercial landings.

Georges Bank stock

Landings at age of GB yellowtail flounder landings at age have expanded at the end of the time series with more older ages being observed in recent years (Figure 2.4.2, Table 2.4.2).

Southern New England/Mid Atlantic stock

The proportion at age of SNEMA yellowtail flounder landings at age has expanded at the end of the time series with a greater proportion of older ages being observed since 2010, though abundance of older age classes remains low (Figure 2.4.3, Table 2.4.3). However, from 2019 onward, landings were less than 1 mt, considered insufficient to derive landings-at-age.

Commercial Discards

Methodology

At-sea observer data from 1994 to 2022 were used to estimate fleet-based discards from the observed ratios of discarded yellowtail flounder to multispecies kept catch, expanded to total discards using each fleet’s total multispecies landings (NMFS 2023). For 1973–1988, total discards are determined using a hindcasting method. Discarded lengths from observer data were converted to ages using age-length keys from the NEFSC bottom trawl surveys. At least 20 lengths per semester were needed, else lengths were pooled into an annual estimate. If less than 20 lengths were available annually, additional length data were imputed from the previous year.

Historical discards of yellowtail flounder were substantial, with >50% of catch being discarded in some years (NEFSC 2018), large mesh regulations in the mid 1990s helped to reduce discards. However, in recent years due to to low stock size and reduced markets discards are a large proportion of GB and SNEMA catch. Discard mortality of yellowtail flounder in the previous assessment was assumed to be 100%. However, based on a recent study (Barkley and Cadrin 2012), this new assessment assumed a 90% discard mortality rate in the commercial catch.

Cape Cod/Gulf of Maine stock

Total discards decreased to a time series low of 34 mt in 2020 from the peak of 559 mt in 1997 (Figure 2.5.1, Table 2.5.1). Discards have been a small proportion of total catch in the commercial fleet for CCGOM (mean 15.1%, since 1994). The proportion of discards to landings has remained relatively stable as landings have declined (Figure 2.5.2). The limited access scallop dredge fleet was a major source of commercial discards prior to the early 2000s, as was the large mesh otter trawl fishery continuing until 2022 (Figure 2.5.3a-f).

Georges Bank stock

Total discards have varied widely in the past several decades, from a low of 1.6 mt in 2019 to 753.8 mt in 2009 (Table 2.5.2). Recent total discards in the GB stock are far below historic values. Discards in the US commercial fleet outweighed Canadian discards for the majority of the time series from pre-1940 to the mid-1970s, after which Canadian and US discards were similar (Figure 2.5.4). Discards have remained a modest proportion of landings (time series mean since 1995 = 30.9%, Figure 2.2.8). The scallop dredge fleet was a major source of commercial discards from the 1990s to 2022, whereas the otter trawl fleet was a prominent source of discards prior to 2010 (Figure 2.5.5a-c).

Southern New England/Mid Atlantic stock

Total discards have remained below 500 mt since 1994 (Figure 2.5.6, Table 2.5.3). Starting in 2005, commercial discards became a significant component, accounting for over 50% of the total catch (1994-2021 average 34.2%, Figure 2.5.7). Increases in discards were partly the result of restrictive trip limits that were in effect from 2003 through 2008. The scallop fleet has been a primary source of yellowtail discards. Discards of yellowtail remain approximately 60% of the total catch. The majority of discards come from the large mesh otter trawl and the limited access scallop dredge fisheries (Figure 2.5.8a-e).

Discards at Length

Cape Cod/Gulf of Maine stock

The number of yellowtail flounder discards measured per year (1989–2022) averaged 3071 mt, ranging from 588 in 2020 to 13,529 in 2005. Discarded fish had an average length of 31 cm and ranged in size from 8 to 65 cm (Figure 2.6.1). Length distributions of discards from the commercial fishery were sampled proportionately relative to survey length distributions (Figure 2.6.2).

Georges Bank stock

The number of yellowtail flounder discards measured per year (1989–2022) averaged 5145 mt, ranging from 49 in 199 to 35,046 in 2000. Discarded fish had an average length of 34.5 cm and ranged in size from 11 cm to 145 cm (Figure 2.6.3). Length distributions of discards from the commercial fishery were sampled proportionately relative to survey length distributions (Figure 2.6.4).

Southern New England/Mid Atlantic stock

The number of yellowtail flounder measured per year (1989– 2022) averaged 1997 cm, ranging from 21 in 2022 to 1337 in 1990. Discarded fish had an average length of 32.8 cm and ranged in size from 13 cm to 65 cm (Figure 2.6.5). Length distributions of discards from the commercial fishery were sampled proportionately relative to survey length distributions (Figure 2.6.6).

Discards at Age

Cape Cod/Gulf of Maine stock

Discards are predominantly of fish age five or less, though a greater proportion of older discards have been observed since 2015. (Figure 2.7.1, Table 2.6.1).

Georges Bank stock

Discards are predominantly of fish aged 2 to 4 (Figure 2.7.2, Table 2.6.2)

Southern New England/Mid Atlantic stock

The paucity of length data in recent years makes estimating discards-at-age a challenge for this stock. Discards are predominantly of fish aged 2 to 5, however, there are insufficient data to support discards at age from 2020 onwards (Figure 2.7.3, Table 2.6.3).

Total Catch

Cape Cod/Gulf of Maine stock

In the period from 1985–2022, total catch per year averaged 2187 mt, catch ranged from 12,937 mt in 1990 to 190 mt in 2020 (Figure 2.8.1, Table 2.7.1).

Georges Bank stock

In the period from 1935–2022, total catch per year averaged 5811 mt, catch ranged from 21,410 mt in 1970 to 8 mt in 2019 (Figure 2.8.2, Table 2.7.2).

Southern New England/Mid Atlantic stock

In the period from 1973–2022, total catch per year averaged 3874 mt, catch ranged from 22,211 mt in 1983 to 5 mt in 2021 (Figure 2.8.3, Table 2.7.3).

Total Catch at Age

Cape Cod/Gulf of Maine stock

Catch is predominantly of fish ages 2-4 (Figure 2.9.1, Table 2.8.1). Proportion of ages 2, 3, and 4 from 1985–2021 was 27.5%, 45.6% and 17.9%, respectively. Proportion at age has become more uniform since 2010, prior to which catches were dominated by fish aged 2 and 3.

Georges Bank stock

Catch is predominantly of fish ages 2–4 (Figure 2.9.2, Table 2.8.2). Proportion of ages 2, 3, and 4 from 1973-2022 was 36.4%, 32.1% and 16.3%, respectively. Proportion at age has expanded into older age classes since 2010.

Southern New England/Mid Atlantic stock

Catch is predominantly of fish ages 2–4 (Figure 2.9.3, Table 2.8.3). Proportion of ages 2, 3, and 4 from 1973–2019 was 37.5%, 36.7% and 12.5%, respectively. Proportion at age has expanded into older age classes since 2015.

Recreational Catch

Yellowtail flounder catch consists of commercial landings and discards. Recreational catch of yellowtail flounder is negligible.

LPUE index

Patterns of landings per unit effort (LPUE) of yellowtail flounder were standardized and compared with survey indices. New England groundfish assessments previously included fishery catch rates as indices of abundance (NEFMC 2020). Lux (1964) developed LPUE indices for all three yellowtail stocks using port interviews of trips that landed 50% yellowtail or greater, standardized to 26-50 ton vessels. O'Brien & Mayo (1988) standardized yellowtail LPUE by vessel tonnage class. LPUE indices were discontinued in the late 1990s because of management and data changes (NEFSC 1996, 1997).

For this RT, yellowtail flounder catch rate series were developed for the New England trawl fishery using 1996-2019 logbook data (Figure 2.10.1, NEFSC 1996, 1997). Generalized linear models (GLM) of ln(LPUE) with year, quarter, statistical area and tonnage class (<50t; 51-100t; 101-150t; >150t) main effects, and first order year interaction effects (Gavaris 1980). The standardized LPUE was strongly correlated with the Georges Bank surveys (NEFSC Spring = 0.76, NEFSC Fall = 0.90, DFO = 0.86). The LPUE index showed variable correlation with the CCGOM stock survey indices (NEFSC Spring = 0.67, NEFSC Fall = 0.23, MADMF Spring = 0.58, MADMF Fall = 0.13, MENH Spring = 0.49, MENH Fall = 0.02) For the SNE stock, while the LPUE index was moderately correlated with NEFSC bottom trawl surveys (NEFSC Spring = 0.74, NEFSC Fall = 0.54, NEFSC Winter = 0.25), the recent declining trend lagged behind survey trends (Cadrin WP).

The LPUE indices were ultimately not used in the assessment models due to data distribution problems and poorly estimated interaction coefficients. Recent low catch limits and avoidance behavior were thought to introduce bias. Future efforts may wish to consider spatiotemporal analysis of fine-scale fishery data (e.g., at-sea observers, study fleet). These may fit data distributions and account for spatial and temporal interactions better than conventional GLMs (Grüss et al. 2019).

Tables

Table 2.1.1 Number of biological samples (boxes of fish) and number of fish sampled annually from landings of yellowtail flounder from CCGOM (1964-2022).

Year	Landings (mt)	Number of lengths	Metric tons/100 lengths	Number of ages
1964	1890.58	0	0	0
1965	1599.51	0	0	50
1966	1848.95	0	0	798
1967	1617.92	0	0	858
1968	1605.25	0	0	576
1969	1433.38	1074	133.5	195
1970	1328.16	675	196.8	0
1971	1728.14	716	241.4	0
1972	1526.43	128	1192.5	48
1973	1725.39	2210	78.1	749
1974	2159.39	937	230.5	399
1975	2249.61	281	800.6	150
1976	3855.63	321	1201.1	120
1977	3731.49	672	555.3	354
1978	4071.00	456	892.8	202
1979	4444.08	408	1089.2	151
1980	5582.48	529	1055.3	198
1981	3575.62	313	1142.4	148
1982	3636.75	265	1372.4	75
1983	2209.22	2080	106.2	683
1984	1372.01	739	185.7	198
1985	1171.77	1977	59.3	482
1986	1205.09	1307	92.2	295
1987	1353.22	1306	103.6	328
1988	1275.08	1520	83.9	398
1989	1117.44	1010	110.6	301
1990	3222.76	1611	200	0
1991	1736.92	1730	100.4	475
1992	1030.75	1100	93.7	321
1993	786.41	645	121.9	207
1994	1144.05	681	168	175
1995	1368.41	1438	95.2	327
1996	1176.14	1340	87.8	367
1997	1133.62	2886	39.3	688
1998	1307.13	967	135.2	259
1999	1302.28	534	243.9	78

2000	2436.51	6341	38.4	1423
2001	2385.25	2702	88.3	630
2002	2056.75	4634	44.4	1131
2003	1832.73	6293	29.1	1479
2004	887.83	3192	27.8	794
2005	673.06	4427	15.2	858
2006	541.18	4215	12.8	1029
2007	495.03	7215	6.9	1551
2008	544.00	4768	11.4	1233
2009	469.35	1636	28.7	459
2010	549.74	5089	10.8	1096
2011	688.44	3135	22	657
2012	945.58	6362	14.9	1573
2013	588.80	4320	13.6	1157
2014	415.40	2631	15.8	718
2015	304.95	4430	6.9	1178
2016	301.72	6531	4.6	1570
2017	313.76	5999	5.2	1687
2018	230.20	3484	6.6	904
2019	184.11	326	56.5	96
2020	156.40	739	21.2	353
2021	292.37	330	88.6	102
2022	226.93	588	38.6	221

Table 2.1.2 Number of biological samples (boxes of fish) and number of fish sampled annually from landings of yellowtail flounder from GB (1964-2022).

Year	Landings (mt)	Number of lengths	Metric tons/100 lengths	Number of ages
1964	14919.01	0	0	0
1965	14247.28	0	0	2671
1966	11340.86	0	0	2630
1967	8406.915	0	0	2592
1968	12799.24	0	0	2774
1969	15944.11	8630	184.8	2983
1970	15505.39	11709	132.4	5261
1971	11877.93	10579	112.3	4038
1972	14156.38	8221	172.2	3442
1973	15899	6690	237.7	3014
1974	14607.21	9264	157.7	4128
1975	13204.8	12907	102.3	4913
1976	11335.56	8376	135.3	3044
1977	9444.178	6241	151.3	2537
1978	4518.953	2730	165.5	1207
1979	5475.146	3874	141.3	1670
1980	6484.327	2463	263.3	1306
1981	6181.741	2341	264.1	1252
1982	10633.86	7791	136.5	3059
1983	11349.38	4688	242.1	1756
1984	5763.747	4799	120.1	1209
1985	2477.056	4427	56	1181
1986	3040.872	2990	101.7	740
1987	2742.819	2617	104.8	712
1988	1866.2	2505	74.5	707
1989	1134.283	2261	50.2	655
1990	2751.029	2548	108	657
1991	1784.091	1735	102.8	400
1992	2859.148	1759	162.5	472
1993	2088.702	2200	94.9	1223
1994	1430.853	1241	115.3	302
1995	359.245	1109	32.4	284
1996	743.099	964	77.1	260
1997	887.993	1912	46.4	508
1998	1622.972	1329	122.1	293
1999	1818.584	1148	158.4	213
2000	3375.461	2338	144.4	529

2001	3611.323	3024	119.4	702
2002	2476.08	2144	115.5	543
2003	3236.56	4542	71.3	1144
2004	5938.852	8490	70	1699
2005	3202.165	8048	39.8	1798
2006	1184.174	9505	12.5	2248
2007	1059.226	7592	14	1575
2008	936.115	7712	12.1	1671
2009	954.99	12592	7.6	2883
2010	649.915	10921	6	2234
2011	899.881	11470	7.8	2356
2012	447.77	4594	9.7	968
2013	130.65	2138	6.1	607
2014	69.781	1322	5.3	330
2015	63.934	1426	4.5	514
2016	26.489	497	5.3	271
2017	35.452	1046	3.4	229
2018	29.413	400	7.4	30
2019	2.605	137	1.9	58
2020	5.181	35	14.8	30
2021	0.666	0	0	0
2022	0.301	5	6	5

Table 2.1.3 Number of biological samples (boxes of fish) and number of fish sampled annually from landings of yellowtail flounder from SNEMA (1964-2022).

Year	Landings (mt)	Number of lengths	Metric tons/100 lengths	Number of ages
1964	19149.04	0	0	0
1965	18841.84	0	0	1584
1966	15535.28	0	0	2228
1967	13701.04	0	0	2566
1968	14752.45	0	0	2445
1969	11968.9	13049	91.7	3496
1970	13339.87	17812	74.9	6238
1971	10825.94	11352	95.4	3379
1972	13286.07	8876	149.7	2992
1973	9283.077	8476	109.5	2668
1974	7246.636	8882	81.6	3224
1975	3308.98	4690	70.6	1684
1976	1680.847	3321	50.6	1350
1977	2932.95	3839	76.4	1511
1978	2358.226	3935	59.9	1357
1979	5483.533	4818	113.8	1670
1980	6208.605	7492	82.9	3067
1981	4907.317	4061	120.8	1549
1982	10780.11	8229	131	2738
1983	17600.78	7342	239.7	2222
1984	8918.411	9769	91.3	2004
1985	2895.351	8844	32.7	1887
1986	3506.726	6093	57.6	1278
1987	1749.061	4019	43.5	939
1988	952.372	3385	28.1	884
1989	3013.556	3824	78.8	985
1990	8407.532	3580	234.8	893
1991	4254.574	3356	126.8	843
1992	1765.098	2890	61.1	776
1993	687.91	1279	53.8	633
1994	367.321	754	48.7	204
1995	200.28	78	256.8	36
1996	477.398	1820	26.2	456
1997	849.913	3123	27.2	729
1998	689.537	1328	51.9	337
1999	1307.092	2434	53.7	337
2000	1122.289	1539	72.9	348
2001	1292.672	2702	47.8	736

2002	792.37	2439	32.5	553
2003	496.285	1149	43.2	289
2004	412.598	416	99.2	72
2005	242.492	696	34.8	128
2006	213.701	2499	8.6	851
2007	201.494	5627	3.6	1497
2008	192.108	6377	3	1556
2009	183.242	3275	5.6	785
2010	113.153	3239	3.5	923
2011	242.707	5787	4.2	1412
2012	323.931	6379	5.1	1602
2013	461.749	5367	8.6	1168
2014	516.589	4771	10.8	950
2015	284.111	5037	5.6	1315
2016	125.938	3442	3.7	728
2017	48.019	1055	4.6	260
2018	10.846	853	1.3	261
2019	2.187	3	72.9	3
2020	2.09	0	0	0
2021	0.566	0	0	0
2022	0.219	0	0	0

Table 2.2.1 Total landings (mt) of CCGOM yellowtail flounder 1964-2022.

Year	Landing s (mt)
1964	1890.58
1965	1599.51
1966	1848.95
1967	1617.92
1968	1605.25
1969	1433.38
1970	1328.16
1971	1728.14
1972	1526.43
1973	1725.39
1974	2159.39
1975	2249.61
1976	3855.63
1977	3731.49
1978	4071.00
1979	4444.08
1980	5582.48
1981	3575.62
1982	3636.75
1983	2209.22
1984	1372.01
1985	1171.77
1986	1205.09
1987	1353.22
1988	1275.08
1989	1117.44
1990	3222.76
1991	1736.92
1992	1030.75
1993	786.41
1994	1144.05
1995	1368.41
1996	1176.14
1997	1133.62
1998	1307.13
1999	1302.28
2000	2436.51
2001	2385.25
2002	2056.75
2003	1832.73
2004	887.83
2005	673.06
2006	541.18
2007	495.03
2008	544.00
2009	469.35

2010	549.74
2011	688.44
2012	945.58
2013	588.80
2014	415.40
2015	304.95
2016	301.72
2017	313.76
2018	230.20
2019	184.11
2020	156.29
2021	292.37
2022	226.33

Table 2.2.2 Landings of CCGOM yellowtail flounder by statistical area (mt), 1964-2022.

	Statistical Area											
Year	464	465	466	467	500	510	511	512	513	514	515	521
1964	30.43	2.05	0.14	0.79	0	0	0.41	0	3.98	1272.55	1.57	578.66
1965	15.01	0.41	0.45	1.92	75.84	0	0.27	0	7.21	1025.93	0.35	472.14
1966	4.85	3.67	0.50	4.65	0.71	0	1.41	1.85	22.65	1135.09	0.57	673.01
1967	11.60	2.03	1.69	11.25	0	0	1.79	0	47.65	849.39	0.33	692.20
1968	16.07	1.97	2.28	3.67	0	0	0.73	0	10.10	970.20	1.81	598.42
1969	5.63	2.47	0.45	3.31	0	0	0.48	0	73.38	789.08	1.41	557.18
1970	12.99	0.60	3.37	1.23	0	0	0	0.21	110.81	688.64	14.15	496.16
1971	8.36	1.03	0	0.92	0	0	0.68	0.17	54.84	900.87	0.14	761.13
1972	4.26	1.56	0	0	0	0	0.45	0.26	152.98	863.36	2.55	501.00
1973	0.15	1.15	0	0	0	0	0	0	61.37	1027.17	1.18	634.37
1974	1.85	0	0	0	0	0	0	5.81	97.84	1176.88	0.30	876.71
1975	6.92	22.22	0	0	0	0	0.61	0.13	189.15	1385.07	4.08	641.44
1976	10.23	0	0.64	0	0	0	0.05	1.01	255.45	2022.84	1.09	1564.33
1977	6.35	3.40	0.09	0	0	0	0	0.76	250.70	2191.34	0.64	1278.21
1978	0.31	0	0	0	0	0	0.08	11.01	371.16	1842.24	5.33	1840.87
1979	1.42	0	0	0	0	1.86	1.31	1.86	266.04	2270.44	6.85	1894.30
1980	3.75	0	0	0	0	0	0.60	6.29	440.75	2540.37	14.93	2575.80
1981	0	0	0	0	0	0.04	0.01	9.83	375.15	1722.70	40.17	1427.72
1982	1.43	0	0	0	0	0	4.91	11.98	420.78	1752.93	48.17	1396.54
1983	0.53	0	0	0	0	0	2.43	12.62	305.07	990.58	4.20	893.78
1984	7.03	0	0	0	0	0	1.32	3.84	234.96	598.29	4.11	522.46
1985	0	0.30	0	0	0	0	0.58	4.29	191.15	552.90	8.77	413.80
1986	0	0.04	0	0.22	0	0	0.87	2.09	153.80	652.07	6.95	389.06
1987	0.04	0	0	0	0	0	1.13	3.43	187.94	801.60	1.42	357.66
1988	0	0	0	0	0	0	0.19	6.18	182.56	748.15	0.97	337.03
1989	0	0	0	0	0	0	0.15	10.20	195.80	510.08	2.44	398.77
1990	0.61	0	0	0	0	0	5.60	3.20	223.17	902.16	5.97	2082.05
1991	0.03	0	0	0	0	0	0.93	5.12	243.43	902.38	15.42	569.61
1992	0	0	0	0	0	0	0.21	3.82	188.55	630.98	10.48	196.71
1993	0	0	0	0	0	0	0.16	2.97	145.37	423.26	9.82	204.82
1994	0.11	0.17	0	0	0	0	0.18	0.58	98.54	629.22	33.21	382.04
1995	0.57	0	0	0	0	0	0.27	3.68	109.08	847.28	16.05	391.47
1996	0.07	0	0	0	0	0	0.07	0.11	87.77	805.27	13.31	269.54
1997	0	0.39	0	0	0	0	0.02	1.10	54.33	790.02	20.27	267.49
1998	0.03	0	0	0	0	0	0	0.79	41.80	949.28	15.32	299.91
1999	0.09	0	0	0	0.05	0	0.01	0.83	40.52	727.46	19.62	513.70
2000	1.21	0.25	0	0	0	0	0	0.92	81.00	1667.76	25.55	659.83
2001	2.21	0	0	0	0	0	0.03	0.24	86.79	1290.61	6.80	998.57
2002	0.15	0	0	0	0	0	0	2.65	44.83	1091.65	21.88	895.58
2003	0.99	0	0	0	0	0	0.04	0.07	31.76	1227.75	25.19	546.93

2004	0.41	0	0	0	0	0	0	1.89	23.76	567.38	6.59	287.80
2005	0.60	0	0	0	0	0	0	0.23	23.90	484.13	3.93	160.28
2006	0.15	0	0	0	0	0	0	0	9.37	405.93	12.10	113.63
2007	0.10	0	0	0	0	0	0.06	0.89	6.27	348.48	5.29	133.94
2008	0.31	0	0	0	0	0	0.03	0.58	18.71	426.78	3.91	93.68
2009	0.01	0.11	0	0	0	0	0	0.93	9.68	398.33	7.03	53.27
2010	0.10	0	0	0	0	0	0	1.05	14.63	420.80	10.20	102.98
2011	0.50	0.18	0	0	0	0	0	3.19	12.36	471.33	8.69	192.18
2012	0.10	0	0	0	0	0	0	0.23	15.36	726.39	3.32	200.18
2013	0.12	0	0	0	0	0	0.47	0.13	10.02	463.60	2.11	112.35
2014	0.10	0	0	0	0	0	0	0	5.24	368.64	0.31	41.11
2015	0.13	0	0	0	0	0	0	0	4.53	246.90	1.68	51.70
2016	0.10	0.08	0	0	0	0	0.11	0.10	2.74	270.98	0.62	26.98
2017	0	0	0	0	0	0	0.22	0.09	2.94	288.54	0.87	21.11
2018	0	0	0	0	0	0	0.11	0.22	2.27	220.20	0.74	6.66
2019	0	0	0	0	0	0	0	0.06	2.62	175.53	1.95	3.95
2020	0	0	0	0	0	0	0	0.02	3.30	150.37	0.56	2.05
2021	0	0	0	0	0	0	0	0	3.05	281.89	0.63	6.80
2022	0.01	0	0	0	0	0	0	0	1.16	218.73	2.98	3.45

Table 2.2.3 Landings (mt) of CCGOM yellowtail flounder by gear type, 1964-2022.

		Gear			
Year	Gillnet	Other/ Unknown	Scallop Dredge	Trawl	Total
1964	0	6.71	3.46	1880.41	1890.58
1965	0.03	0	1.74	1597.75	1599.51
1966	0	0.75	0	1848.21	1848.95
1967	0	0.60	0.57	1616.76	1617.92
1968	0.01	0.55	0.77	1603.92	1605.25
1969	0	0	0.25	1433.12	1433.38
1970	2.17	0	0.50	1325.49	1328.16
1971	3.05	1.53	2.80	1720.76	1728.14
1972	3.79	10.46	2.85	1509.34	1526.43
1973	2.72	4.09	12.51	1706.07	1725.39
1974	4.18	0.80	3.50	2150.90	2159.39
1975	5.07	29.45	2.56	2212.54	2249.61
1976	29.26	63.39	11.71	3751.27	3855.63
1977	9.42	78.73	24.55	3618.79	3731.49
1978	14.04	249.16	22.71	3785.09	4071.00
1979	13.55	185.60	70.35	4174.58	4444.08
1980	26.44	129.80	109.71	5316.53	5582.48
1981	15.03	136.52	29.64	3394.43	3575.62
1982	20.65	155.38	30.40	3430.31	3636.75
1983	16.94	151.89	12.81	2027.59	2209.22
1984	5.73	81.38	2.15	1282.76	1372.01
1985	9.54	77.79	2.70	1081.74	1171.77
1986	37.13	60.61	16.37	1090.99	1205.09
1987	96.21	77.96	38.99	1140.06	1353.22
1988	85.17	23.21	44.78	1121.92	1275.08
1989	96.90	10.29	68.25	942.01	1117.44
1990	211.10	11.71	112.77	2887.19	3222.76
1991	121.79	31.37	134.07	1449.70	1736.92
1992	133.73	22.55	60.42	814.06	1030.75
1993	125.74	11.70	51.93	597.04	786.41
1994	159.16	17.87	21.09	945.94	1144.05
1995	273.33	26.09	10.72	1058.27	1368.41
1996	259.77	18.31	12.92	885.14	1176.14
1997	293.87	9.52	8.98	821.25	1133.62
1998	399.36	15.61	9.94	882.22	1307.13
1999	281.04	8.96	2.91	1009.38	1302.29
2000	368.92	5.93	3.48	2058.18	2436.51
2001	303.86	10.26	1.58	2069.56	2385.26
2002	117.81	8.14	1.20	1929.59	2056.74

2003	209.45	2.77	0.75	1619.76	1832.73
2004	164.61	41.52	1.00	680.70	887.83
2005	116.52	36.71	1.68	518.15	673.06
2006	140.01	20.16	7.17	373.84	541.18
2007	92.68	33.80	0.55	368.01	495.03
2008	110.50	39.34	0.71	393.45	544.00
2009	113.34	31.80	0.16	324.05	469.35
2010	142.37	14.65	0.09	392.64	549.74
2011	133.85	5.75	0.04	548.80	688.44
2012	166.91	18.21	0.36	760.10	945.58
2013	92.75	12.52	0.30	483.23	588.80
2014	84.95	8.57	0	321.88	415.40
2015	25.36	7.22	0	272.36	304.94
2016	32.64	6.56	0	262.52	301.72
2017	25.39	12.56	0	275.81	313.76
2018	38.83	12.21	0.02	179.15	230.20
2019	36.78	4.52	0	142.82	184.11
2020	20.09	0.52	0	135.68	156.29
2021	21.80	0.43	0	270.15	292.37
2022	20	1.09	0.01	205.24	226.33

Table 2.2.4 Total US and Canadian landings (mt) of GB yellowtail flounder 1964-2022.

Year	US Landings (mt)	Canadian Landings (mt)
1964	14919.01	0.00
1965	14247.28	0.00
1966	11340.86	0.00
1967	8406.92	0.00
1968	12799.24	122.20
1969	15944.11	327.37
1970	15505.39	70.67
1971	11877.93	104.94
1972	14156.38	7.96
1973	15899	12.14
1974	14607.21	5.38
1975	13204.8	7.89
1976	11335.56	12.34
1977	9444.18	44.06
1978	4518.95	68.58
1979	5475.15	18.66
1980	6484.33	91.62
1981	6181.74	14.58
1982	10633.86	21.51
1983	11349.38	106.31
1984	5763.75	8.23
1985	2477.06	25.42
1986	3040.87	57.05
1987	2742.82	68.67
1988	1866.2	56.44
1989	1134.28	40.38
1990	2751.03	25.09
1991	1784.09	80.70
1992	2859.15	65.27
1993	2088.7	682.08
1994	1430.85	2138.73
1995	359.25	464.09
1996	743.1	472.00
1997	887.99	810.00
1998	1622.97	1175.00

1999	1818.58	1971.00
2000	3375.46	2859.00
2001	3611.32	2913.00
2002	2476.08	2642.00
2003	3236.56	2107.00
2004	5938.85	96.00
2005	3202.17	30.35
2006	1184.17	24.82
2007	1059.23	16.64
2008	936.12	40.82
2009	954.99	5.01
2010	649.92	17.43
2011	899.88	22.14
2012	447.77	45.57
2013	130.65	0.53
2014	69.78	1.00
2015	63.93	3.00
2016	26.49	0.56
2017	35.45	0.49
2018	29.41	0.28
2019	2.61	0.19
2020	5.18	0.10
2021	0.67	0.01
2022	0.33	0.50

Table 2.2.5 Landings (mt) of GB yellowtail flounder by statistical area, 1964-2022.

					Statistical Area						
Year	520	522	523	524	525	541	542	543	552	561	562
1964	0	1106.04	646.14	12279.79	882.08	0	0	0	0	0	0
1965	0	1676.22	146.67	8988.14	3436.25	0	0	0	0	0	0
1966	0	1480.29	124.25	4451.10	5285.22	0	0	0	0	0	0
1967	0	631.69	149.03	4965.93	2660.26	0	0	0	0	0	0
1968	0	498.35	130.18	9817.26	2353.45	0	0	0	0	0	0
1969	0	541.88	550.68	11966.60	2884.95	0	0	0	0	0	0
1970	0	1198.54	753.69	9436.38	4116.79	0	0	0	0	0	0
1971	0	2090.23	480.04	6015.57	3292.09	0	0	0	0	0	0
1972	0	2406.19	296.07	5770.01	5684.11	0	0	0	0	0	0
1973	0	1830.42	918.79	6955.22	6194.57	0	0	0	0	0	0
1974	0	2567.47	649.79	7296.53	4093.43	0	0	0	0	0	0
1975	0	1615.37	439.83	6723.57	4426.03	0	0	0	0	0	0
1976	0	1585.71	374.86	5355.04	4019.96	0	0	0	0	0	0
1977	0	1497.18	397.59	5517.04	2032.37	0	0	0	0	0	0
1978	0	608.98	262.51	2829.48	817.99	0	0	0	0	0	0
1979	0.06	1332.84	394.69	2812.38	935.19	0	0	0	0	0	0
1980	0	1726.92	446.13	2074.59	2233.17	3.52	0	0	0	0	0
1981	0	929.88	363.92	2509.37	2378.57	0	0	0	0	0	0
1982	13.37	796.78	298.54	6570.71	2954.46	0	0	0	0	0	0
1983	0	1178.46	778.34	6372.75	3019.82	0	0	0	0	0	0
1984	0	488.64	336.76	3760.65	1177.70	0	0	0	0	0	0
1985	0	230.80	0	0	515.90	0	0	0	0	67.97	1662.39
1986	0	110.28	0	0	379.07	0	0	0	0	34.20	2517.32
1987	0	180.91	0	0	255.64	0	0	0	0	66.60	2239.66
1988	0	198.52	0	0	139.13	0	0	0	0	92.50	1436.06
1989	0	215.69	0	0	228.20	0	0	0	0	45.55	644.84
1990	0	403.58	0	0	917.14	0	0	0	0	42.35	1387.96
1991	0	324.98	0	0	388.22	0	0	0	0	47.55	1023.34
1992	0	199.50	0	0	448.18	0	0	0	0	57.87	2153.60
1993	0	162.83	0	0	299.79	0	0	0	2.31	161.02	1462.75
1994	0	228.20	0	0	71.48	0.14	0.08	0	0	131.40	999.56
1995	0	231.99	0	0	71.66	0.85	0.04	0	0	30.89	23.82
1996	0	266.81	0	0	298.47	0	0.24	0.89	0	97.94	78.74
1997	0	276.92	0	0	425.06	0	0	0	0	47.63	138.38
1998	0	382.76	0	0	926.07	0	5.67	0	0	105.77	202.71
1999	0	445.63	0	0	603.56	1.73	0.01	4.68	0	222.22	540.76
2000	0	611.22	0	0	1633.88	0	0.87	16.69	0	403.72	709.08
2001	0	666.53	0	0	1686.05	0	0.02	0	0	724.86	533.87

2002	0	396.90	0	0	1202.03	0	0.01	30.95	0	343.81	502.39
2003	0	451.39	0	0	1299.02	1.39	6.38	6.21	0	440.92	1031.25
2004	0	526.00	0	0	1675.47	0	0	8.33	0	135.15	3593.90
2005	0	304.62	0	0	2064.33	0	0.01	1.99	0	47.34	783.88
2006	0	166.05	0	0	735.51	0	0.05	7.33	0	70.78	204.46
2007	0	152.07	0	0	703.92	0.07	0	0	0	40.14	163.03
2008	0	276.02	0	0	392.13	0.01	0	0	0	178.02	89.94
2009	0	288.26	0	0	523.42	0	0	0	0	79.95	63.35
2010	0	106.94	0	0	463.74	0	0	0	0	45.43	33.80
2011	0	142.61	0	0	591.23	0	0.08	0	0	76.58	89.39
2012	0	72.66	0	0	303.91	0	0	0	0	24.07	47.14
2013	0	22.22	0	0	82.30	0	0	0	0	13.16	12.97
2014	0	22.78	0	0	40.38	0	0	0	0	4.03	2.60
2015	0	31.63	0	0	8.60	0	0	0	0	6.78	16.92
2016	0	8.21	0	0	4.97	0	0	0	0	1.61	11.69
2017	0	4.18	0	0	30.45	0	0	0	0	0.66	0.16
2018	0	3.06	0	0	24.71	0	0	0	0	0.16	1.48
2019	0	0.92	0	0	1.52	0	0	0	0	0.15	0.02
2020	0	0.83	0	0	2.69	0	0	0	0	0.18	1.48
2021	0	0.39	0	0	0.23	0	0	0	0	0.04	0.01
2022	0	0.19	0	0	0.01	0	0	0	0	0.13	0.01

Table 2.2.6 Landings (mt) of GB yellowtail flounder by gear type, 1964-2022.

	Gear			
Year	Gillnet	Scallop Dredge	Trawl	Other/Unknown
1964	--	19.37	14899.64	--
1965	--	8.46	14238.82	--
1966	--	1.55	11339.31	--
1967	--	1.18	8405.74	--
1968	--	1.46	12797.78	--
1969	--	10.94	15933.17	--
1970	--	0.56	15504.84	--
1971	--	23.97	11853.96	--
1972	--	17.44	14131.66	7.29
1973	--	25.76	15873.24	0
1974	--	11.46	14595.75	0
1975	--	8.32	13196.49	0
1976	--	1.81	11333.75	0
1977	--	3.86	9440.32	0
1978	--	17.73	4500.91	0.32
1979	--	338.04	5137.11	0
1980	--	469.18	6014.70	0.45
1981	--	233.73	5944.61	3.40
1982	--	106.01	10527.67	0.19
1983	--	20.47	11328.91	0
1984	--	50.87	5711.84	1.03
1985	--	15.30	2461.76	0
1986	--	53.85	2987.02	0
1987	--	68.51	2674.31	0
1988	--	124.51	1741.62	0.08
1989	0.13	185.43	948.73	0
1990	0.01	300.12	2450.91	0
1991	0	218.39	1565.70	0
1992	0.01	175.82	2683.25	0.07
1993	0	223.10	1865.60	0
1994	1.26	35.60	1391.60	2.38
1995	0.33	7.79	349.89	1.24
1996	0.05	8.34	734.52	0.20
1997	0.50	12.57	873.90	1.03
1998	0.70	7.78	1614.46	0.04
1999	0.18	39.95	1777.93	0.52
2000	0.42	40.92	3329.71	4.41
2001	0.04	33.03	3578.26	0

2002	2.35	0.24	2472.13	1.35
2003	1.63	0.10	3234.82	0
2004	0.08	3.12	5843.26	92.40
2005	0.01	8.09	3174.39	19.68
2006	0.75	2.56	1162.03	18.84
2007	0.28	1.46	1057.47	0.02
2008	0.01	0.34	935.77	0
2009	0.19	1.88	952.68	0.24
2010	0.08	0.18	649.45	0.20
2011	5.95	8.58	880.80	4.56
2012	0.56	16.41	430.33	0.48
2013	0.27	6.58	123.80	0
2014	0.09	1.03	68.56	0.11
2015	0.15	0	63.67	0.11
2016	0.40	0	25.87	0.23
2017	0	0	35.23	0.22
2018	0	0	29.41	0
2019	0	0	2.61	0
2020	0	0	5.18	0
2021	0	0	0.67	0
2022	0	0	0.33	0

Table 2.2.7 Total landings (mt) of SNEMA yellowtail flounder, 1964-2022.

Year	Landings (mt)
1964	19149.04
1965	18841.84
1966	15535.28
1967	13701.04
1968	14752.45
1969	11968.90
1970	13339.87
1971	10825.94
1972	13286.07
1973	9283.08
1974	7246.64
1975	3308.98
1976	1680.85
1977	2932.95
1978	2358.23
1979	5483.53
1980	6208.61
1981	4907.32
1982	10780.11
1983	17600.78
1984	8918.41
1985	2895.35
1986	3506.73
1987	1749.06
1988	952.37
1989	3013.56
1990	8407.53
1991	4254.57
1992	1765.10
1993	687.91
1994	367.32
1995	200.28
1996	477.40
1997	849.91
1998	689.54
1999	1307.09
2000	1122.29
2001	1292.67

2002	792.37
2003	496.29
2004	412.60
2005	242.49
2006	213.70
2007	201.49
2008	192.11
2009	183.24
2010	113.15
2011	242.71
2012	323.93
2013	461.75
2014	516.59
2015	284.11
2016	125.94
2017	48.02
2018	10.85
2019	2.17
2020	2.09
2021	0.57
2022	0.22

Table 2.2.8a Landings of SNEMA yellowtail flounder by statistical area for statistical areas 526-539, 1964-2022.

	Statistical Area							
Year	526	531	533	534	536	537	538	539
1964	13481.18	0	0	0	0	4124.64	36.90	1318.73
1965	13428.51	0	0	0	0	3922.91	20.73	1027.62
1966	11376.41	0	0	0	0	2264.50	34.94	1253.57
1967	6168.87	0	0	0	0	2520.87	71.45	2078.78
1968	8031.36	0	0	0	366.36	3931.25	45.38	1900.43
1969	5971.26	0	0	0	0	3735.16	56.16	1619.99
1970	8035.84	0	0	0	0	3071.47	40.13	1489.20
1971	5350.97	0	0	0	0	2101.50	42.14	671.72
1972	4179.51	0	0	0	0	3435.50	41.47	568.41
1973	4851.22	0	0	0	0	1881.16	17.06	400.52
1974	3959.25	0.22	0	0.01	0	2108.01	19.60	297.14
1975	2126.09	0	0	0	0	793.88	18.14	201.44
1976	1165.22	0	0	0	0	388.11	12.02	49.54
1977	1357.00	0	0	0	0	1049.34	15.36	381.82
1978	1279.44	0	0	0	0	807.37	21.90	187.05
1979	2281.82	0	0	0	0	2062.88	29.58	956.86
1980	3535.89	0	0	0	0	1357.37	36.06	1089.93
1981	1752.23	0	0	0	0	2075.36	17.31	902.03
1982	4457.80	0	1.85	0	0	4749.44	47.69	1097.72
1983	7039.81	0	0	0	0	8049.67	59.61	1862.95
1984	3968.86	0	0	0	0	3180.32	19.18	714.12
1985	1350.35	0	0	0	0	1232.55	6.67	155.26
1986	1931.21	0	0	0	0	1141.52	14.12	172.37
1987	1074.43	0	0	0	0	332.40	7.15	164.34
1988	521.14	0	0	0	0	286.46	14.80	36.04
1989	2007.72	0	0	0	0	541.60	4.99	62.10
1990	6091.71	0	0	0	0	1612.90	4.25	463.02
1991	2360.79	0	0	0	0	1362.96	2.67	315.06
1992	889.35	0	0	0	0	443.05	6.00	186.35
1993	320	0	0	0	0	120.86	1.01	71.92
1994	115.49	0	0.04	0.22	0	88.68	33.06	27.78
1995	30.88	0	0.02	0.62	0	62.93	12.21	46.76
1996	37.49	0	0.43	0.22	0	164.67	19.07	104.41
1997	51.30	0	0	0.53	0	138.08	13.57	82.64
1998	154.69	0	0	0	0	198.54	14.65	108.47
1999	270.49	0	0	2.72	0	405.76	11.24	166.91
2000	169.92	0	0	8.79	0	340.03	50.72	248.27
2001	340.88	0	0	6.86	0	374.71	22.52	285.43
2002	193.27	0	0	2.92	0	300.12	13.27	139.37
2003	94.96	0	0.09	0	0	129.83	37.84	137.85

2004	44.21	0	0	0	0	133.16	66.35	85.17
2005	16.99	0	2.53	0.68	0	127.45	34.94	36.23
2006	21.71	0	0	0	0	104.30	26.58	42.96
2007	10.78	0	0	0.14	0	74.53	7.22	74.32
2008	14.00	0	0.71	0.58	0	62.80	4.82	83.37
2009	4.35	0	0.01	0.44	0	55.93	2.77	87.36
2010	15.38	0	0	0.47	0	35.34	3.12	42.82
2011	32.49	0	0.06	0	0	100.26	3.40	90.44
2012	35.20	0	0	0	0	99.57	0.62	173.68
2013	33.07	0	0	0	0	131.90	1.25	243.05
2014	18.51	0	0.24	0	0	324.24	0.75	113.24
2015	2.72	0	0	0	0	150.06	0.41	80.51
2016	0.18	0	0	0	0	30.55	0.18	72.32
2017	1.29	0	0	0	0	17.55	0.39	23.42
2018	0.11	0	0	0	0	3.03	0.04	5.96
2019	0.01	0	0	0	0	0.72	0.02	1.24
2020	0	0	0	0	0	0.13	0.39	1.39
2021	0	0	0	0	0	0.05	0	0.49
2022	0	0	0	0	0	0.05	0.05	0.11

Table 2.2.8b Landings (mt) of SNEMA yellowtail flounder by statistical area for statistical areas 600-616, 1964-2022.

	Statistical Area							
Year	600	610	611	612	613	614	615	616
1964	187.59	0	0	0	0	0	0	0
1965	442.07	0	0	0	0	0	0	0
1966	605.86	0	0	0	0	0	0	0
1967	2861.07	0	0	0	0	0	0	0
1968	0	203.43	5.08	0	262.23	0	0.09	5.78
1969	0	0	134.66	0	435.65	0	0	16.03
1970	0	0	56.94	0	630.28	0	0	16.01
1971	0	0	103.70	0.40	2552.61	0	0.91	1.99
1972	0	0	27.15	0	4956.61	0	35.55	40.42
1973	0	3.99	23.65	47.77	1828.11	0	13.94	207.93
1974	0	0	38.57	10.78	799.45	0	0.34	13.28
1975	0	0	7.40	0.04	136.51	0	0.42	25.06
1976	0	0	15.54	3.91	42.62	0	0.12	3.77
1977	0	0	21.16	0	102.96	0	2.30	3.01
1978	0	0	24.84	7.65	26.02	0	1.07	2.45
1979	0	0	37.31	8.33	78.36	0.03	12.08	9.31
1980	0	0	29.57	18.15	122.57	0	10.04	1.06
1981	0	0	17.47	14.87	100.47	0.13	6.28	20.77
1982	0	0	11.11	20.77	363.62	0.01	8.96	13.71
1983	0	0	52.18	40.94	355.14	0.06	37.82	99.46
1984	0	0	24.10	11.49	889.93	0.30	74.38	31.43
1985	0	0	3.80	10.28	86.42	7.08	33.21	4.93
1986	0	0	0.40	5.88	212.56	0.17	6.40	15.01
1987	0	0	2.95	6.27	151.71	0.23	3.48	3.44
1988	0	0	8.90	4.05	66.83	0	8.12	4.86
1989	0	0	1.98	0.69	387.26	0.51	2.45	4.21
1990	0	0	7.37	28.55	148.34	0	16.23	34.00
1991	0	0	25.05	64.23	96.31	0	1.16	25.71
1992	0	0	24.37	30.30	88.35	0.07	7.54	89.03
1993	0	0	8.90	18.53	112.15	0.15	5.82	28.23
1994	0	0	57.65	1.13	19.38	0.17	3.53	16.03
1995	0	0	2.95	0.89	15.68	0	0.80	16.75
1996	0	0	24.93	26.35	82.44	0	5.93	11.12
1997	0	0	17.59	201.42	302.08	0.26	6.10	36.24
1998	0	0	14.93	59.33	79.26	0.88	3.52	26.10
1999	0	0	24.53	84.53	316.94	0	7.07	14.79
2000	0	0	26.50	21.93	235.22	0	6.43	4.33
2001	0	0	29.30	35.75	146.30	1.00	5.16	34.66
2002	0	0	17.32	5.92	93.23	0	12.17	2.56
2003	0	0	19.28	16.63	58.90	0	0.08	0.83

2004	0	0	39.68	2.37	19.34	0	0.63	7.92
2005	0	0	2.31	1.85	11.02	0	7.84	0.19
2006	0	0	2.26	0.36	13.29	0	1.04	0.98
2007	0	0	4.17	0.19	19.25	0.10	0.15	1.69
2008	0	0	5.37	0.18	13.56	2.23	0.07	1.61
2009	0	0	2.97	0.64	19.23	0.73	0.12	2.95
2010	0	0	1.06	0.40	10.09	0.06	0.08	1.40
2011	0	0	1.87	5.10	7.52	0.09	0.15	1.32
2012	0	0	0.94	7.14	4.66	0	0	1.51
2013	0	0	6.62	8.64	35.03	0	0.72	1.46
2014	0	0	1.39	3.24	52.14	0	0.03	0.43
2015	0	0	5.97	0.34	42.71	0	1.14	0.13
2016	0	0	1.89	0	20.26	0	0.24	0.06
2017	0	0	1.04	0	4.16	0	0	0.16
2018	0	0	0.37	0	0.96	0	0.28	0.02
2019	0	0	0.03	0	0.14	0	0	0.02
2020	0	0	0.09	0	0.10	0	0	0
2021	0	0	0	0	0.02	0	0	0
2022	0	0	0	0	0	0	0	0

Table 2.2.8c Landings (mt) of SNEMA yellowtail flounder by statistical area for statistical areas 621-631, 1964-2022.

	Statistical Area							
Year	621	622	623	624	625	626	628	631
1964	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0
1968	1.06	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0
1972	0.16	0	0	0	0	1.29	0	0
1973	7.74	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0
1978	0.32	0.01	0	0	0	0.12	0	0
1979	6.76	0.11	0	0	0	0.13	0	0
1980	1.10	3.51	0	0	2.65	0	0	0
1981	0.15	0.02	0	0	0	0	0	0
1982	1.59	4.88	0	0	0	0.95	0	0
1983	0.21	2.41	0	0	0	0.31	0	0.21
1984	1.22	2.63	0	0	0.03	0.27	0	0.08
1985	3.30	1.50	0	0	0	0	0	0
1986	4.19	2.89	0	0	0	0	0	0
1987	0.12	2.52	0	0	0	0.02	0	0
1988	0.45	0.62	0	0	0	0.10	0	0
1989	0	0.05	0	0	0	0	0	0
1990	0.06	1.07	0	0	0	0.05	0	0
1991	0.12	0.47	0	0	0	0.05	0	0
1992	0.08	0.45	0	0	0	0.16	0	0
1993	0.07	0.26	0	0	0	0.01	0	0
1994	0.57	0.88	0	0	0.06	1.67	0	0.03
1995	0.31	0.87	0.23	0.09	0.09	0.22	0	0
1996	0.27	0.04	0	0	0.01	0.02	0	0
1997	0	0	0.02	0	0	0.11	0	0
1998	19.08	0.21	0	0	0.45	1.99	0	7.43
1999	0.01	0.51	0	0	0	1.54	0	0
2000	2.30	0	0.48	0	0.04	0.08	0	2.63
2001	3.60	0.24	0	0	0	0	0	6.27
2002	7.46	4.76	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0

2004	7.09	1.40	0	0	0	5.30	0	0
2005	0	0.46	0	0	0	0	0	0
2006	0.22	0	0	0	0	0	0	0
2007	1.38	0.13	0.01	0	7.12	0	0	0
2008	2.27	0.01	0	0	0.03	0	0	0.32
2009	0.10	2.14	0	0	1.23	2.26	0	0
2010	0.39	2.23	0	0	0.05	0.16	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0.02
2014	0	0.68	0	0	0	0	0	1.69
2015	0	0	0	0	0	0	0	0
2016	0	0	0	0	0.25	0.02	0	0
2017	0	0	0	0	0	0	0	0.02
2018	0	0.05	0.01	0	0	0	0	0
2019	0	0.01	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0

Table 2.2.8d Landings (mt) of SNEMA yellowtail flounder by statistical area for statistical areas 632-799, 1964-2022.

	Statistical Area								
Year	632	633	635	636	637	638	639	640	799
1964	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0.73	0	0	0	0
1981	0	0	0	0	0.23	0	0	0	0
1982	0.01	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0
1984	0	0	0.06	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0
1994	0.88	0.03	0	0	0	0	0	0.05	0
1995	0.01	0	0	0.05	0	0	0	7.93	0
1996	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0.01
1999	0.02	0	0.03	0	0	0	0	0	0
2000	0	0	4.65	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0

2004	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0
2007	0	0.32	0	0	0	0	0	0	0
2008	0	0	0	0.12	0	0	0.08	0	0
2009	0	0	0	0	0	0.02	0	0	0
2010	0	0	0	0	0	0	0.12	0	0
2011	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0.60	0	0
2013	0	0	0	0	0	0	0	0	0
2014	0	0	0.02	0	0	0	0	0	0
2015	0	0	0.11	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0	0

Table 2.2.9 Landings (mt) of SNEMA yellowtail flounder by gear type, 1964-2022.

	Gear			
Year	Gillnet	Scallop Dredge	Trawl	Other/Unknown
1964	0	19149.04	19149.04	0
1965	0	18841.84	18841.84	18841.84
1966	0	15535.28	15535.28	0
1967	0	13701.04	13701.04	0
1968	0	14752.45	14752.45	14752.45
1969	0	11968.90	11968.90	11968.90
1970	0	13339.87	13339.87	0
1971	0	10825.94	10825.94	10825.94
1972	0	13286.07	13286.07	13286.07
1973	0	9283.08	9283.08	9283.08
1974	0	7246.64	7246.64	7246.64
1975	3309.98	3308.98	3308.98	3308.98
1976	0	1680.85	1680.85	1680.85
1977	0	2932.95	2932.95	2932.95
1978	0	2358.23	2358.23	2358.23
1979	5484.53	5483.53	5483.53	5483.53
1980	0	6208.61	6208.61	6208.61
1981	4908.32	4907.32	4907.32	4907.32
1982	10781.11	10780.11	10780.11	10780.11
1983	17601.78	17600.78	17600.78	17600.78
1984	8919.41	8918.41	8918.41	8918.41
1985	2896.35	2895.35	2895.35	0
1986	3507.73	3506.73	3506.73	3506.73
1987	1750.06	1749.06	1749.06	0
1988	953.37	952.37	952.37	952.37
1989	3014.56	3013.56	3013.56	3013.56
1990	8408.53	8407.53	8407.53	8407.53
1991	4255.57	4254.57	4254.57	4254.57
1992	1766.10	1765.10	1765.10	1765.10
1993	688.91	687.91	687.91	687.91
1994	368.32	367.32	367.32	367.32
1995	201.28	200.28	200.28	200.28
1996	478.40	477.40	477.40	477.40
1997	850.91	849.91	849.91	849.91
1998	690.54	689.54	689.54	689.54
1999	1308.09	1307.09	1307.09	1307.09
2000	1123.29	1122.29	1122.29	1122.29
2001	1293.67	1292.67	1292.67	1292.67
2002	793.37	792.37	792.37	792.37
2003	497.29	496.29	496.29	496.29

2004	413.60	412.60	412.60	412.60
2005	243.49	242.49	242.49	242.49
2006	214.70	213.70	213.70	213.70
2007	202.49	201.49	201.49	201.49
2008	193.11	192.11	192.11	192.11
2009	184.24	183.24	183.24	183.24
2010	114.15	113.15	113.15	113.15
2011	243.71	242.71	242.71	242.71
2012	324.93	323.93	323.93	323.93
2013	462.75	461.75	461.75	461.75
2014	517.59	516.59	516.59	516.59
2015	285.11	0	284.11	284.11
2016	126.94	0	125.94	125.94
2017	49.02	0	48.02	48.02
2018	11.85	0	10.85	10.85
2019	3.17	0	2.17	0
2020	3.09	2.09	2.09	2.09
2021	1.57	0.57	0.57	0
2022	1.22	0.22	0.22	0.22

Table 2.3.1 Landings (mt) of CCGOM yellowtail flounder by market category 1964-2022.

		Market Category		
Year	Small	Medium/ Select	Large	Unclassified
1964	--	--	--	1890.58
1965	--	--	--	1599.51
1966	--	--	--	1848.95
1967	--	--	--	1617.92
1968	--	--	--	1605.25
1969	--	--	--	1433.38
1970	--	--	--	1328.16
1971	--	--	--	1728.14
1972	--	--	--	1526.43
1973	130.87	--	852.16	742.35
1974	320.86	--	1838.47	0.05
1975	491.07	--	1758.54	0
1976	1025.00	--	2824.83	5.81
1977	988.44	--	2742.28	0.77
1978	1085.83	--	2984.78	0.40
1979	1426.46	--	3017.23	0.40
1980	1459.12	--	4072.20	51.16
1981	1267.40	--	2225.52	82.70
1982	1386.58	--	2020.59	229.58
1983	635.27	--	1372.03	201.93
1984	546.94	59.49	704.40	61.19
1985	454.07	63.28	596.55	57.88
1986	620.01	57.32	463.13	64.64
1987	601.38	58.10	579.61	114.14
1988	539.39	65.73	542.09	127.87
1989	458.02	60.96	490.44	108.02
1990	1794.33	75.48	1193.40	159.55
1991	687.59	35.84	858.00	155.50
1992	462.51	28.39	410.58	129.27
1993	366.08	16.42	320.16	83.75
1994	486.41	13.75	542.21	101.69
1995	600.40	15.22	646.31	106.48
1996	577.69	22.05	503.55	72.85
1997	488.53	21.11	558.07	65.92
1998	565.19	24.68	475.89	241.37
1999	505.60	30.73	499.25	266.70
2000	1008.36	66.46	914.16	447.54
2001	877.88	44.34	990.46	472.58
2002	730.38	55.70	918.23	352.43

2003	566.19	34.48	654.06	578.01
2004	300.07	42.03	306.85	238.89
2005	199.41	2.20	295.83	175.62
2006	192.24	2.15	248.72	98.07
2007	148.99	1.49	246.40	98.16
2008	163.26	2.40	254.14	124.19
2009	157.70	17.87	174.70	119.08
2010	135.78	7.26	227.07	179.63
2011	217.04	4.33	224.70	242.37
2012	363.39	6.12	232.96	343.11
2013	191.07	13.11	176.29	208.33
2014	178.80	14.08	76.66	145.85
2015	122.43	17.25	81.92	83.35
2016	121.10	11.73	65.68	103.21
2017	135.24	14.37	43.07	121.08
2018	121.49	20.18	21.42	67.11
2019	111.70	8.33	13.71	50.38
2020	108.74	5.77	13.51	28.28
2021	205.72	4.44	31.86	50.35
2022	166.13	2.04	17.65	40.52

Table 2.3.2 Landings (mt) of GB yellowtail flounder by market category 1964-2022.

	Market Category			
Year	Small	Medium/Select	Large	Unclassified
1964	--	--	--	14919.01
1965	--	--	--	14247.28
1966	--	--	--	11340.86
1967	--	--	--	8406.92
1968	--	--	--	12799.24
1969	--	--	--	15944.11
1970	--	--	--	15505.39
1971	--	--	--	11877.93
1972	--	--	--	14156.38
1973	1516.21	--	9026.31	5356.47
1974	2979.25	--	11615.60	12.36
1975	5047.68	--	8142.67	14.45
1976	5223.40	--	5902.67	209.49
1977	2382.10	--	6966.03	96.06
1978	920.82	--	3577.22	20.92
1979	1957.17	--	3390.39	127.59
1980	939.48	--	5448.04	96.81
1981	653.92	--	5461.53	66.29
1982	3997.25	--	6449.87	186.74
1983	4595.78	--	6667.58	86.02
1984	1818.92	7.73	3919.67	17.43
1985	921.40	1.09	1551.02	3.55
1986	1253.90	1.41	1774.24	11.32
1987	668.24	4.00	2067.28	3.30
1988	402.94	4.50	1448.41	10.35
1989	398.64	1.26	708.29	26.09
1990	1229.78	2.81	1468.23	50.21
1991	557.65	0.43	1176.96	49.05
1992	1591.99	0.02	1200.04	67.11
1993	854.33	0	1201.94	32.44
1994	650.83	0	773.24	6.79
1995	162.27	0	194.43	2.55
1996	256.02	0.01	484.52	2.55
1997	267.79	0.04	606.61	13.56
1998	718.33	0.00	831.60	73.04
1999	539.48	0.26	1215.45	63.40
2000	941.37	0.02	2341.46	92.61
2001	820.37	0	2663.87	127.09
2002	470.98	0.20	1949.91	55.00
2003	715.55	0	2483.61	37.40

2004	1133.25	29.14	4690.99	85.47
2005	1157.96	21.76	1991.84	30.60
2006	321.98	14.29	821.78	26.14
2007	384.46	17.89	623.01	33.87
2008	315.59	10.57	583.51	26.44
2009	128.00	7.90	802.50	16.60
2010	153.48	3.69	450.51	42.23
2011	265.91	10.25	561.98	61.74
2012	117.63	0.52	310.11	19.52
2013	25.55	0.23	104.25	0.62
2014	16.77	1.21	50.71	1.09
2015	18.79	1.00	43.24	0.90
2016	6.19	0.21	18.50	1.59
2017	4.77	0	30.40	0.28
2018	4.09	0	24.76	0.56
2019	0.25	0	2.06	0.30
2020	1.05	0	3.87	0.26
2021	0.39	0	0.24	0.05
2022	0.09	0.01	0.05	0.18

Table 2.3.3 Landings (mt) of SNEMA yellowtail flounder by market category 1964-2022.

	Market Category			
Year	Small	Medium/ Select	Large	Unclassified
1964	--	--	--	19149.04
1965	--	--	--	18841.84
1966	--	--	--	15535.28
1967	--	--	--	13701.04
1968	--	--	--	14752.45
1969	--	--	--	11968.90
1970	--	--	--	13339.87
1971	--	--	--	10825.94
1972	--	--	--	13286.07
1973	3160.86	--	1774.37	4347.85
1974	3851.53	--	3392.62	2.50
1975	1646.49	--	1661.92	0.57
1976	625.63	--	857.72	197.50
1977	818.08	--	1123.76	991.11
1978	877.29	--	956.83	524.10
1979	2618.90	--	1284.52	1580.11
1980	2219.20	--	1927.94	2061.46
1981	1560.07	--	1074.47	2272.78
1982	5565.34	--	1384.61	3830.17
1983	10560.64	--	1890.44	5149.70
1984	6062.89	43.99	1557.74	1253.79
1985	1951.80	0.09	869.90	73.55
1986	2658.82	3.91	582.24	261.75
1987	1069.18	3.89	517.81	158.18
1988	520.99	2.37	345.94	83.08
1989	1887.32	0.09	568.47	557.67
1990	6151.82	50.19	1858.34	347.19
1991	2570.74	0.01	1449.04	234.78
1992	903.71	0	591.70	269.68
1993	295.28	0.07	232.61	159.95
1994	154.71	0.02	191.09	21.50
1995	92.26	0.10	64.96	42.95
1996	201.25	0.39	98.24	177.52
1997	183.23	0.18	134.24	532.27
1998	287.50	0.19	168.17	233.67
1999	525.20	0.08	386.01	395.81
2000	421.13	0.51	436.33	264.32
2001	475.26	0.27	563.19	253.95
2002	242.17	2.11	423.45	124.64

2003	152.74	0.02	258.52	85.01
2004	87.02	10.32	278.21	37.06
2005	86.42	16.02	117.98	22.07
2006	71.05	29.19	93.67	19.79
2007	80.95	37.79	63.63	19.13
2008	55.42	24.79	99.00	12.91
2009	35.58	15.63	112.14	19.90
2010	29.41	14.80	58.44	10.51
2011	57.99	24.44	148.71	11.57
2012	79.01	34.71	195.48	14.74
2013	113.45	89.05	215.37	43.88
2014	94.82	122.14	245.02	54.61
2015	36.14	41.69	162.08	44.21
2016	12.90	21.73	68.02	23.29
2017	6.92	8.95	22.89	9.26
2018	1.86	1.77	5.82	1.40
2019	0.42	0.36	0.97	0.42
2020	0.81	0.38	0.66	0.24
2021	0.11	0.25	0.19	0.02
2022	0.04	0.07	0.06	0.05

Table 2.4.1a Number of CCGOM yellowtail flounder (1000s) landed by age (ages 1-7), 1994-2022.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1994	0	106735	1368180	668857	198476	50815	45149
1995	0	379429	1442823	1136149	175645	112674	20016
1996	0	428661	1874969	417861	47379	805	5920
1997	0	629776	1184195	608590	112636	8845	2066
1998	0	51240	1897015	651564	50945	0	0
1999	0	479778	1973871	376777	25410	7005	0
2000	0	929780	2791627	1345626	125071	21205	4948
2001	0	941876	3325432	823328	144932	13709	9579
2002	20506	1005125	2351562	878187	105525	12894	10336
2003	0	612970	1929633	1150441	148102	52158	14207
2004	0	81903	1141120	445052	226004	51075	10562
2005	0	96475	719333	488719	74793	39386	2687
2006	0	109486	525118	357347	74659	37092	11159
2007	0	119684	531910	344601	55665	12392	2338
2008	0	32273	525983	436643	109572	17636	975
2009	680	48975	414924	432721	89228	4151	2401
2010	0	51240	492704	400257	137924	29191	7500
2011	0	95295	480301	498940	253516	40363	4290
2012	2263	162073	775217	793006	313164	65627	7449
2013	7903	110411	453853	436039	245572	37920	6765
2014	1559	174701	372775	331716	78011	11807	3635
2015	511	99887	309489	176665	88178	10184	1877
2016	0	37204	356892	253883	74788	19132	3425
2017	0	55493	220463	208572	166740	43210	20901
2018	0	53108	211233	165579	122874	21905	6598
2019	0	0	82204	81016	186941	89740	44966
2020	0	0	133946	85703	76457	60296	34260
2021	0	69960	102627	211377	155668	121644	47514
2022	0	10993	43968	123092	146943	97705	29762

Table 2.4.1b Number of CCGOM yellowtail flounder landed by age (ages 8-14,) 1994-2022.

Year	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1994	7125	4750	0	0	0	0	0
1995	28079	8892	0	0	0	0	0
1996	829	0	0	0	0	0	0
1997	4622	827	0	0	0	0	0
1998	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0
2000	3496	0	0	0	0	0	0
2001	0	0	0	0	0	0	0
2002	5814	3876	0	0	0	0	0
2003	2895	0	939	0	0	0	0
2004	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0
2006	3572	0	0	0	0	0	0
2007	389	213	0	0	0	0	0
2008	1139	0	0	0	0	0	0
2009	0	0	0	0	0	0	0
2010	465	0	0	0	0	0	0
2011	0	0	0	0	0	0	0
2012	339	288	0	0	0	0	0
2013	0	0	0	0	0	0	0
2014	115	0	0	0	0	0	0
2015	1092	173	0	0	0	0	0
2016	263	0	113	0	0	0	0
2017	4749	727	712	0	0	0	0
2018	3120	830	284	0	0	0	0
2019	4455	404	553	0	0	0	0
2020	7003	5304	272	1263	272	0	0
2021	0	20019	6562	0	0	0	0
2022	40823	12849	6383	12311	1781	0	2351

Table 2.4.2a Number of GB yellowtail flounder landed by age (ages 1-8) 1994-2022.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1994	0	50148	2328907	805610	163035	65062	5357	3061
1995	0	105720	376907	283984	57606	13137	3984	0
1996	0	234752	852860	401689	110488	6600	6600	2640
1997	0	142083	605732	856358	104096	18423	17537	3322
1998	0	254725	1391029	815972	696361	29537	2043	0
1999	5202	450662	2090885	434208	304682	129672	0	0
2000	0	1362750	2681322	1722047	381393	145684	15857	13602
2001	0	877928	3164025	1800431	513591	136665	23955	6965
2002	9299	637907	1390741	1352989	428135	129194	82540	35929
2003	0	812367	1841003	1389623	559684	197876	197253	79491
2004	0	369007	2400081	3425820	1847764	839511	375957	67909
2005	0	922859	3329872	1515914	338098	114736	31712	13702
2006	0	319479	761835	610138	272051	93511	51778	12382
2007	2779	343867	1123129	535629	117478	38492	7680	1246
2008	0	96880	1158521	609521	81498	8963	3254	0
2009	0	39639	468710	766759	344349	35004	6317	1314
2010	0	15074	256790	495266	275481	52762	6064	770
2011	0	41638	490554	719910	268849	59999	7163	706
2012	0	17786	153683	373901	182963	26072	3082	2660
2013	210	3139	30885	91128	69677	14126	1423	348
2014	0	2253	25443	43546	30959	13401	1500	0
2015	0	5567	28740	27459	28997	13722	3838	1001
2016	0	0	9700	20328	12325	4723	1610	240
2017	0	51	4725	8485	16797	11376	9178	4635
2018	0	0	4316	895	7880	12044	11676	7629
2019	0	0	533	786	563	963*	491	445
2020	0	0	273	0	0	205	751	1079
2022	0	0	108	216	216	0	0	0

Table 2.4.2b Number of GB yellowtail flounder landed by age (ages 9-16), 1994-2022.

Year	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1994	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0
1998	0	1167	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0
2000	1501	0	0	0	0	0	0	0
2001	3063	0	0	0	0	0	0	0
2002	4537	4604	0	0	0	0	0	0
2003	41853	21927	1119	0	0	0	0	0
2004	67393	30522	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0
2006	6308	2484	262	0	0	0	0	0
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0
2017	1041	181	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0
2019	71	0	0	0	0	0	0	0
2020	942	983	137	137	137	0	0	137
2022	0	0	0	0	0	0	0	0

Table 2.4.3 Number of SNEMA yellowtail flounder landed by age, 1994-2022.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
1994	0	14460	280517	232948	232596	78987	5581	0	0	0
1995	0	0	90466	272537	50364	11403	19956	0	0	0
1996	0	294857	623958	174136	20477	13716	5478	3256	0	0
1997	0	39909	1024253	700119	91731	16734	19155	4542	2658	0
1998	0	650405	816133	299486	44101	4681	1064	0	0	0
1999	0	248595	2130416	530348	104980	18378	0	0	0	0
2000	1610	688081	1244806	505064	53610	8521	0	0	0	0
2001	0	402710	1725202	504617	135869	26795	13623	2462	0	0
2002	0	239959	1022116	411377	24976	0	0	0	0	0
2003	0	129246	497585	372846	24216	1345	2866	945	0	0
2004	0	0	166972	249740	184024	80531	5590	16177	0	0
2005	0	102895	134831	127966	88467	24026	11888	0	0	0
2006	0	102237	169616	106520	42541	27182	17301	3035	1504	283
2007	0	37341	294444	94903	26008	10781	3852	2252	747	295
2008	0	3713	121600	260494	19970	2643	1783	260	158	0
2009	0	23187	37411	180603	118682	4731	228	154	0	0
2010	0	3077	69984	40695	69651	28416	931	118	118	0
2011	0	27586	129566	127074	107098	66262	8209	0	0	0
2012	0	25273	146410	199055	148526	85154	22619	2619	0	0
2013	0	15736	328240	339481	172352	75299	31403	1519	0	0
2014	107	214620	232222	487478	159938	35545	6296	2549	0	0
2015	0	24596	123399	89906	257313	37700	18156	2331	1407	995
2016	0	8286	30609	59326	37171	91322	9329	3606	349	0
2017	0	369	29523	9558	26837	6297	23141	2023	110	303
2018	0	518	2165	2589	2572	5662	1522	3911	84	89
2019	0	0	0	1632	0	3264	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0	0	0

Table 2.5.1 Total discards (mt) of CCGOM yellowtail flounder, 1994-2022.

Year	Discards	CV
1994	82.78	39.47
1995	113.47	61.44
1996	254.62	177.43
1997	558.94	219.14
1998	302.66	131.69
1999	161.32	94.21
2000	101.36	51.23
2001	226.87	69.86
2002	109.20	34.49
2003	125.14	38.31
2004	252.08	72.73
2005	183.99	64.15
2006	79.05	27.86
2007	130.35	45.98
2008	161.51	45.89
2009	171.67	56.75
2010	92.69	24.13
2011	72.68	9.24
2012	156.45	17.37
2013	73.57	20.28
2014	50.84	15.26
2015	45.53	8.11
2016	63.78	27.24
2017	48.82	9.47
2018	45.77	8.75
2019	41.16	8.23
2020	33.57	9.79
2021	71.69	11.65
2022	75.75	7.7

Table 2.5.2 Total discards (mt) of GB yellowtail flounder, 1994-2022.

Year	Discards (mt)	CV
1994	152.61	182.31
1995	42.02	34.06
1996	137.34	51.22
1997	321.21	173.30
1998	166.87	164.53
1999	560.47	138.31
2000	722.51	118.72
2001	86.17	33.58
2002	50.81	20.61
2003	266.82	146.76
2004	463.89	123.65
2005	414.11	72.58
2006	379.63	79.57
2007	490.76	77.47
2008	408.36	51.06
2009	753.84	129.15
2010	291.74	72.57
2011	192.53	35.33
2012	188.80	57.51
2013	48.60	11.23
2014	72.59	15.14
2015	40.50	10.89
2016	7.16	7.21
2017	57.06	18.63
2018	10.58	9.31
2019	1.60	0.84
2020	199.76	114.08
2021	44.51	21.24
2022	13.07	76.97

Table 2.5.3 Total discards (mt) of SNEMA yellowtail flounder, 1994-2022.

Year	Discards (mt)	CV
1994	160.72	193.75
1995	130.57	60.31
1996	251.38	107.82
1997	419.60	205.12
1998	264.46	112.63
1999	109.79	71.47
2000	100.64	175.24
2001	160.36	81.11
2002	153.46	60.95
2003	159.31	122.50
2004	94.76	87.43
2005	82.31	32.38
2006	125.31	45.44
2007	164.66	50.16
2008	186.62	46.50
2009	240.48	83.35
2010	130.36	38.73
2011	144.54	34.91
2012	172.42	45.86
2013	179.37	30.60
2014	102.63	15.89
2015	53.46	12.47
2016	23.86	6.32
2017	15.98	7.48
2018	6.77	1.38
2019	5.50	2.01
2020	5.40	3.47
2021	4.11	2.09
2022	4.53	0.64

Table 2.6.1 Total discards (mt) at age for CCGOM yellowtail flounder, 1994-2022.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1994	26.81	210.02	109.01	40.38	18.36	2.60
1995	59.18	112.44	167.22	65.41	31.73	0.61
1996	6.07	231.62	327.49	182.60	57.82	0.78
1997	8.12	646.73	652.07	367.77	178.33	27.78
1998	49.09	482.20	398.76	169.39	64.43	3.07
1999	23.68	210.82	202.71	78.20	22.80	4.77
2000	2.75	101.06	109.31	42.32	13.26	17.47
2001	10.45	244.63	295.37	123.97	22.68	0
2002	8.87	106.89	122.65	93.48	21.01	4.27
2003	6.93	191.92	157.06	82.67	20.30	0.14
2004	19.87	341.43	343.85	136.67	32.83	2.00
2005	12.01	230.78	279.64	100.09	5.04	1.67
2006	10.19	91.78	106.19	55.69	2.43	0.31
2007	7.54	133.28	160.79	102.95	16.79	0
2008	5.64	133.68	194.17	122.91	27.04	1.24
2009	19.44	166.19	216.53	112.43	28.20	1.90
2010	23.41	90.17	122.33	50.25	15.99	1.59
2011	7.53	58.62	94.06	71.55	16.07	1.54
2012	16.76	150.31	198.52	115.87	57.20	2.83
2013	35.76	72.81	69.63	46.44	22.58	6.73
2014	22.91	85.69	46.94	30.13	10.80	3.09
2015	11.78	58.23	52.15	24.55	10.08	4.06
2016	11.54	52.80	64.92	41.77	21.65	12.74
2017	6.60	40.31	48.60	36.28	21.94	12.40
2018	8.40	64.28	52.63	28.69	19.35	12.97
2019	26.32	122.24	126.79	87.85	42.91	44.13
2020	12.64	38.92	57.52	39.49	15.71	32.39
2021	21.69	61.82	86.86	56.22	22.37	46.85
2022	4.44	30.39	40.34	37.78	28.38	69.91

Table 2.6.2 Total discards (mt) at age for GB yellowtail flounder, 1994 -2022.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1994	9.48	134.56	223.71	59.36	11.67	1.72
1995	5.73	31.13	73.64	24.22	6.23	0.25
1996	138.01	230.16	188.19	43.16	1.70	0.14
1997	30.60	355.38	466.03	235.14	30.95	1.94
1998	59.04	428.54	324.68	124.22	23.55	5.61
1999	100.19	465.40	506.78	197.95	115.89	27.31
2000	69.27	330.81	444.56	223.83	83.12	61.36
2001	25.32	102.38	97.89	23.90	5.55	1.47
2002	22.37	73.02	40.41	13.66	4.72	1.05
2003	96.99	468.54	436.46	85.89	11.21	9.29
2004	56.33	732.87	393.44	139.59	52.67	13.81
2005	74.98	404.91	404.94	151.85	59.37	13.05
2006	56.42	450.83	350.18	227.17	43.94	14.82
2007	55.41	670.03	532.59	214.37	53.37	8.08
2008	4.71	325.66	423.64	182.62	38.19	4.46
2009	40.22	278.61	655.02	409.99	185.13	66.47
2010	14.17	149.56	229.68	175.30	91.64	38.76
2011	9.94	113.03	160.39	100.73	30.63	1.98
2012	14.51	99.09	144.87	109.85	48.84	10.72
2013	10.36	17.55	33.66	27.29	14.08	7.93
2014	1.89	18.31	42.14	48.85	25.20	13.40
2015	0.57	4.93	18.00	24.77	20.79	5.81
2016	0.28	1.36	3.75	3.67	1.36	1.71
2017	1.19	3.71	15.79	36.51	24.34	26.36
2018	0.34	1.85	1.11	1.89	2.38	11.22
2019	3.55	2.80	0.78	0.85	0.33	3.12
2020	2.30	3.59	81.46	53.00	6.99	9.64
2021	0.14	0.24	23.93	23.37	7.39	10.97
2022	4.35	0.69	1.34	7.43	5.02	3.50

Table 2.6.3 Total discards at age (mt) for SNEMA yellowtail flounder, 1994 -2019. There was insufficient data to produce estimates for 2020-2022.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1994	129.45	229.91	100.69	65.86	23.59	3.51
1995	25.98	57.37	55.64	23.15	7.37	0.11
1996	19.98	119.81	195.40	70.27	9.63	1.39
1997	30.52	267.50	406.06	267.09	41.91	3.02
1998	26.31	267.47	283.88	155.97	48.51	13.58
1999	29.86	507.88	485.75	205.49	95.41	31.82
2000	131.67	778.15	669.71	276.55	47.93	16.42
2001	16.11	96.25	111.69	21.42	4.61	0.22
2002	10.83	49.49	37.38	19.13	8.75	1.19
2003	77.10	363.51	400.99	108.76	24.30	14.69
2004	27.95	712.85	368.25	166.56	62.99	10.64
2005	176.16	343.84	348.30	166.15	82.32	6.21
2006	94.32	496.54	321.12	220.84	48.65	11.99
2007	38.95	480.82	506.57	244.70	73.96	12.14
2008	14.88	290.04	431.96	204.70	29.52	0.56
2009	152.87	362.83	704.86	397.14	161.27	56.47
2010	5.67	93.89	190.95	186.27	118.65	34.69
2011	70.09	159.72	162.41	87.18	25.24	4.14
2012	54.95	168.62	156.94	101.24	36.82	8.71
2013	18.56	26.14	42.98	29.85	12.68	4.60
2014	5.11	31.69	51.82	49.88	22.29	9.12
2015	1.15	7.41	15.59	22.75	21.56	6.18
2016	1.35	2.57	9.69	2.83	0.98	1.13
2017	6.41	10.26	11.57	21.22	14.51	41.53
2018	2.70	2.57	1.65	2.21	2.29	10.21
2019	9.36	10.55	5.62	5.02	3.52	12.96
2020	--	--	--	--	--	--
2021	--	--	--	--	--	--
2022	--	--	--	--	--	--

Table 2.7.1 Total catch for CCGOM yellowtail flounder (mt), 1985 -2022.

Year	Catch
1985	3923
1986	5457
1987	4713
1988	5521
1989	4572
1990	12937
1991	5927
1992	8585
1993	2618
1994	1227
1995	1482
1996	1431
1997	1693
1998	1610
1999	1464
2000	2538
2001	2612
2002	2166
2003	1958
2004	1140
2005	857
2006	620
2007	625
2008	706
2009	641
2010	642
2011	761
2012	1102
2013	662
2014	466
2015	350
2016	366
2017	363
2018	276
2019	225
2020	190
2021	364
2022	303

Table 2.7.2 Total catch for GB yellowtail flounder, 1935-2022.

Year	Catch	Year	Catch	Year	Catch
1935	400	1965	19448	1995	1135
1936	400	1966	13741	1996	1700
1937	400	1967	15307	1997	2464
1938	400	1968	18321	1998	3985
1939	500	1969	21271	1999	4963
1940	800	1970	21410	2000	7341
1941	1200	1971	15610	2001	7419
1942	2100	1972	18039	2002	5663
1943	1700	1973	16953	2003	6562
1944	2300	1974	17211	2004	6815
1945	1900	1975	16750	2005	3852
1946	1200	1976	14988	2006	2057
1947	3100	1977	10639	2007	1664
1948	7700	1978	6944	2008	1499
1949	9800	1979	6935	2009	1806
1950	5300	1980	7539	2010	1170
1951	5800	1981	6979	2011	1171
1952	5000	1982	12520	2012	725
1953	3900	1983	11989	2013	218
1954	3900	1984	6280	2014	159
1955	3900	1985	3267	2015	118
1956	2200	1986	3474	2016	44
1957	3100	1987	3580	2017	95
1958	6100	1988	2759	2018	45
1959	5500	1989	1783	2019	8
1960	5900	1990	4089	2020	68
1961	5700	1991	2564	2021	51
1962	7700	1992	5299	2022	15
1963	16690	1993	4300		
1964	19814	1994	4158		

Table 2.7.3 Total catch for SNEMA yellowtail flounder, 1973-2022.

Year	Catch	Year	Catch
1973	14549	1998	954
1974	17088	1999	1417
1975	5732	2000	1223
1976	3436	2001	1453
1977	5223	2002	946
1978	8085	2003	656
1979	9883	2004	507
1980	8021	2005	325
1981	6607	2006	339
1982	15764	2007	366
1983	22211	2008	379
1984	11225	2009	424
1985	4817	2010	244
1986	4620	2011	387
1987	2652	2012	496
1988	2782	2013	641
1989	8349	2014	619
1990	17916	2015	338
1991	6430	2016	150
1992	2695	2017	64
1993	771	2018	18
1994	528	2019	8
1995	331	2020	7
1996	729	2021	5
1997	1270	2022	5

Table 2.8.1 Total catch at age (1000s) of CCGOM yellowtail flounder, 1985-2022.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1985	686	1245	907	635	329	121
1986	95	4225	785	304	40	8
1987	19	1885	2331	309	116	53
1988	452	2582	1503	744	199	41
1989	118	2297	1812	298	38	9
1990	84	2897	9400	493	35	28
1991	465	1372	1765	1953	298	74
1992	1709	3979	1961	731	191	14
1993	159	425	1074	795	111	54
1994	27	317	1477	709	217	110
1995	59	492	1610	1202	207	170
1996	6	660	2202	600	105	8
1997	8	1277	1836	976	291	44
1998	49	533	2296	821	115	3
1999	24	691	2177	455	48	12
2000	3	1031	2901	1388	138	47
2001	10	1187	3621	947	168	23
2002	29	1112	2474	972	127	37
2003	7	805	2087	1233	168	70
2004	20	423	1485	582	259	64
2005	12	327	999	589	80	44
2006	10	201	631	413	77	52
2007	8	253	693	448	72	15
2008	6	166	720	560	137	21
2009	20	215	631	545	117	8
2010	23	141	615	451	154	39
2011	8	154	574	570	270	46
2012	19	312	974	909	370	77
2013	44	183	523	482	268	51
2014	24	260	420	362	89	19
2015	12	158	362	201	98	17
2016	12	90	422	296	96	36
2017	7	96	269	245	189	83
2018	8	117	264	194	142	46
2019	26	122	209	169	230	184
2020	13	39	191	125	92	141
2021	22	132	189	268	178	243
2022	4	41	84	161	175	274

Table 2.8.2 Total catch at age (1000s) of GB yellowtail flounder, 1973-2022.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1973	359	5175	13565	9473	3815	1650
1974	2368	9500	8294	7658	3643	1520
1975	4636	26394	7375	3540	2175	1207
1976	635	31938	5502	1426	574	918
1977	378	9094	10567	1846	419	495
1978	9962	3542	4580	1914	540	211
1979	321	10517	3789	1432	623	325
1980	318	3994	9685	1538	352	113
1981	107	1097	5963	4920	854	145
1982	2164	18091	7480	3401	1095	96
1983	703	7998	16661	2476	680	155
1984	514	2018	4535	5043	1796	379
1985	970	4374	1058	818	517	81
1986	179	6402	1127	389	204	113
1987	156	3284	3137	983	192	137
1988	499	3003	1544	846	227	53
1989	190	2175	1121	428	110	30
1990	231	2114	6996	978	140	26
1991	663	147	1491	3011	383	71
1992	2414	9167	2971	1473	603	42
1993	5233	1386	3327	2326	411	91
1994	9	185	2553	865	175	75
1995	6	137	451	308	64	17
1996	138	465	1041	445	112	16
1997	31	497	1072	1091	135	41
1998	59	684	1716	940	720	39
1999	105	916	2598	632	421	157
2000	69	1694	3126	1946	464	238
2001	25	980	3262	1824	520	172
2002	31	711	1431	1367	433	258
2003	97	1281	2277	1476	571	549
2004	56	1102	2793	3566	1901	1395
2005	75	1328	3735	1668	397	173
2006	56	770	1112	837	316	182
2007	58	1014	1656	750	170	55
2008	5	423	1583	793	119	16
2009	40	319	1124	1177	529	109
2010	14	165	487	670	367	99
2011	10	155	651	821	300	70
2012	15	117	299	484	232	43
2013	10	21	65	118	84	24
2014	2	20	67	93	56	28
2015	1	11	47	52	50	25

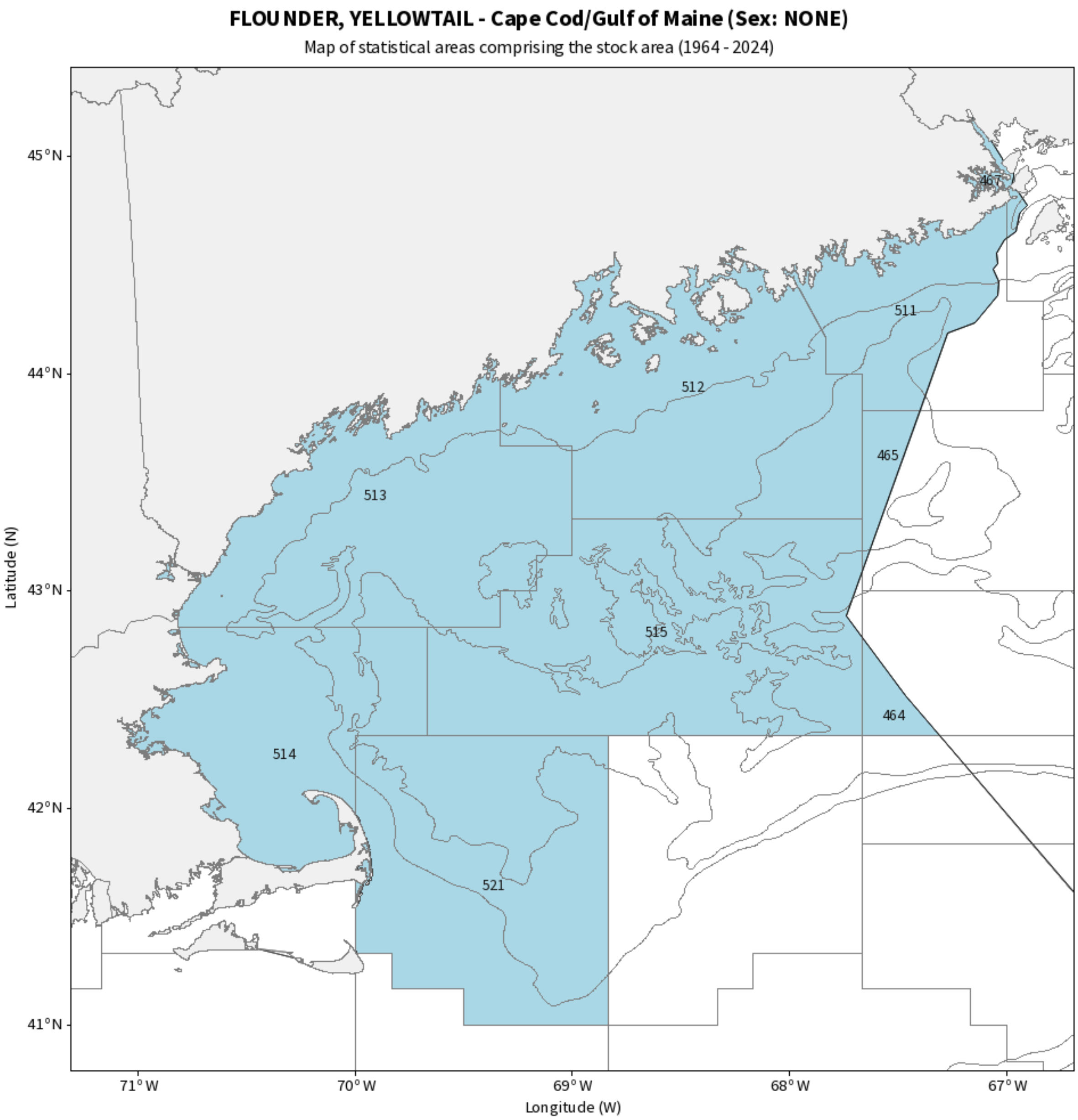
2016	0	1	14	24	13	9
2017	1	4	21	45	41	52
2018	0	2	5	3	10	42
2019	8	4	3	3	2	18
2020	1	2	27	17	2	7
2021	0	0	15	15	5	8
2022	6	1	4	18	14	9

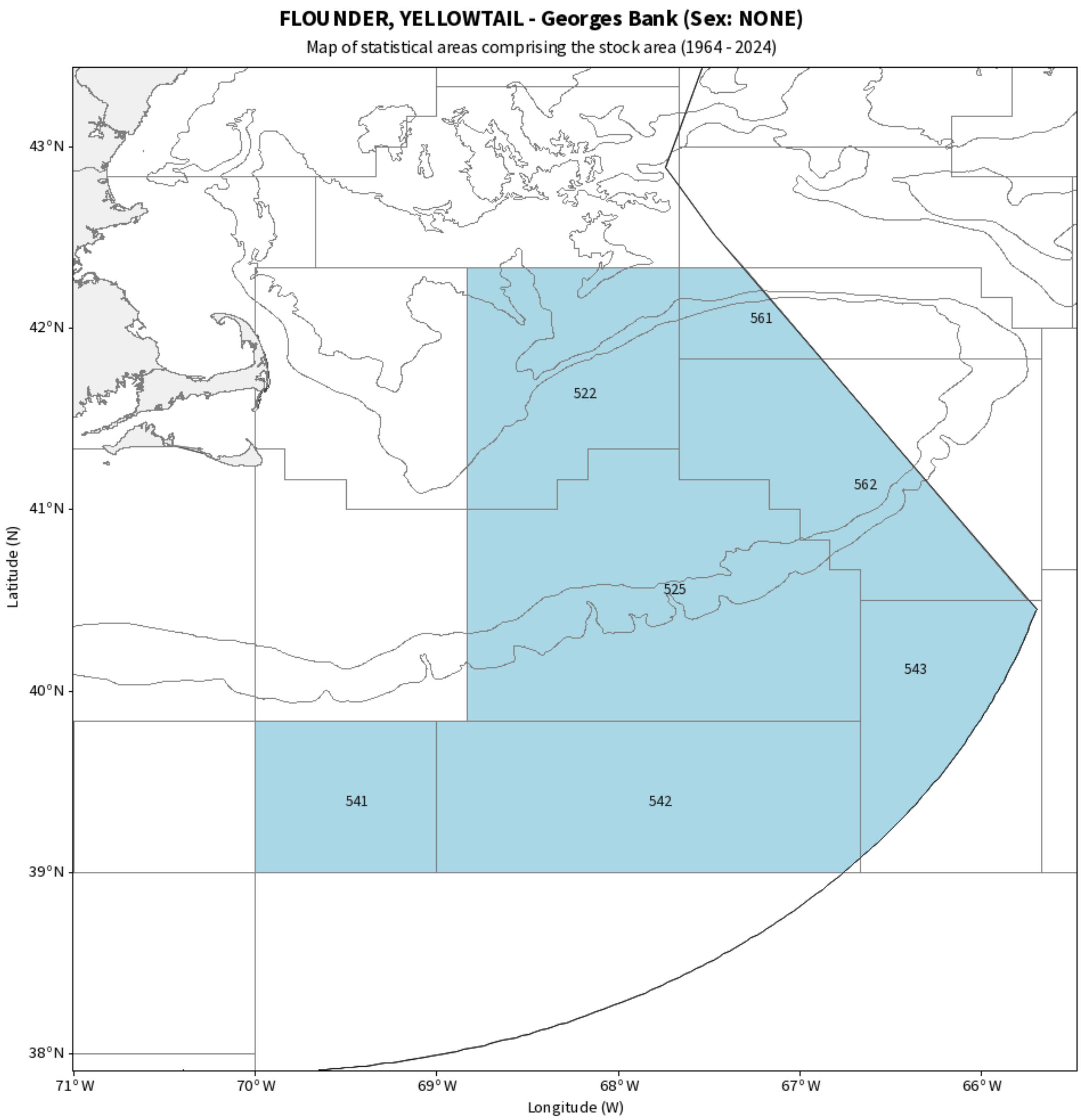
Table 2.8.3 Total catch at age (1000s) of SNEMA yellowtail flounder, 1973-2022.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1973	201	5333	11815	7973	5226	6286
1974	788	25853	5477	7366	3687	3347
1975	8037	3986	1884	1129	1597	1452
1976	193	6156	1179	327	449	896
1977	4968	4750	4886	507	278	649
1978	7830	13181	2163	1470	247	179
1979	186	17988	8655	1062	438	131
1980	919	9671	6593	3829	512	167
1981	34	6627	7546	2926	1111	183
1982	158	33925	14267	1858	415	86
1983	2407	18801	42269	3600	385	192
1984	470	5885	19895	8121	878	276
1985	2032	7769	2173	1968	1109	246
1986	421	9594	3322	635	356	149
1987	1442	3234	2366	926	167	65
1988	5309	2020	536	506	134	32
1989	22	18520	3164	449	48	3
1990	173	1893	40271	2142	89	5
1991	401	1475	4886	9414	166	51
1992	429	1338	1989	2674	294	18
1993	12	436	445	711	145	4
1994	129	244	382	299	257	89
1995	26	57	146	296	57	31
1996	20	415	819	244	30	23
1997	31	307	1430	967	134	46
1998	26	917	1100	455	93	20
1999	30	757	2616	735	200	50
2000	134	1466	1915	782	102	25
2001	16	499	1837	526	141	43
2002	11	289	1059	430	34	1
2003	77	493	899	482	48	20
2004	28	713	535	417	247	113
2005	176	447	483	294	170	42
2006	94	599	491	328	92	61
2007	39	518	801	340	100	30
2008	15	294	554	465	50	6
2009	153	386	742	578	280	61
2010	6	97	261	227	189	65
2011	70	188	292	214	132	78
2012	55	194	303	300	186	119
2013	19	42	371	369	185	113
2014	5	247	284	537	182	53
2015	1	32	139	113	279	67

2016	1	11	41	62	38	106
2017	6	10	42	31	42	74
2018	3	4	4	5	5	21
2019	9	11	6	7	4	16
2020	–	–	–	–	–	–
2021	–	–	–	–	–	–
2022	–	–	–	–	–	–

Figures


FLOUNDER, YELLOWTAIL - Cape Cod/Gulf of Maine (Sex: NONE)
Map of statistical areas comprising the stock area (1964 - 2024)
45°N
44°N
43°N
42°N
41°N
Latitude (N)
71°W
70°W
69°W
68°W
67°W
Longitude (W)
467
511
512
513
465
515
464
514
521


FLOUNDER, YELLOWTAIL - Georges Bank (Sex: NONE)
Map of statistical areas comprising the stock area (1964 - 2024)
Latitude (N)
Longitude (W)
43°N
42°N
41°N
40°N
39°N
38°N
71°W
70°W
69°W
68°W
67°W
66°W
561
522
562
525
543
541
542

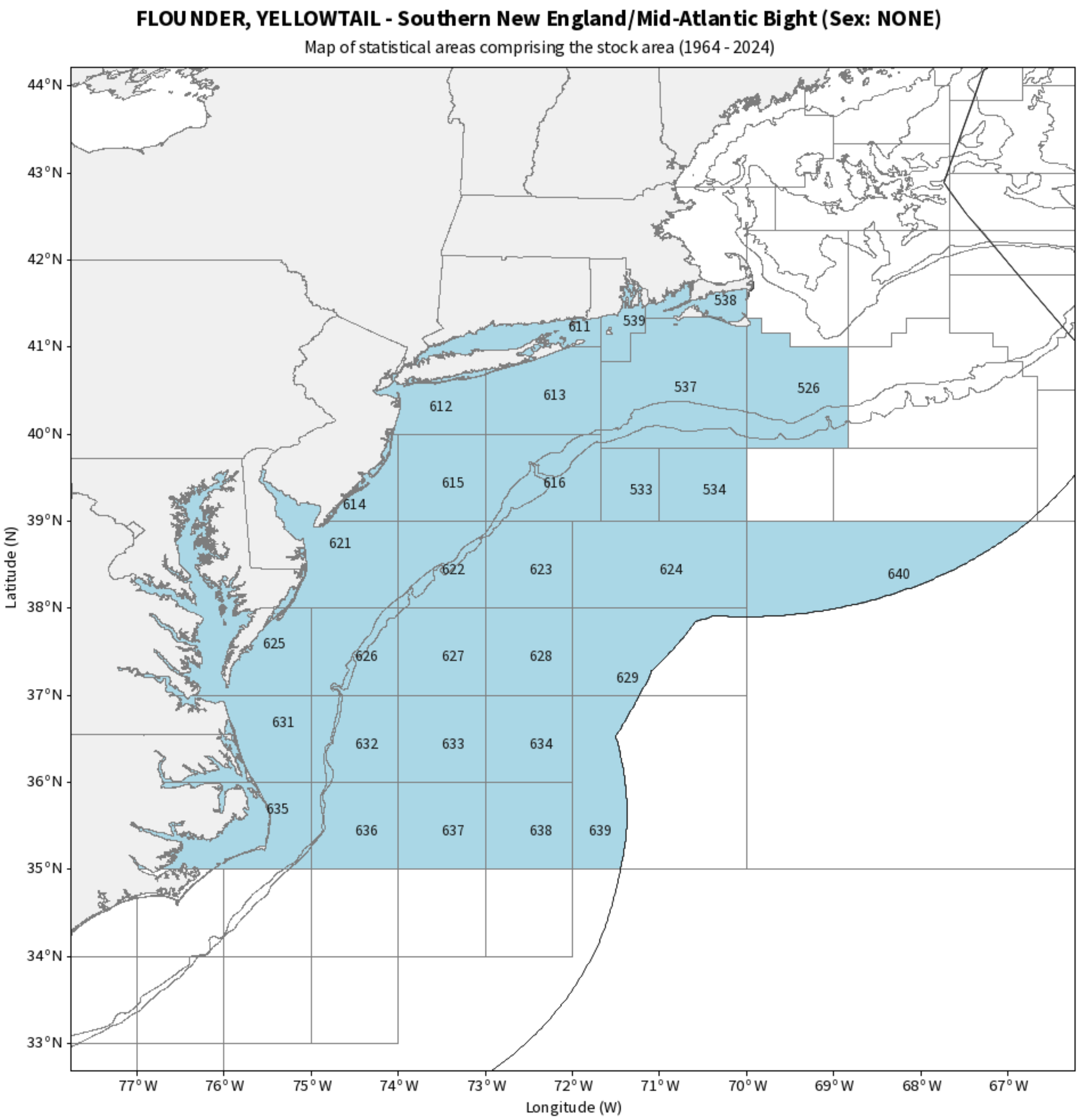


Figure 2.1.1 Statistical areas used to define Yellowtail flounder commercial catch for three stocks. From top: CCGOM, GB, SNEMA. For GB, the blue box represents US waters.

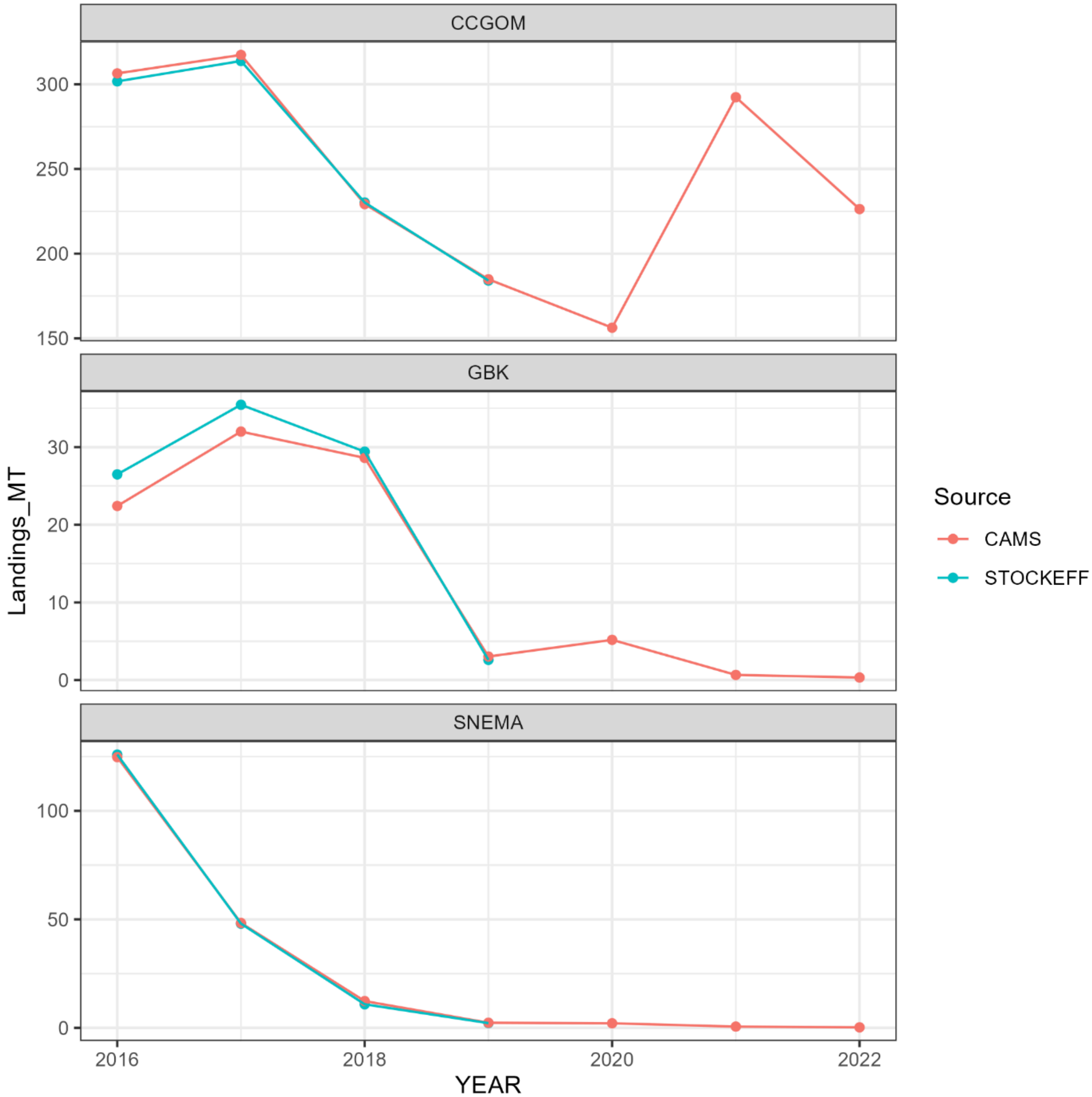


Figure 2.1.2 Landings (mt) from 2016-2022 sourced from either the Catch Accounting Monitoring System (CAMS) or the previous system (STOCKEFF).

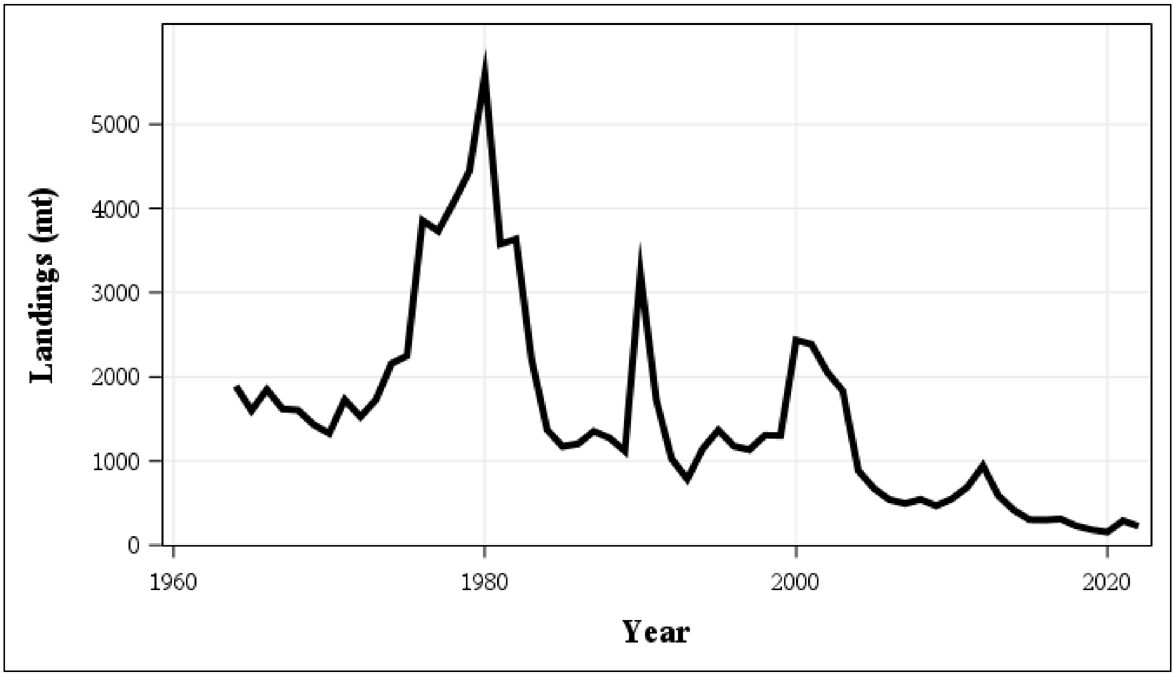


Figure 2.2.1 Total commercial landings (mt) for CCGOM yellowtail flounder.

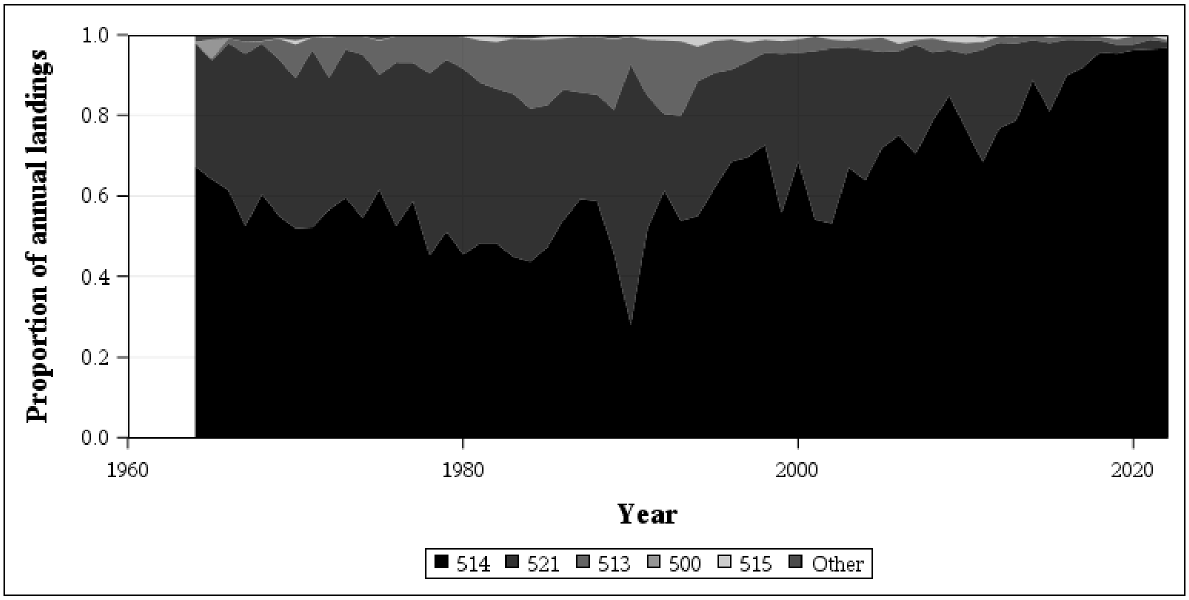


Figure 2.2.2 Proportion of landings by statistical area for CCGOM yellowtail flounder from 1964–2022.

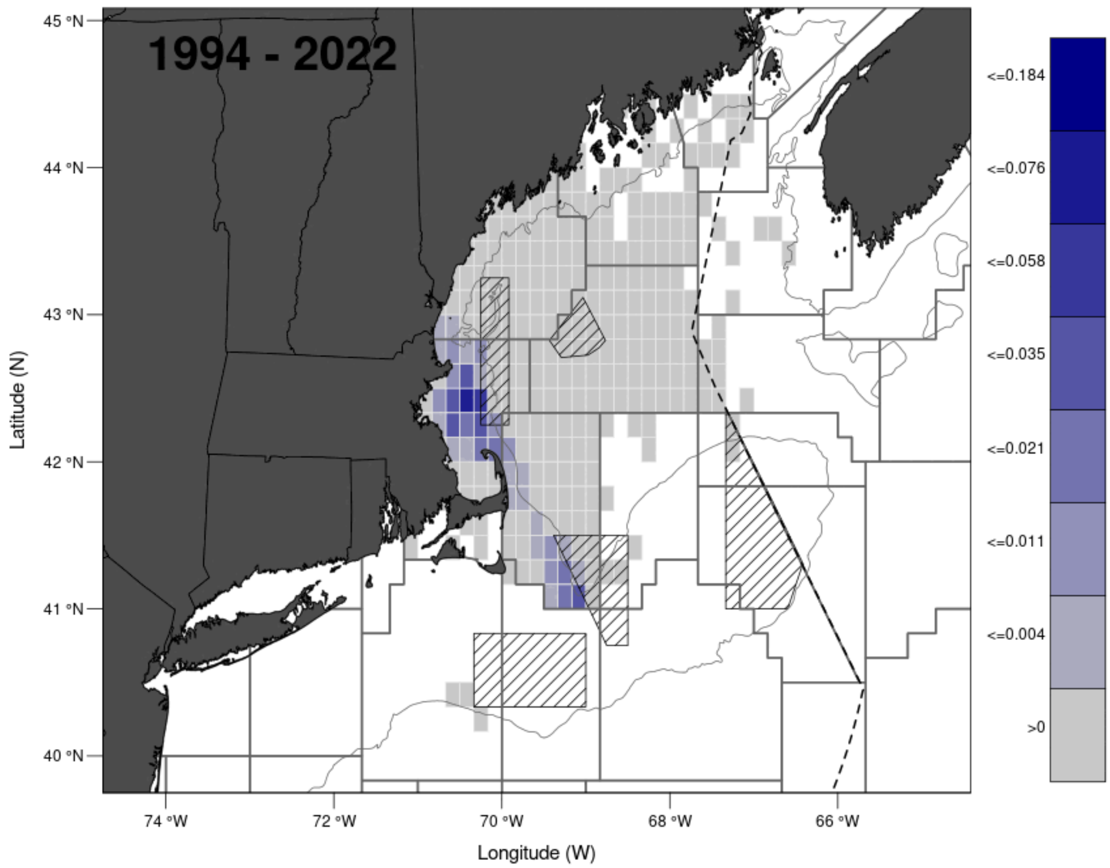


Figure 2.2.3 Commercial landings 1994-2022, derived from the spatial information provided from VTRs for CCGOM yellowtail flounder. Color ramp represents the fraction of total landings per 10-minute square.

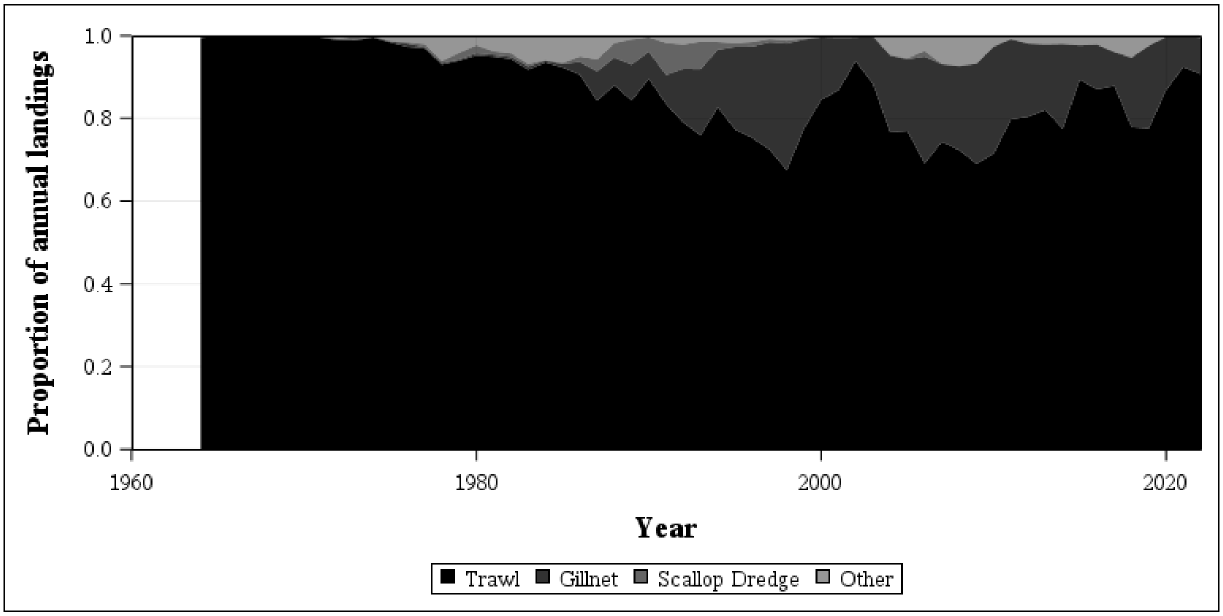


Figure 2.2.4 Proportion of landings by gear type for CCGOM yellowtail flounder.

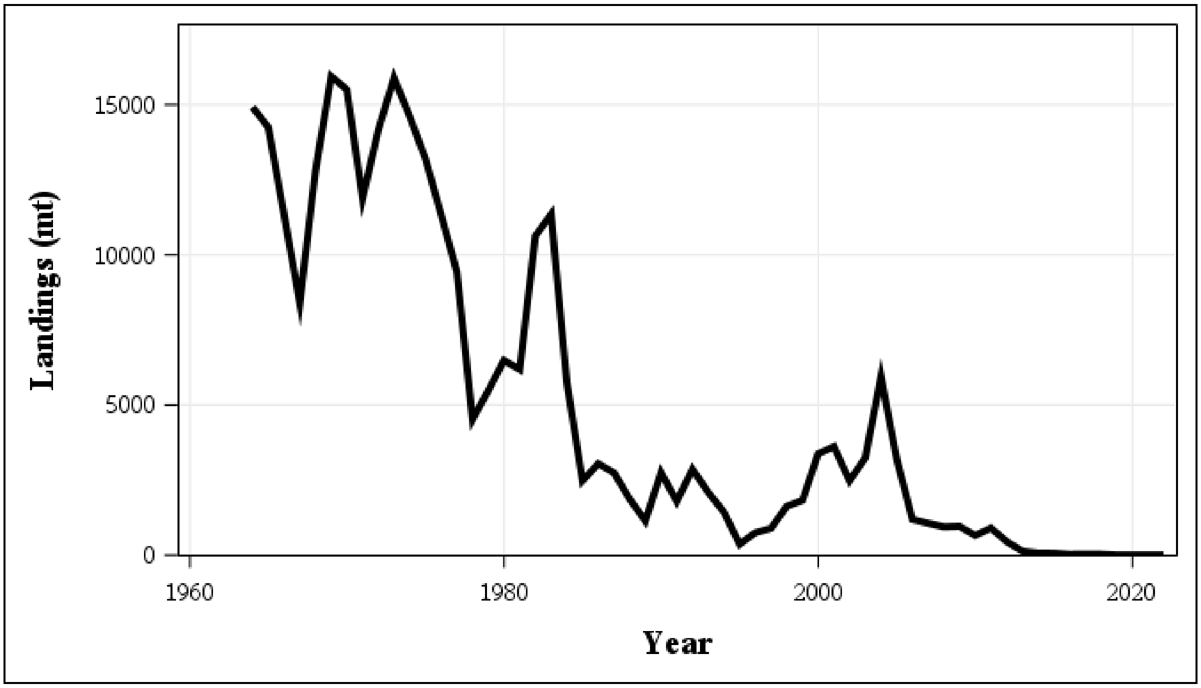


Figure 2.2.5 Total landings of commercial catch (mt) for GB yellowtail flounder from 1964-2022.

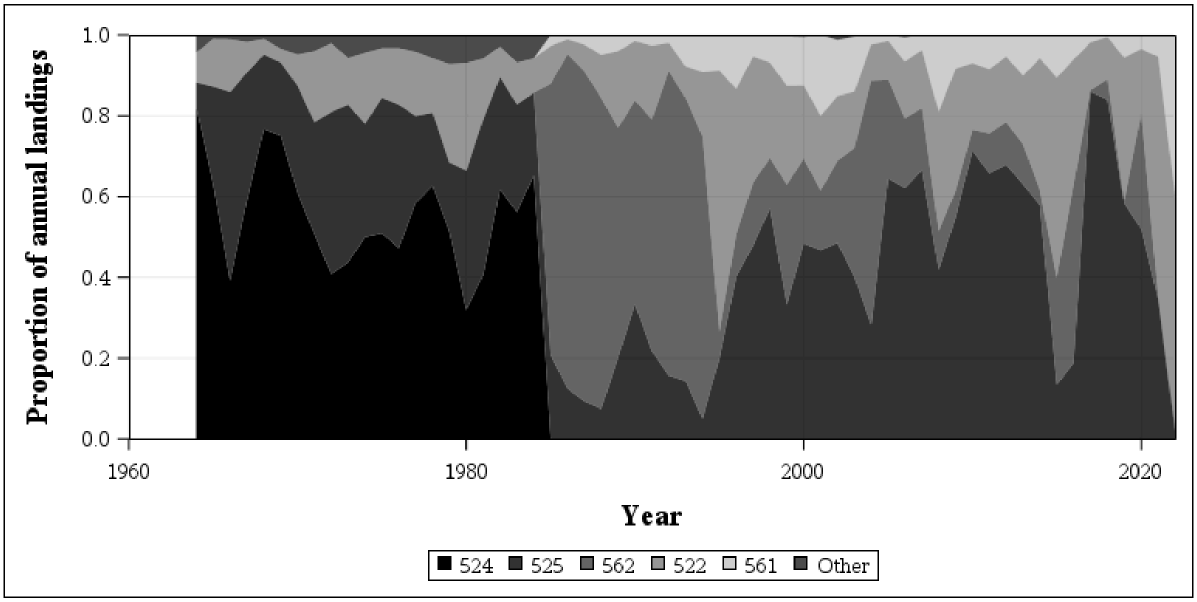


Figure 2.2.6 Proportion of landings by statistical area for GB yellowtail flounder from 1964-2022. Note: The transition in stock area composition for GB landings in the mid-1980s corresponds to the implementation of the Hague Line in 1984.

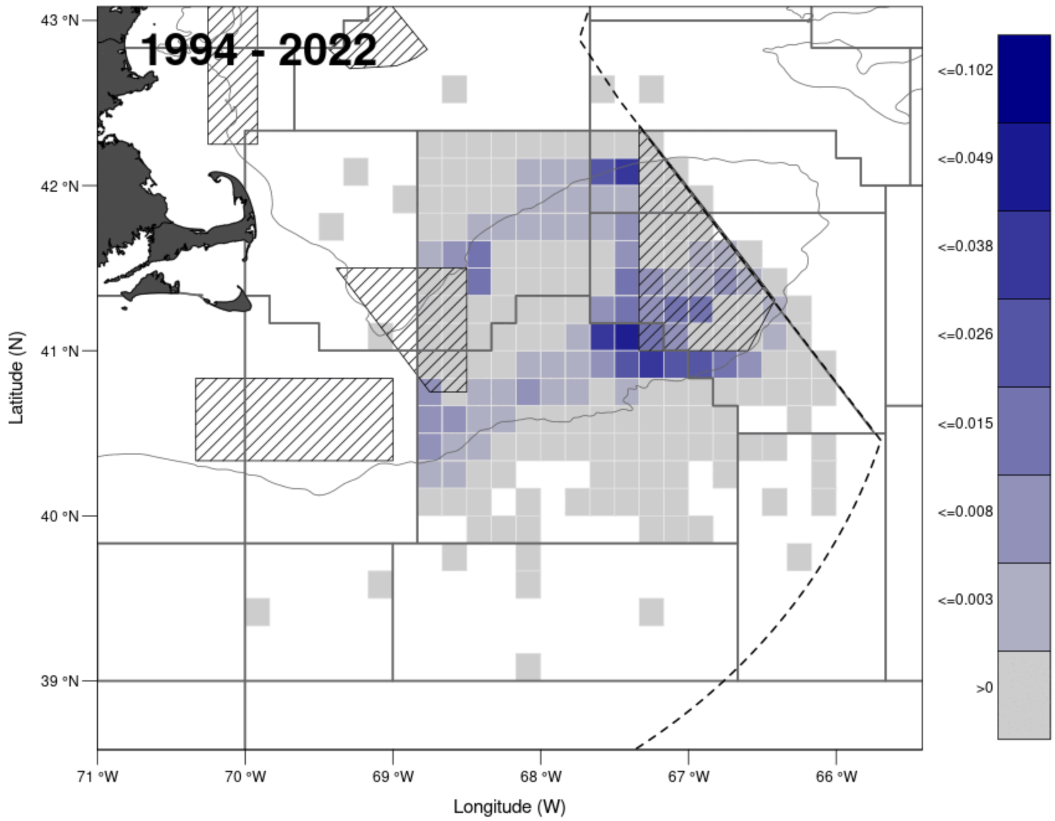


Figure 2.2.7 Commercial landings 1994-2022, derived from the spatial information provided fromVTRs for GB yellowtail flounder. Color ramp represents the fraction of total landings per 10-minute square.

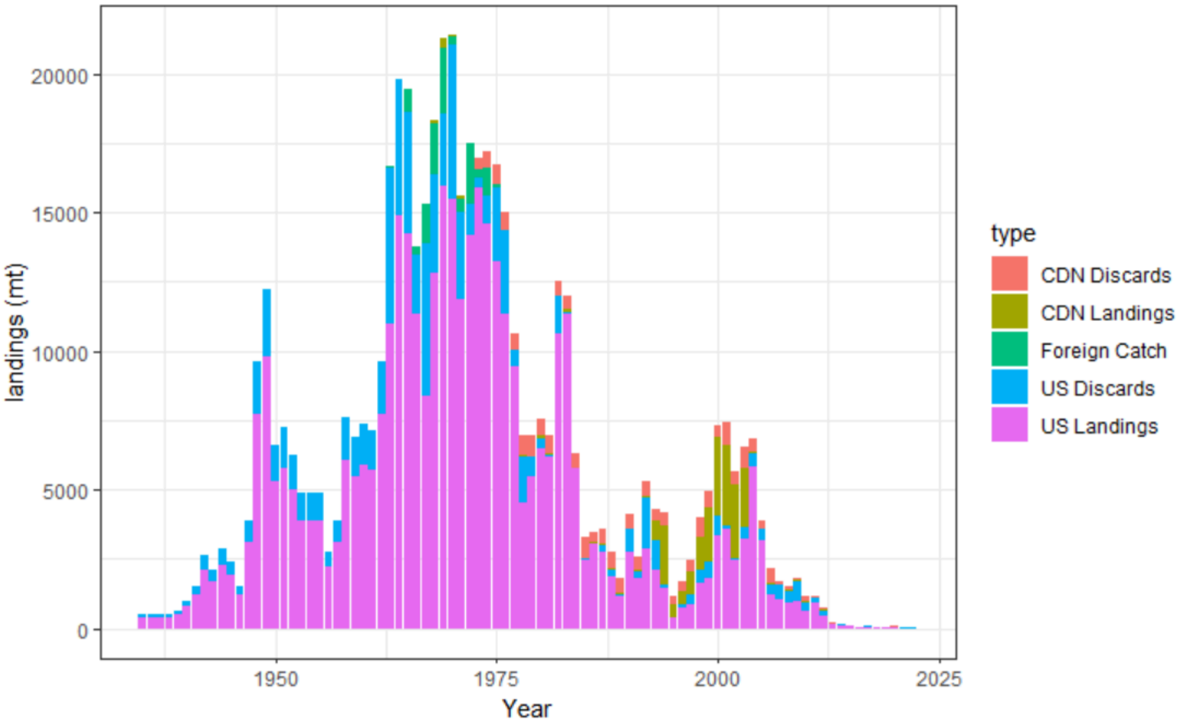


Figure 2.2.8 Composition of GB yellowtail flounder catch (mt)showing the relative amount of Canadian landings, Canadian discards, foreign catch, US landings and US discards.

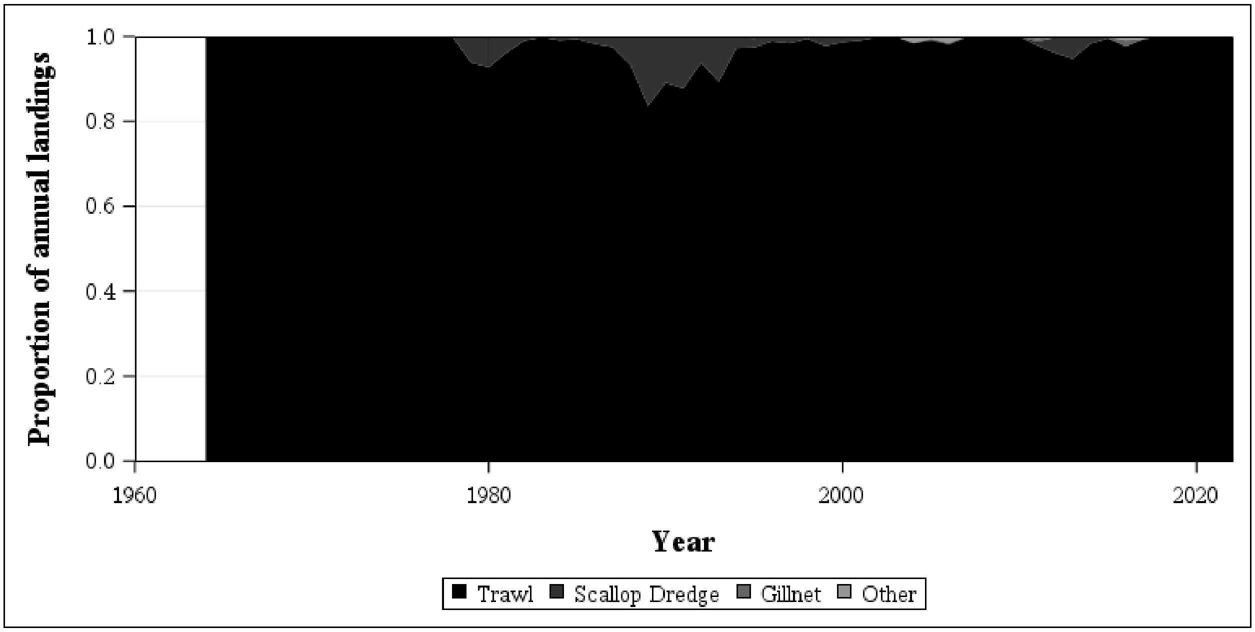


Figure 2.2.9 Proportion of landings by gear type for GB yellowtail flounder (1964–2022).

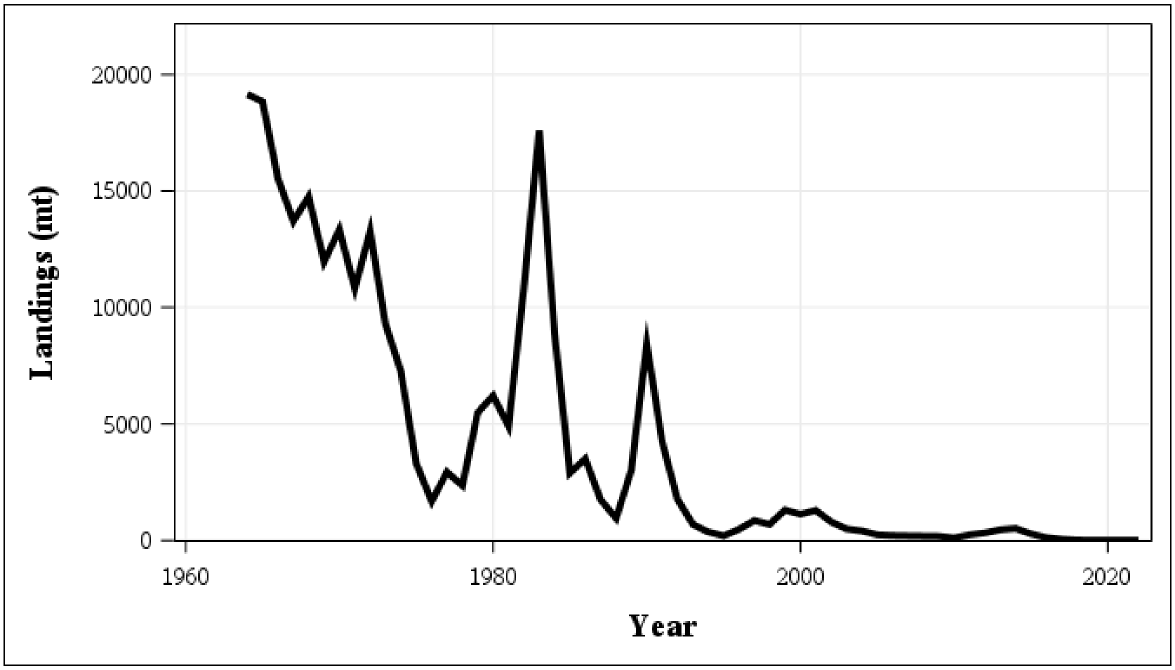


Figure 2.2.10 Total landings of commercial catch(mt) for SNEMA yellowtail flounder from 1964–2022.

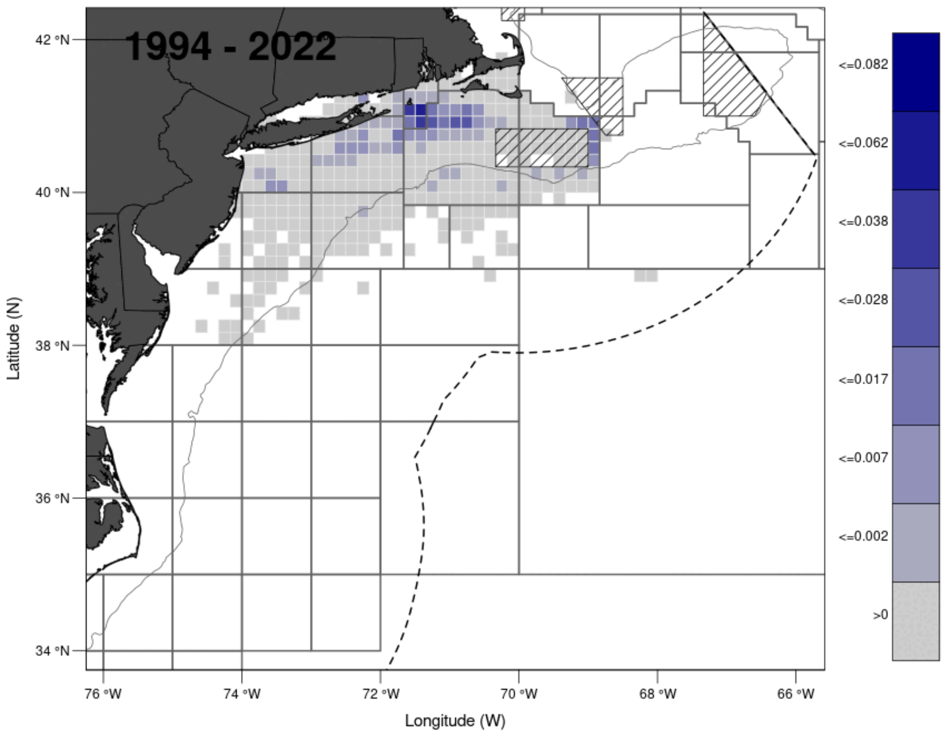


Figure 2.2.11 Commercial landings 1994–2022, derived from the spatial information provided forVTRs for SNEMA yellowtail flounder. Color ramp represents the fraction of total landings per 10-minute square.

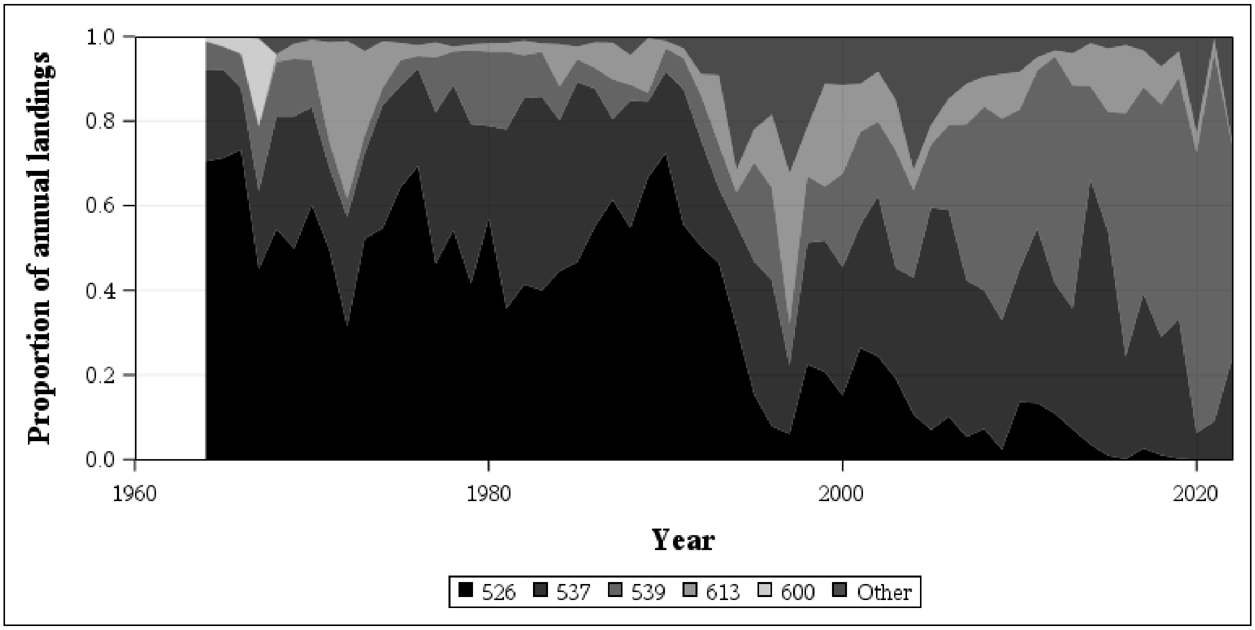


Figure 2.2.12 Proportion of landings by statistical area for SNEMA yellowtail flounder.

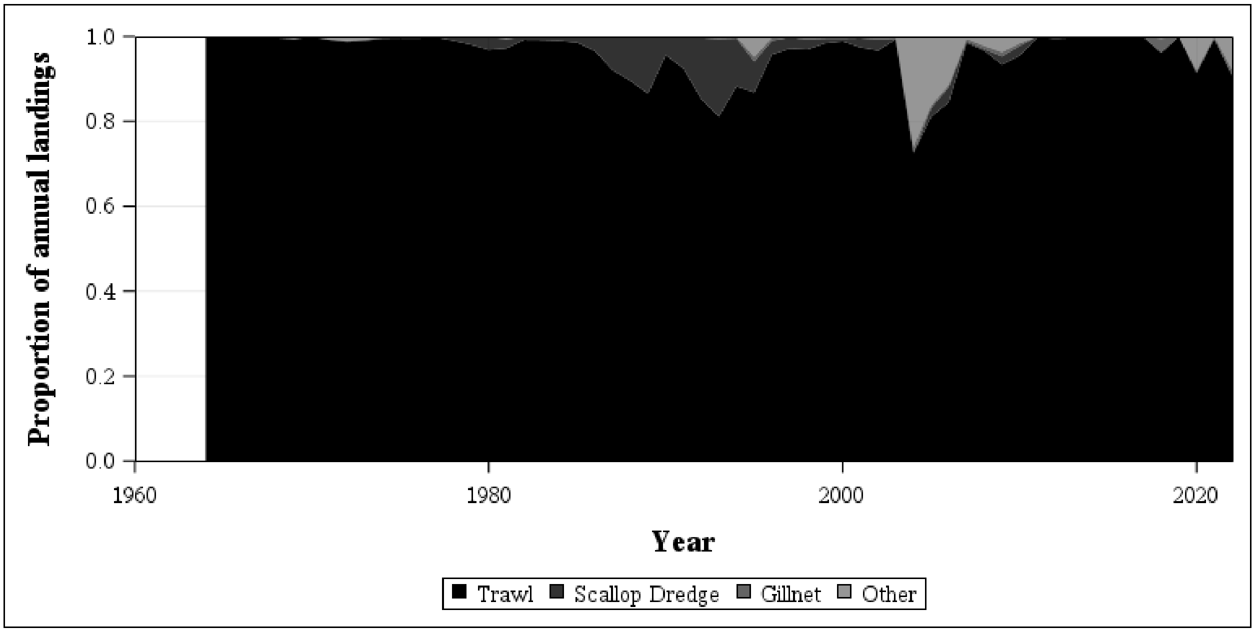


Figure 2.2.13 Proportion of landings by gear type for SNEMA yellowtail flounder.

Figure 2.3.1 Proportion of landings by market category for CCGOM yellowtail flounder.

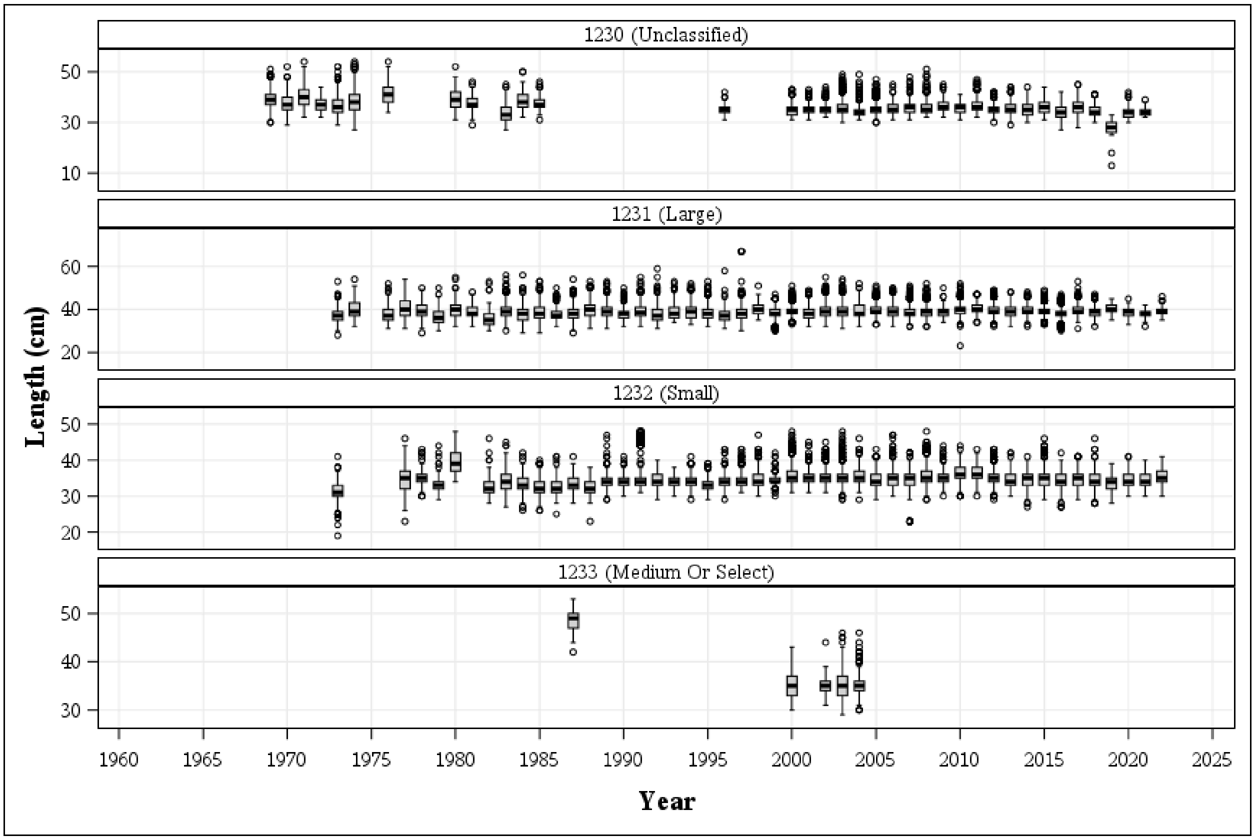


Figure 2.3.2 Length distribution of CCGOM yellowtail flounder by market category.

Figure 2.3.3 Proportion of landings by market category for GB.

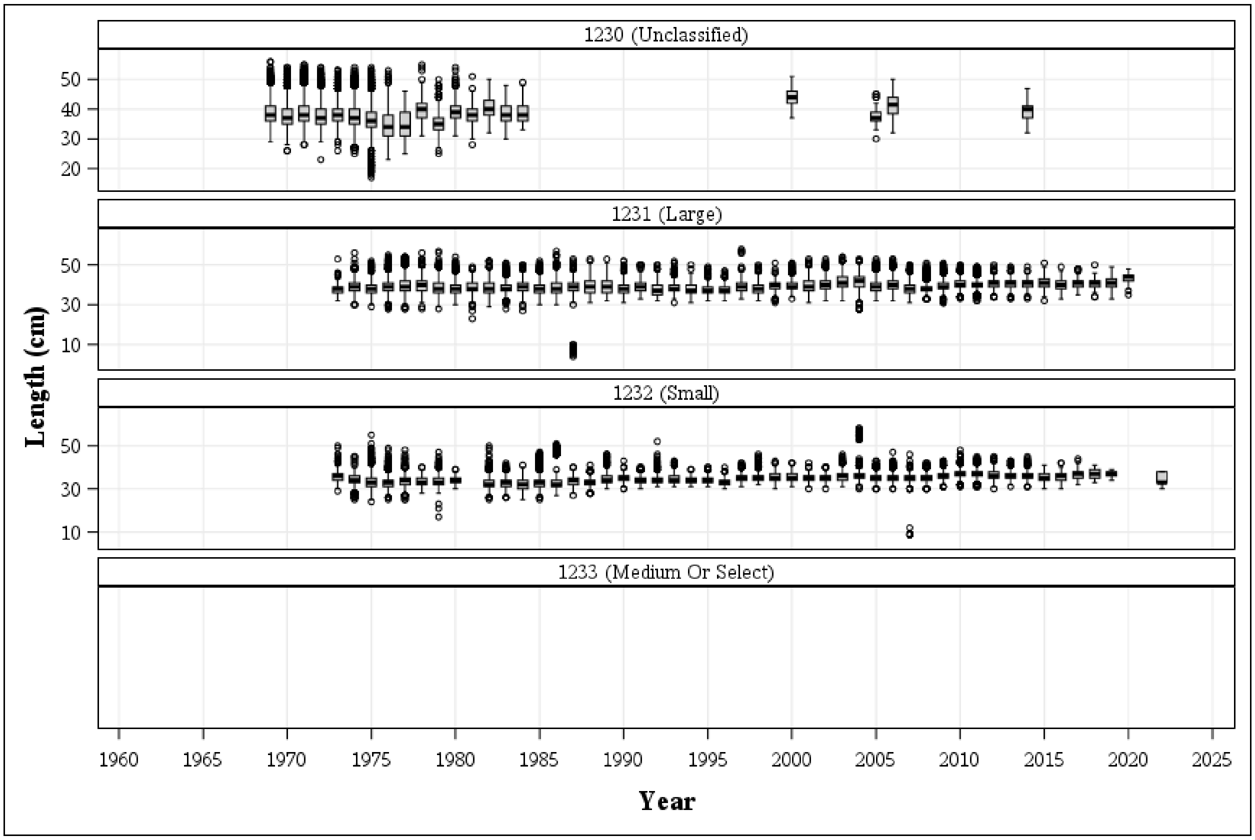


Figure 2.3.4 Length distribution of GB yellowtail flounder by market category.

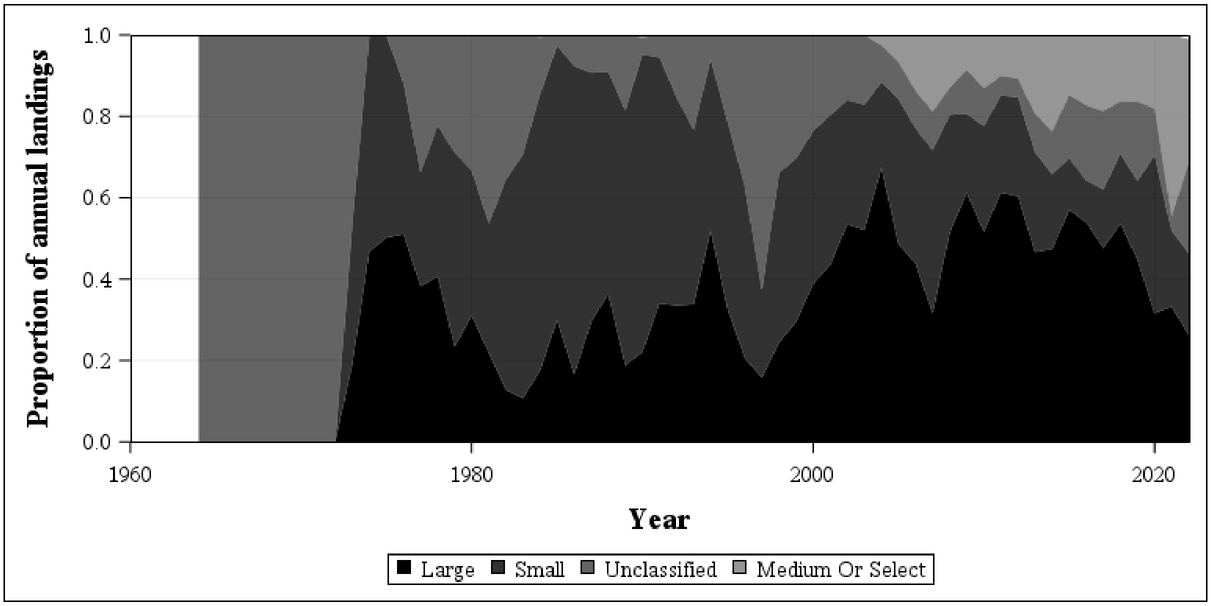


Figure 2.3.5 Proportion of landings by market category for SNEMA yellowtail flounder.

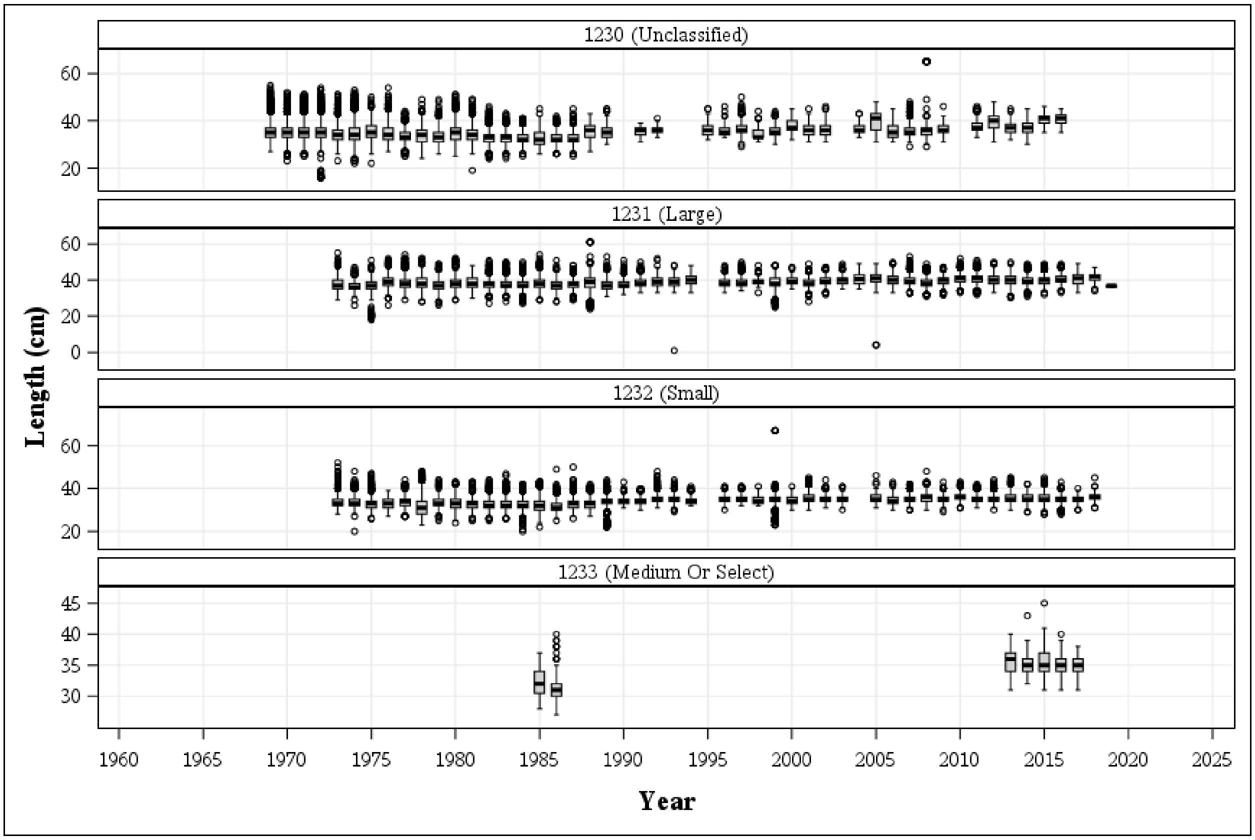


Figure 2.3.6 Length distribution of SNEMA yellowtail flounder by market category.

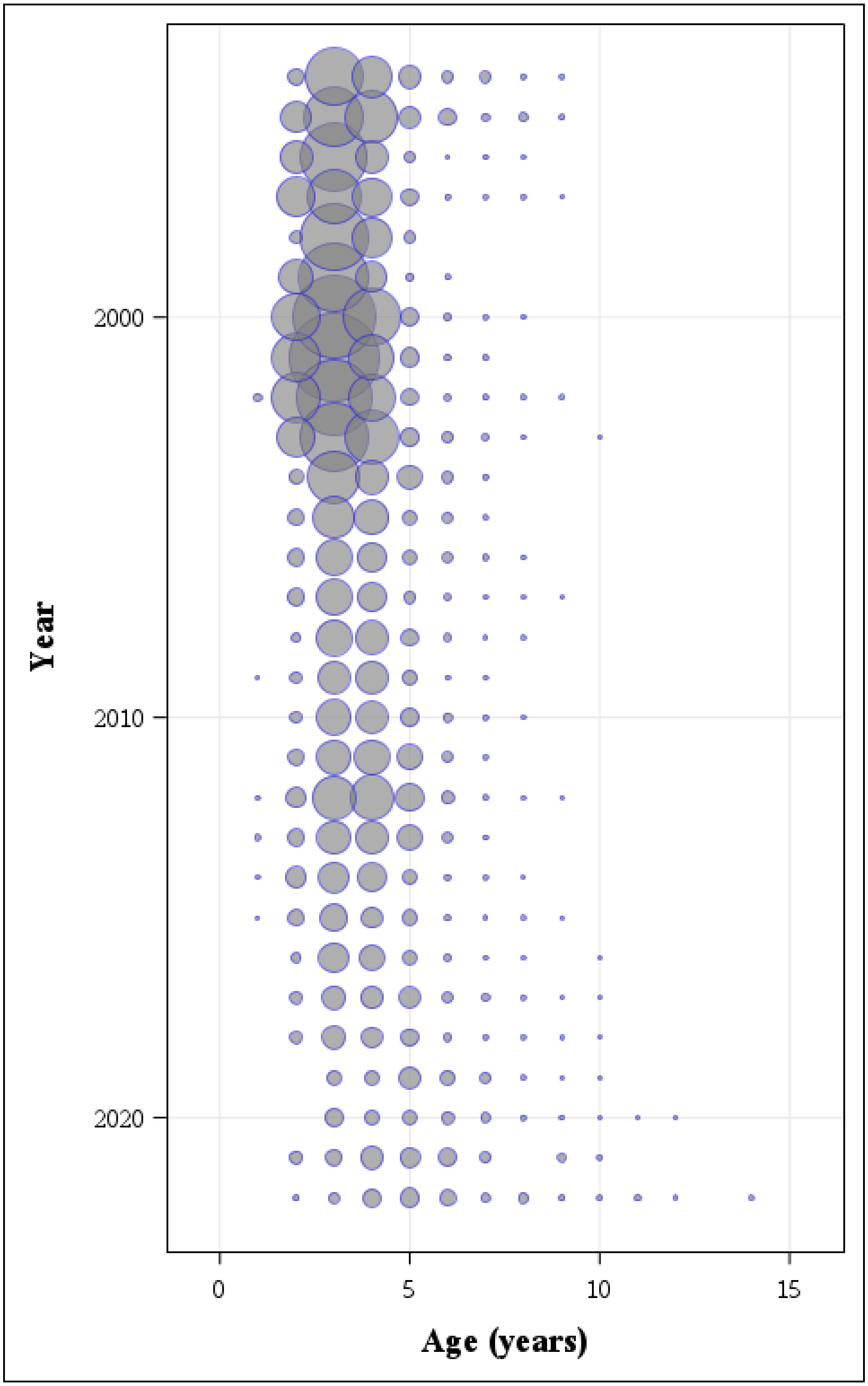


Figure 2.4.1 Commercial landings-at-age for CCGOM yellowtail flounder 1994-2022. The size of the bubble is proportional to the number of observations.

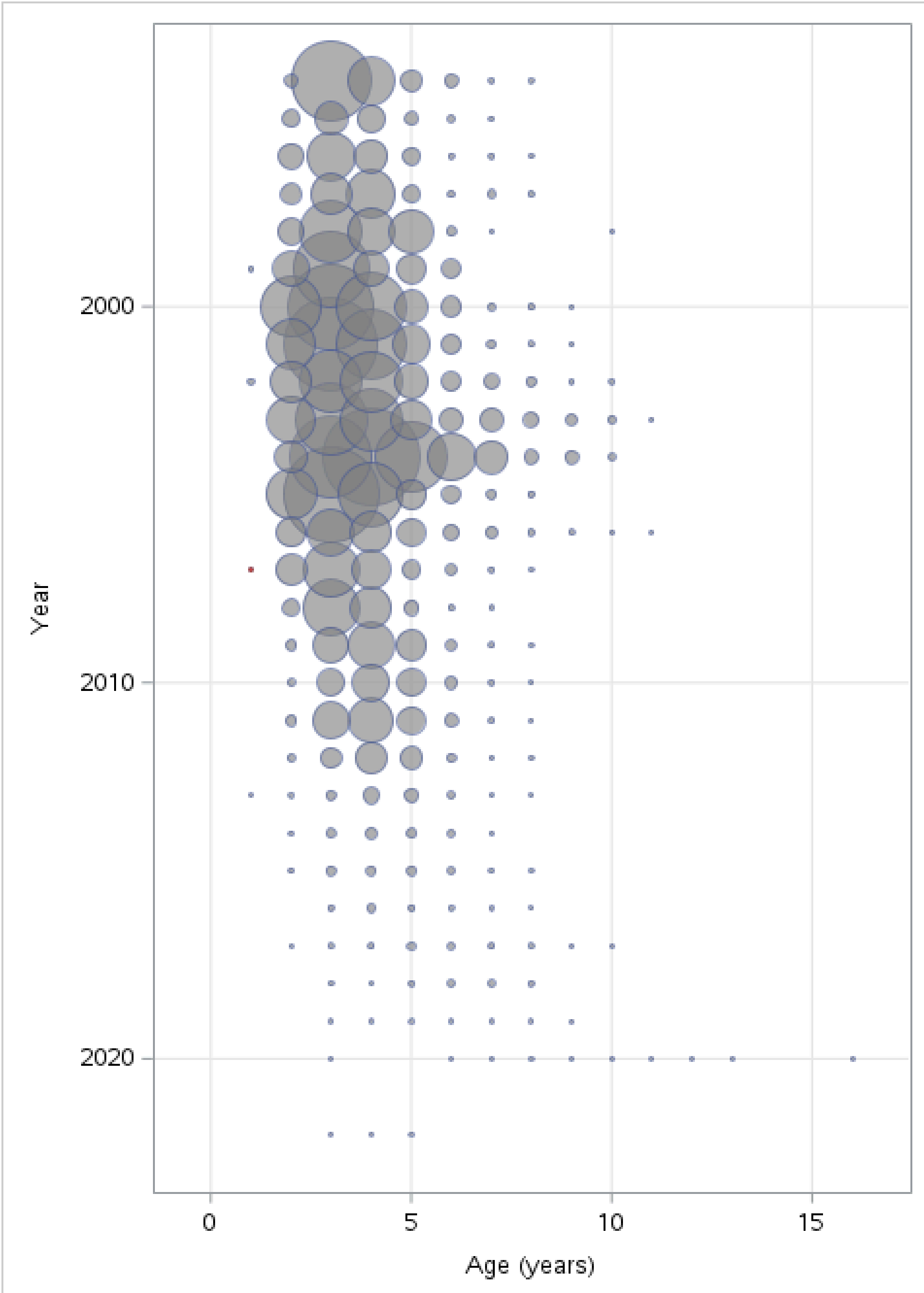


Figure 2.4.2 Commercial landings-at-age for GB. The size of the bubble is proportional to the number of observations.

Figure 2.4.3 Commercial landings-at-age for SNEMA yellowtail flounder 1994-2022. The size of the bubble is proportional to the number of observations.

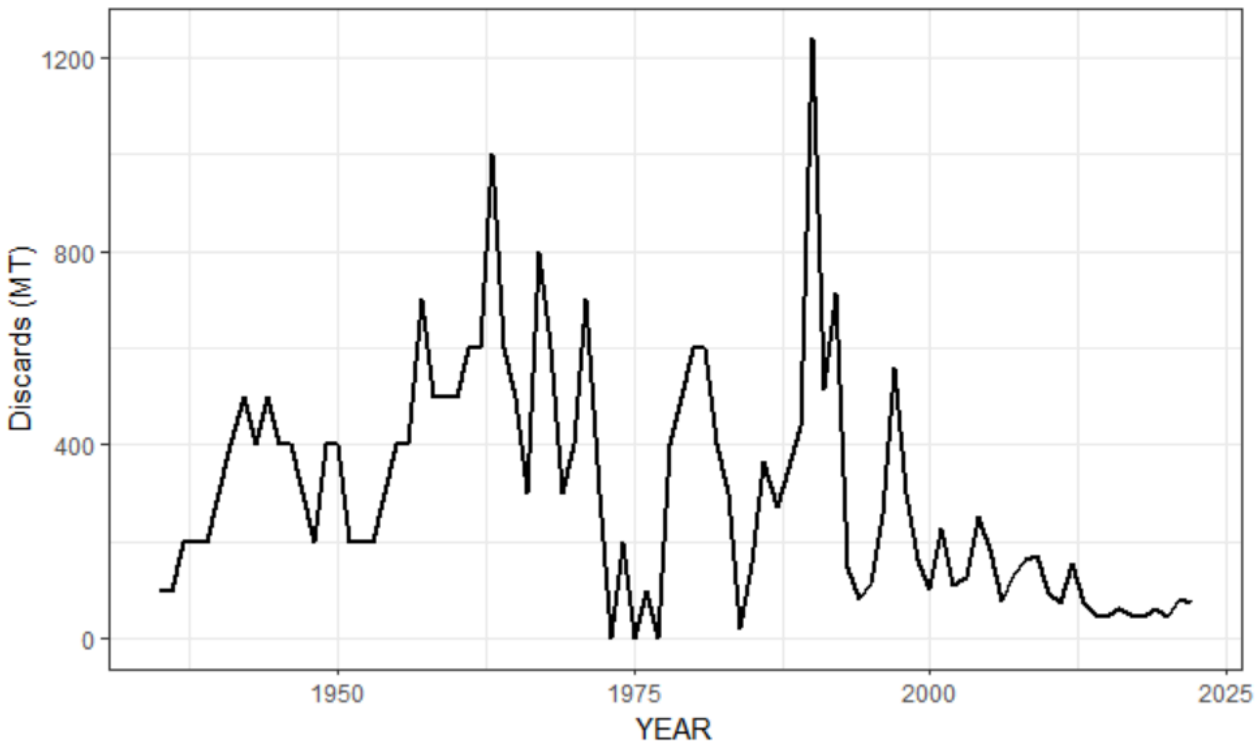


Figure 2.5.1 Total commercial discards in mt for CCGOM yellowtail flounder.

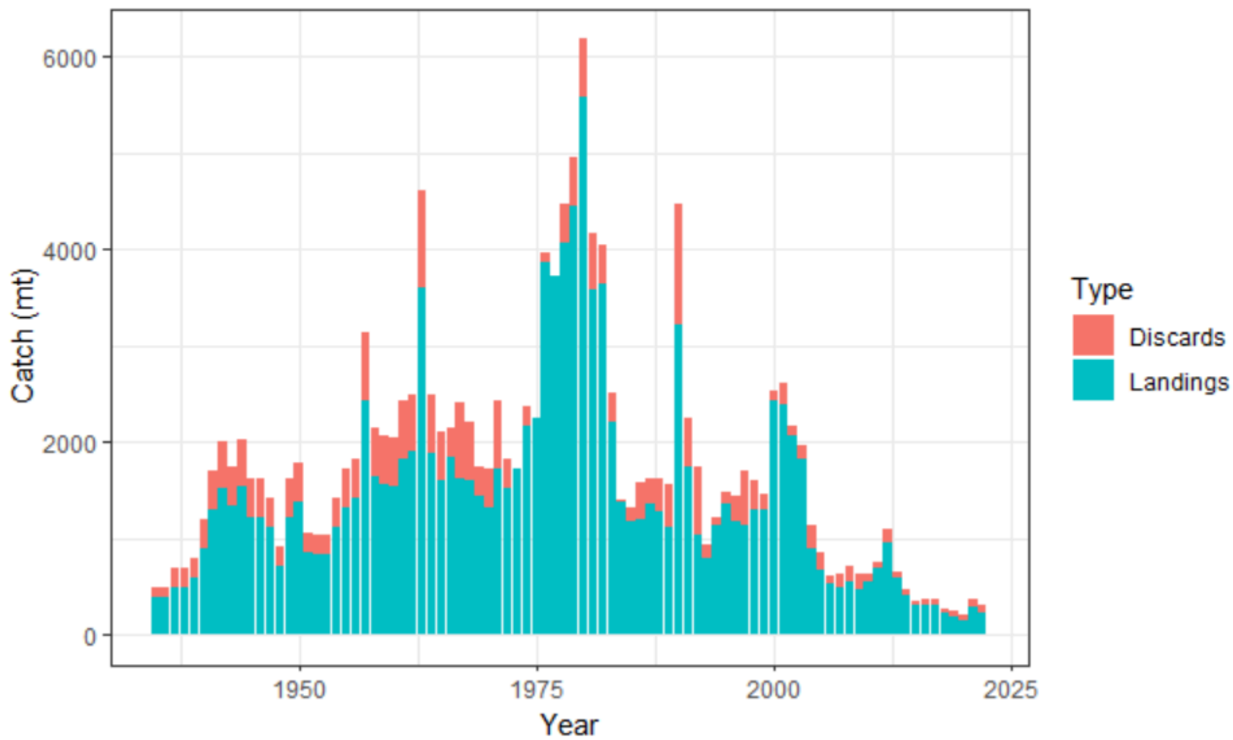
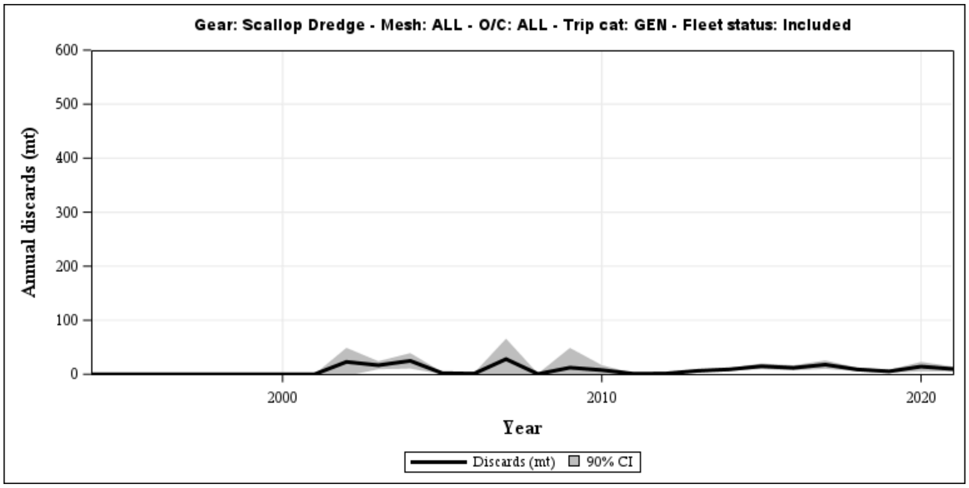
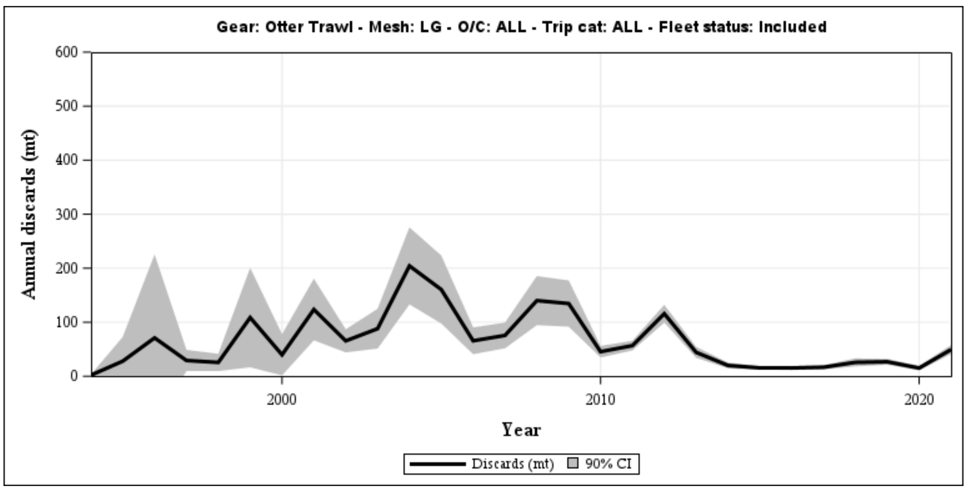
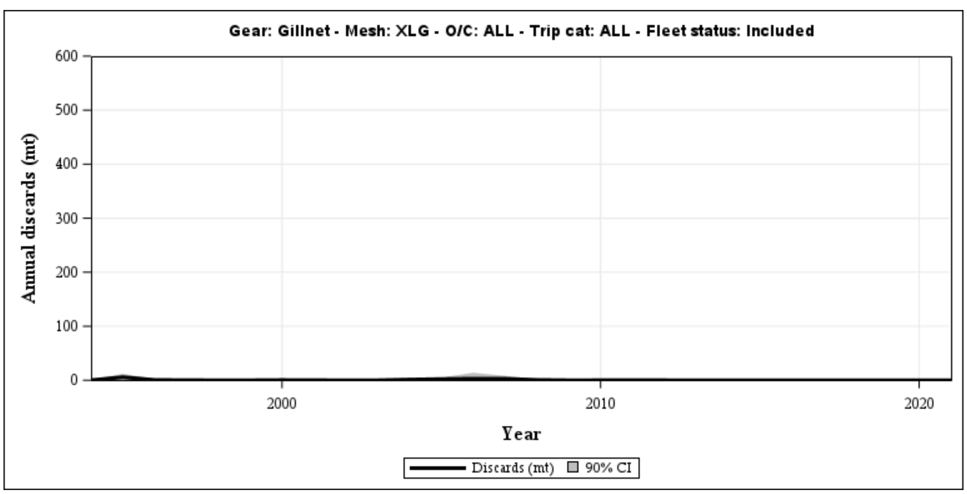


Figure 2.5.2 Comparison of commercial discards and landings in CCGOM yellowtail flounder.


Gear: Scallop Dredge - Mesh: ALL - O/C: ALL - Trip cat: GEN - Fleet status: Included
600
500
400
300
200
100
0
Annual discards (mt)
2000
2010
2020
Year
Discards (mt)
90% CI


Gear: Otter Trawl - Mesh: LG - O/C: ALL - Trip cat: ALL - Fleet status: Included
600
500
400
300
200
100
0
Annual discards (mt)
2000
2010
2020
Year
Discards (mt)
90% CI


Gear: Gillnet - Mesh: XLG - O/C: ALL - Trip cat: ALL - Fleet status: Included
600
500
400
300
200
100
0
Annual discards (mt)
2000
2010
2020
Year
Discards (mt)
90% CI

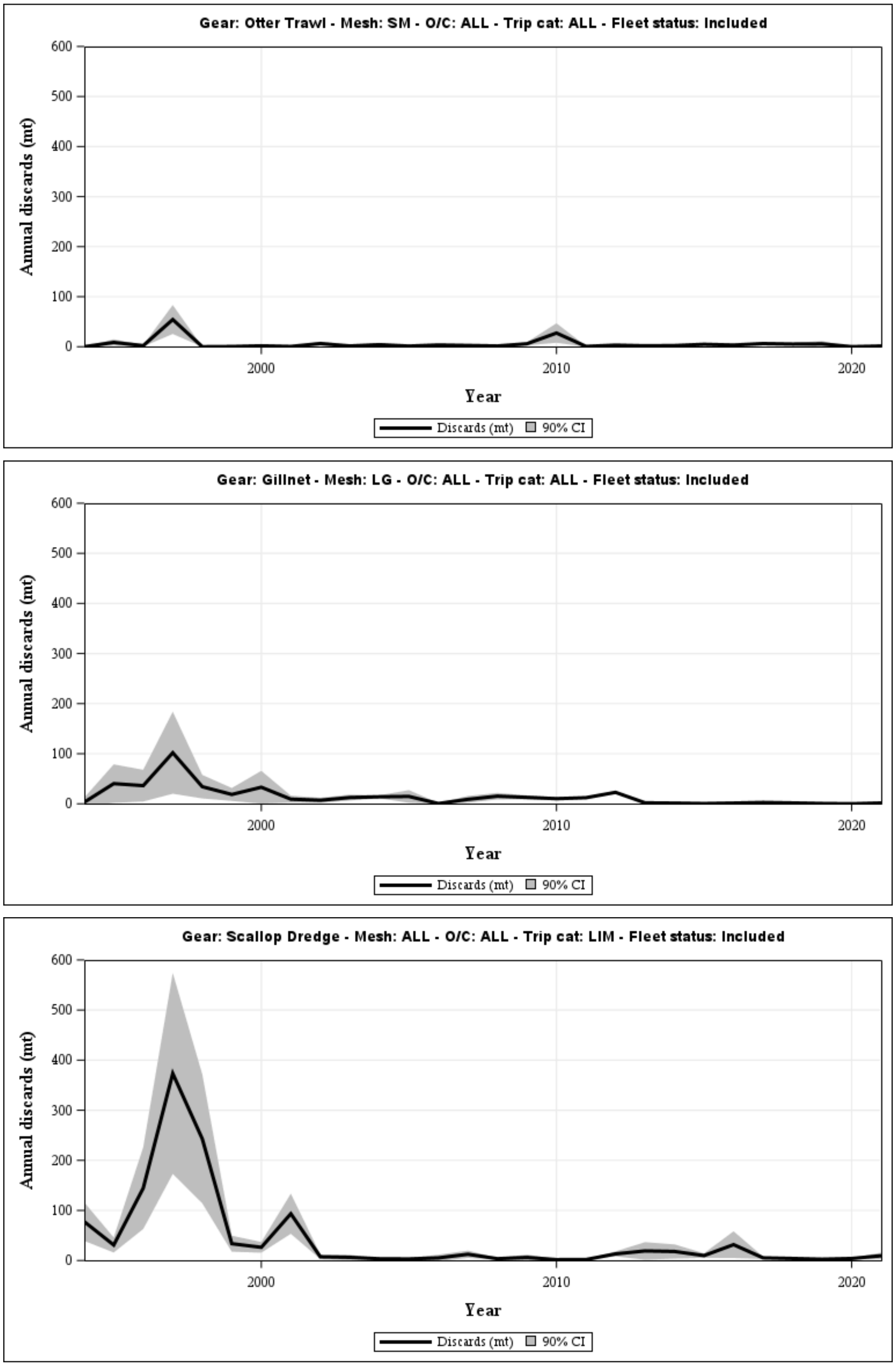


Figure 2.5.3 Commercial discards by gear type in the commercial CCGOM Yellowtail flounder fishery. From the top: a) General access scallop dredge, b) large mesh otter trawl, c) extra-large mesh gillnet, d) small mesh otter trawl, e) large mesh gillnet, f) limited access scallop dredge.

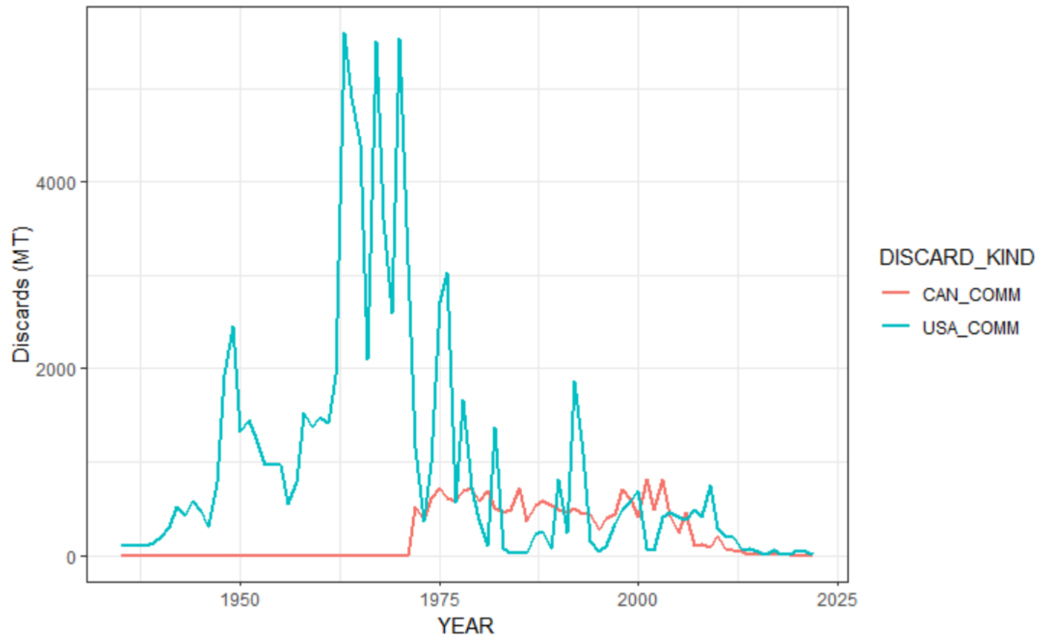


Figure 2.5.4 Total commercial discards of GB yellowtail flounder (mt) from the United States and Canada.

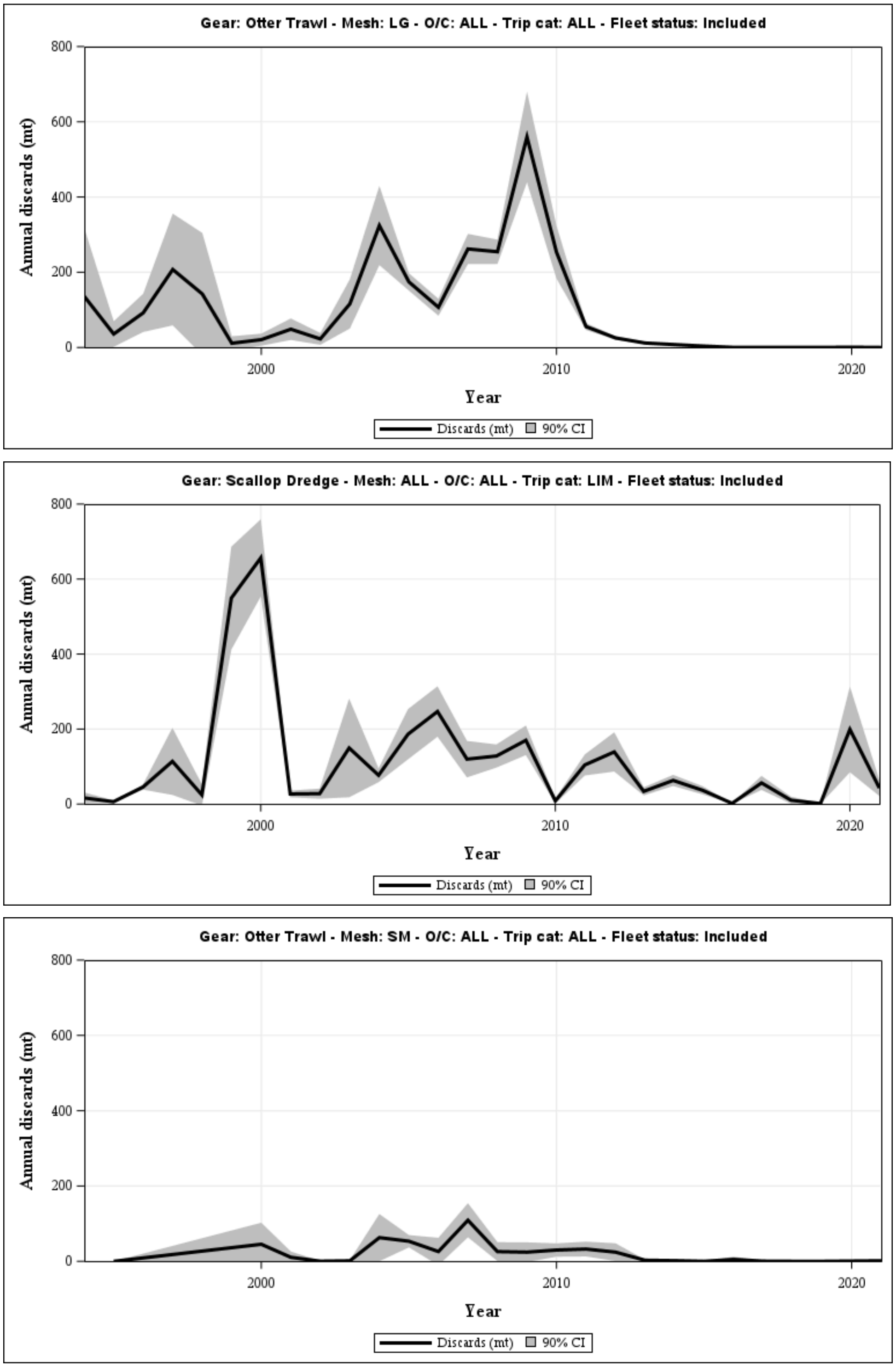


Figure 2.5.5 Commercial discards by gear type in the commercial GB Yellowtail flounder fishery. From the top: a) Large mesh otter trawl, b) limited access scallop dredge, c) small mesh otter trawl.

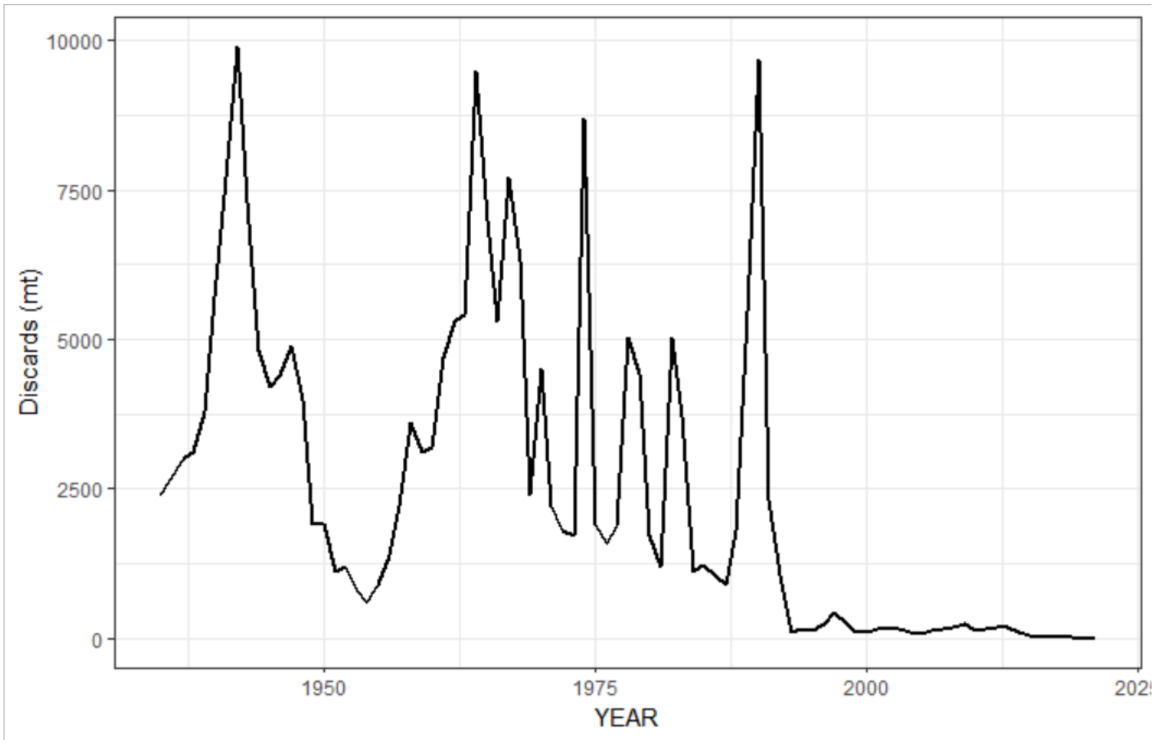


Figure 2.5.6 Total commercial discards of SNEMA yellowtail flounder (mt).

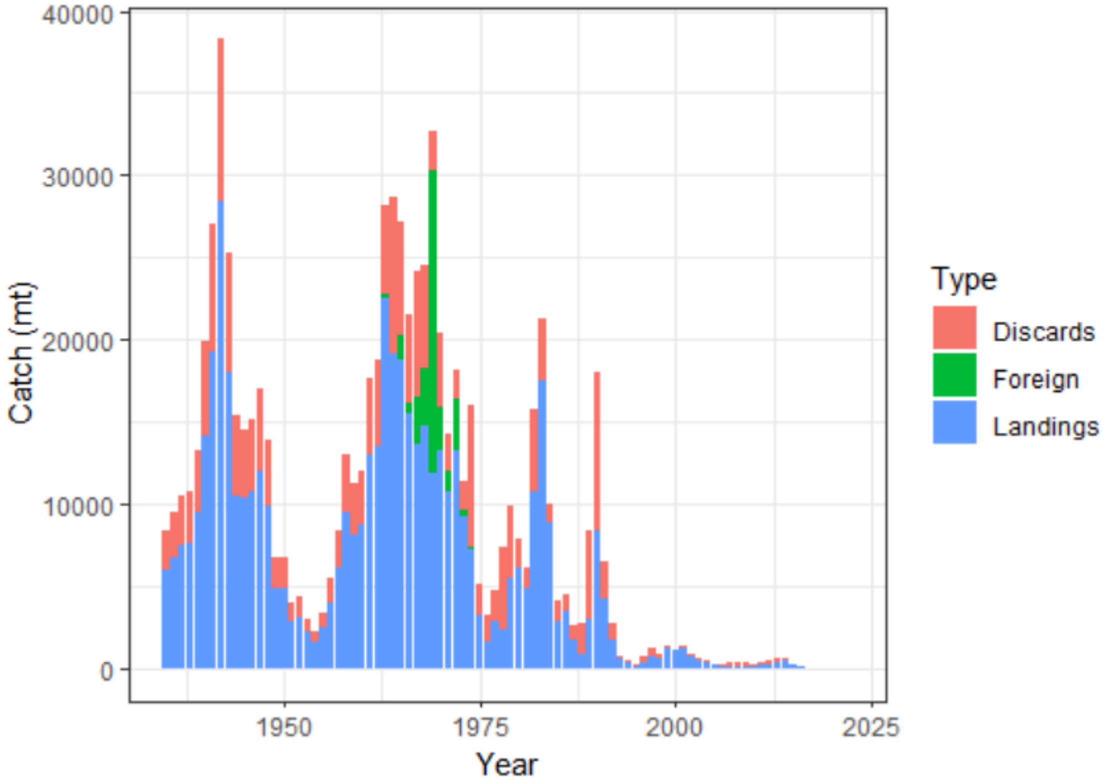
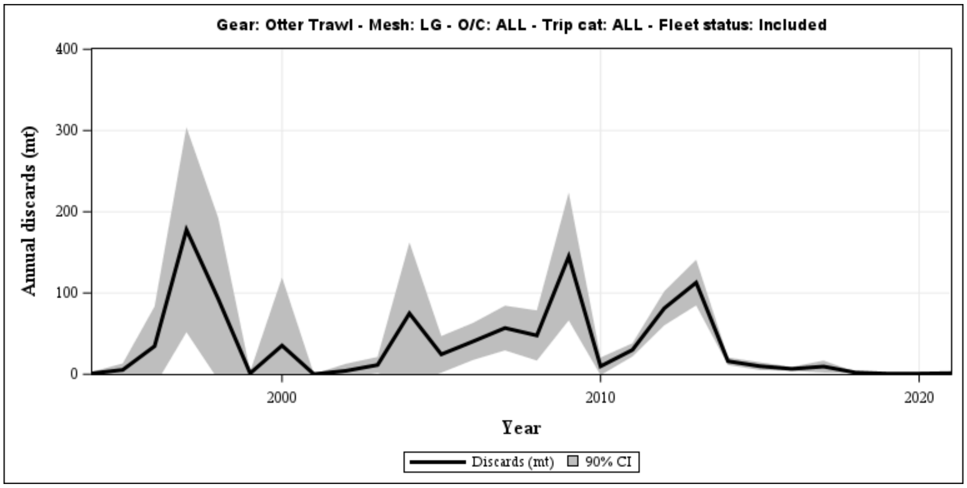
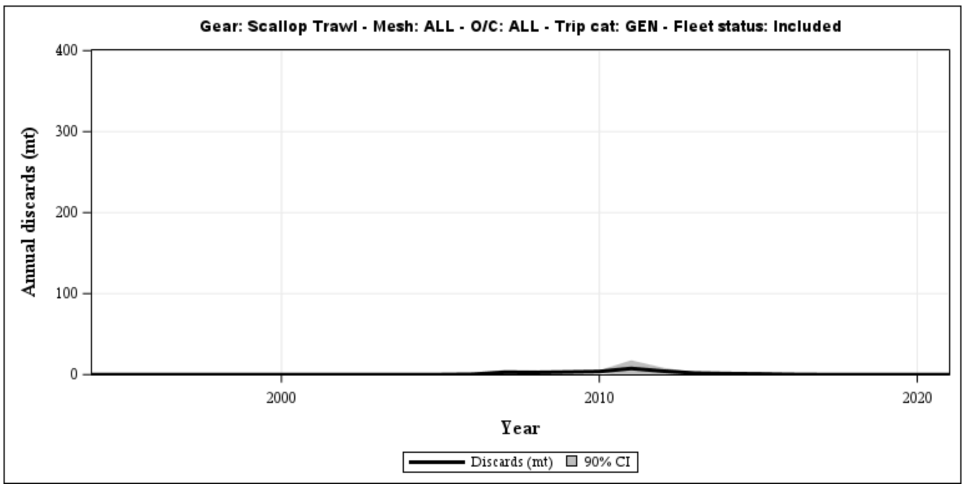
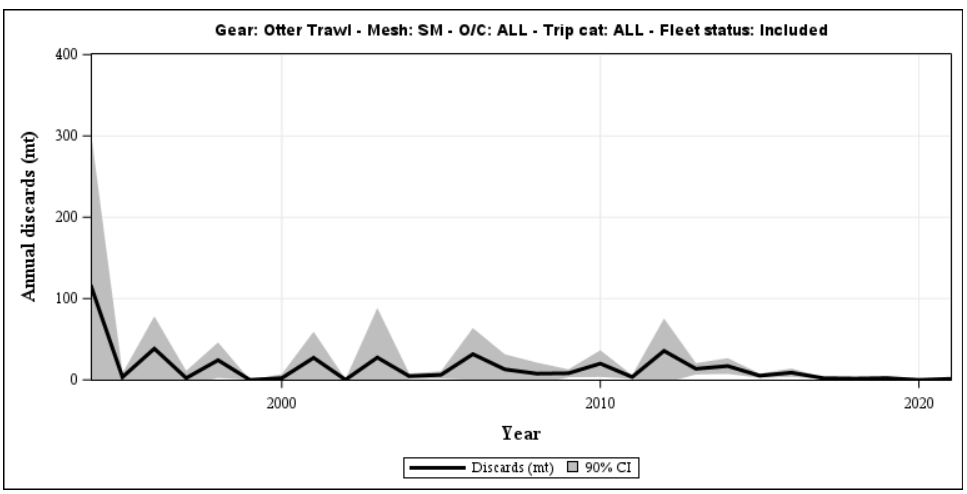


Figure 2.5.7 Comparison of commercial discards and landings from US fisheries and foreign catch (mt) of SNEMA yellowtail flounder.


Gear: Otter Trawl - Mesh: LG - O/C: ALL - Trip cat: ALL - Fleet status: Included
Annual discards (mt)
0
100
200
300
400
2000
2010
2020
Year
Discards (mt)
90% CI


Gear: Scallop Trawl - Mesh: ALL - O/C: ALL - Trip cat: GEN - Fleet status: Included
Annual discards (mt)
0
100
200
300
400
2000
2010
2020
Year
Discards (mt)
90% CI


Gear: Otter Trawl - Mesh: SM - O/C: ALL - Trip cat: ALL - Fleet status: Included
Annual discards (mt)
0
100
200
300
400
2000
2010
2020
Year
Discards (mt)
90% CI

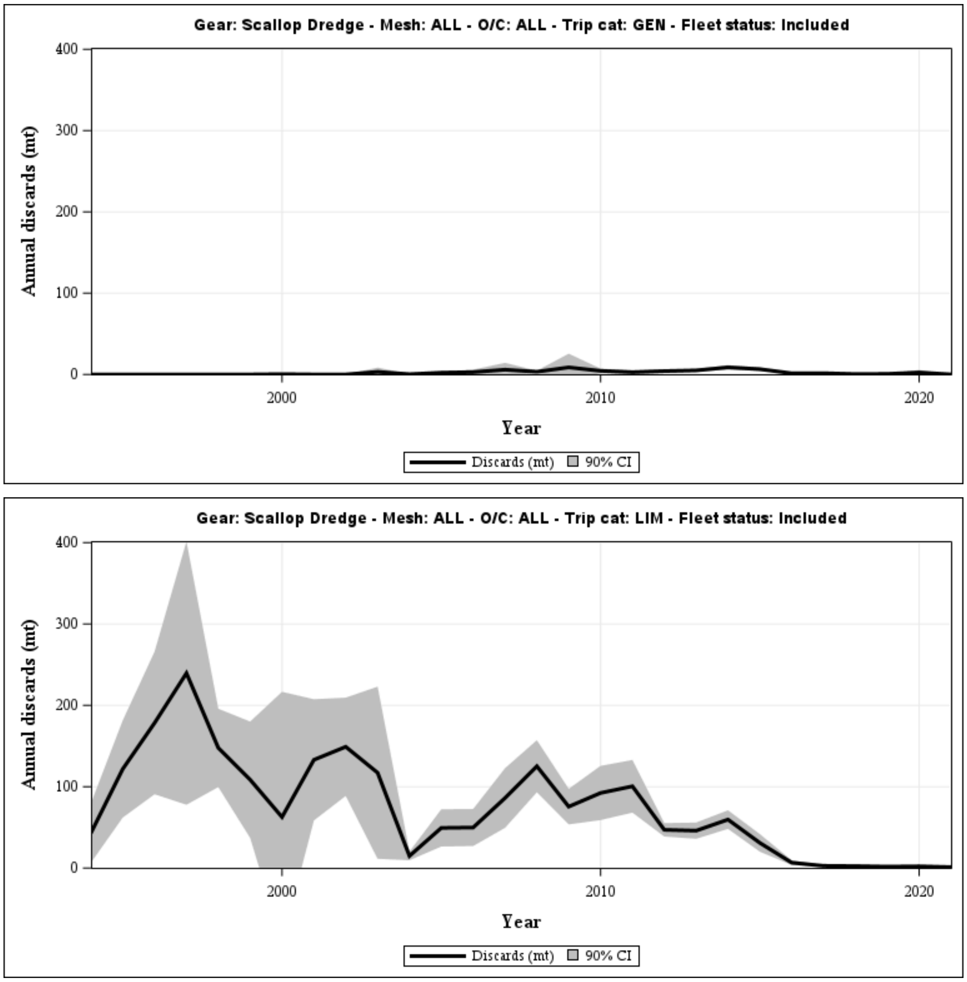


Figure 2.5.8 Commercial discards by gear type in the commercial SNEMA Yellowtail flounder fishery. From the top: a) Large mesh otter trawl, b) general access scallop dredge, c) small mesh otter trawl, d) general access scallop dredge, e) limited access scallop dredge.

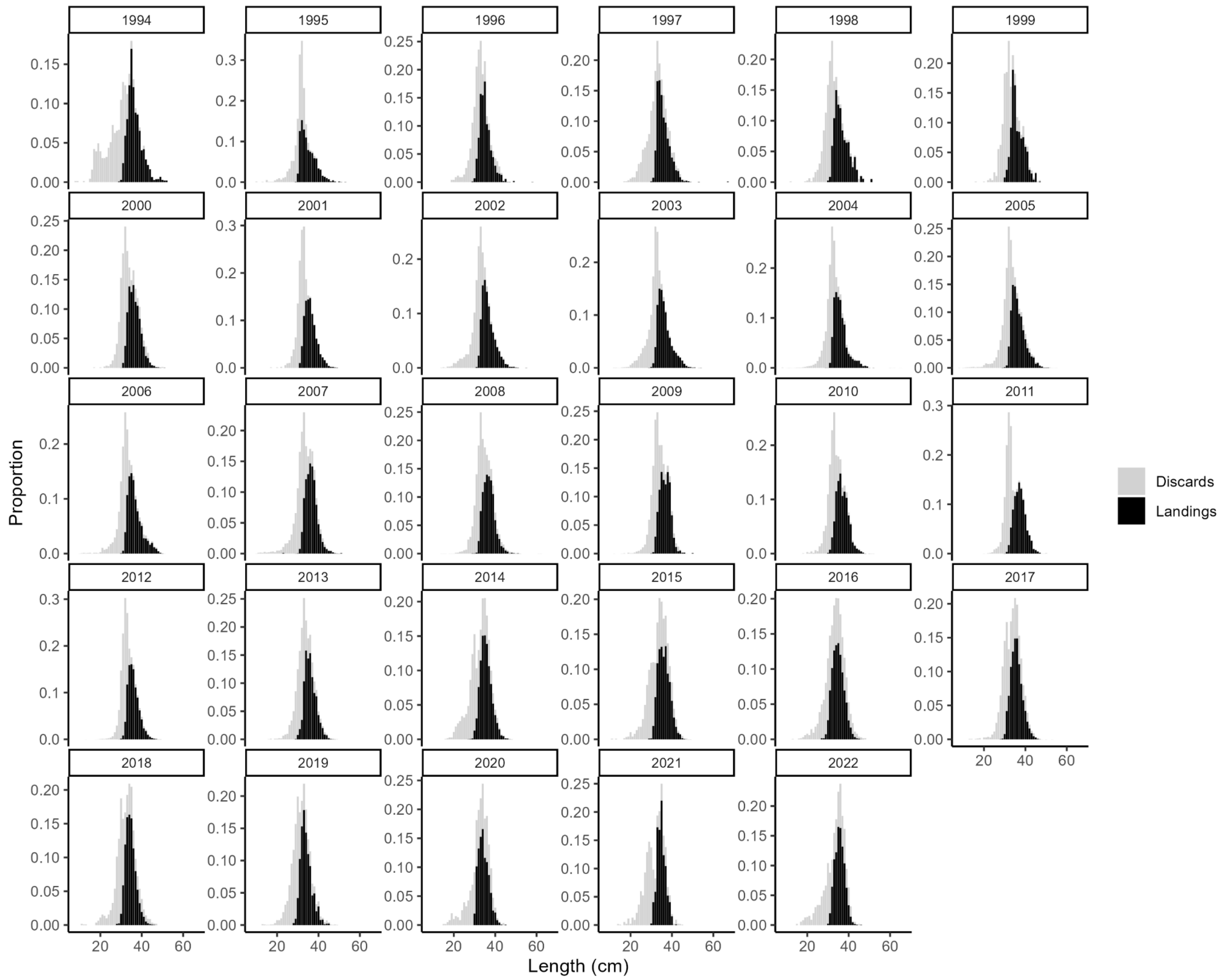


Figure 2.6.1 Commercial discards at length vs landings at length in the commercial CCGOM yellowtail flounder fishery, 1994-2022.

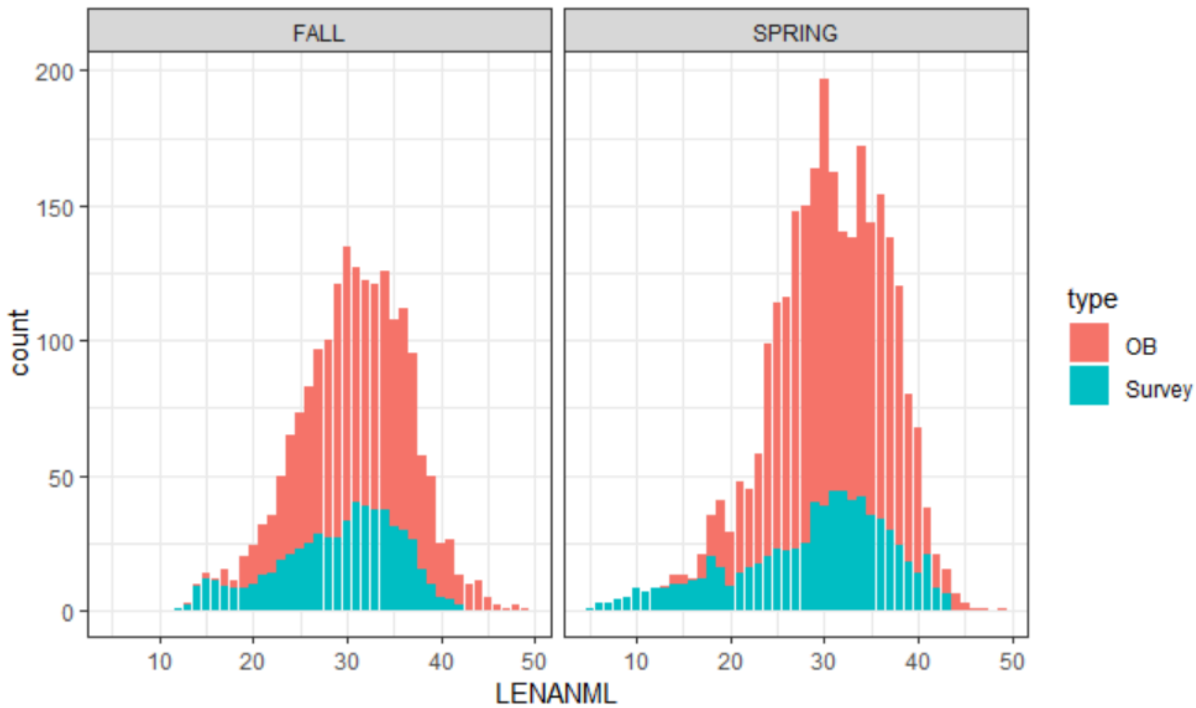


Figure 2.6.2 Commercial discard lengths from fisheries observer data relative to survey lengths for CCGOM yellowtail flounder from 1989 to 2022.

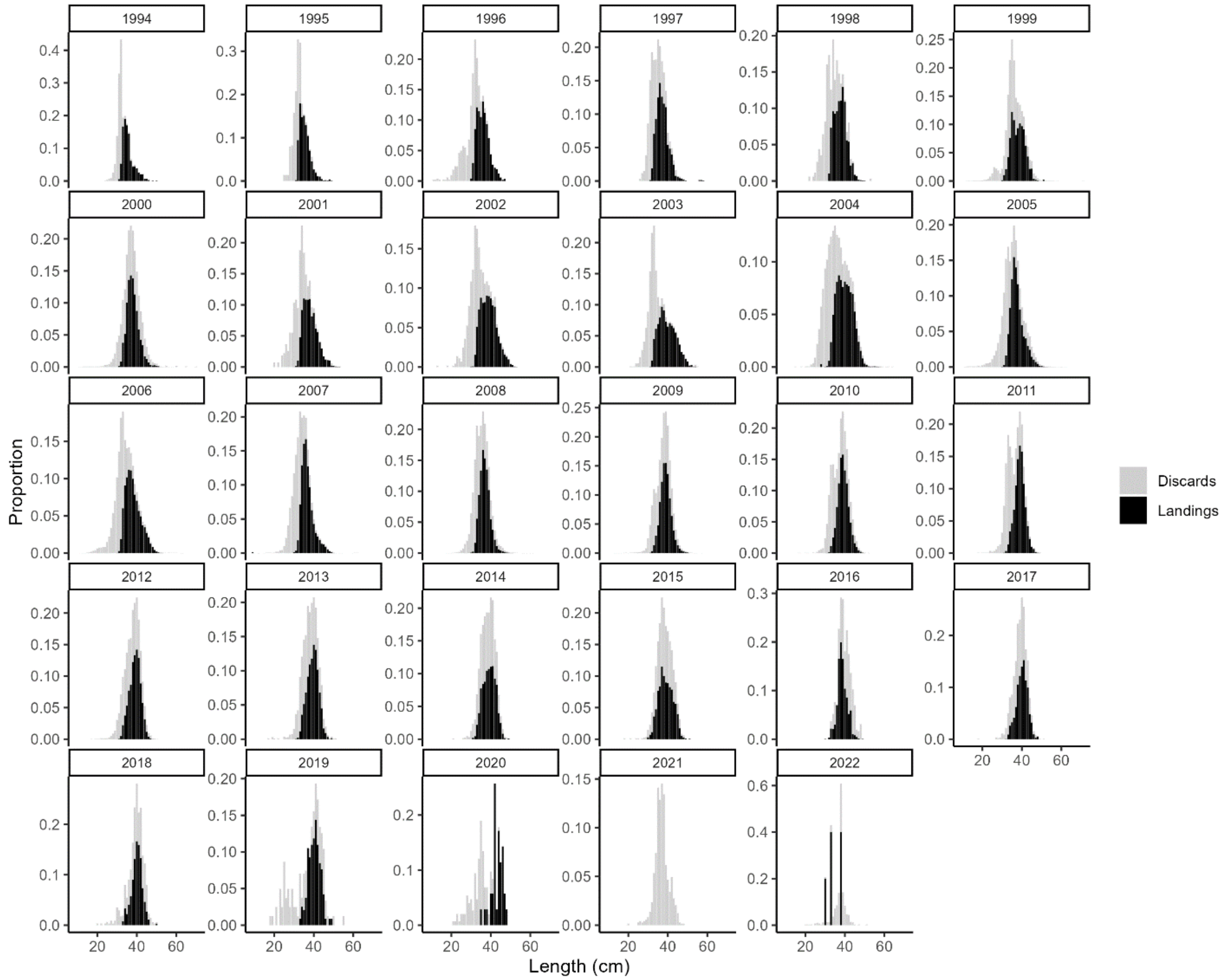


Figure 2.6.3 Commercial discards vs landings at length in the commercial GB yellowtail flounder fishery, 1994-2022.

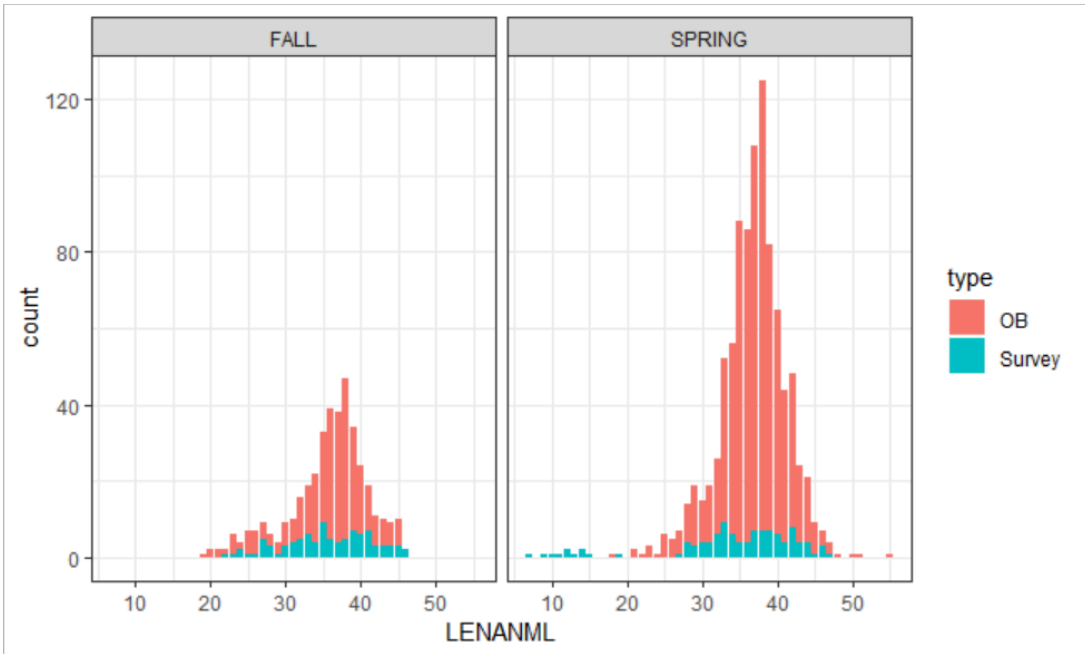


Figure 2.6.4 Commercial discard lengths from fishery observers relative to survey lengths for GB yellowtail flounder from 1989 to 2022.

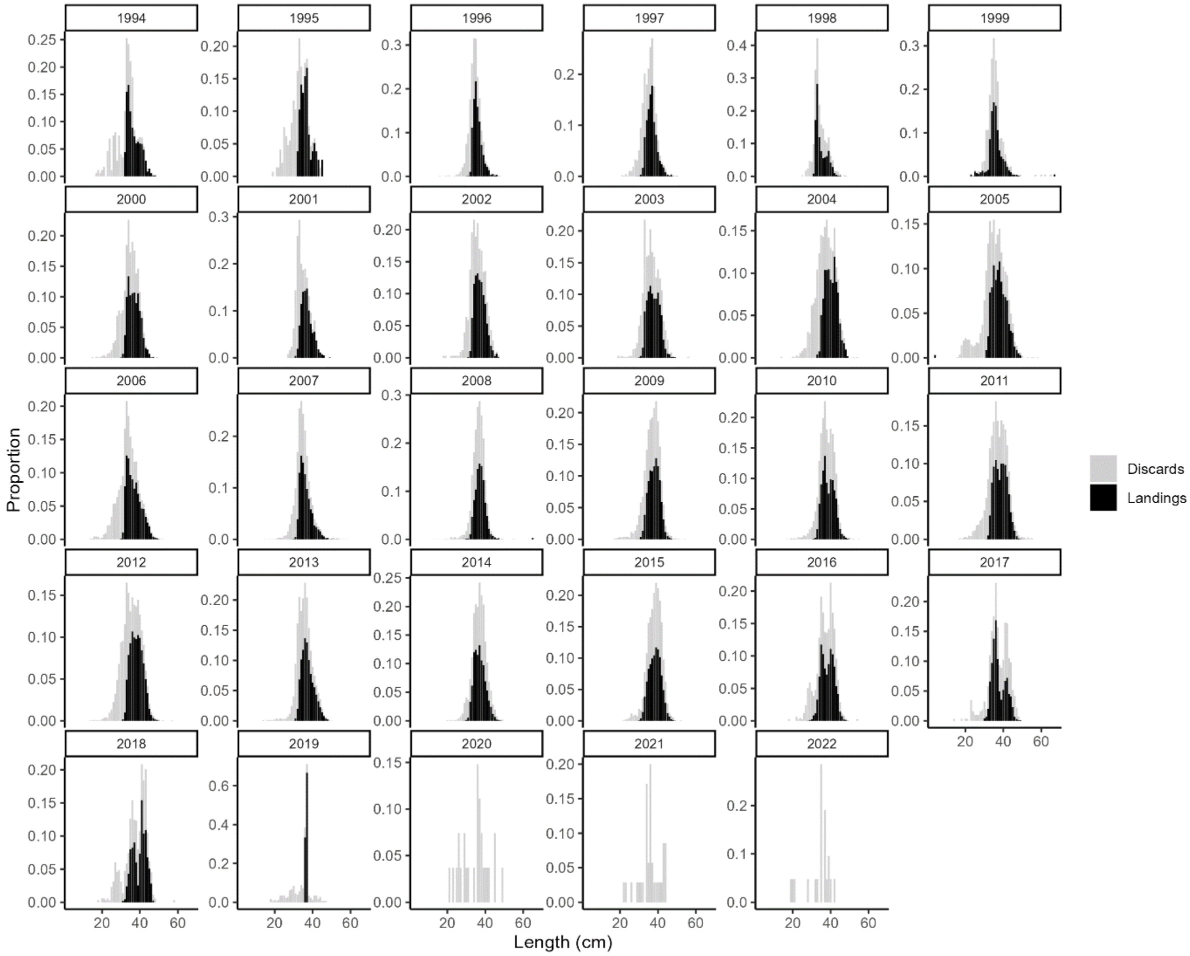


Figure 2.6.5 Commercial discards vs. landings at length in the commercial SNEMA yellowtail flounder fishery 1994-2022. Proportion within each 1 cm length bin to total is given.

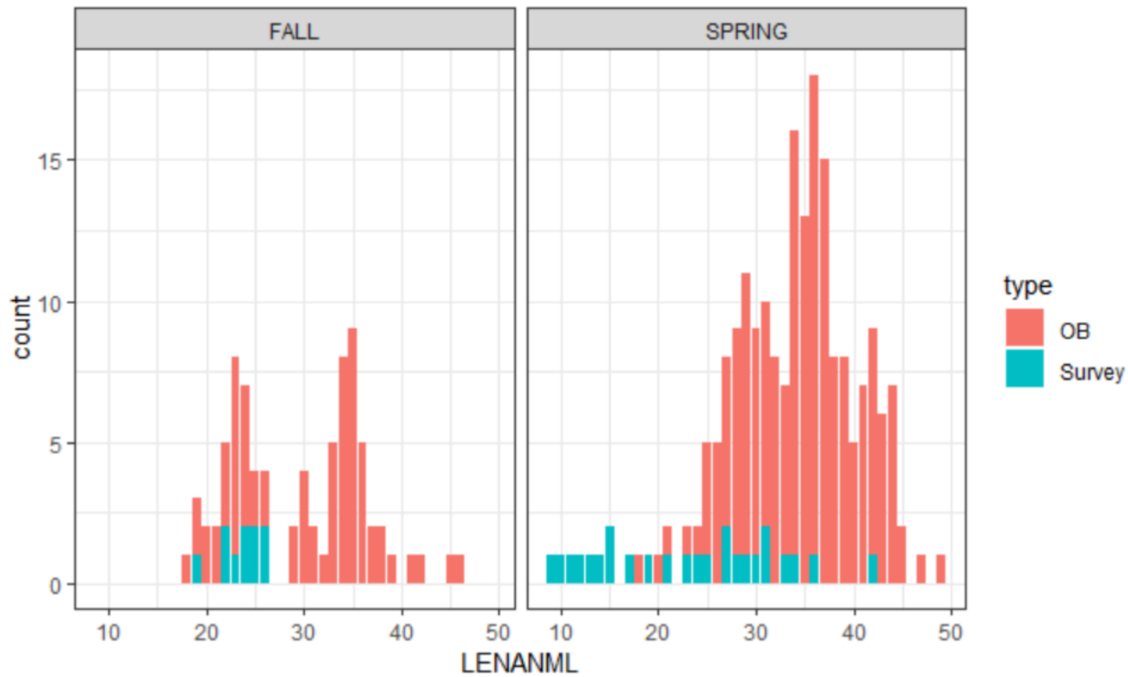


Figure 2.6.6 Commercial discard lengths (cm) relative to survey lengths for SNEMA yellowtail flounder from 1989 to 2022.

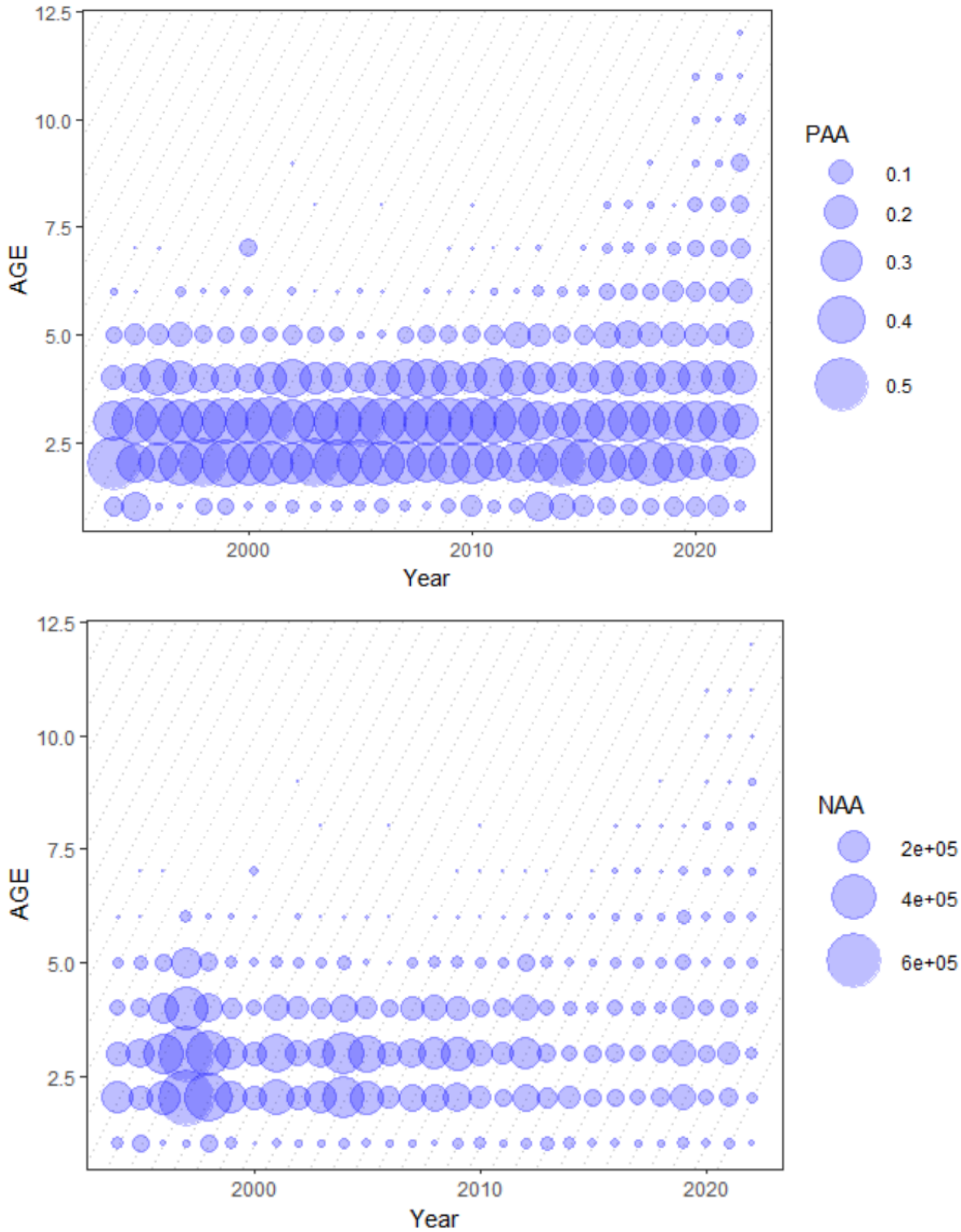


Figure 2.7.1 Commercial discards at age CCGOM yellowtail flounder 1994-2022. The size of the bubble is proportional to the number of observations: Proportion at age (top), numbers at age (bottom).

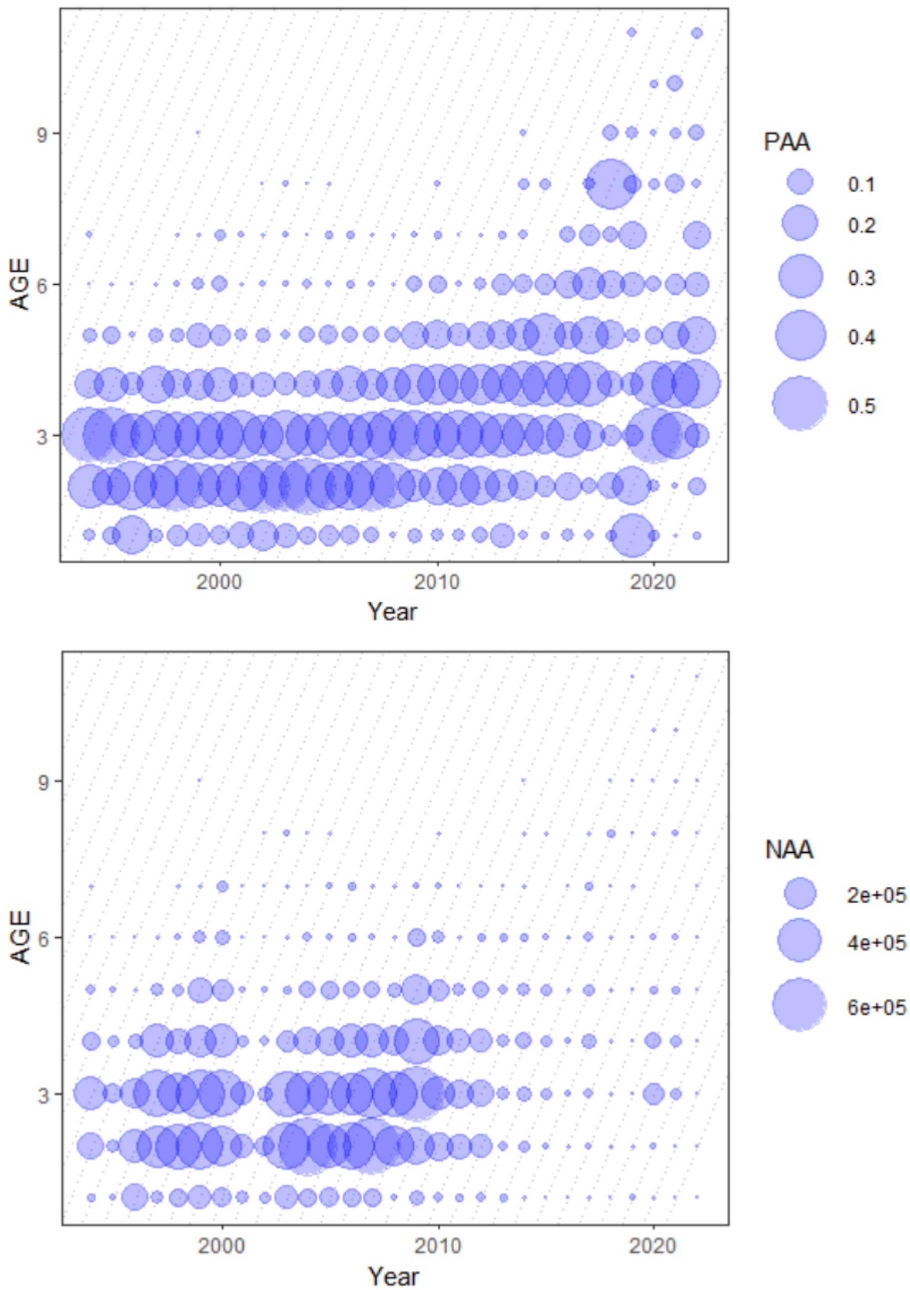
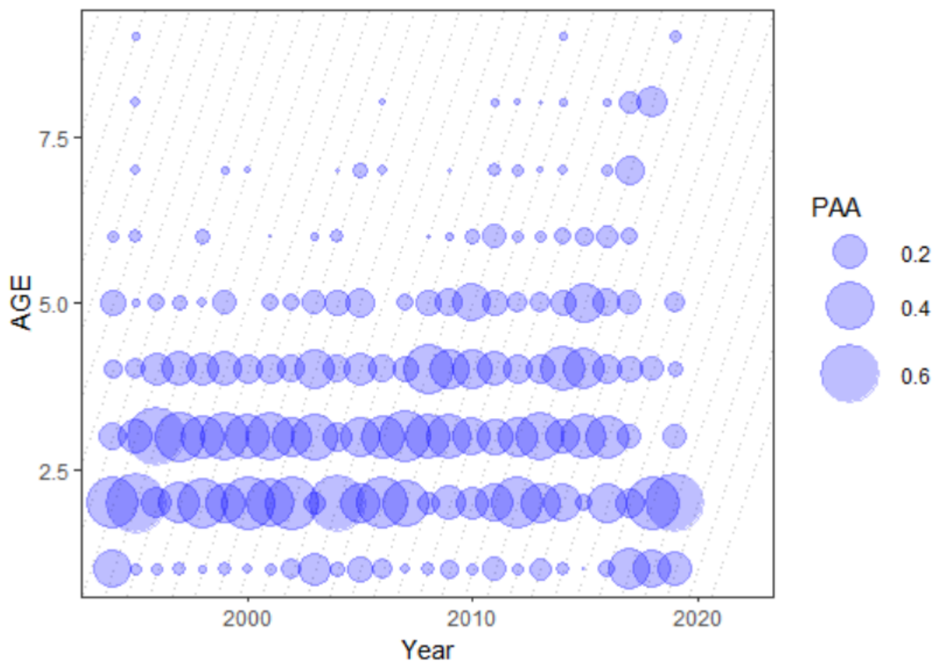


Figure 2.7.2 Commercial discards at age for GB yellowtail flounder. The size of the bubble is proportional to the number of observations: Proportion at age (top), numbers at age (bottom).



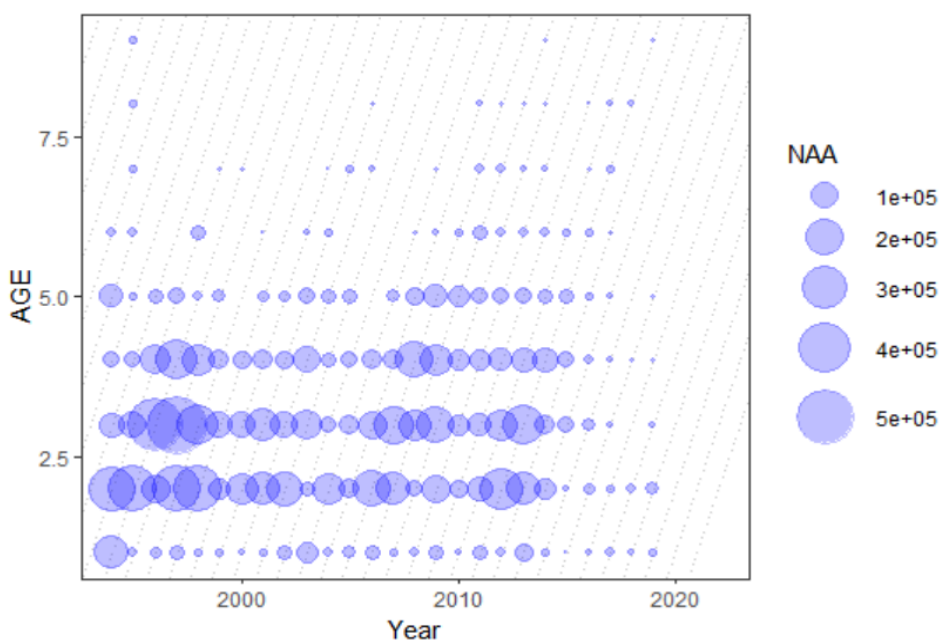


Figure 2.7.3 Commercial discards at age for SNEMA yellowtail flounder. The size of the bubble is proportional to the number of observations: proportion at age (top), numbers at age (bottom).

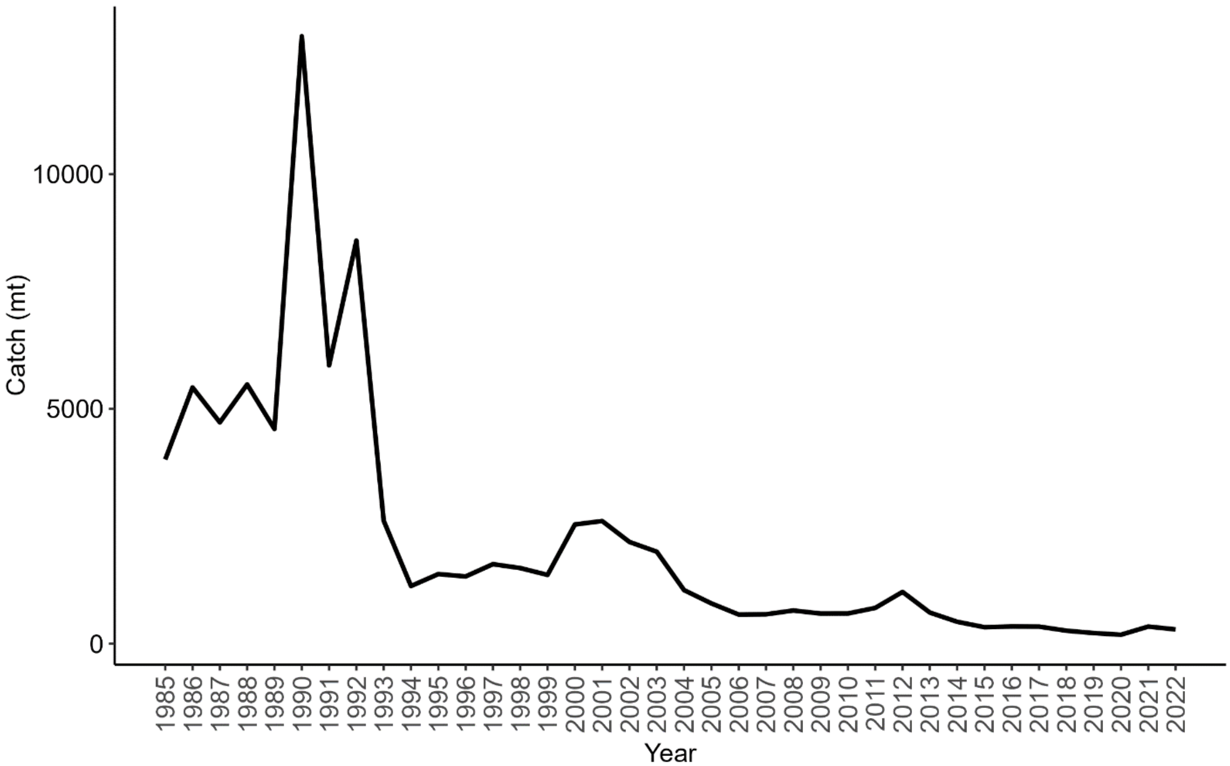


Figure 2.8.1 Total commercial catch (mt) of CCGOM yellowtail flounder 1985-2022.

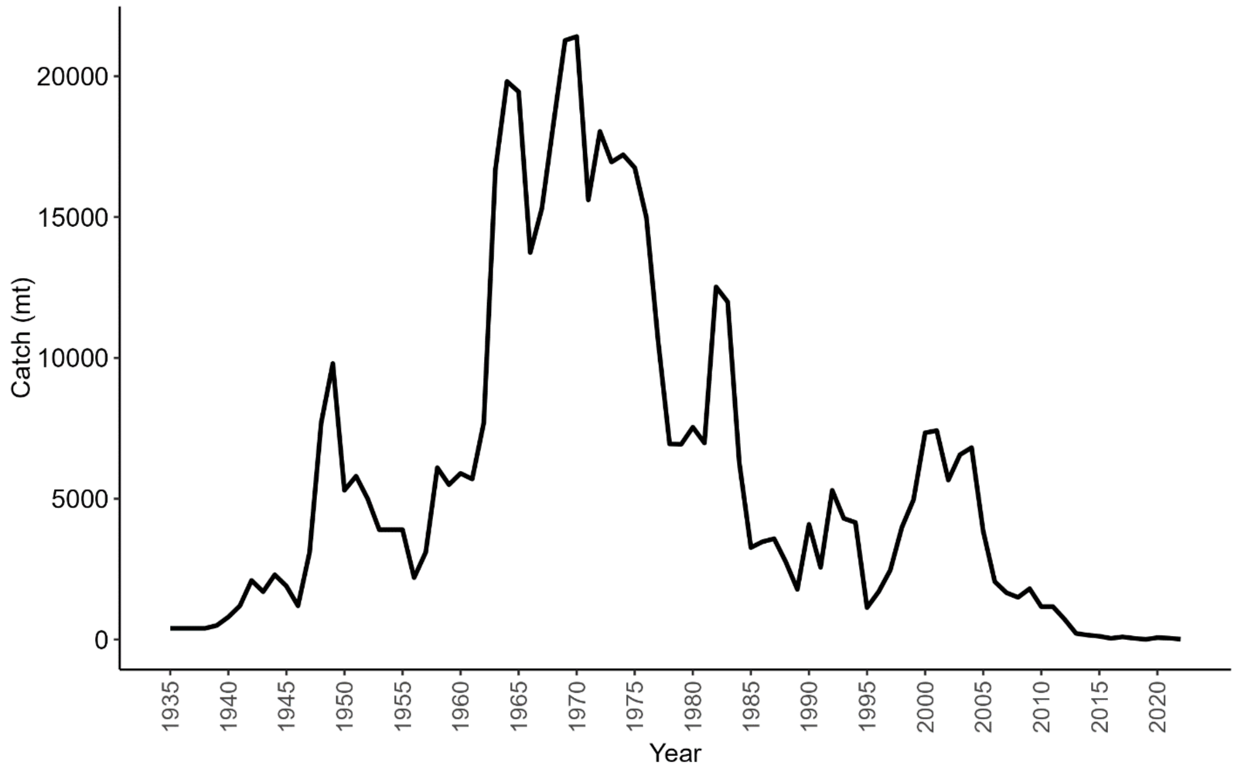


Figure 2.8.2 Total commercial catch (mt) of GB yellowtail flounder 1935-2022.

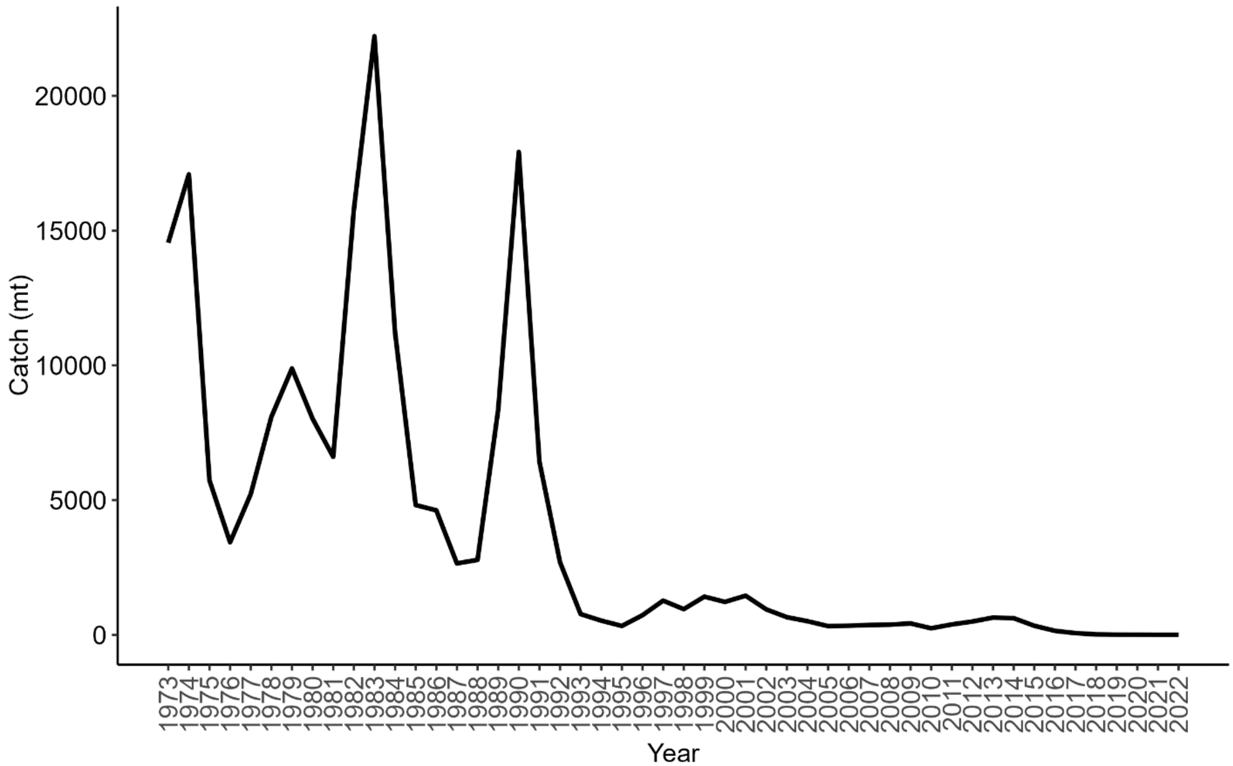


Figure 2.8.3 Total commercial catch (mt) of SNEMA yellowtail flounder 1973-2022.

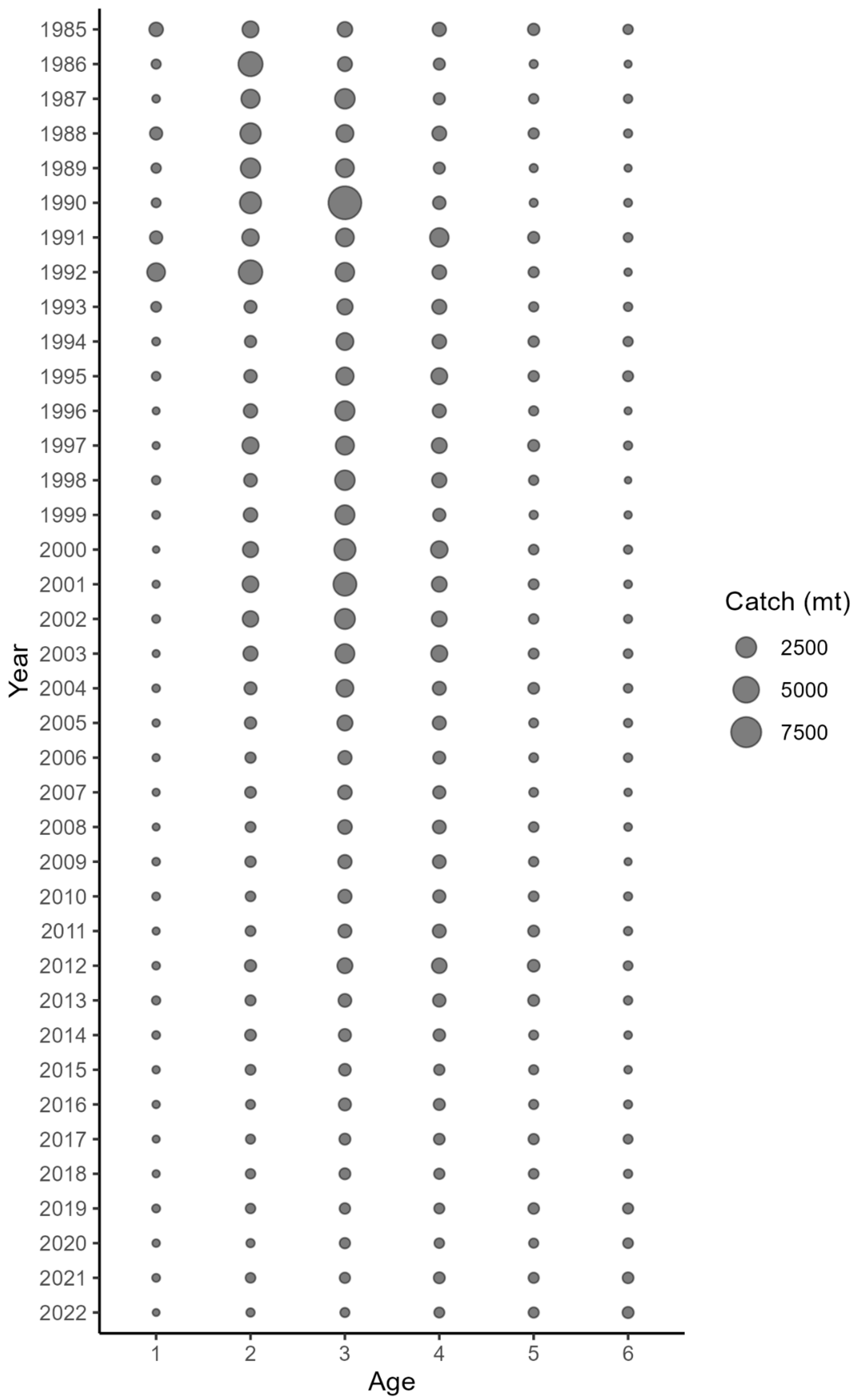


Figure 2.9.1 Commercial catch-at-age (mt) of CCGOM yellowtail flounder 1985-2022.

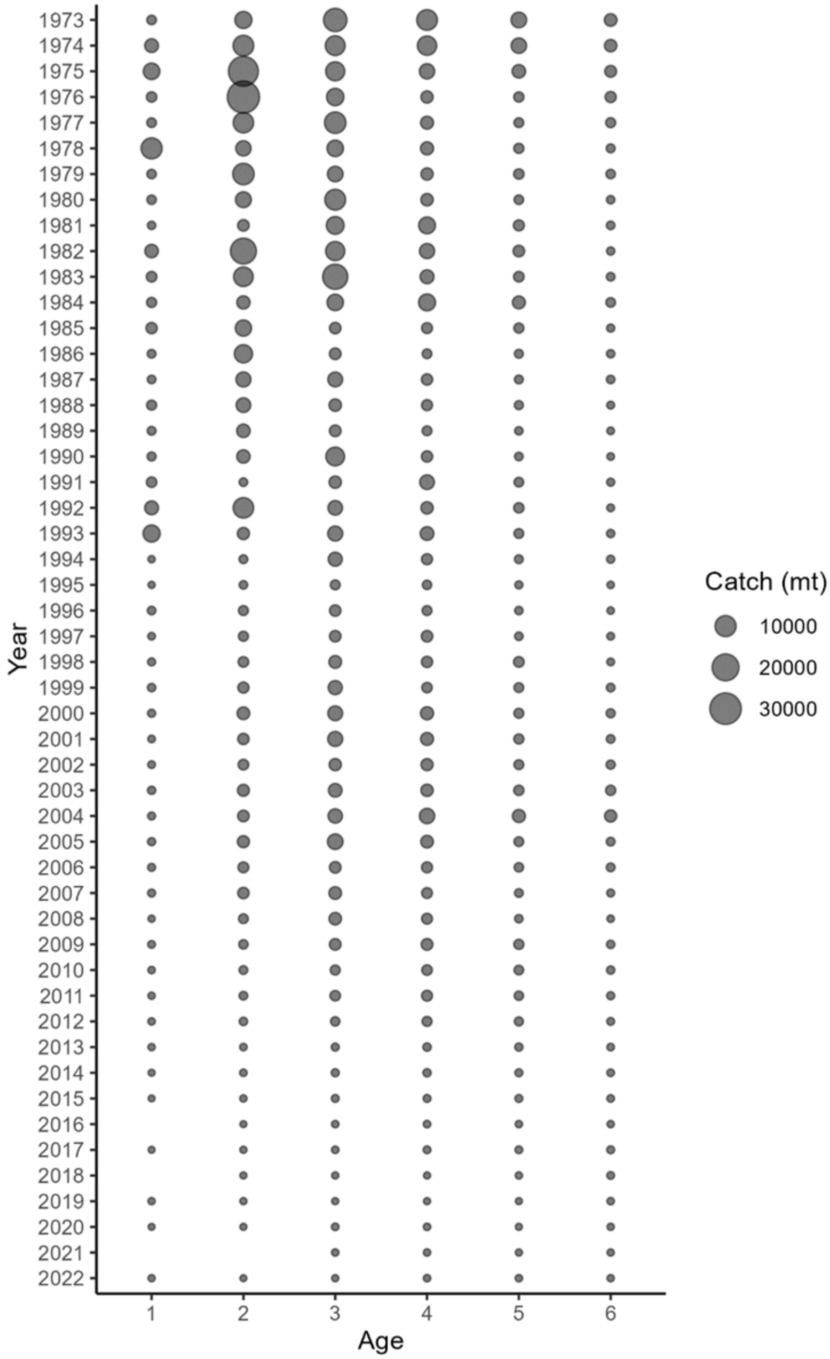


Figure 2.9.2 Commercial catch-at-age (mt) of GB yellowtail flounder, 1973-2022.

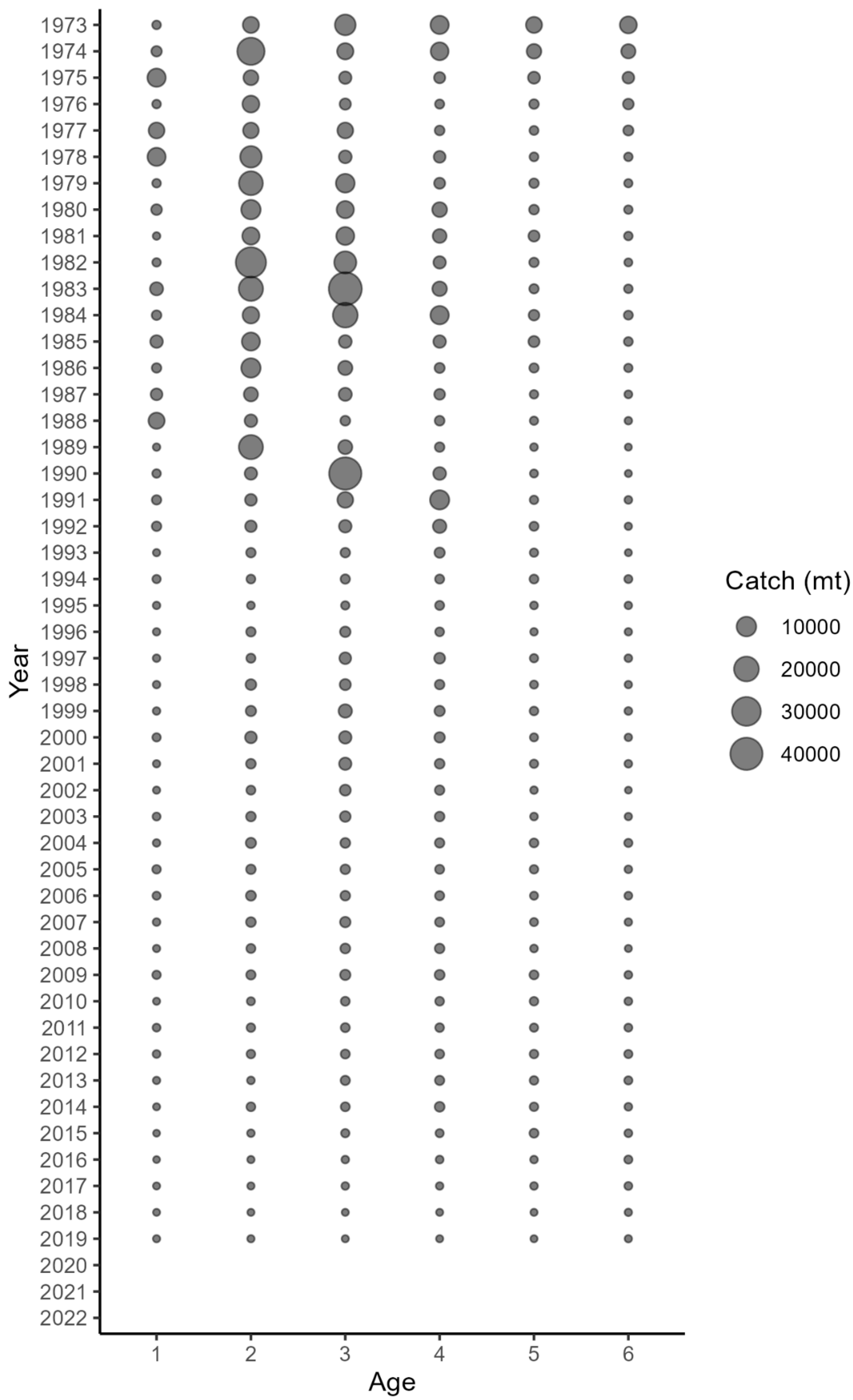


Figure 2.9.3 Commercial catch-at-age (mt) of SNEMA yellowtail flounder, 1973-2022.

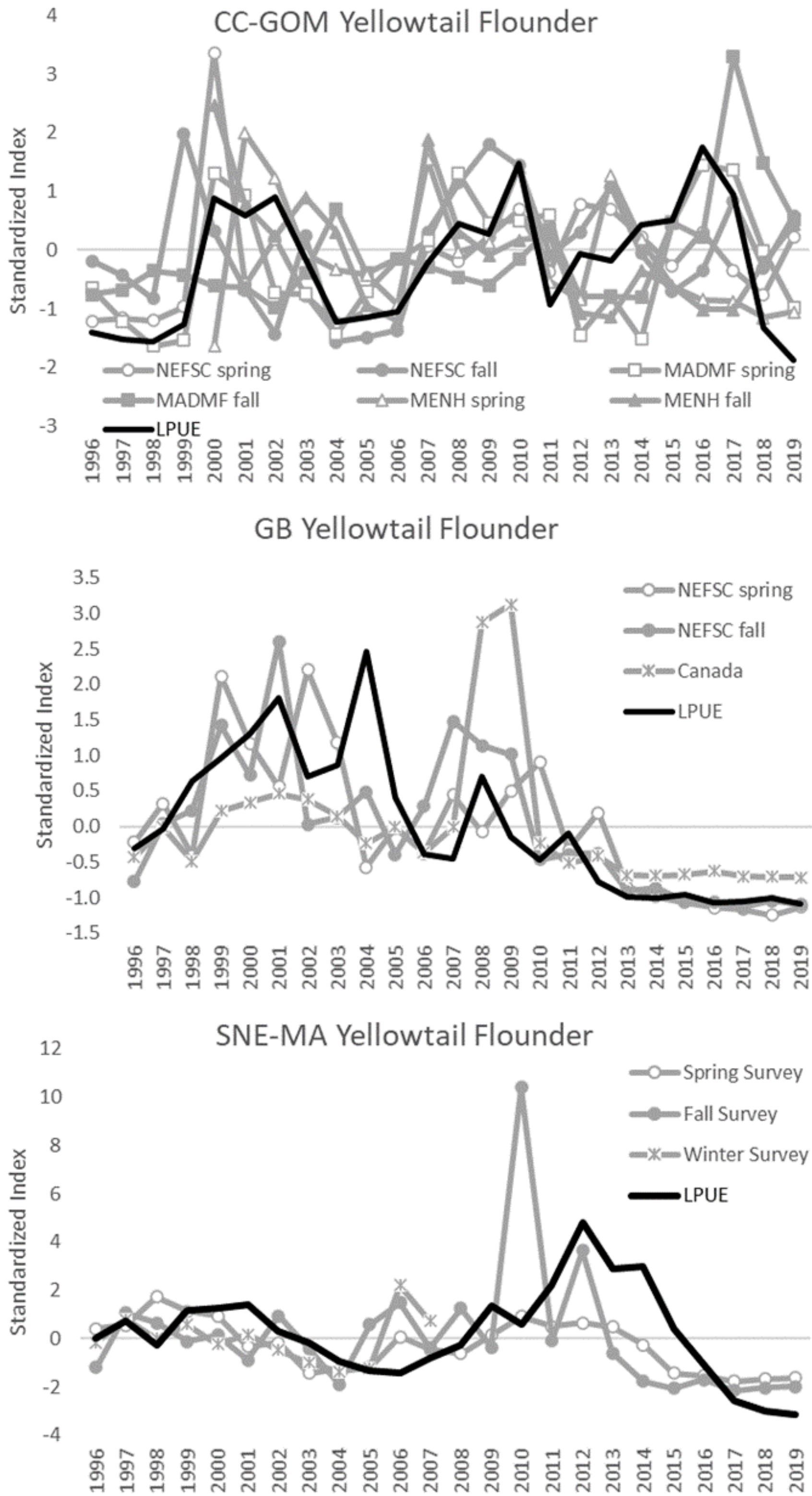


Figure 2.10.1. Standardized trawl LPUE and survey biomass indices for New England yellowtail flounder stocks.

TOR3: SURVEY DATA

"Present the survey data used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, application of catchability and calibration studies, etc.) and provide a rationale for which data are used. Describe the spatial and temporal distribution of the data. Characterize the uncertainty in these sources of data."

3.1 NEFSC Bottom Trawl Survey

Overview and history

The standardized NEFSC bottom trawl survey began in fall 1963, using a stratified random design to sample offshore strata 1-40 from the Gulf of Maine to Hudson Canyon off New Jersey, at depths between 27 m (15 fathoms) and 366 m (200 fathoms) (Figure 3.1.1, Politis et al. 2014). In fall 1967, the survey expanded to include offshore strata 61-76 in the Mid-Atlantic, and a dedicated spring survey was added in 1968. Inshore strata south of Massachusetts, with depths less than 27 m (15 fathoms), were incorporated in 1972, and inshore strata around Massachusetts were added in 1979 (Johnston and Sosebee 2014). Strata sets for each stock are described below. Since 1979, the average number of tows per survey has been approximately 330, with 343 in the fall and 335 in the spring. Additionally, a winter survey was conducted from 1992 to 2007 to address the perceived low catchability of flatfish in the spring and fall surveys; it was discontinued when it was evident that the new gear and vessel would likely capture flatfish well (Johnston and Sosebee 2014)

Changes to the vessel, gear and calibration coefficients

Significant changes in equipment and vessels occurred over the NEFSC time series. From 1963 to 2008, the main survey platform was the FRV Albatross IV (hereafter Albatross), occasionally using the FRV Delaware II (1970-2003) or the FRV Atlantic Twin (1972-1975). In spring 2009, the FSV Henry B. Bigelow (hereafter Bigelow) replaced the Albatross. The Bigelow differs in size, towing power, and fishing gear characteristics from the Albatross (Table 3.1.1), resulting in different fishing power and survey catchability. Calibration coefficients between the Albatross and Bigelow were calculated for most species, including yellowtail (Table 3.1.2).

The relative efficiency of the Bigelow trawl with rockhopper ground gear to a chain sweep trawl was estimated using paired tows across different regions conducted from 2015 to 2017 (Miller 2023). Yellowtail flounder were caught in 192 paired tows and 14,134 fish were measured. The best estimation model considered size effects and variations in catch efficiency. Rockhopper gear efficiency was applied to estimate yellowtail flounder biomass in spring and fall surveys from 2009 to 2019, adjusting for gear differences.

Impact of reduced sampling on survey indices

Survey indices may be missing data due to a variety of reasons. Decisions on how to account for missing data may impact analyses that use survey data. Therefore, it is important to analyze the impact of missing data and compare approaches to handling it. The NEFSC spring bottom trawl survey was cut short (only 32 of 77 strata were sampled) in 2020 due to COVID-19, while the NEFSC 2020 fall survey was canceled altogether. Data was missing from 2017 for the SNEMA stock area because of vessel mechanical issues. The WG conducted a resampling procedure to assess the sensitivity of survey indices to missing data (Figure 3.1.2). Specifically, data from the Fall survey 2009-2021 was resampled 100 times, pulling a number of tows equivalent to the number of tows in 2022. The resulting annual stratified random mean was plotted against the raw survey indices. In all cases the resampled results were within the survey's 95% CI.

Cape Cod/Gulf of Maine stock

NEFSC survey

The CCGOM stock area includes offshore strata 25-27 and 39-40; and inshore strata 56, 58-61 and 63-66.The WG decided to drop 57 and 62 as they have never been sampled, and to restore 58 and 63 for the Albatross, which had previously been dropped to have the same footprint for the entire time series. Due to the increased draft of the Bigelow, inshore strata with depths less than 18 m are no longer sampled (Figure 3.1.3); thus, as noted above, strata 58 and 63 were excluded from 2009 to present, and the Albatross and Bigelow were treated as a separate time series for this stock. Stratum 27 was added to the spring strata set in SAW 36 (NEFSC 2003) but not the fall strata set because, as it was noted at the time, yellowtail had only been caught in 4 years since 1963 by the fall survey. For the current assessment, it was found that yellowtail have been caught in stratum 27 in the fall in 5 years since 2014 (Table 3.1.3); thus the WG decided to add this stratum to the fall strata set as well.

Survey trends

Distribution of the CCGOM stock in the survey shows a greater concentration in spring compared to fall, potentially indicative of spawning aggregations (Figure 3.1.4). The aggregate survey indicates fluctuating stock biomass, with peaks in the 1970s-80s (Fall survey) and 2000s (Spring survey), followed by a sharp decline then a moderate increasing trend began in the mid-2000s, a trend consistent across both seasons (Figure 3.1.5, Table 3.1.4). Fall biomass indices peaked at 8.2 kg/tow in 1977, then fell to 2.2 kg/tow in 1978, increasing to 7.6 kg/tow in 2022. Spring biomass peaked in the year 2000 at 9.9 kg/tow, then fell to 2.3 kg/tow by 2001, rose moderately and then peaked again in 2022 at 9.0 kg/tow. Mean NAA fluctuates over time, with the majority of catch being ages 2 and 3, and more recently age-4 (Figure 3.1.6, Tables 3.1.5, 3.1.6). The NEFSC Bottom Trawl Survey had weak to moderate correlation strength in cohort tracking (r^2: 0.1-0.54 in the fall and 0.2-0.77 in the spring, Figure 3.1.7).

Maine-New Hampshire

The CCGOM assessment has used the Maine-New Hampshire inshore bottom trawl survey, which is conducted by the Maine Department of Marine Resources (MEDMR), and this survey was considered for the current RT assessment.

Survey strata and methods

The MEDMR spring and fall surveys began in fall 2000. There were no spring surveys in 2003–2005, 2009 and 2020 (the latter due to COVID-19). The survey has a stratified random sampling design with a fixed component. Sampling occurs in region five and four depth zones that range from five fathoms to greater than 55 fathoms (Sherman et al. 2005; Figure 3.2.1). From Fall 2000 to Fall 2002, the outer depth stratum was not sampled. The fourth stratum, 56 fathom to the 12-mile limit was added in the Spring 2003 survey. The ME-NH inshore groundfish trawl survey has been included in yellowtail flounder stock assessments since 2008 (NEFSC 2008). Age composition data was not available for the ME-NH survey. Several age-length key options were evaluated for applicability to the ME-NH survey: The NEFSC age-length key, the MADMF survey's age-length key, and a second version of the MADMF age-length key that focused on truncated survey strata (strata 31-36), specifically targeting areas north of Cape Cod Bay for more localized data representation. The MADMF survey age-length key with truncated strata was recommended due to improved correlations between age groups which facilitated more accurate cohort tracking. The ME-NH survey intersects the CCGOM stock area only.

Survey Trends

Abundance in the Fall ME-NH survey has remained relatively steady since 2000, hovering around a mean of 1.0 individuals per tow, with a mean coefficient of variation (CV) of 0.88 (Figure 3.2.2, Table 3.2.1). Abundance is higher in the spring, averaging 2.3 individuals per tow (average CV 0.60). Trends in biomass since 2000 were similarly stable (Figure 3.2.3). The mean biomass for the Fall and Spring surveys were 0.2 kg/tow and 0.5 kg/tow, respectively. The CV was larger in the fall: 0.90 on average, compared to 0.62 in the spring. Mean NAA remained relatively steady over time in both the fall and spring (Figures 3.2.4 and 3.2.5; Tables 3.2.2. And 3.2.3), with the greatest abundance in ages 2 through 4.

Massachusetts Division of Marine Fisheries Resource Assessment Survey

The CCGOM assessment has used the Massachusetts Division of Marine Fisheries (MADMF) bottom trawl survey in the past, and this survey was considered for the current RT.

Survey strata and methods

Spring and fall bottom trawl surveys have been conducted by the MADMF since spring 1978. No spring or fall survey was conducted in 2020 due to COVID-19. The MADMF survey covers state waters < 3 nm from shore to the north of Cape Cod, including strata 17-36 (King et al. 2010). The survey strata that are used (17-36) mostly intersect the CCGOM stock area, but portions of strata 17-20 are south of Cape Cod, in the SNEMA stock area. The study area is stratified based on five bio-geographic regions and six depth zones (Figure 3.3.1). Stations are assigned in proportion to the area of each stratum, with a minimum of two stations assigned to each stratum. In 2005, station assignments were updated to reflect improved stratum area estimates. A net addition of two stations brought the total to 103. Survey timing is planned for availability of adult finfish in the inshore waters in spring (May) while the fall survey (September) is intended to sample juveniles prior to migration beyond state waters. Since 1982, stations have been assigned a priori by a random selection process. All tows are conducted during daylight hours. A standard tow is 20 minutes duration at a speed of 2.5 knots. The total weight and length frequency are recorded for each species. Sampling protocols and survey design largely follow the methods established by the NEFSC. All spring and fall surveys from 1978 – 1981 were conducted aboard the F/V Frances Elizabeth. Surveys since 1982 have employed the R/V Gloria Michelle. Trawl design and trawl doors have been consistent for the duration of the survey.

Survey trends
The MADMF survey encountered higher abundances in the spring compared to the fall (time series mean was 15.8 individuals per tow, CV = 0.19 for fall; and a mean of 25.1 individuals per tow, CV = 0.18 for spring) . Abundance during the spring was more concentrated, especially around Cape Ann (Figure 3.3.2). Abundance peaked early in the time series, reaching greater than 68 individuals per tow in the spring survey in 1981, and over 50 individuals per tow in Fall 1979 (Figure 3.3.3, Table 3.3.1). The 1980s-2010s was a period of variable to low abundance, reaching a time series minimum of approximately three individuals per tow in Fall 2002 and seven individuals per tow in Spring 1999. By 2017, abundance had rebounded to greater than 48 and 59 individuals per tow in the Fall and Spring, respectively. Biomass peaked in the beginning of the time series at 7.5 kg/tow during the fall of 1979 and 14.9 kg/tow during Spring 1981 (Figure 3.3.4). The survey predominantly captures ages four and younger, with an expansion to older age classes in recent years (Figure 3.3.5, Tables 3.3.2, 3.3.3). There is no aging data available for the fall survey between 1980 and 1995, so NEFSC fall ages were used to generate fall age composition for the years where direct age data was unavailable. Cohort tracking, correlation of abundance at age and the abundance of that age the previous year, shows weak to moderate coherence between cohorts of adjacent ages (Figure 3.3.6).

Georges Bank stock

NEFSC survey
The Georges Bank (GB) stock area consists of strata 13-21.

Survey trends
Yellowtail flounder catches in the NEFSC survey show greater concentration in the fall compared to the Spring (Figure 3.4.1). The aggregate survey stratified means show high biomass in the 1960s and early 1970s, peaking at 13.6 kg/tow in the Fall of 1964 and 11.2 kg/tow in the fall of 1979, followed by a decline to a low of 0.2 kg/tow in the Fall of 1988 and 0.6 in Spring 1991, a temporary increase in the early 2000s (to 11.6 kg/tow and 9.6 kg/tow in the Fall and Spring, respectively) followed by consistent low abundance for the remainder of the series (Figure 3.4.2, Tables 3.4.1, 3.4.2). Mean NAA indicate that fish aged 4 or younger dominated survey catch in both fall and spring, though few fish at any age class were caught after 2011 (Figure 3.4.3, Tables 3.4.3). There was moderate to high correlation between abundance at age

and abundance of that cohort the previous year (r^2: -0.19-0.77 in the fall and -0.33-0.78 in the spring, Figure 3.4.4)

Canadian Ecosystem Survey

The GB assessment has used the Canadian Department of Fisheries and Oceans (DFO) bottom trawl survey in the past, and this survey was considered for the current RT.

Description of included strata and decisions to exclude strata:

Since 1987, the DFO has annually conducted a bottom trawl survey on Georges Bank, covering statistical areas 5Zj, 5Zm, 5Zh, 5Zn, 5Zg, and 5Zo (Figure 3.5.1). The DFO survey began in 1986 as a pilot year, with full-scale sampling of Georges Bank commencing in 1987. Initially, the survey evenly split tows between two areas, but later focused predominantly on the eastern bank (5Z1-5Z4). The spring survey, conducted in February-March, focuses on 5Ze with additional coverage of 4X when possible. Some years within the past two decades saw incomplete bank coverage, leading to exclusion from assessments. Areas 5Z1-5Z9 comprise 103 stations. Areas 5Z1-5Z4 have been covered in all years and 5Z9 has been covered since 2009 (Figure 3.5.2, Table 3.5.1). Mechanical issues have caused delays in recent years (2015, 2017, and 2018). The survey employs a stratified random design based on depth contours, international boundaries, and bank regions, with strata depths ranging from less than 93 meters (50 fm) to 183 meters (100 fm). The survey averaged 65.57 tows annually from 1987 to 2021 (There was no sampling in 2022). On average over that time period 55% of tows caught yellowtail flounder, Detailed reports are accessible on the Canadian Science Advisory Secretariat website (https://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm).

Changes to the vessel, gear and calibration coefficients:

The CCGS Alfred Needler is the primary vessel for the DFO Georges Bank survey. In instances when it's unavailable, other ships, including the CCGS Wilfred Templeman, CCGS Teleost, and Mersey Venture (the sister ship to the CSGS Teleost), have been used in various years (Table 3.5.2). These substitutes, while lacking specific conversion factors, are considered similar in fishing capacity to the Needler and are equipped with the same gear. Comparative fishing was conducted for the Needler and Teleost vessels in 2005 and 2006. No effect was found between the two and were deemed interchangeable. Since 1987, the standard DFO survey gear, including a Western IIA net with a 20 mm stretched mesh cod-end liner, has been consistently used. The survey is transitioning to the NEST trawl, consistent with US protocol. In April 2022 (outside of the normal survey window), a survey of 5Z was completed with the new vessel, the Jaques Cartier and the new methods (NEST trawl and no standard survey was conducted). This data is not available until comparative fishing is conducted and conversion factors are generated. Comparative fishing between the historical (Needler/Teleost) and the new vessel (Cartier) was completed for the summer survey with the peer review process expected to be completed in November 2023.

Survey methods
The survey operates on a 24-hour basis, weather permitting, with tows lasting between 20 to 33 minutes at speeds of 3.3 to 3.7 knots, covering a standard distance of 1.75 nautical miles. Tows falling within these parameters are considered valid and analyzed accordingly. Conditions that invalidate a tow include being outside of the specified time and speed ranges, a change in depth exceeding 10%, or damage to the trawl.. The transition to NEST involves a switch to TOGA/SHG protocols, aligned with NEFSC protocols. Data collected includes species identification, total catch weight, and individual fish data stratified by length. Additional data collected includes length, sex, weight, otoliths, and maturity, with special sampling requests accommodated for other scientific projects. For yellowtail flounder, individual length is recorded per one-centimeter interval, with specific observations made for sex, weight, and otoliths, particularly noting the absence of individual weight data for yellowtail flounder from 1992 to 1995. Otoliths collected during the DFO spring survey are sent to NEFSC for aging, with resultant data shared with Canada and stored on DFO databases.

Description of survey trends
Total biomass of yellowtail flounder in the DFO survey has been low (under 20 mt) since the late 1980s, with the exception of a period of high biomass in 2008-2009, caused by large individual tows (7.5 mt in 2008 and 5.2 mt in 2009, Figure 3.5.3, Table 3.5.3). Numbers (biomass) at age are relatively even prior to the mid-1990s and post-2010 in the survey, whereas biomass concentrates in ages 3-5 in the interim period (Figure 3.5.4, Table 3.5.4).

Southern New England/Mid Atlantic stock

NEFSC survey
The Southern New England/Mid Atlantic (SNEMA) stock area consists of strata 1-2, 5-6, 9-10, 69 and 73-74 in the winter and spring, and just 1-2, 5-6 and 9-10 in the fall.

Survey trends
Distribution of the SNEMA stock in the survey shows a greater concentration in spring compared to fall. Individuals are concentrated off of the east end of Long Island, NY and Block Island Sound in the winter (Figure 3.6.1). The southernmost strata 61-76 were not sampled until 1967. These southern strata were included in spring and winter surveys, but not the fall survey. The majority of yellowtail caught in the SNEMA by the survey are in the spring and winter strata sets. The aggregate survey stratified means show high biomass in the 1960s and early 1970s, peaking at 40.4 kg/tow in the fall of 1972, and 23.9 kg/tow in the spring of 1968, before decreasing to below 1 kg/tow in the mid-1970s (a low of 0.7293 kg/tow in the fall of 1973 and 0.8286 in the spring of 1979). Biomass has remained below 5 kg/tow since the mid-1980s (Figure 3.6.2, Table 3.6.1). Abundance in the winter survey, though only available from 1992-2007, has consistently hovered around 4 kg/tow. Mean NAA indicate that fish age 6 or younger dominated survey catch prior to 1980, with ages < 5 making up the majority of the catch

post 1990 (Figure 3.6.3, Tables 3.6.2, 3.6.3, 3.6.4). Cohort tracking showed high correlation for the spring and fall surveys (mean r^2 = 0.72 and 0.74, for spring and fall, respectively) and moderate correlation (mean r^2 = 0.58) for the winter survey (Figure 3.6.4).

Yellowtail flounder larval index

The SNEMA assessment has used a larval index in the past, and this survey was considered for the current RT.

Survey methods

Larval yellowtail flounder abundance data in the Southern New England/Mid-Atlantic Bight (SNE/MAB) region were collected from Marine Resources Monitoring, Assessment, & Prediction (MARMAP, 1977-1987) and Ecosystem Monitoring (EcoMon, 1999-2022), as detailed in Richardson et al. (2010). Additional surveys from 1988-1999, initially focused on zooplankton, were later processed for ichthyoplankton. Sampling used 61-cm bongo nets, first with 333-µm and 505-µm mesh nets, later standardized to paired 333-µm nets. Due to insufficient yellowtail larvae for calibration, separate indices were created for different periods. To develop the larval index, spatial strata encompassing the spawning distribution were defined, focusing on NEFSC trawl strata 69-76 and 1-12 (Figure 3.7.1). Peak egg hatching occurs in mid-May. Comprehensive sampling was not achieved in 2003 and 2008, so no indices were calculated for those years. The analytical method, detailed in Richardson et al. (2010), accounts for larval mortality, spawning seasonality, and sampling timing, using non-linear least squares methodology. The input data includes stratified mean abundance by age, year, and day of year, with age estimated from length data from Rabe and Brown (2000).

Survey Trends

Two separate larval indices were calculated. The first covers 1977-1987 and is based on samples from the wider mesh plankton net (Figure 3.7.2, Table 3.7.1). The second covers 1995, 2000-2010 (excluding 2003 and 2008) and is based on samples from the finer mesh net (Table 3.7.2).

Northeast Area Monitoring and Assessment Program (NEAMAP)

Indices from the NEAMAP survey were considered for inclusion in the SNEMA stock assessment models, but were ultimately excluded due to very low catches (e.g., a total of 6 fish have been caught since 2016). The NEAMAP project concluded that “the number of yellowtail flounder caught is so small that meaningful abundance indices cannot be calculated” (https://fluke.vims.edu/mrg/neamap_abundance/YellowtailFlounder.htm).

Scallop dredge surveys

Survey indices of GB yellowtail flounder abundance were considered from the following surveys: (1) SMAST Video Trawl Survey of Closed Area II, (2) VIMS Industry-Based Scallop

Dredge, (3) Coonamessett Farm Foundation Eastern Georges Bank survey. The WG raised concerns about using these surveys as assessment model inputs in TOR4 for the following reasons: (1) All three surveys focused on the Closed Area II Access Area, which is only a portion of the GB stock, and thus is not representative of the entire stock. (2) The VIMS surveys also overlapped with the other two stocks, but either caught too few fish (SNEMA) or had too few years and too limited spatial extent (CCGOM) to be used. (3) All three surveys have had changes in protocols and sampling areas, which would present challenges when trying to create a time series. (4) The GB stock is jointly managed with Canada and it is unknown whether Canada would accept a survey from only one side of the Hague line. (5) Insufficient resources to operationalize scallop survey indices for management tracks every two years; and annually for the GB stock.

Tables

Table 3.1.1 Vessel and gear differences between the FSV Henry B. Bigelow and FRV Albatross IV (adapted from Brooks et al. 2010).

	FSV Henry B. Bigelow	FRV Albatross IV	FRV Gloria Michelle	FRV Frances Elizabeth	F/V Robert Michael	F/V Tara Lynn
Survey	NMFS Bottom Trawl Survey: Fall, Spring	NMFS Bottom Trawl Survey: Fall, Spring	MADMF Resource Assessment Survey Fall & Spring	MADMF Resource Assessment Survey Fall & Spring	ME/NH Fall & Spring Survey: Fall 2000-2002, 2004; Spring 2003, 2004	ME/NH Fall & Spring Survey: Fall 2003; Spring 2001, 2002. Backup vessel from Spring 2004-present
Years used	2009-2022	1963-2008	1982-2022	1978-1981	2000-2022	2000-2022
Tow speed	3.0 knots SOG	3.8 knots SOG	2.5 knots	2.5 knots	2.2-2.3 knots	2.2-2.3 knots
Tow duration	20 minutes	30 minutes	20 minutes	20 minutes	20 minutes	20 minutes
Headrope height	3.5-4 m	1-2 m	11.9 m	11.9 m		
Ground gear	Rockhopper sweep	Roller sweep	7.6 cm rubber disk sweep	7.6 cm rubber disk sweep	2- 3/8" cookies	2- 3/8" cookies
	Total length = 25.5 m	Total length = 24.5 m				
	Center = 8.9 m length	Center = 5 m length	15.5 m footroop	15.5 m footroop		70 ft footrope
	16" rockhoppers	16" rollers	19.2 m, 9.5 mm chain bottom legs	19.2 m, 9.5 mm chain bottom legs		58 ft, 5/8th in chain bottom legs
	Wings = 8.2 m each	Wings = 9.75 m each	18.3 m, 9.5 mm wire top legs	18.3 m, 9.5 mm wire top legs		
	14" rockhoppers	4" cookies	1.8 x 1.0 m wooden doors	1.8 x 1.0 m wooden doors	6" rubber cookies	6" rubber cookies

Mesh Size	Polyethylene mesh	Nylon webbing	Nylon webbing	Nylon webbing	Polyethylene mesh	Polyethylene mesh
	Forward portion of the trawl = 12 cm, 4 cm	Body of trawl = 12.7 cm			Body of trawl = 2 in mesh	Body of trawl = 2 in mesh
	Square aft to codend = 6 cm, 2.5 mm					
	Codend = 23 cm, 4 mm dbl	Codend = 11.5 cm	Codend = 0.25 in	Codend = 0.25 in		
	Codend liner = 2.54 cm, knotless	Liner (codend and aft portion of top belly) = 1.27 cm knotless	Codend liner = 6.4 mm, knotless	Codend liner = 6.4 mm, knotless	Codend liner = 1 inch mesh	Codend liner = 1 inch mesh
Net design	4 seam, 3 bridle		North Atlantic two seam otter trawl	North Atlantic two seam otter trawl	modified shrimp net	modified shrimp net
other	Wing end to door distance = 36.5 m	Wing end to door distance = 9 m				

Table 3.1.2 Calibration factors applied to calibrate between the Albatross and the Bigelow in the NEFSC Bottom Trawl Survey.

Index type	Survey	Calibration type	Calibration	Calibration factor
NUMBER	NMFS fall BTS	BIGELOW	Length-based	See below
		DOOR	Constant	1.22
		GEAR	Constant	1.76
		VESSEL	Constant	0.85
	NMFS spring BTS	BIGELOW	Length-based	See below
		DOOR	Constant	1.22
		GEAR	Constant	1.76
		VESSEL	Constant	0.85
WEIGHT	NMFS fall BTS	BIGELOW	Constant	2.402
		DOOR	Constant	1.28
		GEAR	Constant	1.73
		VESSEL	Constant	0.85
	NMFS spring BTS	BIGELOW	Constant	2.244
		DOOR	Constant	1.28
		GEAR	Constant	1.73
		VESSEL	Constant	0.85

Table 3.1.3. Number of yellowtail caught in stratum 27 in the fall.

Cruise6	Fish per station	Biomass (kg)
197106	1	0
197208	3	0.5
198106	5	0.6
199306	1	0.4
199406	1	0.2
201404	4	0.561
201704	3	1.23
201904	1	0.238
201904	1	0.194
201904	1	0.122
202104	4	1.25
202204	6	1.28

Table 3.1.4 Indices of abundance (number/tow) and biomass (kg/tow) of Cape Cod Gulf of Maine yellowtail flounder, caught in the NMFS Bottom Trawl Survey. *Indicates year with incomplete strata.

	Abundance (number/tow)				Biomass (kg/tow)			
	Fall		Spring		Fall		Spring	
Year	Index	CV	Index	CV	Index	CV	Index	CV
1963	21.06	0.323	--	--	5.858	0.325	--	--
1964	6.553	0.835	--	--	2.224	0.844	--	--
1965	7.456	0.241	--	--	1.944	0.139	--	--
1966	9.591	0.316	--	--	2	0.492	--	--
1967	1.316	0.424	--	--	0.506	0.418	--	--
1968	1.57	0.522	0.539	0.537	0.485	0.325	0.121	0.887
1969	4.237	0.463	0.38	0.73	1.586	0.619	0.116	0.594
1970	2.095	0.386	3.983	0.238	0.609	0.362	1.448	0.262
1971	2.495	0.631	2.595	0.398	0.665	0.61	0.502	0.394
1972	18.302	0.672	2.146	0.33	5.168	0.592	0.945	0.211
1973	2.86	0.468	1.42	0.394	1.085	0.486	0.339	0.353
1974	0.395	0.627	1.744	0.239	0.235	0.655	0.741	0.306
1975	1.665	0.394	2.742	0.478	0.744	0.41	0.333	0.456

1976	8.601	0.574	3.025	0.274	2.264	0.502	0.925	0.224
1977	21.177	0.45	0.992	0.532	8.189	0.384	0.419	0.458
1978	6.889	0.576	0.296	0.44	2.227	0.436	0.155	0.429
1979	10.78	0.164	1.167	0.200	3.019	0.154	0.532	0.171
1980	26.395	0.308	4.338	0.244	7.227	0.224	1.529	0.268
1981	10.771	0.224	4.396	0.224	2.381	0.205	1.551	0.163
1982	8.203	0.455	6.992	0.138	2.683	0.45	3.082	0.218
1983	1.39	0.123	8.249	0.187	0.333	0.194	2.854	0.31
1984	4.381	0.395	3.045	0.214	1.814	0.638	1.069	0.259
1985	7.976	0.212	2.113	0.182	1.575	0.22	0.626	0.134
1986	4.986	0.535	2.294	0.323	0.907	0.486	0.481	0.255
1987	2.456	0.102	5.678	0.283	0.543	0.137	2.527	0.493
1988	8.326	0.172	6.533	0.086	1.145	0.138	1.077	0.07
1989	8.187	0.454	3.875	0.46	1.871	0.405	0.733	0.345
1990	10.736	0.207	7.592	0.324	1.993	0.228	1.693	0.313
1991	4.754	0.041	7.112	0.219	1.048	0.066	1.544	0.195
1992	8.784	0.36	3.391	0.318	2.0	0.336	0.776	0.352
1993	8.286	0.566	2.403	0.296	0.958	0.565	0.514	0.318
1994	14.234	0.154	5.576	0.275	2.821	0.215	1.061	0.253
1995	2.765	0.152	8.854	0.175	0.783	0.166	2.079	0.208
1996	10.698	0.17	4.492	0.258	2.741	0.237	1.149	0.242
1997	8.663	0.322	4.598	0.21	2.337	0.426	1.238	0.2
1998	6.686	0.289	4.813	0.266	1.7	0.304	1.18	0.266
1999	21.117	0.228	5.661	0.258	6.265	0.285	1.62	0.279
2000	12.837	0.318	30.439	0.307	3.562	0.333	9.87	0.321
2001	6.48	0.212	7.46	0.207	1.94	0.215	2.332	0.232
2002	2.622	0.255	12.653	0.186	0.726	0.289	3.834	0.193
2003	12.074	0.254	6.14	0.436	3.444	0.254	1.976	0.481
2004	2.098	0.358	4.169	0.093	0.504	0.337	1.091	0.096
2005	3.692	0.142	5.985	0.226	0.642	0.172	1.471	0.258
2006	4.933	0.156	6.242	0.309	0.824	0.156	1.32	0.26
2007	13.739	0.164	13.35	0.365	3.551	0.168	3.572	0.357
2008	19.198	0.386	12.054	0.197	4.906	0.39	3.075	0.2
2009	28.439	0.301	17.088	0.427	6.591	0.334	4.003	0.41
2010	28.499	0.442	18.484	0.345	5.588	0.433	4.619	0.352
2011	13.84	0.292	12.248	0.256	3.168	0.294	2.883	0.256
2012	18.631	0.6	20.625	0.381	4.189	0.622	5.05	0.402
2013	21.692	0.699	21.992	0.294	4.807	0.768	5.246	0.292
2014	14.437	0.354	19.138	0.225	2.885	0.389	3.728	0.218
2015	10.366	0.248	15.051	0.268	1.902	0.257	3.062	0.265
2016	14.452	0.244	19.787	0.232	2.688	0.224	4	0.207
2017	25.908	0.417	14.821	0.239	4.697	0.392	2.872	0.222
2018	14.28	0.196	10.116	0.21	2.599	0.206	1.986	0.189
2019	25.41	0.388	18.441	0.346	4.042	0.314	3.643	0.377
2020	--	--	--	--	--	--	--	--

2021	27.44	0.318	26.97	0.258	4.73	0.271	4.44	0.222
2022	38.225	0.492	48.024	0.342	7.598	0.501	9.039	0.351

Table 3.1.5a Abundance at age (ages 1-6) of CCGOM yellowtail flounder caught in the spring NMFS Bottom Trawl survey (1970-2022).

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1970	0	0.684	1.222	0.523	0.281	0.514
1971	0.035	1.357	0.372	0.348	0.086	0.052
1972	0	0.539	0.845	0.287	0.351	0
1973	0	0.4	0.629	0.179	0.02	0
1974	0.079	0.094	0.666	0.429	0.053	0
1975	0.052	1.859	0.18	0.101	0.006	0
1976	0	1.111	0.904	0.127	0.051	0.033
1977	0	0.441	0.223	0.119	0.027	0.057
1978	0	0	0.123	0.025	0.061	0
1979	0	0.118	0.432	0.434	0.048	0.013
1980	0	2.092	1.232	0.502	0.102	0
1981	0	1.285	1.171	0.627	0.266	0.213
1982	0	1.238	3.128	1.573	0.398	0.201
1983	0	2.985	2.421	1.477	0.116	0.082
1984	0	1.275	0.763	0.479	0.306	0.029
1985	0.048	0.73	0.884	0.2	0.116	0.034
1986	0.017	1.601	0.202	0.14	0.085	0
1987	0	1.345	2.004	0.541	0.459	0.485
1988	0.851	3.781	0.922	0.512	0.268	0.074
1989	0.1	1.852	1.128	0.316	0.233	0
1990	0	1.867	5.316	0.161	0	0.086
1991	0.341	3.146	2.514	0.856	0.181	0
1992	0.051	0.888	1.856	0.502	0.019	0
1993	0.066	0.682	1.088	0.567	0	0
1994	0.307	2.325	1.395	0.836	0.52	0.18
1995	0.186	1.062	4.062	3.03	0.416	0.049
1996	0.015	0.575	1.463	2.09	0.348	0
1997	0.022	0.9	1.961	1.539	0.176	0
1998	0	0.763	2.997	0.906	0.147	0
1999	0.018	0.812	2.915	1.413	0.286	0.218
2000	0.05	10.366	17.523	1.726	0.136	0.05
2001	0	1.192	4.995	1.052	0.22	0
2002	0.016	1.596	7.36	3.402	0.195	0.027
2003	0.097	0.912	2.498	1.786	0.819	0
2004	0.337	0.606	2.617	0.408	0.141	0
2005	0.071	0.59	3.973	1.335	0	0
2006	0.14	1.157	3.556	1.255	0.099	0
2007	0.031	2.349	6.471	4.276	0.222	0
2008	0.179	1.831	8.213	1.622	0.16	0.048
2009	0.394	3.018	8.179	5.095	0.248	0
2010	0.09	2.787	10.109	4.707	0.729	0.03
2011	0.189	0.222	6.222	4.812	0.717	0.077
2012	0.251	2.239	8.962	7.013	2.046	0.108
2013	0.421	6.943	7.44	5.09	1.865	0.216
2014	0.238	10.349	5.913	2.152	0.427	0.059

2015	0.13	4.136	8.386	1.885	0.425	0.058
2016	0.22	5.69	9.909	3.124	0.618	0.176
2017	0.793	3.507	6.508	2.245	1.511	0.144
2018	0.063	1.322	5.077	2.013	1.201	0.318
2019	0.523	2.876	5.818	5.415	2.581	0.928
2021	1.264	7.602	10.693	3.823	1.663	0.624
2022	0.108	8.373	13.082	15.361	5.778	3.053

Table 3.1.5b Abundance at age (ages 7-12) of CCGOM yellowtail flounder caught in the spring NMFS Bottom Trawl survey (1970-2022).

Year	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1970	0	0.142	0.072	0	0	0
1971	0.069	0	0.035	0	0	0
1972	0	0	0.072	0	0	0
1973	0	0	0	0	0	0
1974	0	0	0	0	0	0
1975	0	0	0	0	0	0
1976	0.015	0	0.029	0	0	0
1977	0	0	0	0	0	0
1978	0	0	0	0	0	0
1979	0	0.012	0	0	0	0
1980	0	0	0	0	0	0
1981	0.03	0	0	0	0	0
1982	0.15	0	0	0.038	0	0.029
1983	0	0	0	0	0	0
1984	0.041	0.059	0.029	0	0	0
1985	0	0	0	0	0	0
1986	0	0	0	0	0	0
1987	0.484	0.14	0	0	0.083	0
1988	0.034	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0	0	0	0	0	0
1991	0.042	0	0	0	0	0
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	0	0	0	0	0	0
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0
2001	0	0	0	0	0	0
2002	0	0	0.027	0	0	0
2003	0	0.026	0	0	0	0
2004	0	0	0	0	0	0
2005	0	0	0	0	0	0
2006	0	0.035	0	0	0	0
2007	0	0	0	0	0	0
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	0.029	0.002	0	0	0	0
2011	0.009	0	0	0	0	0
2012	0.006	0	0	0	0	0
2013	0.011	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0.032	0	0	0	0	0

2016	0.028	0.022	0	0	0	0
2017	0.064	0.048	0	0	0	0
2018	0.11	0.013	0	0	0	0
2019	0.274	0	0	0	0	0
2021	0.415	0.585	0.095	0.097	0.11	0
2022	0.775	1.068	0.195	0.066	0.099	0.066

Table 3.1.6a Abundance at age (ages 1-6) of CCGOM yellowtail flounder caught in the fall NMFS Bottom Trawl survey (1970-2022).

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1963	0	4.885	4.826	7.471	1.009	0.418
1965	0	0.404	3.159	1.186	0.146	0
1966	0	3.197	1.326	1.413	0.171	0.078
1967	0	0.175	0.38	0.366	0.044	0
1970	0.091	1.004	0.182	0.274	0	0.182
1971	0	1.118	0.31	0.312	0.243	0.068
1972	0	2.588	8.527	3.792	1.837	0.444
1973	0.09	0.356	0.791	0.87	0.302	0.144
1974	0	0	0.044	0	0.132	0.11
1975	0	0	0.571	0.105	0	0.284
1976	0	3.728	4.144	0.541	0.025	0.061
1977	0	4.998	9.675	5.172	0.817	0.204
1978	0	0.089	3.283	2.446	0.113	0.114
1979	0	4.371	4.523	1.371	0.327	0.062
1980	0	10.32	9.44	4.335	1.65	0.362
1981	0	2.967	5.625	1.015	0.21	0.115
1982	0	0.567	3.447	3.192	0.416	0.438
1983	0	0.229	0.437	0.345	0	0
1984	0	0.095	1.361	0.507	0.955	0.683
1985	0	4.426	1.854	0.798	0	0
1986	0	0.523	3.445	0.27	0	0
1987	0	0.459	1.35	0.523	0.048	0.018
1988	0	3.054	4.657	0.455	0.118	0
1989	0	1.343	4.379	1.612	0.26	0.068
1990	0	2.975	5.271	2.443	0.039	0.008
1991	0	1.604	1.432	1.429	0.29	0
1992	0	2.501	2.976	1.879	1.005	0.147
1993	0	3.751	3.925	0.524	0.086	0
1994	0	2.581	7.816	2.589	0.865	0.372
1995	0	0.516	0.678	1.033	0.283	0.171
1996	0	1.109	3.047	5.165	1.236	0.14
1997	0	1.077	2.504	3.022	1.255	0.687
1998	0	1.071	3.102	1.252	1.017	0.245
1999	0	4.273	8.475	5.793	1.773	0.725
2000	0	0.98	6.904	4.538	0.235	0
2001	0	0.049	3.761	2.269	0.077	0
2002	0	0.4	1.451	0.561	0.142	0.02
2003	0	0.597	8.775	1.846	0.434	0.253
2004	0	0.243	1.147	0.645	0.025	0
2005	0	1.435	1.303	0.577	0.056	0
2006	0	2.418	1.554	0.873	0.07	0
2007	0	0.391	6.625	5.09	1.503	0.131
2008	0	1.452	5.875	8.838	2.738	0.059
2009	0	2.316	15.52	9.818	0.679	0.076
2010	0	3.281	15.437	8.719	1.011	0.048

2011	0	1.101	7.034	3.835	1.439	0.34
2012	0	2.648	9.554	5.137	1.013	0.279
2013	0	4.538	8.145	6.773	1.995	0.155
2014	0	5.22	7.235	1.502	0.363	0
2015	0	2.341	6.48	1.3	0.12	0.024
2016	0	3.094	7.327	3.489	0.427	0.061
2017	0	8.161	9.521	5.263	2.183	0.651
2018	0.028	1.879	5.48	4.138	1.635	0.304
2019	0	7.272	11.144	3.649	1.688	0.741
2021	0	3.979	6.699	11.046	4.567	0.649
2022	0.796	3.872	11.854	8.429	7.984	2.594

Table 3.1.6b Abundance at age (ages 7-12) of CCGOM yellowtail flounder caught in the fall NMFS Bottom Trawl survey (1970-2022).

Year	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1963	0	0.033	0.065	0	0	0
1965	0	0	0	0	0	0
1966	0	0.249	0.059	0	0	0
1967	0	0	0	0	0	0
1970	0	0	0.091	0	0	0
1971	0.091	0.068	0.068	0	0	0
1972	0	0.354	0.267	0	0	0
1973	0	0	0	0.044	0	0
1974	0	0.022	0	0	0	0
1975	0	0.166	0.088	0	0	0
1976	0	0	0	0	0	0
1977	0.043	0.055	0.064	0	0	0.064
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
1980	0	0	0.039	0	0	0
1981	0	0	0	0	0	0
1982	0	0	0	0	0	0
1983	0	0	0	0	0	0
1984	0.094	0.189	0	0	0	0
1985	0	0	0	0	0	0
1986	0	0	0	0	0	0
1987	0	0	0	0	0	0
1988	0	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0	0.16	0	0	0	0
1993	0	0	0	0	0	0
1994	0	0	0	0	0	0
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0.118	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0.028	0	0	0	0
2000	0	0	0	0	0.115	0
2001	0	0	0	0	0	0
2002	0	0	0	0	0	0
2003	0	0	0	0	0.169	0
2004	0	0	0	0	0	0
2005	0	0	0	0	0.027	0
2006	0	0	0	0	0	0
2007	0	0	0	0	0	0
2008	0	0	0	0	0.177	0
2009	0	0	0	0	0.03	0
2010	0	0	0	0	0.004	0

2011	0	0.084	0	0	0.007	0
2012	0	0	0	0	0	0
2013	0	0	0	0	0.086	0
2014	0	0.046	0	0	0.047	0
2015	0	0	0	0	0.101	0
2016	0	0.013	0	0	0.04	0
2017	0	0.032	0	0	0.096	0
2018	0	0.017	0.033	0	0.766	0
2019	0	0.74	0.175	0	0	0
2021	0.075	0.257	0.164	0	0	0
2022	0.505	1.101	0.643	0	0	0

Table 3.2.1 Indices of abundance (number/tow) and biomass (kg/tow) of yellowtail flounder, caught in the Maine-New Hampshire Inshore Trawl Survey.

	Abundance (number/tow)				Biomass (kg/tow)			
	Fall		Spring		Fall		Spring	
Year	Index	CV	Index	CV	Index	CV	Index	CV
2000	2.530	1.177	--	--	0.611	1.141	--	--
2001	1.412	0.906	3.346	1.397	0.352	0.849	1.197	1.522
2002	0.942	0.527	3.142	0.533	0.271	0.468	0.948	0.510
2003	1.177	0.055	1.993	0.417	0.366	0.056	0.517	0.402
2004	1.119	0.446	1.792	0.480	0.281	0.382	0.426	0.494
2005	0.355	1.100	1.757	0.501	0.088	1.159	0.394	0.492
2006	0.185	1.538	1.009	0.461	0.045	1.517	0.232	0.474
2007	2.029	0.847	4.623	0.593	0.513	0.921	1.116	0.579
2008	1.379	0.718	2.358	0.640	0.274	0.797	0.525	0.624
2009	0.868	0.752	2.486	0.547	0.221	0.744	0.577	0.589
2010	1.185	0.871	4.295	0.559	0.257	0.917	1.006	0.555
2011	1.168	1.257	1.690	0.561	0.268	1.465	0.357	0.595
2012	0.330	1.027	1.312	0.501	0.067	1.122	0.257	0.530
2013	0.361	0.697	4.404	0.360	0.064	0.733	0.958	0.371
2014	0.944	1.139	3.088	0.654	0.177	1.137	0.596	0.687
2015	0.797	0.601	1.825	0.481	0.148	0.594	0.341	0.517
2016	0.426	0.708	1.328	0.401	0.076	0.676	0.254	0.451
2017	0.470	1.171	1.315	0.976	0.080	1.182	0.253	1.003
2018	1.064	1.366	0.896	0.962	0.198	1.459	0.158	0.902
2019	1.565	1.306	1.296	0.759	0.314	1.323	0.187	0.781
2020	0.487	0.657	--	--	--	--	--	--
2021	0.945	0.462	2.141	0.455	0.158	0.464	0.336	0.436
2022	1.865	0.865	2.795	0.434	0.333	0.875	0.459	0.432

Table 3.2.2 Numbers at age for the spring Maine-New Hampshire Inshore Trawl Survey 2001-2022.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
2001	0	0.834	1.993	0.434	0.072	0.013	0	0	0	0	0	0
2002	0	0.359	2.011	0.707	0.053	0.013	0	0	0	0	0	0
2003	0	0.520	0.783	0.676	0.014	0	0	0	0	0	0	0
2004	0	0.245	1.136	0.410	0	0	0	0	0	0	0	0
2005	0.017	0.398	1.144	0.196	0.002	0	0	0	0	0	0	0
2006	0	0.229	0.637	0.136	0.003	0.003	0	0	0	0	0	0
2007	0	1.145	2.579	0.824	0.075	0	0	0	0	0	0	0
2008	0.155	0.487	1.333	0.352	0.031	0	0	0	0	0	0	0
2009	0.012	0.559	1.326	0.555	0.035	0	0	0	0	0	0	0
2010	0.007	0.903	2.581	0.677	0.122	0.006	0	0	0	0	0	0
2011	0.051	0.253	0.880	0.474	0.032	0	0	0	0	0	0	0
2012	0.068	0.462	0.389	0.356	0.035	0.002	0	0	0	0	0	0
2013	0.059	2.378	1.151	0.546	0.261	0.009	0	0	0	0	0	0
2014	0	1.589	1.081	0.350	0.058	0.010	0	0	0	0	0	0
2015	0	0.564	1.077	0.123	0.050	0.011	0	0	0	0	0	0
2016	0.016	0.501	0.582	0.161	0.060	0.003	0.006	0	0	0	0	0
2017	0	0.310	0.683	0.200	0.096	0.025	0	0	0	0	0	0
2018	0	0.215	0.365	0.205	0.078	0.031	0.003	0	0	0	0	0
2019	0.010	0.413	0.419	0.257	0.136	0.050	0.011	0	0	0	0	0
2020	--	--	--	--	--	--	--	--	--	--	--	--
2021	0.036	1.074	0.640	0.227	0.066	0.048	0.039	0.007	0.004	0	0	0
2022	0.021	0.616	0.788	0.583	0.375	0.120	0.092	0.060	0.100	0.039	0	0

Table 3.2.3 Numbers at age for the fall Maine-New Hampshire Inshore Trawl Survey 2001-2022.

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
2000	0	0.052	1.797	0.640	0.030	0.010	0	0	0	0	0	0	0
2001	0	0.066	0.914	0.421	0.011	0	0	0	0	0	0	0	0
2002	0	0	0.202	0.558	0.177	0.005	0	0	0	0	0	0	0
2003	0	0	0.393	0.417	0.367	0	0	0	0	0	0	0	0
2004	0	0.009	0.503	0.472	0.134	0	0	0	0	0	0	0	0
2005	0	0	0.161	0.182	0.012	0	0	0	0	0	0	0	0
2006	0	0	0.092	0.091	0.002	0	0	0	0	0	0	0	0
2007	0	0.017	0.950	0.923	0.139	0	0	0	0	0	0	0	0
2008	0.141	0.119	0.535	0.537	0.044	0.003	0	0	0	0	0	0	0
2009	0	0.021	0.558	0.251	0.038	0	0	0	0	0	0	0	0
2010	0	0.136	0.662	0.379	0.007	0	0	0	0	0	0	0	0
2011	0	0.124	0.543	0.387	0.099	0.014	0	0	0	0	0	0	0
2012	0	0.041	0.175	0.078	0.037	0	0	0	0	0	0	0	0
2013	0	0.133	0.181	0.043	0.003	0.001	0	0	0	0	0	0	0
2014	0	0.143	0.649	0.122	0.026	0.003	0	0	0	0	0	0	0
2015	0	0.084	0.521	0.160	0.032	0	0	0	0	0	0	0	0
2016	0	0.071	0.180	0.143	0.029	0.002	0	0	0	0	0	0	0
2017	0	0.080	0.155	0.179	0.047	0.008	0	0	0	0	0	0	0
2018	0.023	0.114	0.606	0.216	0.062	0.036	0	0.006	0	0	0	0	0
2019	0	0.076	0.758	0.382	0.243	0.092	0.014	0	0	0	0	0	0
2020	0	0.071	0.199	0.134	0.057	0.021	0.001	0.001	0.003	0	0	0	0
2021	0	0.116	0.346	0.295	0.117	0.032	0.013	0.009	0.017	0	0	0	0
2022	0	0.025	0.636	0.619	0.305	0.098	0.089	0.026	0.043	0.004	0.017	0	0.005

Table 3.3.1 Indices of abundance (number/tow) and biomass (kg/tow) of Yellowtail flounder, caught in the MADMF Resource Assessment Survey (1978-2022).

	Abundance (number/tow)				Biomass (kg/tow)			
	Spring		Fall		Spring		Fall	
Year	Index	CV	Index	CV	Index	CV	Index	CV
1978	--	--	--	--	9.659	0.158	2.851	0.132
1979	--	--	--	--	9.805	0.17	7.492	0.181
1980	--	--	--	--	8.804	0.118	5.404	0.13
1981	--	--	--	--	14.902	0.104	2.27	0.189
1982	--	--	--	--	10.432	0.152	3.564	0.132
1983	--	--	--	--	6.531	0.146	2.988	0.214
1984	--	--	--	--	5.894	0.177	1.054	0.153
1985	--	--	--	--	4.852	0.198	1.308	0.294
1986	--	--	--	--	4.404	0.185	1.369	0.271
1987	--	--	--	--	3.417	0.123	1.055	0.2
1988	--	--	--	--	3.501	0.179	3.916	0.392
1989	--	--	--	--	4.342	0.157	1.462	0.075
1990	--	--	--	--	6.323	0.134	3.434	0.195
1991	--	--	--	--	2.849	0.148	2.203	0.232
1992	--	--	--	--	5.348	0.156	1.913	0.22
1993	--	--	--	--	3.969	0.179	3.031	0.191
1994	--	--	--	--	5.578	0.12	2.37	0.129
1995	--	--	--	--	7.741	0.113	4.661	0.166
1996	29.555	0.115	6.507	0.115	6.583	0.112	1.185	0.106
1997	21.964	0.195	6.892	0.108	4.733	0.231	1.38	0.08
1998	13.27	0.183	12.861	0.207	3.342	0.197	2.08	0.137
1999	7.641	0.158	9.443	0.075	2.05	0.151	1.926	0.135
2000	28.153	0.136	5.93	0.15	8.345	0.13	1.534	0.159
2001	20.113	0.132	5.393	0.144	6.408	0.122	1.447	0.149
2002	9.429	0.145	3.182	0.156	3.246	0.142	0.706	0.186
2003	12.136	0.157	7.622	0.341	3.515	0.173	2.022	0.381
2004	13.657	0.19	19.888	0.323	3.986	0.208	4.369	0.366
2005	23.885	0.241	9.227	0.292	6.373	0.246	1.987	0.291
2006	30.522	0.213	10.548	0.205	8.201	0.221	2.521	0.23
2007	36.535	0.218	8.746	0.278	9.214	0.212	2.227	0.281
2008	24.067	0.19	8.722	0.186	6.618	0.178	1.843	0.195
2009	20.036	0.156	8.119	0.154	5.266	0.153	1.548	0.138
2010	20.047	0.149	9.89	0.168	5.359	0.136	2.504	0.155
2011	20.233	0.218	15.756	0.166	5.492	0.204	3.646	0.184
2012	8.21	0.224	5.088	0.186	2.158	0.222	1.115	0.199
2013	12.368	0.278	5.663	0.15	3.211	0.258	1.112	0.178
2014	8.815	0.263	7.708	0.156	1.964	0.248	1.093	0.153
2015	23.017	0.201	19.986	0.3	5.175	0.176	3.893	0.313
2016	35.374	0.232	16.333	0.201	6.974	0.199	3.324	0.187
2017	59.377	0.134	48.41	0.137	13.159	0.125	10.044	0.141
2018	40.873	0.112	36.502	0.102	8.676	0.122	6.099	0.084
2019	28.749	0.255	19.196	0.255	5.492	0.262	3.858	0.273
2020	--	--	--	--	--	--	--	--

2021	21.747	0.257	45.006	0.23	4.461	0.254	9.166	0.245
2022	46.627	0.342	21.23	0.183	9.252	0.301	4.245	0.168

Table 3.3.2a Abundance at age (ages 1-5) of Yellowtail flounder caught in the spring MADMF Resource Assessment Survey (1978-2022).

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1978	1.57	21.579	11.228	1.468	0.563	0.481
1979	2.151	17.376	12.423	3.386	0.593	0
1980	2.103	16.146	9.055	1.824	0.131	0
1981	2.367	44.796	9.149	1.654	0.636	0
1984	0.115	14.055	6.211	1.926	0.525	0
1985	1.758	6.542	6.709	1.172	0.347	0.2
1986	1.457	14.77	1.692	0.194	0.072	0
1987	2.334	4.497	4.925	0.978	0.246	0.091
1988	2.131	12.538	2.422	0.488	0	0
1989	0.174	18.067	3.309	0.866	0.044	0
1990	0.203	10.067	14.936	0.61	0.087	0.014
1991	0.057	4.404	2.988	1.866	0.409	0.091
1992	1.027	7.7	7.702	2.034	1.316	0.032
1993	0.481	5.91	5.429	1.806	0.227	0.058
1994	2.123	20.337	6.924	1.41	0.31	0.106
1995	5.89	10.214	18.33	2.176	0.868	0
1996	0.95	11.755	10.057	5.13	1.435	0
1997	0.451	10.929	7.592	2.634	0.312	0
1998	0.575	3.066	8.638	0.834	0.141	0.016
1999	0.11	3.986	6.05	0.734	0.057	0
2000	0.509	11.155	16.195	5.535	0.677	0.241
2001	0.058	5.07	17.334	4.831	0.861	0
2002	0.326	1.009	8.827	3.553	0.2	0.109
2003	0.046	5.474	5.331	5.897	0.894	0.043
2004	0.086	2.217	7.247	3.567	0.453	0.018
2005	0.261	5.606	14.138	3.713	0.069	0.023
2006	0.61	6.002	18.593	4.996	0.221	0.092
2007	0.443	11.785	17.292	6.311	0.666	0
2008	0.037	5.822	19.694	6.77	0.782	0
2009	0.294	6.473	13.297	7.019	0.615	0.046
2010	0.216	4.318	15.47	5.777	1.15	0.101
2011	0.261	1.966	14.691	10.301	1.143	0.02
2012	0.573	1.974	4.025	4.395	0.6	0.035
2013	0.056	8.644	5.316	2.871	1.486	0.073
2014	0.111	5.9	5.308	1.396	0.259	0.058
2015	0.168	7.611	16.034	3.331	0.926	0.196
2016	0.935	16.27	19.296	5.643	1.662	0.126
2017	0.54	9.652	30.784	10.847	5.849	1.434
2018	0.24	8.714	15.923	10.178	4.745	0.909
2019	0.158	7.398	6.738	6.172	5.074	2.481
2020	--	--	--	--	--	--
2021	0.167	7.332	6.726	3.856	1.374	0.865
2022	0.279	8.303	12.942	8.757	7.172	2.64

Table 3.3.2b Abundance at age (ages 6-11) of Yellowtail flounder caught in the spring MADMF Resource Assessment Survey (1978-2022).

Year	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
1978	0.481	0.105	0.114	0	0	0
1979	0	0.15	0	0	0	0
1980	0	0	0	0	0	0
1981	0	0	0	0	0	0
1984	0	0	0	0	0	0
1985	0.2	0	0	0	0	0
1986	0	0.012	0	0	0	0
1987	0.091	0.038	0	0	0	0
1988	0	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0.014	0	0.01	0	0	0
1991	0.091	0.043	0	0	0	0
1992	0.032	0.044	0	0	0	0
1993	0.058	0.198	0	0	0	0
1994	0.106	0	0	0	0	0
1995	0	0.021	0	0	0	0
1996	0	0.053	0	0	0	0
1997	0	0	0	0	0	0
1998	0.016	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0.241	0	0	0	0	0
2001	0	0	0	0	0	0
2002	0.109	0	0	0	0	0
2003	0.043	0	0	0	0	0
2004	0.018	0	0	0	0	0
2005	0.023	0	0	0	0	0
2006	0.092	0	0	0	0	0
2007	0	0	0	0	0	0
2008	0	0	0	0	0	0
2009	0.046	0.012	0	0	0	0
2010	0.101	0	0	0	0	0
2011	0.02	0	0	0	0	0
2012	0.035	0	0	0	0	0
2013	0.073	0	0	0	0	0
2014	0.058	0	0	0	0	0
2015	0.196	0	0	0	0	0
2016	0.126	0.17	0	0	0	0
2017	1.434	0.142	0	0	0	0
2018	0.909	0	0.138	0	0	0
2019	2.481	0.432	0.026	0	0	0
2020	--	--	--	--	--	--
2021	0.865	0.797	0.393	0.057	0	0
2022	2.64	1.817	1.492	2.296	0.696	0.072

Table 3.3.3a Abundance at age (ages 0-6) of Yellowtail flounder caught in the fall MADMF Resource Assessment Survey (1978-2022).

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
1978	0	8.066	8.503	1.362	0.051	0	0.015
1979	0.326	24.187	21.531	0.678	0	0	0
1980	0	24.520	11.170	1.991	0.068	0	0
1994	0	2.050	8.660	1.253	0.112	0	0
1995	0	8.590	12.704	4.488	0	0	0
1996	0	1.654	2.973	1.680	0.120	0	0
1997	0	0.992	5.141	0.606	0.079	0.046	0
1998	0	5.898	5.246	1.692	0	0	0
1999	0	3.474	6.729	2.343	0.362	0.045	0
2000	0	1.013	5.124	2.281	0.184	0.069	0
2001	0	0.417	4.374	2.421	0.086	0	0
2002	0.086	1.299	0.544	1.809	0.714	0.024	0
2003	0.031	0.389	4.645	2.485	1.995	0.058	0
2004	0.587	2.327	8.683	6.357	1.905	0.009	0
2005	0.075	0.883	4.248	3.817	0.205	0	0
2006	0.085	1.251	4.996	3.808	0.408	0	0
2007	0.000	0.383	4.398	3.397	0.568	0	0
2008	0.401	2.338	4.084	4.205	0.550	0.056	0
2009	0.043	2.643	6.184	1.857	0.187	0	0
2010	0.068	0.875	7.069	4.594	0.481	0.025	0
2011	0.038	3.568	8.927	6.401	1.649	0.038	0
2012	0	1.394	2.733	1.901	0.581	0.035	0
2013	0.092	2.801	3.236	1.191	0.231	0.027	0
2014	0.288	4.020	4.140	1.242	0.211	0.066	0
2015	0.094	5.428	16.538	4.652	0.780	0.056	0
2016	0	2.618	9.750	7.033	1.540	0.187	0.031
2017	0.972	6.802	12.536	19.944	6.017	1.904	0.045
2018	3.622	8.282	15.655	5.856	2.102	0.776	0.023
2019	0	1.390	8.608	4.850	3.060	1.176	0.099
2020	0	4.310	14.274	14.998	7.423	1.491	1.381
2021	0	1.240	5.815	6.226	4.141	1.357	0.962
2022	1.240	5.815	6.226	4.141	1.357	0.962	0.457

Table 3.3.3b Abundance at age (ages 7-12) of Yellowtail flounder caught in the fall MADMF Resource Assessment Survey (1978-2022).

Year	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
1980	0	0	0	0	0	0
1994	0	0	0	0	0	0
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0.031	0	0	0	0	0
2001	0	0	0	0	0	0
2002	0	0	0	0	0	0
2003	0	0	0	0	0	0
2004	0	0	0	0	0	0
2005	0	0	0	0	0	0
2006	0	0	0	0	0	0
2007	0	0	0	0	0	0
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
2011	0	0	0	0	0	0
2012	0	0	0	0	0	0
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
2016	0	0	0	0	0	0
2017	0.132	0.045	0	0	0	0
2018	0.137	0	0	0	0	0
2019	0	0	0	0	0	0
2020	0.714	0.366	0	0	0	0
2021	0.457	0.492	0.124	0.271	0.026	0.117
2022	0.492	0.124	0.271	0.026	0.117	0

Table 3.4.1 Indices of abundance (number/tow) and biomass (kg/tow) of Georges Bank Yellowtail flounder, caught in the NMFS Bottom Trawl Survey.

	Abundance (number/tow)				Biomass (kg/tow)			
	Fall		Spring		Fall		Spring	
Year	Index	CV	Index	CV	Index	CV	Index	CV
1963	36.746	0.189	--	--	12.788	0.186	--	--
1964	28.007	0.366	--	--	13.567	0.393	--	--
1965	18.346	0.296	--	--	9.120	0.321	--	--
1966	18.013	0.329	--	--	3.928	0.345	--	--
1967	22.662	0.240	--	--	7.670	0.261	--	--
1968	31.254	0.221	7.778	0.170	10.536	0.233	2.79	0.22
1969	30.185	0.206	26.759	0.235	9.807	0.262	11.17	0.29
1970	16.321	0.197	13.911	0.131	4.979	0.277	5.15	0.15
1971	18.593	0.198	13.564	0.171	6.365	0.197	4.62	0.19
1972	17.767	0.273	19.184	0.216	6.328	0.278	6.46	0.21
1973	17.996	0.327	9.296	0.226	6.490	0.306	2.94	0.17
1974	12.133	0.165	6.293	0.170	3.669	0.190	2.72	0.18
1975	9.419	0.183	4.829	0.232	2.326	0.155	1.68	0.22
1976	3.078	0.271	7.300	0.209	1.508	0.235	2.27	0.16
1977	5.615	0.178	2.277	0.256	2.781	0.206	1.00	0.31
1978	7.442	0.221	2.506	0.233	2.343	0.208	0.74	0.21
1979	4.040	0.257	3.319	0.172	1.494	0.288	1.27	0.20
1980	13.217	0.191	11.078	0.309	6.607	0.211	4.46	0.36
1981	6.344	0.283	3.806	0.323	2.576	0.307	1.960	0.33
1982	6.711	0.305	6.514	0.175	2.270	0.299	2.50	0.19
1983	4.898	0.223	5.490	0.218	2.131	0.219	2.64	0.30
1984	1.781	0.337	2.865	0.397	0.593	0.324	1.65	0.44
1985	2.205	0.274	3.000	0.510	0.709	0.259	0.99	0.52
1986	1.812	0.338	2.373	0.313	0.820	0.367	0.85	0.31
1987	1.031	0.269	0.480	0.286	0.509	0.278	0.33	0.35
1988	0.377	0.357	1.187	0.272	0.171	0.311	0.57	0.27
1989	3.172	0.646	1.605	0.238	0.977	0.609	0.73	0.27
1990	2.321	0.306	1.761	0.329	0.725	0.309	0.699	0.32
1991	3.172	0.355	1.659	0.206	0.730	0.297	0.63	0.25
1992	1.592	0.299	4.767	0.433	0.576	0.294	1.57	0.47
1993	2.123	0.431	1.180	0.246	0.546	0.435	0.48	0.27
1994	3.441	0.288	1.792	0.232	0.897	0.313	0.66	0.23
1995	1.143	0.307	8.167	0.591	0.354	0.360	2.58	0.60
1996	2.891	0.542	7.006	0.317	1.303	0.578	2.85	0.33
1997	8.612	0.326	9.838	0.262	3.781	0.342	4.36	0.26
1998	12.531	0.366	5.401	0.179	4.347	0.337	2.32	0.22
1999	20.394	0.207	20.738	0.433	7.973	0.209	9.31	0.42
2000	11.355	0.417	16.919	0.230	5.838	0.512	6.70	0.23

2001	24.282	0.355	12.225	0.322	11.553	0.392	5.01	0.33
2002	10.948	0.512	21.624	0.252	3.754	0.505	9.56	0.25
2003	9.796	0.279	15.516	0.381	4.038	0.310	6.72	0.40
2004	14.619	0.424	4.420	0.246	5.117	0.424	1.89	0.27
2005	8.529	0.444	9.880	0.329	2.463	0.499	3.41	0.33
2006	17.694	0.250	7.542	0.174	4.521	0.250	2.42	0.19
2007	22.859	0.314	14.932	0.191	8.151	0.315	4.70	0.21
2008	18.258	0.290	9.413	0.207	7.109	0.282	3.25	0.21
2009	20.359	0.275	14.829	0.247	6.876	0.270	5.08	0.23
2010	8.744	0.287	17.947	0.267	2.301	0.296	5.95	0.26
2011	8.866	0.259	9.571	0.230	2.646	0.265	2.91	0.24
2012	8.342	0.439	13.103	0.405	2.851	0.454	4.22	0.43
2013	3.101	0.339	3.779	0.216	0.908	0.352	1.15	0.21
2014	3.547	0.281	2.265	0.179	1.091	0.324	0.76	0.18
2015	1.481	0.554	1.664	0.194	0.491	0.618	0.55	0.19
2016	1.596	0.368	0.743	0.240	0.476	0.341	0.31	0.25
2017	0.647	0.330	0.619	0.218	0.208	0.359	0.24	0.22
2018	1.811	0.558	0.038	0.669	0.510	0.575	0.01	0.66
2019	1.079	0.227	0.809	0.391	0.316	0.275	0.33	0.50
2020	--	--	--	--	--	--	--	--
2021	0.625	0.308	1.305	0.331	0.203	0.315	0.419	0.354
2022	0.288	0.487	0.272	0.362	0.105	0.508	0.099	0.385

Table 3.4.2 Abundance at age of GB yellowtail flounder caught in the spring NMFS Bottom Trawl survey (1970-2022).

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
1968	0.335	3.176	3.58	0.304	0.073	0.183	0.127	0	0	0	0
1969	1.108	9.313	11.121	3.175	1.345	0.454	0.084	0.16	0	0	0
1970	0.093	4.485	6.03	2.422	0.57	0.155	0.156	0	0	0	0
1971	0.835	3.516	4.813	3.3	0.78	0.202	0.096	0	0	0.022	0
1972	0.141	6.923	7.05	3.704	1.127	0.073	0.166	0	0	0	0
1973	1.94	3.281	2.379	1.068	0.412	0.174	0.023	0.02	0	0	0
1974	0.318	2.234	1.85	1.262	0.347	0.188	0.086	0	0	0	0.009
1975	0.422	3.006	0.834	0.271	0.208	0.076	0.006	0.006	0	0	0
1976	1.112	4.315	1.253	0.312	0.197	0.026	0.048	0.019	0.018	0	0
1977	0	0.674	1.131	0.396	0.063	0.013	0	0	0	0	0
1978	0.94	0.802	0.509	0.22	0.026	0	0.008	0	0	0	0
1979	0.406	2.016	0.407	0.338	0.06	0.058	0.033	0	0	0	0
1980	0.057	4.666	5.787	0.474	0.057	0.036	0	0	0	0	0
1981	0.017	1.02	1.776	0.72	0.213	0.053	0	0.006	0	0	0
1982	0.045	3.767	1.13	1.022	0.458	0.065	0	0.026	0	0	0
1983	0	1.865	2.728	0.53	0.123	0.061	0.092	0.092	0	0	0
1984	0	0.093	0.83	0.863	0.896	0.183	0	0	0	0	0
1985	0.11	2.199	0.262	0.282	0.148	0	0	0	0	0	0
1986	0.027	1.806	0.291	0.056	0.137	0.055	0	0	0	0	0
1987	0.027	0.076	0.137	0.133	0.052	0.055	0	0	0	0	0
1988	0.078	0.275	0.366	0.242	0.199	0.027	0	0	0	0	0
1989	0.047	0.424	0.739	0.29	0.061	0.022	0.022	0	0	0	0
1990	0	0.11	1.062	0.369	0.163	0.012	0.045	0	0	0	0
1991	0.435	0	0.254	0.685	0.263	0.021	0	0	0	0	0
1992	0	2.048	1.896	0.641	0.165	0.017	0	0	0	0	0
1993	0.046	0.29	0.5	0.317	0.027	0	0	0	0	0	0
1994	0	0.62	0.633	0.354	0.145	0.04	0	0	0	0	0
1995	0.04	1.179	4.811	1.485	0.64	0.01	0	0	0	0	0
1996	0.025	0.987	2.626	2.701	0.61	0.058	0	0	0	0	0
1997	0.019	1.169	3.733	4.081	0.703	0.134	0	0	0	0	0
1998	0	2.081	1.053	1.158	0.759	0.322	0.027	0	0	0	0
1999	0.05	4.746	10.819	2.72	1.623	0.426	0.329	0	0.024	0	0
2000	0.183	4.819	7.666	2.914	0.813	0.422	0.102	0	0	0	0
2001	0	2.315	6.563	2.411	0.484	0.352	0.101	0	0	0	0
2002	0.188	2.412	12.334	4.078	1.742	0.378	0.408	0.086	0	0	0
2003	0.202	4.37	6.764	2.876	0.442	0.128	0.536	0.198	0	0	0
2004	0.049	0.986	2.178	0.735	0.255	0.082	0.052	0.082	0	0	0
2005	0	2.013	5.08	2.403	0.27	0.037	0.052	0.025	0	0	0
2006	0.509	0.935	3.523	2.177	0.317	0.082	0	0	0	0	0
2007	0.09	5.048	6.263	2.846	0.556	0.108	0.021	0	0	0	0
2008	0	2.273	5.07	1.732	0.309	0.014	0.014	0	0	0	0

2009	0.221	0.643	7.884	4.858	1.028	0.195	0	0	0	0	0
2010	0.017	0.7	5.391	8.447	2.732	0.557	0.071	0.033	0	0	0
2011	0.036	0.273	3.795	4.246	1.101	0.107	0.013	0	0	0	0
2012	0.108	0.781	4.452	6.059	1.489	0.199	0.014	0	0	0	0
2013	0.053	0.403	1.049	1.456	0.687	0.116	0.014	0	0	0	0
2014	0.028	0.242	0.708	0.71	0.38	0.145	0.011	0.042	0	0	0
2015	0	0.201	0.559	0.457	0.394	0.043	0	0.01	0	0	0
2016	0.005	0.022	0.231	0.279	0.071	0.12	0.013	0	0	0	0
2017	0.011	0.09	0.068	0.104	0.174	0.094	0.055	0.022	0	0	0
2018	0	0.024	0	0	0	0	0	0.014	0	0	0
2019	0.174	0.064	0.087	0.061	0.038	0.136	0.158	0.052	0.029	0	0.01
2021	0.005	0	0.723	0.416	0.078	0.032	0	0.022	0.009	0.021	0
2022	0.005	0.019	0.051	0.095	0.041	0.03	0.02	0	0	0	0.01

Table 3.4.3a Abundance at age (ages 1-5) of GB yellowtail flounder caught in the fall NMFS Bottom Trawl survey (1970-2022).

Year	Age 1	Age 2	Age 3	Age 4	Age 5
1963	0	14.722	7.896	11.227	1.859
1964	0	1.722	9.805	7.312	5.966
1965	0.017	1.197	5.705	5.988	3.531
1966	1.416	11.663	2.251	1.685	0.898
1967	0.061	8.985	9.407	2.727	1.037
1968	0	11.671	12.057	5.758	0.745
1969	1.487	9.949	10.923	5.218	1.811
1970	0.952	4.61	5.132	3.143	1.952
1971	0.031	3.627	6.976	4.914	2.25
1972	0.91	2.462	6.525	4.824	2.094
1973	0.122	2.494	5.498	5.104	2.944
1974	1.234	4.622	2.864	1.516	1.06
1975	0.436	4.625	2.511	0.877	0.572
1976	0	0.344	1.92	0.474	0.117
1977	0	0.934	2.212	1.62	0.617
1978	0.038	4.76	1.281	0.78	0.411
1979	0.018	1.321	2.069	0.261	0.12
1980	0.08	0.766	5.12	6.091	0.682
1981	0.039	1.595	2.348	1.641	0.588
1982	0	2.425	2.184	1.59	0.423
1983	0	0.109	2.284	1.915	0.511
1984	0.033	0.661	0.4	0.306	0.243
1985	0.01	1.378	0.516	0.171	0.051
1986	0	0.282	1.108	0.349	0.074
1987	0	0.129	0.373	0.396	0.053
1988	0.011	0.019	0.213	0.107	0.027
1989	0.023	0.248	1.993	0.773	0.079
1990	0.183	0	0.37	1.473	0.294
1991	0	2.101	0.275	0.439	0.358
1992	0	0.151	0.396	0.712	0.162
1993	0	0.839	0.139	0.586	0.536
1994	0.01	1.195	0.221	0.983	0.713
1995	0.069	0.276	0.119	0.345	0.275
1996	0	0.149	0.352	1.869	0.447
1997	0	1.393	0.533	3.442	2.09
1998	0.05	1.9	4.817	4.202	1.19
1999	0.025	3.09	8.423	5.727	1.432
2000	0.019	0.629	1.697	4.814	2.421
2001	0.037	3.518	6.268	8.091	2.601
2002	0.052	2.093	5.751	2.127	0.594
2003	0.024	1.077	5.03	2.809	0.565

2004	0.019	0.876	5.508	5.01	2.106
2005	1.56	0.313	2.095	3.763	0.614
2006	0.117	6.194	6.251	3.664	1.167
2007	0.014	1.058	11.447	7.866	1.998
2008	0	0.168	7.174	9.883	1.033
2009	0	0.489	4.452	12.436	2.27
2010	0.013	0.128	2.885	4.616	0.8
2011	0.02	0.246	3.027	4.2	1.202
2012	0.009	0.219	1.675	4.131	1.791
2013	0.005	0.337	1.054	0.977	0.561
2014	0	0.175	1.244	1.189	0.69
2015	0.012	0.033	0.414	0.613	0.316
2016	0.006	0.082	0.487	0.597	0.283
2017	0.006	0.05	0.11	0.151	0.184
2018	0.214	0.196	0.119	0.360	0.459
2019	0	0.522	0.07	0.059	0.088
2021	0	0.009	0.036	0.368	0.161
2022	0	0.047	0.028	0	0.152

Table 3.4.3b Abundance at age (ages 6-11) of GB yellowtail flounder caught in the fall NMFS Bottom Trawl survey (1970-2022).

Year	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
1963	0.495	0.281	0.034	0.165	0.068	0
1964	2.714	0.365	0.122	0	0	0
1965	1.573	0.077	0.257	0	0	0
1966	0.101	0	0	0	0	0
1967	0.342	0.042	0.061	0	0	0
1968	0.965	0.058	0	0	0	0
1969	0.337	0.279	0.182	0	0	0
1970	0.452	0.063	0.017	0	0	0
1971	0.498	0.25	0.024	0.024	0	0
1972	0.61	0.342	0	0	0	0
1973	1.217	0.416	0.172	0	0.03	0
1974	0.458	0.249	0.13	0	0	0
1975	0.334	0.032	0	0	0	0.031
1976	0.122	0.033	0	0.033	0.033	0
1977	0.105	0.073	0.037	0.016	0	0
1978	0.136	0.012	0	0.024	0	0
1979	0.138	0.036	0.055	0	0.021	0
1980	0.219	0.172	0.053	0	0.033	0
1981	0.079	0.054	0	0	0	0
1982	0.089	0	0	0	0	0
1983	0.031	0.012	0	0	0.037	0
1984	0.075	0.044	0	0.018	0	0
1985	0.081	0	0	0	0	0
1986	0	0	0	0	0	0
1987	0.079	0	0	0	0	0
1988	0	0	0	0	0	0
1989	0.056	0	0	0	0	0
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0.144	0.027	0	0	0	0
1993	0	0	0.022	0	0	0
1994	0.263	0.031	0.026	0	0	0
1995	0.046	0.013	0	0	0	0
1996	0.075	0	0	0	0	0
1997	1.071	0.082	0	0	0	0
1998	0.298	0.055	0.019	0	0	0
1999	1.437	0.26	0	0	0	0
2000	0.948	0.799	0.027	0	0	0
2001	1.718	0.714	1.334	0	0	0
2002	0.277	0	0	0.055	0	0
2003	0.1	0.092	0.1	0	0	0

2004	0.924	0.176	0	0	0	0
2005	0.185	0	0	0	0	0
2006	0.255	0.032	0.014	0	0	0
2007	0.382	0.076	0.017	0	0	0
2008	0	0	0	0	0	0
2009	0.646	0.052	0.014	0	0	0
2010	0.303	0	0	0	0	0
2011	0.161	0.01	0	0	0	0
2012	0.501	0.016	0	0	0	0
2013	0.12	0.046	0	0	0	0
2014	0.158	0.067	0.013	0	0.011	0
2015	0.073	0.021	0	0	0	0
2016	0.093	0.038	0.011	0	0	0
2017	0.046	0.058	0.044	0	0	0
2018	0.257*	0.122*	0.033*	0.031*	0.012*	0
2019	0.021	0.138	0.132	0.028	0.021	0
2021	0.01	0.031	0	0.01	0	0
2022	0.033	0	0	0.014	0.015	0

Table 3.5.1 Set allocation, depth range (m), trawlable units and area (0.01181 square nautical miles) for each stratum from the Georges Bank survey. Stratum 5Z9 was introduced in 2010 and has not been included in subsequent analyses.

	Set allocation					
Strata	Primary	Secondar y	Total	Depth range (m)	Trawlable units	Square nautical miles
5Z1	6	4	10	93-183	67369	795
5Z2	20	15	35	<93	106096	1252
5Z3	10	5	15	0-183	194482	2295
5Z4	10	5	15	<93	260919	3079
5Z5	5	5	10	93-183	197956	2336
5Z6	8	4	12	<93	138807	1638
5Z7	5	3	8	<93	271088	3199
5Z8	3	3	6	93-183	170669	2014
5Z9 (2010-p resent)	3	3	6	>183	61014	720
Total	70	33	103		1468400	17328

Table 3.5.2 Vessels, years and compatibility with other ships for the survey vessel of the Canadian Ecosystem Survey.

	Years	Sister ship	Gear	Calibration
Templeman	1993, 2004, 2007, 2008	Needler	W. IIA	-
Needler	1987-1992, 1994-2004, 2005-2006, 2009-2015, 2017, 2019	Templeman	W. IIA	Teleost (2005/06)
Teleost	2005-2006, 2016-17, 2020-2021	Mersey Venture	W. IIA	Needler (2005/06)
Jaques Cartier	2022-2023	John Cabot	NEST	*Teleost/Needler (required)*
Mersey Venture	2018, 2023	Teleost	W. IIA	-

Table 3.5.3 Occurrence of yellowtail flounder in the Fisheries and Oceans Canada Ecosystem Survey (Fall 1987-2022).

Year	Number of tows	Number with Yellowtail	Percentage with Yellowtail (%)
1987	34	16	47
1988	84	40	48
1989	70	24	34
1990	75	32	43
1991	78	30	38
1992	69	46	67
1993	63	49	78
1994	44	22	50
1995	64	45	70
1996	69	49	71
1997	67	53	*79*
1998	76	41	54
1999	64	48	75
2000	75	53	71
2001	64	48	75
2002	64	48	75
2003	76	44	58
2004	68	44	65
2005	107	60	56
2006	85	54	64
2007	71	49	69
2008	57	42	74
2009	50	23	46
2010	57	34	60
2011	74	36	49
2012	75	53	71
2013	63	30	48
2014	52	25	48
2015	47	29	62
2016	61	26	43
2017	50	19	38
2018	58	21	36
2019	71	13	18
2020	59	15	25
2021	54	17	31
2022	--	--	--

Table 3.5.4 Fisheries and Oceans Canada survey indices of abundance for Georges Bank yellowtail flounder in both numbers and biomass (B; kg per tow), along with coefficient of variation (CV) for the biomass estimates.

	Numbers at age							
Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+	biomass (kg/tow)	CV biomass
1987	0.12	1.194	1.97	0.492	0.087	0.049	1.987	0.274
1988	0	1.776	1.275	0.61	0.278	0.024	1.964	0.217
1989	0.114	1.027	0.609	0.294	0.066	0.022	0.748	0.257
1990	0	2.387	3.628	0.914	0.209	0.014	2.405	0.222
1991	0.024	0.858	1.186	3.759	0.525	0.014	2.796	0.33
1992	0.055	11.039	3.677	0.99	0.35	0.03	3.937	0.163
1993	0.079	2.431	4.085	4.076	0.887	0.13	4.201	0.151
1994	0	6.056	3.464	3.006	0.781	0.207	4.378	0.228
1995	0.21	1.251	4.353	2.546	0.647	0.101	3.223	0.201
1996	0.446	7.142	9.174	5.406	1.155	0.123	8.433	0.223
1997	0.022	12.482	13.902	16.369	4.044	0.67	21.138	0.233
1998	0.893	3.33	4.907	4.334	1.988	0.558	6.826	0.244
1999	0.159	20.861	20.834	7.669	5.35	2.2	28.093	0.325
2000	0.011	13.765	27.442	19.243	5.069	3.689	31.723	0.253
2001	0.291	19.896	42.124	13.307	4.581	2.397	35.236	0.416
2002	0.088	11.962	31.015	12.234	5.553	2.833	32.916	0.305
2003	0.089	11.889	24.618	11.086	3.421	1.988	25.839	0.317
2004	0.033	3.599	16.26	9.205	2.273	1.416	14.397	0.313
2005	0.6	1.602	27.959	20.564	5.696	1.565	21.24	0.53
2006	0.623	4.893	18.6	6.572	0.82	0.238	10.462	0.444
2007	0.173	12.159	27.708	12.799	2.288	0.248	21.219	0.435
2008	0	48.315	170.363	57.119	8.059	0.055	107.052	0.939
2009	0.021	8.54	137.957	116.966	19.9	4.764	114.566	0.791
2010	0	0.489	9.392	20.943	3.533	1.279	14.532	0.294
2011	0.022	0.651	6.093	8.205	1.701	0.327	6.091	0.294
2012	0.044	0.644	8.243	11.423	3.096	0.453	8.937	0.356
2013	0.081	0.129	0.831	1.254	0.604	0.14	1.109	0.328
2014	0.03	0.395	0.741	0.96	0.471	0.018	0.816	0.337
2015	0	0.467	1.112	1.659	0.747	0.093	1.308	0.367
2016	0	0.218	3.151	2.104	1.257	0.657	2.748	0.608
2017	0	0.014	0.185	0.435	0.437	0.388	0.545	0.469
2018	0	0.006	0.263	0.194	0.315	0.223	0.401	0.378
2019	0.005	0.053	0.029	0.045	0.005	0.092	0.09	0.381
2020	0	0.453	0.266	0.059	0.025	0.065	0.199	0.333
2021	0	0.009	0.381	0.318	0.032	0.016	0.22	0.305
2022	--	--	--	--	--	--	--	--

Table 3.6.1 Indices of abundance (number/tow) and biomass (kg/tow) of Southern New England/Mid-Atlantic yellowtail flounder, caught in the NMFS Bottom Trawl Survey.

	Abundance (number/tow)				Biomass (kg/tow)			
	Fall		Spring		Fall		Spring	
Year	Index	CV	Index	CV	Index	CV	Index	CV
1963	54.079	0.164	--	--	19.102	0.169	--	--
1964	54.808	0.163	--	--	18.054	0.171	--	--
1965	51.750	0.308	--	--	13.146	0.194	--	--
1966	60.777	0.194	--	--	11.698	0.152	--	--
1967	81.940	0.152	--	--	18.002	0.134	--	--
1968	76.092	0.210	102.701	0.144	16.688	0.185	23.929	0.141
1969	75.921	0.246	81.859	0.120	18.392	0.246	18.319	0.121
1970	79.340	0.258	62.001	0.141	20.807	0.252	15.445	0.124
1971	59.238	0.280	50.111	0.123	11.488	0.269	12.226	0.117
1972	150.518	0.345	51.632	0.156	40.375	0.349	13.811	0.140
1973	15.154	0.400	27.535	0.114	4.000	0.361	7.938	0.114
1974	6.431	0.387	10.973	0.196	1.977	0.401	3.639	0.206
1975	3.007	0.450	2.984	0.165	0.729	0.470	1.007	0.142
1976	8.719	0.317	3.556	0.199	2.501	0.317	1.125	0.190
1977	4.624	0.305	4.208	0.266	1.224	0.328	1.332	0.243
1978	7.758	0.255	11.244	0.162	2.180	0.253	2.600	0.142
1979	6.892	0.183	3.541	0.204	1.978	0.186	0.829	0.166
1980	5.320	0.336	8.866	0.124	1.473	0.337	3.180	0.114
1981	21.359	0.228	16.156	0.163	4.402	0.214	4.359	0.163
1982	30.470	0.373	26.043	0.171	7.304	0.364	6.381	0.178
1983	23.564	0.292	18.224	0.138	5.748	0.283	5.245	0.122
1984	5.590	0.266	5.025	0.162	1.323	0.266	1.667	0.161
1985	1.239	0.308	3.635	0.242	0.253	0.324	0.948	0.220
1986	2.701	0.293	4.201	0.116	0.657	0.304	1.052	0.112
1987	2.028	0.395	0.954	0.219	0.401	0.441	0.319	0.245
1988	5.032	0.233	1.262	0.240	0.511	0.268	0.378	0.224
1989	10.312	0.295	10.219	0.166	2.005	0.297	1.776	0.166
1990	4.842	0.318	15.467	0.189	1.109	0.282	4.304	0.183
1991	2.307	0.269	6.887	0.134	0.642	0.242	2.132	0.133
1992	0.548	0.427	2.255	0.184	0.147	0.437	0.794	0.193
1993	0.505	0.341	0.894	0.203	0.098	0.285	0.341	0.204
1994	1.507	0.373	0.330	0.252	0.308	0.365	0.116	0.327
1995	1.209	0.644	1.432	0.183	0.304	0.640	0.329	0.157
1996	0.929	0.456	2.339	0.215	0.208	0.404	0.747	0.199
1997	3.095	0.292	2.475	0.340	0.851	0.309	0.789	0.303
1998	2.728	0.357	3.688	0.212	0.655	0.367	0.848	0.196
1999	1.965	0.574	3.062	0.120	0.468	0.549	1.138	0.126
2000	2.216	0.468	2.873	0.163	0.718	0.462	0.990	0.161
2001	1.231	0.434	1.572	0.223	0.420	0.467	0.653	0.239

2002	3.024	0.403	1.742	0.329	1.095	0.418	0.510	0.315
2003	2.313	0.490	0.449	0.311	0.434	0.515	0.167	0.376
2004	0.264	0.321	0.600	0.345	0.103	0.428	0.229	0.325
2005	2.634	0.232	0.684	0.225	0.496	0.276	0.222	0.295
2006	3.534	0.298	1.995	0.353	0.701	0.311	0.390	0.340
2007	1.727	0.368	1.454	0.178	0.451	0.374	0.367	0.191
2008	3.285	0.354	1.264	0.509	0.936	0.374	0.444	0.523
2009	1.729	0.307	2.051	0.260	0.440	0.297	0.686	0.291
2010	12.158	0.468	2.844	0.111	3.654	0.474	0.824	0.117
2011	2.026	0.629	2.430	0.166	0.644	0.699	0.765	0.166
2012	5.602	0.400	2.596	0.179	1.548	0.437	0.793	0.191
2013	1.512	0.294	2.410	0.194	0.437	0.300	0.645	0.179
2014	0.372	0.523	1.651	0.265	0.123	0.516	0.511	0.258
2015	0.100	0.344	0.444	0.270	0.037	0.385	0.172	0.283
2016	0.438	0.516	0.341	0.304	0.138	0.556	0.108	0.338
2017	--	--	0.110	0.272	--	--	0.032	0.281
2018	0.104	0.445	0.193	0.233	0.022	0.449	0.054	0.249
2019	0.169	0.300	0.234	0.461	0.025	0.305	0.029	0.352
2020	--	--	0	--	--	--	0	--
2021	0.028	0.861	0.017	0.650	0.003	0.861	0.004	0.663
2022	0.020	0.661	0.020	0.540	0.003	0.661	0.004	0.609

Table 3.6.2a Abundance at age (ages 0-5) of SNEMA yellowtail flounder caught in the spring NMFS Bottom Trawl survey (1970-2022).

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5
1968	0	1.931	35.685	47.65	15.86	1.376
1969	0	4.277	22.482	35.917	16.958	2.035
1970	0	1.289	9.616	25.197	20.561	4.342
1971	0	0.564	9.292	9.958	25.305	4.53
1972	0	0.392	14.92	13.665	7.303	12.062
1973	0	0.546	3.305	9.033	5.081	3.941
1974	0	0.354	1.5	1.769	3.418	2.081
1975	0	0.248	0.887	0.299	0.372	0.665
1976	0	0.011	2.573	0.347	0.167	0.158
1977	0.03	0.941	0.983	1.724	0.158	0.099
1978	0	1.858	7.12	1.262	0.539	0.175
1979	0	0.591	1.748	0.926	0.166	0.072
1980	0	0.424	3.902	2.644	1.667	0.164
1981	0	0.508	10.927	2.838	1.464	0.352
1982	0	0.203	17.921	5.818	1.459	0.478
1983	0	0.04	6.482	10.739	0.73	0.211
1984	0	0.047	0.553	1.1	2.667	0.405
1985	0	0.267	1.613	0.406	0.48	0.714
1986	0	0.016	2.893	0.916	0.237	0.124
1987	0	0	0.086	0.701	0.167	0
1988	0	0.285	0.357	0.124	0.174	0.294
1989	0	0.138	9.529	0.456	0.096	0
1990	0	0.076	0.413	13.047	1.878	0.054
1991	0	0.208	0.505	2.133	3.533	0.458
1992	0	0.036	0.051	0.571	1.597	0
1993	0	0.016	0.253	0.112	0.441	0.071
1994	0	0.013	0.229	0.014	0	0.058
1995	0	0.016	1.169	0.068	0.092	0.019
1996	0	0	0.398	1.303	0.567	0.072
1997	0	0.053	0.885	1.144	0.327	0.067
1998	0	0.068	3.016	0.386	0.161	0.036
1999	0	0.035	0.651	1.93	0.349	0.074
2000	0	0.019	1.158	1.483	0.197	0.016
2001	0	0	0.069	1.158	0.24	0.082
2002	0	0.049	1.191	0.235	0.2	0.067
2003	0	0.031	0.075	0.203	0.107	0.032
2004	0	0.016	0.136	0.292	0.082	0.054
2005	0	0.147	0.206	0.097	0.067	0.152
2006	0	0.05	1.584	0.224	0.106	0
2007	0	0	0.576	0.79	0.088	0
2008	0	0	0.05	0.685	0.48	0.049

2009	0	0.081	0.49	0.451	0.692	0.313
2010	0	0.082	0.916	1.013	0.361	0.441
2011	0	0.189	0.556	0.632	0.671	0.18
2012	0	0.027	1.298	0.29	0.395	0.278
2013	0	0.254	0.207	1.281	0.371	0.164
2014	0	0.008	0.399	0.337	0.701	0.146
2015	0	0.009	0.012	0.132	0.116	0.168
2016	0	0.088	0.024	0.048	0.052	0.06
2017	0	0.011	0.023	0.013	0	0.014
2018	0	0.032	0.092	0	0.016	0
2019	0	0.129	0.071	0.008	0.009	0.009
2021	0	0	0.007	0.01	0	0
2022	0	0.004	0	0.008	0.008	0

Table 3.6.2b Abundance at age (ages 6-11) of SNEMA yellowtail flounder caught in the spring NMFS Bottom Trawl survey (1970-2022). *Indicates age length key was incomplete.

Year	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
1968	0.121	0.079	0	0	0	0
1969	0.166	0.025	0	0	0	0
1970	0.81	0.165	0	0.022	0	0
1971	0.452	0.005	0	0	0.005	0
1972	2.94	0.35	0	0	0	0
1973	4.902	0.526	0.147	0.054	0	0
1974	0.81	0.919	0.104	0.017	0	0
1975	0.368	0.055	0.09	0	0	0
1976	0.205	0.073	0.021	0	0	0
1977	0.131	0.067	0.049	0	0.027	0
1978	0.088	0.085	0.11	0.007	0	0
1979	0.01	0.01	0.009	0	0	0.007
1980	0.044	0.007	0.004	0.008	0	0.002
1981	0.067	0	0	0	0	0
1982	0.152	0.012	0	0	0	0
1983	0.022	0	0	0	0	0
1984	0.253	0	0	0	0	0
1985	0.136	0.019	0	0	0	0
1986	0.016	0	0	0	0	0
1987	0	0	0	0	0	0
1988	0.029	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0	0	0	0	0	0
1991	0.051	0	0	0	0	0
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	0.016	0	0	0	0	0
1995	0.037	0	0.016	0.016	0	0
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0.021	0	0	0	0	0
1999	0	0.023	0	0	0	0
2000	0	0	0	0	0	0
2001	0.023	0	0	0	0	0
2002	0	0	0	0	0	0
2003	0	0	0	0	0	0
2004	0	0.019	0	0	0	0
2005	0	0.016	0	0	0	0
2006	0	0.016	0.016	0	0	0
2007	0	0	0	0	0	0
2008	0	0	0	0	0	0

2009	0.016	0.008	0	0	0	0
2010	0.031	0	0	0	0	0
2011	0.168	0.021	0.012	0	0	0
2012	0.093	0.178	0.021	0	0	0
2013	0.084	0.045	0	0	0	0
2014	0.021	0.02	0.01	0.01	0	0
2015	0	0	0	0	0	0
2016	0.044	0.008	0.017	0	0	0
2017	0	0.029	0.008	0	0	0
2018	0	0	0.053	0	0	0
2019	0	0	0	0.009	0	0
2021	0	0	0	0	0	0
2022	0	0	0	0	0	0

Table 3.6.3 Abundance at age of SNEMA yellowtail flounder caught in the fall NMFS Bottom Trawl survey (1970-2022).

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
1963	0.036	17.359	16.153	11.409	7.514	1.272	0.196	0.087	0.052	0
1964	0	16.957	23.262	4.125	6.534	3.224	0.706	0	0	0
1965	0.41	26.35	16.382	5.188	1.799	1.453	0.17	0	0	0
1966	0.865	40.173	15.259	3.114	1.141	0.227	0	0	0	0
1967	3.066	24.399	36.65	15.623	1.42	0.585	0.051	0.146	0	0
1968	1.195	13.284	28.836	30.059	2.084	0.448	0.186	0	0	0
1969	0.658	12.414	15.734	41.543	5.501	0.072	0	0	0	0
1970	0	5.467	9.818	36.493	23.036	4.031	0.438	0.057	0	0
1971	0.671	16.772	15.355	9.766	13.699	2.328	0.198	0.448	0	0
1972	0	3.959	40.185	40.369	40.358	22.733	2.803	0.113	0	0
1973	0	1.801	2.273	5.154	2.827	2.008	0.923	0.169	0	0
1974	0.161	0.913	1.424	0.507	1.979	0.838	0.362	0.178	0.017	0.051
1975	0	1.711	0.482	0.171	0.259	0.257	0.046	0.082	0	0
1976	0	2.396	5.129	0.427	0.056	0.089	0.232	0.268	0.121	0
1977	0.029	2.344	1.492	0.586	0.034	0.029	0.025	0.056	0.029	0
1978	0	2.157	4.948	0.307	0.244	0.025	0.006	0.05	0	0.021
1979	0	1.548	3.404	1.637	0.249	0.027	0.026	0	0	0
1980	0	1.196	3.015	0.785	0.324	0	0	0	0	0
1981	0	9.757	9.849	1.404	0.205	0.119	0.026	0	0	0
1982	0	2.46	21.709	5.358	0.653	0.291	0	0	0	0
1983	0	2.314	13.77	6.835	0.566	0.047	0	0.032	0	0
1984	0	1.762	1.555	1.865	0.408	0	0	0	0	0
1985	0	0.739	0.362	0.092	0.046	0	0	0	0	0
1986	0	0.469	1.627	0.458	0.131	0.015	0	0	0	0
1987	0	1.012	0.492	0.428	0.039	0.033	0	0.024	0	0
1988	0	4.392	0.318	0.141	0.141	0.013	0.026	0	0	0
1989	0	0.02	8.9	1.236	0.147	0.01	0	0	0	0
1990	0	0.024	1.7	2.888	0.23	0	0	0	0	0
1991	0	0.48	0.207	1.306	0.312	0	0	0	0	0
1992	0	0.168	0.024	0.072	0.284	0	0	0	0	0
1993	0	0.282	0.024	0.11	0.088	0	0	0	0	0
1994	0	0.76	0.446	0.107	0.116	0.053	0.025	0	0	0
1995	0	0.139	0.645	0.257	0.115	0	0	0.025	0.028	0
1996	0	0.448	0.161	0.319	0	0	0	0	0	0
1997	0	0.822	0.519	1.459	0.271	0.024	0	0	0	0
1998	0.023	0.89	1.62	0.123	0.049	0	0.023	0	0	0
1999	0	1.238	0.392	0.279	0.028	0.028	0	0	0	0
2000	0	0.049	1.669	0.303	0.171	0	0	0.023	0	0
2001	0	0.39	0.611	0.158	0.071	0	0	0	0	0
2002	0.026	0.254	1.748	0.855	0.141	0	0	0	0	0
2003	0.612	1.17	0.008	0.269	0.229	0	0.025	0	0	0

2004	0	0.07	0.098	0	0.023	0.048	0.025	0	0	0
2005	0	1.888	0.464	0.185	0.049	0.048	0	0	0	0
2006	0	1.192	2.152	0.171	0.019	0	0	0	0	0
2007	0	0.224	1.12	0.356	0	0.026	0	0	0	0
2008	0	1.065	0.394	1.073	0.669	0.059	0.025	0	0	0
2009	0	0.398	0.644	0.382	0.283	0.022	0	0	0	0
2010	0.004	0.293	5.685	3.128	2.243	0.805	0	0	0	0
2011	0	0.284	0.476	0.655	0.403	0.19	0.017	0	0	0
2012	0	0.314	3.031	1.212	0.686	0.165	0.157	0.036	0	0
2013	0	0.239 *	0.232 *	0.749 *	0.16 *	0.08 *	0.034 *	0	0.01 *	0
2014	0	0.038	0.143	0.058	0.111	0	0.023	0	0	0
2015	0	0	0	0.04	0.048	0	0.012	0	0	0
2016	0	0.103	0.125	0.031	0.086	0.036	0.053	0.005	0	0
2018	0	0.043	0.061	0	0	0	0	0	0	0
2019	0	0.169	0	0	0	0	0	0	0	0
2021	0	0.028	0	0	0	0	0	0	0	0
2022	0	0.02	0	0	0	0	0	0	0	0

Table 3.6.4 Abundance at age of SNEMA yellowtail flounder caught in the winter NMFS Bottom Trawl survey (1992-2007).

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1992	0	1.618	3.477	8.063	0.959	0	0	0
1993	0.596	1.924	1.057	2.487	0.292	0	0	0
1994	0.366	8.655	0.742	1.654	0.966	0.353	0.118	0
1995	0.074	10.681	2.698	0.597	0.253	0.185	0.016	0
1996	0.041	1.285	8.235	0.851	0.14	0.065	0.015	0.015
1997	0	2.38	9.785	2.958	0.529	0	0.038	0
1998	0.118	7.841	1.596	1.158	0.112	0	0.018	0
1999	0.243	2.909	10.176	0.777	0.311	0.056	0.023	0
2000	0.027	4.917	3.006	1.16	0.073	0.1	0	0
2001	0.017	0.895	8.542	1.615	0.253	0.078	0.028	0
2002	0	2.735	2.578	2.047	0.1	0.02	0	0
2003	0.39	0.821	3.055	0.623	0.05	0	0.03	0
2004	0.051	0.962	0.319	0.589	0.121	0.044	0	0
2005	0.381	0.769	0.616	0.519	0.481	0.032	0.043	0
2006	0.696	18.736	4.558	0.345	0.089	0.113	0.017	0.014
2007	0.032	6.828	7.538	1.336	0.095	0	0	0

Table 3.7.1 Larval index for southern New England yellowtail flounder for years during which the 505 μm mesh net was used. Note that this index is not directly comparable to the index values obtained with the 330 μm mesh net.

Year	index
1977	33.6
1978	27.3
1979	38.2
1980	112.5
1981	68.2
1982	47.3
1983	166
1984	51.5
1985	16.6
1986	22.2
1987	70.2

Table 3.7.2. Larval index for southern New England yellowtail flounder for years during which the 330 µm mesh net was used. Note that this index is not directly comparable to the index values obtained with the 505 µm mesh net.

Year	index
1995	43.447
1996	--
1997	--
1998	--
1999	--
2000	59.885
2001	246.391
2002	121.669
2003	--
2004	78.517
2005	58.215
2006	48.696
2007	49.82
2008	--
2009	66.242
2010	203.402
2011	227.08
2012	2.733
2013	6.053
2014	68.827
2015	23.505
2016	10.724
2017	4.296
2018	3.197
2019	1.428
2020	--
2021	0.061
2022	0.004

Figures

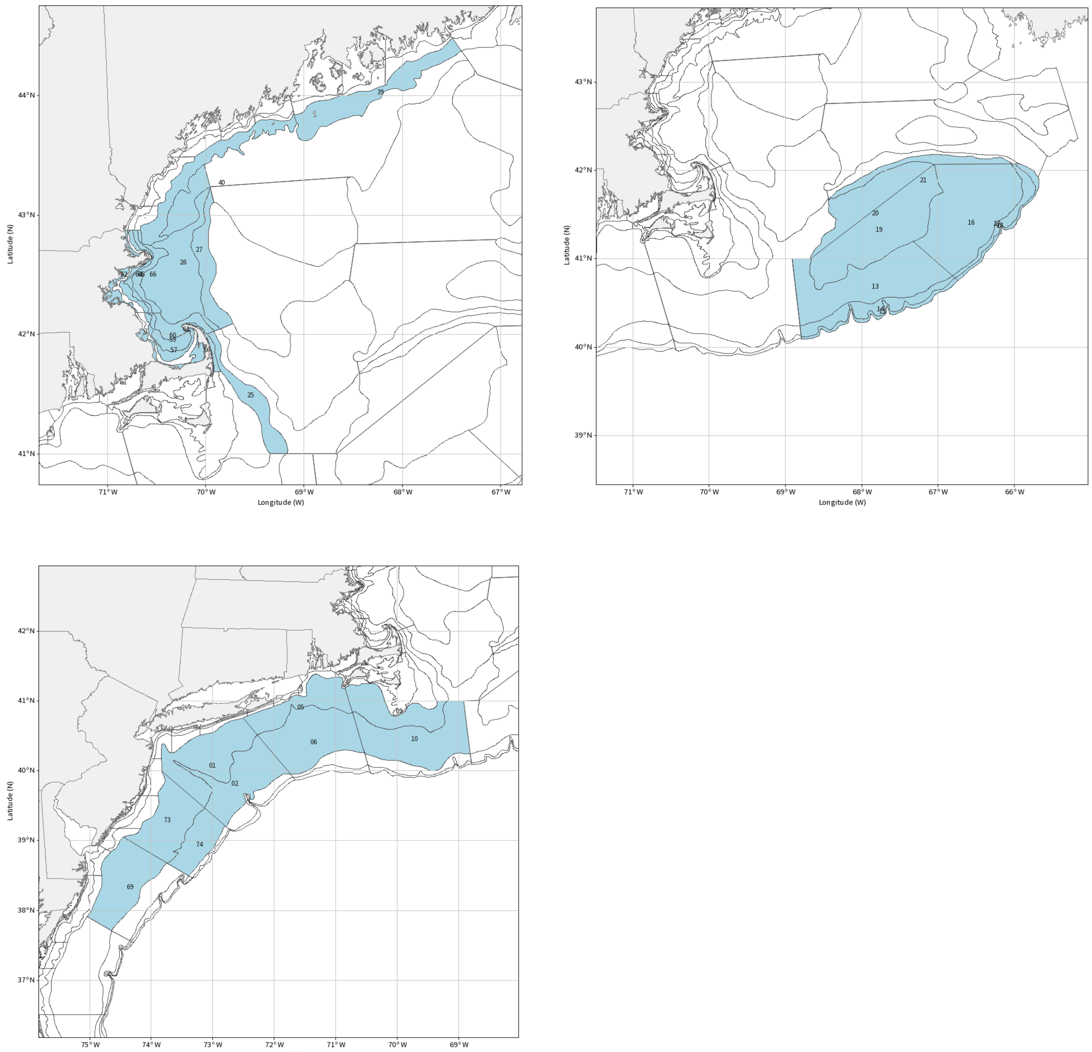


Figure 3.1.1 Strata covered by the current NEFSC bottom trawl survey for three stock areas, clockwise from top left: Cape Cod/Gulf of Maine, Georges Bank and Southern New England.

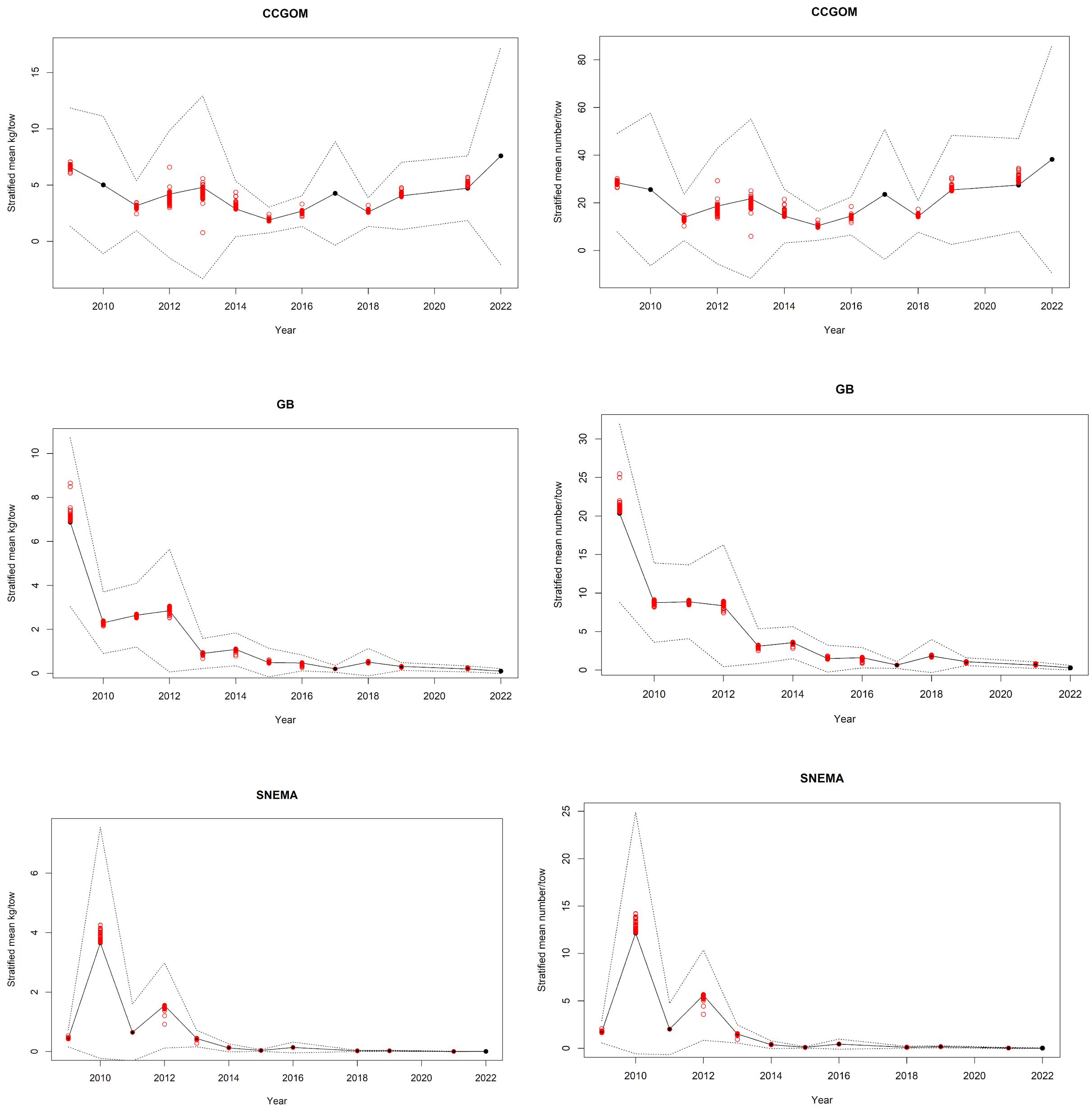


Figure 3.1.2 Results of a resampling procedure to assess the sensitivity of the FSV Henry B. Bigelow index to missing data. Data from the NMFS BTS Fall survey 2009-2021 was resampled 100 times, pulling a number of tows equivalent to the number of tows in 2022. The resulting annual stratified random mean (red dots) was plotted against the raw survey indices (black line). The 95% confidence intervals for the survey indices are given as black dotted lines. The weight (left column) and number of fish (right column) are given for each stock area: Cape Cod/Gulf of Maine (top row), Georges Bank (middle row) and Southern New England/Mid-Atlantic (bottom row).

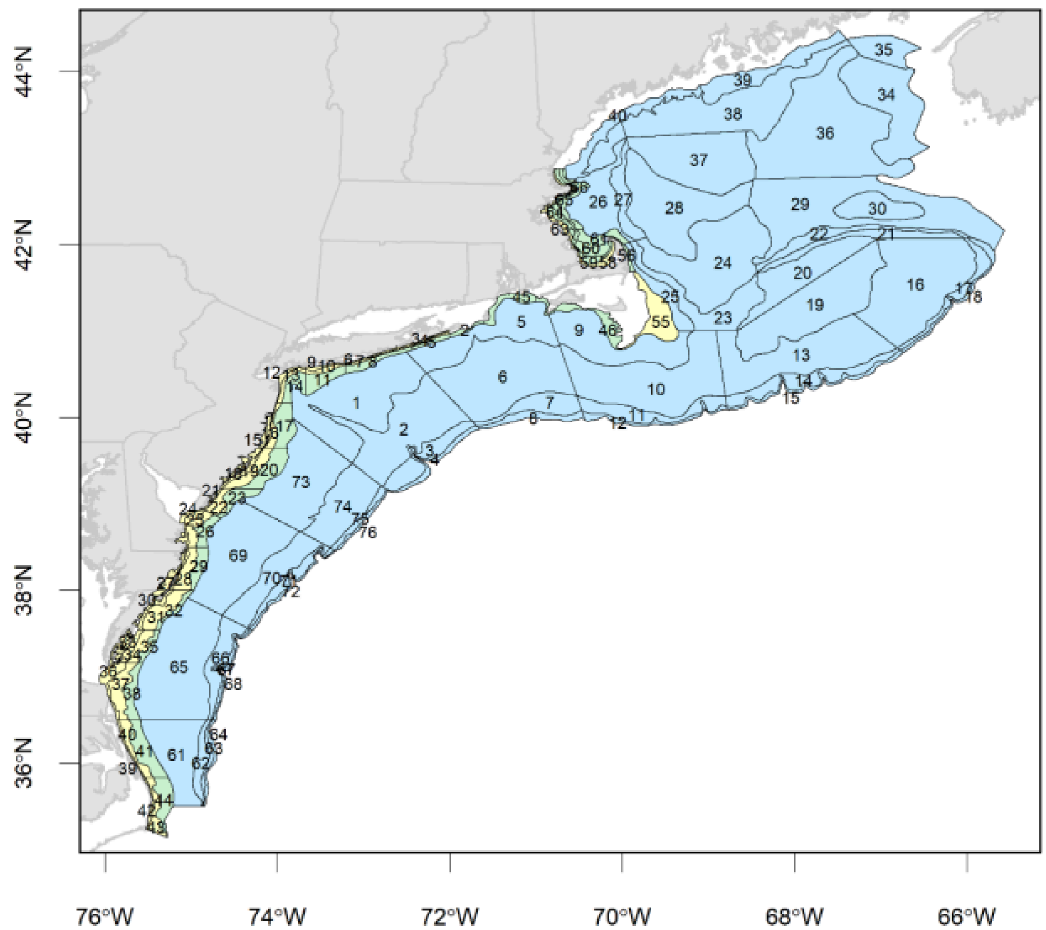


Figure 3.1.3 Northeast Fisheries Science Center bottom trawl survey strata. Offshore strata (prefix 01) are in blue, and inshore strata (prefix 03) are in green. The shallow inshore strata (< 18 m) that were sampled by the FRV Albatross IV but not sampled by the FSV Henry B. Bigelow are in yellow.

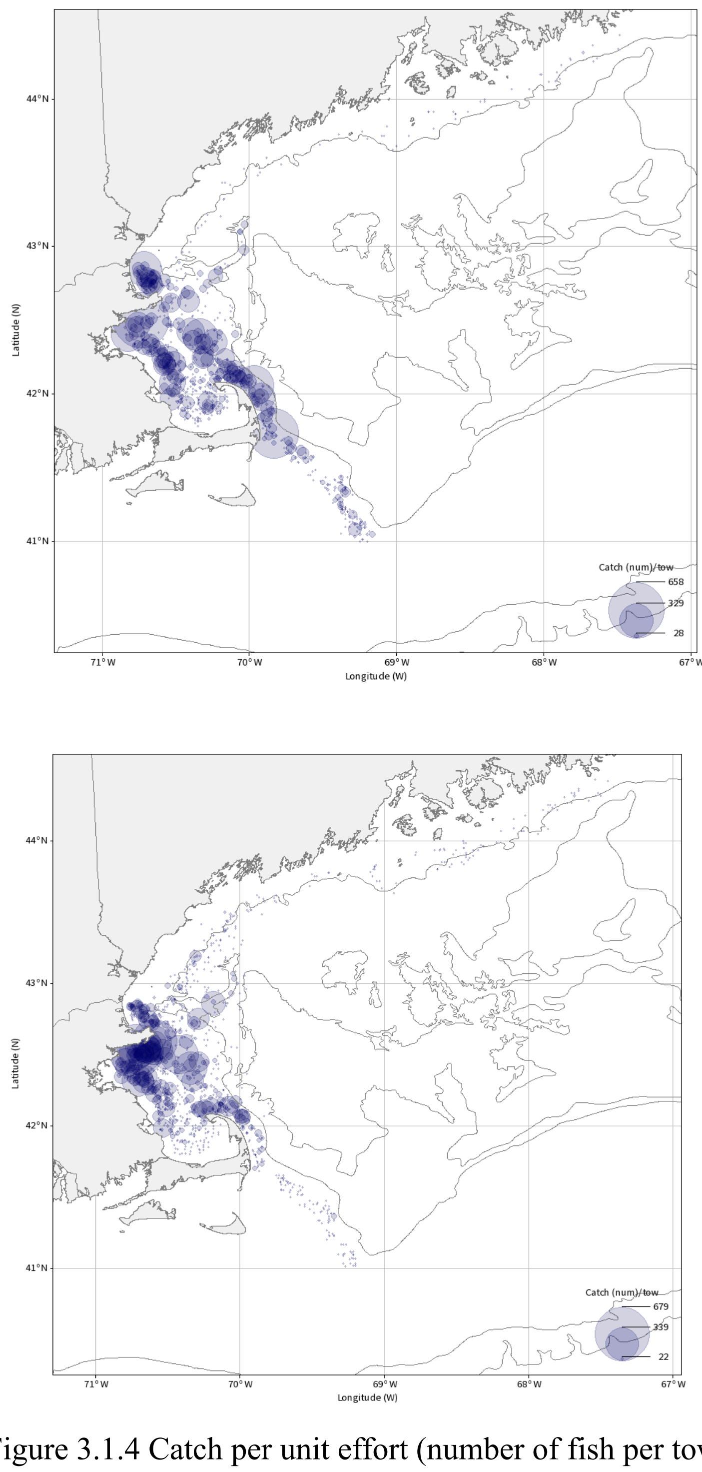


Figure 3.1.4 Catch per unit effort (number of fish per tow) in the NEFSC Bottom Trawl Survey for the Cape Cod Gulf of Maine stock: Fall (top panel) and Spring (bottom panel) 1963-2022.

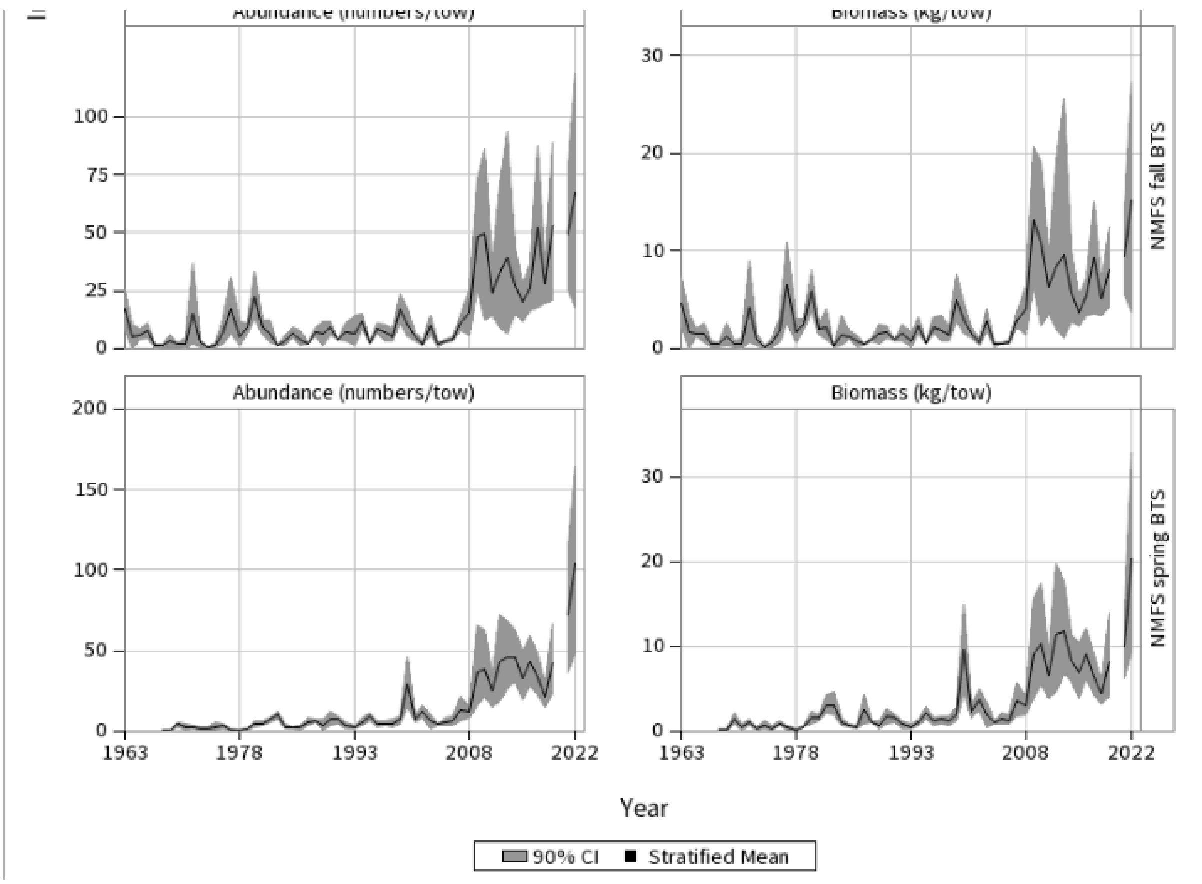


Figure 3.1.5 Stratified mean abundance and biomass for the Cape Cod Gulf of Maine stock, as captured by the NMFS Bottom Trawl Survey, for the Fall (top row) and Spring (bottom row). Red points indicate incomplete sampling.

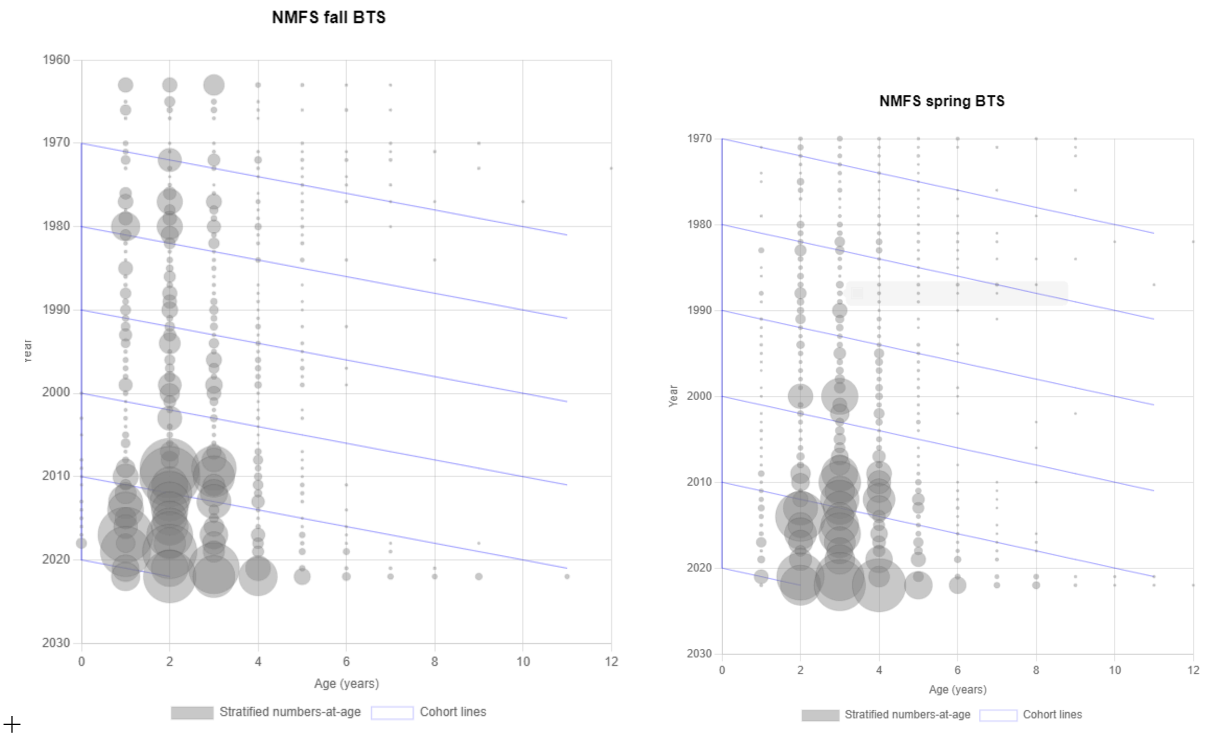


Figure 3.1.6 Stratified mean numbers at age of CCGOM yellowtail flounder caught in the NEFSC Bottom Trawl Survey Fall (left panel) and Spring (right panel) from 1963-2022 (fall) and 1968-2022 (spring). Years with incomplete strata are indicated in red.

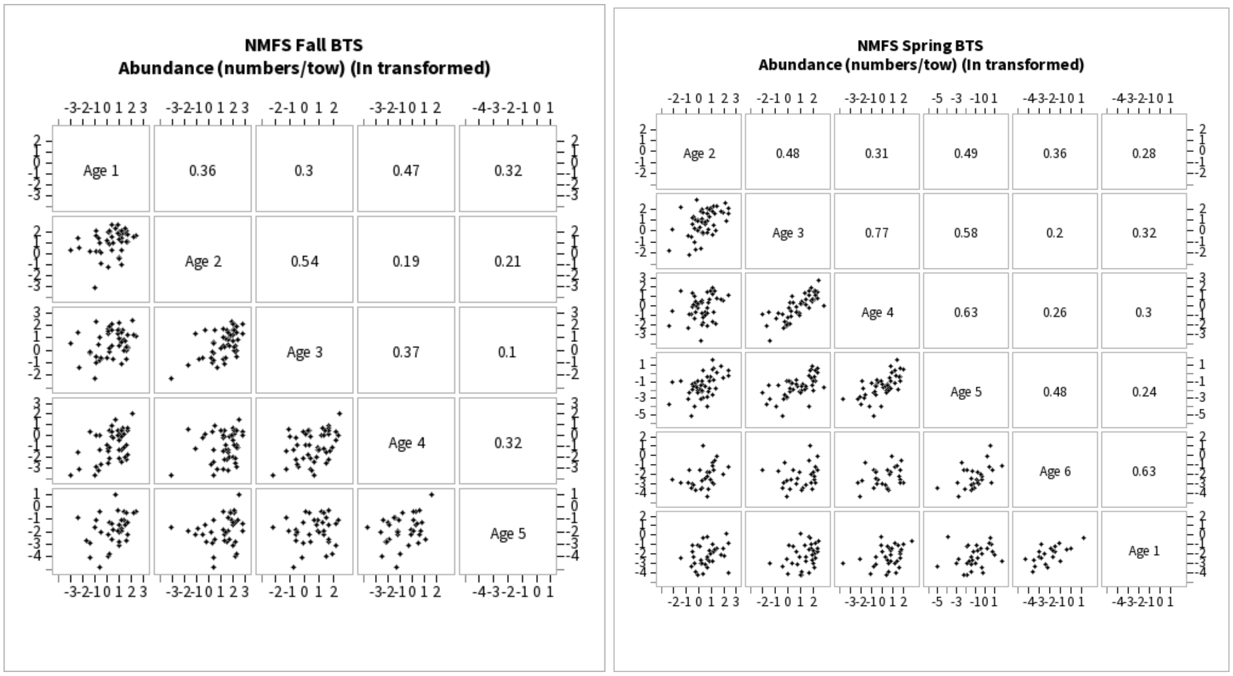


Figure 3.1.7 Cohort tracking described by correlation of abundance at age and the abundance of that age the previous year for the Cape Cod Gulf of Maine stock, as captured by the NMFS Bottom Trawl Survey, for the fall (top row, left panel), spring (top row, right panel) and winter (bottom row).

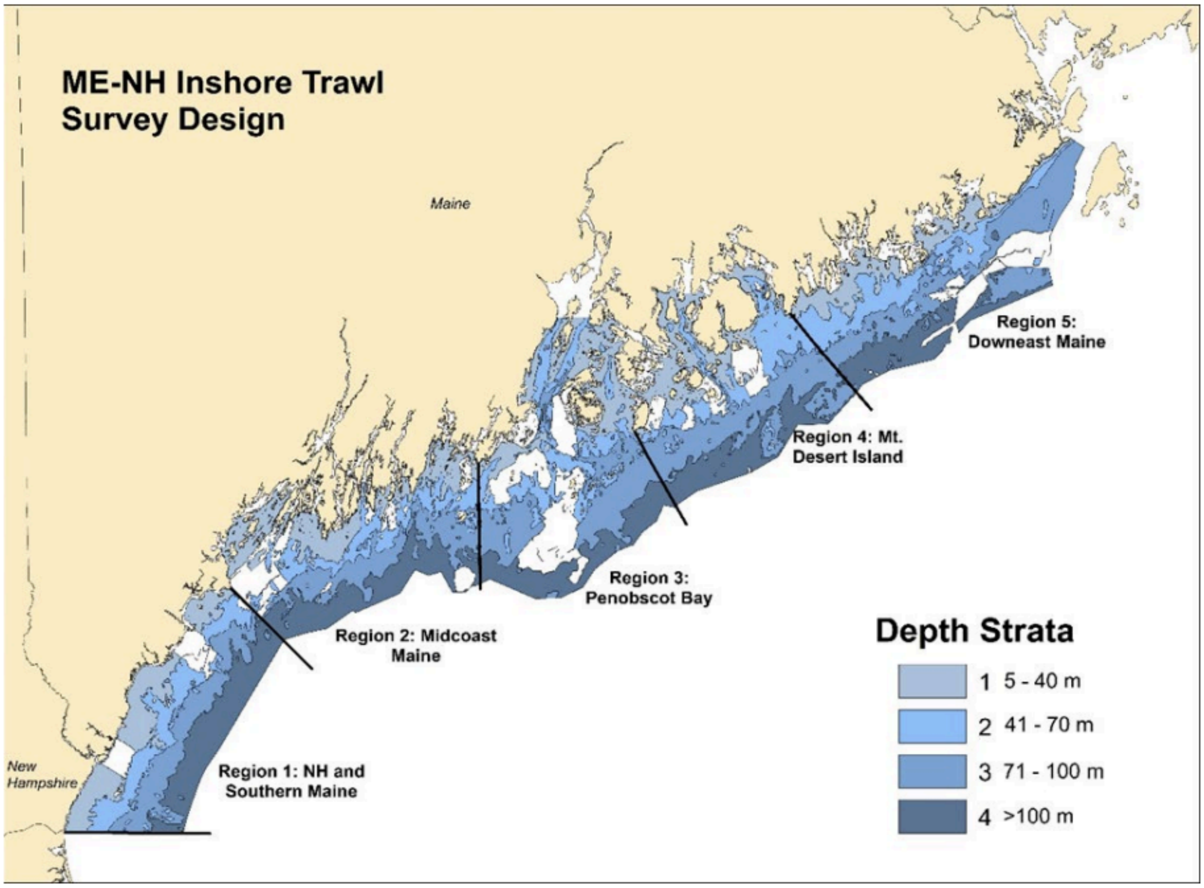


Figure 3.2.1 Regional and depth strata for the Maine-New Hampshire Inshore Trawl Survey.

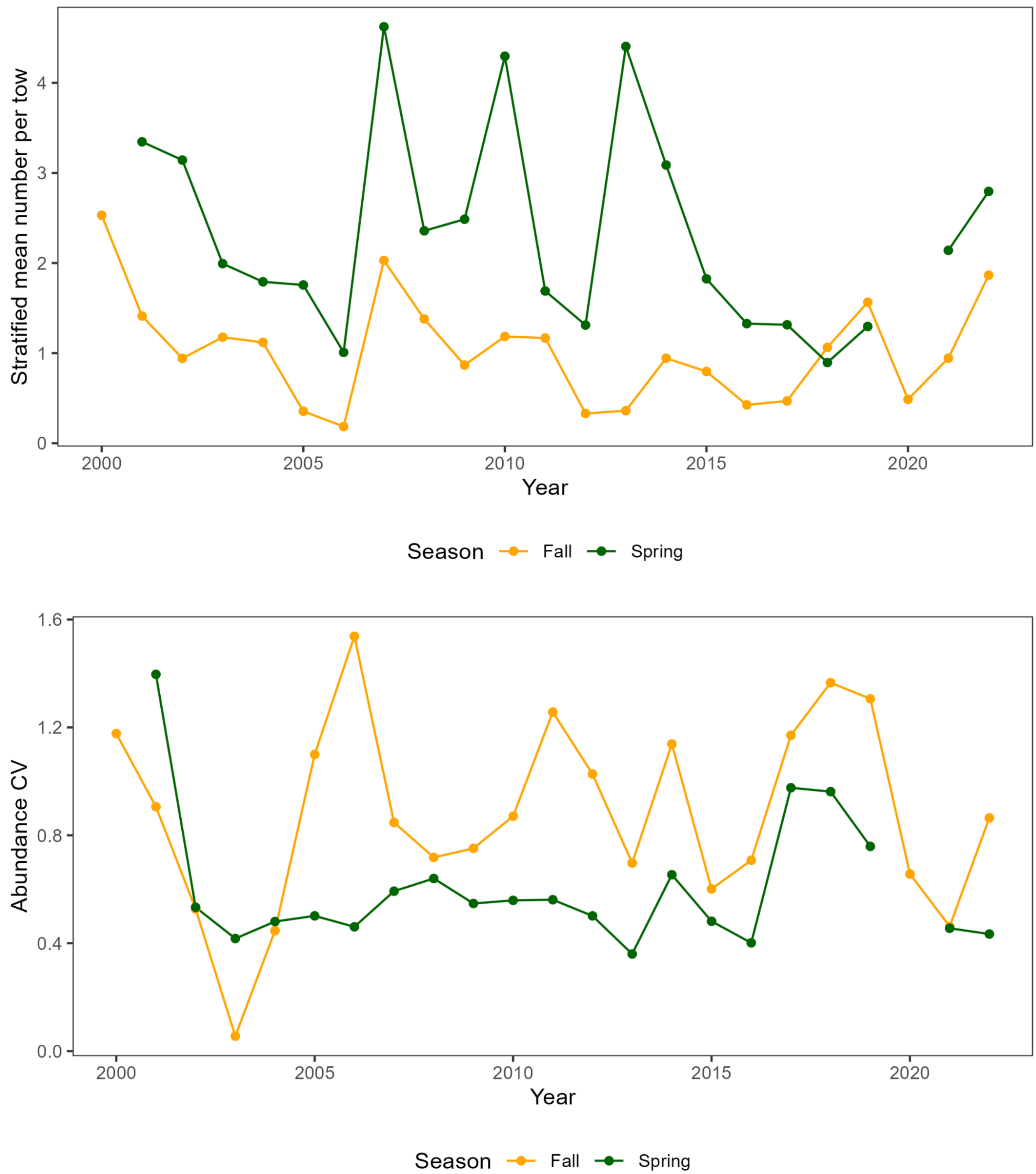


Figure 3.2.2 Abundance (stratified mean number per tow, top panel) and coefficient of variation (CV, bottom panel) of yellowtail flounder caught in the Maine-New Hampshire Inshore Trawl survey from 2000-2022.

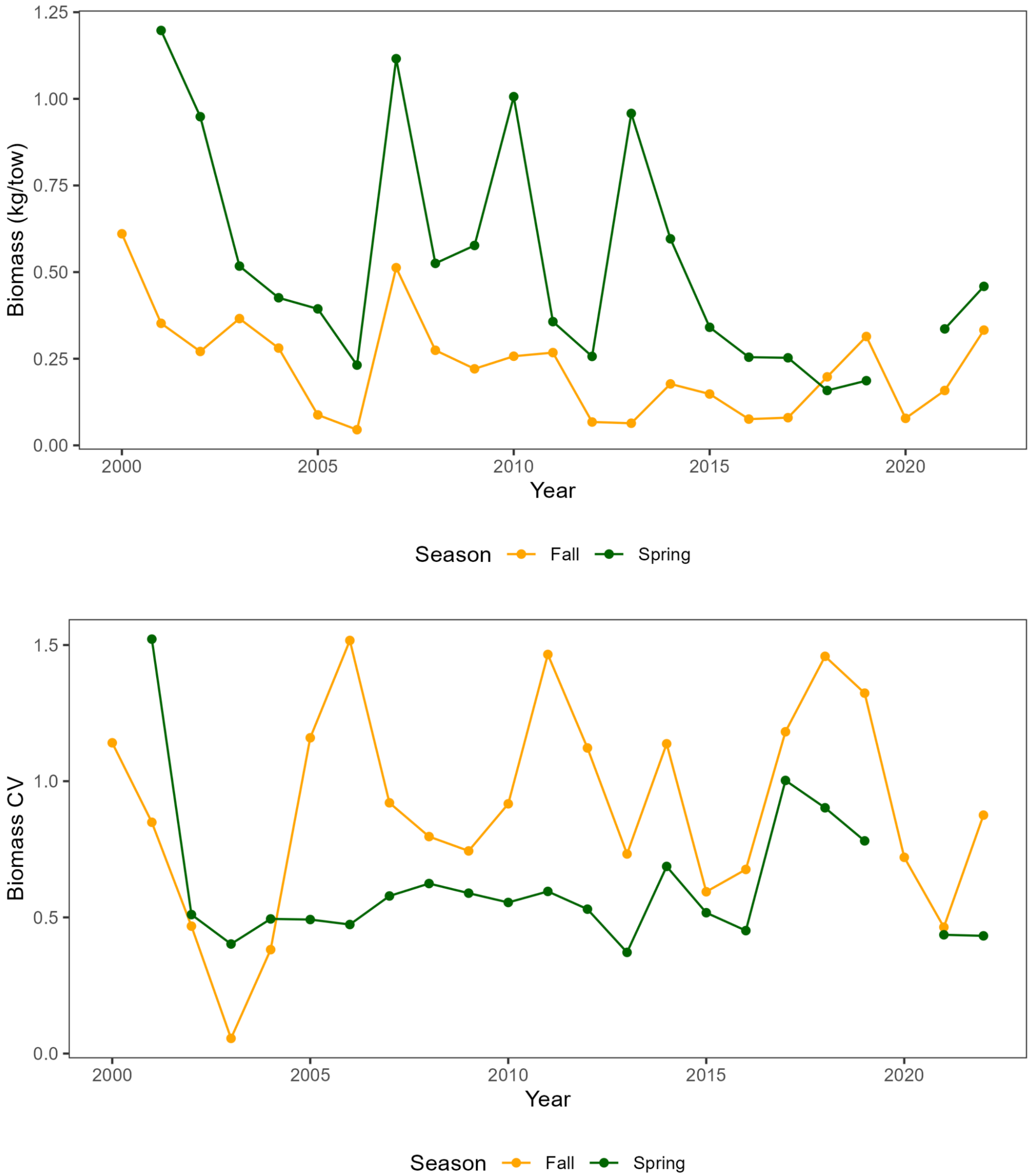


Figure 3.2.3 Biomass (kg per tow, top panel) and CV (bottom panel) of yellowtail flounder caught in the Maine-New Hampshire Inshore Trawl survey from 2000-2022.

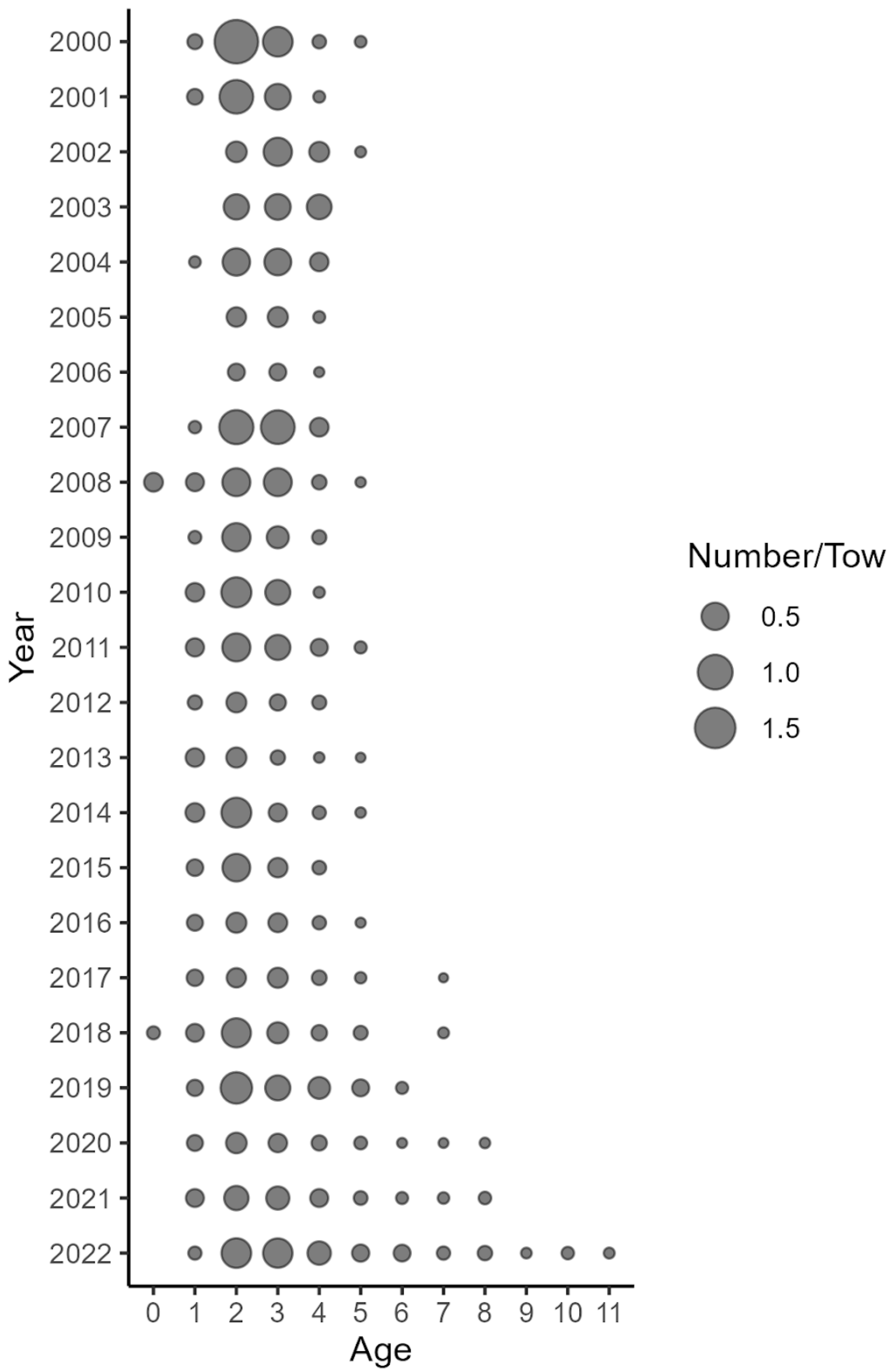


Figure 3.2.4 Numbers at age per tow of yellowtail flounder caught in the Fall Maine-New Hampshire Inshore Trawl survey from 2000-2022.

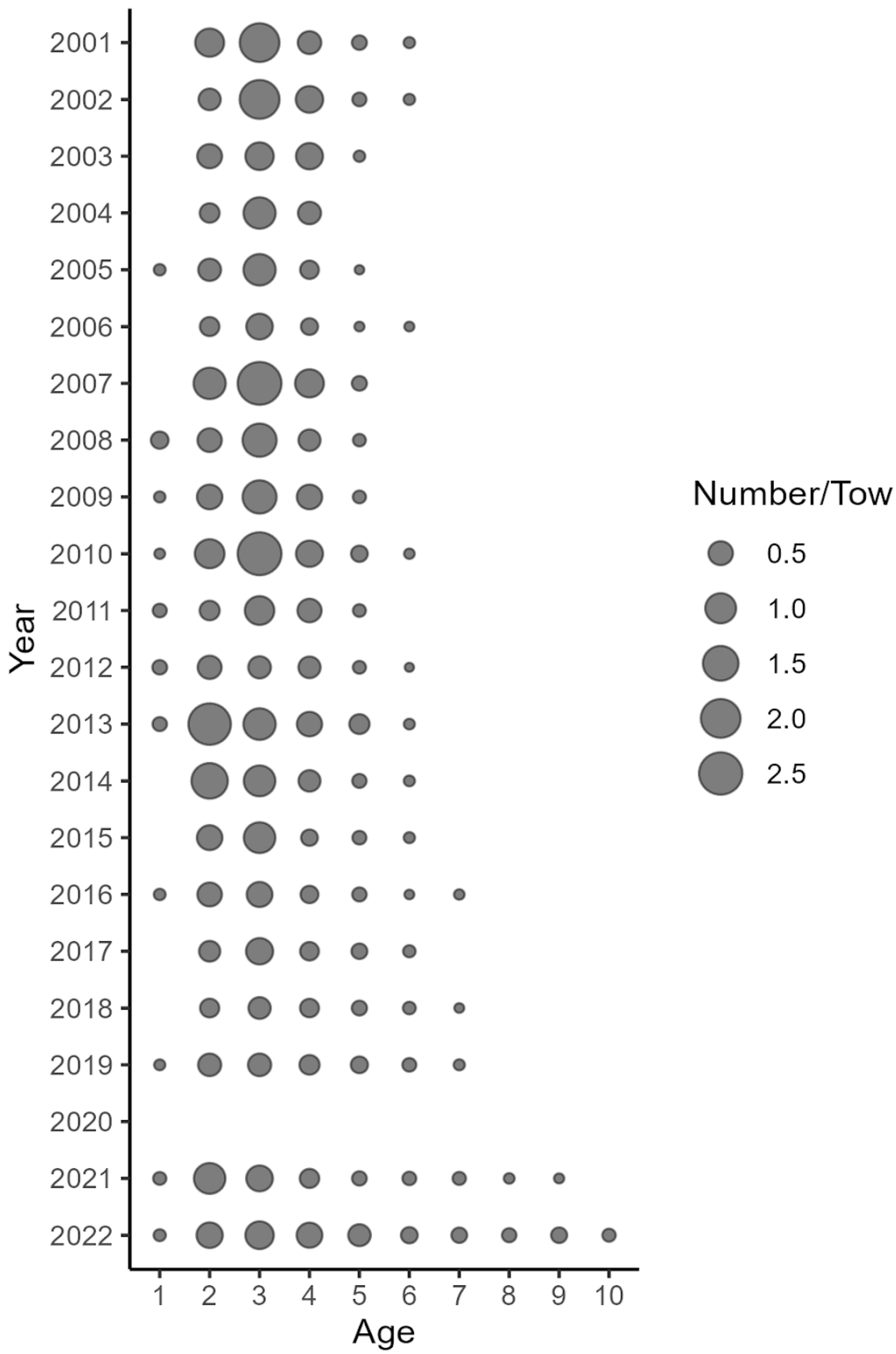


Figure 3.2.5 Numbers at age per tow of yellowtail flounder caught in the Spring Maine-New Hampshire Inshore Trawl survey from 2000-2022.

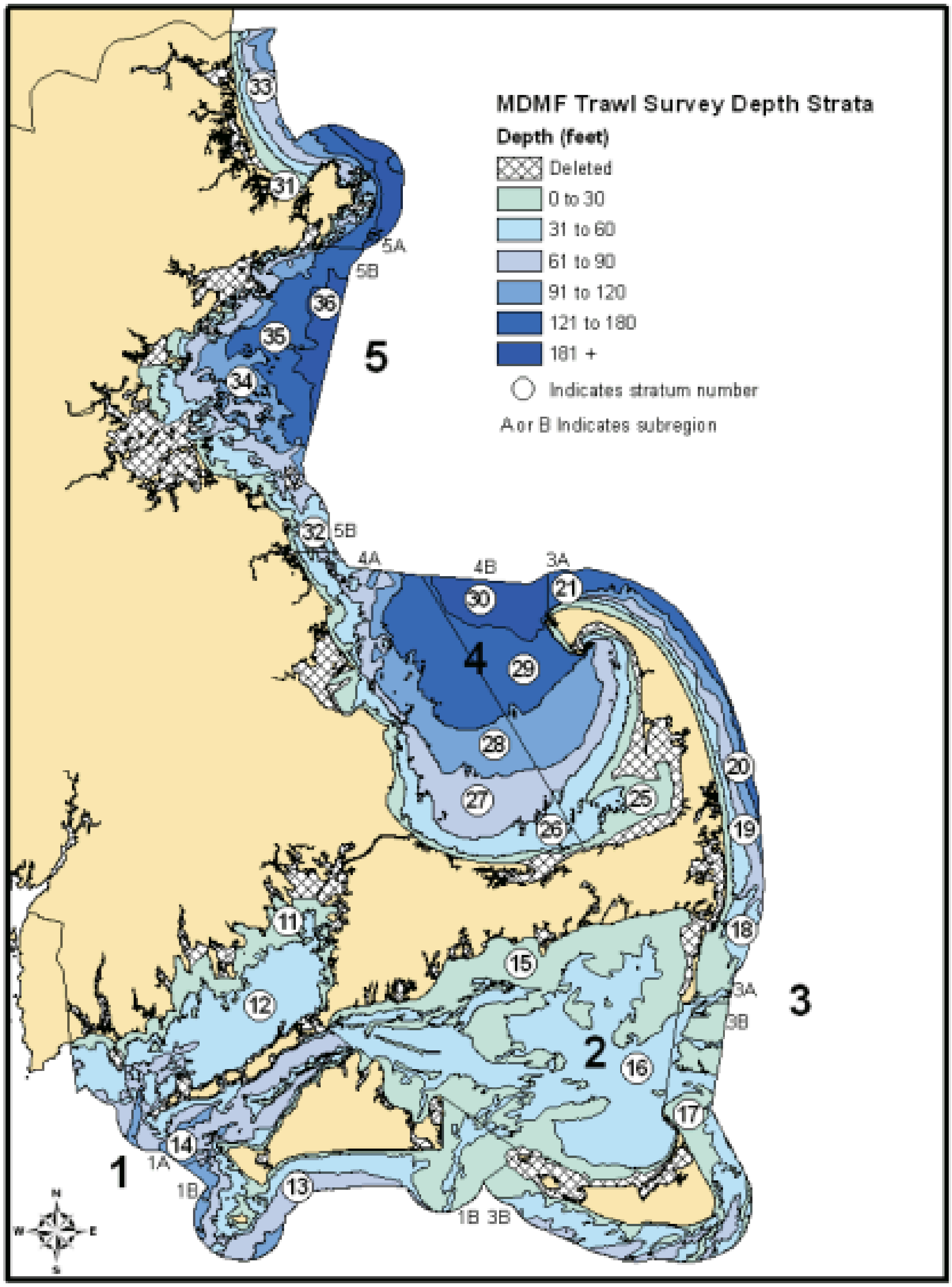
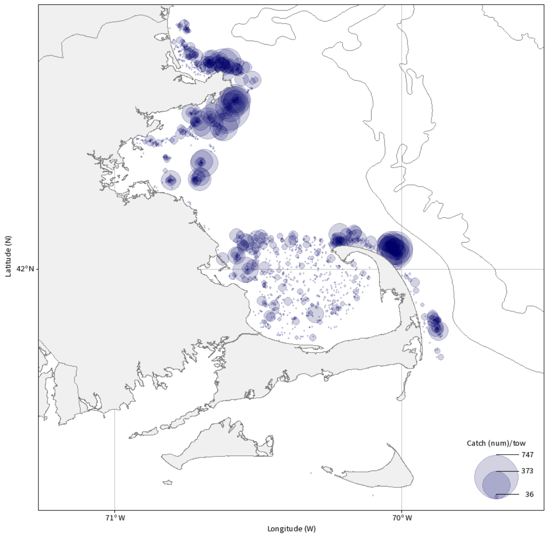


Figure 3.3.1 Massachusetts Division of Marine Fisheries Resource Assessment Survey strata 1977-2022.



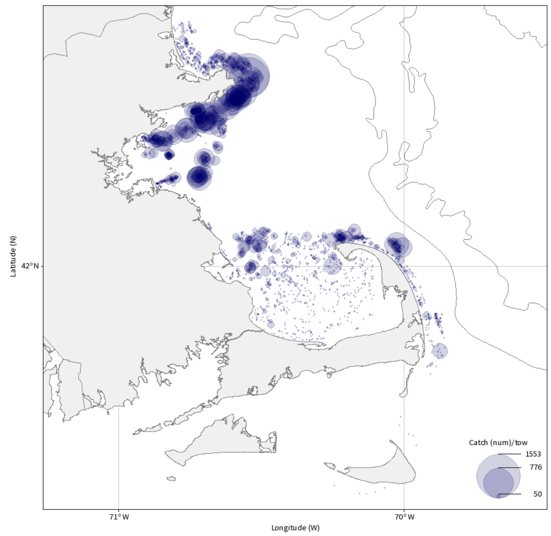


Figure 3.4.2 Catch per unit effort (number of fish per tow) by area in the Massachusetts Division of Marine Fisheries Resource Assessment Survey tows: Fall (left panel) and Spring (right) 1978-2022.

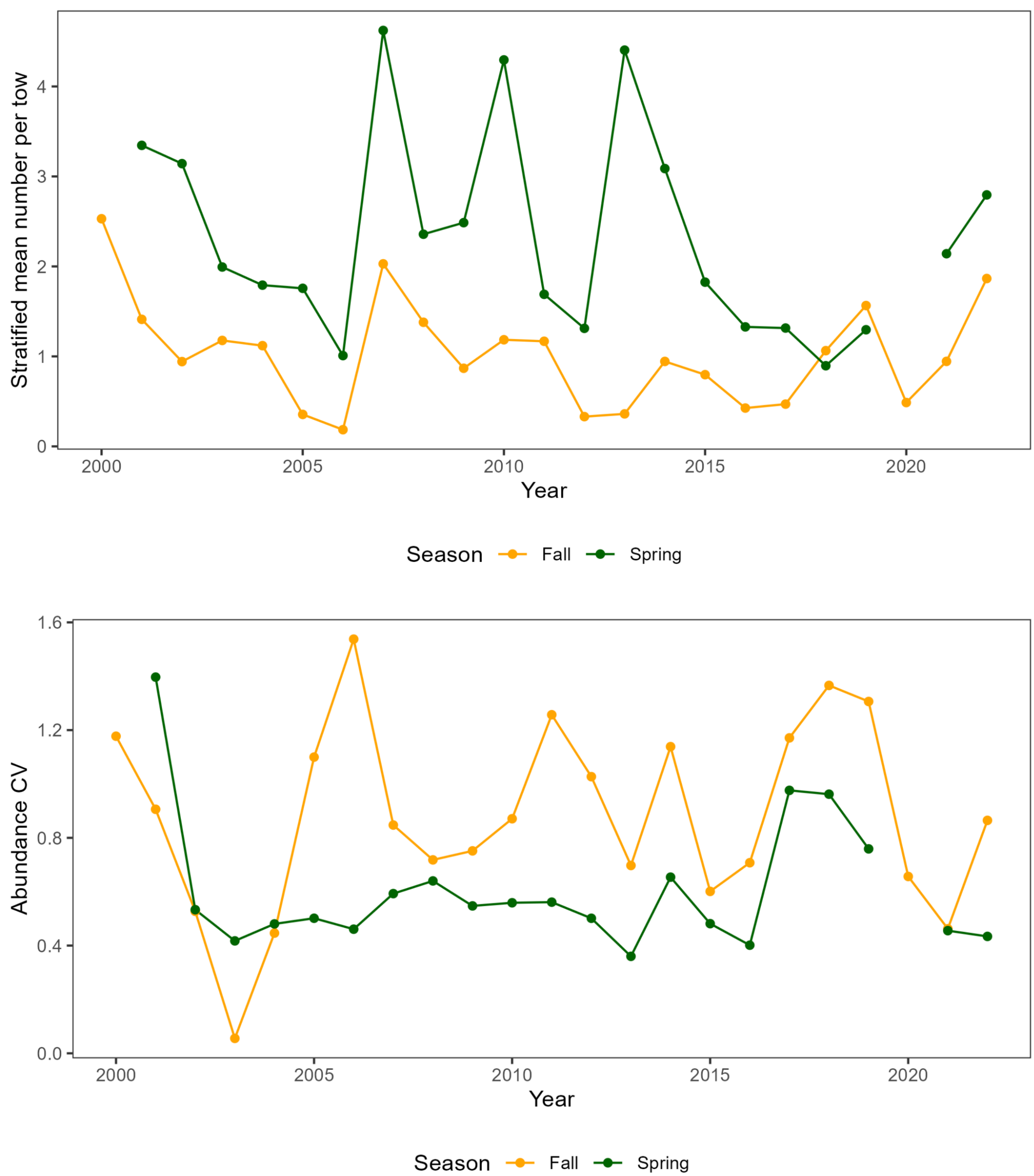


Figure 3.3.3 Abundance (stratified mean number per tow, top panel) and coefficient of variation (CV, bottom panel) of yellowtail flounder caught in the MADMF Fall and Spring surveys from 1978-2022.

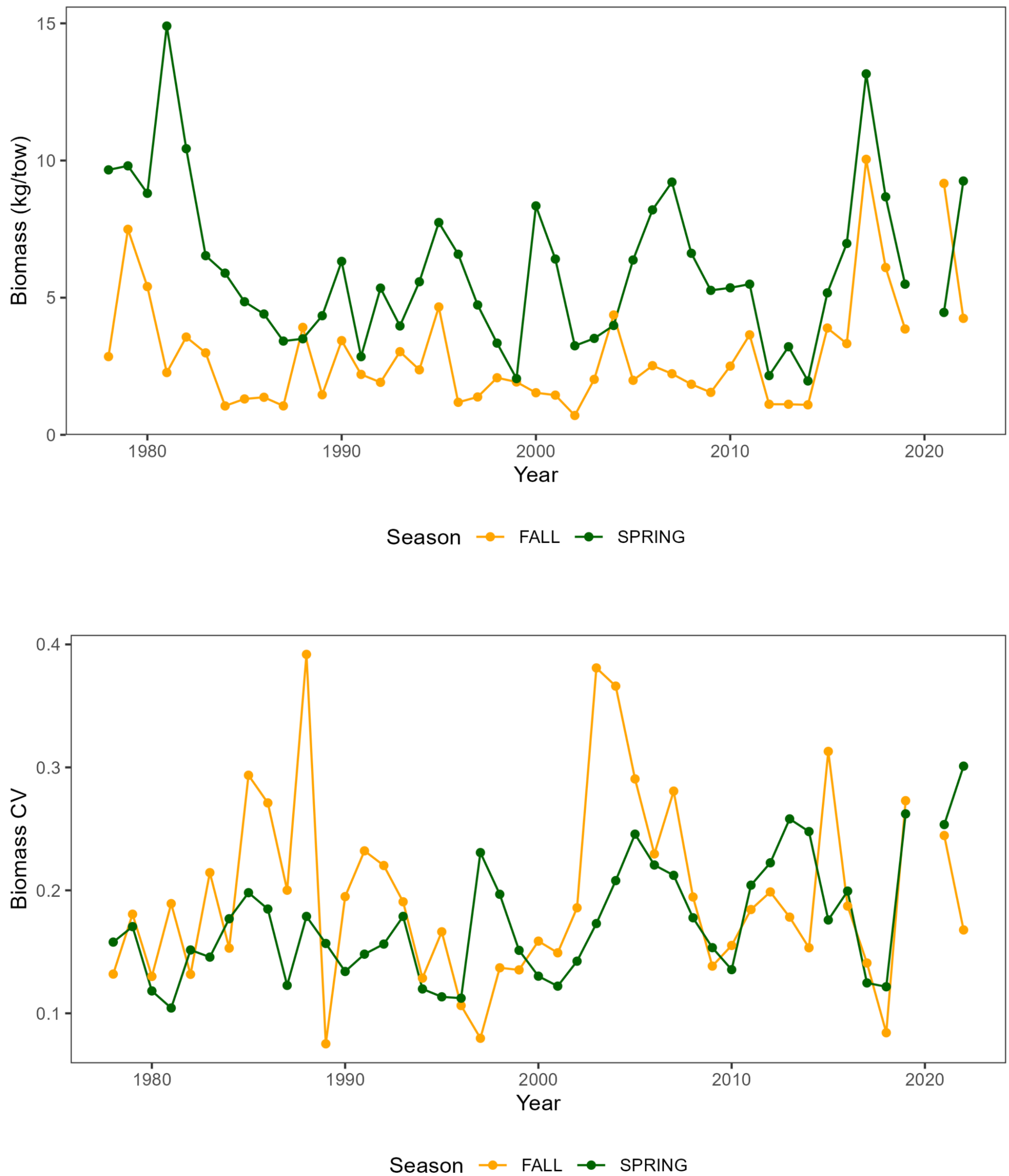


Figure 3.3.4 Biomass (kg per tow, top panel) and coefficient of variation (CV, bottom panel) of yellowtail flounder caught in the MADMF Fall and Spring surveys from 1978-2022.

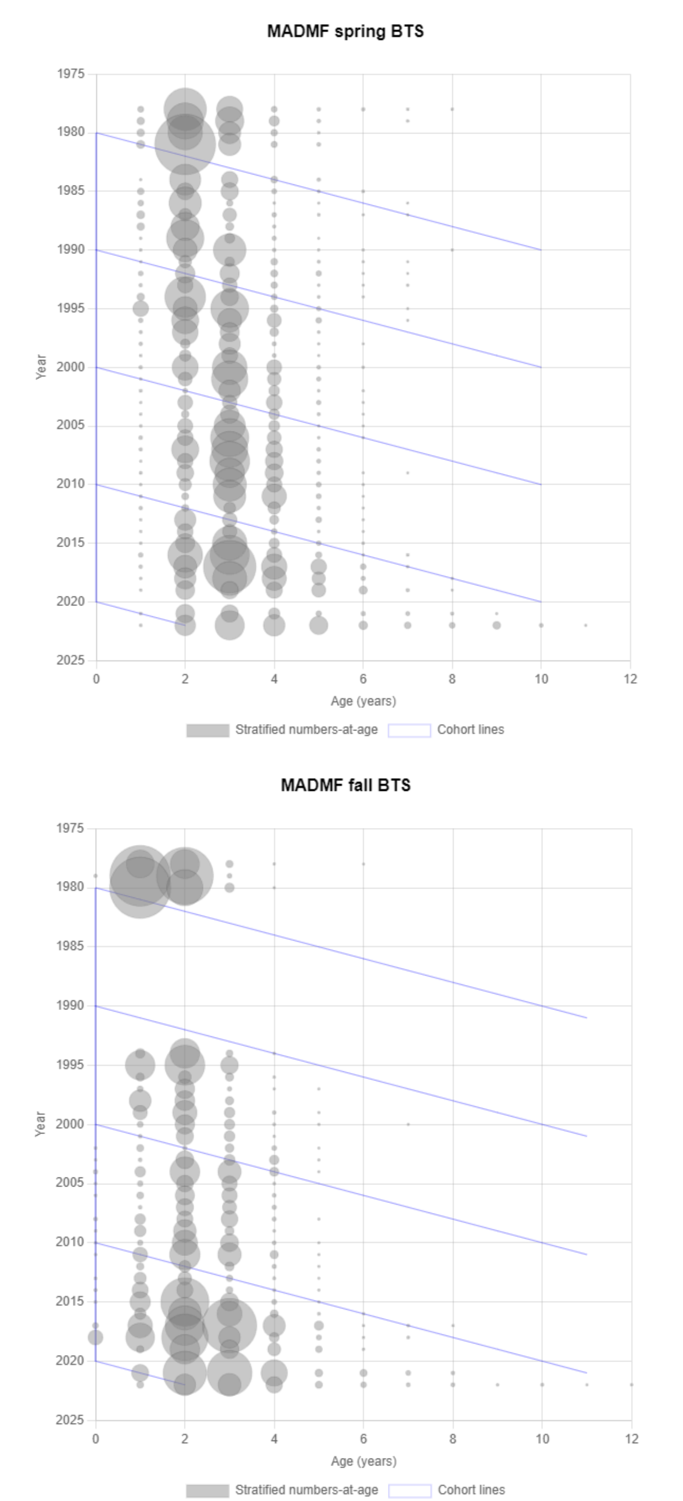


Figure 3.3.5 Stratified mean numbers at age from the Massachusetts Division of Marine Fisheries Resource Assessment Survey, Fall (top) and Spring (bottom).

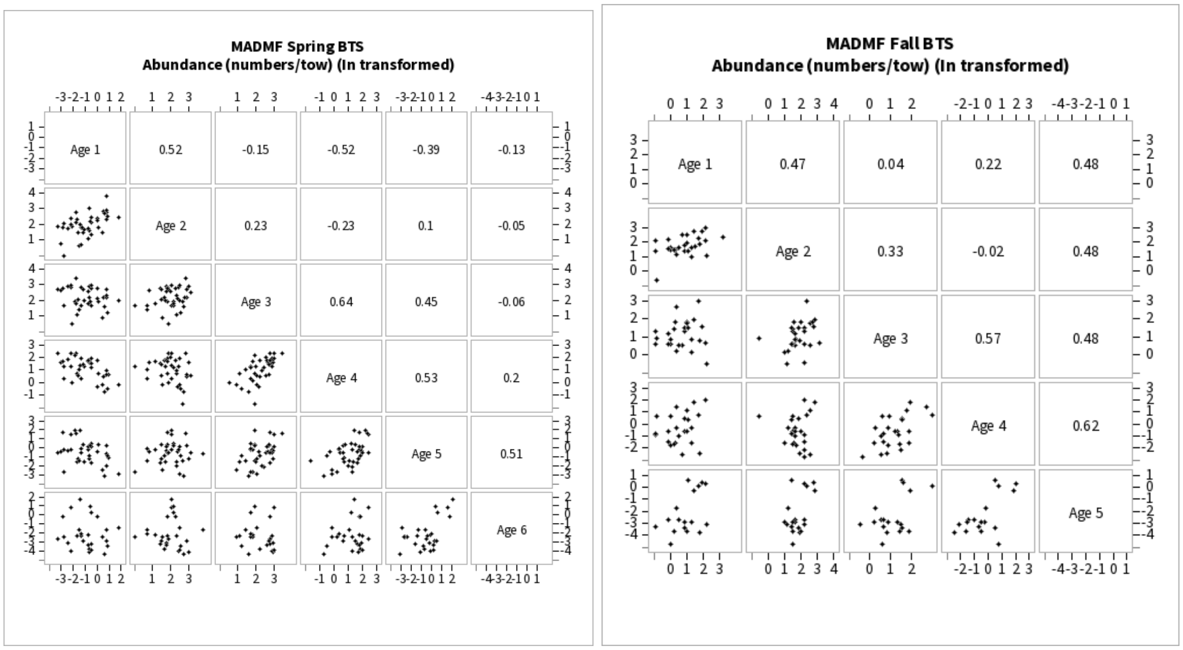
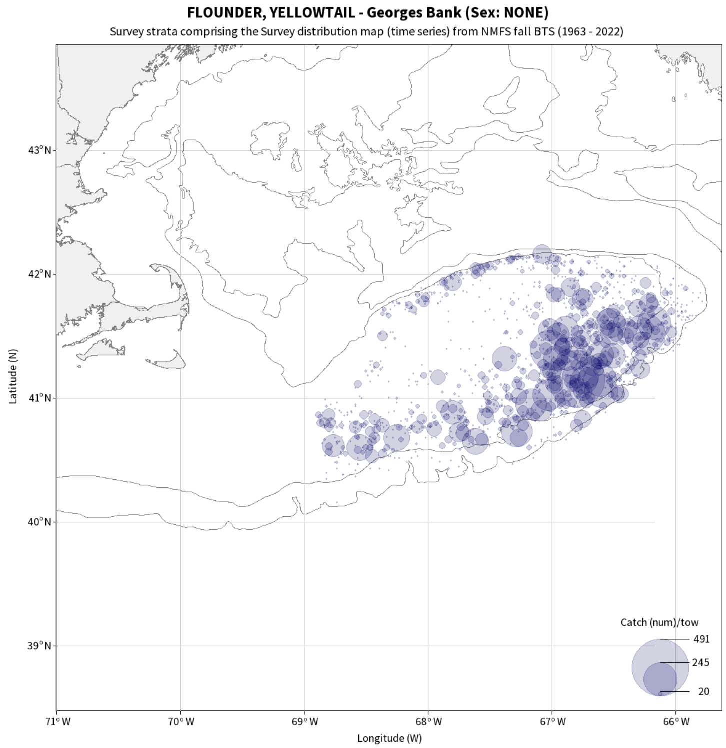


Figure 3.3.6 Cohort tracking described by correlation of abundance at age and the abundance of that age the previous year, as captured by the Massachusetts Division of Marine Fisheries Resource Assessment Survey, for the spring (left panel), and fall (right panel).



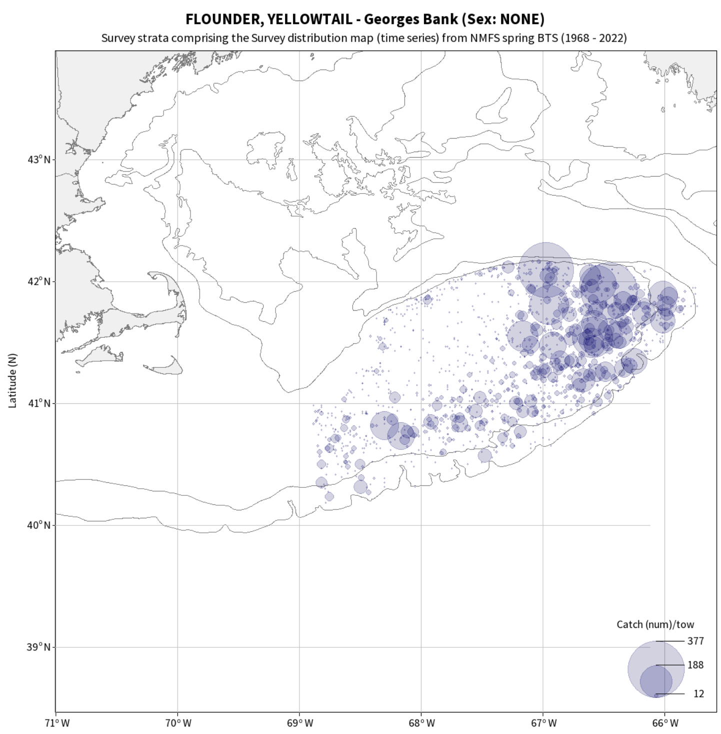


Figure 3.4.1 concentration of catch on Georges Bank in the NMFS BTS for the fall (top) and spring (bottom) surveys.

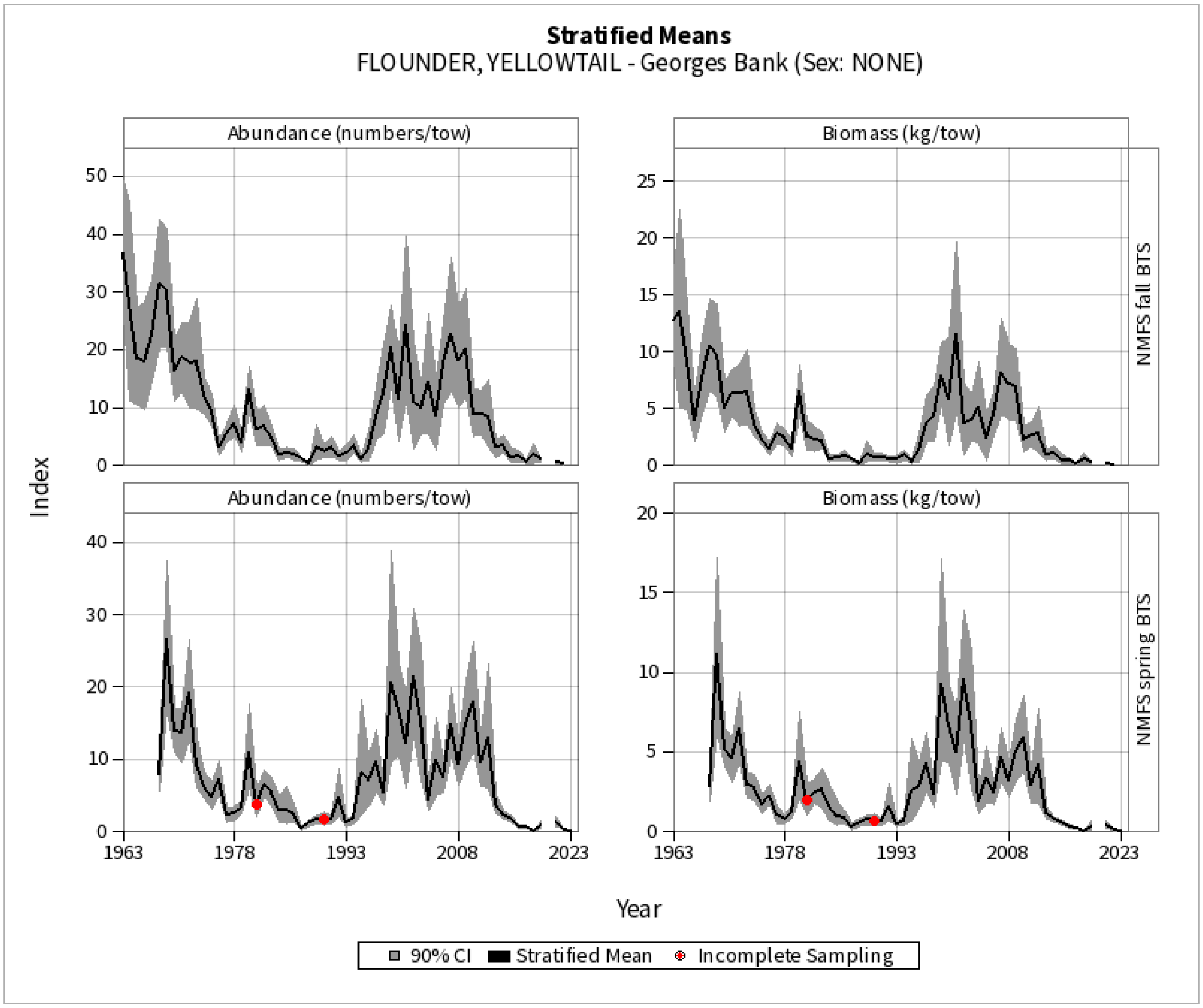


Figure 3.4.2 Stratified mean abundance (numbers/tow) and biomass (kg/tow) for Georges Bank Yellowtail flounder caught in the NMFS Bottom Trawl Survey in the fall (top row) and spring (bottom row).

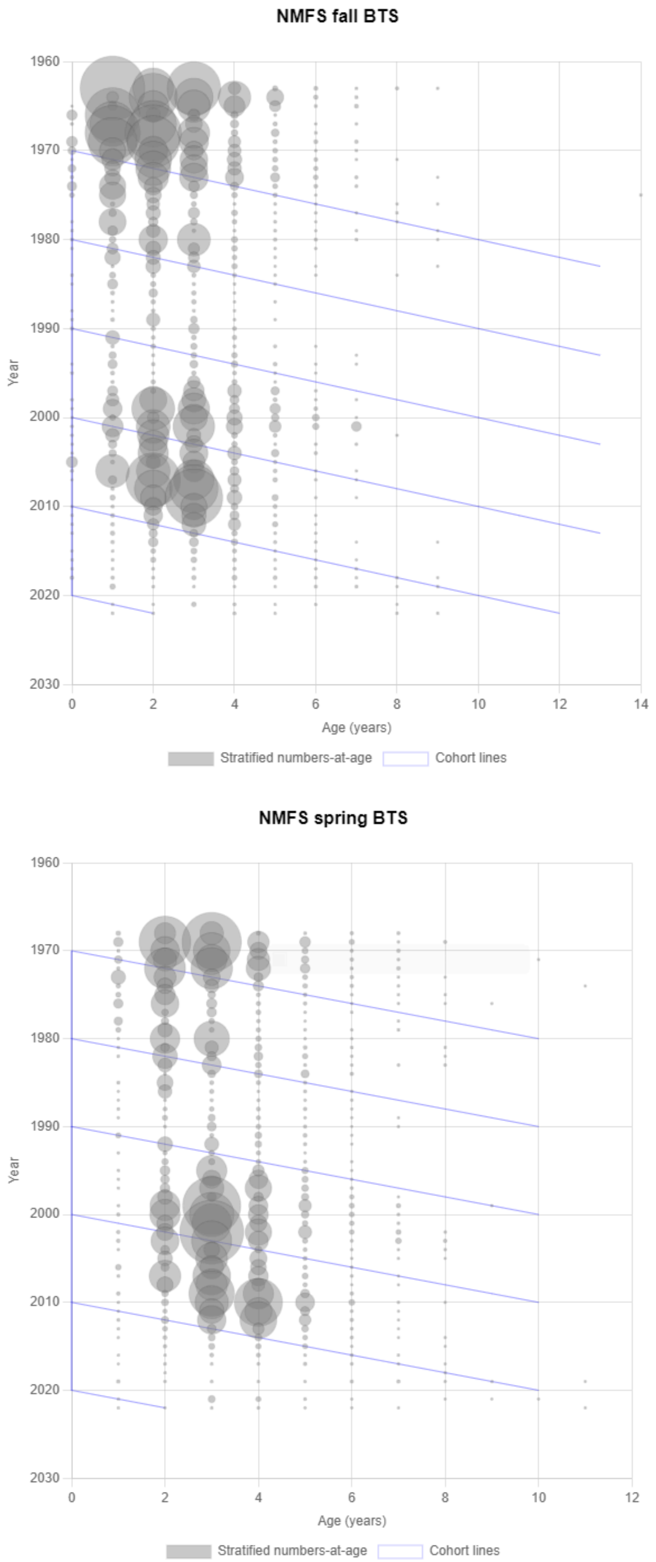
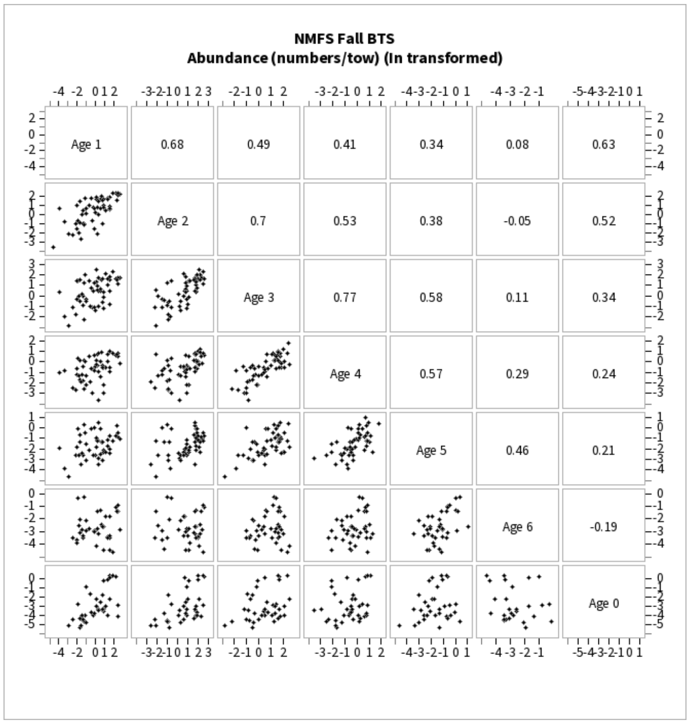


Figure 3.4.3 Stratified numbers at age of Georges Bank Yellowtail flounder captured in the NMFS Bottom Trawl Survey in the fall (top, 1963-2022) and spring (bottom, 1968-2022).



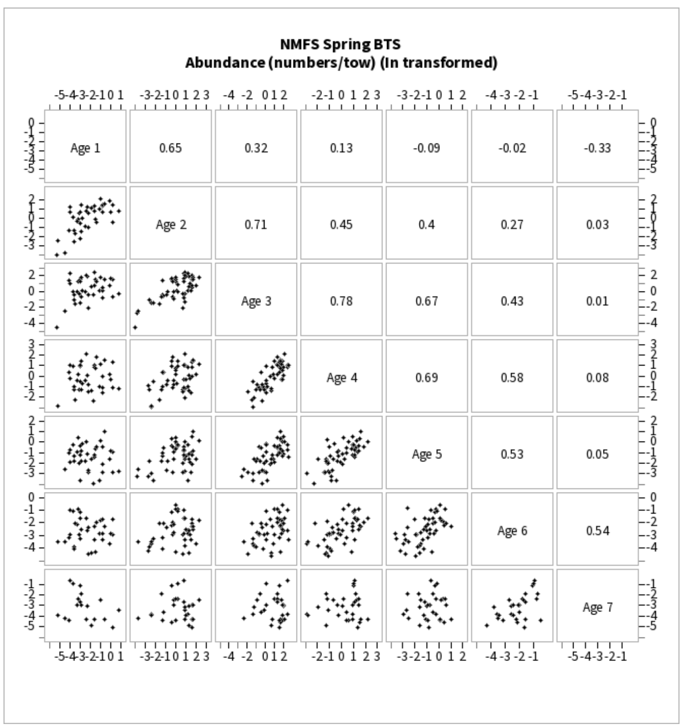


Figure 3.4.4 Cohort tracking described by correlation of abundance at age and the abundance of that age the previous year for Georges Bank Yellowtail flounder, as captured by the NMFS Bottom Trawl Survey, for the fall (top panel) and spring (bottom panel).

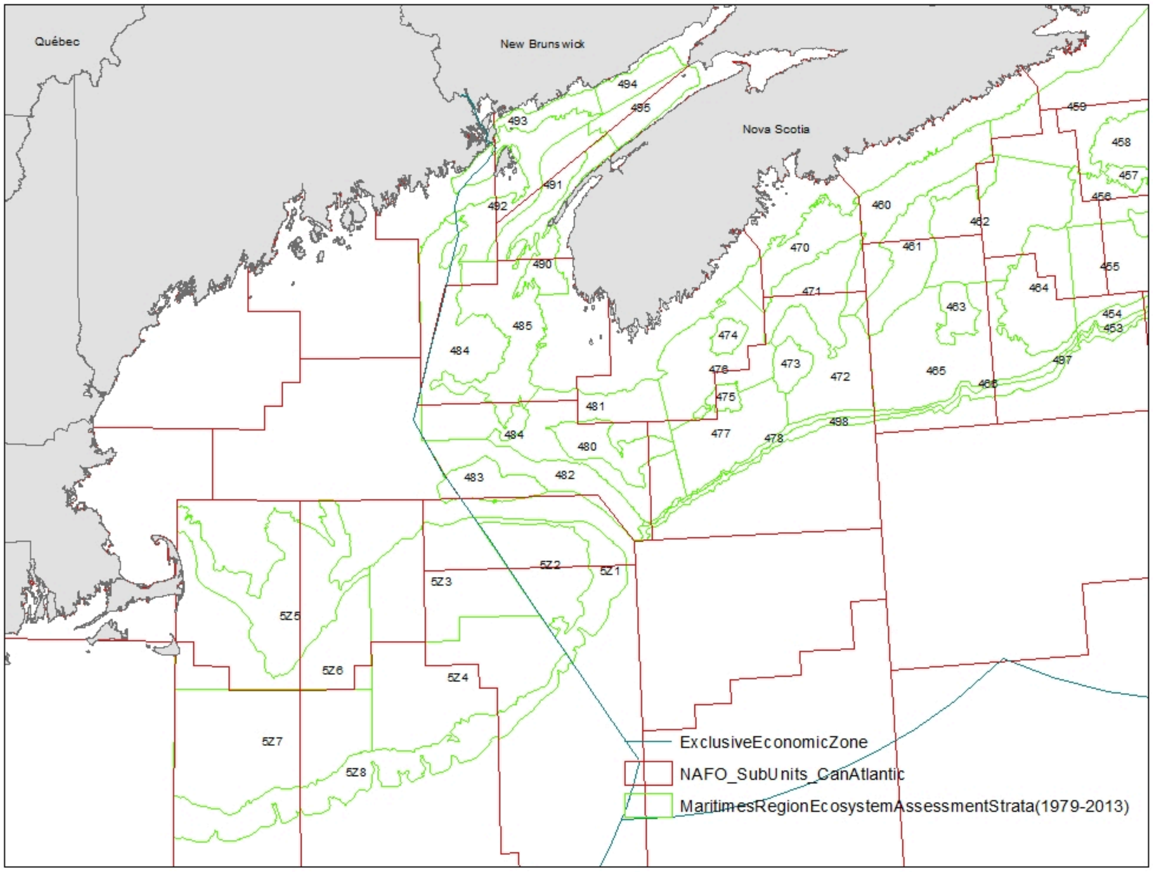


Figure 3.5.1 Canadian Department of Fisheries and Oceans (DFO) survey strata.

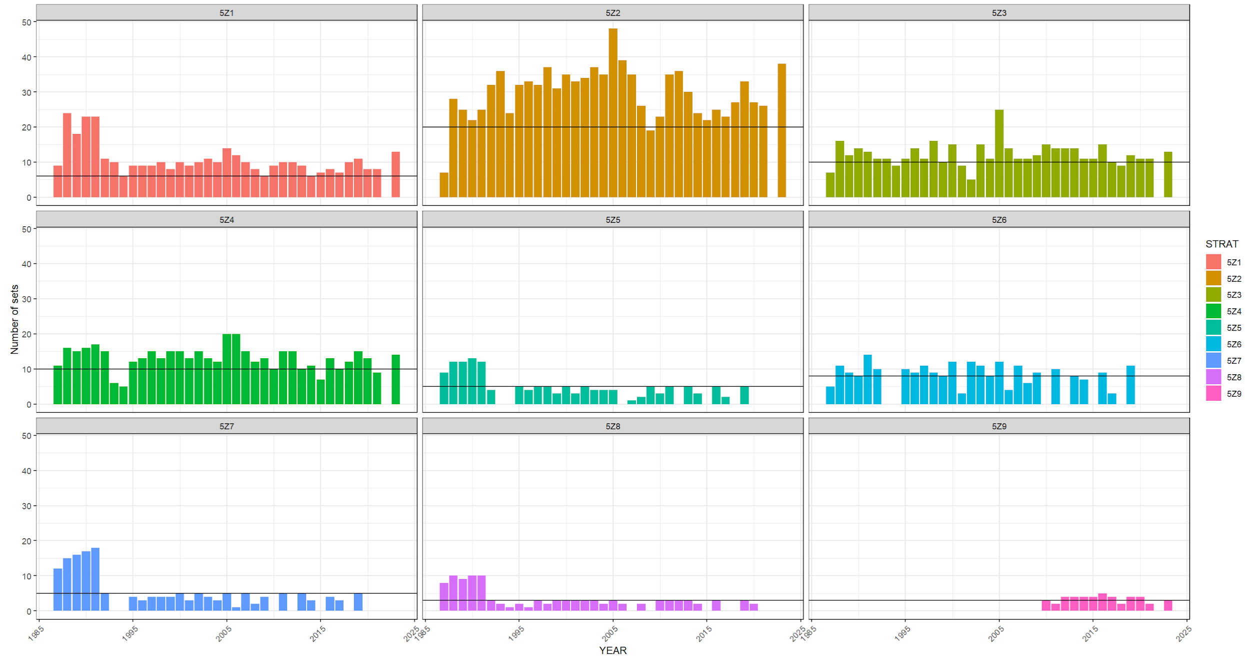


Figure 3.5.2 Strata coverage for the Canadian Ecosystem Survey by statistical area. The black line indicates full coverage for each stratum.

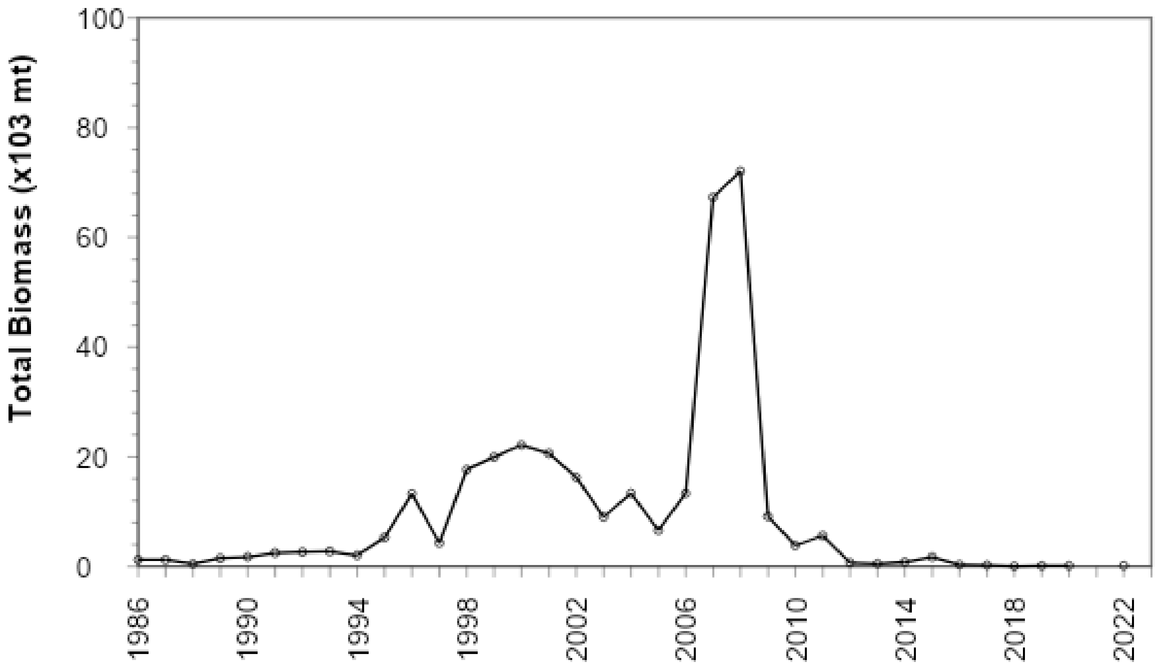


Figure 3.5.3 Total biomass (mt) of yellowtail flounder caught in the Canadian Ecosystem Survey, 1986-2022.

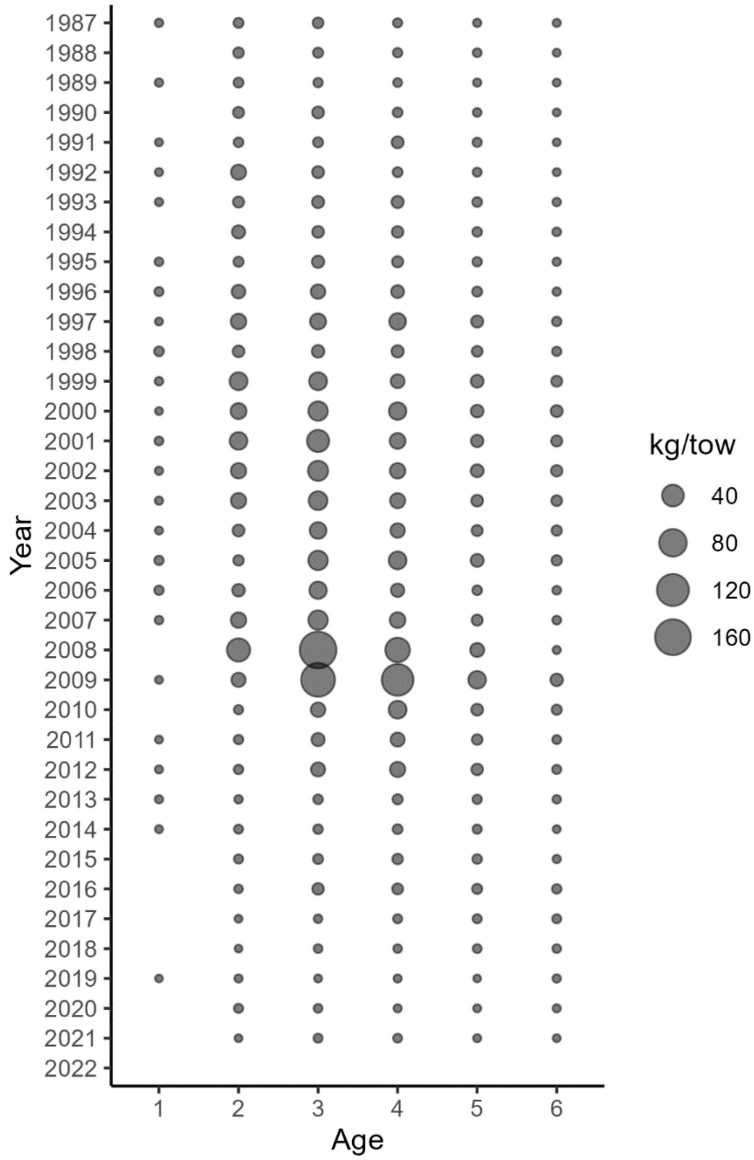


Figure 3.5.4 Biomass-at-age (kg/tow) caught in the Canadian Ecosystem Survey (1987-2022). Note that data was unavailable for 2022.

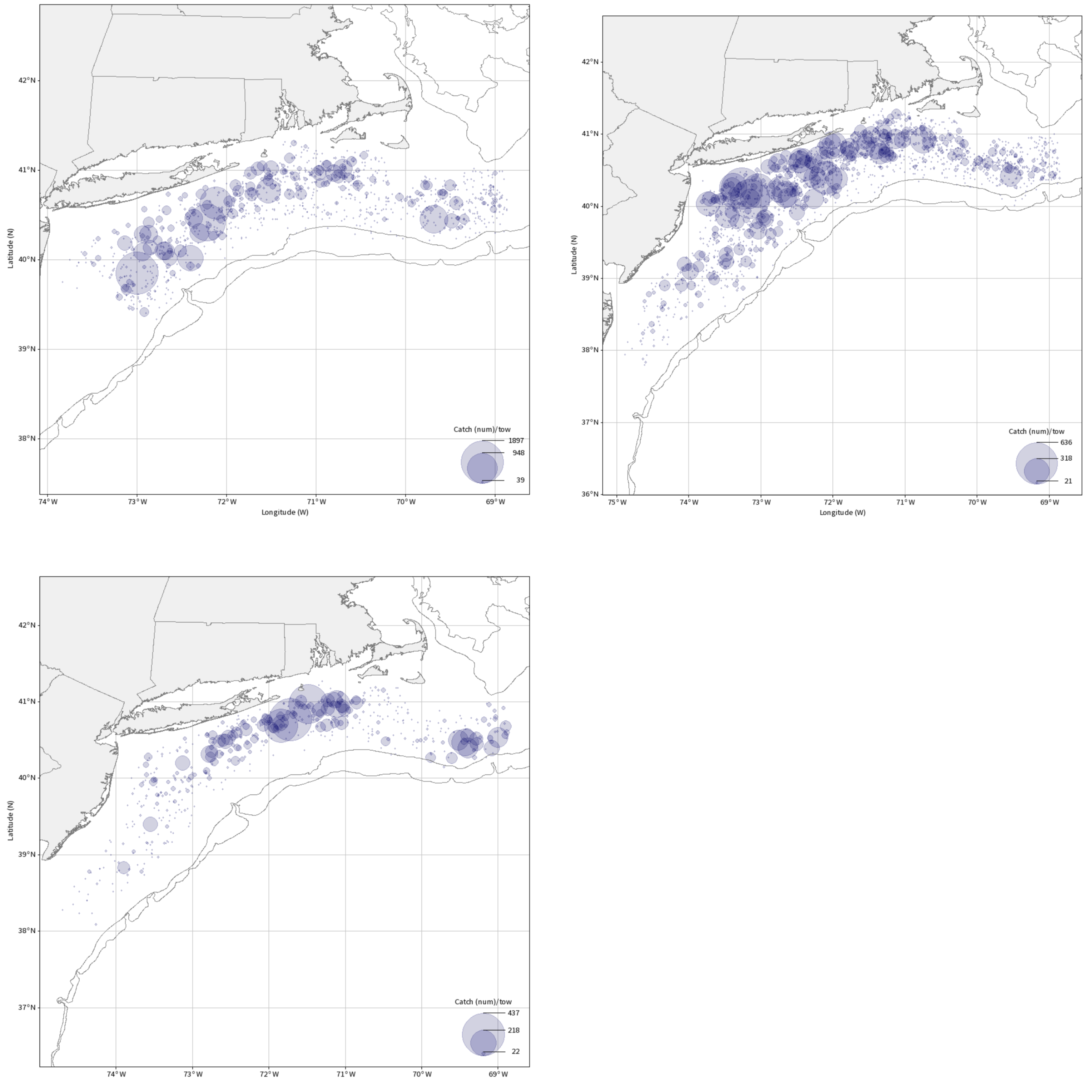


Figure 3.6.1 Catch per unit effort (number of fish per tow) in the NEFSC Bottom Trawl Survey for the Southern New England Mid-Atlantic stock: Fall (top row, left panel), Spring (top row, right panel) and Winter (bottom row) 1963-2022.

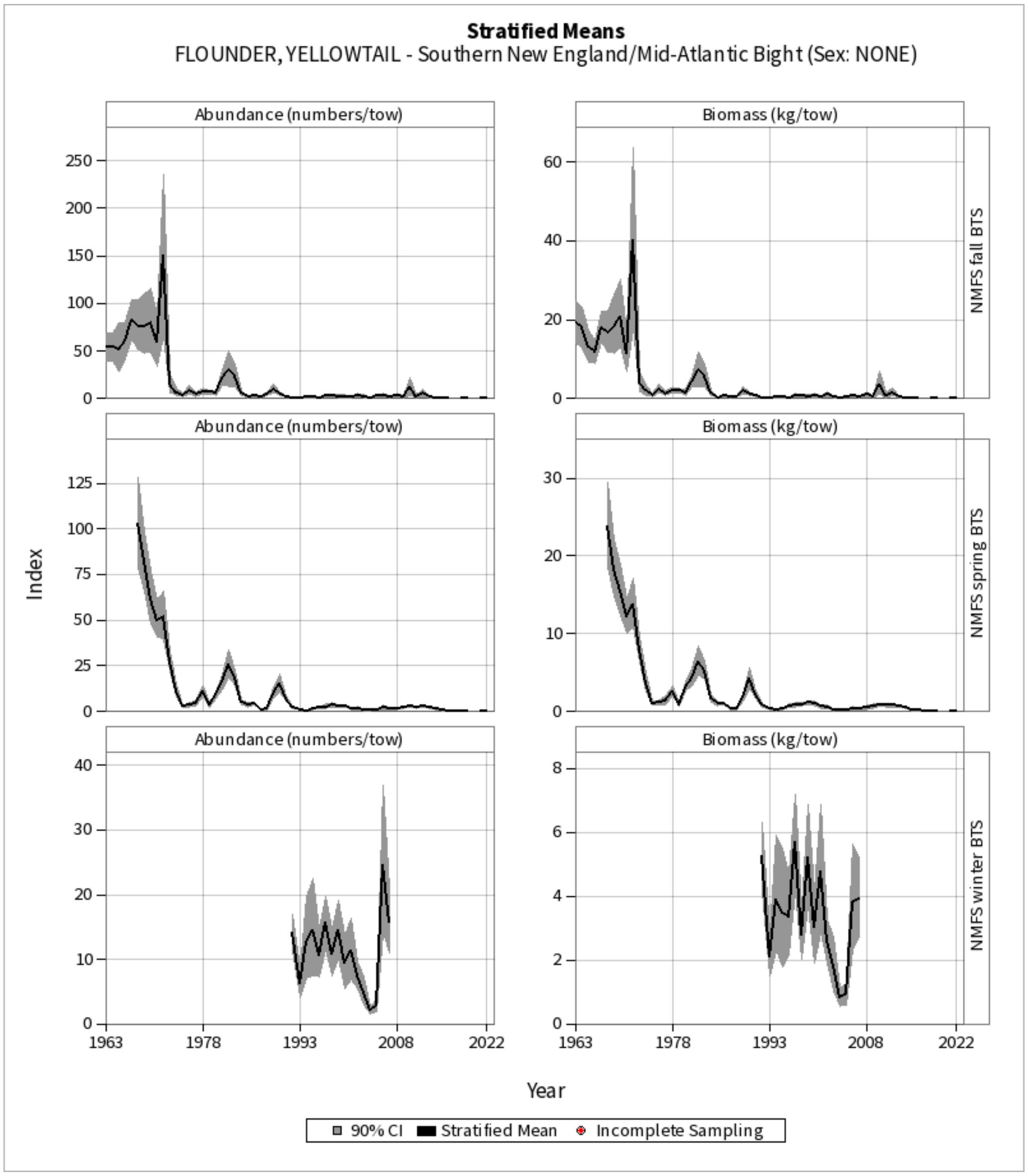


Figure 3.6.2 Aggregate survey stratified mean abundance and biomass for the Southern New England/Mid-Atlantic stock, as captured by the NMFS Bottom Trawl Survey, for the Fall (top row), Spring (middle row) and Winter (bottom row).

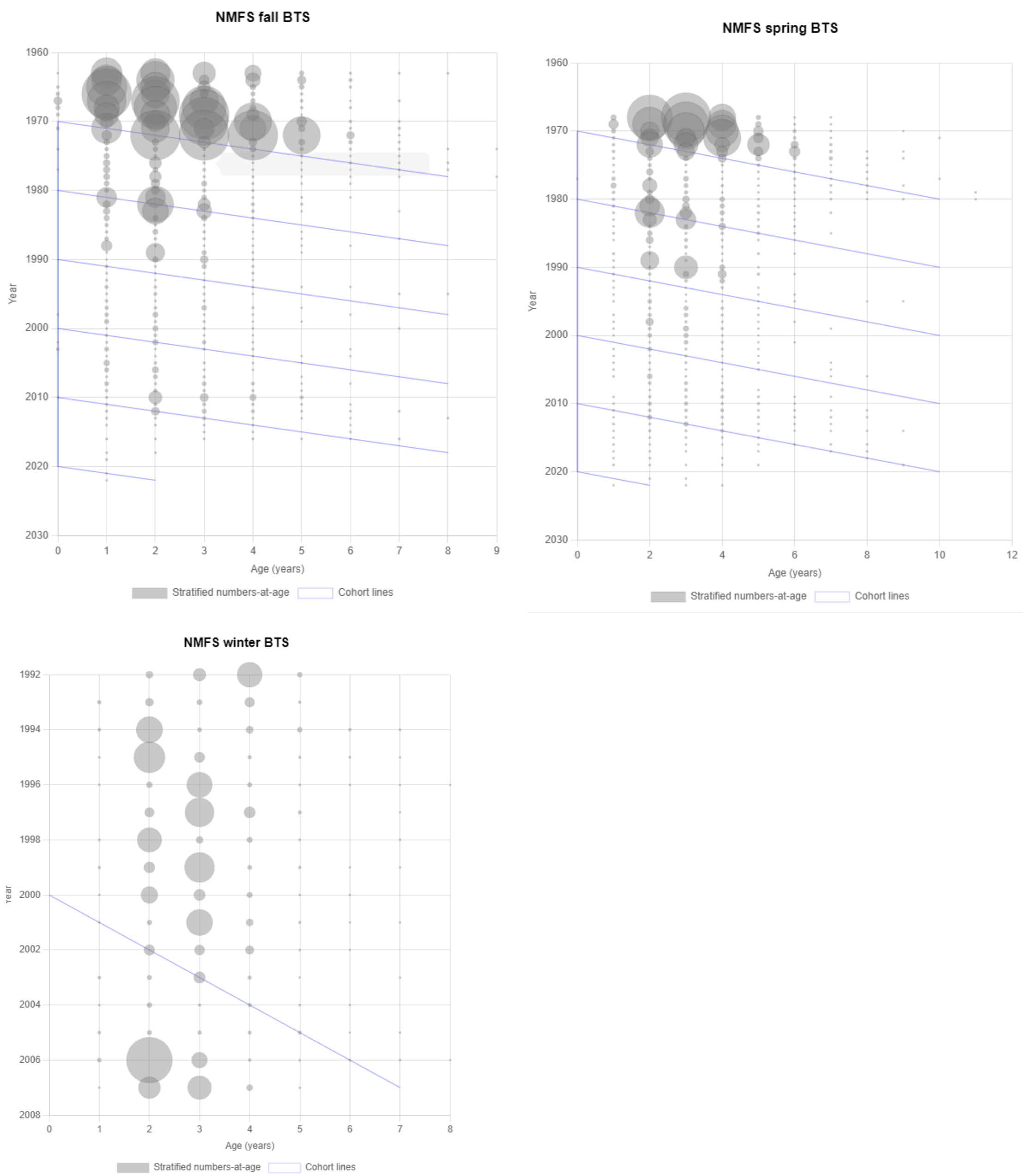


Figure 3.6.3 Stratified numbers at age of Southern New England/Mid-Atlantic Yellowtail flounder captured in the NMFS Bottom Trawl Survey in the fall (top left, 1963-2022), spring (top right, 1968-2022), and winter (bottom left 1992-2007).

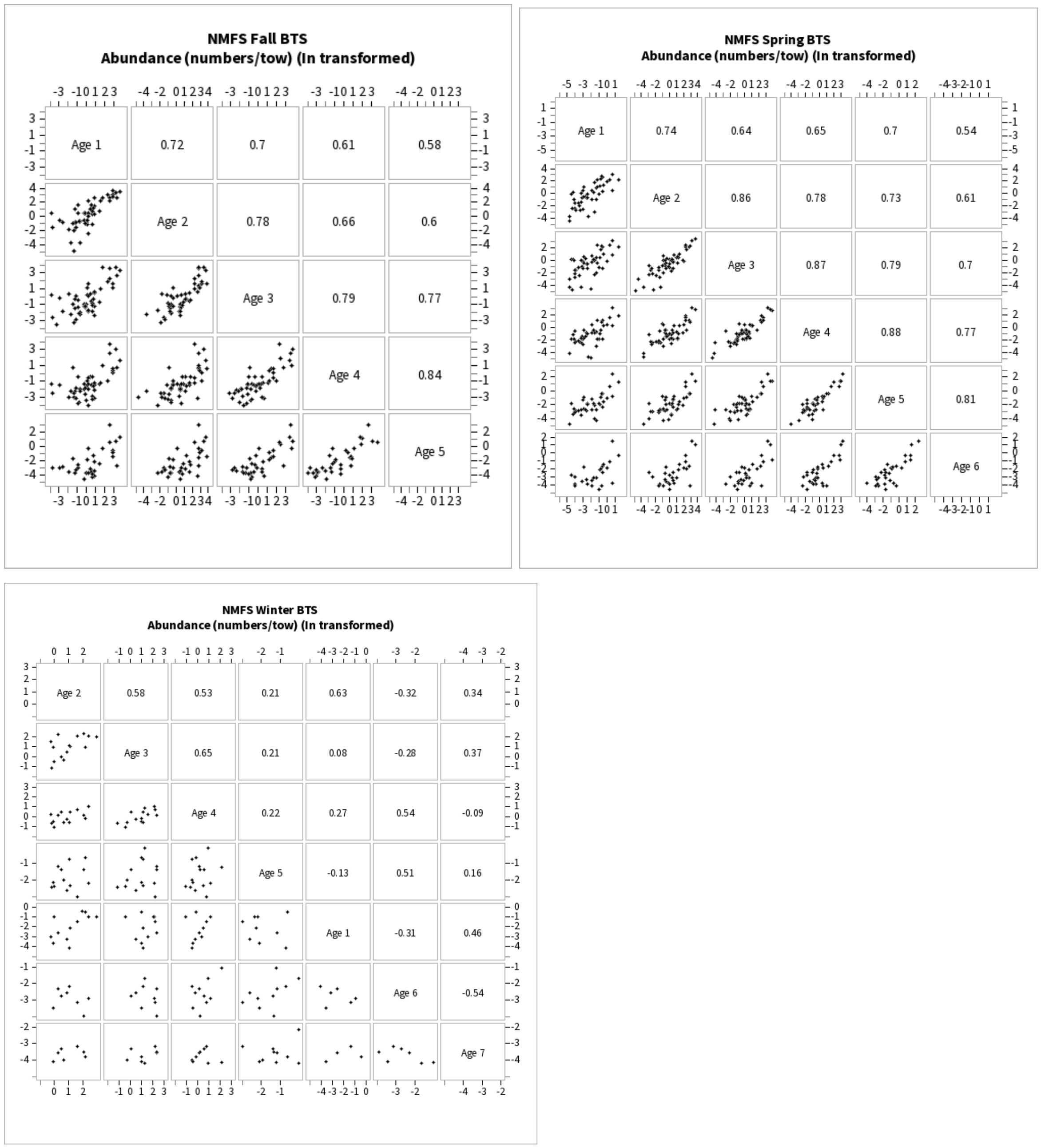


Figure 3.6.4 Cohort tracking described by correlation of abundance at age and the abundance of that age the previous year for the Southern New England/Mid-Atlantic stock, as captured by the NMFS Bottom Trawl Survey, for the fall (top row, left panel), spring (top row, right panel) and winter (bottom row).

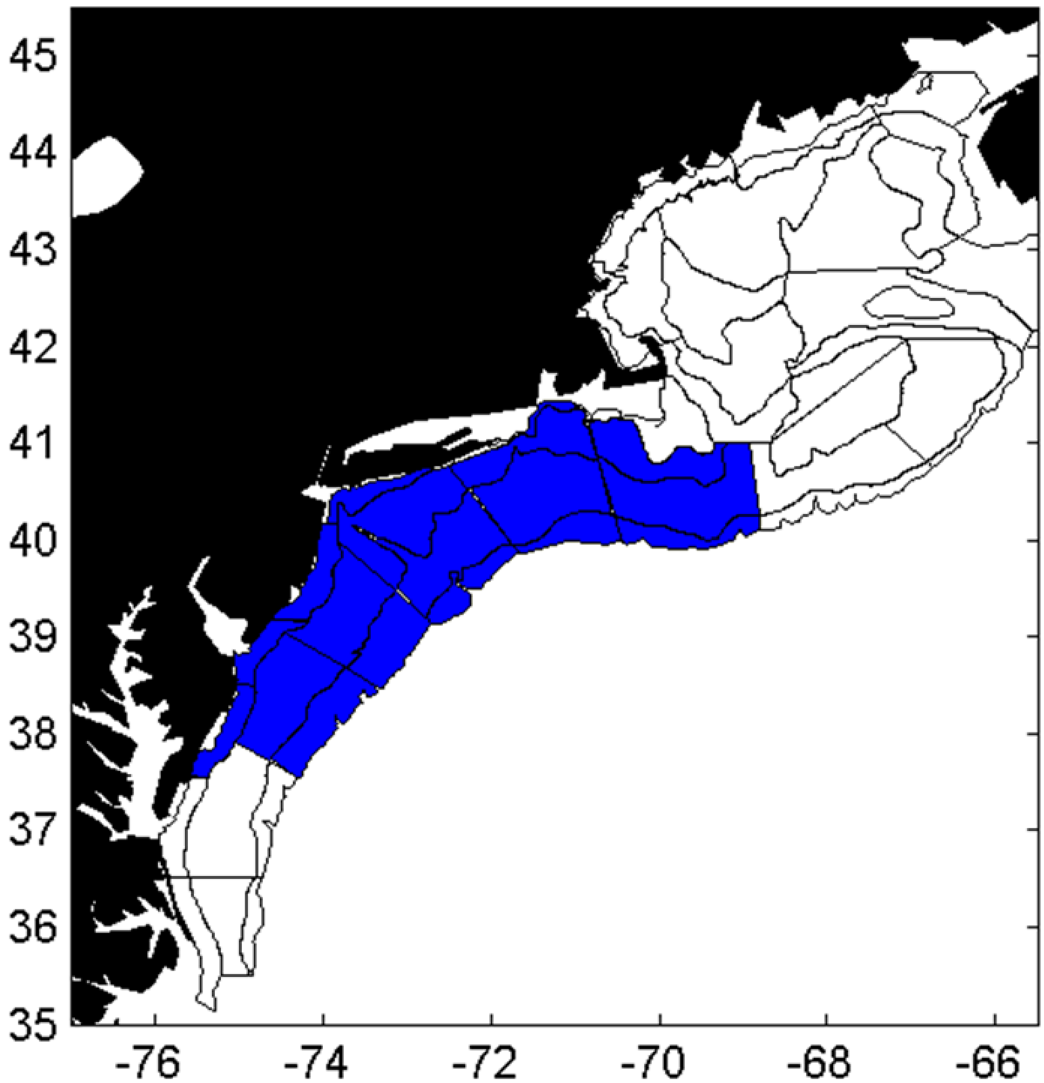


Figure 3.7.1. Strata used for the combined larval index 1970-2022.

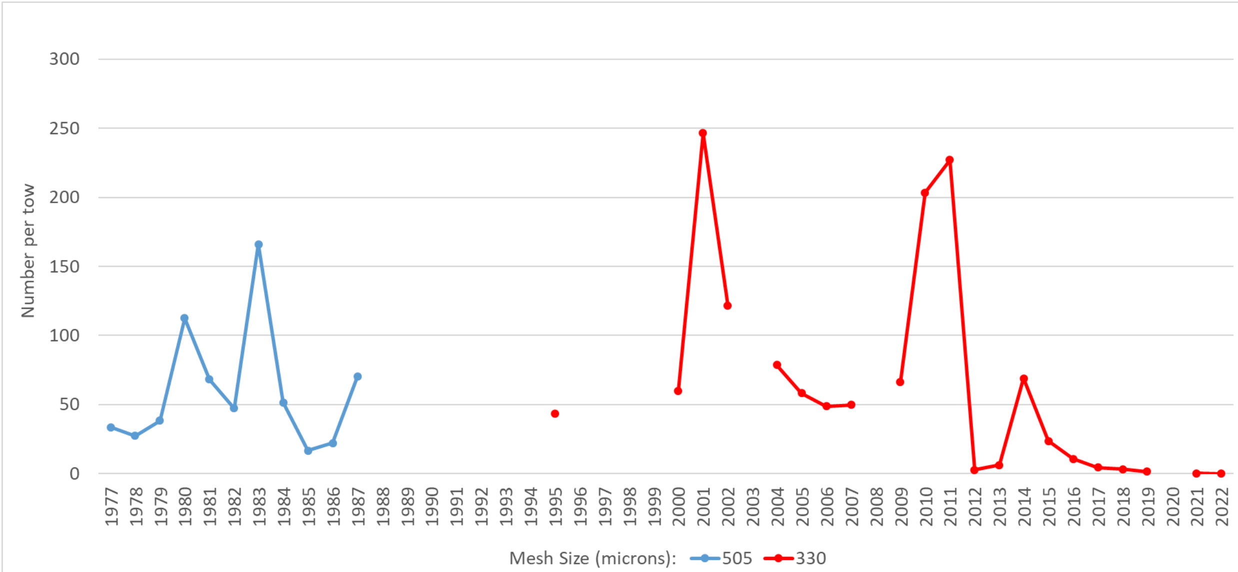


Figure 3.7.2 Stratified mean abundance of age-0 yellowtail flounder for southern New England from 1977-2022. Size of the mesh net (μm) is indicated by color, where red represents years when the 303 μm was used and purple represents years when the 505 μm mesh net was used. Note that these indices are not directly comparable to one another.

TOR4: ESTIMATE STOCK SIZE AND FISHING MORTALITY

"Use appropriate assessment approach to estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and estimate their uncertainty. Compare the time series of these estimates with those from the previously accepted assessment(s). Evaluate a suite of model fit diagnostics (e.g., residual patterns, sensitivity analyses, retrospective patterns), and (a) comment on likely causes of problematic issues, and (b), if possible and appropriate, account for those issues when providing scientific advice and evaluate the consequences of any correction(s) applied."

As was noted in the assessment histories above, the most recent assessment for the CCGOM stock used VPA; the GB stock uses the Limiter; and SNEMA used an ASAP model. One of the primary goals of the WG for this RT was to get all three stocks into the Woods Hole Assessment Model (WHAM). WHAM is a state-space model that can estimate time-and age-varying random effects on annual transitions in NAA, M, and selectivity, as well as fitting environmental covariates with process and observation errors (Stock and Miller 2021).

Model evaluation criteria

The WG considered the diagnostics of convergence (including Jitter analysis), residuals, retrospective patterns, Akaike's Information Criteria (AIC) and simulation self-tests to identify candidate models:

- Convergence: Initial model acceptance focused on the requirement that the model converge on a solution. Models passed first order convergence criteria when the maximum gradient change was less than a software-specific threshold (e.g., e-10 for WHAM, e-3 for ASAP). Models met the second order convergence criterion when the Hessian matrix was invertible. Jitter analysis (rerunning models with randomized starting values for estimated parameters) to confirm convergence on a global solution was done for candidate model runs.
- Residuals: Goodness of fit was evaluated by examining whether predicted values were within confidence bounds. One-step ahead (OSA) residuals were also used to judge model fit for WHAM. OSA residuals should be uncorrelated and normally distributed for models that appropriately describe the system.
- Retrospective patterns: Retrospective patterns were evaluated for all model runs and measured using Mohn's ρ for spawning stock biomass and fully selected fishing mortality. For candidate models a visual inspection of the terminal year of recruitment was done to insure that one peel was not driving the ρ value.
- Akaike's Information Criteria: AIC was used to compare models fit to the same data and comparable statistical distributions (see below). Smaller AIC scores indicated model improvement when data inputs are identical, and scores within ± 2 were considered equivalent across comparable models, in which case the more parsimonious of the two models was selected.
    - Dirichlet and logistic normal are comparable
    - Multinomial and Dirichlet-multinomial are comparable
- Model performance: Model performance was evaluated using simulation self-tests for candidate model runs. Each model run was used to generate up to 100 datasets with

parameters fixed at their estimated values. Simulations then refit the model to these generated datasets to evaluate relative error in F, SSB, R, and catch estimates and model convergence rates.

Mean absolute scaled error (MASE; Carvalho et al., 2021; Kell et al., 2021) was not used as a diagnostic because of the concerns raised by Tim Miller (bulleted below), and the findings of Li et al. (2024) that MASE is generally not useful for model selection.

- There are discrepancies in the calculation methods of the two different papers that suggest using it
- It does not account for differences in observation error (CV) between indices or across different years
- It currently is only designed for iid normal observations but it should be allowed for multivariate and non-normal observations (like age composition observations)
- If the index is flat in recent years it is difficult to get a MASE score that is less than 1

Likelihood profiles are another common diagnostic related to the gradient of the total -Ln(L) in the convergence criterion, above. Profiles can identify which data source is making the gradient steep or shallow as well as data conflicts. Models with fewer conflicts among the same data sources could be considered better using this criterion, but the WG did not consider this to be a valid justification for data decisions because removing data due only to conflict with other sources could hide actual uncertainty in the model.

Cape Cod/Gulf of Maine stock

Overview

A WHAM model was developed for the CCGOM yellowtail flounder stock over the period 1985-2022. The WHAM model replaces the previously used VPA model, which showed retrospective patterns and limited flexibility for fitting uncertain data. For the WHAM model, both commercial catch (landings and discards, as well as age composition) and four fishery-independent surveys—NEFSC spring and fall bottom trawl surveys, the MADMF fall bottom trawl survey, and MEDMR fall bottom trawl surveys— (stock trends and age composition) were integrated. Estimates of SSB varied across the series, while recent years (2020-2022) had low recruitment estimates.

Data

The terminal year for this assessment is 2022, with the WHAM formulation combining both landings and discards into a single, combined fleet (Figure 4.CCGOM.1), for which age composition data is available across the entire time series (Figure 4.CCGOM.2). The starting year of the assessment series was 1985, due to limited commercial sampling data in earlier years, as indicated by SAW36. While consideration for extending the time series was discussed by the WG, random effects within the WHAM framework would only benefit from full age composition data.

Six fishery-independent surveys were initially considered for the WHAM framework in assessing the CCGOM yellowtail flounder stock, covering a range of data from 1985 through 2022. These surveys included:

- NEFSC Spring Bottom Trawl Survey (1985-2022)
- NEFSC Fall Bottom Trawl Survey (1985-2022)
- MADMF Spring Bottom Trawl Survey (1985-2022)
- MADMF Fall Bottom Trawl Survey (1985-2022)
- MEDMR Spring Bottom Trawl Survey (2001-2022)
- MEDMR Fall Bottom Trawl Survey (2000-2022)

The WG tested model configurations with and without the length-based calibration factors to the Bigelow data described in TOR3. Ultimately, separate Albatross and Bigelow series were selected. Additionally, due to model performance considerations, the MADMF and MEDMR spring surveys were excluded from the final candidate model. Full rationale and implications of these choices are further discussed in the model development section.

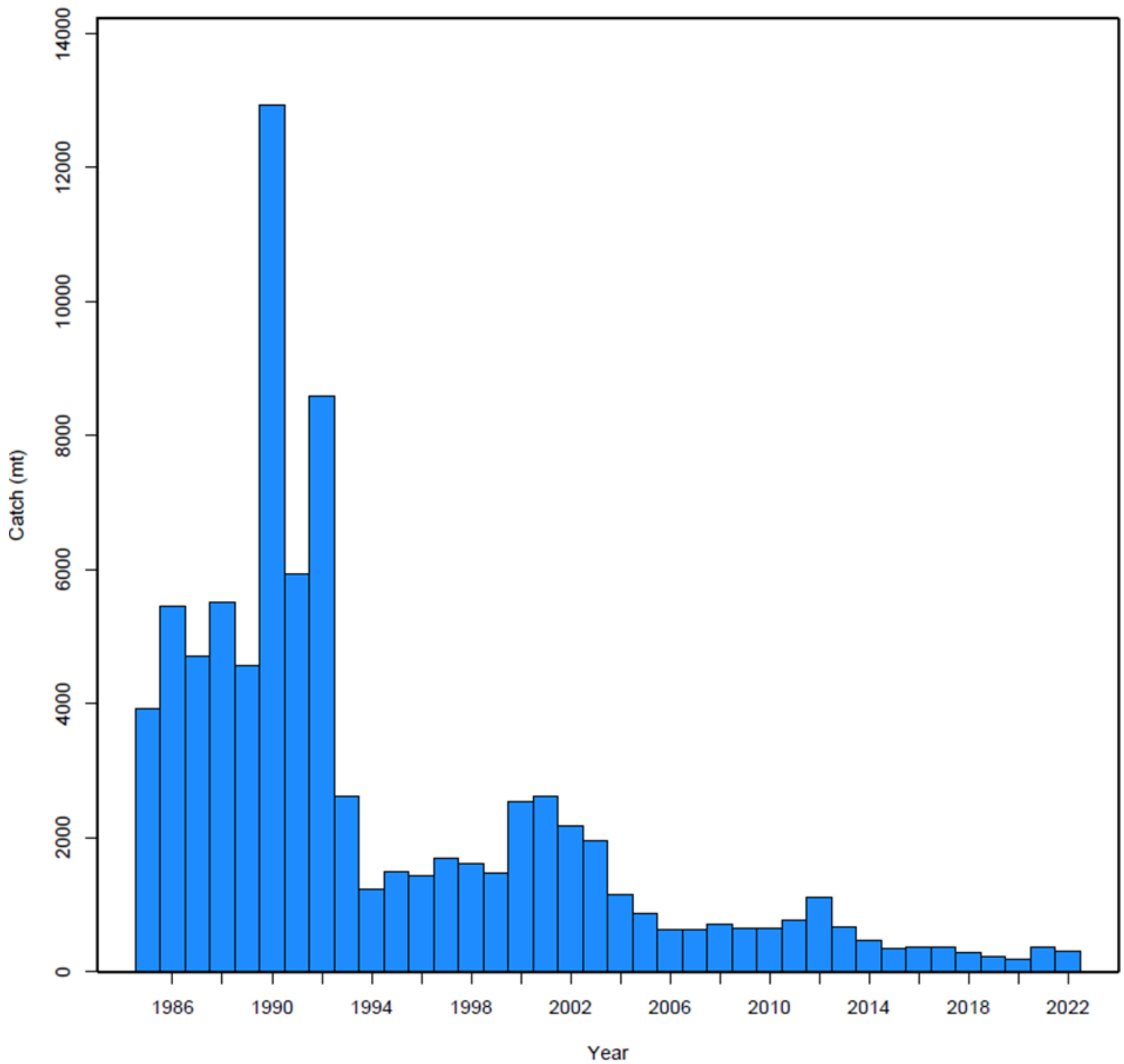


Figure 4.CCGOM.1: Total removals of yellowtail flounder from the Cape Cod/Gulf of Maine stock in the stock assessment model (a longer time series is in the ToR2 section). This represents a combined landings and discards.

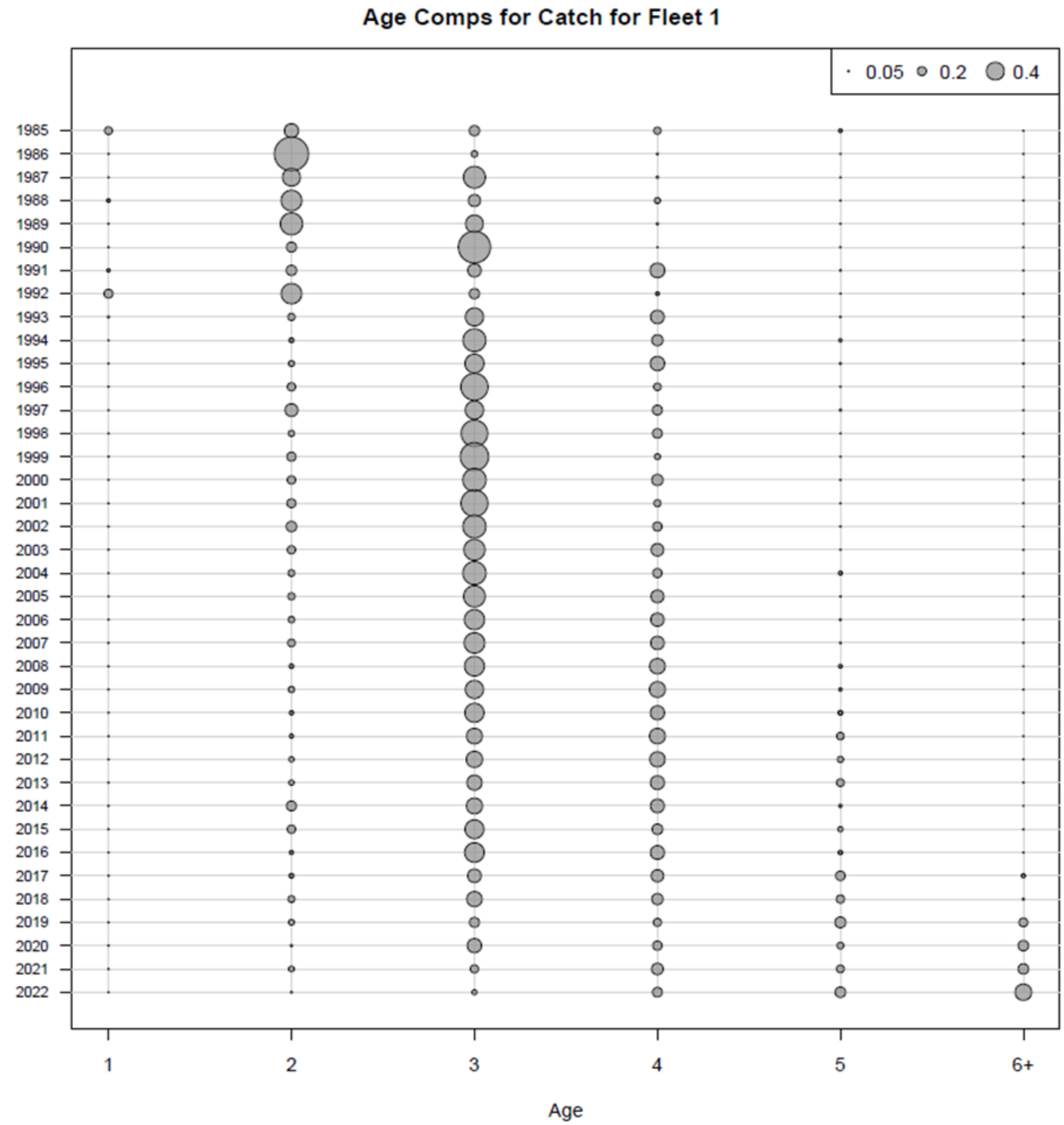


Figure 4.CCGOM.2: Age composition of the combined fishery catch in the stock assessment model.

Model Development

The transition from VPA to WHAM required a structured approach.. WHAM's ability to incorporate process error facilitated error integration in parameters like abundance transitions, natural mortality, selectivity, and catchability, and are beneficial in incorporating environmental covariates. Over 800 model configurations were tested, exploring factors like fleet selectivity, recruitment assumptions, and random effects structures. Each of the model decisions are documented below, but these decisions were not conducted in a linear fashion; earlier decisions were revisited when necessary due to model changes from latter decisions. Further explorations of these decisions can be found in Alade (WP).

Virtual population Analysis (VPA)

To bridge from the VPA to a more advanced modeling framework, a transition was developed through the ASAP and ultimately into the WHAM framework. ASAP served as an intermediate model, allowing data and assumptions from VPA to be seamlessly incorporated into WHAM's more flexible structure. This bridge facilitated the integration of VPA-derived inputs, such as age-specific indices and catch-at-age data, while providing a foundation for WHAM's capacity to include process errors, random effects, and environmental covariates. Through this stepwise approach, the assessment was able to retain VPA's historical data while advancing to WHAM's capabilities in handling environmental influences and addressing retrospective issues more effectively.

Initial WHAM Parameterization - (model m0)

The initial WHAM setup was configured to emulate an ASAP-like model without process error, using age classes (1-6+), an effective sample size of 150 for age compositions, and a low CV for combined fleet landings (0.01). Unlike ASAP, where recruitment deviations are estimated around a mean, WHAM in this configuration estimated recruitment as fixed parameters annually. This model successfully met both convergence criteria, showing a maximum gradient of 1.45e-11 and an invertible Hessian matrix. Subsequently, over 800 model variations were explored, adjusting fleet and survey selectivities, recruitment, age compositions, life history parameters, and environmental factors. Throughout this process, initial decisions were often revisited and refined as new insights emerged from ongoing model developments.

NEFSC survey ("To split or Not to split") – (model m1)

As was noted in TOR3, splitting the Albatross and Bigelow allowed for the inclusion of strata 58 and 63 for the Albatross. Models with split indices demonstrated better diagnostics, including improved fits to the surveys and reduced retrospective patterns. The WG adopted the split survey indices for both fall and spring with slightly revised strata definitions (see ToR3, above).

Fishery Selectivity - (model m5)

The initial fleet selectivity assumed a logistic function, estimating minimal selectivity at age-1 and full selection at older ages. Alternatively, age-specific selectivity models were estimated, fixing full selectivity at age-4 and estimating selectivity freely for other ages. To capture fishery selectivity variability, several random effect structures were explored, including independent and identically distributed (IID) effects, autoregressive (ar1) effects across selectivity parameters, autoregressive processes across years (ar1y), and two-dimensional autoregressive processes across both parameters and years (2dar1). The model assuming logistic selectivity with 2dar1 random effects provided the best fit and retrospective performance, establishing this configuration as the candidate model.

Survey Selectivity – (model m5)

In the initial model, six surveys (NEFSC fall and spring, MADMF and MENH fall and spring inshore surveys) were tested assuming either logistic or age-specific selectivities, without random effects. Logistic selectivity provided the best model fit and retrospective consistency (Mohn's rho) across most surveys. Spring surveys exhibited a gradual increase in selectivity at age, reaching full selection by ages 4-6+, while fall surveys had a more rapid increase, with age-1 slightly higher and achieving full selection by ages 2-6+. This pattern was incorporated into the candidate model to align with observed data trends.

Numbers-at-age - (model m14)

In the WHAM framework, testing various random effects configurations for NAA (i.e., process error in cohort survival) was crucial for enhancing model performance. Configurations included IID effects, autoregressive processes across years (ar1_y) and ages (ar1_a), and both dimensions (2dar1). The best results came from the autoregressive across ages (ar1_a) model, which showed the lowest AIC, improved residual fit, and better retrospective performance (Mohn's rho). Despite these improvements, substantial differences in the time series of stock estimates among retrospective peels surfaced, prompting further investigations.

Recruitment assumption and Environmental Covariates - (model m87 and Ecov Runs)

Initial analyses tested recruitment assumptions, comparing random mean recruitment with a Beverton-Holt stock-recruitment model with IID process error. Although the Beverton-Holt model met convergence criteria, diagnostics, including Mohn's rho and residuals, were poor. Environmental covariates like the Atlantic Multidecadal Oscillation (AMO) and spring bottom temperature were then tested, assuming recruitment might be influenced by prior-year conditions. However, none of these covariates improved model diagnostics. Ultimately, the random deviation from the time series mean recruitment model without environmental covariates yielded the lowest AIC and best fit, leading to its selection for the candidate model with an autoregressive (ar1_y) process for recruitment.

Natural Mortality and Environmental Covariates – (Ecov Runs)

M was fixed at 0.4 across ages and years, based on longevity estimates for yellowtail flounder. Various configurations, including random effects models (ar1_y and 2dar1) or age-specific M were explored but did not improve model fit or retrospective patterns. Additionally, environmental covariates such as the Atlantic Multidecadal Oscillation (AMO) and spring bottom temperature were assessed for potential impact on M using linear and polynomial models with random walk and autoregressive processes. These, too, failed to enhance model performance. Consequently, the decision was made to retain the fixed M = 0.4 assumption in the candidate model.

Fishery and Survey Age Composition - model m(101)

The logistic-normal-miss0 distribution was selected as the assumed statistical distribution of age composition. The analysis tested 27 combinations across age composition structures, including multinomial, Dirichlet multinomial, logistic-normal-miss0, logistic-normal-ar1-miss0 and logistic-normal-pool0 across the combined fleet and survey indices. The logistic-normal-miss0 structure, enhanced with an autoregressive (ar1) process, offered the best model fit in terms of residuals and Mohn's rho retrospective results. This structure was selected for most surveys and the combined fleet, except for the MADMF fall survey, which retained the simpler logistic-normal-miss0 configuration.

Survey Inclusion/Exclusion - (models m304 or m406)

The candidate model initially had retrospective peels with substantially different estimates of stock size for the entire time series, suggesting potential challenges with including surveys that do not index the entire stock. To address this, 255 model runs were conducted with various survey configurations by systematically excluding up to seven surveys(from a total of eight, due to the NEFSC Bigelow and Albatross split) to identify which surveys might contribute to retrospective scaling inconsistencies. Results showed that excluding the MADMF and MEDMR spring surveys significantly improved the scaling in the retrospective patterns. It is hypothesized that this scaling effect in the retrospective patterns is likely attributed to the overlap in spatial and temporal patterns of these surveys with spawning and migration. Consequently, these surveys were excluded from the candidate model to enhance stability in population scaling.

Fleet Selectivity – Revisited (model m452)

Model 304 initially appeared to be reasonable, but further analysis of reference points revealed abnormally high FMSY proxy values that resulted from unrealistic estimates of fishery selectivity (e.g., only the 6+ age was fully selected in recent years). Suspecting the 2dar1 random effects as a potential cause, the team re-evaluated selectivity with different blocking and random effect configurations. Testing multiple configurations, a two-block selectivity structure (1985-1994 and 1995-2022) without random effects yielded more realistic FMSY values and superior diagnostic performance. This led to model 452 becoming the base model, showing improved Mohn's rho, bias reduction from the simulation self-test while fitting indices and catch data well.

Candidate Model Setup

Table 4.CCGOM.1 provides a summary of all candidate model settings based on the criteria outlined above. The final model m452 features a two-block logistic fleet selectivity with distinct periods from 1985-1993 and 1994-2022 and excludes random effects for fleet selectivity. This configuration uses six fishery-independent surveys: NEFSC spring and fall bottom trawl surveys, split between the Albatross (1985-2008) and Bigelow (2009-2022) series, along with MADMF and MENH fall inshore surveys. A logistic functional form was applied across these surveys. Fleet age composition uses a logistic-normal-miss0 distribution, with surveys modeled via a logistic-normal-ar1-miss0 structure. NAA are modeled with autoregressive random effects (ar1_a), correlating recruitment to older ages (2-6+).

Table 4.CCGOM.1 Candidate model (m452) settings.

Age Classes	1-6+
Fleet Selectivity	Logistic
Fleet Selectivity Random Effects	None
Fleet Age Composition	Logistic normal-miss0
Fleet CV	0.05
Survey Selectivities	Logistic
Survey Selectivity Random Effects	None
Survey Catchability Random Effects	None
Survey Catchability Environmental Effects	None
Survey Age Compositions	Logistic normal-ar1-miss0
Recruitment Assumptions	Not decoupled from ages 2-6+

	Random about the mean (1985-2022)
Environmental Covariate	None
Natural Mortality Assumptions	M = 0.4 across all ages and years
Numbers-at-Age Random Effects	ar1_a

Model Diagnostics

The candidate model m452 exhibited robust diagnostics, meeting both first-order (maximum gradient of 2.58e-10) and second-order convergence criteria, with an invertible Hessian matrix ensuring reliable optimization. Jitter analysis confirmed stability with a 100% convergence rate (Figure 4.CCGOM.3). A low CV for the aggregate fleet (0.05) supported a strong data fit, showing minimal patterning (Figure 4.CCGOM.4), with similar success across the NEFSC and state surveys, though some residual patterning persisted (Figures 4.CCGOM.5-10). OSA residuals across the aggregate fleet and surveys indicated approximate normality, with only minor tailing, suggesting consistent fit across time (Figures 4.CCGOM.11-16). Age composition residuals were also generally normally distributed with occasional tailing at the ends of the distributions (Figures 4.CCGOM.17-24). Retrospective analysis showed minor patterns in spawning stock biomass (SSB) underestimation (Mohn's ρ = -0.063) and a slight fishing mortality (F) overestimation (Mohn's ρ = 0.054) . (Figures 4.CCGOM.25-26). Self-tests further validated the model's stability, showing low bias for F, R, and SSB (9.71%, -8.7%, -17.66%, respectively) with consistent convergence (Figure 4.CCGOM.27).

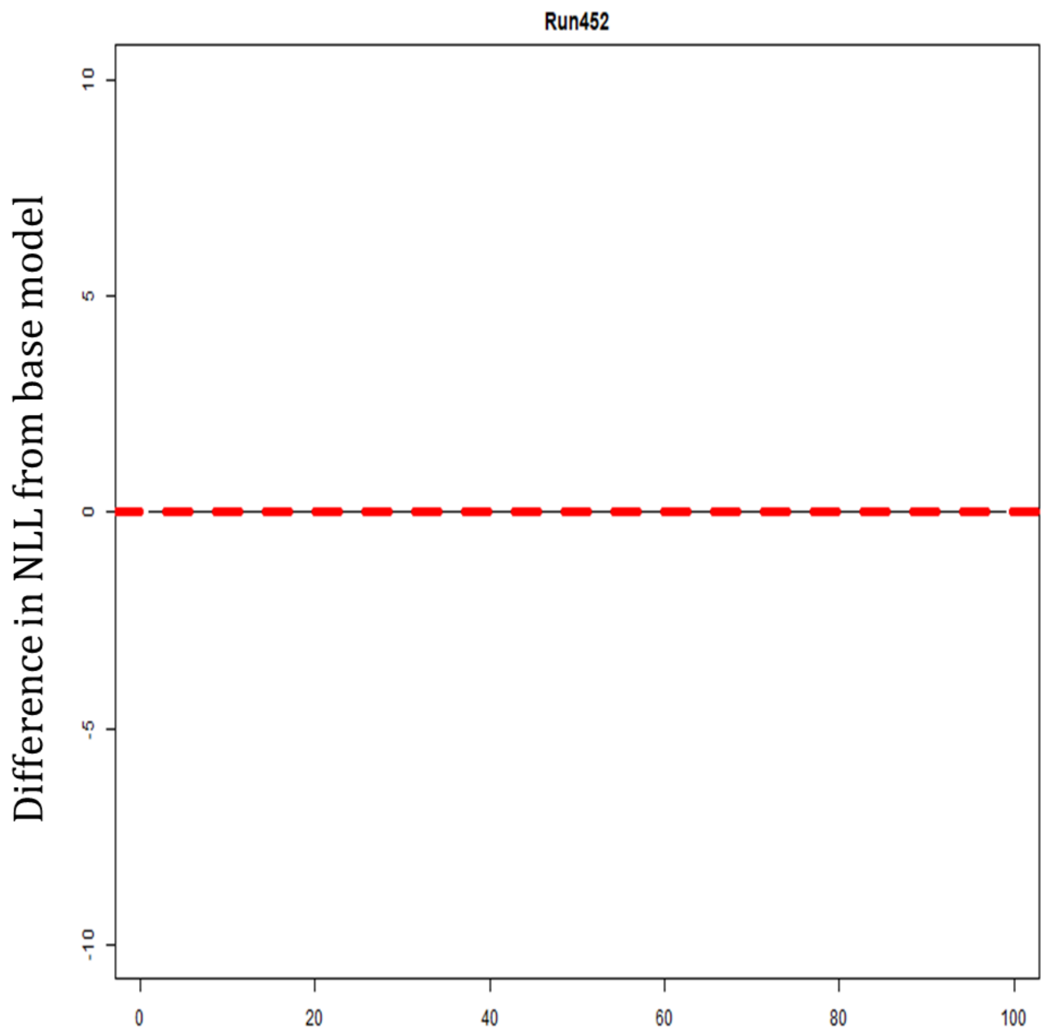


Figure 4.CCGOM.3: Jitter analysis results of the candidate model. Convergence rate was 100% and all runs (of 100) converged to the global minimum, indicating high stability.

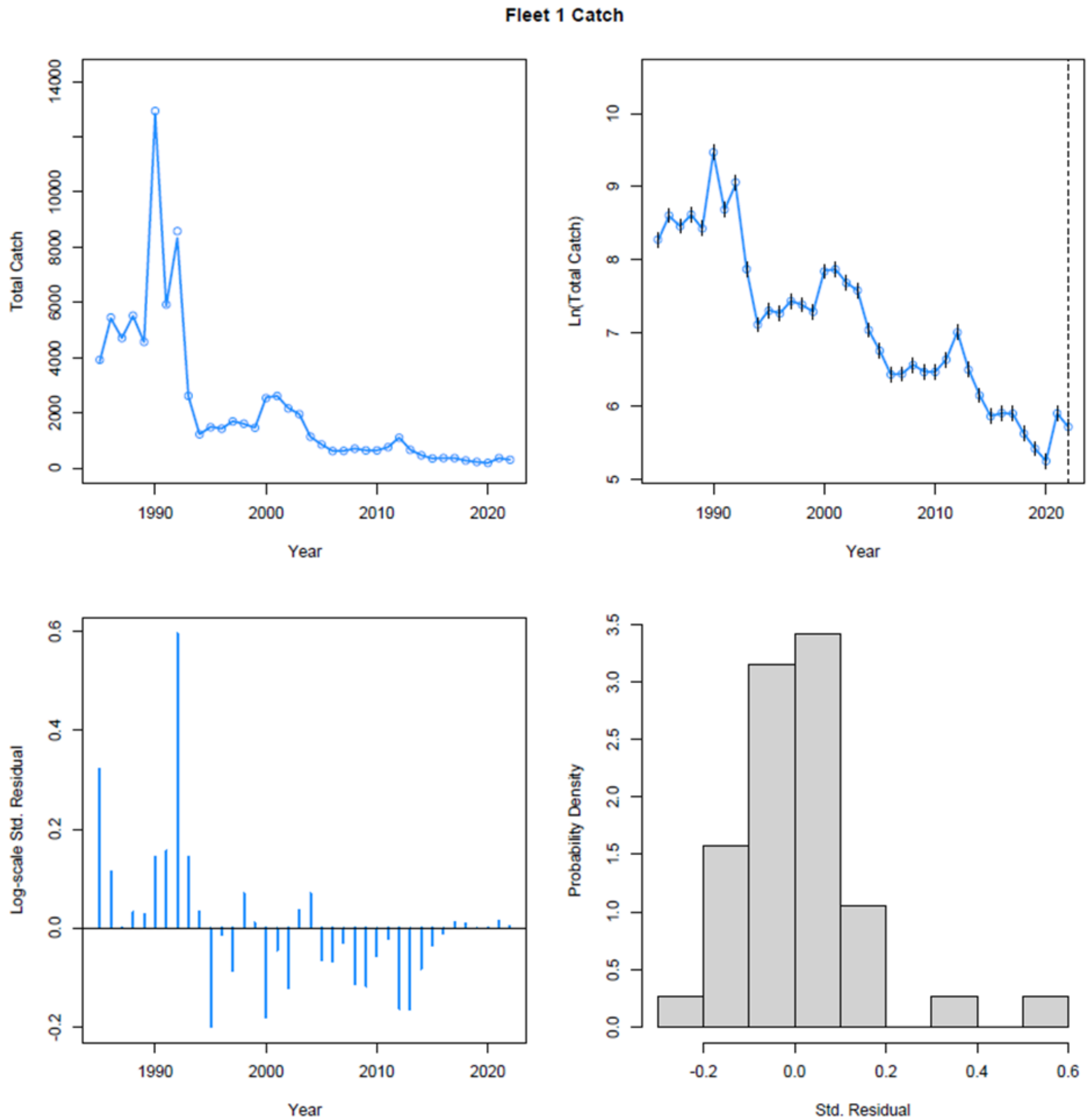


Figure 4.CCGOM.4: Candidate model m452 model fit to the aggregate fleet data.

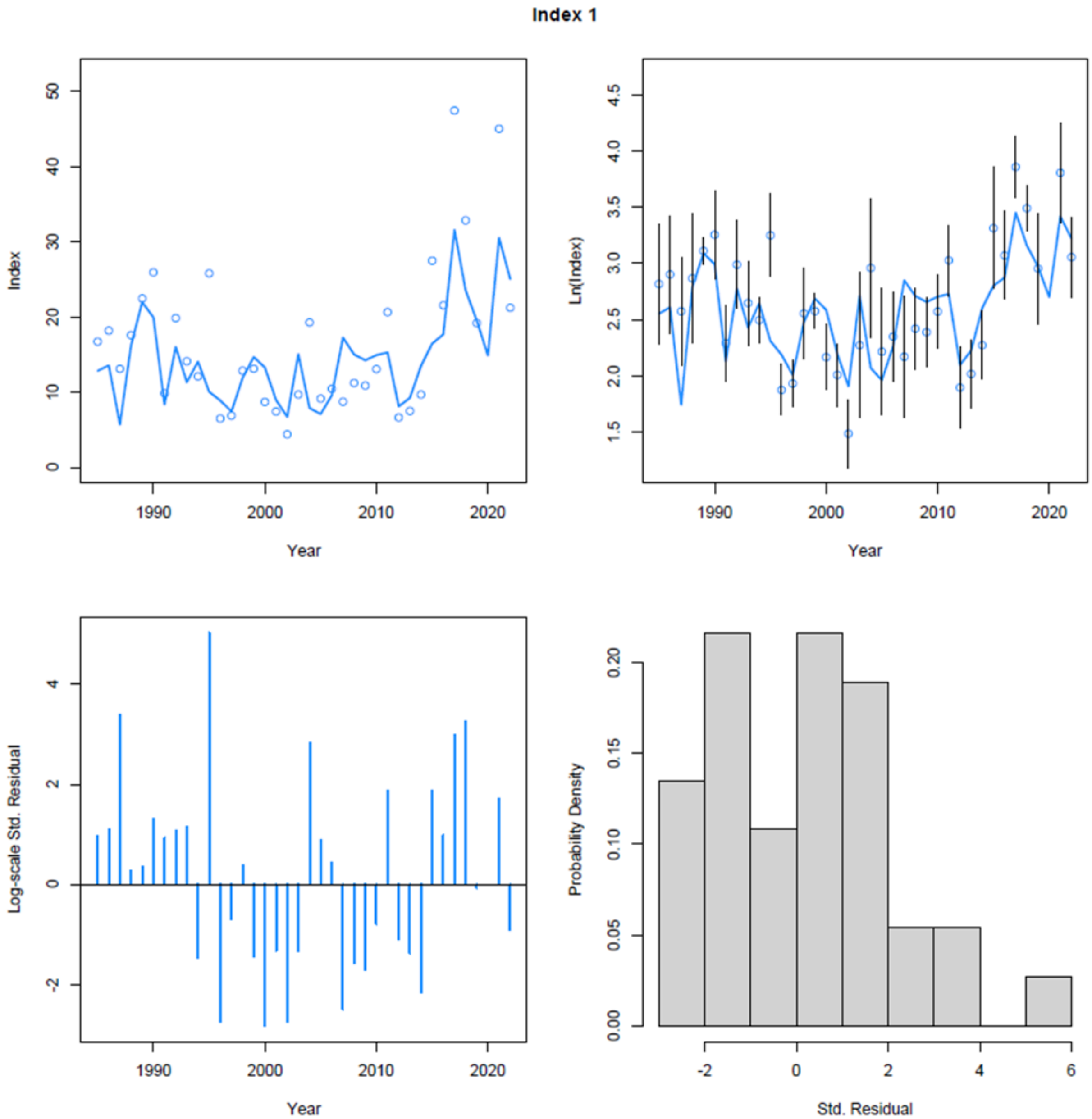


Figure 4.CCGOM.5: Candidate model m452 model fit to the aggregate MADMF fall bottom trawl survey index.

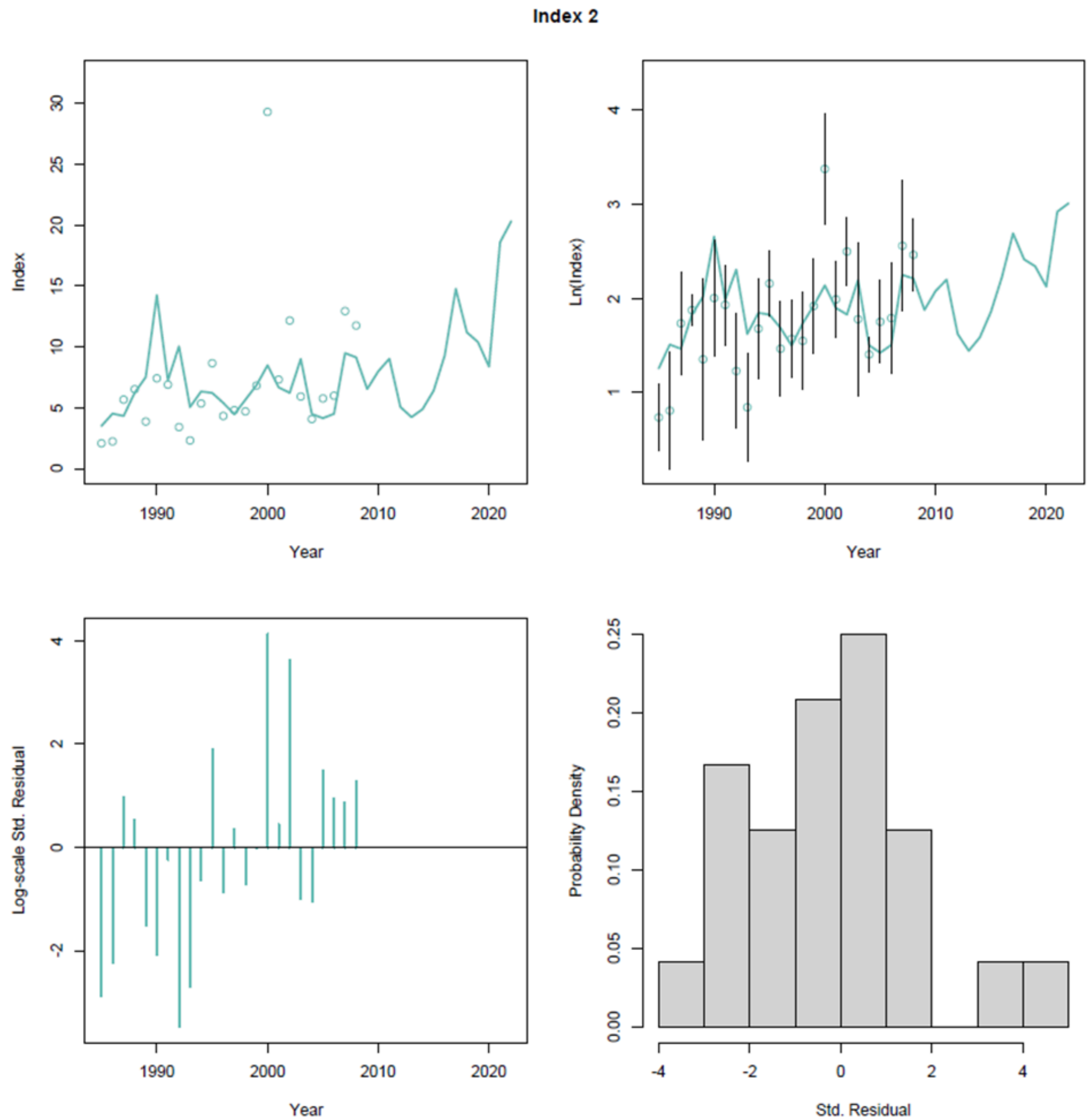


Figure 4.CCGOM.6: Candidate model m452 model fit to the aggregate NEFSC spring bottom trawl survey index for the Albatross vessel (1985-2008).

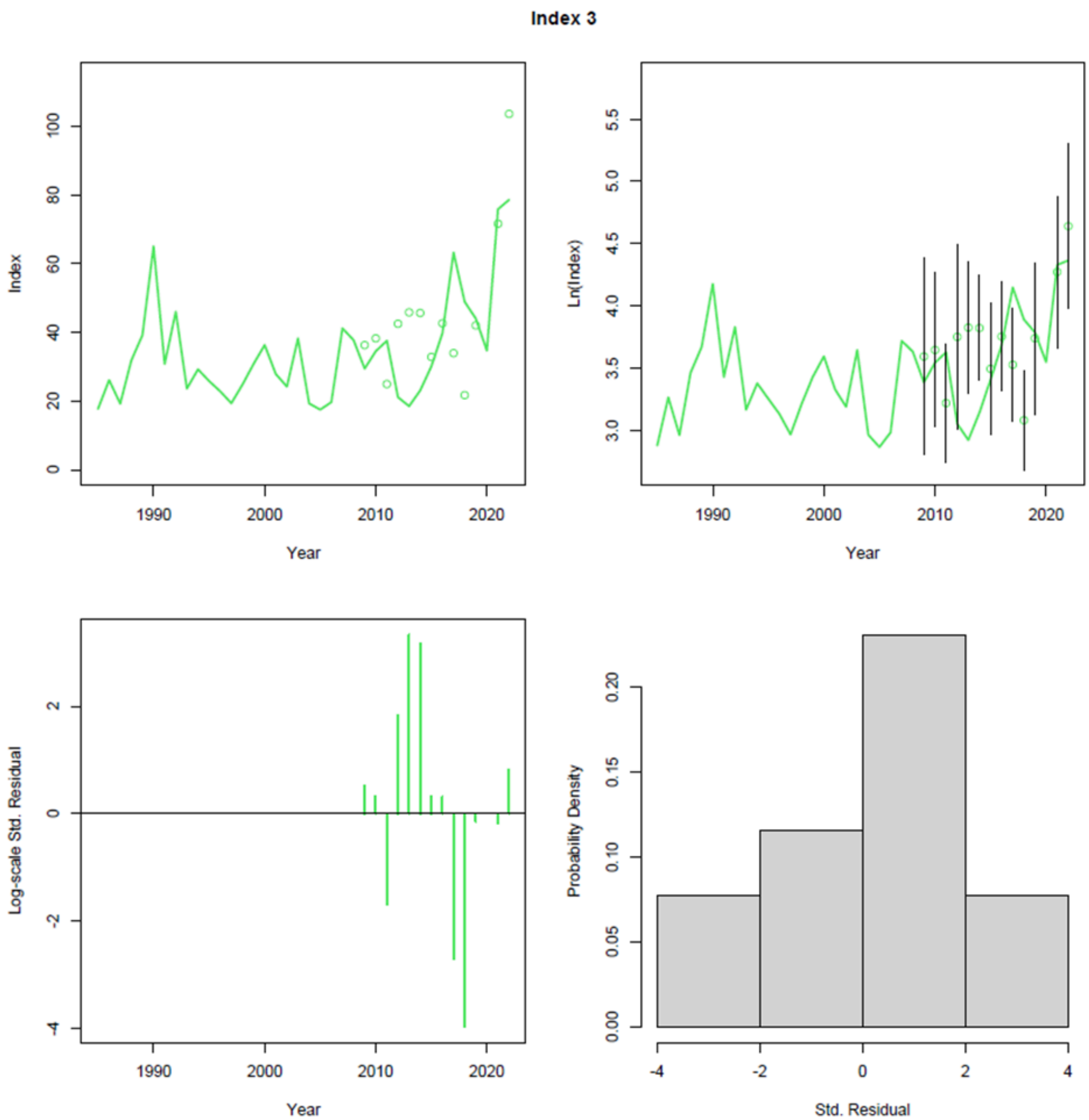


Figure 4.CCGOM.7: Candidate model m452 model fit to the aggregate NEFSC spring bottom trawl survey index for the Bigelow vessel (2009-2022).

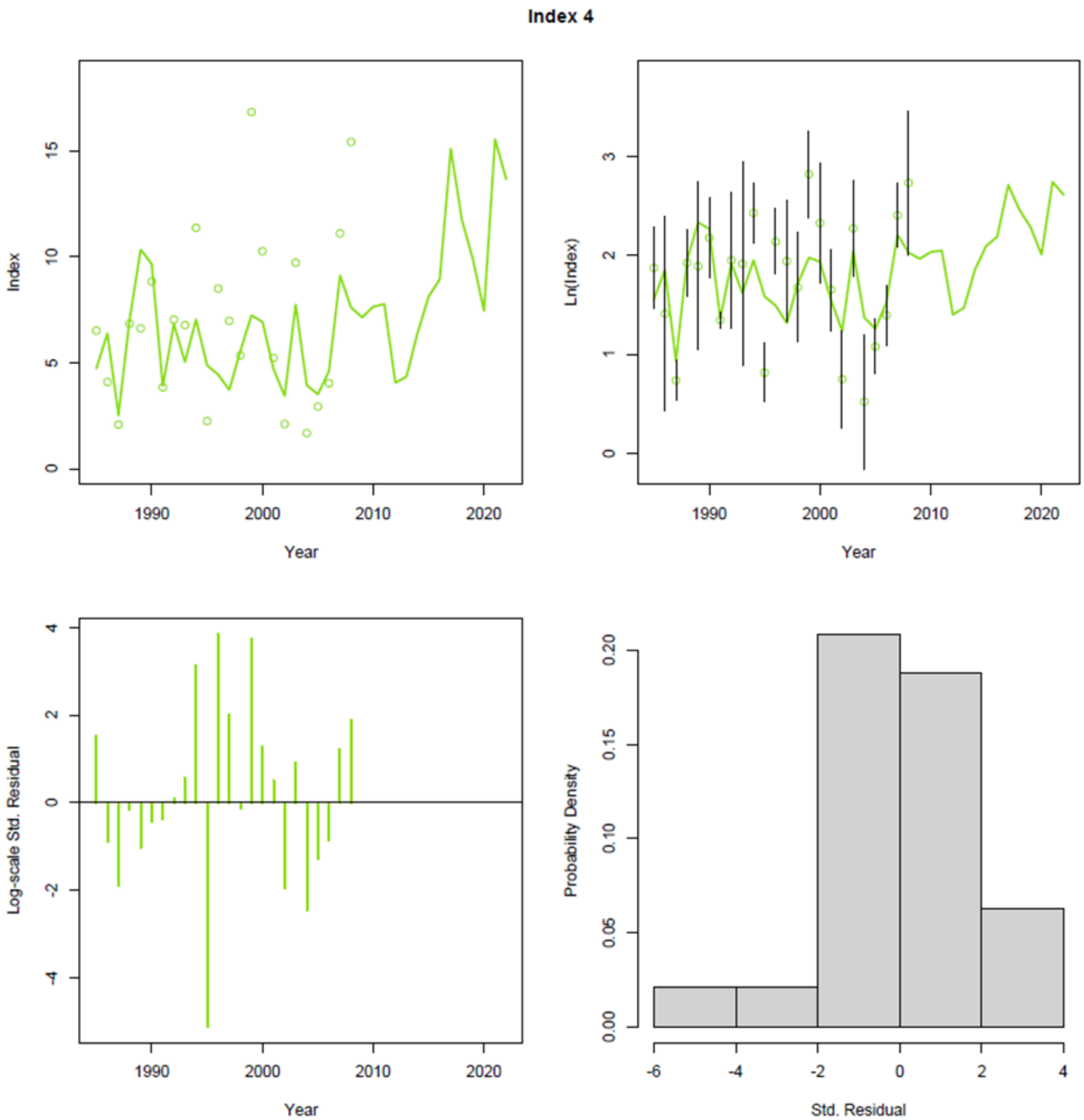


Figure 4.CCGOM.8: Candidate model m452 model fit to the aggregate NEFSC fall bottom trawl survey index for the Albatross vessel (1985-2008).

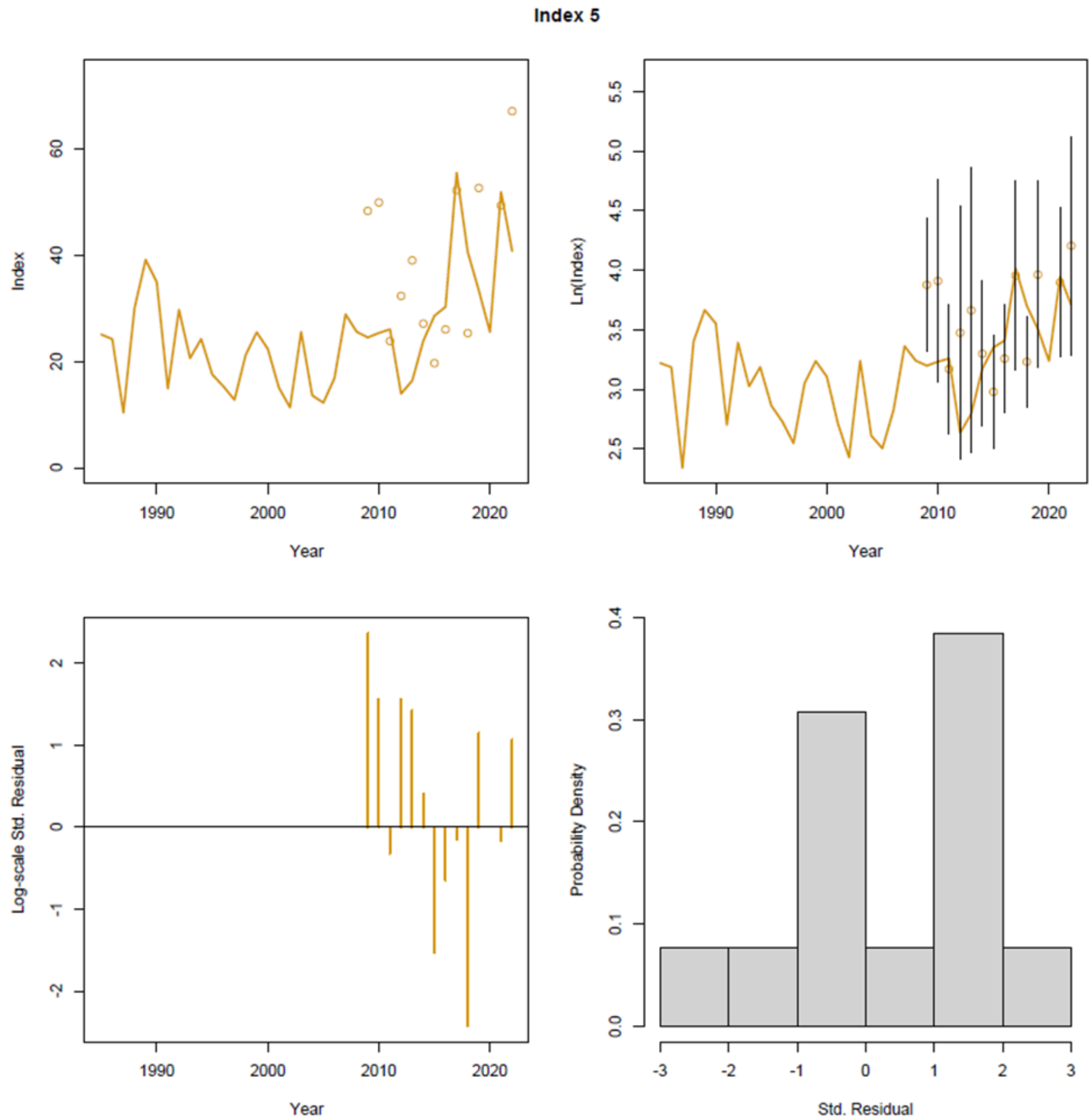


Figure 4.CCGOM.9:Candidate model m452 model fit to the aggregate NEFSC fall bottom trawl survey index for the Bigelow vessel (2009-2022).

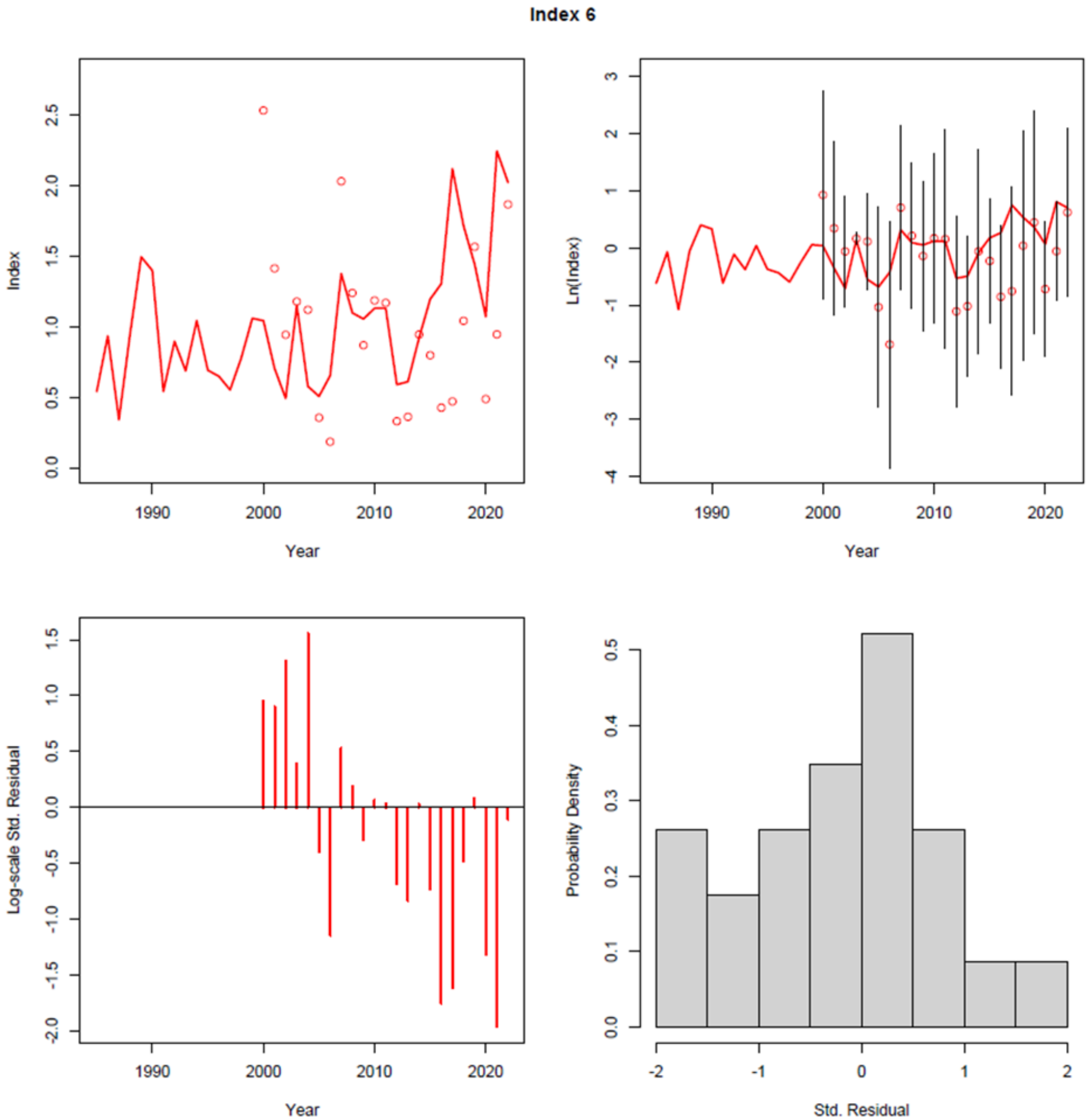


Figure 4.CCGOM.10: Candidate model m452 model fit to the aggregate Inshore MENH fall bottom trawl survey index.

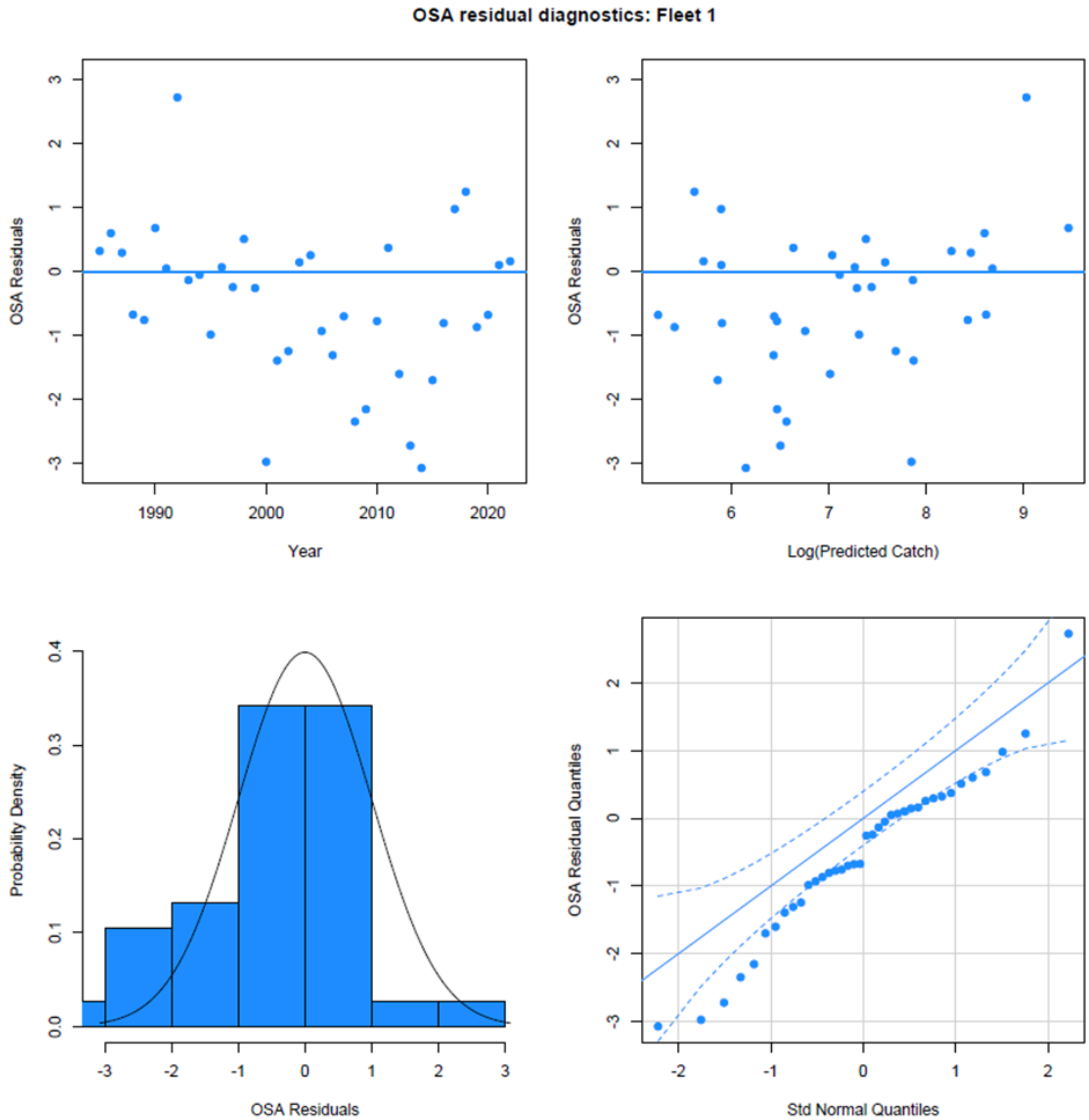


Figure 4.CCGOM.11: Candidate model m452 OSA residual diagnostic for the aggregate fleet.

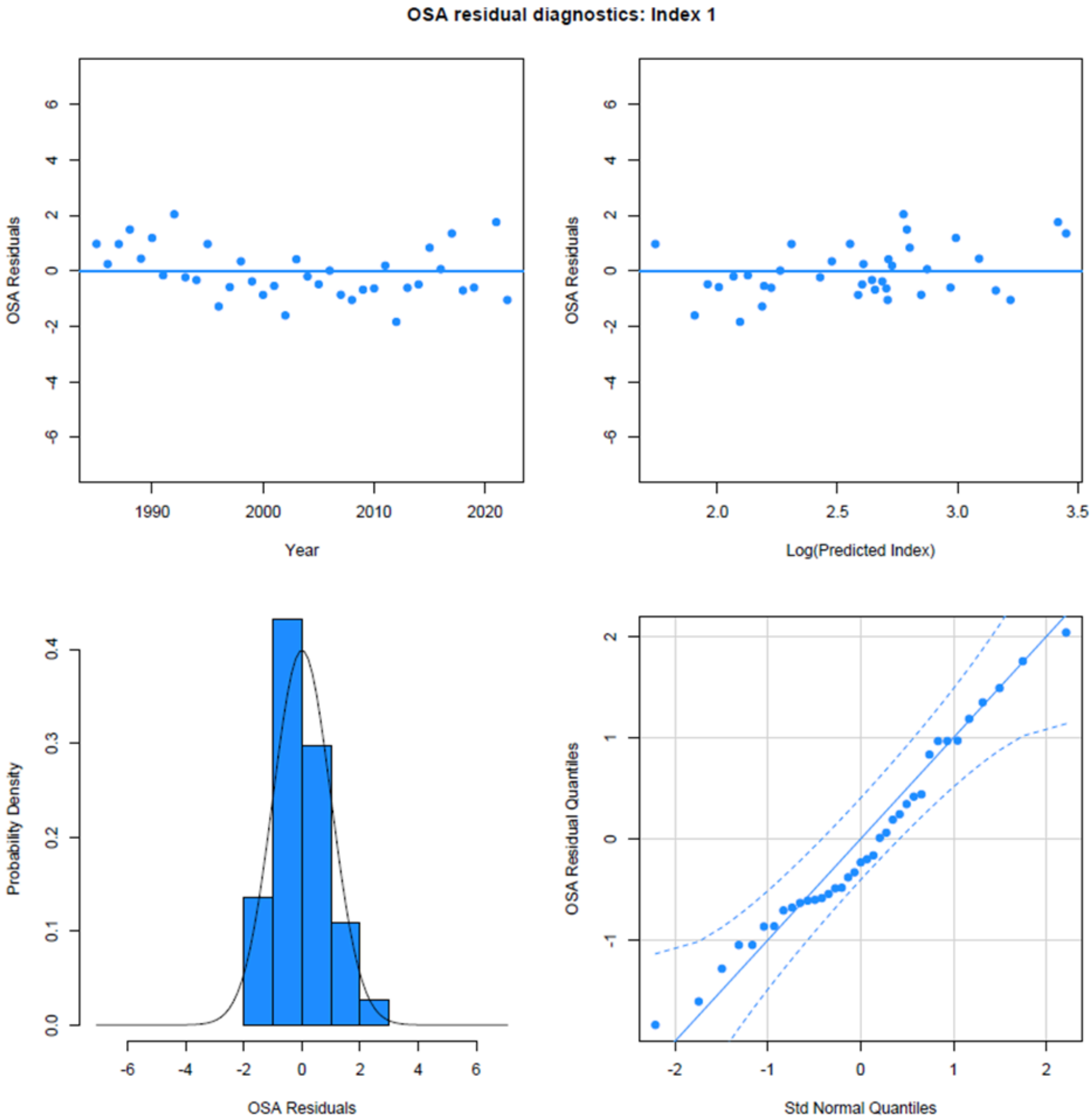


Figure 4.CCGOM.12: Candidate model m452 OSA residual diagnostic for the Inshore MADMF fall bottom trawl index.

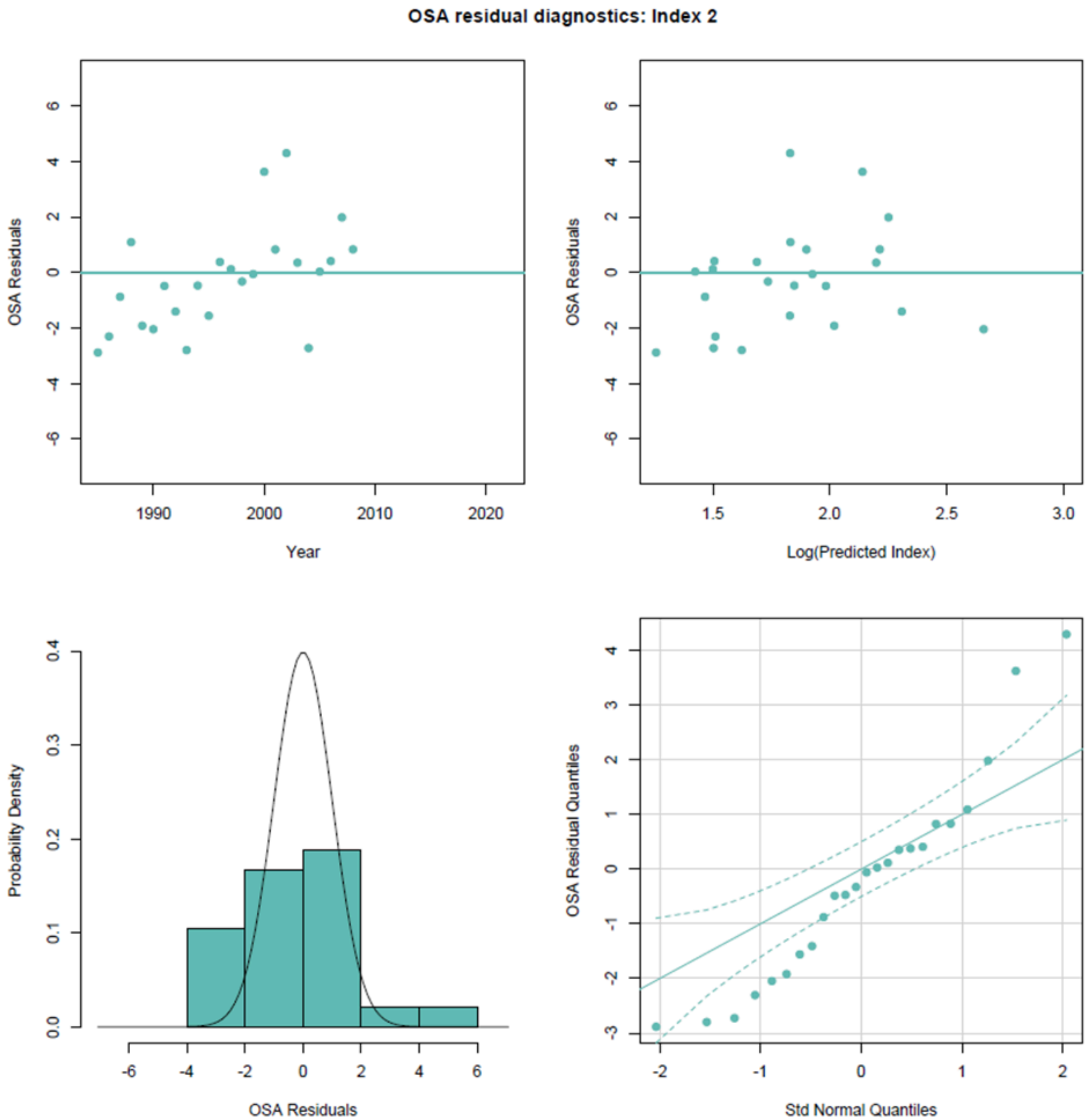


Figure 4.CCGOM.13: Candidate model m452 OSA residual diagnostic for the NEFSC Spring bottom trawl index for the Albatross vessel (1985-2008).

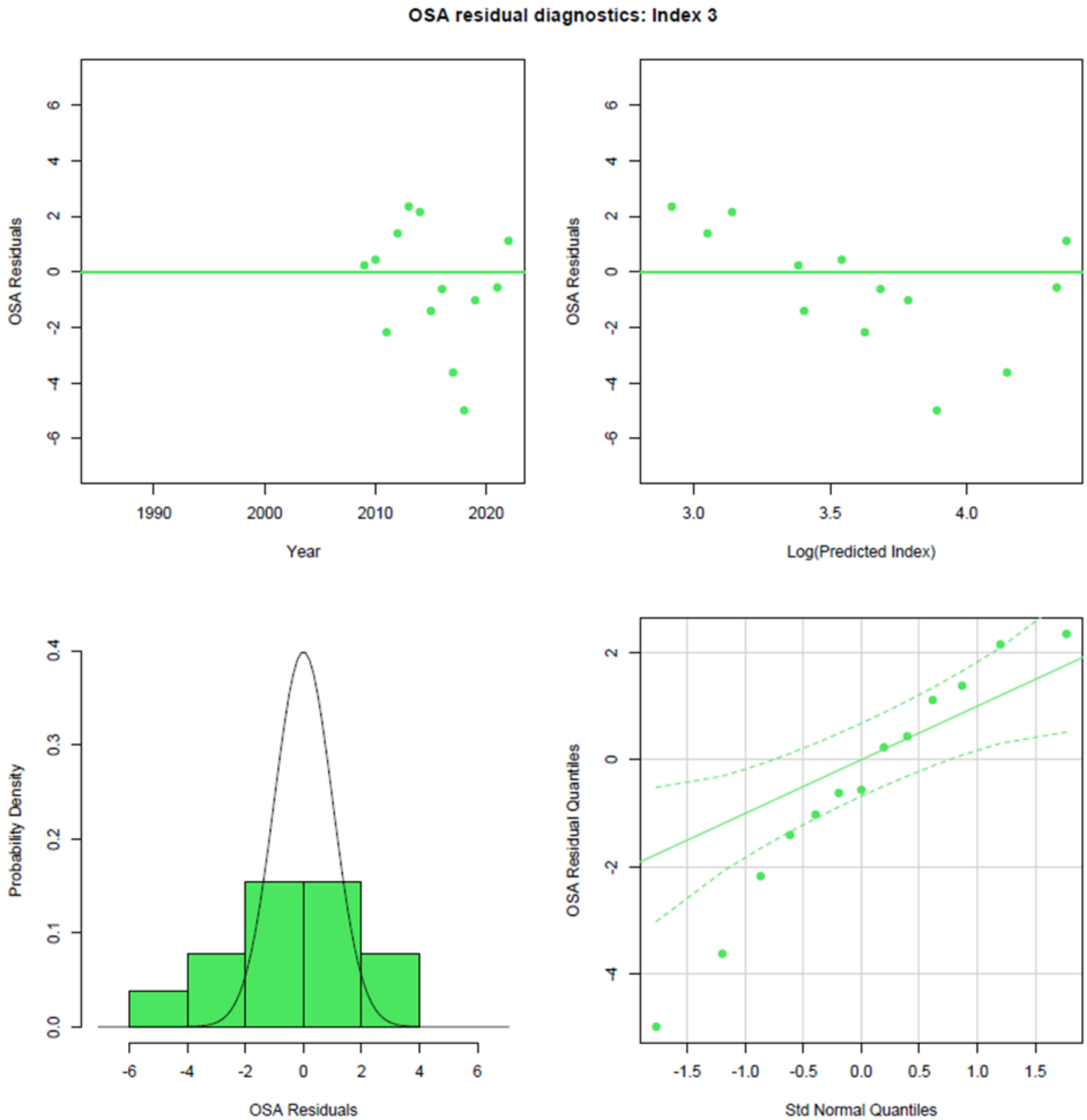


Figure 4.CCGOM.14: Candidate model m452 OSA residual diagnostic for the NEFSC Spring bottom trawl index for the Bigelow vessel (2009-2022).

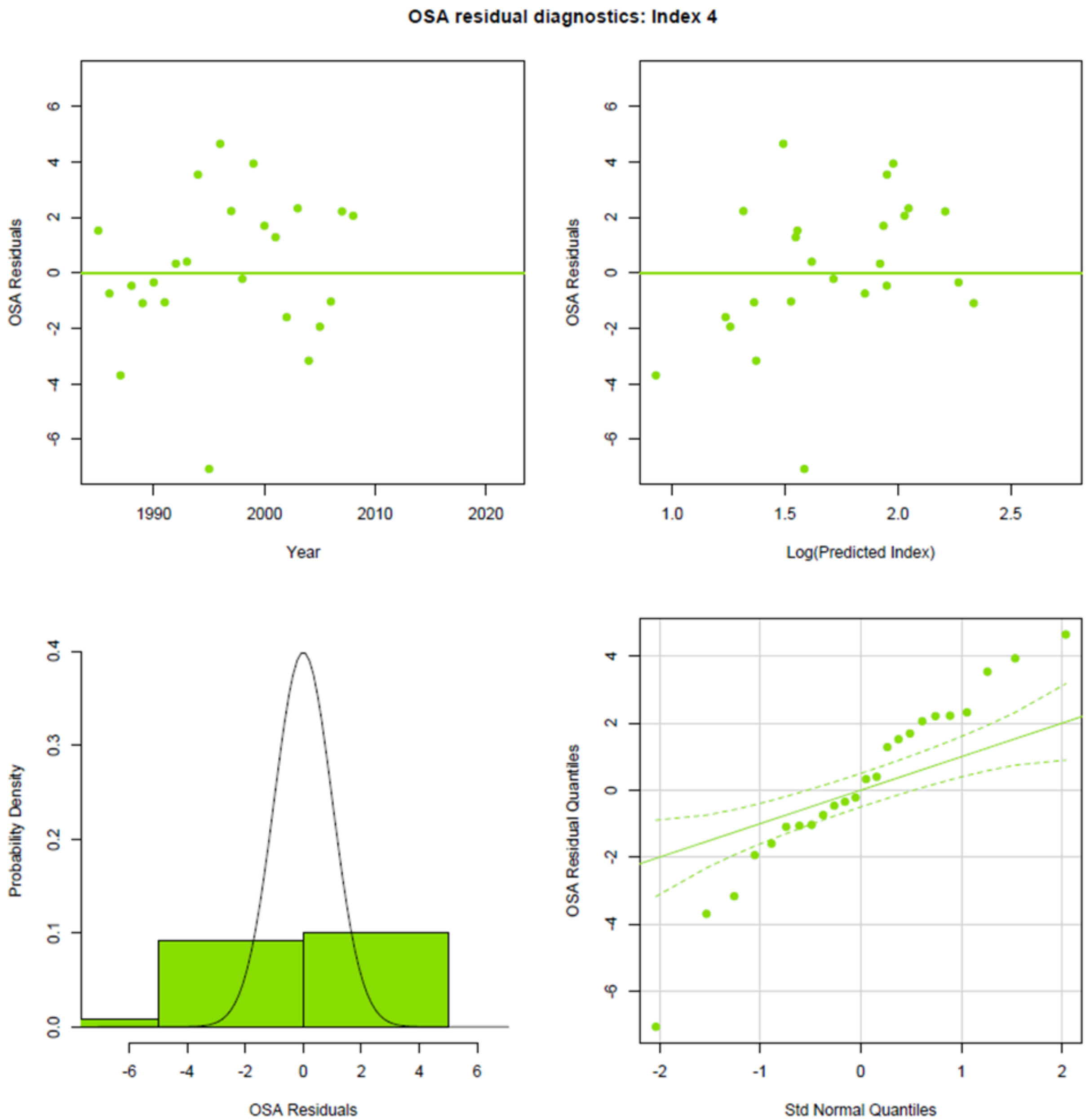


Figure 4.CCGOM.15: Candidate model m452 OSA residual diagnostic for the NEFSC Fall bottom trawl index for the Albatross vessel (1985-2008).

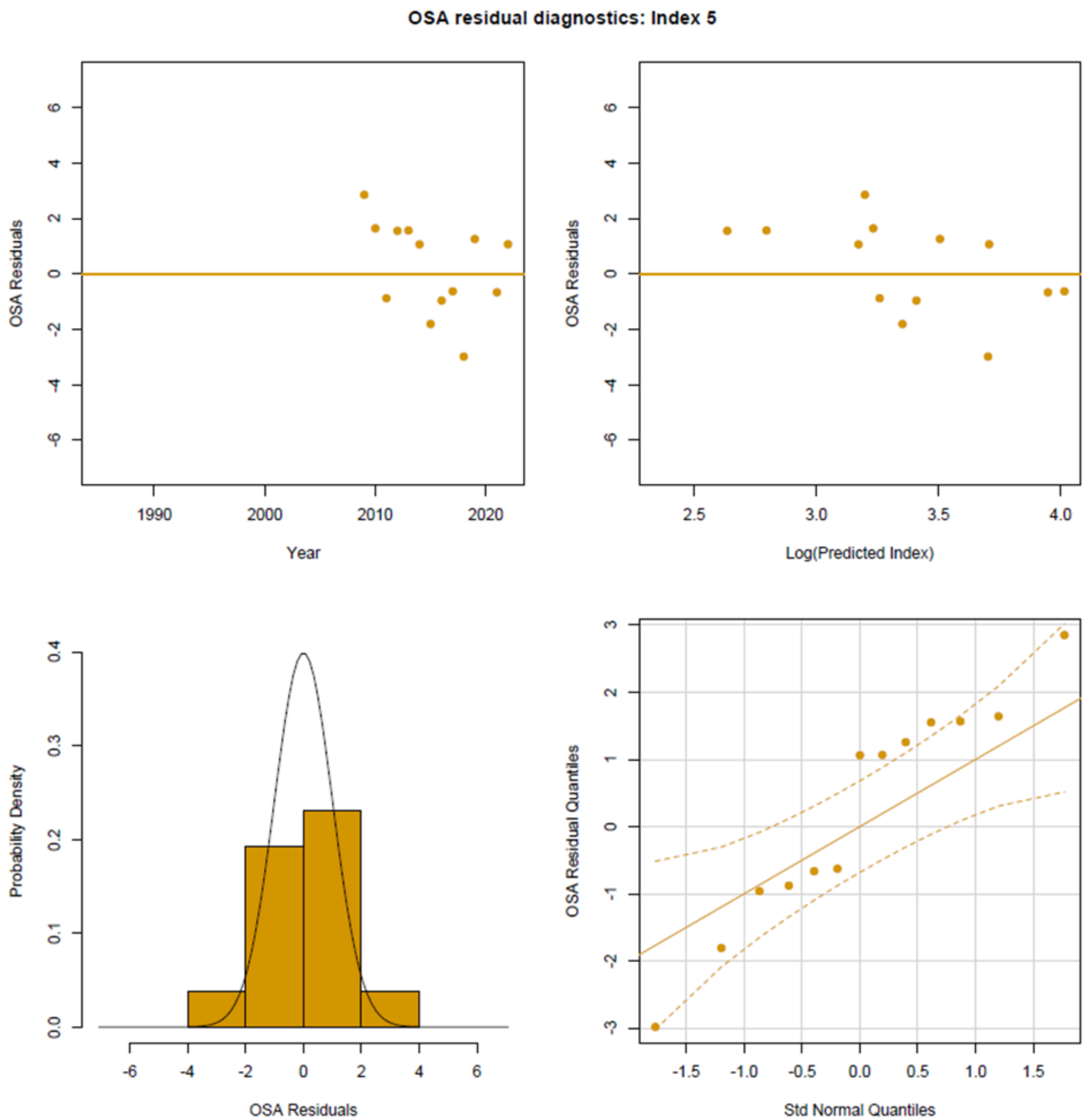


Figure 4.CCGOM.16: Candidate model m452 OSA residual diagnostic for the NEFSC Fall bottom trawl index for the Bigelow vessel (2009-2022).

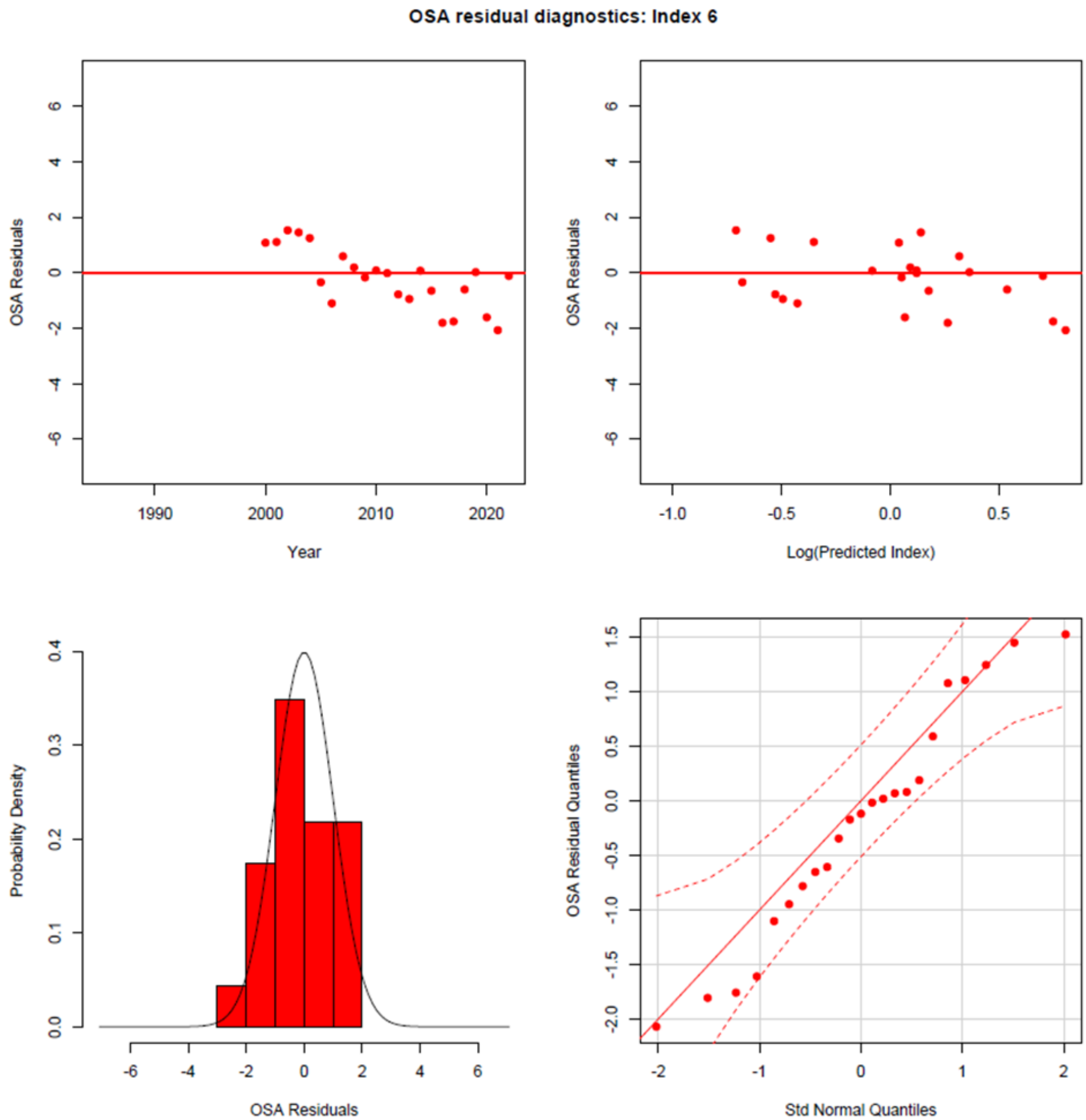


Figure 4.CCGOM.17: Candidate model m452 OSA residual diagnostic for the Inshore MENH Fall bottom trawl index.

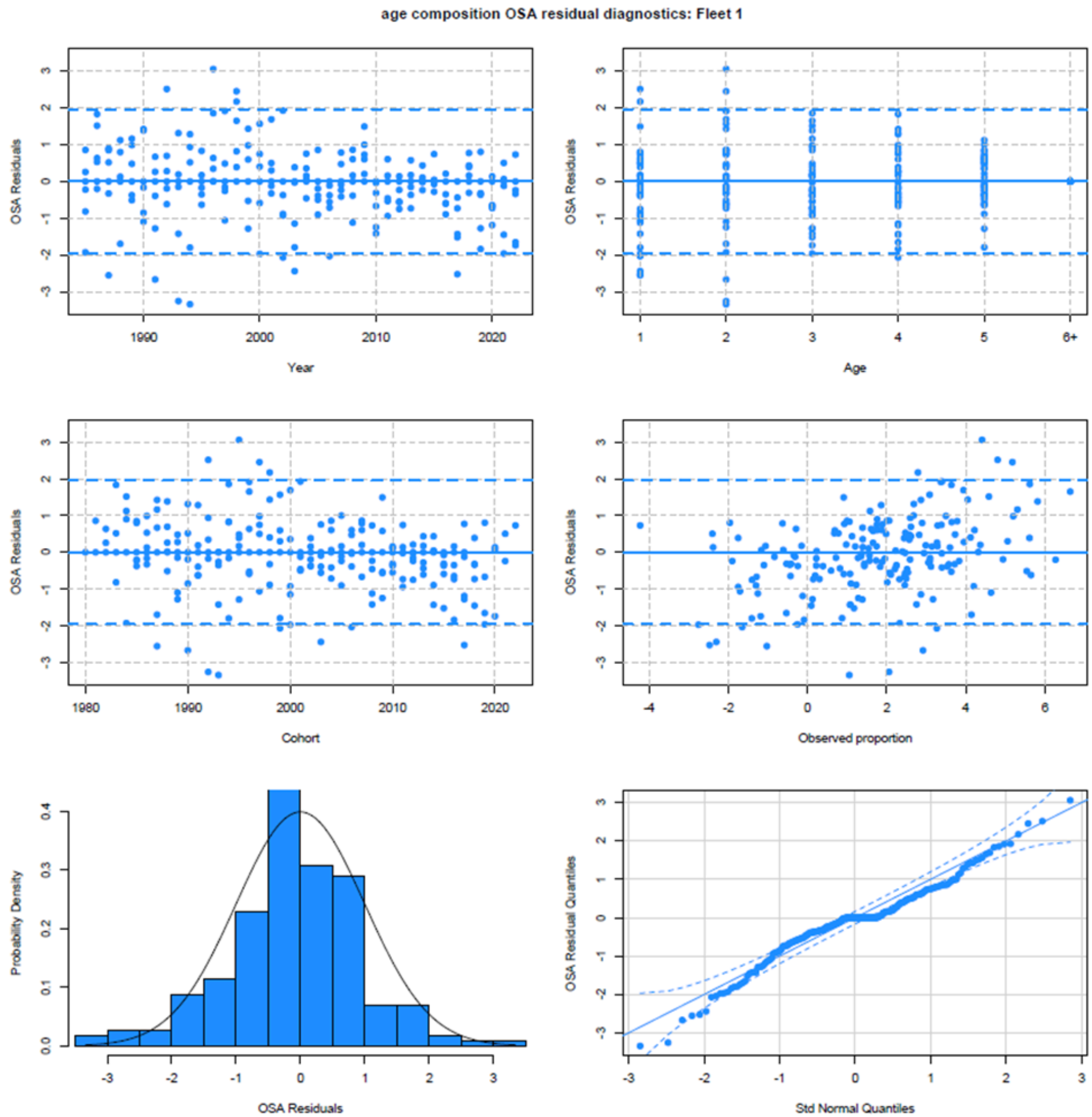


Figure 4.CCGOM.18: Candidate model m452 OSA residual diagnostic for the aggregate fleet age composition.

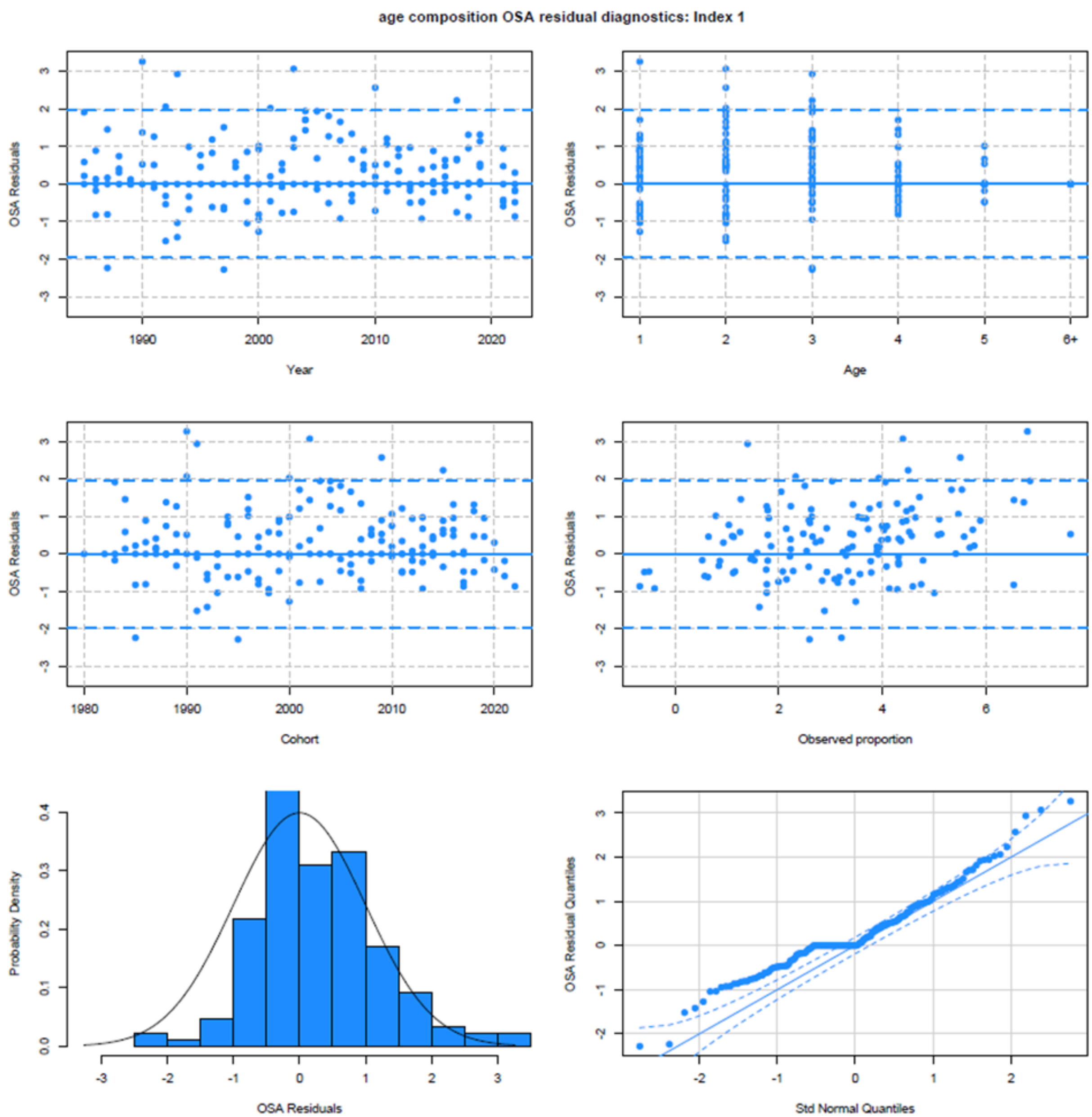


Figure 4.CCGOM.19:Candidate model m452 OSA residual diagnostic for the Inshore MADMF Fall bottom trawl index age composition.

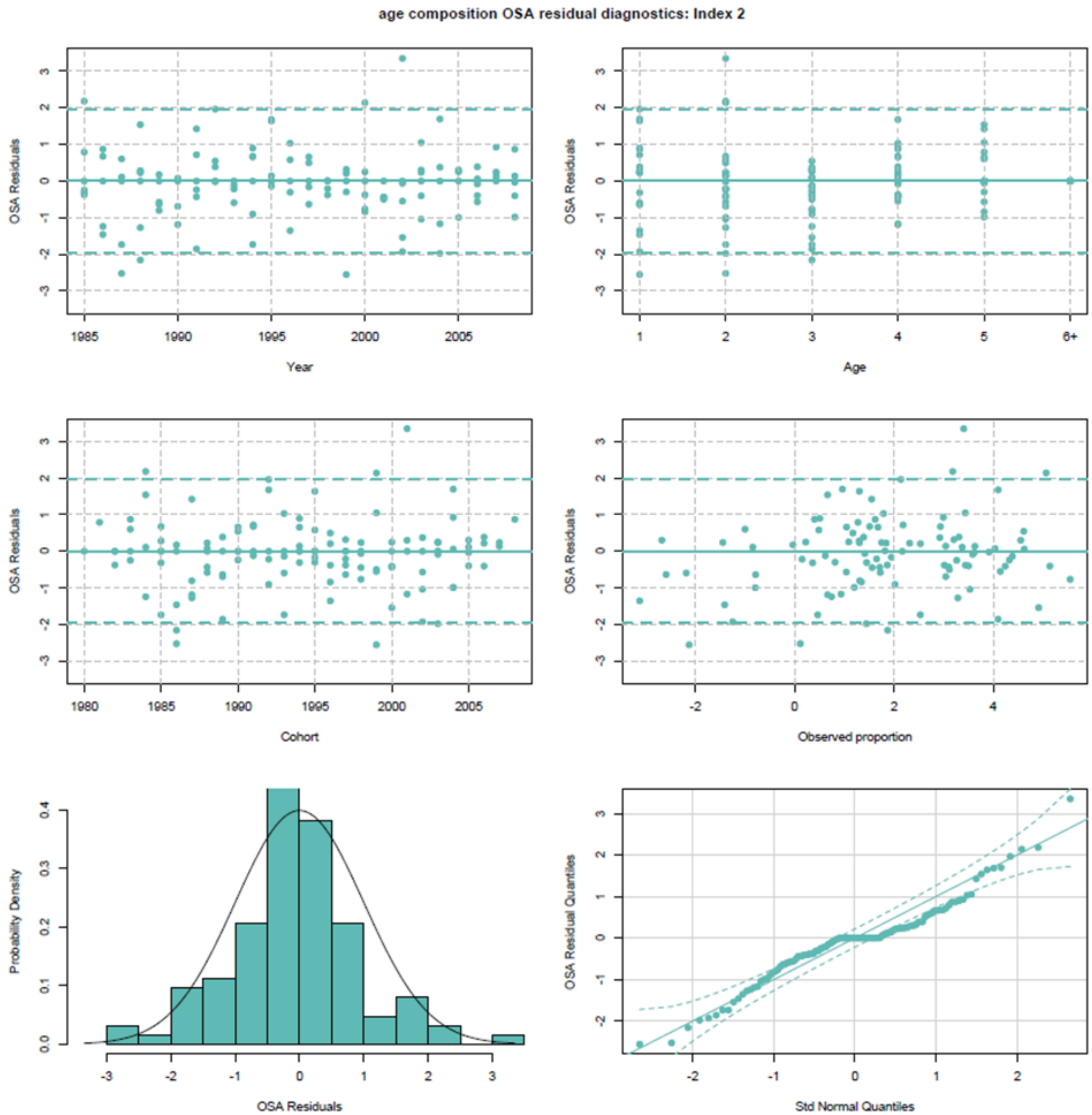


Figure 4.CCGOM.20: Candidate model m452 OSA residual diagnostic for the NEFSC Spring bottom trawl index age composition for the Albatross vessel (1985-2008).

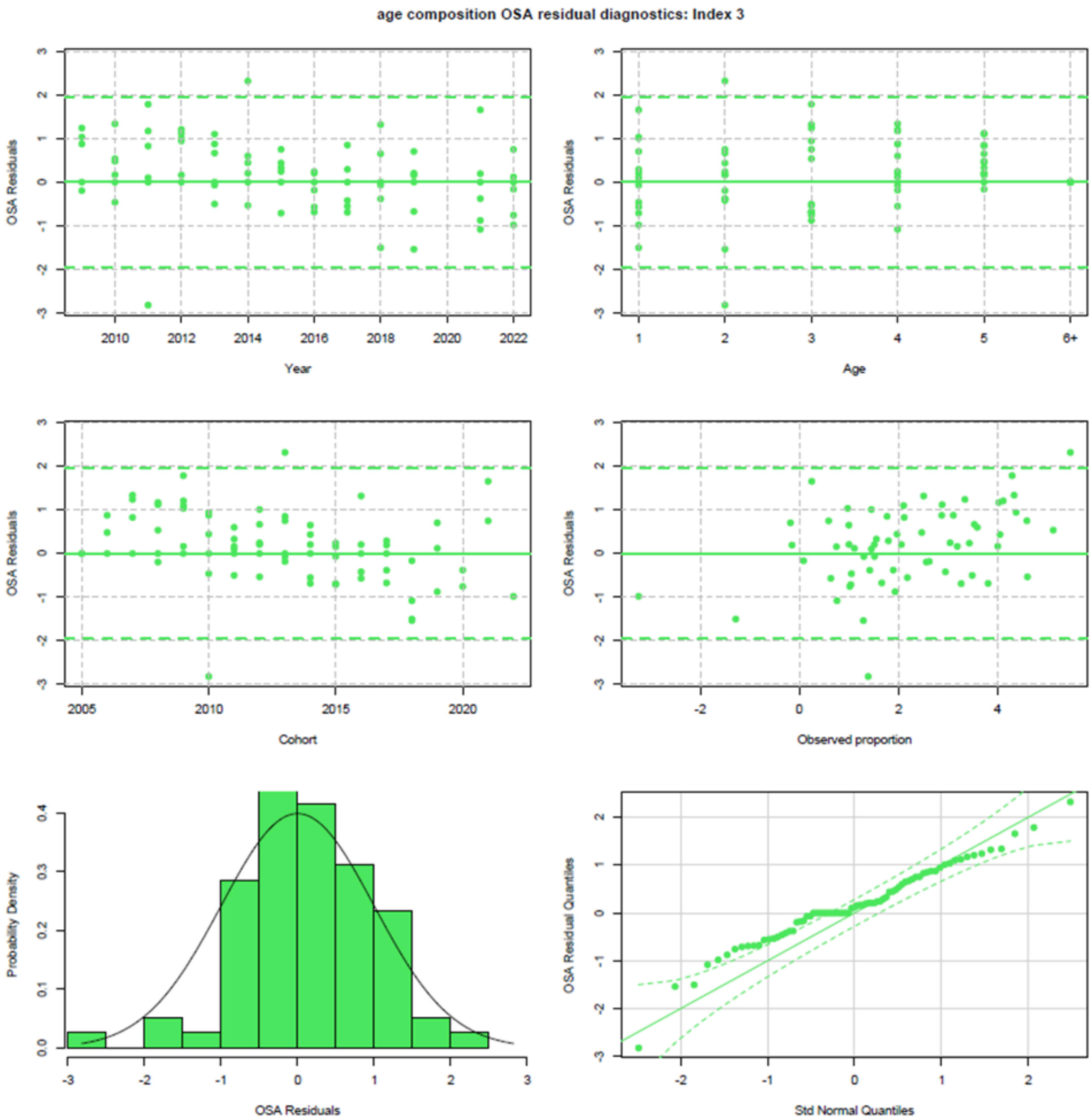


Figure 4.CCGOM.21: Candidate model m452 OSA residual diagnostic for the NEFSC Spring bottom trawl index age composition for the Bigelow vessel (2009-2022).

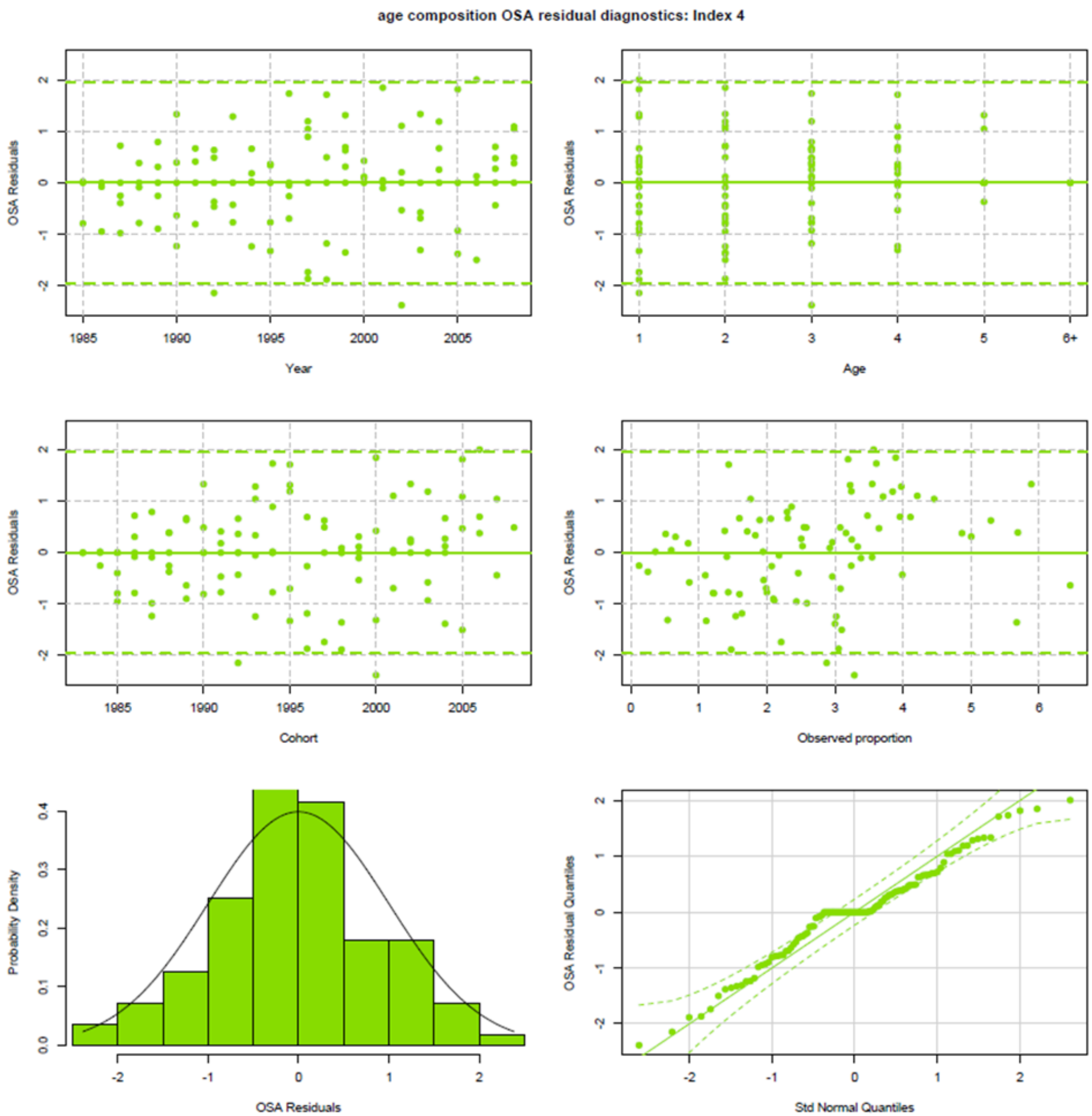


Figure 4.CCGOM.22: Candidate model m452 OSA residual diagnostic for the NEFSC Fall bottom trawl index age composition for the Albatross vessel (1985-2008).

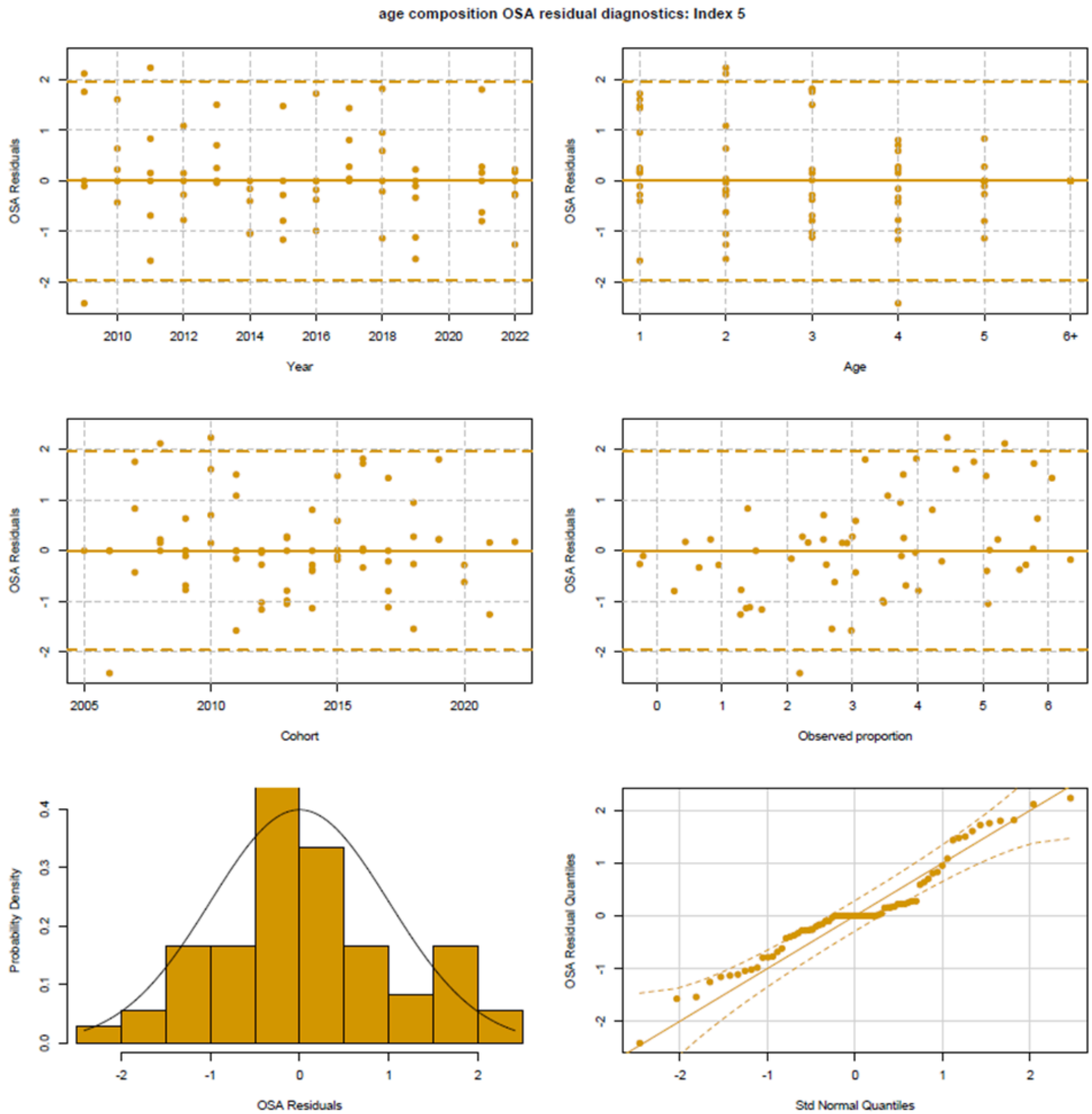


Figure 4.CCGOM.23: Candidate model m452 OSA residual diagnostic for the NEFSC Fall bottom trawl index age composition for the Bigelow vessel (2008-2022).

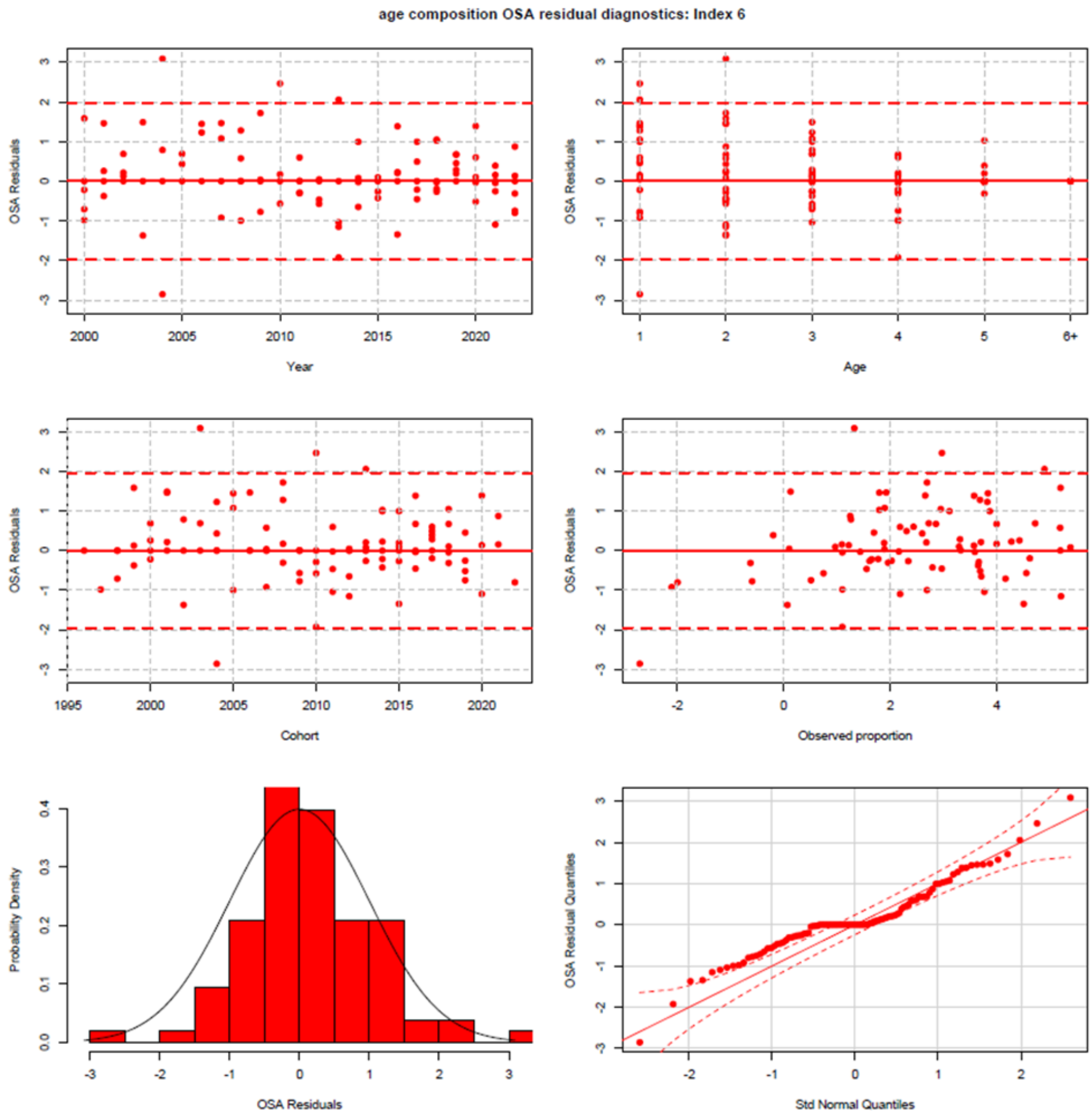


Figure 4.CCGOM.24: Candidate model m452 OSA residual diagnostic for the Inshore MENH Fall bottom trawl index age composition.

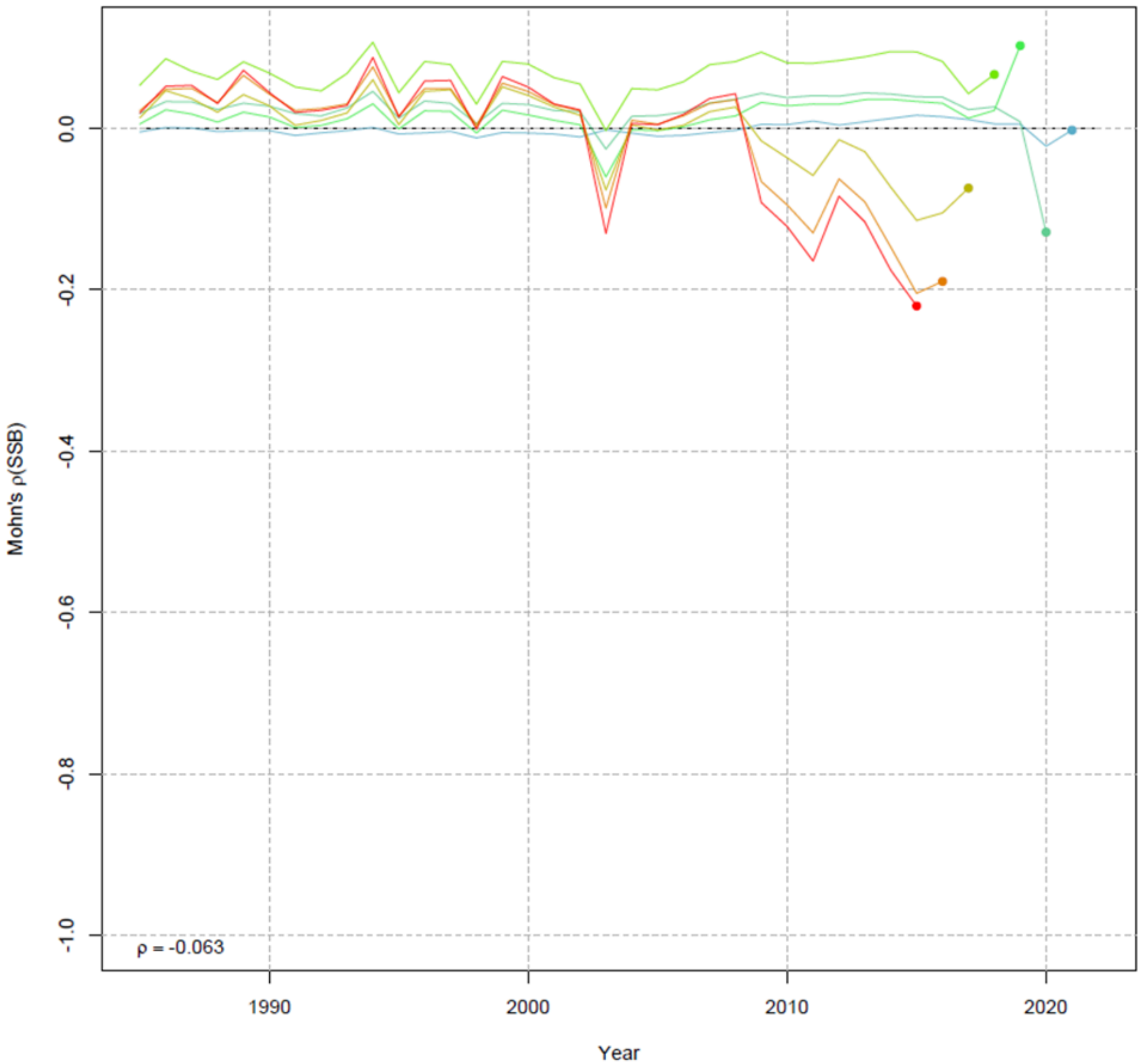


Figure 4.CCGOM.25: Relative retrospective pattern of SSB for the candidate model m452.

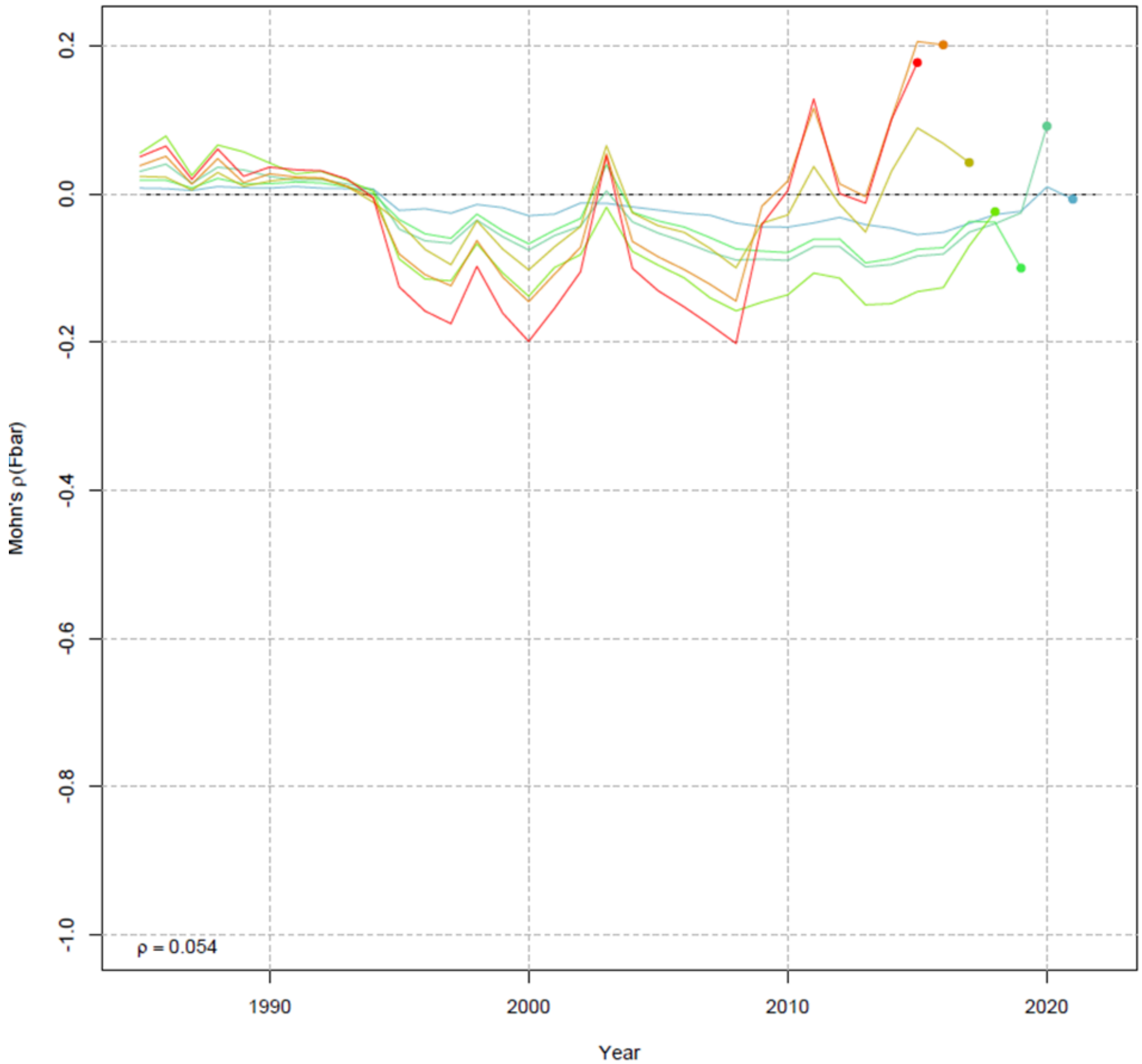


Figure 4.CCGOM.26: Relative retrospective pattern of F for the candidate model m452.

Model Results

The candidate model results for the CCGOM yellowtail flounder show a significant decline in F, decreasing by 97% from F = 1.79 in 1985 to F = 0.06 in 2022, with fluctuations in the 1990s and a steady downward trend since (Figure 4.CCGOM.27). SSB has fluctuated markedly, peaking at 8559 mt in 2017, an over 7-fold increase from 1985, and showing recent stability with SSB at 8645 mt in 2022 (Figure 4.CCGOM.27). Recruitment (R) also varied, peaking at 69,533 individuals in 1985, then falling to a low in 2001, with recent levels fluctuating, including a 70%

drop from 2021 to 2022 (Figure 4.CCGOM.28). The coefficients of variation (CVs) for F, SSB, and R demonstrate higher uncertainty in recent years, notably in recruitment CVs which peaked at 0.44 in 2020 (Figure 4.CCGOM.29). Age structure has shifted with an increasing presence of older age groups; age-6+ individuals grew from 0.3% of the population in 1985 to 12.5% in 2022, indicating a maturing stock (Figure 4.CCGOM.30-31). Similarly, SSB composition shows a rising proportion of older fish, with age-6+ contributing 13.6% in 2022, reflecting broader age diversity in recent years (Figure 4.CCGOM.32-33).

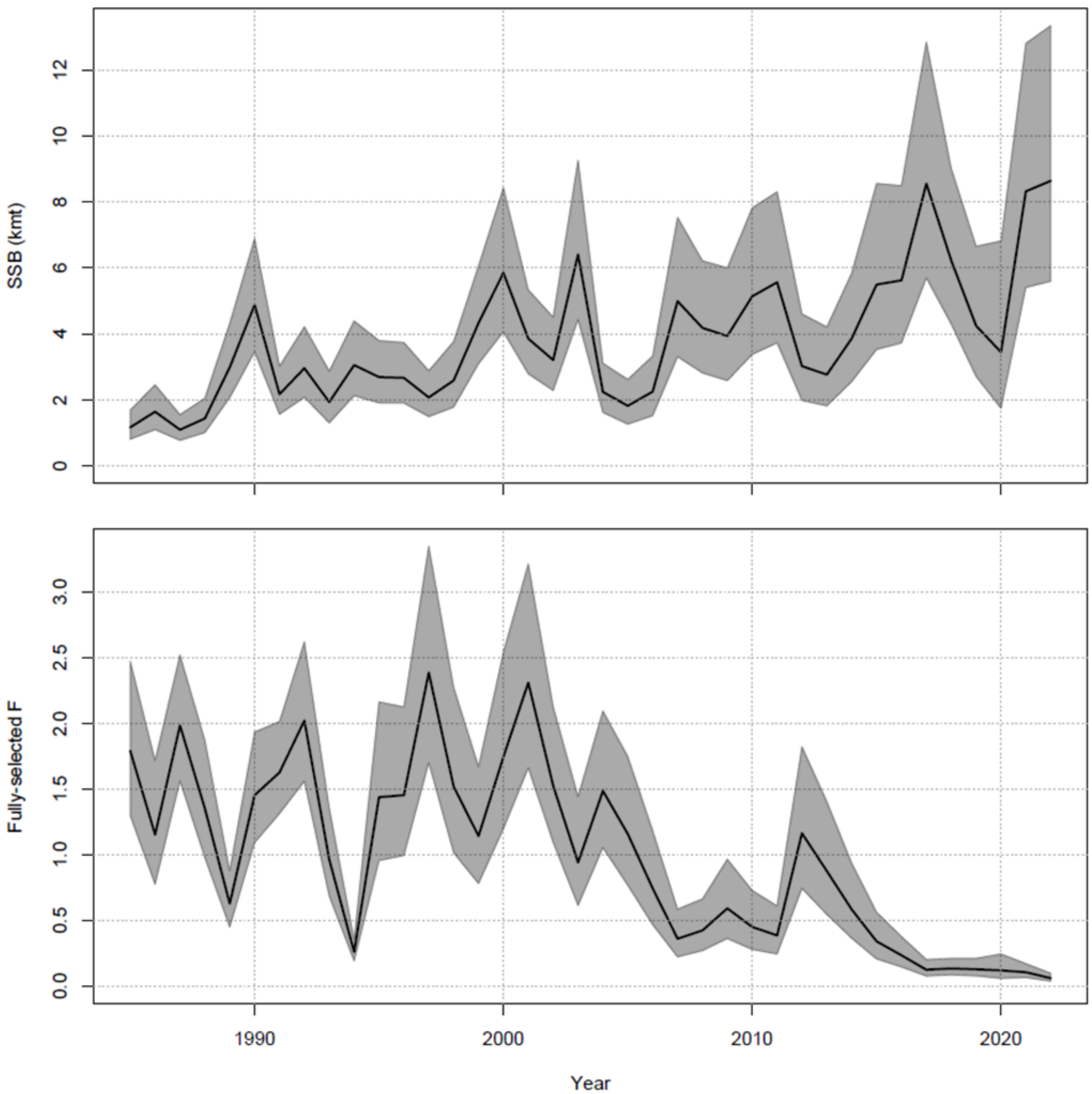


Figure 4.CCGOM.27: SSB (top) and F (bottom) from the candidate model m452.

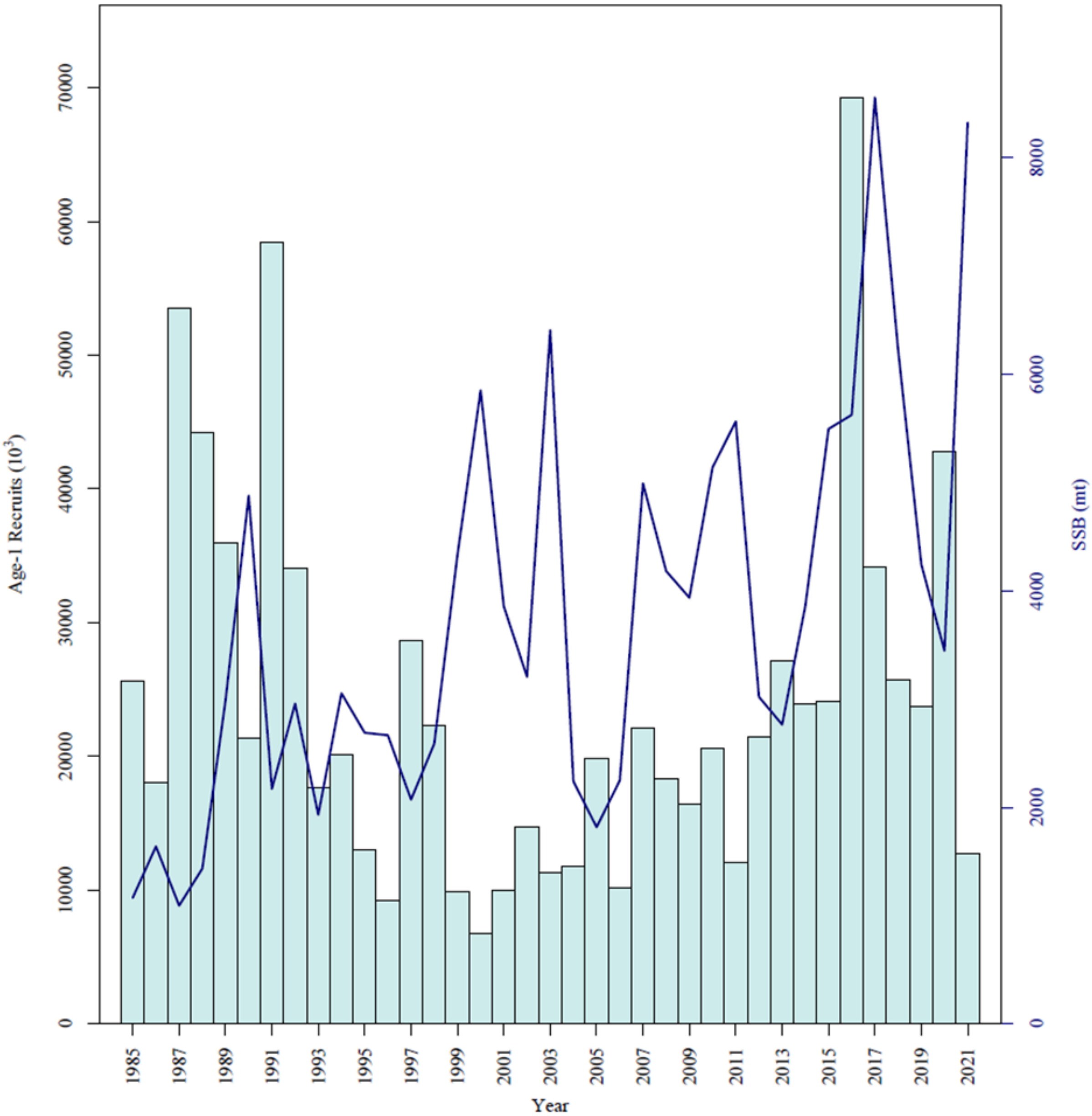


Figure 4.CCGOM.28: SSB (line) and age-1 recruitment (bars) from the candidate model m452.

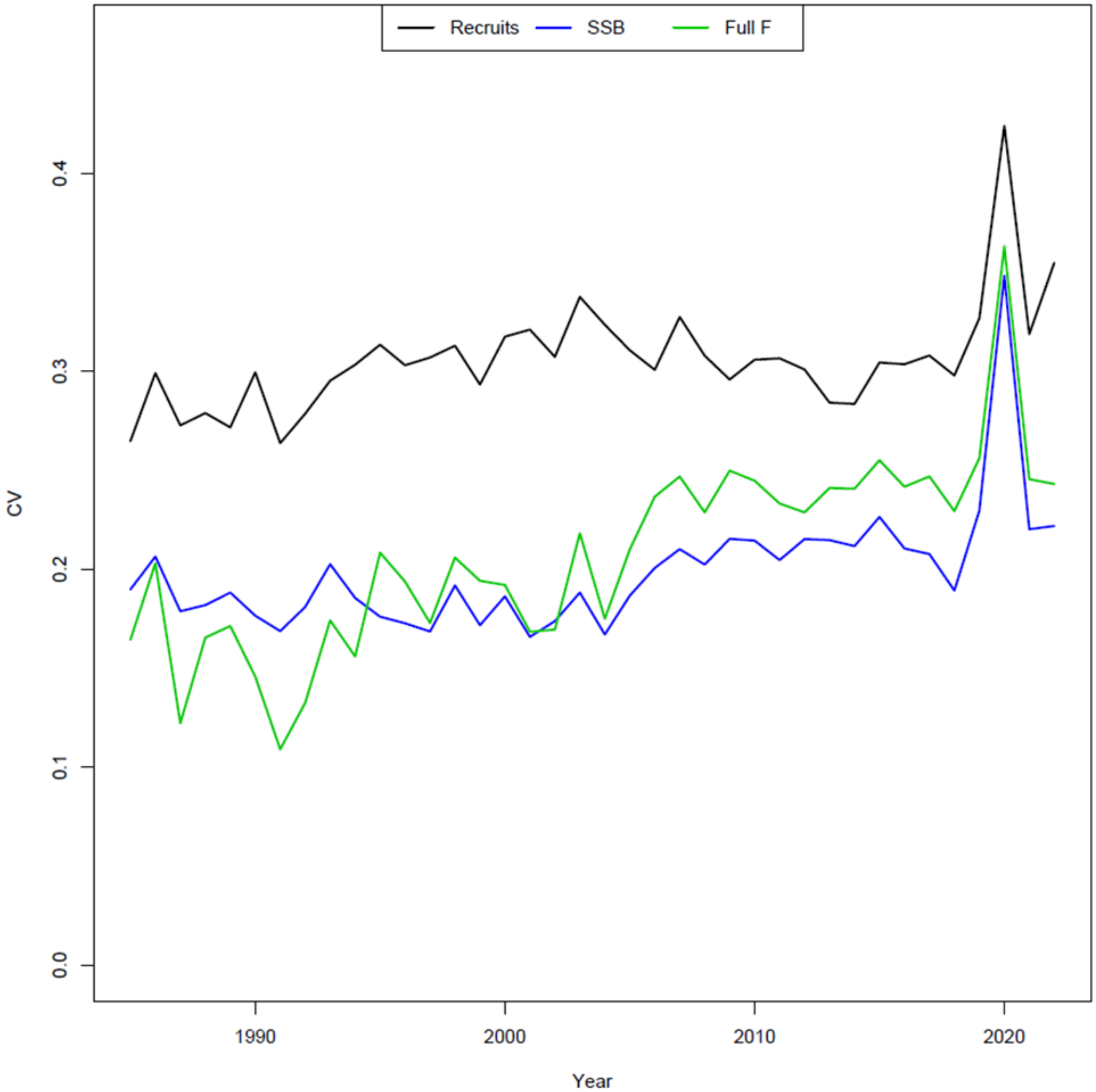


Figure 4.CCGOM.29: CV's of SSB, F and R from the candidate model m452.

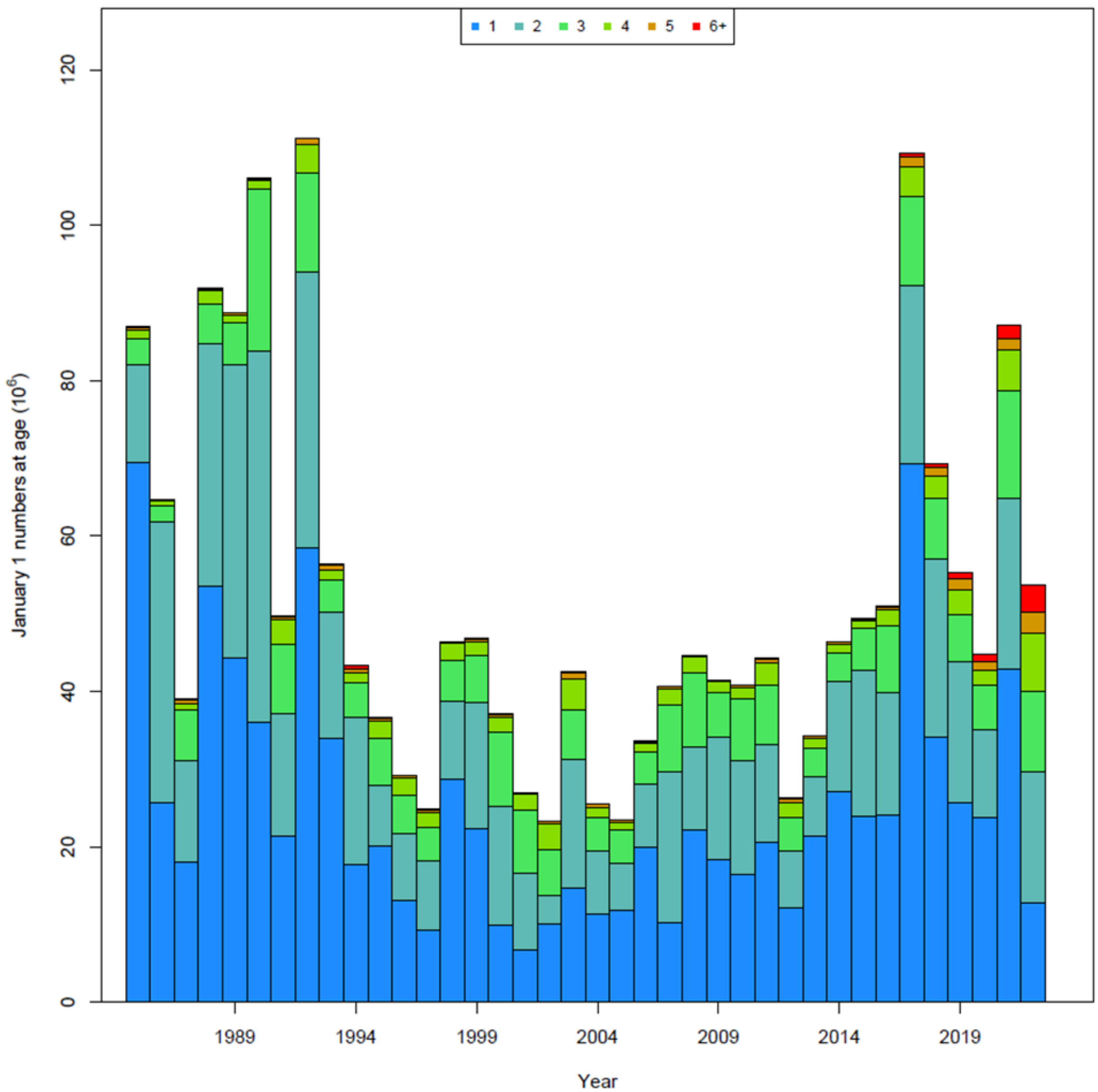


Figure 4.CCGOM.30: January 1st NAA from candidate model m452.

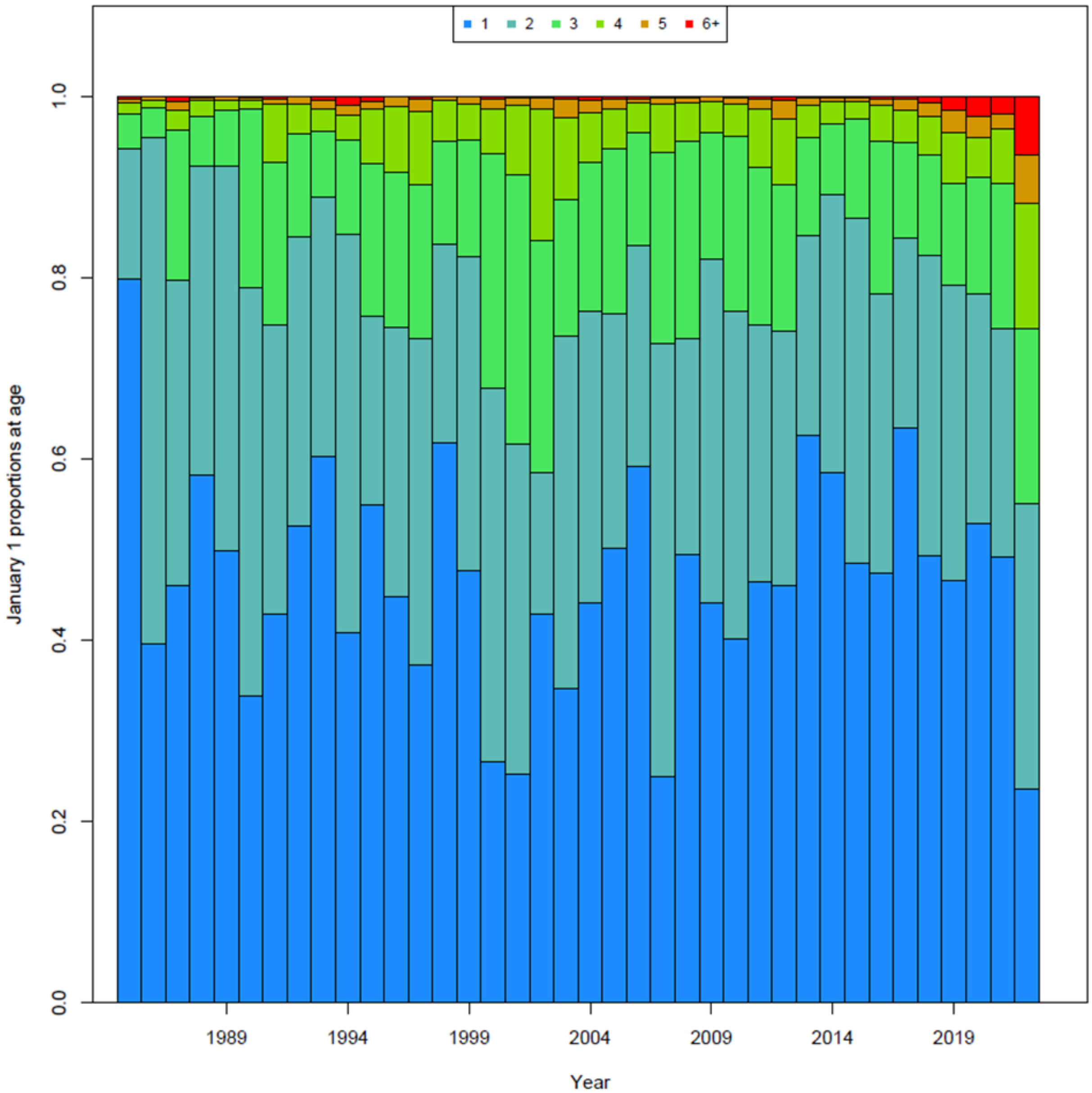


Figure 4.CCGOM.31: Proportion January 1st NAA from the candidate model m452.

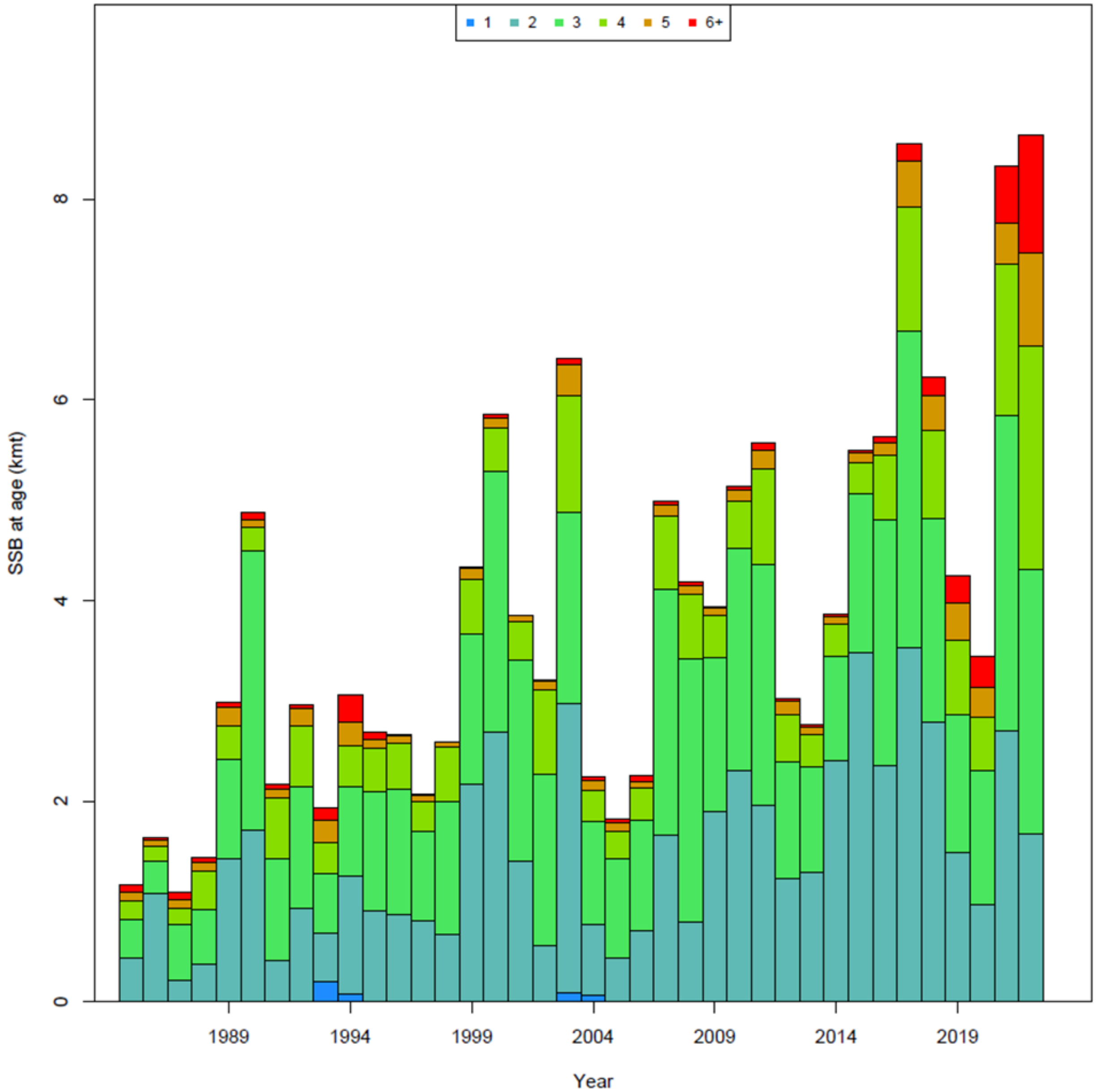


Figure 4.CCGOM.32: SSB-at-age from candidate model m452.

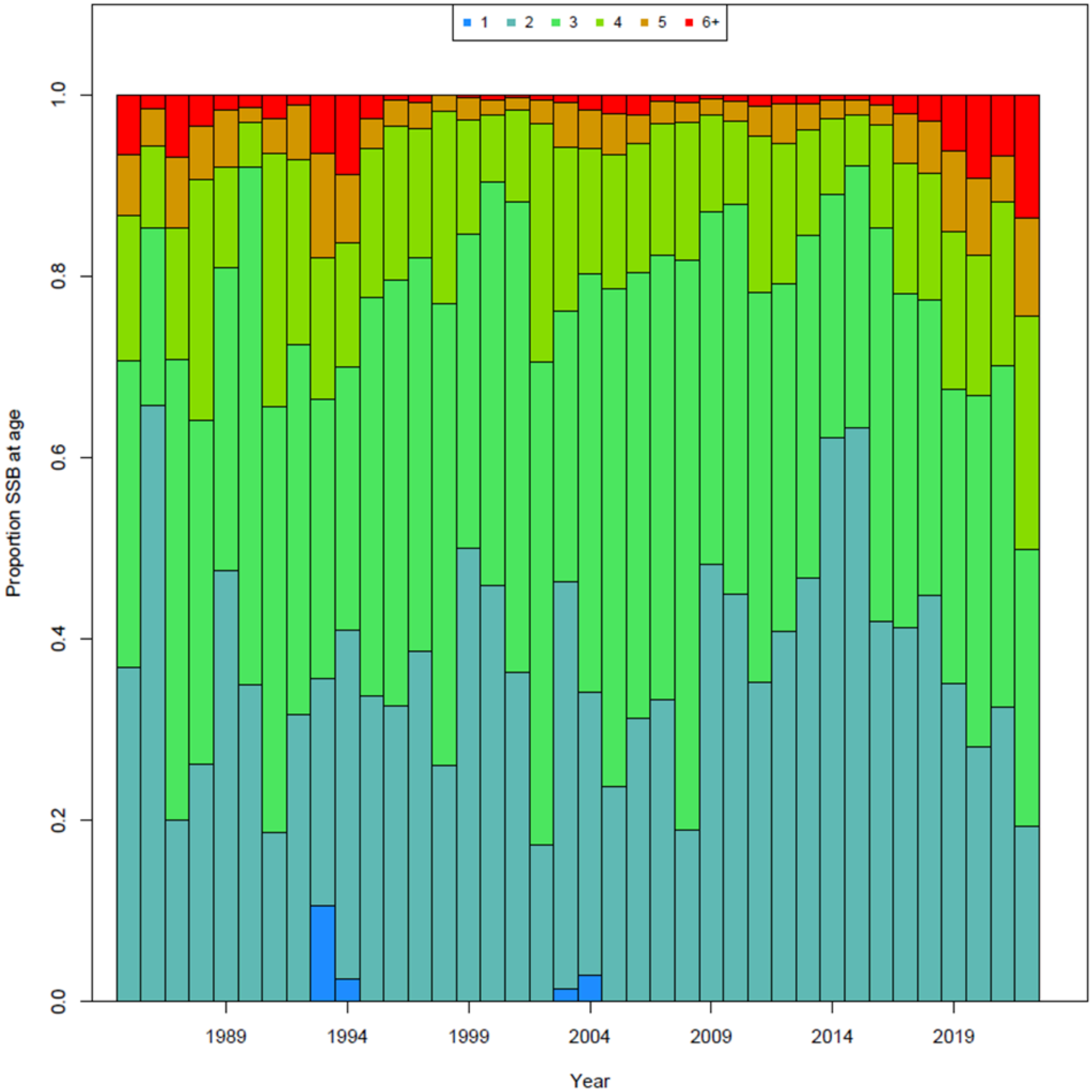


Figure 4.CCGOM.33: Proportion SSB-at-age from candidate model m452.

Georges Bank stock

For more detail on the GB assessment model see Hansell et al. (WP).Until 2024, the stock was assessed as part of the Transboundary Resources Assessment Committee (TRAC) where scientists from the US and Canada worked together annually to update and revise the assessment to determine best available science (TRAC, 2023). The current assessment uses The Limiter, which is based on an average area-swept biomass from the three surveys that cover the stock area (Northeast Fisheries Science Center (NEFSC) spring, NEFSC fall and Fisheries and Oceans Canada spring).. The Limiter does not produce biological reference points or projections. However, the state of the resource is considered to be low and in poor condition (TRAC, 2023). Peer reviewers from past assessments have recommended re-examination of analytical assessment models for this stock to integrate all available information (TRAC, pers. comm.).

Data

The terminal year of the assessment was 2022 and data inputs included: a combined fleet (US and Canadian); catch rates from the NEFSC fall and spring surveys as well as the DFO spring survey (Figure 4.GB.1.). Commercial catch at age data were available from 1973-2022 (Figure 4.GB.2.). Catch at age data were available since 1973 for the NEFSC surveys and since 1986 for the DFO survey (Figure 4.GB.3.). For all model runs, the maturity ogive was time invariant, while weight at age was time varying. Alternative assumptions about natural mortality were explored during model fitting.

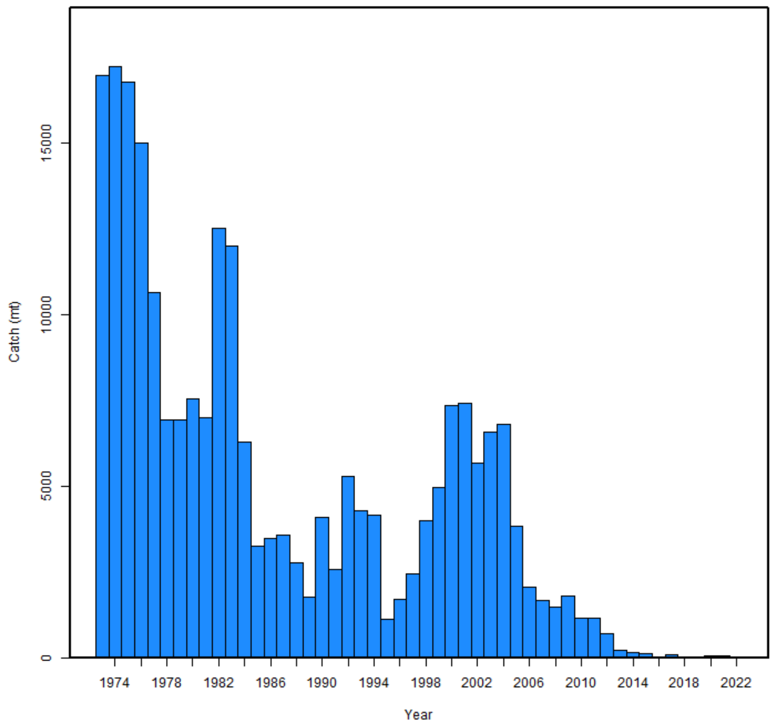


Figure 4.GB.1. Total removals of yellowtail flounder from the Georges Bank stock region.

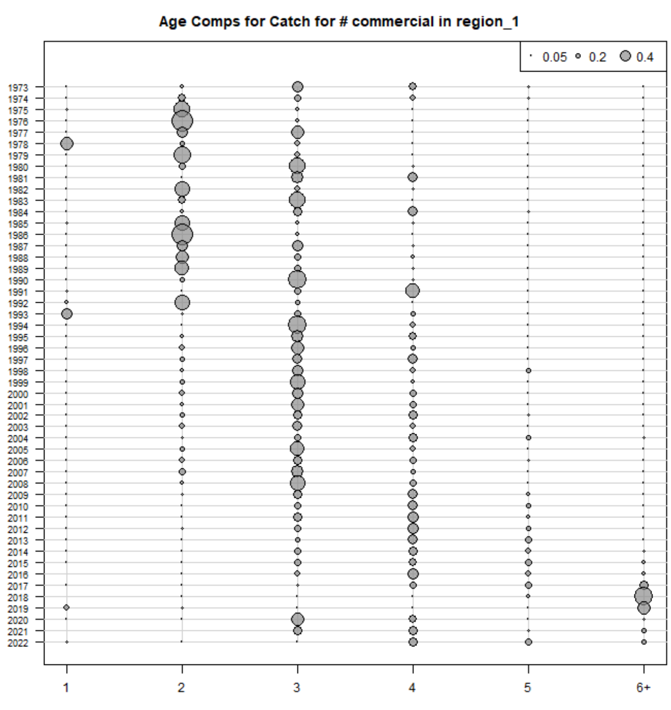


Figure 4.GB.2. Age composition (ages 1-6+) of the combined fleet catch 1973-2022.

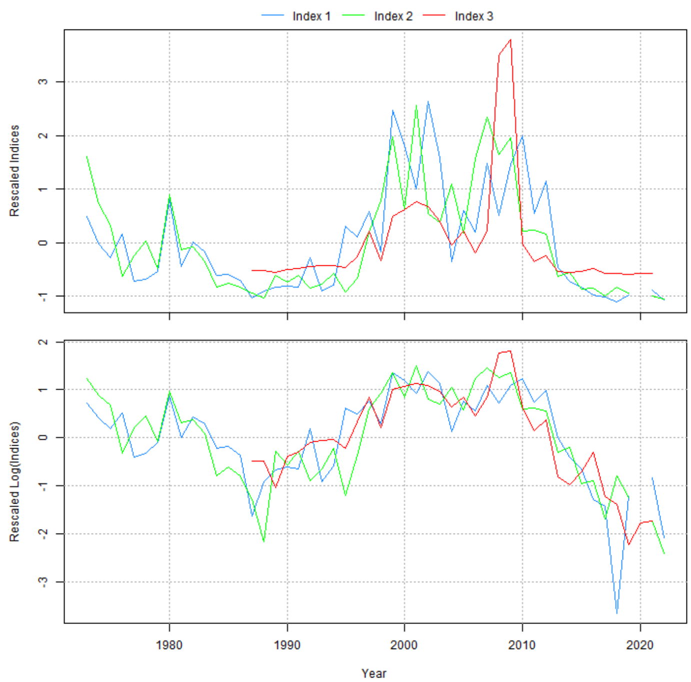


Figure 4.GB.3. Survey indices (index 1 = Spring NEFSC, index 2 = Fall NEFSC, index 3 = DFO) used in the assessment.

Model Development

Model exploration followed the process document outlined by the RT WG. Model exploration proceeded in an order of: 1) age distributions; 2) recruitment assumptions; 3) time varying selectivity; 4) full state-space models; and 5) environmental covariates. WHAM allows for 10 statistical distributions for age-composition and all were explored. Input effective sample sizes were assumed to be 200 for all data sources and years. High input effective sample sizes were needed for the Dirichlet age composition distributions.

For recruitment estimation, model runs treating estimates as fixed effects and using annual deviations from the time series mean estimated as, IID or AR1_y were explored. Beverton-Holt stock recruit relationships were also explored with annual deviations estimated as IID or Ar1_Y random effects. For selectivity, both age-based and logistic assumptions were examined for the commercial fleet and all three surveys. To account for changes in commercial selectivity alternative selectivity periods were explored that accounted for fisheries regulations (1973-1993, 1994-2009) and to account for changes in fishing behavior (2010-2022, annual catch limits and primarily bycatch). Alternative process error assumptions (IID, AR1_Y, 2DAR1) were also explored for time varying fleet selectivity. All available process error correlation structures were explored for full state space models. Environmental covariates identified by the working group from ToR 1 (bottom water temperature and Atlantic Multi-decadal Oscillation Index) were explored as covariates on recruitment and natural mortality. For recruitment, environmental covariates were explored as annual deviations from both mean recruitment and the Beverton-Holt stock recruit relationship. On the Beverton-Holt stock recruit relationship the covariates were explored as influencing density independent mortality (controlling) or carrying capacity (limiting; Stock & Miller, 2021). These environmental covariates were also explored to estimate annual process errors for time varying natural mortality. Both constant and age varying natural mortalities were explored during model fitting. The assessment also attempted to freely estimate natural mortality and different process error assumptions were explored that allowed natural mortality to vary with time.

For reference points, MSY and MSY-proxy reference points were tested. Inputs for reference points and projections are: weights at age, natural mortality, fleet selectivity, recruitment and maturity. Typically, an average of the most recent years is assumed for each of these values and to calculate reference points and projections. We explored the sensitivity of using alternative time periods (2 year average,5 year average, time series average). Natural mortality and recruitment were assumed to be constant. Root mean squared error was used to determine the optimal number of years to calculate average weight at age for use in the reference points and projections. Changepoint analyses of the bottom water temperature time series tested if conditions have changed and are influencing recruitment. Changepoint analyses explored using mean and linear relationships to identify changepoints. Analyses also explored the number of changepoints. Sensitivity analyses examined how to treat environmental covariates in the projection years (e.g., average, linear, AR1_y).

A total of 165 WHAM models were completed for the Georges Bank yellowtail flounder stock. Model runs exploring alternative statistical distributions for age compositions supported using the logistic-normal-pool0 for the commercial fleet and all three surveys. The logistic-normal-pool-0 had low AIC, few residual patterns and small retrospective patterns. Initial runs with fixed effects for recruitment deviations had the lowest AIC and similar SSB and F retrospectives as runs that included process error. Initial runs exploring time vary selectivity on the commercial fleet did not support the inclusion or process error or blocking. However, in the final model configuration an AR1_Y process error was used to estimate time varying selectivity in the commercial fleet. The inclusion of this process error improved residual diagnostics and led to realistic time varying selectivity that captured observed changes in the fleet (e.g., switch to annual catch limits and primarily bycatch in the 2010s).

In total, nine runs were explored to examine process error on NAA (i.e., the cohort survival process). AIC supported the use of either 2DAR1 or AR1_Y (coupled and decoupled) process error. Retrospective patterns and self-tests supported using IID process error. Because of diagnostic tradeoffs among alternative runs, all four process errors were carried forward for model development.

Model runs with IID process error and fit to the bottom temperature covariate on recruitment had good convergence. AIC supported using a Beverton-Holt stock recruit relationship with IID deviations informed by bottom water temperature. Retrospective patterns were better when the environmental relationship influenced the stock recruit relationship by assuming density independent mortality (i.e., controlling effect of bottom temperature on recruitment).

Model diagnostics were not improved by using environmental covariates (bottom temperature or AMO) to help estimate time varying natural mortality. Similarly, using process error or allowing the model to freely estimate natural mortality did not improve model diagnostics. Many of the models that explored alternative natural mortality assumptions had convergence problems . Thus, a constant value for M of 0.4 was used in subsequent runs (Cadrin WP).

The WG decided to move forward with the IID process error on NAA and include the bottom water temperature time series as a covariate on the Beverton-Holt stock recruit relationship. The bottom temperature time series followed an AR1 process because this could be explored in projections. A controlling process was used because it was selected by AIC and had improved retrospective patterns. The bottom water temperature covariate was chosen over AMO because it is more biologically relevant and at a more appropriate scale (i.e., AMO is derived from sea surface from the entire North Atlantic, and the bottom temperature series is for the GB yellowtail stock area).

In conclusion, the WG determined that the preferred model included: logistic-normal-pool0 age compositions on the commercial fleet and all three surveys, an AR1_Y correlation structure on commercial fleet selectivity, IID random effects on NAA, a Beverton-Holt stock recruit relationship with deviations estimated using a bottom temperature time series that had an AR1_y correlation structure. This run met all of the model evaluation criteria outlined by the WG.

Model Diagnostics

The optimal model successfully converged. The optimal run had good fits to the catch data and the two NEFSC survey indices, but it had some nonrandom residual patterns for the DFO survey (e.g., negative residuals for most recent years; Figure 4.GB.4-11). The model fit the commercial age data well (Figure 4.GB.12). The model fit well to age composition from all three surveys (Figure 4.GB.13-15). Additionally, the AR1_Y process error on selectivity had a realistic fit to the commercial catch at age and accounted for known changes in the fishery. The model fit the bottom water temperature time series well (Figure 4.GB.16). The Beverton-Holt stock recruit relationship had a good fit and produced results that showed recruitment decreased in recent years with the increase in bottom water temperature.

Retrospective patterns for fishing mortality (rho=-0.03) and spawning stock biomass (rho=0.06) were minor (Figure 4.GB.11-18). Retrospective patterns for recruitment were larger, but including the bottom water temperature time series improved retrospective consistency (rho=0.79). The model successfully passed a self test (mean F bias = -0.05; mean SSB bias = 0.045; mean R bias =0.099). The model successfully passed a jitter analysis with a convergence rate of 92% .

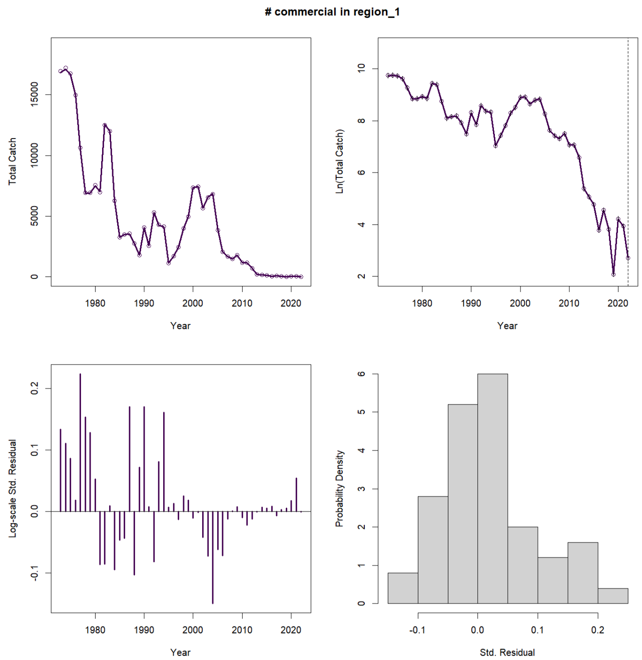


Figure 4.GB.4. Optimal WHAM run fit to the annual catch time series.

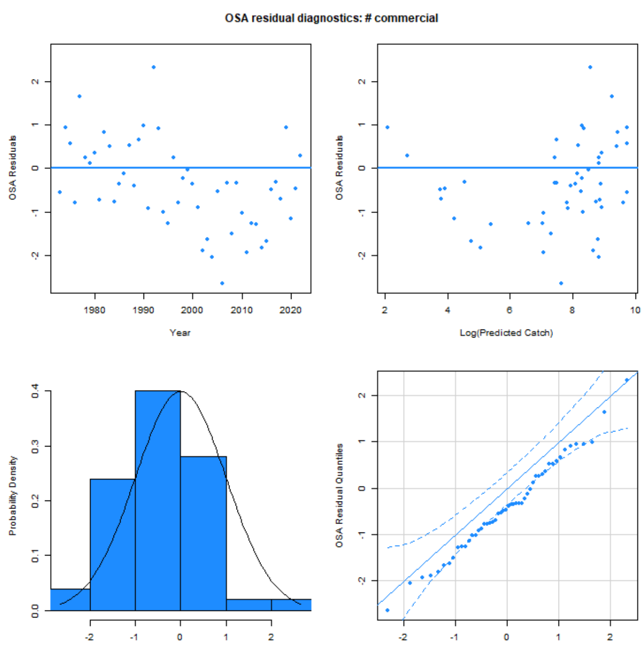


Figure 4.GB.5. Optimal WHAM run OSA fit to the annual catch time series.

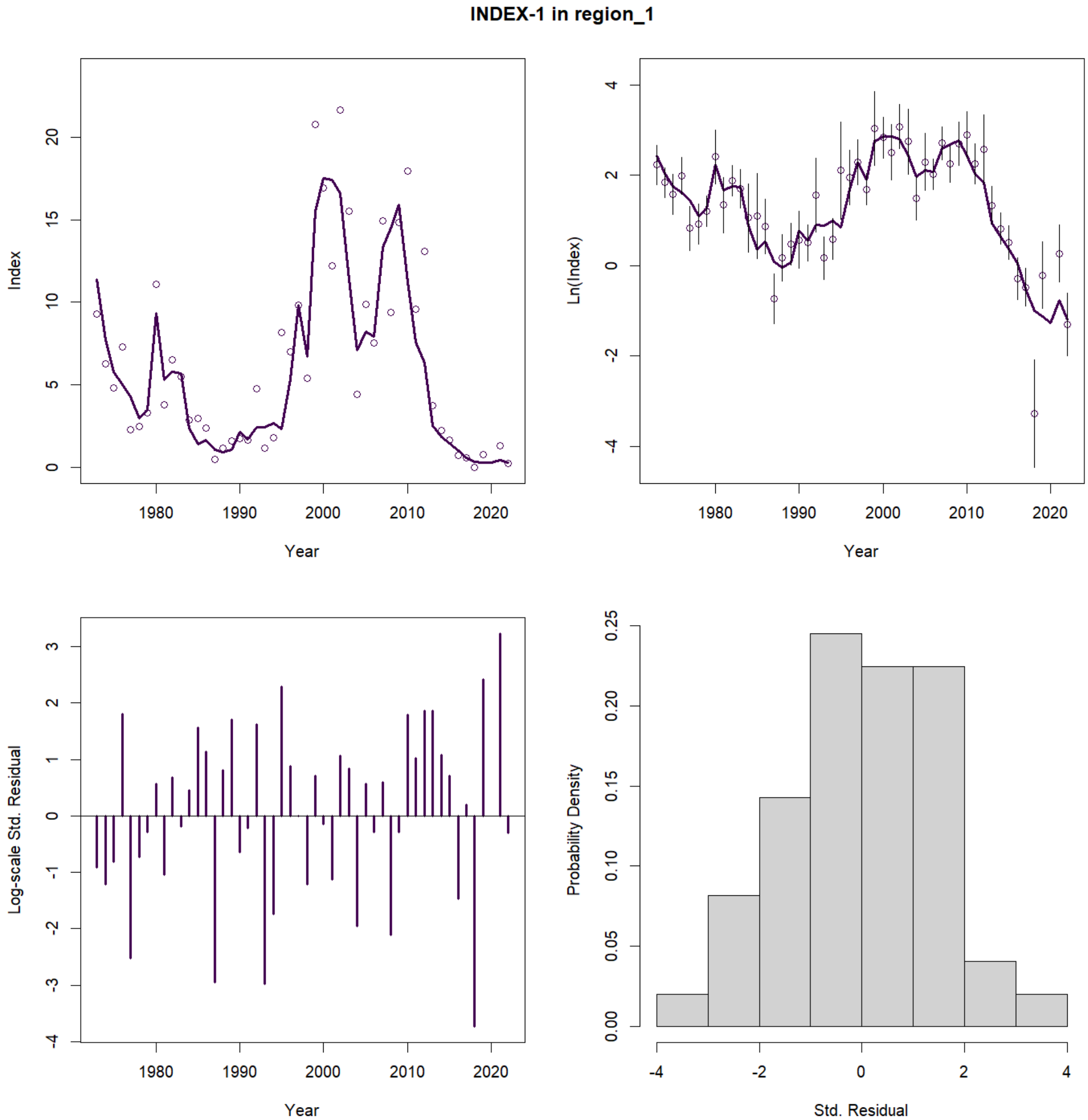


Figure 4.GB.6. Optimal WHAM run fit to the spring NEFSC survey.

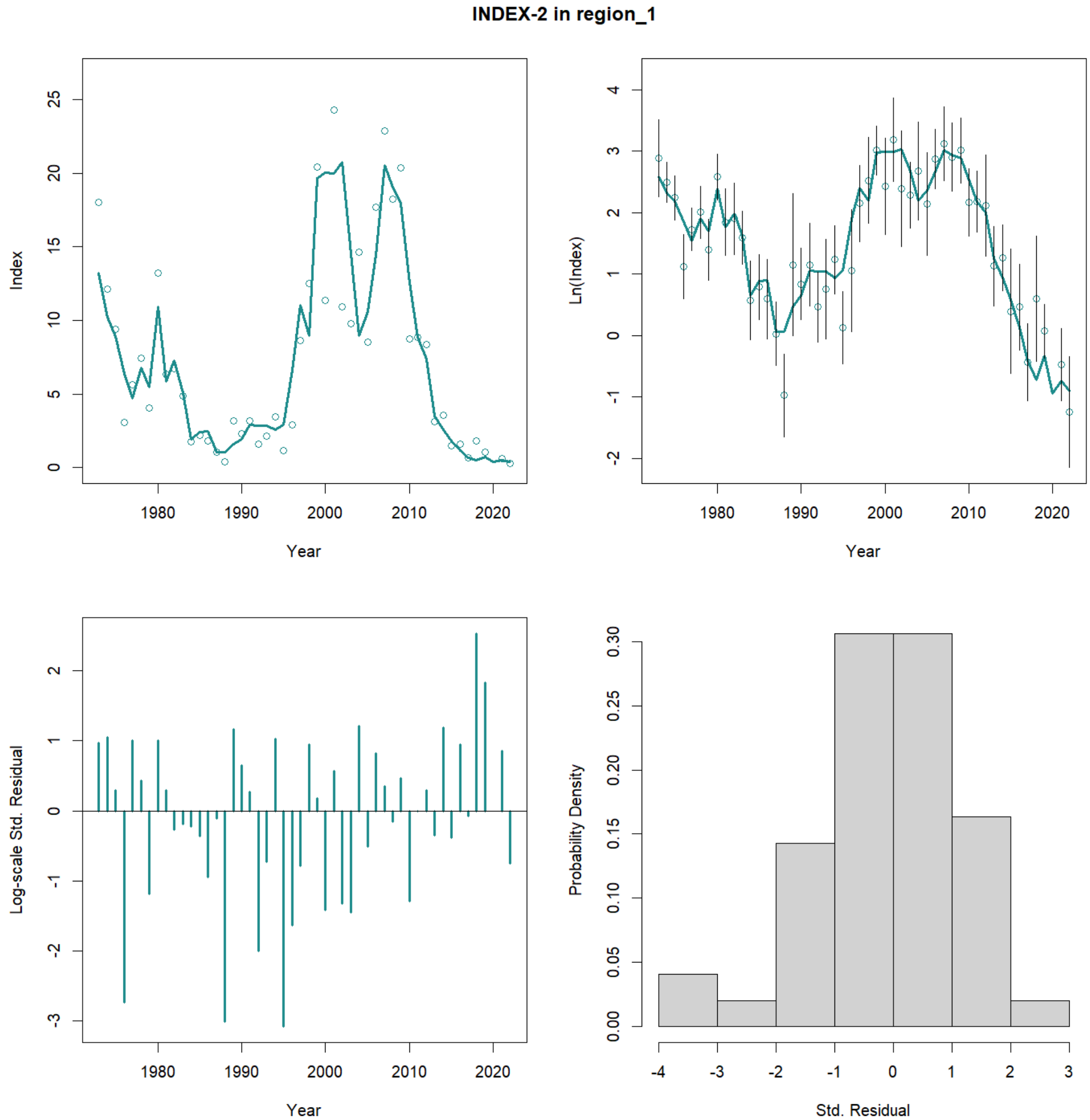


Figure 4.GB.7. Optimal WHAM run fit to the fall NEFSC survey.

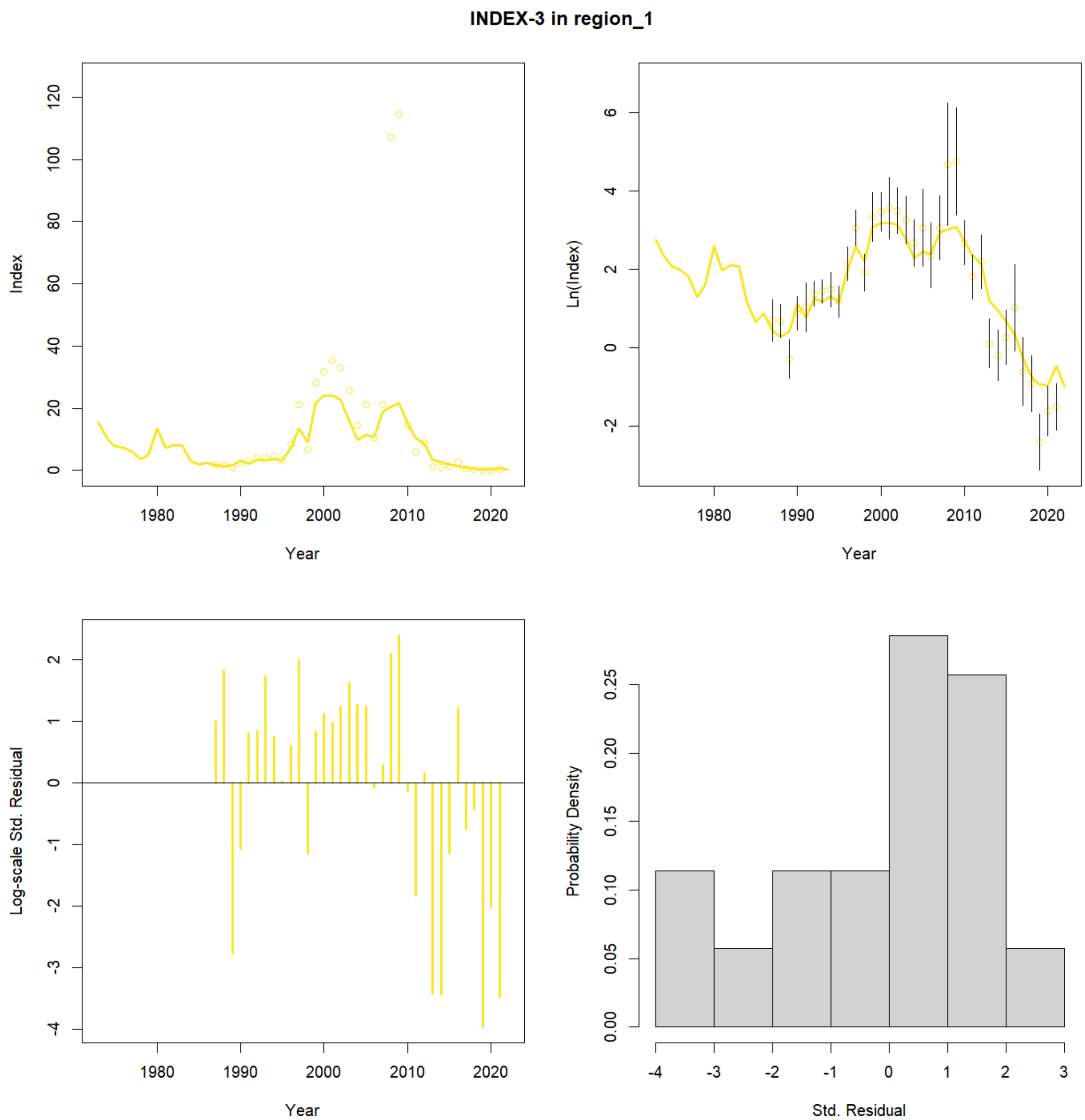


Figure 4.GB.8. Optimal WHAM run fit to the DFO survey.

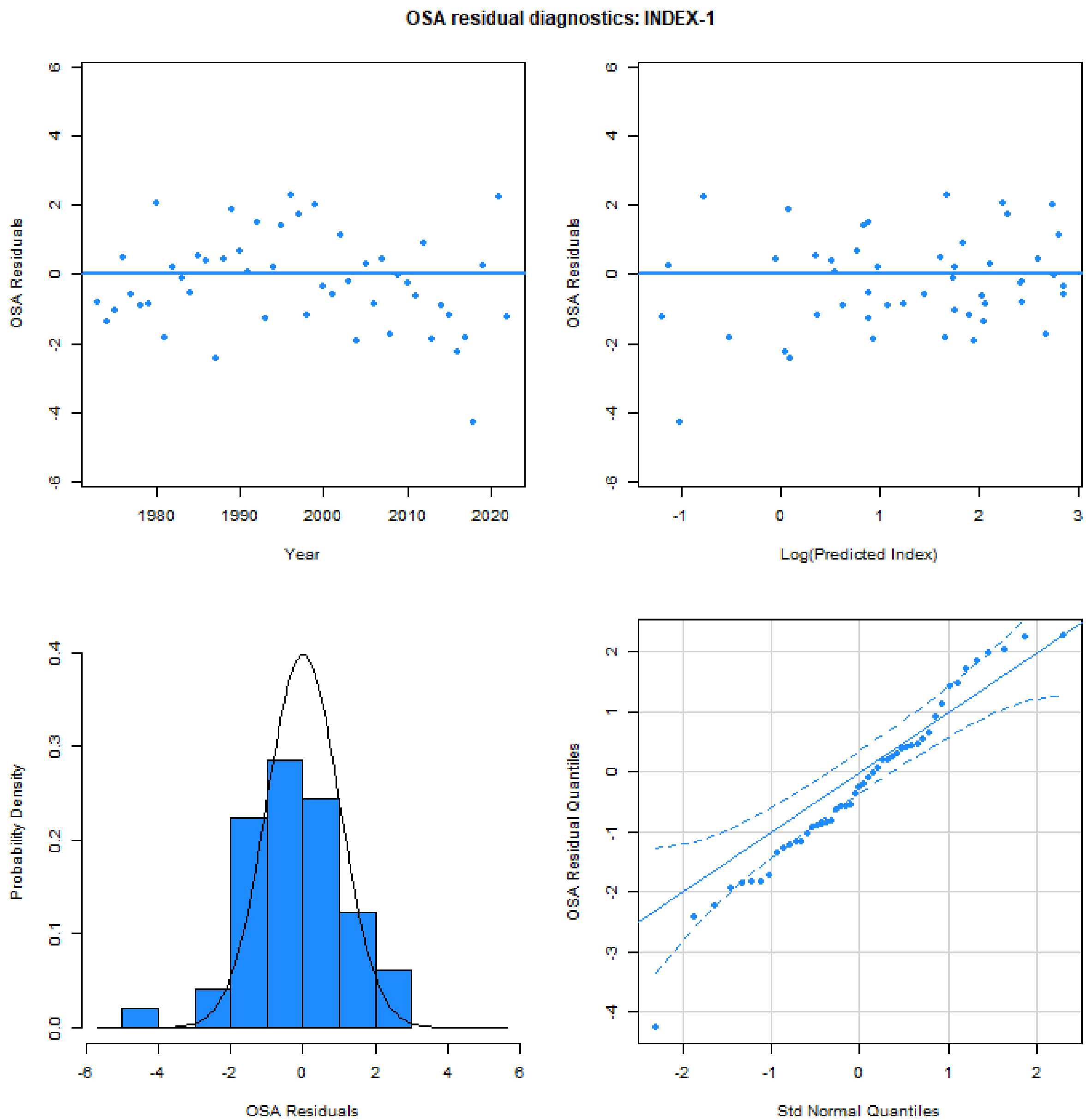


Figure 4.GB.9. Optimal WHAM run OSA fit to the spring NEFSC survey.

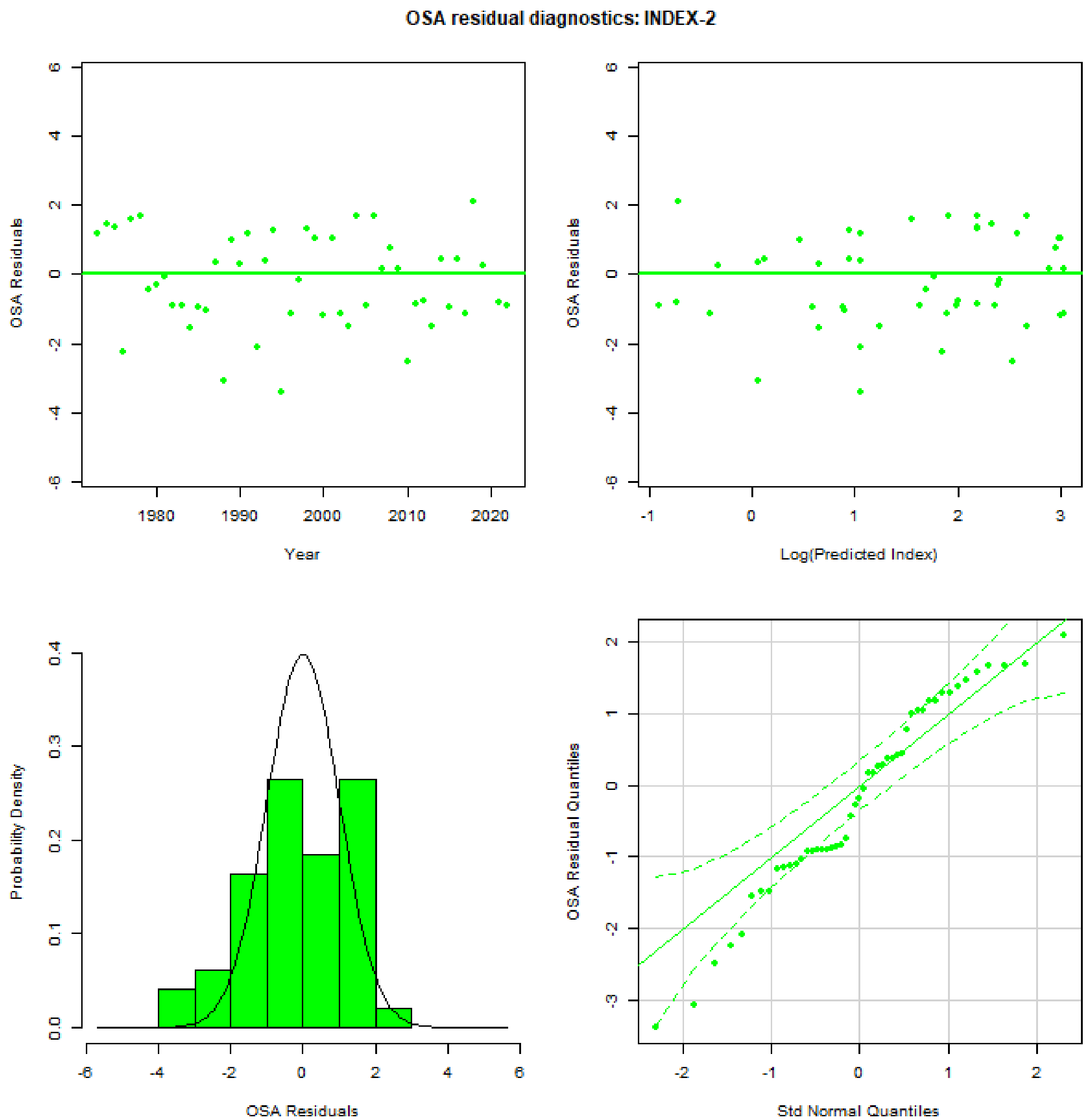


Figure 4.GB.10. Optimal WHAM run OSA fit to the fall NEFSC survey.

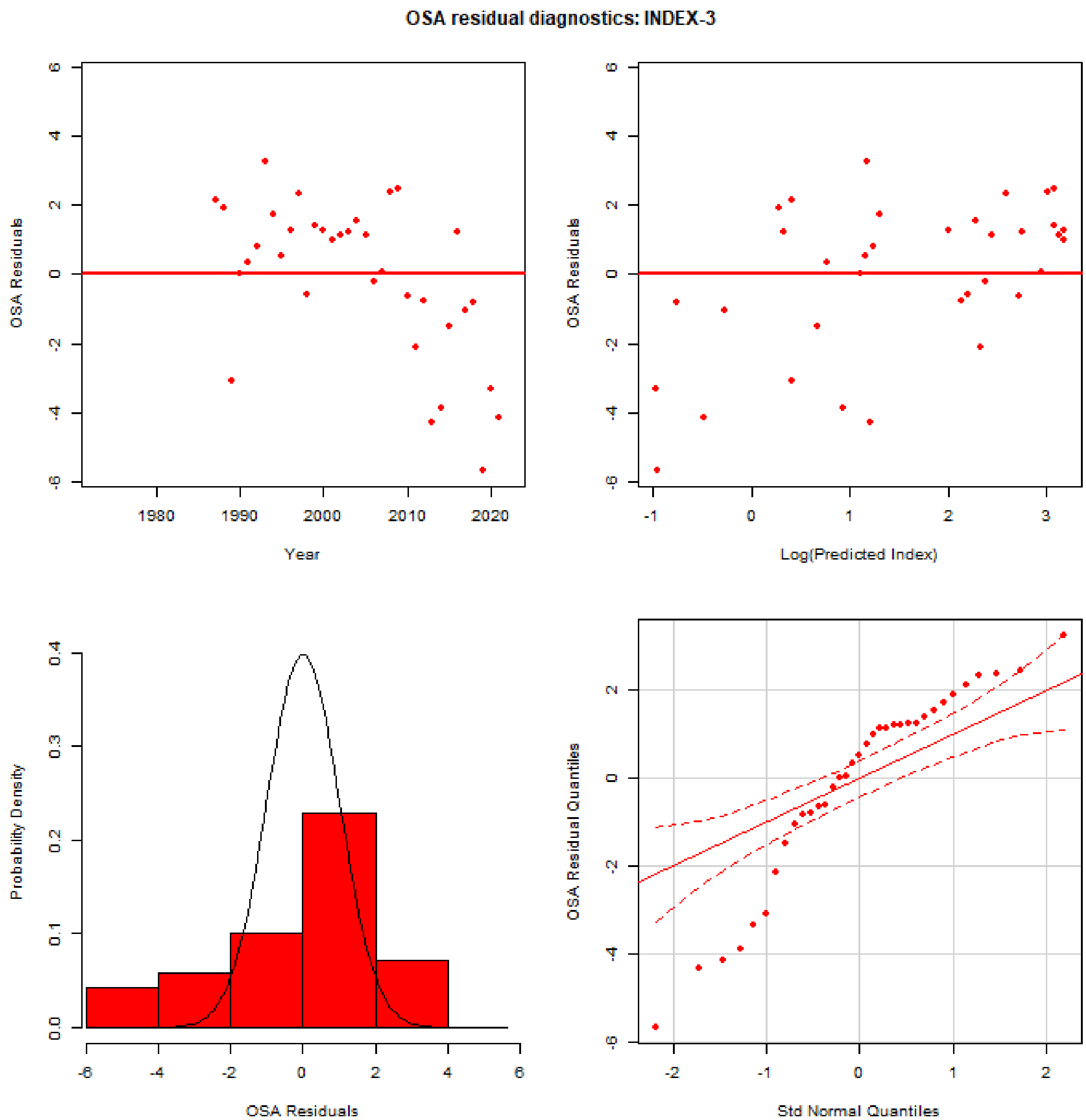


Figure 4.GB.11. Optimal WHAM run OSA fit to the DFO survey.

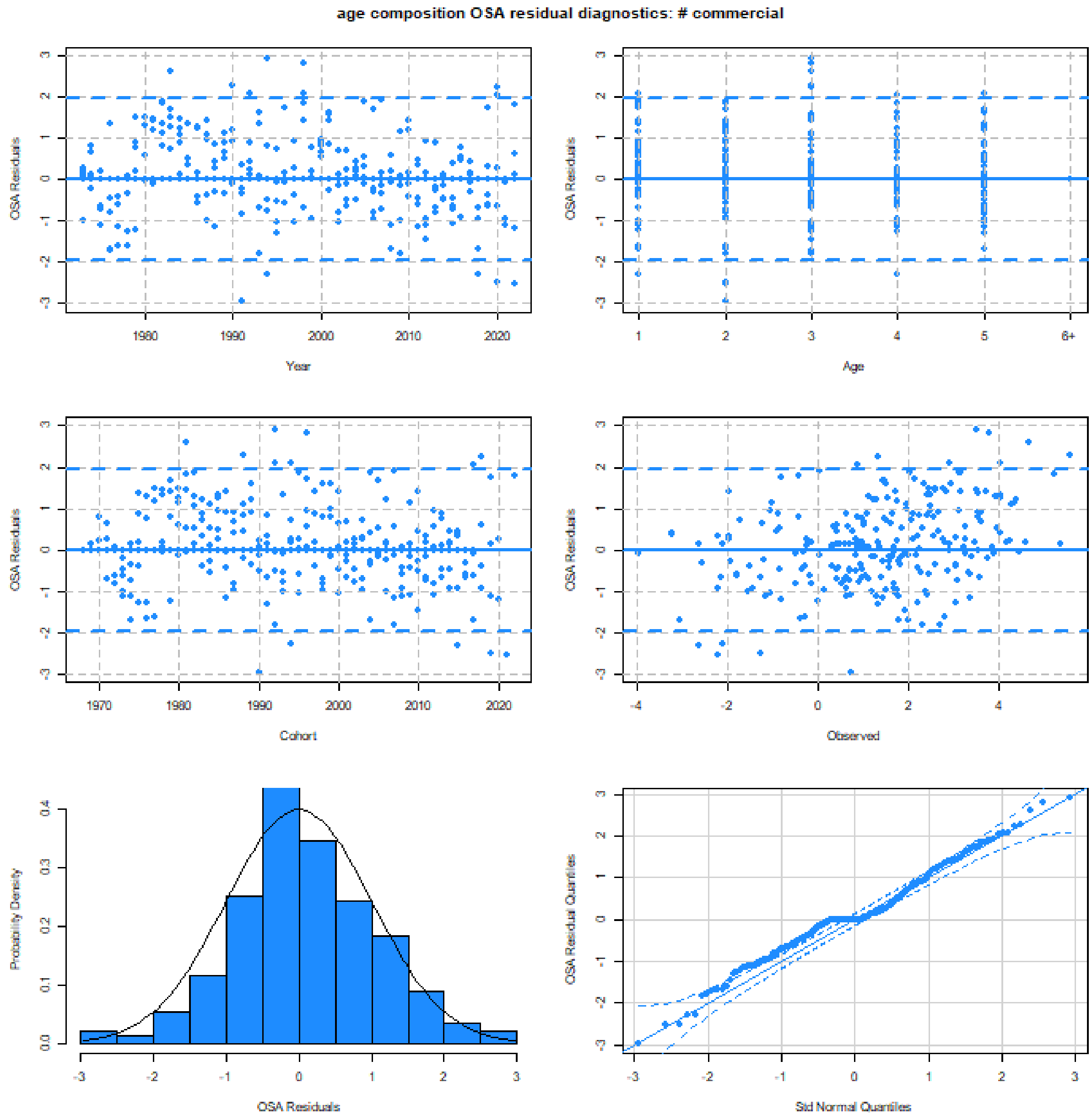


Figure 4.GB.12. Optimal WHAM run OSA fit to the commercial age compositions.

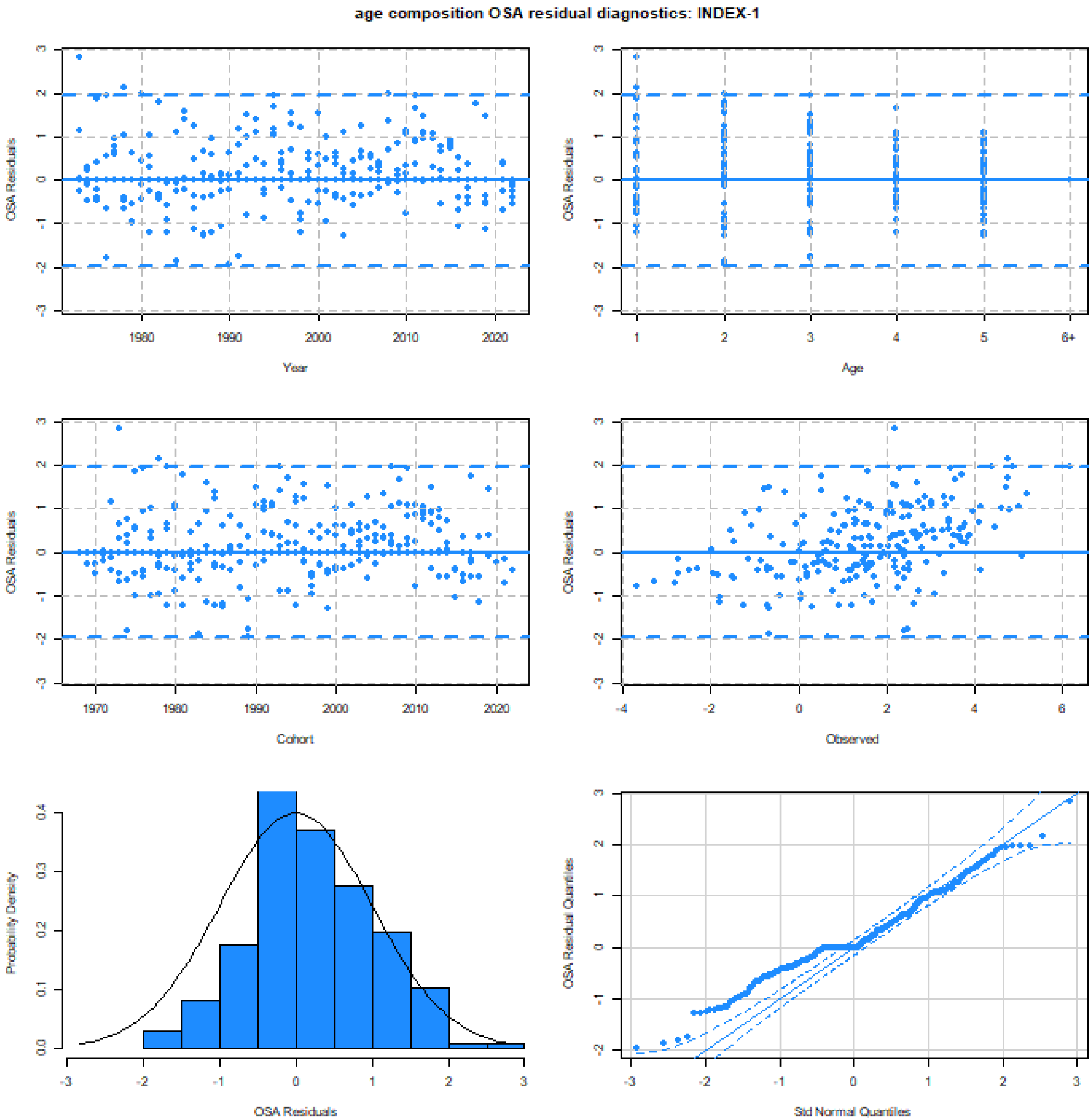


Figure 4.GB.13. Optimal WHAM run OSA fit to the spring NEFSC age compositions.

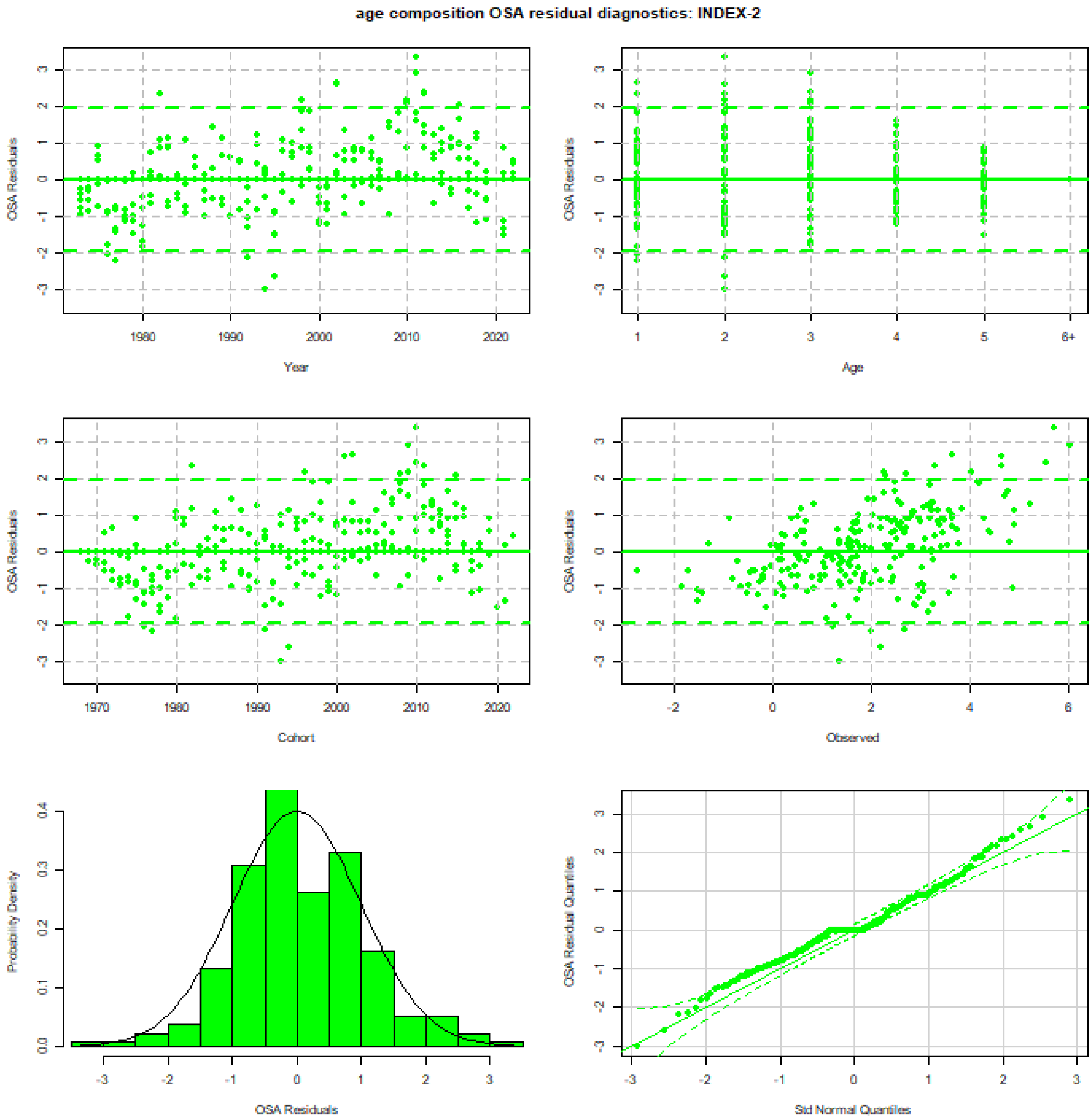


Figure 4.GB.14. Optimal WHAM run OSA fit to the fall NEFSC age compositions.

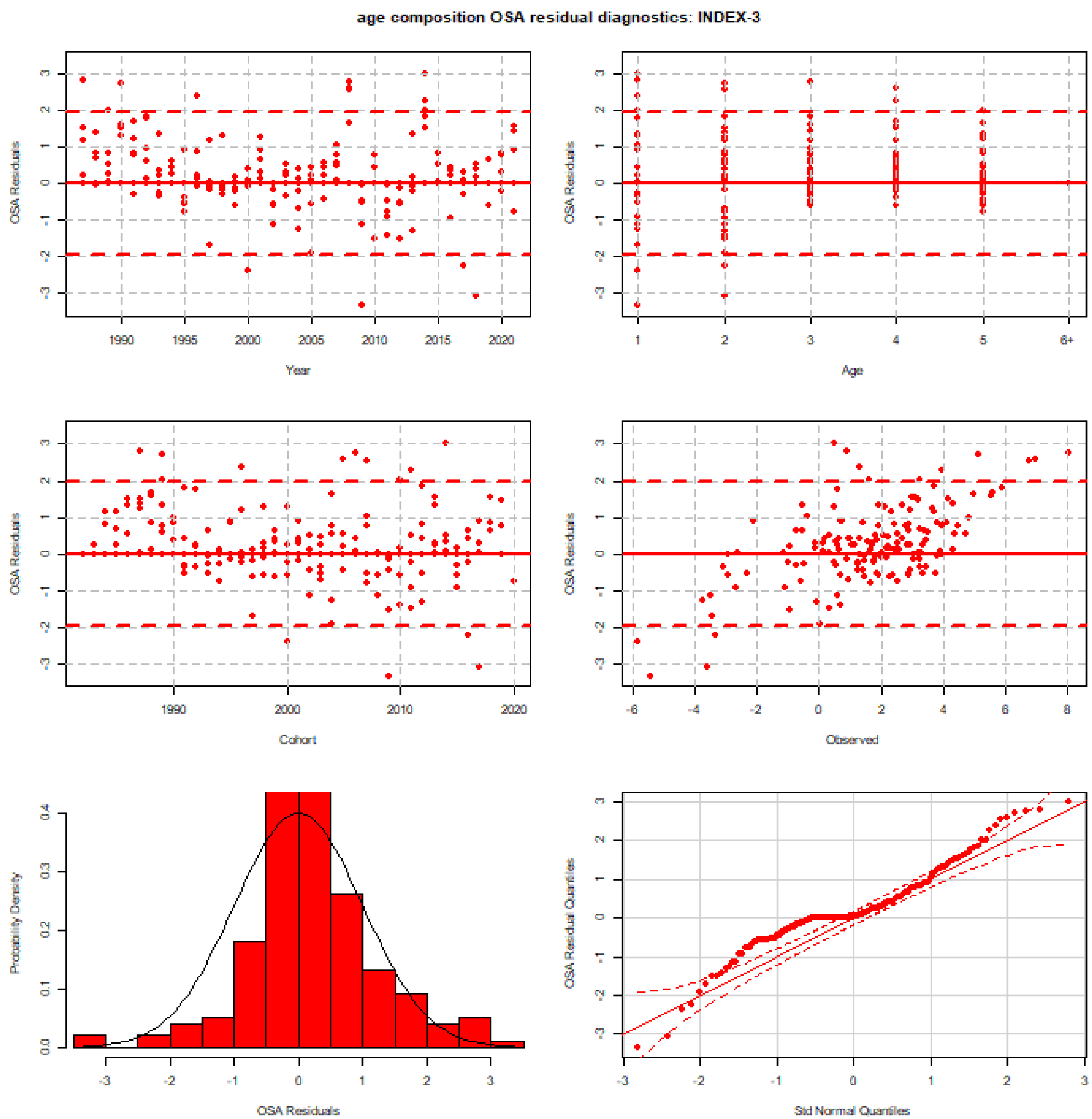


Figure 4.GB.15. Optimal WHAM run OSA fit to the DFO age compositions.

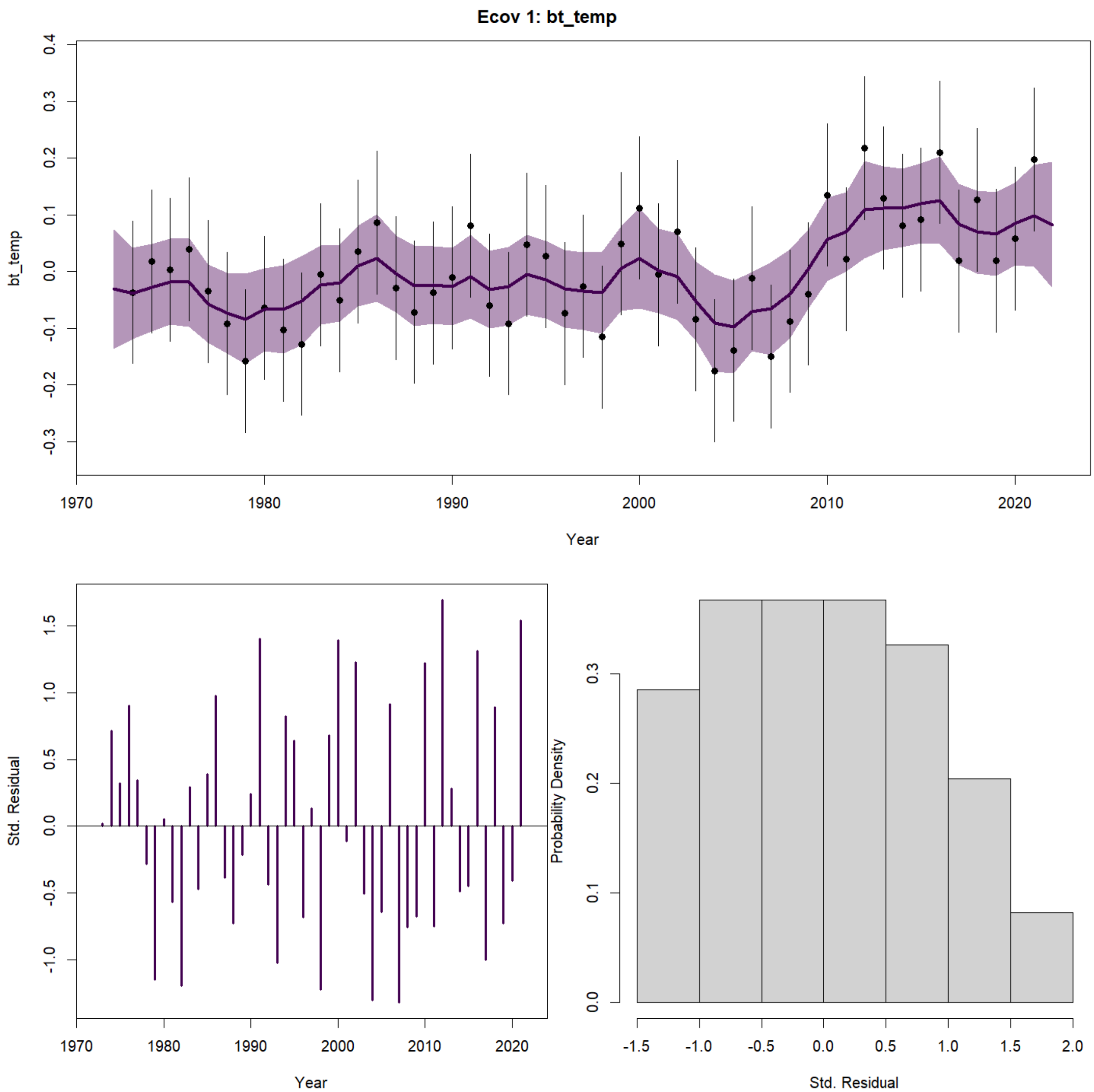


Figure 4.GB.16. Optimal WHAM run fit to the bottom water temperature time series. Bottom water temperatures were used to inform deviations off of the Beverton-Holt stock recruit relationship.

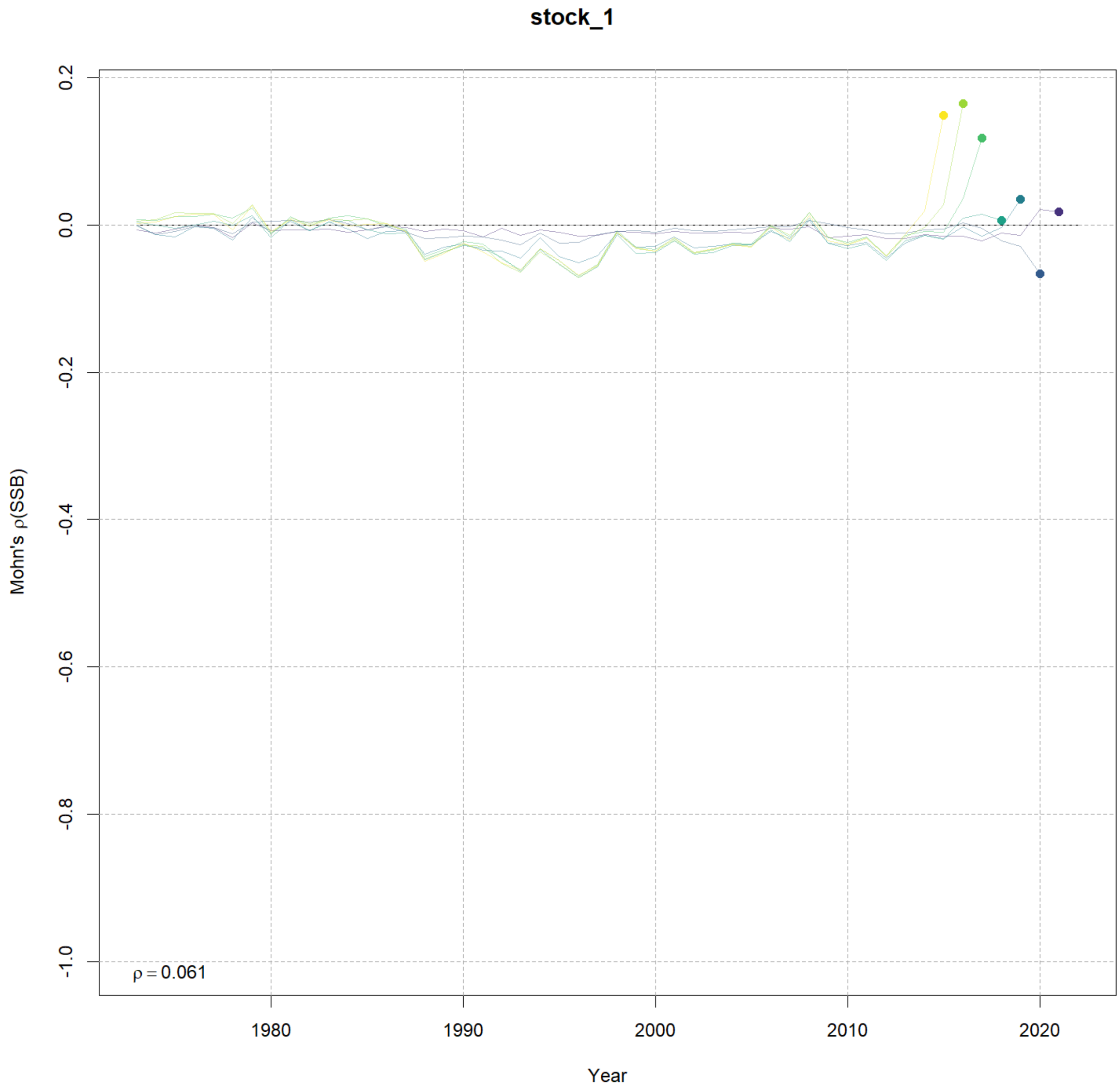


Figure 4.GB.17. Optimal WHAM run retrospective patterns for SSB.

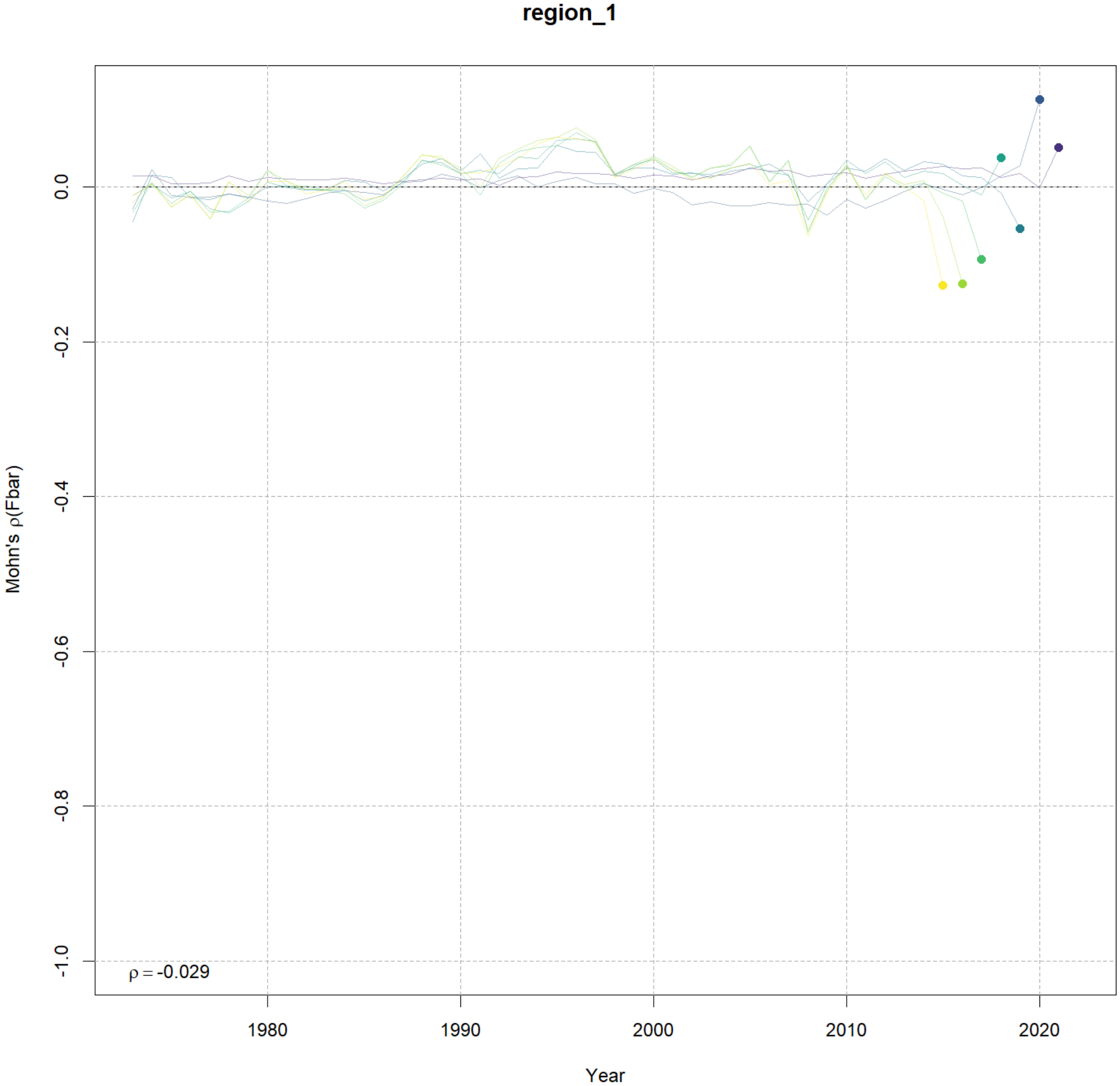


Figure 4.GB.18. Optimal WHAM run retrospective patterns for fishing mortality.

Model Results

Model results suggest that both fishing mortality and spawning stock biomass are low (Figure 4.GB.19). Recruitment has decreased in recent years while the amount of older fish has increased (Figure 4.GB.20).

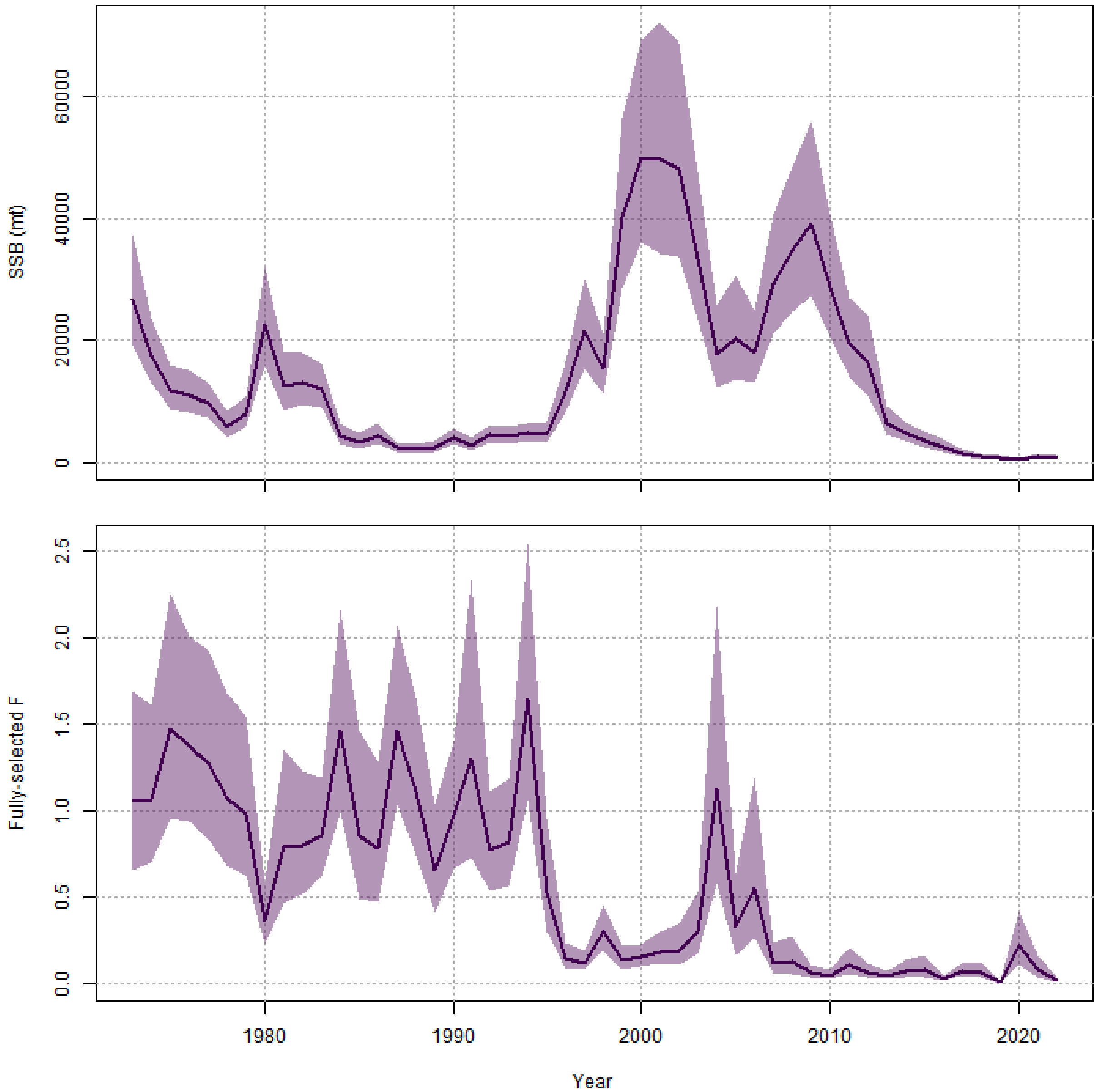


Figure 4.GB.19. Optimal WHAM run trends in SSB and fishing mortality (F).

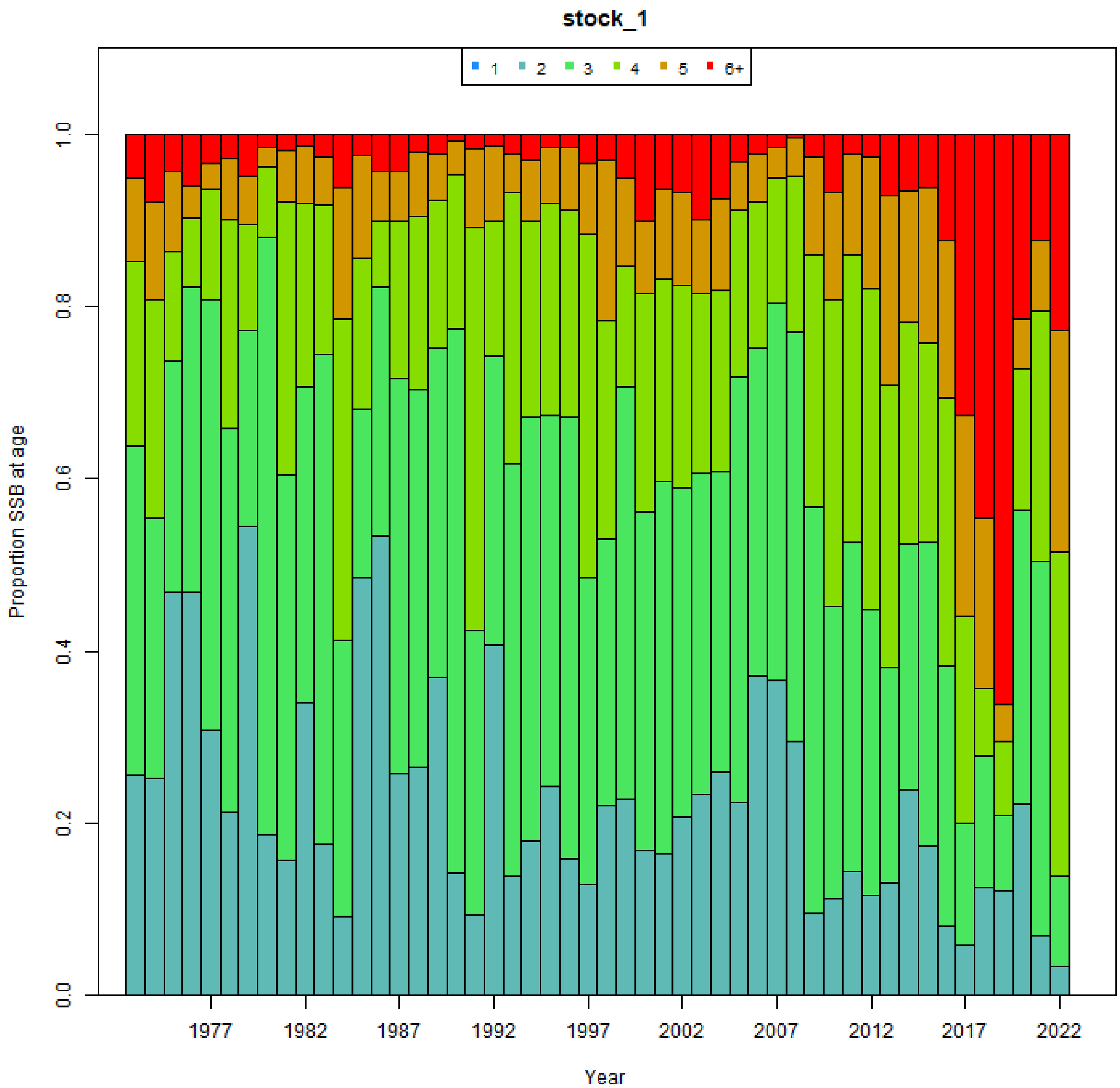


Figure 4.GB.20. Optimal WHAM run trends in proportions SSB at age.

Southern New England/Mid Atlantic stock

Overview

Recent assessments of the SNEMA yellowtail flounder stock used ASAP (NEFSC 2012; 2022). These ASAP assessments had strong retrospective patterns present due in part to low or missing survey information in the recent time series (NEFSC 2022). Additionally, the long-term projections for this stock were uncertain (NEFSC 2022) and possibly strongly correlated with environmental effects (Miller et al., 2016; Xu et al. 2017; Stock and Miller 2021; du Pontavice et al. 2022). In an attempt to mitigate these challenges, we transitioned the SNEMA yellowtail assessment from ASAP to WHAM. Details on model selection process, candidate model diagnostics, and candidate model results beyond what is presented here for TOR 4 are provided by Hodgdon (WP).

Data

WHAM combines commercial landings and discards into a single fleet (Figure 4.SNEMA.1). Age composition data is available for this combined fleet for most of the time series with the exception of the last few years (Figure 4.SNEMA.2), where biological sample collection was constricted by low catches. Age compositions of the combined fleet were historically centered on ages 2-4, but in the recent period have shifted to ages 4-6.

Of the available fishery-independent survey datasets available for the SNEMA stock, five were considered for inclusion in the WHAM framework. These five surveys were:

- NEFSC Spring Bottom Trawl Survey (1973-2022)
- NEFSC Fall Bottom Trawl Survey (1973-2022)
- NEFSC Winter Bottom Trawl Survey (1992-2007)
- MARMAP Larval Survey (1977-1987)
- ECOMON Larval Survey (1995-2022)

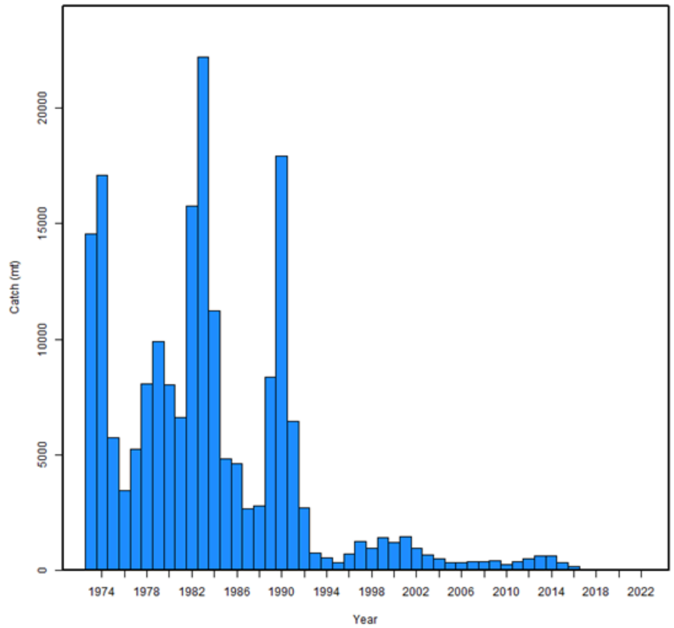


Figure 4.SNEMA.1. Total removals of yellowtail flounder from the southern New England / Mid-Atlantic stock region. This data represents a combined index of landings and discards 1973-2022. Note that catches in 2018-2022 occurred, but are at relatively low values compared to the historical series.

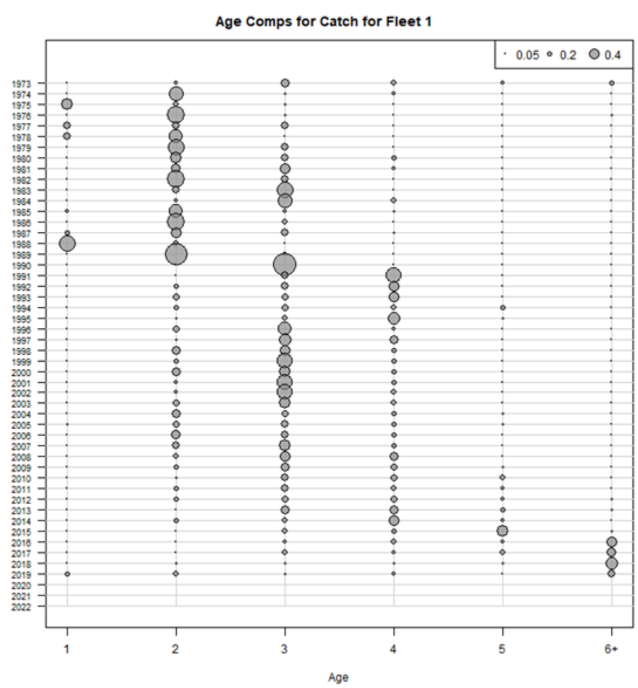


Figure 4.SNEMA.2. Age composition (ages 1-6+) of the combined fleet catch 1973-2022. Size of the circle represents relative cohort size.

Model Development

Initial Parameterization

Due to WHAM's ability to emulate ASAP, the initial setup was identical to the setup of the last management track assessment of SNEMA yellowtail flounder (NEFSC 2022). This setup included a starting year of 1973 for the time series of age composition, the number of age classes (1-6+) and CV on the combined fleet landings (0.05). From here, over 400 model variations were tested. Each of these decisions are documented below, but as should be noted, the decisions were not conducted in a linear fashion, but rather past decisions were revisited when necessary due to model changes from latter decisions. Further explorations of these decisions can be found in Hodgdon (WP).

Fishery Selectivity and Age Composition

Logistic fishery selectivity was assumed in the candidate model due to problems with model convergence associated with an age-specific fishery selectivity. Alternative runs with annual random effects on logistic fleet selectivity were conducted, and IIDrandom effects led to a model with better fits and retrospective patterns.

Several probability distributions for fishery age composition were explored (multinomial, dirichlet, dirichlet multinomial, logistic normal, and multivariate tweedie). For details on these different distributions, see Stock and Miller (2021). Dirichlet and logistic normal age compositions in WHAM have the ability to either treat the zero observations in the data as missing (miss0) or to pool zero observations with adjacent (non-zero) age classes (pool0). Logistic normal-miss0 could also have an added autoregressive process (ar1) to relate neighboring age classes (logistic normal-ar1-miss0). Logistic normal-ar1-miss0 led to the best residuals, fits, and retrospectives across the age composition options.

Survey Selectivities and Age Compositions

Similar to what was done for the combined fleet, each of the five surveys in the model were assumed to have logistic or age-specific selectivities. Logistic selectivities had better fits and retrospective patterns for the NEFSC spring and winter bottom trawl indices, and age-specific selectivities had better fits and retrospective patterns for the two larval indices and the NEFSC fall bottom trawl survey. The addition of random effects on survey selectivities did not improve diagnostics.

Similar to what was done for the age composition of the aggregate fleet, multiple probability distributions were explored for each of the five survey-based indices. Similar to findings for the aggregate fleet, logistic normal-ar1-miss0 was found to be the best age composition distribution for all five indices: the NEFSC spring, fall, and winter bottom trawl indices and the two larval indices.

Survey Catchability

Random effects on catchability of the NEFSC bottom trawl surveys did not lead to better model diagnostics, but the larval surveys required catchability random effects in the form of an autoregressive process across years (ar1), otherwise issues with model fits and convergence arose. Additionally, effects of bottom temperature on catchability were examined for the three NEFSC surveys, but these did not improve diagnostics.

Survey Inclusion/Exclusion

The five surveys included as stock indices in initial model runs were the NEFSC spring, NEFSC fall, and NEFSC winter bottom trawl surveys as well as two larval indices based on Richardson et al. (2010). After appropriate selectivities and catchabilities had been determined for each of these surveys (see above), a leave-one-out analysis was conducted where each survey was excluded and the model re-run. In the candidate model, the larval indices were excluded due to 1) fixed selectivity at all ages, 2) unrealistic catchability estimates, and 3) extremely low sample sizes not capturing true population trends. These problems are discussed more in depth in Hodgdon (WP).

Natural Mortality Assumptions

A value of M = 0.5 across all ages and years was used based on a longevity estimate (for details, see Cadrin WP). Alternative M assumptions (age-specific and with random effects) were tested, but many did not converge. Due to the results for SNEMA yellowtail flounder from TOR1, effects of the Atlantic Multidecadal Oscillation, average fall bottom temperature, and average spring bottom temperature were tested on M. None of these environmental effects led to a converged model with better fits or retrospective patterns than the basecase assumption of M = 0.5 across all ages and years.

Recruitment Assumptions

Recruitment was modeled as several alternatives: random around a mean; a random walk; a random deviation from a Beverton-Holt stock/recruit relationship; or deviation from a Ricker stock/recruit relationship. In the absence of any environmental effects on recruitment, both Beverton-Holt and Ricker stock/recruit relationships improved model diagnostics (with Beverton-Holt providing slightly better AIC/residuals than Ricker).

Based on analyses outlined in ToR 1, effects of Atlantic Multidecadal Oscillation, North Atlantic Oscillation, spring bottom temperature, the Cold Pool Index, the Gulf Stream Index (GSI), and the spring GSI were all tested for inclusion in the WHAM framework as a covariate which influenced recruitment. For all of these tests, the Beverton-Holt stock-recruit relationship was replaced by the effect of the environmental covariate. This was done because models that incorporated both a stock-recruit relationship and the effect of a covariate would not converge. Spring bottom temperature and GSI both improved model diagnostics and of these two effects, GSI performed better.

Numbers-at-Age

Random effects were additionally tested on NAA (i.e., the cohort survival process) in the WHAM framework. Autoregressive processes across both ages and years (2dar1) improved overall model fit and retrospective patterns, leading to inclusion in the candidate model.

Candidate Model Setup

All candidate model settings based on the above criteria can be found in Table 4.SNEMA.1. The model (m164_GSI) assumed logistic fleet selectivity with IID random effects, logistic NEFSC spring and winter selectivities, and age-specific NEFSC fall selectivity. The age composition of the aggregate fleet and all surveys was modeled as logistic normal-ar1-miss0 and NAA have 2dar1 random effects. Recruitment was decoupled from ages 2-6+ (but still had an autoregressive process across years ar1_y) and were informed by GSI (modeled via ar1) lagged one year via a "controlling" process.

Table 4.SNEMA.1. Candidate model settings for the SNEMA yellowtail flounder stock. Details of settings can be found in Hodgdon (WP##) and explanations of how these settings interact within WHAM can be found in Stock and Miller (2021).

Years	1973-2022
Age Classes	1-6+
Fleet Selectivity	Logistic
Fleet Selectivity Random Effects	iid
Fleet Age Composition	Logistic normal-ar1-miss0
Fleet CV	0.05
Survey Selectivities	NEFSC Spring and Winter: Logistic NEFSC Fall: Age-specific
Survey Selectivity Random Effects	None
Survey Catchability Random Effects	None

Survey Catchability Environmental Effects	None
Survey Age Compositions	Logistic normal-ar1-miss0
Recruitment Assumptions	Decoupled from ages 2-6+ GSI Informed (controlling effect)
Gulf Stream Index	Modeled via ar1 process
Natural Mortality Assumptions	M = 0.5 across all ages and years
Numbers-at-Age Random Effects	2dar1

Model Diagnostics

The candidate model met all diagnostic criteria. Both first-order convergence criteria (max gradient 5.11e-11) and second-order convergence criteria (Hessian matrix was invertible) were satisfied. Jitter analysis confirmed that the model converged on a global solution and was stable with a convergence rate of 93%. Fits to the aggregate fleet catch, survey indices, and GSI were good with relatively small residuals, minimal nonrandom patterning across years and ages, and few outliers (Figures 4.SNEMA.3 – 4.SNEMA.7). OSA residuals for the aggregate fleet and age compositions, survey indices and age compositions, and GSI were approximately normally distributed (Figure 4.SNEMA.8 – 4.SNEMA.16). Retrospective analysis revealed that the candidate model had minor tendencies to revise retrospective estimates of SSB downward (Mohn's ρ = 0.145; Figure 4.SNEMA.17) and revise retrospective estimates of F upward (Mohn's ρ = -0.014; Figure 4.SNEMA.18). Simulation self-tests revealed the mean percent bias was <1% for F and SSB, and -16% for R, with an overall convergence rate of 90%.

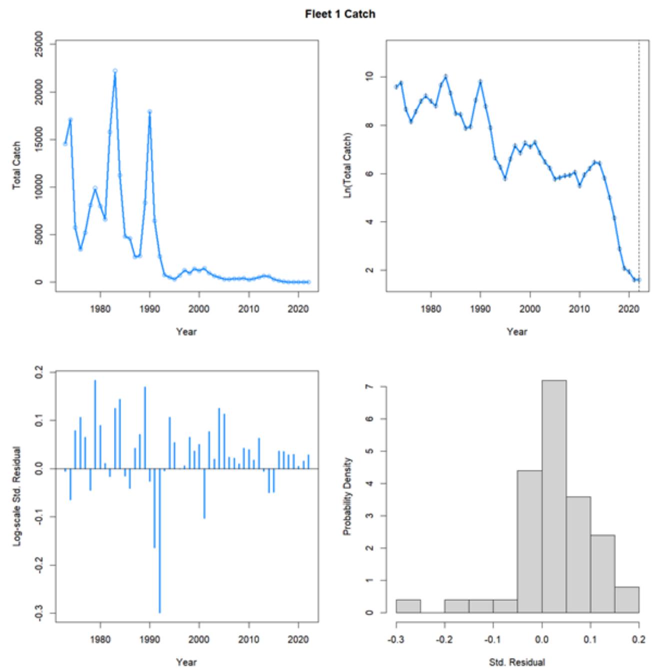


Figure 4.SNEMA.3. Candidate model fit to the aggregate fleet total catch.

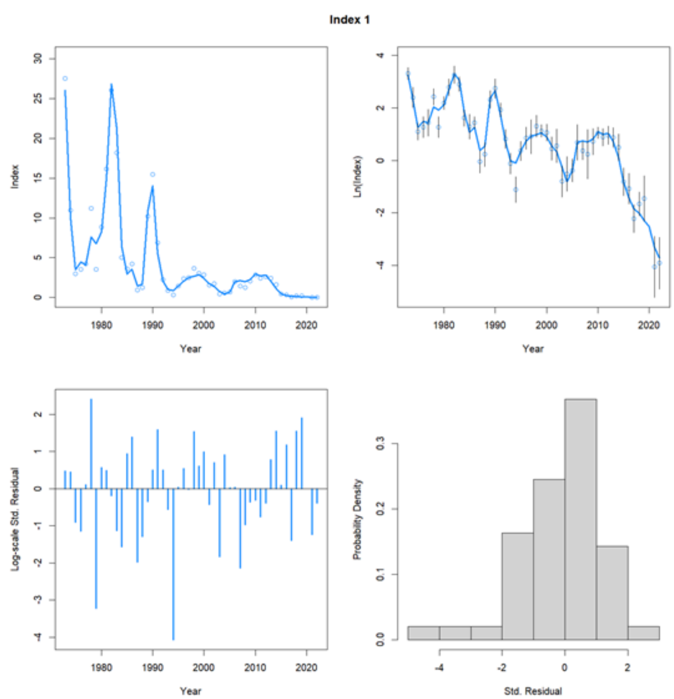


Figure 4.SNEMA.4. Candidate model fit to the NEFSC spring bottom trawl survey index.

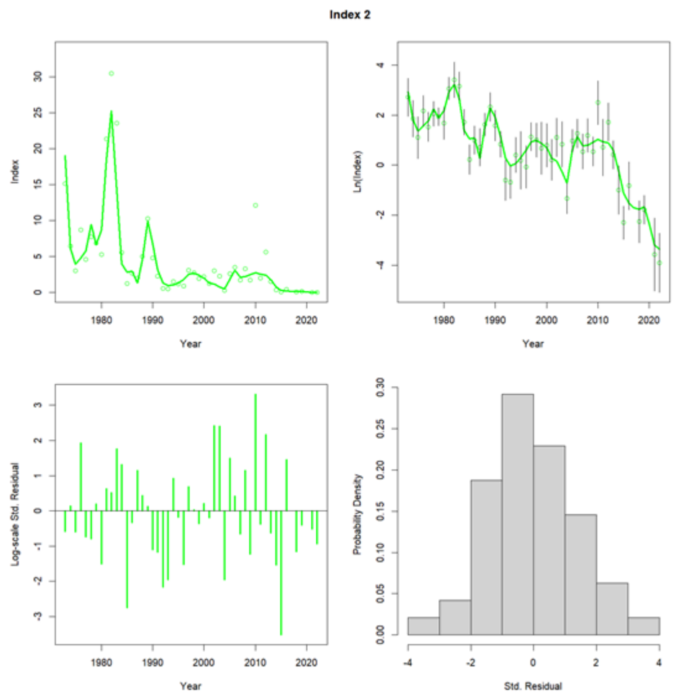


Figure 4.SNEMA.5. Candidate model fit to the NEFSC fall bottom trawl survey index.

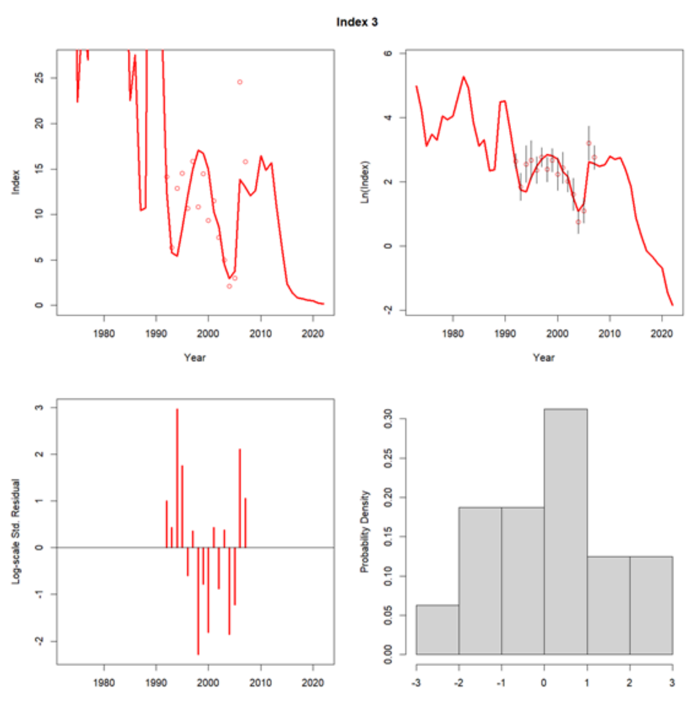


Figure 4.SNEMA.6. Candidate model fit to the NEFSC winter bottom trawl survey index.

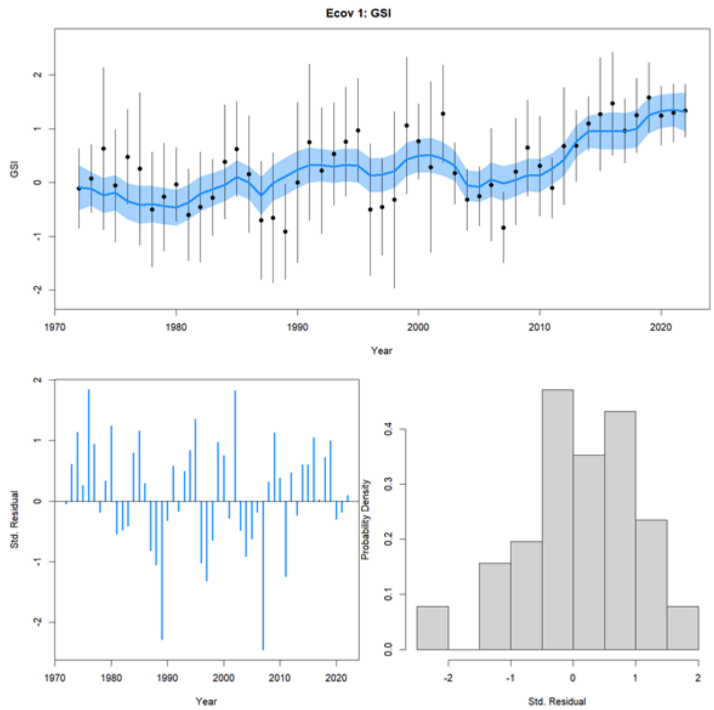


Figure 4.SNEMA.7. Candidate model fit to the Gulf Stream Index.

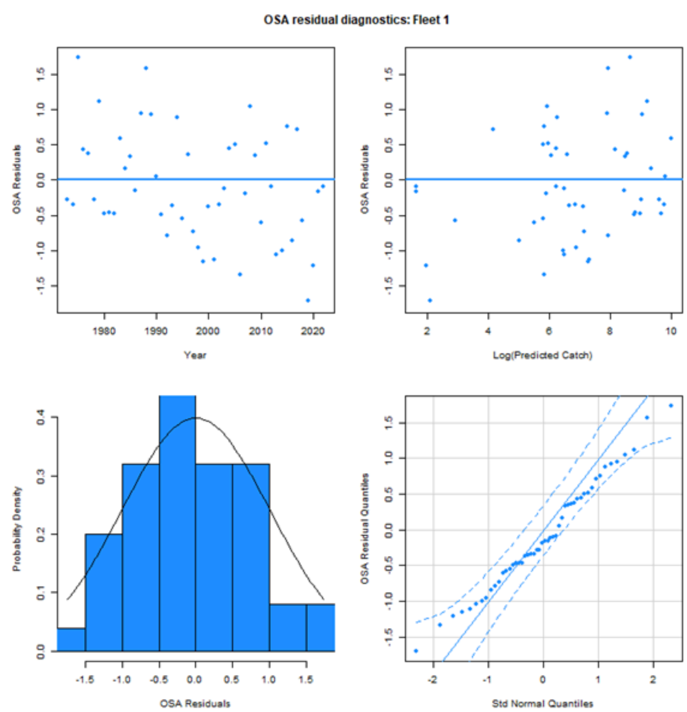


Figure 4.SNEMA.8. OSA residual diagnostics for the aggregate fleet total catch.

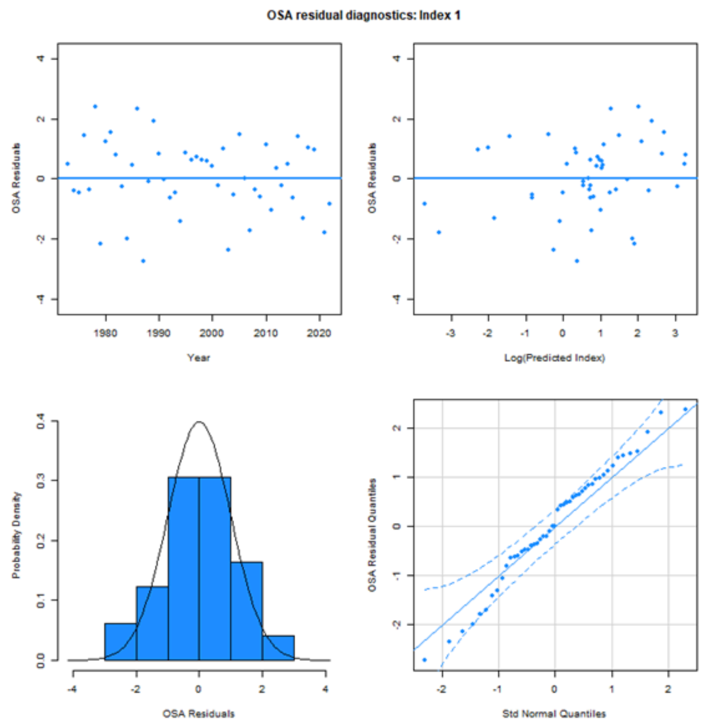


Figure 4.SNEMA.9. OSA residual diagnostics for the NEFSC spring bottom trawl index.

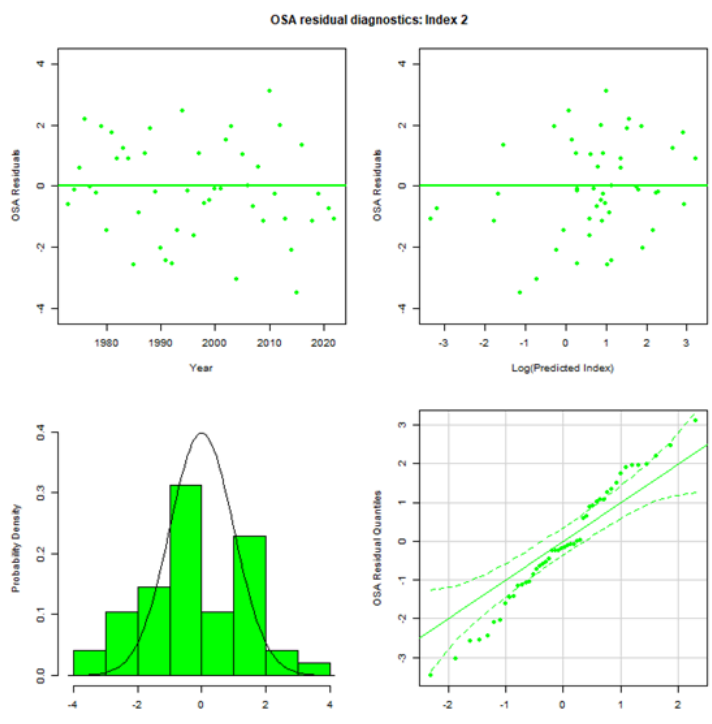


Figure 4.SNEMA.10. OSA residual diagnostics for the NEFSC fall bottom trawl index.

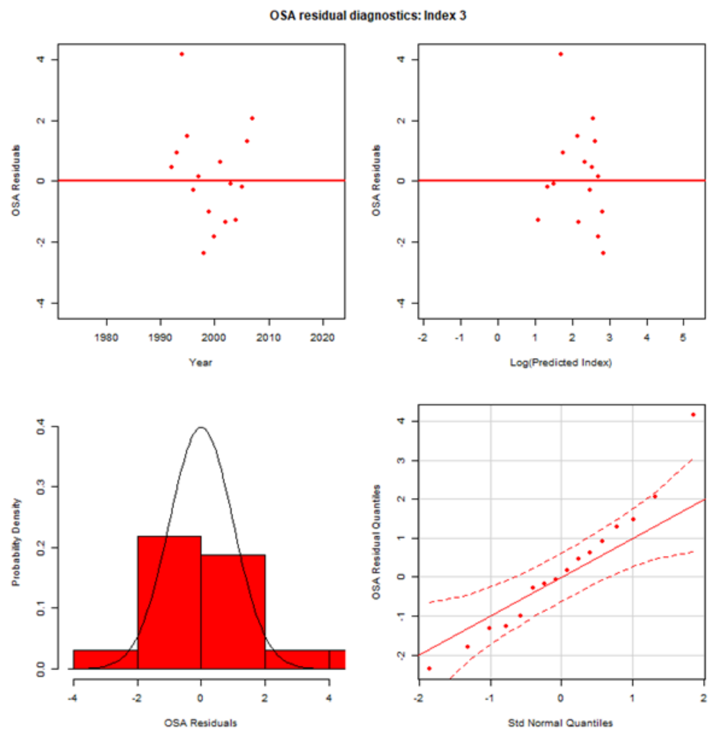


Figure 4.SNEMA.11. OSA residual diagnostics for the NEFSC winter bottom trawl index.

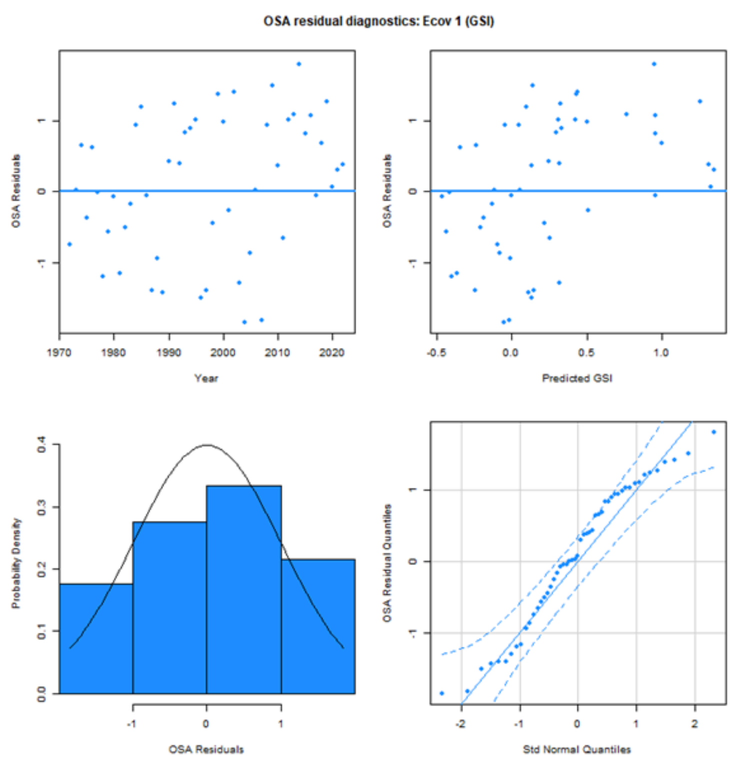


Figure 4.SNEMA.12. OSA residual diagnostics for the Gulf Stream Index.

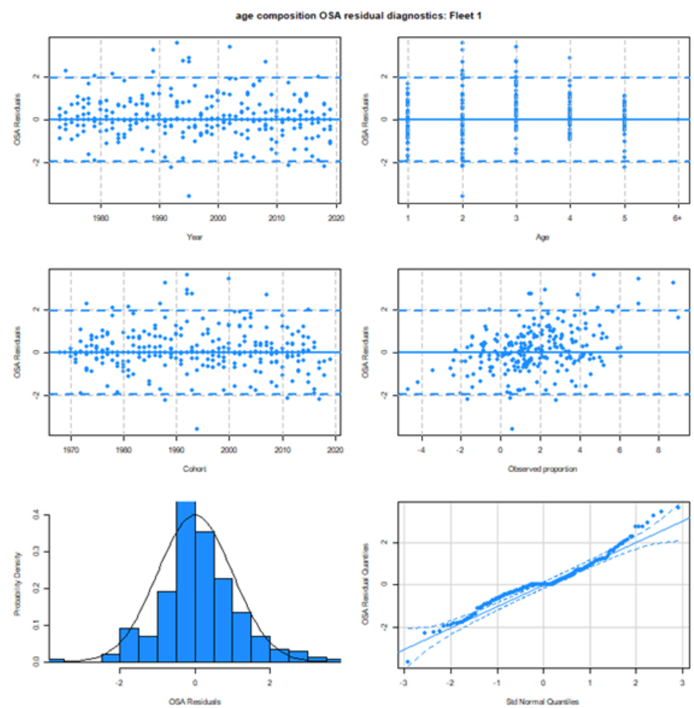


Figure 4.SNEMA.13. OSA residual diagnostics for the aggregate fleet age composition.

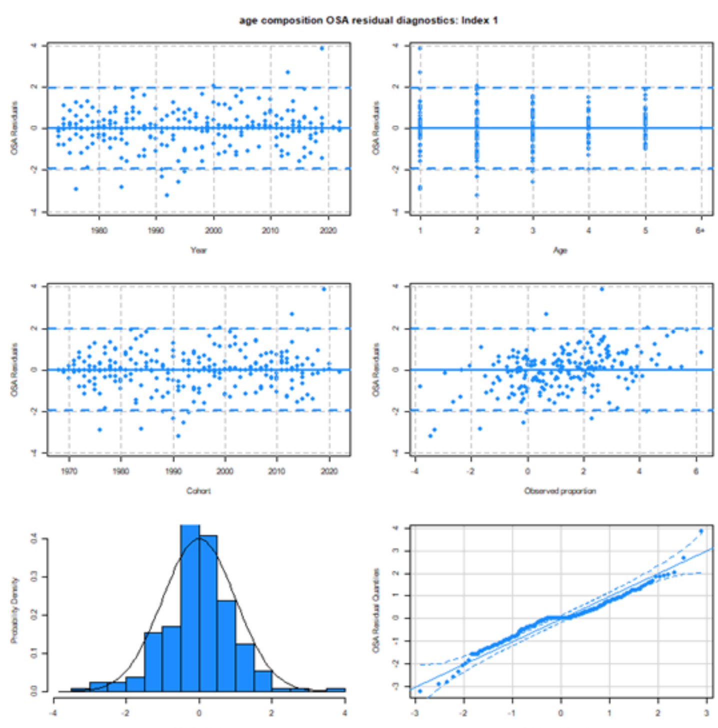


Figure 4.SNEMA.14. OSA residual diagnostics for the NEFSC spring bottom trawl index age composition.

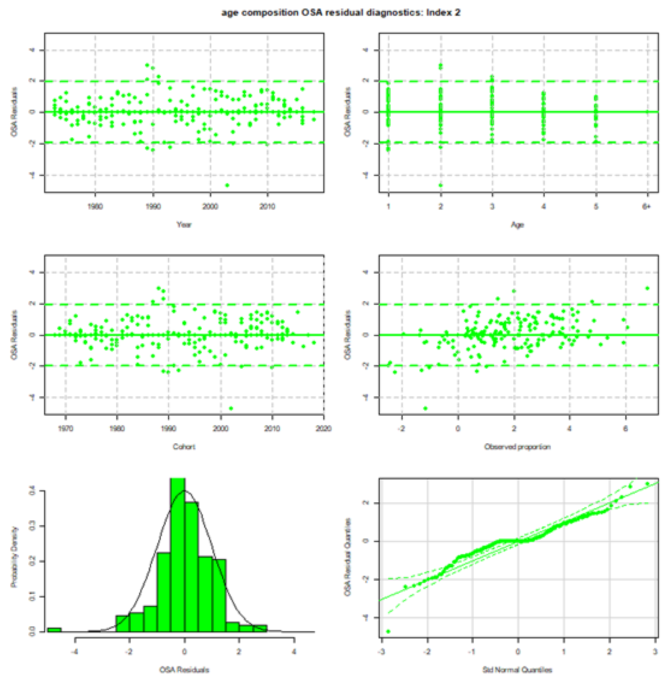


Figure 4.SNEMA.15. OSA residual diagnostics for the NEFSC fall bottom trawl index age composition.

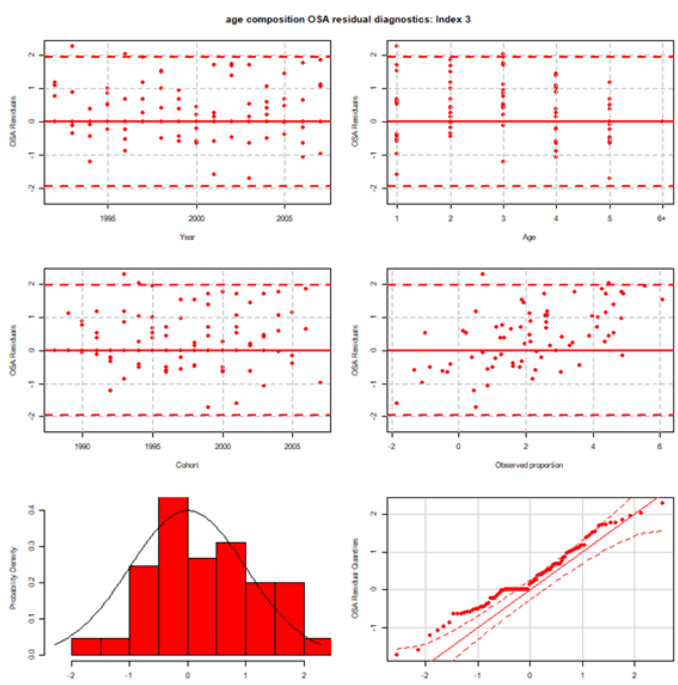


Figure 4.SNEMA.16. Bubble plot of OSA residual diagnostics for the NEFSC winter bottom trawl index age composition.

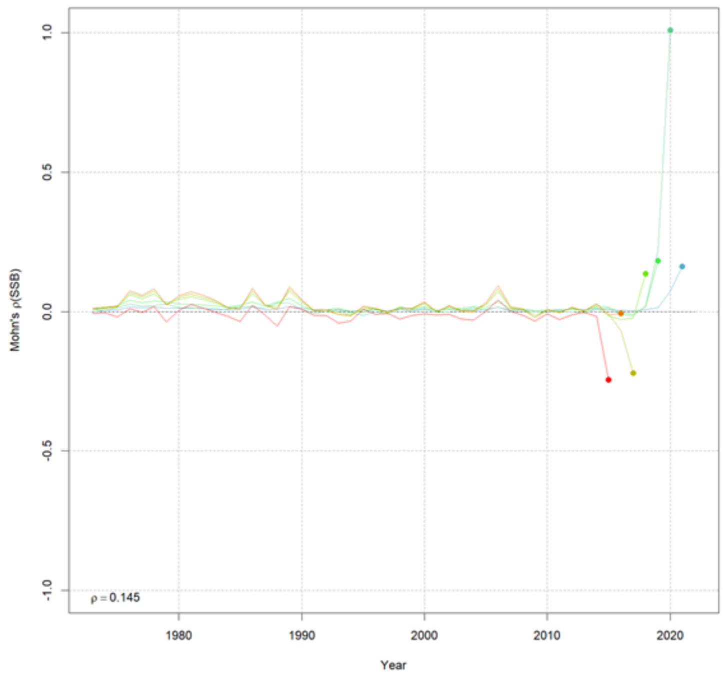


Figure 4.SNEMA.17. Relative retrospective pattern of SSB for the candidate model.

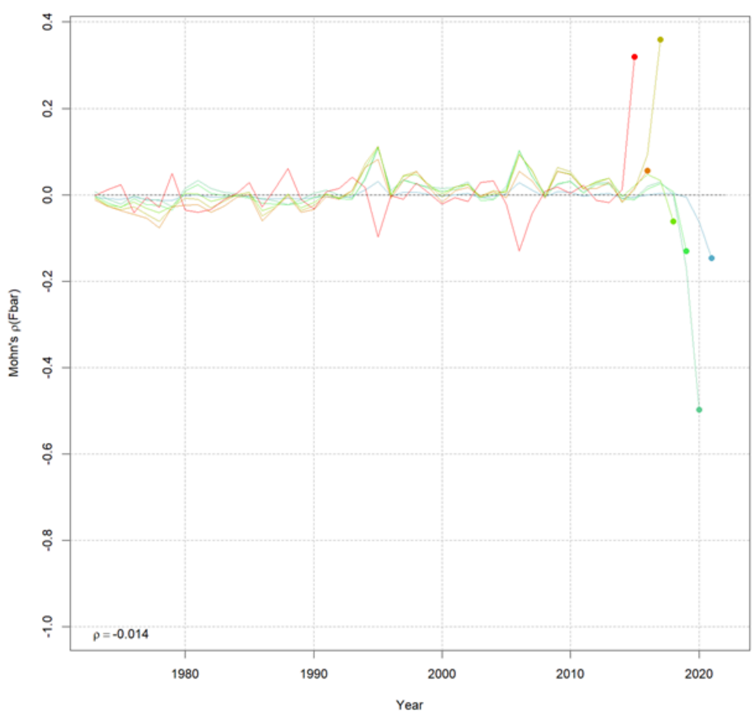


Figure 4.SNEMA.18. Relative retrospective pattern of F for the candidate model.

Model Results

The candidate model (m164_GSI) estimated that F, SSB, and R have all generally decreased since the 1990s (Figures 4.SNEMA.19 – 4.SNEMA.20). Terminal year (2022) estimates were F = 0.11, SSB = 44 mt, and R = 495,000. NAA over most of the time series was dominated by age-1 individuals, and there was a slight increase in the proportion of age-6+ (Figure 4.SNEMA.21). This proportional increase in the plus group is also largely apparent in changes of SSB-at-age (Figure 4.SNEMA.22), coinciding with record-low SSB values.

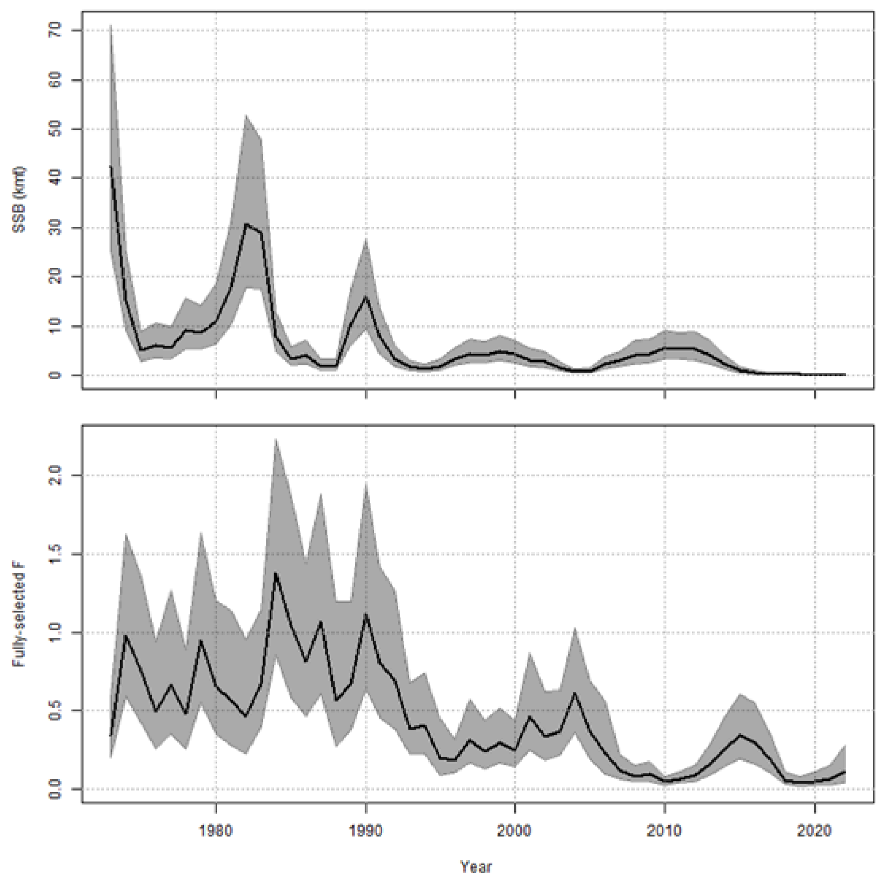


Figure 4.SNEMA.19. SSB (top) and F (bottom) from the candidate model.

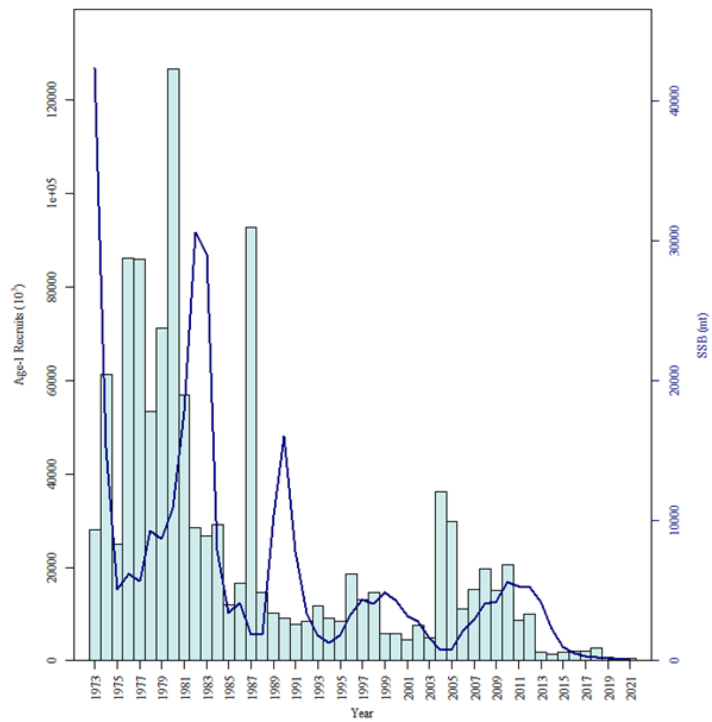


Figure 4.SNEMA.20. SSB (line) and R (bars) from the candidate model.

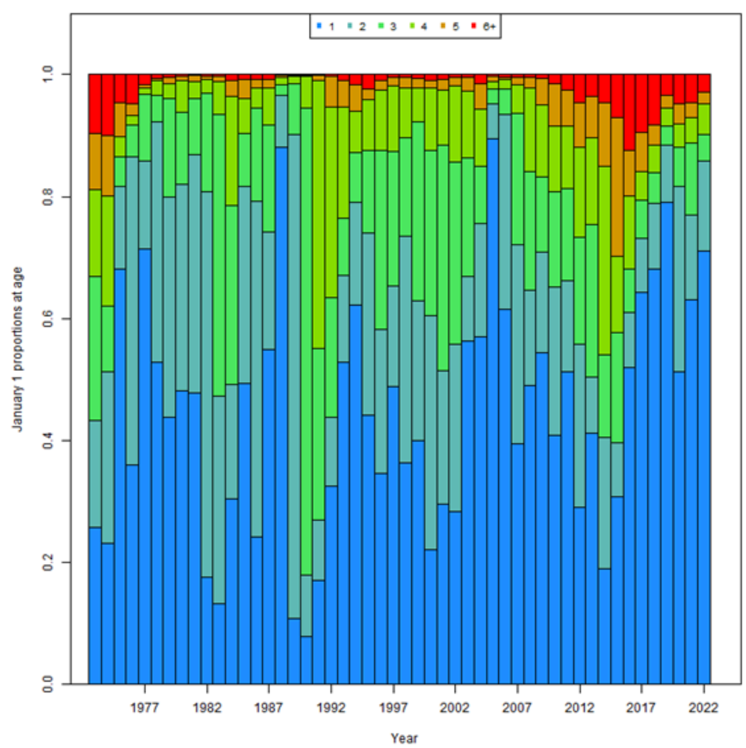


Figure 4.SNEMA.21. Proportional January 1st NAA from the candidate model.

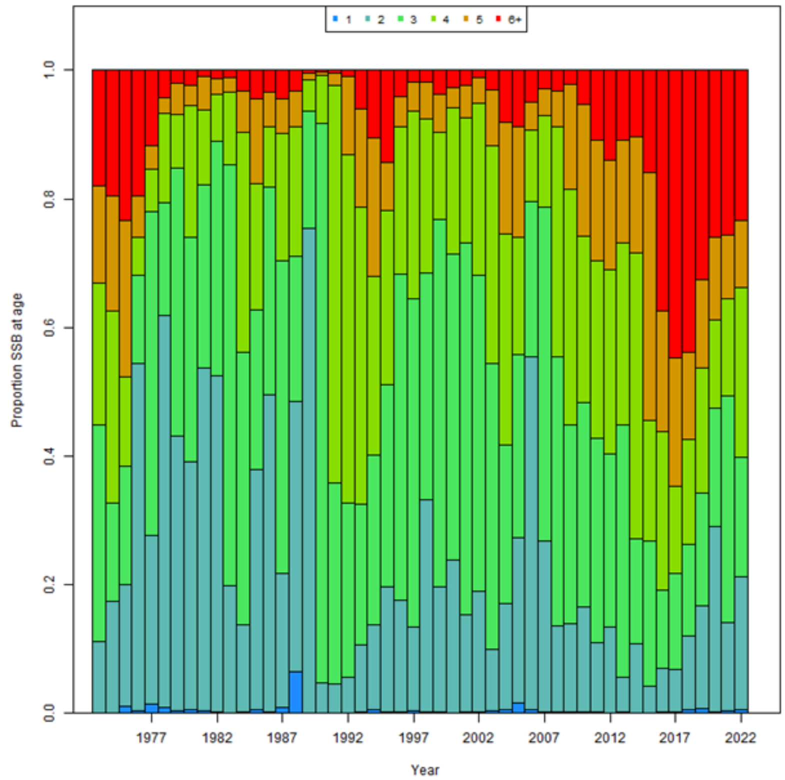


Figure 4.SNEMA.22. Proportional SSB-at-age from the candidate model.

TOR5: STATUS DETERMINATION CRITERIA

"Update or redefine status determination criteria (SDC; point estimates or proxies for B_{MSY}*,* $B_{THRESHOLD}$*,* F_{MSY} *and MSY reference points) and provide estimates of those criteria and their uncertainty, along with a description of the sources of uncertainty. If analytic model-based estimates are unavailable, consider recommending alternative measurable proxies for reference points. Compare estimates of current stock size and fishing mortality to existing, and any redefined, SDCs."*

Cape Cod/Gulf of Maine stock

The spawner-per-recruit analysis for the CCGOM yellowtail flounder aimed to determine the FMSY proxy reference point, F40%. This required a moving-window analysis to identify the optimal averaging period for weight-at-age (WAA) and maturity while maintaining constant natural mortality and fleet selectivity, as they were consistent across the time series. The analysis revealed that a two-year window provided the lowest RMSE. Using these two-year averages, the estimated F40% for the candidate model was 1.64, which was substantially less than model m304's unrealistically high estimate of 3.0, highlighting the importance of selectivity settings in achieving plausible reference points (Table 5.CCGOM.1). A further analysis suggested that assumptions about natural mortality (M=0.4 vs. M=0.2) can substantially impact F40%, with assumptions at M=0.2 (what was used in the most recent assessment), resulting in F40% = 0.47. This exploration emphasizes that higher M allows for increased fishing pressure without diminishing SSB significantly.

For SSB40%, the analysis employed mean recruitment across 1985-2022 with two-year averages for maturity and WAA, yielding an SSBF40% estimate of 4870 mt. The decision to use the full recruitment series reflects the assumption that recruitment fluctuations represent long-term productivity without persistent trends, aligning with practices for regional groundfish stocks (NEFSC 2022b). For 2022, SSB/SSB40% and F/F40% ratios were calculated at 1.77 and 0.04, respectively (Figure 5.CCGOM.1; Table 5.CCGOM.1).

Table 5.CCGOM.1. Biological reference points estimated as described in section 6.0 and terminal year (2022) values of SSB and F.

$F_{40\%}$	1.64
F_{2022}	0.06
$SSB_{40\%}$	4870 mt
SSB_{2022}	8645 mt
MSY proxy	1998 mt

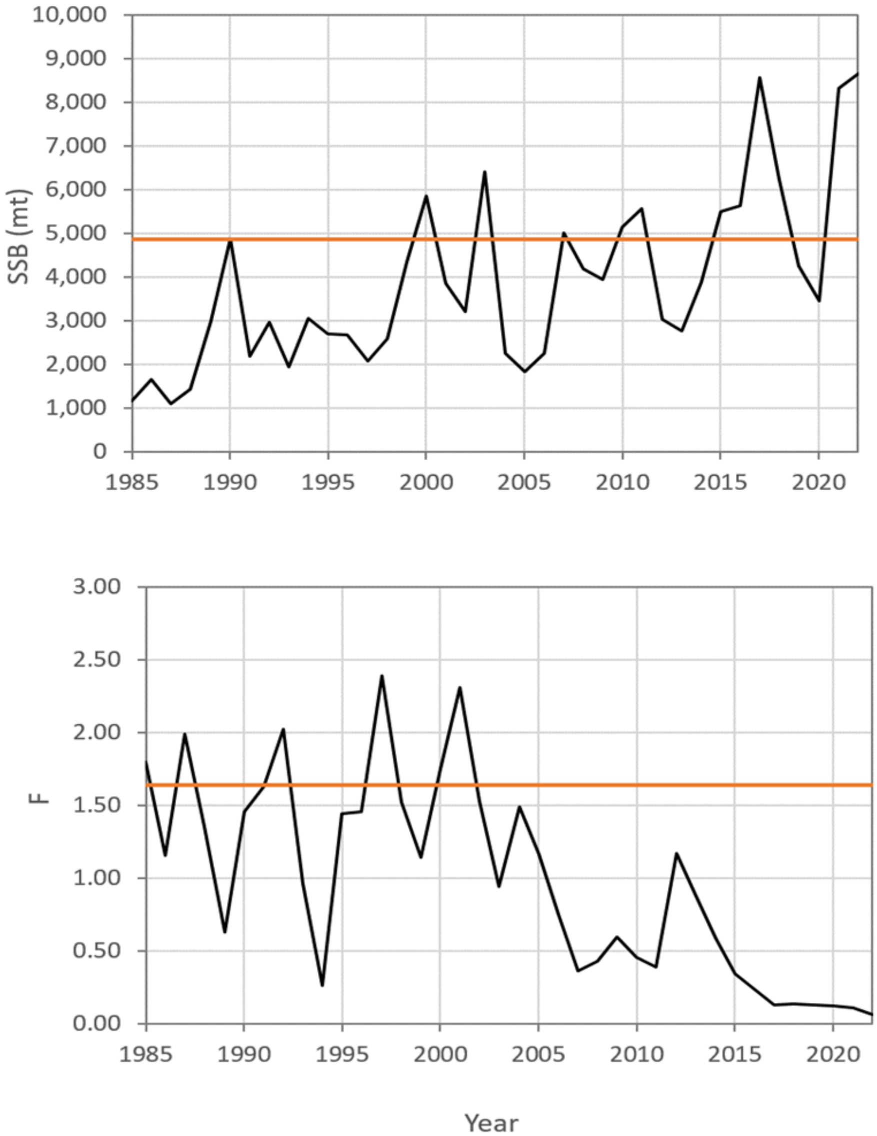


Figure 5.CCGOM.1: SSB 1985-2022 with a red line at SSB40% = 4870 mt (top) and F 1985-2022 with a red line at F40% = 1.64 (bottom)

Georges Bank stock

For more detail on the GB reference points see Hansell et al. (WP). All biological reference points were calculated in WHAM. Both MSY and MSY-proxy reference points were tested. The data inputs for biological reference points are: weight at age, natural mortality, fleet selectivity, recruitment and maturity. For GB yellowtail, natural mortality and maturity were assumed to be constant. An analysis using root mean squared error found that using an average from the most recent two years of weight at age led to the best prediction accuracy . For fleet selectivity, the AR1_y correlation process was used in the projections, over the long term it reverts back to the mean. The changepoint analysis in the bottom water temperature covariate found several different breakpoints; however, the WG decided to use a single breakpoint in 2009. The WG decided to use MSY reference points because the Beverton-Holt stock recruit relationship was included in the preferred model based on diagnostics . To ensure that reference points and projections were consistent the stock was projected 200 years into the future at Fmsy (0.15) and the equilibrium SSBmsy and MSY were chosen as final reference points. Using the static SSBmsy and MSY reference points would not allow the stock to rebuild under current environmental conditions. Thus, the proposed reference points for GB yellowtail flounder are: MSY = 554 mt (54 – 5,661 mt); Fmsy = 0.15 (0.12-0.19); and SSBmsy = 4942 mt (485-50,258 mt; Table 5.GB.1). The lower Fmsy value (0.15) is the result of the environmental covariate since the changepoint. Terminal year (2022) SSB/SSB_{msy} (747/4942) = 0.15 and terminal year (2022) F/F_{msy} (0.02/0.15) = 0.13. (Table 5.GB.1).

Table 5.GB.1. Biological reference points estimated from optimal model for Georges Bank yellowtail flounder.

Reference point	Value
MSY	554 mt (54 – 5,661)
Fmsy	0.15 (0.12 – 0.19)
SSBmsy	4942 mt (485 – 50,358)

Southern New England/Mid Atlantic stock

A spawner-per-recruit analysis was conducted to determine the F_{MSY} proxy reference point; $F_{40\%}$. This overfishing definition of $F_{40\%}$ represents the fishing mortality rate that resulted in 40% of the un-fished spawning potential and was equal to 0.73 (Table 5.SNEMA.1). In this analysis, the following specifications were used:

- *M*: Lifetime *M* from candidate model (*M* = 0.5)
- *Maturity*: Lifetime maturity from the candidate model

- *WAA*: Terminal 2-year average
- *Selectivity*: Terminal 2-year average

M and maturity were assumed to be constant over the time series 1973-2022 and in the spawner-per-recruit analysis. The optimal period over which to estimate WAA (and which was also used for selectivity) was determined through a moving-window analysis using root mean squared error, details on which can be found in Hodgdon (WP).

Due to the effect of GSI on R in the candidate model, the SSB_{MSY} proxy reference point, $SSB_{40\%}$, was estimated via a long-term projection. The equilibrium spawning biomass from long-term (100 year) projections of fishing at a rate of $F_{40\%}$ = 0.73 and an average GSI of years 2012-2022 (see TOR 6) was set as the biomass reference point $SSB_{40\%}$ = 126 mt (Table 5.SNEMA.1). Terminal year (2022) SSB/$SSB_{40\%}$ = 44/126 = 0.35 and terminal year (2022) F/$F_{40\%}$ = 0.11/0.73 = 0.15. (Table 5.SNEMA.1).

Table 5.SNEMA.1. Biological reference points estimated from the candidate model and terminal year (2022) values of SSB and F.

$F_{40\%}$	0.73
F_{2022}	0.11
$SSB_{40\%}$	126 mt
SSB_{2022}	44 mt
MSY proxy	97 mt

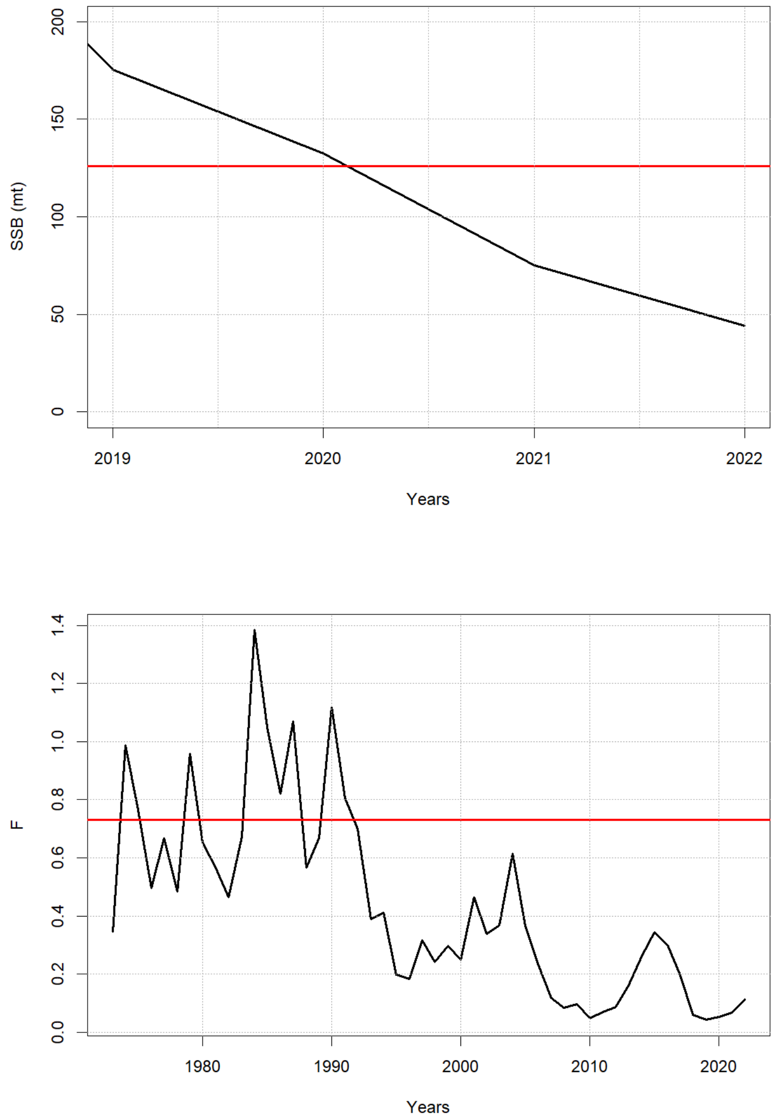


Figure 5.SNEMA.1. SSB 2019-2022 with a red line at $SSB_{40\%}$ = 126 mt (top) and F 1973-2022 with a red line at $F_{40\%}$ = 0.73 (bottom).

TOR6: PROJECTION METHODS

"Define appropriate methods for producing projections; provide justification for assumptions of fishery selectivity, weights at age, maturity, and recruitment; and comment on the reliability of resulting projections considering the effects of uncertainty and sensitivity to projection assumptions."

Cape Cod/Gulf of Maine stock

The WHAM model's projection capabilities for the CCGOM yellowtail flounder stock were used to forecast short-term trends, with settings aligned to those included in the Biological Reference points. Projections assumed that 2023 catch levels would match those of 2022 and applied the F40% rate (1.64) from 2024–2026, maintaining constant fleet selectivity and natural mortality throughout the period. Average weights-at-age and maturity were calculated from the final two years of data, while recruitment relied on the full 1985–2022 time series. These projection settings are detailed in Table 6.CCGOM.1.

Projection results suggest an initial increase in catch, rising to 5076 tons in 2024 before stabilizing around 2440 tons by 2026, while SSB is projected to decrease from 8382 tons in 2023 to approximately 4768 tons by 2025, remaining below historical levels (Table 6.CCGOM.2; Figure 6.CCGOM.1).

Table 6.CCGOM.1. Settings used for projections of the candidate model m452.

Random Effects	ar1_a for NAA
Natural Mortality	Constant (M = 0.4)
Weight-at-Age	Terminal 2-year average
Maturity	Terminal 2-year average
Recruitment	Mean 1985 - 2022
Environmental Covariates	None

Table 6.CCGOM.2. Estimates and uncertainties (90% and 95% confidence intervals) of four years of projected Catch (mt), F, R (000s), and SSB (mt). Forecasts were done using bridge year (2023) catch equal to 2022 catch and then fishing at $F_{40\%}$ = 0.73 in years 2024-2026.

Type	*Year*	*Estimation*	*Low 90*	*High 90*	*Low 95*	*High 95*
Catch	2023	303	303	303	303	303
Catch	2024	5,076	1,502	17,152	1,189	2,1658
Catch	2025	2,476	594	10,304	452	13,540
Catch	2026	2,439	475	12,526	347	17,137
F	2023	0.056	0.022	0.141	0.019	0.168
F	2024	1.638	1.273	1.876	1.226	1.947
F	2025	1.638	1.273	1.876	1.226	1.947
F	2026	1.638	1.273	1.876	1.226	1.947
SSB	2023	8,382	3456	20327	2,917	24087.16
SSB	2024	5,838	1,850	18,422	1,485	22959
SSB	2025	4,768	1,162	19,571	886	25652
SSB	2026	4,784	1,104	20,739	833	27468
R	2023	25,286	7,721	82,808	6,152	103,937
R	2024	25,286	7,721	82,808	6,152	103,937
R	2025	25,286	7,721	82,808	6,152	103,937
R	2026	25,286	7,721	82,808	6,152	103,937

Georges Bank stock

For more detail on the GB projections see Hansell et al. (WP). Projections were conducted within WHAM. Projection inputs are consistent with those included in the biological reference points. Natural mortality (0.4; Cadrin WP) and maturity were assumed to be constant. Weights at age are the average from the terminal two years (2021-2022) of the assessment. Process error in fleet selectivity (AR1_Y) were propagated into the projection years; over the long-term, the projected values revert to the mean. Recruitment in the projections is influenced by the average bottom water temperature from 2009-2022. This time period was chosen based on a changepoint analysis. The average bottom water temperature during this time informs deviations from the Beverton-Holt stock recruit relationship (Hansell et al. WP).

The example projections presented here assume that catch in the first year (2023) is equal to catch in 2022. The projections are then carried forward three years fishing at Fmsy (0.15). These methods, including the changepoint analysis will be updated and applied to short-term projections for future management track assessments.

Table 5.GB.1 Estimates and uncertainties (90% confidence intervals) of four years of projected Catch (mt), F, R (000s), and SSB (mt). Forecasts were done using bridge year (2023) catch equal to 2022 catch and then fishing at F_{msy} = 0.15 in years 2024-2026.

Year	Metric	Estimation	Low 90 %	High 90%
2023	Catch	15	-	-
2024	Catch	141	12	337
2025	Catch	144	12	414
2026	Catch	150	11	521
2023	F	0.03	0.012	0.058
2024	F	0.15	0.083	0.518
2025	F	0.15	0.083	0.518
2026	F	0.15	0.083	0.518
2023	SSB	912	432	1925
2024	SSB	1126	396	3198
2025	SSB	1117	365	3417
2026	SSB	1189	356	3972
2023	R	2196	598	8058
2024	R	2645	624	11214
2025	R	3210	650	15859
2026	R	3189	613	16595

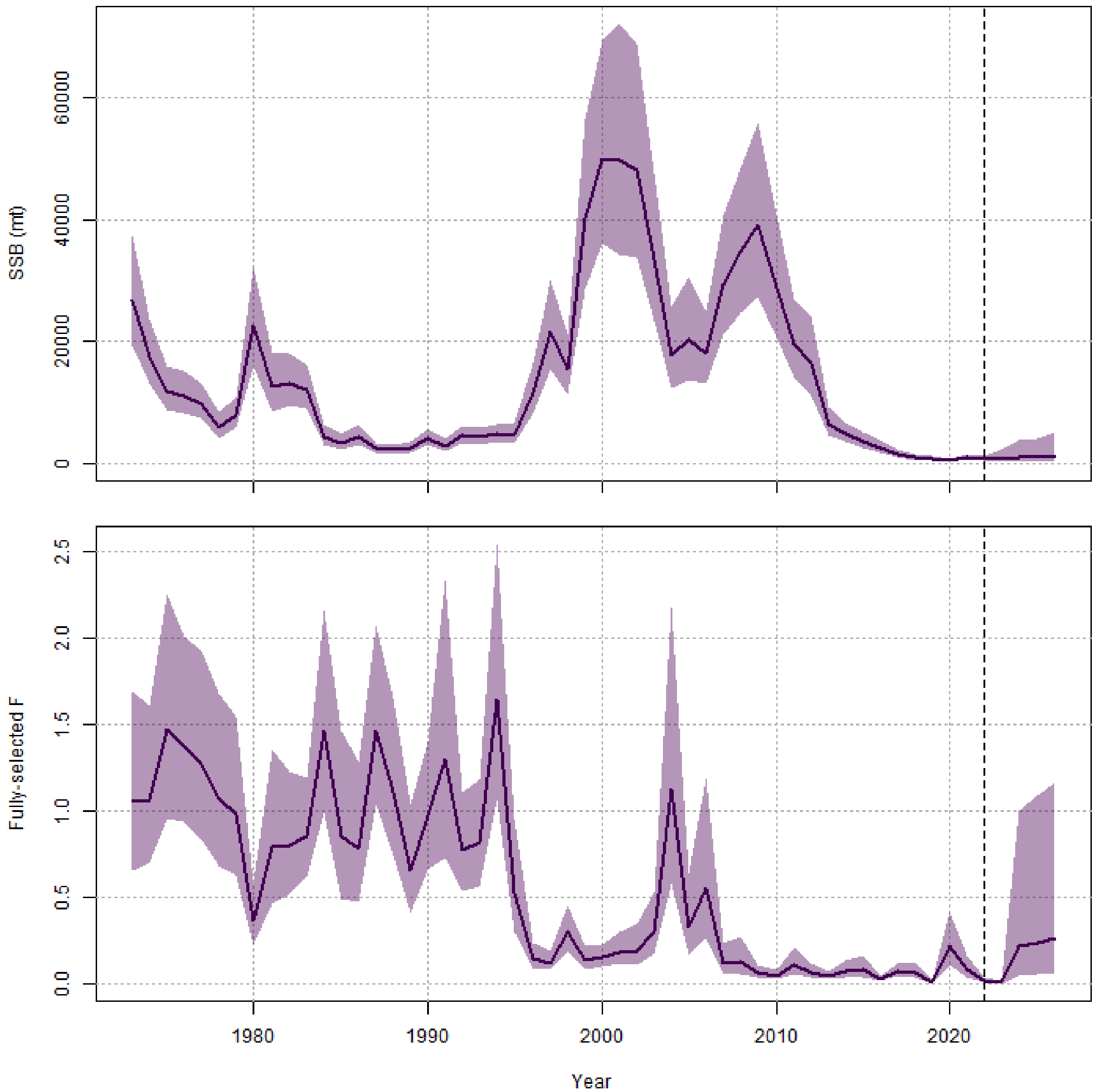


Figure 6.GB. 1: Example short-term projections of SSB and F.

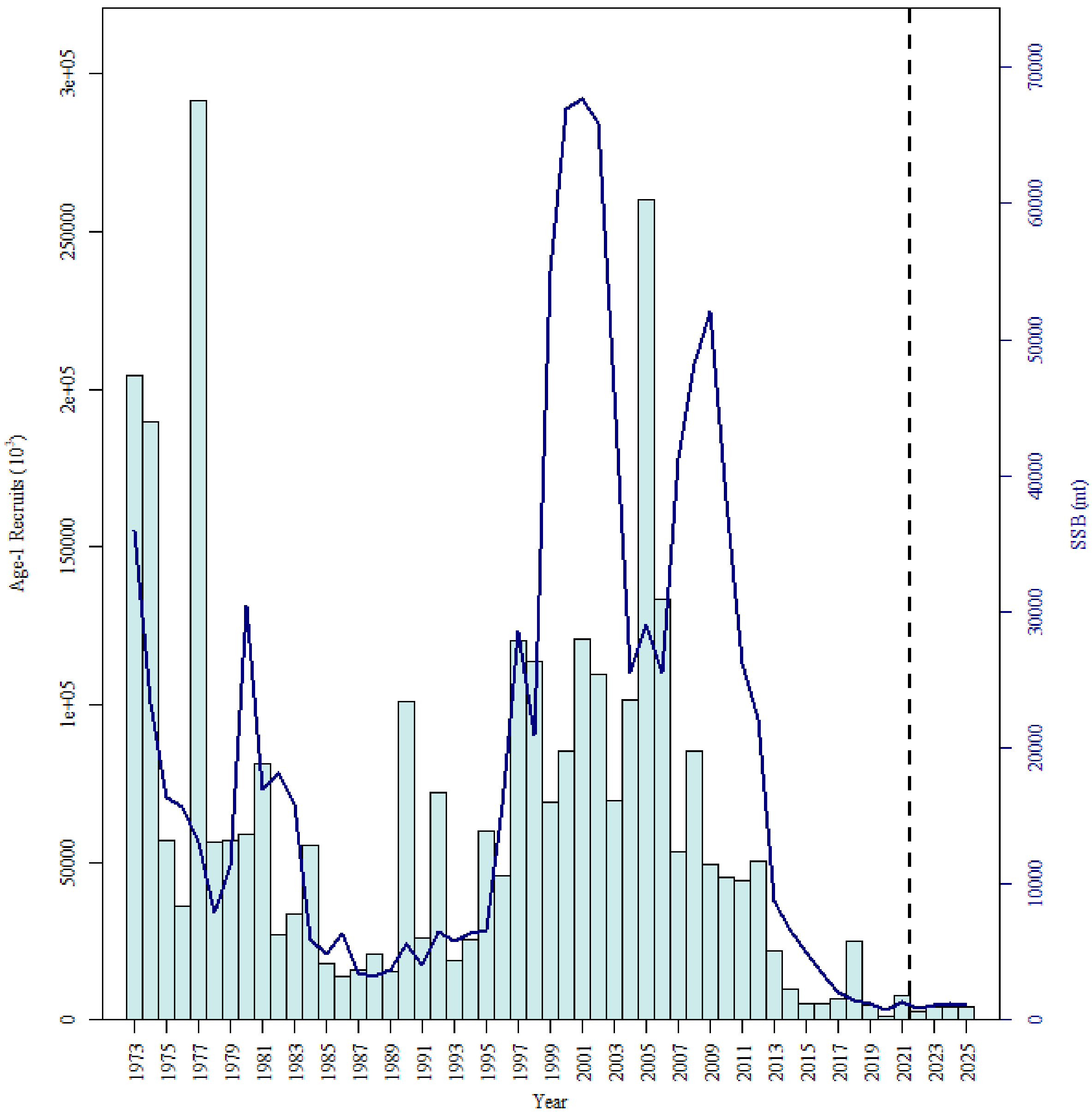


Figure 6.GB. 2: Example short-term projections of age-1 recruits and SSB.

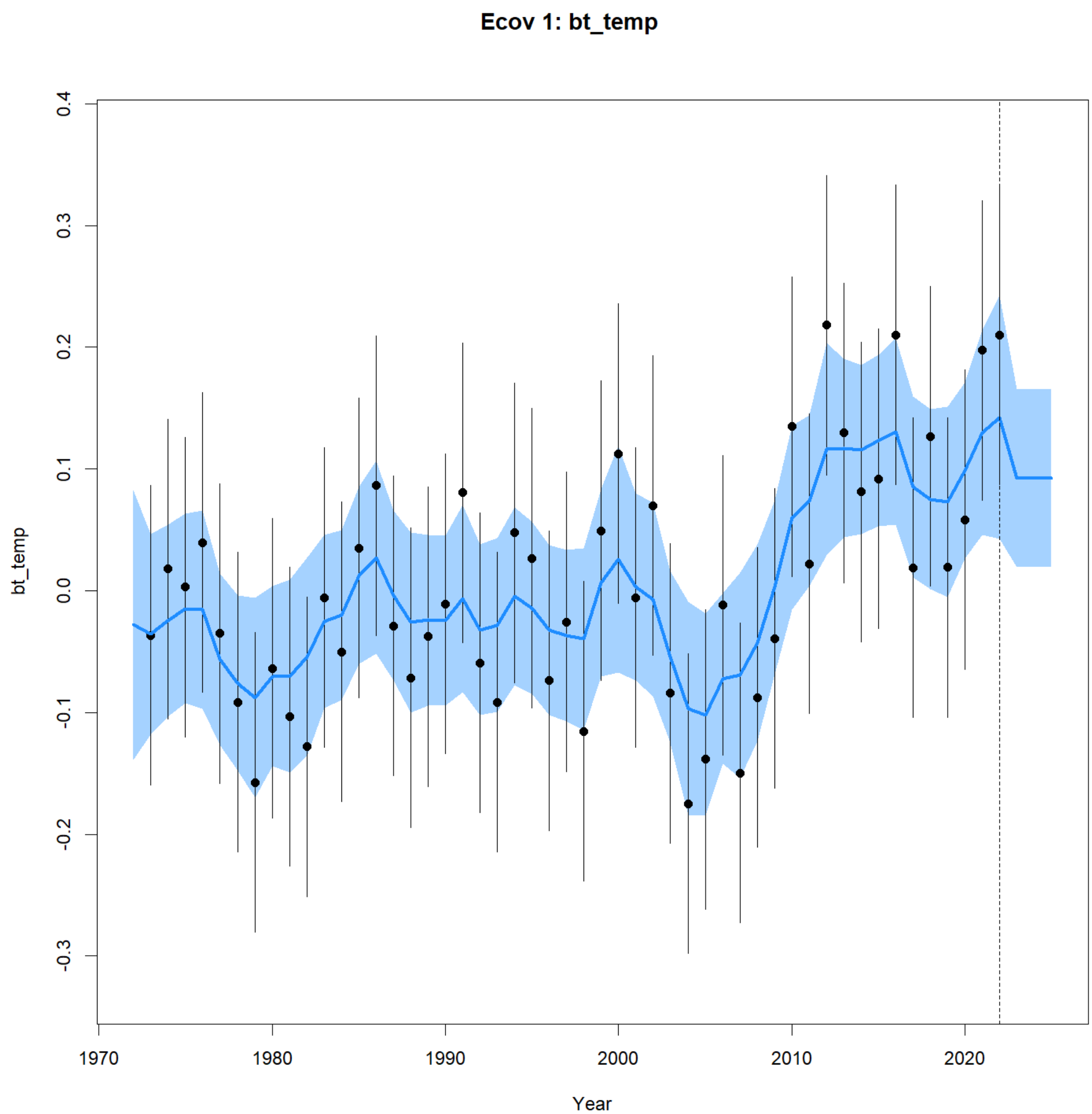


Figure 6.GB. 3: Example short-term projections of bottom temperature using a mean of 2009-2022.

Southern New England/Mid Atlantic stock

Projection Settings

The WHAM framework has an integrated capacity to perform projections. For the candidate model, these WHAM projections incorporate uncertainty in parameter estimates and propagate forward random effects in NAA (ar1 for age-1; 2dar1 for ages 2-6+). For consistency with the proposed reference points estimated for TOR5, maturity and natural mortality remained constant in the projection period while projected WAA represented an average of the terminal two years (2021-2022). Recruitment in the projections was a function of the GSI. GSI in the projection period was set as the mean for 2012-2022, because this time period represented a recent series that is different from the historical values, and was thought to be more representative of the recent period of lower recruitment sizes (for details, see Hodgdon WP).

Short-term projections were conducted under an assumption of setting 2023 catch equal to that of 2022 and then fishing at $F_{40\%}$ = 0.73 in years 2024-2026. These methods will be updated and applied to short-term projections for future management track assessments

Projection Results

Short-term projections under the settings described above for the candidate model show increases of catch, SSB, and recruitment (Table 6.SNEMA.1; Figures 6.SNEMA.1 – 6.SNEMA.3), but still well below historical levels.

Table 6.SNEMA.1. Estimates and uncertainties (90% and 95% confidence intervals) of four years of projected Catch (mt), F, R (000s), and SSB (mt). Forecasts were done using bridge year (2023) catch equal to 2022 catch and then fishing at $F_{40\%}$ = 0.73 in years 2024-2026.

Type	*Year*	*Estimation*	*Low 90*	*High 90*	*Low 95*	*High 95*
Catch	2023	5 (input)	5	5	5	5
Catch	2024	31	9	106	7	135
Catch	2025	50	8	322	5	460
Catch	2026	67	8	572	5	863
F	2023	0.13	0.05	0.34	0.04	0.42
F	2024	0.73 (input)	0.54	0.97	0.51	1.03
F	2025	0.73 (input)	0.54	0.97	0.51	1.03
F	2026	0.73 (input)	0.54	0.97	0.51	1.03
SSB	2023	35	13	96	11	117
SSB	2024	35	9	129	7	165

SSB	2025	56	9	362	6	517
SSB	2026	79	9	702	6	1067
R	2023	659	168	2581	129	3352
R	2024	1428	189	10799	128	15911
R	2025	1429	189	10818	128	15941
R	2026	1429	189	10819	128	15944

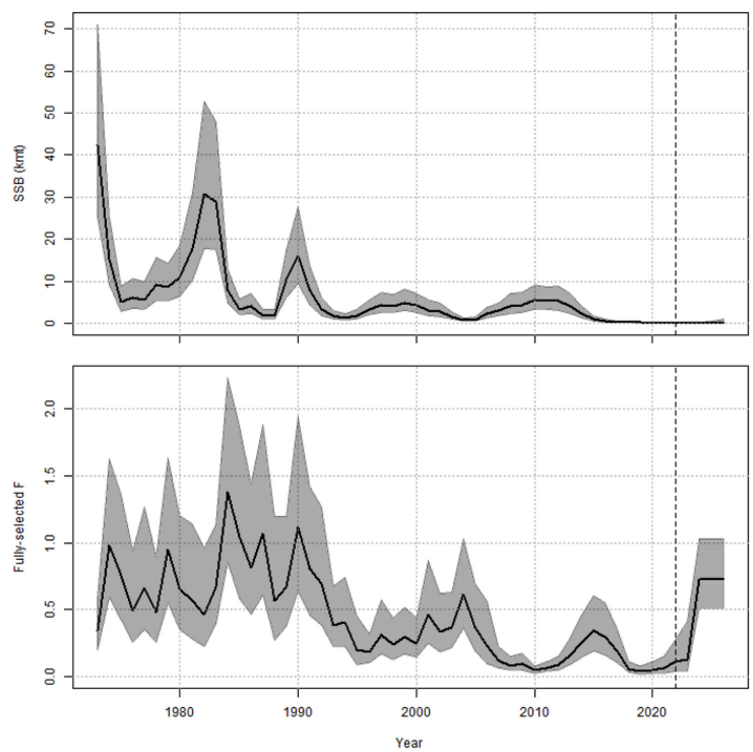


Figure 6.SNEMA.1. Short-term projections of SSB (top) and F (bottom).

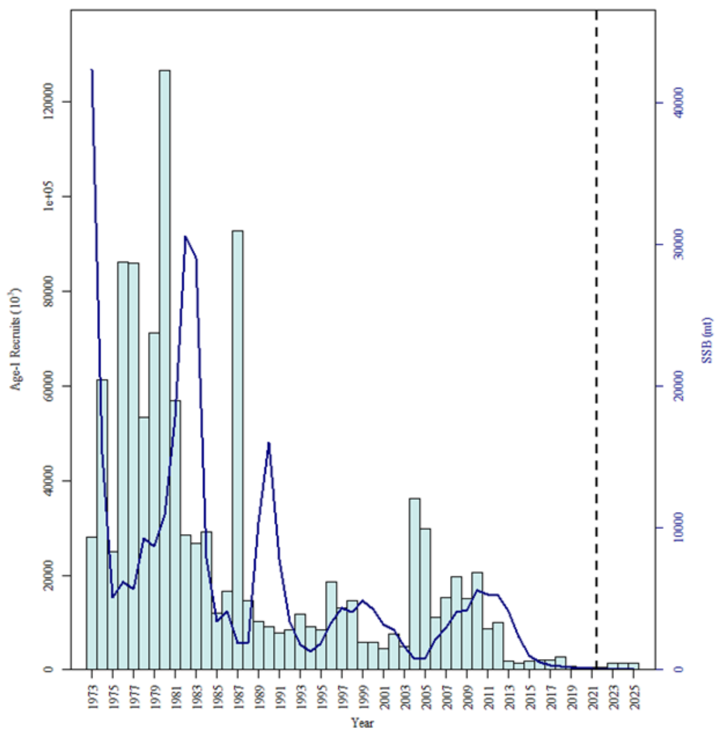


Figure 6.SNEMA.2. Short term projections of SSB (blue line) and recruitment (bars).

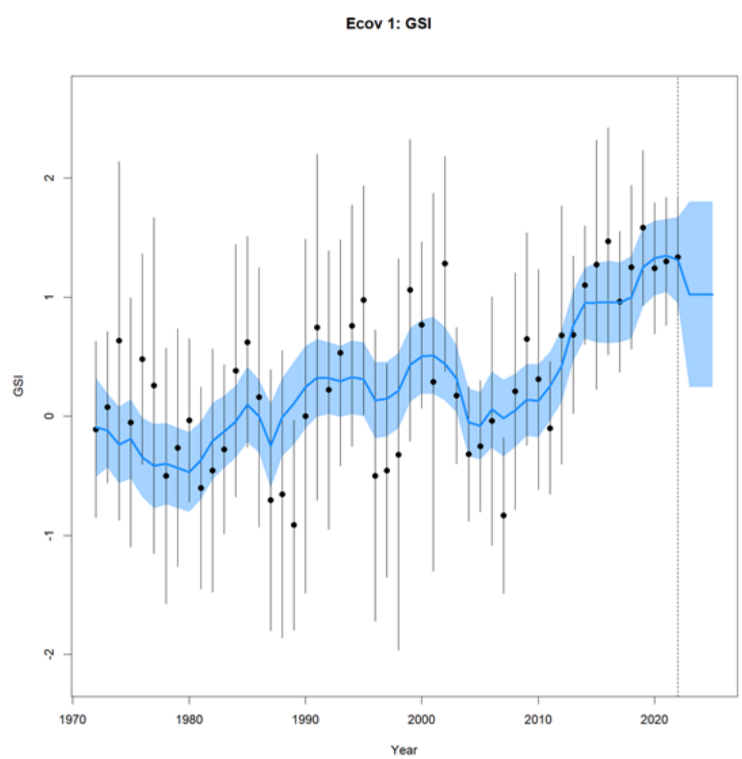


Figure 6.SNEMA.3. Short-term projection of GSI using a mean 2012-2022.

TOR7: RESEARCH RECOMMENDATIONS

"Review, evaluate, and report on the status of research recommendations from the last assessment peer review, including recommendations provided by the prior assessment working group, peer review panel, and SSC. Identify new recommendations for future research, data collection, and assessment methodology. If any ecosystem influences from TOR 1 could not be considered quantitatively under that or other TORs, describe next steps for development, testing, and review of quantitative relationships and how they could best inform assessments. Prioritize research recommendations."

Cape Cod/Gulf of Maine

<u>Research recommendations from the 2022 Management Track Assessment:</u>

Report

- The Cape Cod-Gulf of Maine yellowtail flounder assessment could be improved with a change in model platform that incorporates statistical fits and accounts for measures of uncertainty in the model. *This research recommendation was completed by transitioning to the Woods Hole Assessment Model (WHAM) which incorporates statistical fits and accounts for uncertainty within the model.*

- This assessment could benefit from updated growth and maturity studies. The current maturity and growth parameters are based on GARM III estimates (NEFSC 2008) which are over a decade old. *Updates to maturity were addressed with a white paper on geographic variation in maturity for all three yellowtail flounder stocks (Alade and Hansell WP). A literature review of stock structure found faster growth and maturation in the southern stocks (Cadrin 2003). Life history parameters were updated for all three stocks.*

Peer Review

- This stock was assessed as a Level 1 - Direct Delivery. No peer review comments are available.

<u>Research recommendations from 2019 Operational Assessment and Peer Review:</u>

Report

- The Cape Cod – Gulf of Maine yellowtail flounder assessment could potentially benefit from updated growth and maturity studies. The current values are based on GARM III estimates (NEFSC 2008) which are approximately 10 years old. *Addressed. See response from the 2022 Management Track Assessment above.*

- Future modeling efforts should consider forward-projecting statistical catch-at-age models to account for uncertainty in the data inputs. *Addressed. WHAM is an age-structured model that allows for projections.*

- Investigations to characterize spatial dynamics in age and size dependent distribution of yellowtail and any potential implications it may have on the survey catch. *Spatial dynamics in age and size-dependent distribution of yellowtail flounder were broadly characterized as part of the literature review on stock structure (Cadrin 2003), yet fine scale analyses are still needed. For state inshore surveys (MADMF and MEDMR) it is hypothesized that spatial aspects of spawning migration and shifting distribution may influence catchability as it relates to survey timing. Hence future assessments could explore effects of these state surveys to evaluate this hypothesis more effectively.*

Peer Review
- We are expecting that the remaining VPA stocks, which all have research tracks coming up, will be moving away from the VPA. *Addressed by transitioning to WHAM, see above.*

- A Lorenzen *M* is being used for SNE yellowtail, and it may be that a similar *M* should be considered for this stock. During the RT for all three yellowtail stocks in 2024, a consistent approach to determining natural mortality should be applied across yellowtail flounder stocks. *This recommendation was addressed in a white paper on approximating the natural mortality rate for all three stocks (Cadrin WP). A suite of estimators, including Lorenzen* M*, were compared. Estimating* M *via the Lorenzen (1996) method was one setting that was explored in model comparison for the CCGOM stock but was not selected for the final model.*

- The length-to-weight conversion should be examined in the future to determine if it has changed over time.

<u>Research recommendations from the Report of the 3rd Groundfish Assessment Review Meeting (GARM III) and Peer Review</u>

Report
- The Panel had no specific recommendations for this stock.

Peer Review

Following the approach for the Georges Bank stock, it would be worthwhile splitting the survey time series to explore whether or not similar trends with survey catchability are present. If so, spatial differences in the survey selectivity and/or environmental covariates (temperature) should be investigated as potential causative processes. *This research* *recommendation is less relevant as of the writing of this report, as it pertains to a potential approach for addressing the retrospective pattern in the VPA model platfiorm, which no longer applies to this research track due to the use of the WHAM model platform for this stock. The current model splits the survey time series and updates natural mortality from 0.2 to 0.4, which is time and age invariant. Model runs were conducted to explore environmental covariates on natural mortality and recruitment. None of those model formulations were considered acceptable.*

- The Panel noted the need to investigate long-term changes in stock productivity given the severe decline of the resource. This has implications for the determination of biological reference points. *Addressed via exploration of time-varying recruitment with and without a stock-recruit relationship. This research recommendation is less relevant as of the writing of this report as it was when it was written for GARM III. The stock is now increasing. Time-varying productivity estimated from a stock-recruit relationship was not found to be significant for the CCGOM stock (Tableau et al. 2019). Future studies could continue to reconsider environmental covariates on recruitment.*

Georges Bank

<u>2022 Transboundary Resource Assessment Committee Status Report</u>

Report

- There are no research recommendations in the report.

Peer Review

- Investigate the limiter approach and note the lack of responsiveness in the stock. *Resolved by transitioning to WHAM.*

- Clarify discard estimation procedures. *Resolved within TRAC 2022*

<u>Research recommendations from the Report of the 3rd Groundfish Assessment Review Meeting (GARM III) and Peer Review</u>

Report

- The panel had no specific recommendations for this stock.

Peer Review

- Investigate survey catchability as it relates to habitat shifts. Consider splitting the survey time series in the mid-1990s. *Splitting the NMFS BTS survey in the mid-1990s was* *recommended to improve the diagnostics of the model used in GARM III and is not considered appropriate for the current model framework. However, in this RT splitting the survey for the change in vessel (2009) was explored. Additionally, process error was explored on survey catchability and selectivity.*

-

- Clarify discard estimation procedures. *Resolved within TRAC 2022*

- Consider all three stocks (Georges Bank, Cape Cod – Gulf of Maine and Southern New England – Mid Atlantic Bight) as a complex with migration between components. *This recommendation was addressed by directed research (Goethal et al. 2015). Results indicated that movement among stocks was low, estimates of stock size and fishing mortality were similar to those from conventional stock assessments, and incorporating stock connectivity did not resolve residual patterns.*

- Examine tradeoffs in model specification regarding the likelihood of age composition data and fit to survey trend vs. commercial age. *This recommendation was explored during the RT assessment. After an exploration of tradeoffs, it was concluded that logistic normal age compositions were the most appropriate.*

- The partial recruitment pattern on the ages four plus needs corroboration. Model fits presented at the meeting suggested dome partial recruitments in both the survey and commercial fishery which was at odds with the results of tagging analysis, which suggested no dome. *This recommendation was addressed by changing the modeling platform to WHAM. There were no diagnostic issues that indicated further exploration was needed.*

- Try catch and discards as separate fleets. *This recommendation was addressed by changing the modeling platform to the WHAM. There were no diagnostic issues that indicated further exploration was needed.*

Southern New England

<u>2022 Management Track Assessment</u>

Report

- The Southern New England/Mid-Atlantic yellowtail flounder assessment has been used as an example of how to include environmental factors in stock assessments in a number of recent papers (Miller et al. 2016, Xu et al. 2017, Stock and Miller 2021, du Pontavice et al. 2022). All indicate that the environment for this stock is getting worse and causing expected recruitment to decline as the temperature increases in the region. If this trend continues, as expected under nearly all climate models, then the ability of this stock to support a fishery is questionable. Converting the modeling framework for this stock from ASAP to WHAM (or another state-space model) would allow estimation of the relationship between environmental factors and modeled recruitment. The long-term potential yield of this stock associated with climate change could then be considered. *The modeling framework was converted from ASAP to WHAM and relationships between environmental factors and recruitment were estimated. Time-varying recruitment was modeled using several environmental covariates across model runs. Environmental covariates on recruitment evaluated included the Gulf Stream Index (GSI), Gulf Stream Index Spring, Atlantic Multidecadal Oscillation (AMO), North Atlantic Oscillation (NAO), Spring Bottom Temperature (BTS), and Cold Pool Index (CPI).*

Peer Review

- The Panel did not provide specific research recommendations for this stock.

<u>2019 Operational Assessment and Peer Review</u>

Report

- Recruitment of Southern New England – Mid Atlantic yellowtail flounder continues to be weak compared to the pre-1990s. Should this pattern of poor recruitment continue into the future, the ability of the stock to recover could be compromised. Therefore, future studies should build on current knowledge to further investigate some of the underlying ecological mechanisms of poor recruitment in the stock as it may relate to the physical environment. Recent studies on evaluating environmental effects on Southern New England yellowtail stock productivity suggest that oceanographic features, such as the cold pool and Gulf Stream are likely important predictors of recruitment (Miller et al., 2016; Xu et al., 2017), however the mechanisms driving these predictions are not well known. *Addressed, see response to the 2022 Management Track Assessment above.*

- Other areas of future work should continue to address the retrospective bias, including further work on the sensitivity analyses (i.e., determination of appropriate input data weighting by evaluating the CV and effective sample sizes in the model). *Transitioning to the WHAM framework led to a reduction in retrospective bias.*

Peer Review

- The persistence of a pattern in retrospective inconsistency is a source of uncertainty in this assessment. However, this update resulted in an improvement in retrospective diagnostics relative to the 2017 assessment. *Transitioning to the WHAM framework led to a reduction in retrospective bias.*

SAW/SARC 54 (2012) and Peer Review

Report

- Update the length-weight parameters used to convert commercial landings (in weight) into numbers of fish. This could be accomplished by expanding existing data collection programs (e.g., Cooperative Research, Industry Based Surveys, NEFSC port sampling) to collect individual fish weights while collecting length and age data. This research recommendation is applicable to numerous species/stocks in the northeast, not just SNE/MA yellowtail flounder. *SAW/SARC 54 revised the existing length-weight relationship and adopted the spring length-weight relationship as a basis for fishery weights to numbers.*

- The work on the influence of the cold pool and associated environmental parameters on yellowtail population dynamics has not been fully developed, and merits further research. *SAW/SARC 54 explored the application of the cold pool index in ASAP. The present assessment transitioned to the WHAM framework and evaluated a suite of environmental covariates. See response to the 2022 Management Track Assessment above.*

- If the volume of commercial landings increases in the future, ensure that adequate samples of the landings are obtained for all market categories on at least a quarterly basis. *Adequate port sampling remains an issue in the present assessment. Quarterly resolution was not explored in this assessment for deriving fishery catch data due to low landings.*

Peer Review

- The recommendations of the Peer Review Panel were captured in the report.

Report of the 3rd Groundfish Assessment Review Meeting (GARM III) and Peer Review

Report

- The use of 'windows' of biomass rather than the breakpoint should be explored to create the stanzas in the stock – recruitment relationship. This may better address inconsistencies in rebuilding plans that might arise as the biomass grows from the lower to the higher stanza. *This recommendation is a remnant from the VPA modeling framework. Transitioning to the WHAM framework more accurately captures time-varying recruitment. Model runs with and without a stock-recruit relationship were* *explored. In some cases ecological covariates captured the effects of a stock-recruit relationship. In other runs, the stock-recruit relationship was modeled explicitly.*

Peer Review

- Splitting the survey time series to explore whether trends in survey catchability are present in Southern New England. If so, spatial differences in the survey selectivity and/or environmental covariates (temperature) should be investigated as potential causative processes. *Splitting the NMFS BTS survey in the mid-1990s was recommended to improve the diagnostics of the model used in GARM III and is not considered appropriate for the current model framework. However, the NMFS BTS survey time series was split in 2009, the year that the survey vessel changed from the FRV Albatross IV to the FSV Henry B. Bigelow. The effect of environmentally-mediated annual deviations on survey catchability were explored but led to poor diagnostics.*

- Investigate long-term changes in stock productivity given the severe decline of the resource. This has implications for the determination of biological reference points. *Investigated through directed research (i.e. Perretti et al. 2017). A change point analysis was used in in this RT to capture recent environmental conditions and recruitment.*

- Investigation of spatial differences in the survey selectivity and/or environmental covariates (temperature). *The WG explored many different functional forms for survey selectivity, with and without random effects, and incorporated different selectivities for the NEFSC Spring, Fall and Winter surveys.*

- Partial recruitment of the plus-age groups (particularly with regards to the uncertainty in the catch-at-age of the SNE stock). *The WG tested the use of selectivity blocks for the NMFS BTS, separating the FRV Albatross IV and the FSV Henry B. Bigelow time series in 2009. Selectivity in the plus age group of the fishery data was also explored.*

New research recommendations developed during the 2024 RT Assessment

High Priority

- Enhanced port sampling for improved catch-at-age estimates for all stocks.

- Given the increasingly low survey catches for SNEMA and GB and the increasing chances of true zeroes in the survey data for this stock, it is imperative to modify WHAM to be able to more appropriately address zero values.

- Confirm that the assumptions of current conditions continue for projections and reference points (breakpoints for GB bottom temperature and SNEMA GSI).

- Explore near-term projections of environmental covariates to inform short-term catch projections.

- WHAM configurations should follow guidance on lognormal adjustment bias correction contemporaneous to the assessment being conducted. The decisions and guidance on how and when to apply lognormal adjustment bias correction should be documented within the report.

Lower Priority

- Update and confirm that the relationships of environmental variables continue (bottom temperature for CCGOM and GB, GSI for SNEMA). If relationships break down, consider alternative environmental metrics that may be more directly influencing yellowtail stocks. In general, continue to explore the relationships of recruitment and other parameters with environmental covariates for all three stocks and continue to explore alternative projection methodologies for GSI (SNEMA) and bottom temperature (GB).

- Create a data product for salinity that could be explored in future models.

TOR8: BACKUP ASSESSMENT APPROACH

"Develop a backup assessment approach to providing scientific advice to managers if the proposed assessment approach does not pass peer review or the approved approach is rejected in a future management track assessment."

The proposed assessment approach for all three yellowtail flounder stocks is the Woods Hole Assessment Model (WHAM). Both simplifying and adding complexity are considered part of the management track process for the accepted model and would follow the evaluation criteria that were used in TOR4. Only if all WHAM formulations explored during this RT or future management tracks were rejected for one of the stocks would the backup assessment approach be invoked. The WG considered reasons why future management track WHAM assessment might fail when developing the backup assessment plans. The three stocks were split into two groups of potential failures. For the GB and SNEMA stocks, the WG is concerned that future low abundance might lead to a number of true zero surveys, meaning surveys were conducted as normal but did not catch any yellowtail flounder within the entire stock range. Such a situation, especially if it were to continue for a number of years, might lead to WHAM being unable to converge due to lack of survey information. WHAM currently treats true zero surveys as missing information, although this could change in future updates to the model. For the CCGOM stock, the WG is concerned that future catches may be so low due to a lack of market that WHAM is unable to find a stable magnitude for the population. Continued low catches while the surveys continue to increase make it challenging for any model to distinguish between a very large population with very light exploitation from a large population with light exploitation. See WP_TOR8_Backup_Plan_Legault.pdf on the Data Portal for more information.

Between 2015 and 2017, paired-gear experimental trawls were made using a twin-trawl vessel to compare a chainsweep with the standard roller gear of the bottom trawl survey. These studies allow the bottom trawl survey results for some species to be expanded to account for survey catchability of fish, such as yellowtail flounder, that might not be captured due to passing under the roller gear. The resulting metric tons of yellowtail flounder estimated by expanding the bottom trawl survey to account for the area of the surveys and the catchability of the roller gear are referred to as chainsweep expanded biomass. To allow the most recent information to be used in assessments conducted during the summer/early fall, the NEFSC spring survey in year Y is combined with the NEFSC fall survey in year Y-1. The calculation of the mean can either allow one of the surveys to be missing or allow both surveys to be present.

The WG recommends using the Limiter for GB and SNEMA stocks and the empirical approach for CCGOM stock. The Limiter is based on the idea that the recent population is so low that the survey changes are tracking noise at a low level instead of actual population changes, so it uses a constant quota as long as the mean biomass from the three surveys falls between two limits. The empirical approach uses a constant exploitation rate from earlier years applied to the recent expanded survey biomass, so that as the surveys rise or fall so does the catch advice. The exploitation rate is simply the catch in a year divided by the mean expanded survey biomass. The Limiter does not allow for determination of biological reference points (BRPs) or status determination, while the empirical approach does.

For the GB stock, the WG recommends reverting to the currently accepted Limiter as the backup assessment approach. The current Limiter approach is the result of many years of negotiations and is already in use. It also uses the DFO survey, has agreed bounds of 1,000 to 7,300-8,500 mt, has a negotiated constant catch of 200 mt, and has a pre-defined process for dealing with missing surveys.

For the SNEMA stock, the WG recommends using a modified Limiter as the backup assessment approach. The modification is to not use a lower limit. The other settings for the Limiter are an upper limit of the maximum chainsweep expanded biomass since 2014 and the constant catch advice of 50 mt (approximately half of MSY from the proposed WHAM model).

For the CCGOM stock, the WG recommends an empirical approach as the backup assessment approach. The empirical approach uses 2010-2022 as the stable period for exploitation rate calculation and BRPs.

There are also some reasons these backup approaches might not be acceptable. The recommended approach for SNEMA (modified Limiter) might be rejected because it fails to prevent overfishing. The approaches for all three stocks rely on the chainsweep expanded biomass values from NEFSC bottom trawl surveys. If the surveys are unable to be completed successfully in each region, both approaches could fail. For the CCGOM stock, the selection of the stable period for determining BRPs could lead to incorrect advice.

For all three stocks, the WG recommends that if a backup approach does become necessary in the future that WHAM continue to be applied as best it can as an informational assessment for comparison and context. This approach was demonstrated in the 2024 witch flounder assessment where an empirical approach was used for catch advice but an informational ASAP model was also provided for comparison and context.

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APPENDIX 1. LIST OF WORKING PAPERS

Working papers are available in the data portal https://apps-nefsc.fisheries.noaa.gov/saw/sasi.php

Alade L. 2024. Assessment model development and stock projections for Cape Cod-Gulf of Maine yellowtail flounder stock

Alade L, Hansell A. 2023. Maturity of yellowtail flounder

Cadrin S. 2023. Catch rates of yellowtail flounder in the New England trawl fishery

Cadrin S. 2023. Approximating natural mortality rate for New England yellowtail flounder stocks

Cadrin S. 2023. Stock identification of yellowtail flounder off New England

Hansell A, Kittel J, Carrano Cadrin, S. 2024. Assessment model, biological reference points and projection development for Georges Bank yellowtail flounder

Hodgdon, C. 2024. Assessment Model Development and Stock Projections for the Southern New England / Mid-Atlantic Yellowtail Flounder Stock

Kittel J, Cadrin S, McManus C, du Pontavice H, et al. 2024. Ecosystem and climate influences on yellowtail flounder

Legault C. 2024. Yellowtail flounder backup plan

McManus MC, Richardson DE. 2024. Yellowtail Flounder larval habitat suitability of the Northeast U.S. Continental Shelf.

Wuenschel M, McElroy D, McBride R. 2023. Fecundity & Condition of Yellowtail Flounder

Wuenschel M. 2023. Spawning Phenology of Yellowtail Flounder

Appendix 2. Recent History of New England Groundfish Management

Details of updates and amendments to the Northeast Multispecies (Groundfish) Fishery Management Plan (post-Amendment 16) are provided below:
Framework 44 was also adopted in 2009, and it set specifications for fishery years (FY) 2010 – 2012 and incorporated the best available information in adjusting effort control measures adopted in Amendment 16.

- Framework 45 was approved by the Council in 2010 and adopts further modifications to the sector program and fishery specifications; it was implemented May 1, 2011.
- Framework 46 revised the allocation of haddock to be caught by the herring fishery and was implemented in August 2011.
- Amendment 17 authorizes NOAA-sponsored state-operated permit banks and was implemented on April 23, 2012.
- Framework 47, implemented on May 1, 2012, set specifications for some groundfish stocks for FY 2012 – 2014, modified accountability measures (AMs) for the groundfish fishery and the administration of the scallop fishery AMs, and revised common pool management measures; modification of the Ruhle trawl definition and clarification of regulations for charter/party and recreational groundfish vessels fishing in groundfish closed areas were proposed under the Regional Administrator's (RA) authority.
- Framework 48 was implemented on May 1, 2013, and revised status determination criteria for several stocks, modified the sub-ACL system, adjusted monitoring measures for the groundfish fishery, and changed several AMs.
- Framework 50 was also implemented on May 1, 2013 and set specifications for many groundfish stocks and modified the rebuilding program for Southern New England (SNE)/Mid-Atlantic (MA) winter flounder.
- Framework 49 is a joint Northeast Multispecies/Atlantic Sea Scallop action that modified the dates for scallop vessel access to the year-round groundfish closed areas; this action was implemented on May 20, 2013.
- Framework 51 modified rebuilding programs for Gulf of Maine (GOM) cod and American plaice, set specifications for FYs2014-2016 and modified management measures in order to ensure that overfishing does not occur including, additional management measures related to U.S./Canada shared stocks and yellowtail flounder in the groundfish and scallop fisheries.
- Framework Adjustment 52 was approved on January 15, 2015. This action made two revisions to the accountability measures (AMs) for the groundfish fishery for the northern (GOM/Georges Bank (GB)) and southern (SNE/MA) windowpane flounder stocks.
- Framework 53 was implemented on May 1, 2015. This action updated changes to the status determination criteria, set specifications for FY 2015-2017, adopted U.S./ Canada Total TACs, established management measures for GOM cod that revise rolling closures and possession limits to enable GOM cod protection while providing opportunity for the groundfish fishery to prosecute healthy stocks in other times and areas, implemented default specifications, and revised regulations governing Sector Annual Catch Entitlement (ACE) carryover.
- Monkfish Framework 9 was a joint action with the groundfish plan (Framework 54), and modified regulations for vessels in the DAS program.

- Framework 55 incorporated stock status changes for groundfish stocks, set specifications for all groundfish stocks for FY2016-FY 2018, adopted an additional sector and modified the sector approval process, modified the definition of a haddock separator trawl so that the separator panel is easily identifiable, made changes to the groundfish monitoring program, made changes to the management measures for U.S./Canada TACs in order to move GB cod quota from the eastern management area to the western management area and modified the Gulf of Maine Cod Protection Measures so that the recreational possession limit for GOM cod can once again be modified by the RA.
- Amendment 18, which became effective on May 1 and May 22, 2017, addresses fleet diversity and accumulation limits.
- Framework 56, which became effective on August 1, 2017, adopted U.S./ Canada Total Allowable Catches (TACs), set specifications for witch flounder for FY2017 – FY2019, allocated a northern windowpane flounder sub-ACL to the Atlantic sea scallop fishery, increased the midwater trawl fishery sub-ACL for GB haddock, and temporarily changed the scallop fishery AM implementation policy for GB yellowtail flounder and northern windowpane flounder for FY2017 and FY2018.
- Omnibus Habitat Amendment 2, effective April 9, 2018, revises essential fish habitat and habitat area of particular concern designations, revises or creates habitat management areas, including gear restrictions, to protect vulnerable habitat from fishing gear impacts, establishes dedicated habitat research areas, and implements several administrative measures related to reviewing these measures, as well as other regulatory adjustments to implement these measures.
- Framework 57, which became effective on May 1, 2018, set specifications for all groundfish stocks for FY 2018- FY 2020, adopted US/Canada TACs for FY2018, revised common poll trimester TAC apportionments, provided the Regional Administrator with the authority to modify common pool trimester TAC apportionments under certain conditions, modified Atlantic halibut accountability measures for Federal fisheries, modified southern windowpane flounder AMs for large-mesh non-groundfish trawl fisheries (e.g., summer flounder and scup), temporarily changed the AM implementation policy for SNE/MA yellowtail flounder in the scallop fishery for FY2018, and gave the Regional Administrator temporary authority for FY2018 and FY2019 to adjust the Georges Bank cod management measures for the recreational fishery.
- Framework 58, which became effective July 19, 2019, set 2019–2020 catch limits for 7 of the 20 multispecies (groundfish) stocks, implemented new or revised rebuilding plans for 5 stocks, revised an accountability measure, and made other minor changes to groundfish management measures.
- Framework 59, effective July 30, 2020, set 2020 TACs for U.S./Canada stocks on Georges Bank, implemented 2020-2022 specifications for 15 groundfish stocks, adjusted commercial/recreational allocations based on new data from the Marine Recreational Information Program (MRIP), and revised the Georges Bank cod incidental catch TAC to remove the allocation to the Closed Area I Hook Gear Haddock Special Access Program.
- Framework 61, effective July 27, 2021, set: (1) 2021 total allowable catches for U.S./Canada stocks on Georges Bank; (2) 2021-2023 specifications for roughly half of the groundfish stocks; (3) white hake rebuilding measures; and (4) a universal sector exemption to allow fishing for redfish.

- Framework 63, effective July 15, 2022, (1) set FY2022 total allowable catches for US/Canada management units of Eastern GB cod and Eastern GB haddock, and FY2022-FY2023 specifications for the GB yellowtail flounder stock, (2) set FY2022 specifications for GB cod and FY2022-FY2024 specifications Gulf of Maine (GOM) cod, (3) adjusted FY2022 specifications for white hake based on the new rebuilding plan, (4) revise the current default specifications process, and (5) modified recreational fishery management measures to promote GB cod stock rebuilding.
- Amendment 23, effective December 15, 2022 and January 9, 2023, which: replaced the current process for calculating an annual at-sea monitoring (ASM) coverage target with a fixed monitoring coverage target as a percentage of trips, dependent on Federal funding; approve additional electronic monitoring (EM) technologies as an alternative to human at-sea monitors; exclude from the monitoring requirement all trips in geographic areas with expected low groundfish catch; require periodic evaluation of the monitoring program and exclusions from the monitoring requirement; remove the management uncertainty buffer from the portion of the acceptable biological catch (ABC) allocated to the sector catch share, if warranted, when the monitoring coverage target is 100 percent; and grant authority to the Greater Atlantic Regional Administrator to revise sector reporting requirements to streamline reporting for the industry.
- Framework 65, effective August 18, 2023, set (1) a revised rebuilding plan for Gulf of Maine cod; (2) 2023-2024 total allowable catches (TACs) for U.S./Canada shared resources on Georges Bank; (3) 2023-2024 specifications for Georges Bank yellowtail flounder and Georges Bank cod including a recreational catch target; (4) 2023-2025 specifications for 14 additional groundfish stocks; and (5) temporary adjustments to Georges Bank cod commercial management measures.
- Framework 66, effective May 2, 2024, 1) set fishing year 2024-2025 total allowable catches for the U.S./Canada management units of Eastern Georges Bank cod, Eastern Georges Bank haddock, and Georges Bank yellowtail flounder; 2) set fishing year 2024-2025 specifications for Gulf of Maine haddock, Georges Bank yellowtail flounder, and white hake; 3) set fishing year 2024-2026 specifications for redfish, northern windowpane flounder, and southern windowpane flounder; 4) modify the trigger for implementing accountability measures for Atlantic halibut for commercial fisheries; and 6) temporarily modify the accountability measure implementation policy for Atlantic sea scallops for the Georges Bank yellowtail flounder stock.

These above referenced management action documents are available on the NEFMC website: https://www.nefmc.org/management-plans/northeast-multispecies