

1. Stock assessment for eastern Bering Sea walleye pollock

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1 Executive summary

This chapter covers the Eastern Bering Sea (EBS) region—the Aleutian Islands region (Chapter 1A) and the Bogoslof Island area (Chapter 1B) are presented separately.

A multi-species stock assessment is provided separately. A list of this document contents, including tables and figures is provided in Section [17](#).

1.0.1 Summary of changes in assessment inputs

Relative to last year's BSAI SAFE report, the following substantive changes have been made in the EBS pollock stock assessment. This includes the 2024 NMFS bottom-trawl survey (BTS) covering the EBS and NBS. As before, these data were treated with a spatio temporal model for index standardization. Age data from this survey effort was compiled and included (also with an extensive spatio-temporal model treatment). The NMFS acoustic-trawl survey (ATS) age composition data was revised from the preliminary estimates developed in 2022. The BTS chartered boats also collected acoustic data and the series was updated this year (AVO). Explorations were presented in Ianelli (2023).

Changes in the data

1. Observer data for catch-at-age and average weight-at-age from the 2023 fishery were finalized and included.

2. Total catch as reported by NMFS Alaska Regional office was updated and included through 2024.
3. In summer 2024, the AFSC conducted the bottom trawl survey in the EBS and extended into the NBS. A VAST model evaluation (including the cold-pool extent) was used as the main index.
4. We updated estimates of weight-at-age data used to compute spawning biomass as presented to the Plan Team and SSC in September/October 2023 (see Ianelli (2023) for details) including estimates to 2024.
5. We added a 2024 estimate to the time series from the acoustic data collected from the bottom trawl survey covering 2006-2024 (except for 2020). This represents the updated “AVO” data (as presented in Ianelli (2023)).
6. We added a 2024 estimated biomass and preliminary age-composition from the 2024 ATS survey. The age-composition estimate was based on the BTS age-length key data.

1.0.2 Changes in the assessment methods

The assessment method was the same as presented in December of 2023 (Ianelli et al. (2023)). Based on results shown in September 2024 (Ianelli and McGilliard (2024a)) some alternative consideration of Tier level is provided.

1.1 Summary of EBS pollock results

Results from integrating the survey and fishery observer data indicate that in 2022 the stock reached about 92% of the all-time peak female spawning biomass estimated from 1987. The values for the recent years appear to have stabilized well above B_{MSY} . This continues to be due to the strength of the 2018 year-class of the pollock population.

The following tables are based on results from last year’s selected model (“Model 23.0”). The first table has the ABC recommendation based on Tier 3 calculation as a proxy reduction from the maximum permissible under Tier 1. The second table repeats the result but is simply as a reclassified Tier 3 table. We provide these as options to guide the SSC in their decisions. We also recall the work presented at their October 2024 meeting which indicated the very high value of F_{MSY} estimates when alternative (i.e., less prior influence) assumptions about the stock-recruitment relationship were examined Ianelli and McGilliard (2024a).

Tier 1 version

| Quantity | As estimated or <i>specified</i> last year for: | | As estimated or <i>recommended</i> this year for: | |
|---------------------------------------|--|-------------|--|-------------|
| | 2024 | 2025 | 2025 | 2026 |
| M (natural mortality rate, ages 3+) | 0.3 | 0.3 | 0.3 | 0.3 |
| Tier | 1a | 1a | 1a | 1a |
| Projected total (age 3+) biomass (t) | 10,184,000 t | 9,437,000 t | 8,526,000 t | 8,057,000 t |
| Projected female spawning biomass (t) | 3,518,000 t | 3,255,000 t | 2,969,000 t | 2,705,000 t |
| B_0 | 6,728,000 t | 6,728,000 t | 5,975,000 t | 5,975,000 t |
| B_{msy} | 2,689,000 t | 2,689,000 t | 2,318,000 t | 2,318,000 t |
| F_{OFL} | 0.422 | 0.422 | 0.47 | 0.47 |
| $maxF_{ABC}$ | 0.379 | 0.379 | 0.406 | 0.406 |
| F_{ABC} | 0.33 | 0.33 | 0.37 | 0.37 |
| OFL | 3,162,000 t | 3,449,000 t | 3,593,000 t | 3,423,000 t |
| $maxABC$ | 2,837,000 t | 3,095,000 t | 3,107,000 t | 2,960,000 t |
| ABC | 2,313,000 t | 2,401,000 t | 2,146,000 t | 1,964,000 t |
| Status | 2022 | 2023 | 2023 | 2024 |
| Overfishing | No | n/a | No | n/a |
| Overfished | n/a | No | n/a | No |
| Approaching overfished | n/a | No | n/a | No |

Tier 3 version

| Quantity | As estimated or <i>specified</i> last year for: | | As estimated or <i>recommended</i> this year for: | |
|---------------------------------------|--|-------------|--|-------------|
| | 2024 | 2025 | 2025 | 2026 |
| M (natural mortality rate, ages 3+) | 0.3 | 0.3 | 0.3 | 0.3 |
| Tier | 1a | 1a | 3a | 3a |
| Projected total (age 3+) biomass (t) | 10,184,000 t | 9,437,000 t | 8,526,000 t | 8,057,000 t |
| Projected female spawning biomass (t) | 3,518,000 t | 3,255,000 t | 2,969,000 t | 2,705,000 t |
| B_0 | 6,728,000 t | 6,728,000 t | 5,902,000 t | 5,902,000 t |
| B_{msy} | 2,689,000 t | 2,689,000 t | 2,066,000 t | 2,066,000 t |
| F_{OFL} | 0.422 | 0.422 | 0.462 | 0.462 |
| $maxF_{ABC}$ | 0.379 | 0.379 | 0.364 | 0.364 |
| F_{ABC} | 0.33 | 0.33 | 0.364 | 0.364 |
| OFL | 3,162,000 t | 3,449,000 t | 2,603,000 t | 2,377,000 t |
| $maxABC$ | 2,837,000 t | 3,095,000 t | 2,146,000 t | 1,964,000 t |
| ABC | 2,313,000 t | 2,401,000 t | 2,146,000 t | 1,964,000 t |
| Status | 2022 | 2023 | 2023 | 2024 |
| Overfishing | No | n/a | No | n/a |
| Overfished | n/a | No | n/a | No |
| Approaching overfished | n/a | No | n/a | No |

1.2 Response to SSC and Plan Team comments

- The SSC recommends that Tier 1, 2 and 3 harvest recommendations be presented in December. The SSC welcomes other recommendations for consideration that could result in a more stable approach. Since the author and BSAI GPT did not recommend any specific model changes, the SSC expects any new analyses for the final assessment to be focused on justifications for tier designation.
 - *As with past assessments, we include the Tier 1, 2 and 3 harvest recommendations in this assessment, and also include a hybrid between 1 and 2 (labeled 1.5).*
- the SSC requests that the author document the method used for determining the selectivity in the forward projections, and that an objective method be applied each year rather than an ad hoc choice of selectivity based on a previous year.
 - *As with past assessments, we document how we chose a selectivity to assume for projection purposes and provide more rationale and objectives in making this choice.*

2 Introduction

2.1 General

Walleye pollock (*Gadus chalcogrammus*; hereafter referred to as pollock) are broadly distributed throughout the North Pacific with the largest concentrations found in the Eastern Bering Sea. Also known as Alaska pollock, this species continues to play important roles ecologically and economically.

2.2 Review of Life History

In the EBS pollock generally spawn during March-May and in relatively localized regions during specific periods (Bailey (2000)). Generally spawning begins nearshore north of Unimak Island in March and April and later near the Pribilof Islands (Bacheler et al. (2010)). Females spawn in batches with up to 10 batches of eggs per female per year (during the peak spawning period). Eggs and larvae of EBS pollock are planktonic for a period of about 90 days and appear to be sensitive to environmental conditions. These conditions likely affect their dispersal into favorable areas (for subsequent separation from predators) and also affect general food

requirements for over-wintering survival (Gann et al. (2015), Heintz et al. (2013), Hunt Jr. et al. (2011), Ciannelli et al. (2004)). Duffy-Anderson et al. (2016) provide a review of the early life history of EBS pollock.

Throughout their range juvenile pollock feed on a variety of planktonic crustaceans, including calanoid copepods and euphausiids. In the EBS shelf region, one-year-old pollock are found throughout the water column, but also commonly occur in the NMFS bottom trawl survey. Ages 2 and 3 year old pollock are rarely caught in summer bottom trawl survey gear and are more common in the midwater zone as detected by mid-water acoustic trawl surveys. Younger pollock are generally found in the more northern parts of the survey area and appear to move to the southeast as they age (Buckley et al. (2009)). Euphausiids, principally *Thysanoessa inermis* and *T. raschii*, are among the most important prey items for pollock in the Bering Sea (Livingston (1991); Lang et al. (2000); Brodeur et al. (2002); Ciannelli et al. (2004); Lang et al. (2005)). Pollock diets become more piscivorous with age, and cannibalism has been commonly observed in this region. However, Buckley et al. (2015) showed spatial patterns of pollock foraging varies by size of predators. For example, the northern part of the shelf region between the 100 and 200 m isobaths (closest to the shelf break) tends to be more piscivorous than pollock found in more near-shore shallow areas.

2.3 Stock structure

Stock structure for EBS pollock was evaluated in Ianelli et al. (2015). In that review past work on genetics (e.g., Bailey et al. (1999), Canino et al. (2005)) provided insight on genetic differentiation. The investigation also compared synchrony in year-classes and growth patterns by region. Pollock samples from areas including Zhemchug Canyon, Japan, Prince William Sound, Bogoslof, Shelikof, and the Northern Bering Sea were processed and results presented in Ianelli et al. (2021). Relative to genetics research pursued at the AFSC, we presented in Ianelli et al. (2023) the work noted that the genetic groups mostly aligned with the current stock-management delineations. However, the Aleutian Islands and Bogoslof “stocks” showed subtle differentiation from the GOA management group.

3 Fishery

3.1 Description of the directed fishery

Historically, EBS pollock catches were low until directed foreign fisheries began in 1964. Catches increased rapidly during the late 1960s and reached a peak in 1970–75 when they ranged from 1.3 to 1.9 million t annually. Following the peak catch in 1972, bilateral agreements with Japan and the USSR resulted in reductions. During a 10-year period, catches by foreign vessels operating in the “Donut Hole” region of the Aleutian Basin were substantial totaling nearly 7 million t (Table 1). A fishing moratorium for this area was enacted in 1993 and only trace amounts of pollock have been harvested from the Aleutian Basin region since then. Since the late 1970s, the average EBS pollock catch has been about 1.2 million t, ranging from 0.810 million t in 2009 to nearly 1.5 million t during 2002–2006 (Table 1). United States vessels began fishing for pollock in 1980 and by 1988 the fishery became fully domestic. The current observer program for the domestic fishery formally began in 1991 and prior to that, observers were deployed aboard the foreign and joint-venture operations since the late 1970s. From the period 1991 to 2011 about 80% of the catch was observed at sea or during dockside offloading. Since 2011, regulations require that all vessels participating in the pollock fishery carry at least one observer so nearly 100% of the pollock fishing operations are monitored by scientifically trained observers. Starting in 2021, an increasing proportion of shore-based catcher vessels have adopted electronic monitoring devices. This has replaced at-sea observers on these boats. However, the biological sampling continues to occur at about the same rate as previously but with samples obtained during the offloading. Work continues on linking the log-book data with the EM data so that tow-by-tow estimates can be obtained. Historical catch estimates used in the assessment, along with management measures (i.e., OFLs, ABCs and TACs) are shown in (Table 2).

3.1.1 Catch patterns

The “A-season” for directed EBS pollock fishing opens on January 20th and fishing typically extends into early-mid April. During this season the fishery targets pre-spawning pollock and produces pollock roe that, under optimal conditions, can comprise over 4% of the catch in weight. The summer, or “B-season” presently opens on June 10th and fishing extends through noon on November 1st. The A-season fishery concentrates primarily north and west of Unimak Island depending on ice conditions and fish distribution. There has also been effort along the 100m depth contour (and deeper) between Unimak Island and the Pribilof Islands. The general pattern by season (and area) has varied over time with recent B-season catches occurring in the southeast portion of the shelf (east of 170°W longitude; Figure 1).

Since 2011, regulations and industry-based measures to reduce Chinook salmon bycatch have affected the spatial distribution of the fishery and to some degree, the way individual vessel operators fish (Stram and Ianelli (2014)). Comparing encounters of bycatch relative to the effort (total duration of all tows) the pollock fleet had a slight increase in the Chinook salmon bycatch rate (Figure 2). The nominal catch rate of sablefish in the pollock fishery continue to be above historical averages (Figure 2) while for herring, the rate was low compared to 2020.

The catch estimates by sex for the seasons indicate that over time, the number of males and females has been fairly equal but in the period 2017-2022 the A-season catch of females has been slightly higher and conversely, in the B-season there has been a slightly higher number of males taken (Figure 3). The pattern of catch numbers is impacted by the magnitude of the quota (e.g., the drop in 2022 when the TAC was lower) but also in the relative size of fish. For example, in 2020 estimated absolute numbers of catch were relatively high because fish were smaller (and younger) than average.

The 2023 A-season fishery spatial pattern had a relatively more catch around the Pribilof Islands compared to 2021 (Figure 4). The amount of fishing near the Pribilof Islands was lower than commonly observed in 2022. The 2023 A-season nominal catch rates were near peak levels for all fleet sectors (middle panel, Figure 5). Beginning in 2017, due to a regulatory change, up to 45% of the TAC could be taken in the A-season (previously only 40% of the TAC could be taken). This conservation measure was made to allow greater flexibility to avoid Chinook salmon in the B-season. The pollock fleet as a whole continues to take advantage of this flexibility (Figure 6). This figure shows that the proportion of the TAC has been consistent over time. Pollock roe production remains at a low level but increased over 2022 (Figure 7).

The summer-fall fishing conditions for 2023 were similar to 2022 (Figure 5). The number of hours the fleet required to catch the same tonnage of pollock was also improved relative to 2020. In the B-season catches in the northwestern area increased relative to the previous two years (Figure 8). We updated our work on a measure of fleet dispersion: the relative distance or spread of the fishery in space. Briefly, the calculation computes for a given day, the distance between all trawl tows (within and across boats). These distances are then averaged for year and season. Updated to this year, results indicated that in the A-season dispersion increased slightly but for the B-season in 2023, the fleet appeared to be less dispersed than all the other years and since 2000 (Figure 9).

We continued to investigate the tow specific mean weight of fish. These provide a direct mean somatic mass (pollock body weight) for pollock within a tow. The data arise from the sampled total weight (e.g., of several baskets of pollock) divided by the enumerated number of fish in that sample. Such records exist for each tow. Summing these by extrapolated weight of the pollock catch within that tow, and binning by weight increments (here by 50 gram intervals), allows us to obtain some additional fine-scale information on the size trends in the pollock fishery. The annual patterns of these data suggest that the 2023 A-season size was consistent with the expectation of the 2018 year class predominating the catch (Figure 10). However, the 2023 B-season pattern was smaller than expected. Compiling the data by week we show that

the fish size was consistent with the pattern of fish being consistently smaller than expected through the B-season (Figure 11).

The catch of EBS pollock has averaged 1.26 million t in the period since 1979. The lowest catches occurred in 2009 and 2010 when the limits were set to 0.81 million t due to stock declines (Table 2). The recent 5-year average (2019-2023) catch has been 1.304 million t. Pollock catches that are retained or discarded (based on NMFS observer estimates) in the Eastern Bering Sea and Aleutian Islands for 1991–2024 are shown in Table 3. Since 1991, estimates of discarded pollock have ranged from a high of 9.6% of total pollock catch in 1991 to recent lows of around 0.6% to 1.2%. These low values reflect the implementation of the NMFS' Improved Retention /Improved Utilization program. Prior to the implementation of the American Fisheries Act (AFA) in 1999, higher discards may have occurred under the “race for fish” and pollock marketable sizes were caught incidentally. Since implementation of the AFA, the vessel operators have more time to pursue optimal sizes of pollock for market since the quota is allocated to vessels (via cooperative arrangements). In addition, several vessels have made gear modifications to avoid retention of smaller pollock. In all cases, the magnitude of discards counts as part of the total catch for management (to ensure the TAC is not exceeded) and within the assessment. Bycatch of other non-target, target, and prohibited species is presented in the section titled Ecosystem Considerations below. In that section it is noted that the bycatch of pollock in other target fisheries is more than double the bycatch of other target species (e.g., Pacific cod) in the pollock fishery.

3.2 Management measures

The EBS pollock stock is managed by NMFS regulations that provide limits on seasonal catch. The NMFS observer program data provide near real-time statistics during the season and vessels operate within well-defined limits. In most years, the TACs have been set well below the ABC value and catches have stayed within these constraints (Table 2). Allocations of the TAC split first with 10% to western Alaska communities as part of the Community Development Quota (CDQ) program and the remainder between at-sea processors and shore-based sectors. For a characterization of the CDQ program see Haynie (2014). Seung and Ianelli (2016) combined a fish population dynamics model with an economic model to evaluate regional impacts.

Due to concerns that groundfish fisheries may impact the rebuilding of the Steller sea lion population, a number of management measures have been implemented over the years. Some measures were designed to reduce the possibility of competitive interactions between fisheries and Steller sea lions. For the pollock fisheries, seasonal fishery catch and pollock biomass distributions (from surveys) indicated that the apparent disproportionately high seasonal harvest rates within Steller sea lion critical habitat could lead to reduced sea lion prey densities. Consequently, management measures redistributed the fishery both temporally and spatially according to pollock biomass distributions. This was intended to disperse fishing so that localized harvest rates were more consistent with estimated annual exploitation rates. The

measures include establishing: 1) pollock fishery exclusion zones around sea lion rookery or haulout sites; 2) phased-in reductions in the seasonal proportions of TAC that can be taken from critical habitat; and 3) additional seasonal TAC releases to disperse the fishery in time.

Prior to adoption of the above management measures, the pollock fishery occurred throughout each of the three major NMFS management regions of the North Pacific Ocean: the Aleutian Islands (1,001,780 km² inside the EEZ), the Eastern Bering Sea (968,600 km²), and the Gulf of Alaska (1,156,100 km²). The marine portion of Steller sea lion critical habitat in Alaska west of 150°W encompasses 386,770 km² of ocean surface, or 12% of the fishery management regions.

From 1995–1999 84,100 km², or 22% of the Steller sea lion critical habitat was closed to the pollock fishery. Most of this closure consisted of the 10 and 20 nm radius all-trawl fishery exclusion zones around sea lion rookeries (48,920 km², or 13% of critical habitat). The remainder was largely management area 518 (35,180 km², or 9% of critical habitat) that was closed pursuant to an international agreement to protect spawning stocks of central Bering Sea pollock. In 1999, an additional 83,080 km² (21%) of critical habitat in the Aleutian Islands was closed to pollock fishing along with 43,170 km² (11%) around sea lion haulouts in the GOA and Eastern Bering Sea. In 1998, over 22,000 t of pollock were caught in the Aleutian Island region, with over 17,000 t taken within critical habitat region. Between 1999 and 2004 a directed fishery for pollock was prohibited in this region. Subsequently, 210,350 km² (54%) of critical habitat in the Aleutian Islands was closed to the pollock fishery. In 2000 the remaining phased-in reductions in the proportions of seasonal TAC that could be caught within the BSAI Steller sea lion Conservation Area (SCA) were implemented.

On the EBS shelf, an estimate (based on observer at-sea data) of the proportion of pollock caught in the SCA has averaged about 44% annually. During the A-season, the average is also about 44%. Nonetheless, the proportion of pollock caught within the SCA varies considerably, presumably due to temperature regimes and the relative population age structure. The annual proportion of catch has ranged from an annual low of 11% in 2010 to high of 60% in 1998—the 2019 annual value was 58% and quite high again in the A-season (68%). The higher values in recent years were likely due to good fishing conditions close to the main port. The recent transition from at-sea observer sampling of many catcher vessels to a combination of at-sea electronic monitoring and shore-based observer sampling has resulted in a temporary hiatus in to associate catches with specific areas. Work has progressed to link the position information to offloads so that haul records could be used to evaluate fishing patterns.

The AFA reduced the capacity of the catcher/processor fleet and permitted the formation of cooperatives in each industry sector by the year 2000. Because of some of its provisions, the AFA gave the industry the ability to respond efficiently to changes mandated for sea lion conservation and salmon bycatch measures. Without such a catch-share program, these additional measures would likely have been less effective and less economical (Strong and Criddle (2014)).

An additional strategy to minimize potential adverse effects on sea lion populations is to disperse the fishery throughout more of the pollock range on the Eastern Bering Sea shelf. While the distribution of fishing during the A-season is limited due to ice and weather conditions, there appears to be some dispersion to the northwest area (Figure 4).

The majority (about 56%) of Chinook salmon caught as bycatch in the pollock fishery originate from western Alaskan rivers. This was updated at the June 2022 Council meeting and is activities are monitored and reported closely at the Council ([at this website](#)). In summary, additional Chinook salmon bycatch management measures went into effect in 2011 which imposed revised prohibited species catch (PSC) limits. These limits, when reached, close the fishery by sector and season (Amendment 91 to the BSAI Groundfish Fishery Management Plan (FMP) resulting from the NPFMC's 2009 action). Previously, all measures for salmon bycatch imposed seasonal area closures when PSC levels reached the limit (fishing could continue outside of the closed areas). The current program imposes a dual cap system by fishing sector and season. A goal of this system was to maintain incentives to avoid bycatch at a broad range of relative salmon abundance (and encounter rates). Participants are also required to take part in an incentive program agreement (IPA). These IPAs are approved and reviewed annually by NMFS to ensure individual vessel accountability. The fishery has been operating under rules to implement this program since January 2011.

Further measures to reduce salmon bycatch in the pollock fishery were developed and the Council took action on Amendment 110 to the BSAI Groundfish FMP in April 2015. These additional measures were designed to add protection for Chinook salmon by imposing more restrictive PSC limits in times of low western Alaskan Chinook salmon abundance. This included provisions within the IPAs that reduce fishing in months of higher bycatch encounters and mandate the use of salmon excluders in trawl nets. These provisions were also included to provide more flexible management measures for chum salmon bycatch within the IPAs rather than through regulatory provisions implemented by Amendment 84 to the FMP. The new measure also included additional seasonal flexibility in pollock fishing so that more pollock (proportionally) could be caught during seasons when salmon bycatch rates were low. Specifically, an additional 5% of the pollock can be caught in the A-season (effectively changing the seasonal allocation from 40% to 45% (as noted above in the discussion associated with Figure 6). These measures are all part of Amendment 110 and a summary of this and other key management measures is provided in Table 4.

There are three time/area closures in regulation to minimize herring PSC impacts: *Summer Herring Savings Area 1* an area south of 57°N latitude and between 162°W and 164°W longitude from June 15 through July 1st. *Summer Herring Savings Area 2* an area south of 56° 30' N latitude and between 164°W and 167°W longitude from July 1 through August 15. *Winter Herring Savings Area* an area between 58° and 60°N latitude and between 172°W and 175°W longitude from September 1st through March 1st of the next fishing year.

4 Data

The table below lists the data and periods covered for this assessment.

| Source | Type | Years |
|---------------------------------------|---|---|
| Fishery | Catch biomass | 1964–2024 |
| Fishery | Catch age composition | 1964–2023 |
| Fishery | Japanese trawl CPUE | 1965–1976 |
| EBS bottom trawl | Area-swept biomass and age-specific proportions | 1982–2019, 2021–2024 |
| Acoustic trawl survey | Biomass index and age-specific proportions | 1994, 1996, 1997, 1999, 2000, 2002, 2004, 2006–2010, 2012, 2014, 2016, 2018, 2020, 2022, 2024 |
| Acoustic vessels of opportunity (AVO) | Biomass index | 2006–2019, 2021–2024 |

Note the 2020 acoustic survey data based on unmanned surface vessel (USV) transects and age-specific proportions were unavailable in this year

4.1 Fishery

4.1.1 Catch

Biological sampling by scientifically trained observers form the basis of a major data component of this assessment (as evaluated in Barbeaux et al. 2005). The catch-at-age composition was estimated using the methods described by Kimura (1989) and modified by Dorn (1992). Length-stratified age data are used to construct age-length keys for each stratum and sex. These keys are then applied to randomly sampled catch length frequency data. The stratum-specific age composition estimates are then weighted by the catch biomass within each stratum to arrive at an overall age composition for each year. Data were collected through shore-side sampling and at-sea observers (Barbeaux et al. (2005)). The three strata for the EBS were: i) January–June (all areas, but mainly east of 170°W); ii) INPFC area 51 (east of 170°W) from July–December; and iii) INPFC area 52 (west of 170°W) from July–December. This method was used to derive the age compositions from 1991–2023 (the period for which all the necessary information is readily available). Prior to 1991, we used the same catch-at-age composition estimates as presented in Wespestad et al. (1996).

The catch-at-age estimation method uses a two-stage bootstrap re-sampling of the data. Observed tows were first selected with replacement, followed by re-sampling actual lengths and age specimens given that set of tows. This method allows an objective way to specify the starting values for the input sample size for fitting fishery age composition data within the

assessment model. In addition, estimates of stratum-specific fishery mean weights-at-age (and variances) are provided which are useful for evaluating general patterns in growth and growth variability. For example, Ianelli et al. (2007) showed that seasonal aspects of pollock condition factor could affect estimates of mean weight-at-age. They showed that within a year, the condition factor for pollock varies by more than 15%, with the heaviest pollock caught late in the year from October–December (although most fishing occurs during other times of the year) and the thinnest fish at length tending to occur in late winter. They also showed that spatial patterns in the fishery affect mean weights, particularly when the fishery is shifted more towards the northwest where pollock tend to be smaller at age. Grüss et al. (2021) showed cold-pool-extent impacts on the spatial map of summer condition and relating environmental conditions to fish condition continues to be an active area of research.

In 2011 the winter fishery catch consisted primarily of age 5 pollock (the 2006 year class) and later in that year age 3 pollock (the 2008 year class) were present. In 2012–2016 the 2008 year class was prominent in the catches with 2015 showing the first signs of the 2012 year-class as three year-olds in the catch (Figure 13; Table 5). However, by 2017 the 2013 year-class began to be also evident and surpassed the 2012 year-class in dominance and persist through to 2021. The unusual pattern of switching adjacent year-classes was examined in 2021 to see if there was a pattern of spatial differences. There was a distinct spatial distribution of the different year-classes. Having adjacent strong year-classes appears to be a new characteristic of the stock. In 2020, an unusual presence of age-2 pollock appeared in the catch, along with some from the 2014 year-class while the 2012 year-class was a smaller part of the catch (Figure 13).

By 2021 and 2022, the predominance of 3- and 4-year olds in the catch confirms the abundance year-class from 2018. We note that the center of locations of the 2018 year-class, as plotted based on the locales of samples from that cohort, appears to be more oriented to the south east (by age) when compared to another abundant year-class (the 2008; Figure 14).

The sampling effort for age determinations, weight-length measurements, and length frequencies is shown in Table 6, Table 7, and Table 8. Sampling for pollock lengths and ages by area has been shown to be relatively proportional to catches. The precision of total pollock catch biomass is considered high with estimated CVs to be on the order of 1% (Miller (2005)).

Scientific research catches are reported to fulfill requirements of the Magnuson-Stevens Fisheries Conservation and Management Act. The annual estimated research catches (1963–2022) from NMFS surveys in the Bering Sea and Aleutian Islands Region are given in (Table 9). Since these values represent extremely small fractions of the total removals (about 0.02%) they are ignored for assessment purposes.

4.2 Surveys

4.2.1 Bottom trawl survey (BTS)

Trawl surveys have been conducted annually by the AFSC to assess the abundance of crab and groundfish in the Eastern Bering Sea since 1979 and since 1982 using standardized gear and methods. For pollock, this survey has been instrumental in providing an abundance index and information on the population age structure. This survey is complemented by the acoustic trawl (AT) surveys that sample mid-water components of the pollock stock. Between 1991 and 2023 the BTS biomass estimates ranged from 2.28 to 8.39 million t (Table 10) for the design-based estimates). The values used for the assessment (VAST index, see Section 16 for details) are shown in Figure 15. In the mid-1980s and early 1990s several years resulted in above-average biomass estimates. The stock appeared to be at lower levels during 1996–1999 then increased moderately until about 2003 and since then has averaged just over 4 million t (from the standard EBS region using design-based estimators).

These surveys also provide consistent measurements of environmental conditions, such as the sea surface and bottom temperatures. Large-scale zoogeographic shifts in the EBS shelf documented during a warming trend in the early 2000s were attributed to temperature changes (e.g., Mueter and Litzow (2008)). However, after the period of relatively warm conditions ended in 2005, the next eight years were mainly below average, indicating that the zoogeographic responses may be less temperature-dependent than they initially appeared (Kotwicki and Lauth (2013)). Bottom temperatures increased in 2011 to about average from the low value in 2010 but declined again in 2012–2013. In the period 2014–2016, bottom temperatures increased and reached a new high in 2016. In 2018 bottom temperatures were nearly as warm (after 2017 was slightly above average) but was highly unusual due to the complete lack of “cold pool” (i.e., a defined area where water near bottom was less than zero degrees. In 2019, the mean bottom temperature was the warmest during the period the survey has occurred (since 1982; Figure 16, Rohan et al. (2022)). For the period 2022-2024, the bottom temperatures have been near average.

The AFSC has expanded the area covered by the bottom trawl survey over time. In 1987 the “standard survey area” comprising 6 main strata was increased farther to the northwest and covered in all subsequent years. These two northern strata have varied in estimated pollock abundance. In 2024 about 0.9% of the pollock biomass was found in these strata compared to a long term average of 5% (Table 10). Importantly, this region is contiguous with the Russian border and the NBS region, and treatment of the extent stock shifts between regions continues (e.g., O’Leary et al. (2021)).

The 2024 survey estimate is the highest estimate since 2019, 90% higher than the 2023 estimate and 36% higher than the time-series mean. The 2024 pollock density by station increased relative to 2023, with the largest increases along the shelf (Figure 17). The VAST model provides density-weighted population shifts in distribution. This can be expressed in north-south and east-west trends over time. A representation of such center of gravity

estimates indicate that the stock has moved steadily north since the mid 2000s, but shifted south in 2022 and is slightly further south in 2024, after a northward shift in 2023. The stock center of gravity also moved east from 2010 to about 2017, then shifted west. The 2024 estimate is further west than in 2023 (Figure 18).

The BTS abundance-at-age estimates show variability in year-class strengths with substantial consistency over time (Figure 19). The abundance of 5-year old pollock (the 2018 year-class) decreased from 2022 to 2023, but increased again in 2024 and represents the most abundant year class. The abundance of age-1 pollock in 2024 appears to be slightly above average and is the highest since 2019.

Pollock above 40 cm in length generally appear to be fully selected and in some years, many 1-year olds occur on or near the bottom (with modal lengths around 10–19 cm). Generally speaking, age 2 or 3 pollock (lengths around 20–29 cm and 30–39 cm, respectively) are relatively rare in this survey because they tend to be more pelagic as juveniles. Compared to recent years, pollock lengthened around 20–25 and 40–45 cm were more abundant in 2024. The size compositions were consistent with the age data (Figure 20).

Observed fluctuations in survey estimates may be attributed to a variety of sources including unaccounted-for variability in natural mortality, survey catchability, and **horizontal migrations** and **vertical availability** (Monnahan et al. (2021); O’Leary et al. (2022)). As an example, some strong year classes appear in the surveys over several ages (e.g., the 1989 year class) while others appear only at older ages (e.g., the 1992 and 2008 year class). Sometimes, initially strong year classes appear to wane in successive assessments (e.g., the 1996 year class estimate (at age 1) dropped from 43 billion fish in 2003 to 32 billion in 2007 (Ianelli et al. (2007))). Retrospective analyses (e.g., Parma (1993)) have also highlighted these patterns, as presented in Ianelli et al. (2006, 2011). Kotwicki and Lauth (2013) also found that the catchability of either the BTS or AT survey for pollock is variable in space and time because it depends on environmental variables, and is density-dependent in the case of the BTS survey.

The 2024 survey age compositions were developed from age-structures collected during the survey (June-August) and processed at the AFSC labs within a few weeks after the survey was completed. The level of sampling for lengths and ages in the BTS is shown in Table 11. The estimated numbers-at- age from the BTS for strata 1–9 (except for 1982–84 and 1986, when only strata 6 were surveyed) are presented in Table 12 (based on the method in Kotwicki et al. (2014) and then using VAST—see Section 16 for those details). Compared to the previous design-based age composition estimates, those derived from the spatio-temporal model were generally very similar (see Ianelli (2023)).

In the previous assessments, the BTS mean body mass-at-ages was computed based on the sex-specific mean length-at-age in each year and converted to weight using sex-specific length-weight parameters that were estimated from data prior to 1999. In reconsidering this approach, data on weight-at-age from intervening years have become available and some new methods applied including those corrected by spatio-temporal modeling (Indivero et al.

(2023)). This work was adopted in 2022 and values used are shown in Table 13. The time series of BTS survey indices is shown in Table 14.

The NBS survey area was sampled in 2010, 2017, 2018 (limited to 49 stations), 2019, and 2021-2023. Given that the pollock abundance was quite high in 2017 and 2018, a method for incorporating this information as part of the standard survey was desired. One approach for constructing a full time series that includes the NBS area is to use observed spatial and temporal correlations. We used the vector-autoregressive spatial temporal (VAST) model of Thorson (2019) together with the density-dependent corrected CPUE values from each station (including stations where pollock were absent; Table 14). Please refer to the Section 16 for further details on the implementation. The appendix also includes results that indicate the VAST model diagnostics are reasonable and provide consistent interpretations relative to the observations. Notably, results indicate increased uncertainty in years and areas when stations were missing. As noted in past assessments, application of this index within the stock assessment model required accounting for the time-series covariance estimate.

To date, given other commitments, work on comparing the age-and-growth from NBS samples has stalled. We hope to evaluate these data when they become available in the near future to look at maturity and growth conditions from this region.

4.2.2 Acoustic trawl surveys

Acoustic trawl surveys are typically conducted every other year and are designed to estimate the off-bottom component of the pollock stock (compared to the BTS which are conducted annually and provide an abundance index of the near-bottom pollock). Estimated pollock biomass for the EBS shelf has averaged 3.2 million t since the time-series was revised to include the water column to 0.5 m (previously the estimates were from 3 m off bottom to the surface) starting in 1994 (Table 14). The early 2000s (a relatively ‘warm’ period) were characterized by low pollock recruitment, which was subsequently reflected in lower pollock biomass estimates between 2006 and 2012 (a ‘cold’ period; Honkalehto and McCarthy (2015)). In 2014 and 2016 (another ‘warm’ period) with the growth of the strong 2012 year class, AT biomass estimates increased to over 4 million t (Table 16). The number of trawl hauls, lengths, and ages sampled from the AT survey are presented in Table 15. These surveys have also provided insight on the relative abundance of pollock in areas considered critical to Steller sea lions (the “SCA”; Table 16).

The 2024 AT survey was conducted over the EBS shelf between ~60 m depth and the shelf break during Leg 1 (11-24 June) and Leg 2 (30th June through the 19th of July). Survey transects were spaced at 40 nmi (rather than the normal 20 nmi) with fewer sea days available due to limited funding (usually we have 9 weeks, in 2024 we were initially allotted 6). Survey timing was similar to the survey timing in 2018 and 2022, though survey duration was shorter in 2024. The 5-day delayed start to Leg 1 due to ship staffing issues, a 1-day delayed start to Leg 2 due to flight delays, and an outbreak of COVID-19 onboard during Leg 2 contributed to

loss of sea days. After the survey area coverage was completed at 40 nmi transect resolution, there was sufficient time to add transects on the northwestern shelf where historically most juveniles have been observed. This resulted in transects at 20 nmi spacing between 172° W and the US-Russia maritime boundary.” The areas east of 170°W was surveyed from 11-22 June and west of 170°W was surveyed from the 23rd of June through July 17.

The estimated amount of pollock in the core survey area in 2024 was 11.4 billion fish with a biomass of 2.87 million metric tons (t), a 25% decrease from the estimate of 9.67 billion fish with a biomass of 3.8 million t in 2022. This was a 20% decrease from the 3.617 million t estimated in 2020 by the acoustics-only Saildrone survey, and 10% below the survey mean of 3.2 million tons for all surveys from 1994-2022. Preliminary population age estimates from 2024 using the length compositions applied to the BTS age-length key (Table 17). Six-year-old pollock (2018 year class) dominated the estimated population numbers and comprised 47% of the biomass. The 5-year-olds (2019 year class) represented 15% of the biomass estimate. The age-1+ walleye pollock biomass in midwater was concentrated primarily between the 100 m contour and the shelf break, particularly north and west of Unimak Pass, and between Zhemchug Canyon and Pervenets Canyon. Presumed age 1 pollock (<20 cm FL) were found both east of the Pribilofs, near Unimak Pass, which is unusual, and on the northwestern shelf, which is more common. The majority of the biomass in 2024 was presumed age-4+ fish, with 40% of that biomass found east of 170° W, and 60% found west of 170° W.

Relative estimation errors for the total biomass for the ATS time series were derived from a one-dimensional (1D) geostatistical method, which accounts for observed spatial structure for sampling along transects (Petitgas (1993), Walline (2007), Williamson and Traynor (1996)). The 2024 relative estimation error for the core survey area was 0.056, slightly higher than the time series mean of 0.045, likely due to increased transect spacing. As in previous assessments, the other sources of error (e.g., target strength, trawl selectivity) were accounted for by inflating the annual error estimates to have an overall average CV of 20% for application within the assessment model.

4.3 Other time series used in the assessment

4.3.1 Japanese fishery CPUE index

An available time series relating the abundance of pollock during the period 1965–1976 was included. This series is based on Japanese fishery catch rates which used the same size class of trawl vessels as presented in Low and Ikeda (1980). In lieu of an objective estimate, we applied a default coefficient of variation of 20% to these data.

4.3.2 Biomass index from Acoustic-Vessels-of-Opportunity (AVO)

Acoustic backscatter data (Simrad ES60, 38 kHz) were collected aboard two fishing vessels chartered for the AFSC summer 2024 bottom trawl surveys (F/V Alaska Knight, F/V Northwest Explorer). We processed these Acoustic Vessels of Opportunity (AVO) data each year since 2006 to provide an index of age-1+ midwater pollock abundance. As with last year, we implemented a new subsampling methodology (Levine and De Robertis (2019)) to generate a more spatially extensive AVO index. In developing the new index, we analyzed a 10% systematic subsample of the BTS backscatter data throughout the typical ATS geographic footprint. The new methods were applied to reanalyze years 2009, 2010, 2012, 2014-2019, and 2021-2024. For the remaining 5 years of the time series, the original AVO index (Honkalehto et al. (2011), Stienessen et al. (2020)) was rescaled to match the mean of the new AVO time series (Figure 23). For 2024 the AVO data were processed (Lauffenburger et al. (2024)) to provide an index of age-1+ midwater pollock abundance in each year. These pre-publication results are given below (noting that the final results are unlikely to change):

- 1) The 2024 AVO index of midwater pollock abundance on the EBS shelf was 2.01 million t, which decreased 19% from 2023 and 31% from 2022. Although not the lowest estimate in the time series, it is the lowest estimate since 2014. This compares with the 2024 AFSC biennial acoustic-trawl survey (ATS) conducted using NOAA Ship Oscar Dyson decreased 25% from 2022.
- 2) The correlation between the AVO index and the AT survey biomass remained the same ($r^2 = 0.895$, $n = 9$ surveys).
- 3) The distribution of pollock backscatter east and west of the Pribilof Islands was average since 2009 (33%).
- 4) The strongest pollock backscatter during the AVO and AT surveys was measured along the southern portion of the EBS shelf. The center of gravity estimate for the 2024 AVO survey was similar to that of the AVO 2022 and 2023 estimates, whereas the center of gravity estimate for the 2024 AT survey was shifted southeast compared to the AT 2022 estimate, and more similar to the AVO 2022-2024 center of gravity estimates (Figure 22).

Relative to the original index, the correlation between the AVO index and the AT survey biomass was higher ($R^2 = 0.9$, compared to $R^2 = 0.6$ for the same seven ATS-BTS years from the original index). The new and rescaled index trend dropped 15% relative to 2022 but still is 13% above the long-term mean (Figure 23, Table 18; note that the relative error is based on a variance estimation from (Petitgas (1993)), while the final magnitude of the error term was ascertained based on other model components via an iterative re-weighting process as noted in Ianelli (2023)). The densest spatial distribution of pollock backscatter was predominantly measured along the southern portion of the EBS shelf in the northwest half of the index area (Figure 24). The three grid cells (20 by 20 nautical mile grids used for annual bottom-trawl survey stations) having the strongest pollock backscatter were 2° south of St. Matthew Island close to (58°N , 172°W) and attributed to dense midwater pollock aggregations.

5 Analytic approach

5.1 General model structure

We used a statistical age-structured assessment model conceptually outlined in Fournier and Archibald (1982) and extended (e.g., Methot (1990)). This was developed as an appendix to Wespestad et al. (1996) with current specifications presented in the Section 14 (Ianelli and Fournier (1998)). The model was written in ADMB—a library for non-linear estimation and statistical applications (Fournier et al. (2012)). The data updated from last year’s analyses include:

- The 2023 fishery age composition data
- The catch biomass estimates through the current year
- The 2024 bottom-trawl survey index, weight, and age composition data
- The 2023 acoustic-trawl age composition data were revised using only samples collected from that survey (previously the age compositions were estimated using the bottom-trawl survey age-length keys)
- A completely revised time series of AVO backscatter data collected opportunistically from the bottom trawl survey.

A simplified version of the assessment (with mainly the same data and likelihood-fitting method) is included as a supplemental multi-species assessment model. As presented since 2016, it allows for trophic interactions among key prey and predator species and for pollock, and it can be used to evaluate age and time-varying natural mortality estimates in addition to alternative catch scenarios and management targets (see this volume: [EBS multi-species model](#)).

5.2 Description of alternative models

In the 2019 assessment, the spatio-temporal model fit to BTS CPUE data *including stations from the NBS* was expanded using the VAST methods detailed in Thorson (2018). This data treatment was included as a model alternative and adopted for ABC/OFL specifications by the SSC in 2020 along with other modifications including a spatio-temporal treatment of the

age composition data. This year, we examined additional model and data modifications as presented in Ianelli (2023).

By the SSC's numbering scheme, last year's model was designated Model 23, which here we contrast with the impact of new data made available in this year.

m23.ly The model selected "last year" with last year's data

m23 The same model as last year but with all new data updated (AVO, BTS, ATS, and fishery catch and fishery 2023 age-composition data)

m1 as m23.0 but with new BTS data (age and biomass index estimates) excluded

m2 as m1 but with new ATS data (age and biomass index estimates) excluded

m3 as m2 but with new AVO data (biomass index estimates) excluded

As noted in Ianelli and McGilliard (2024b), we continue to provide some facility to test different stock assessment software (as noted in Li et al. (2021)).

5.2.1 Input sample size

Sample sizes for age-composition data were re-evaluated in Ianelli (2023) and found to be consistent with the relative variability allowed for selectivities and with the observation errors specified for the indices. Principally, this work resulted in tuning the recent era (1991-present year) to an average sample sizes of 350 for the fishery and then using estimated values for the period 1978-1990 and as earlier (Table 19). As rationalized in earlier assessments, we found that assuming average values of 100 and 50 for the BTS and ATS data, respectively resulted in consistent model fits and were (relatively) appropriate given the sampling levels among these surveys (using Francis (2011), equation TA1.8). The inter-annual variability reflects the variability in the number of hauls sampled for ages in the ATS data. For the BTS data we adopted the results presented in Hulson et al. (2023) (with the time series updated this year Hulson and Williams (2024)).

Recent work has shown ways to improve estimation schemes that deal with the interaction between flexibility in fishery selectivity and statistical properties of composition data sample size. Specifically, the Dirichlet-multinomial using either Laplace approximation (Thorson et al. (2015)) or adnnts (Monnahan and Kristensen (2018)) should be implemented (e.g., as shown by Xu et al. (2020)). Progress this year has lagged on this and measures to adopt an alternative software approach (e.g., Kaskr (2024)) would help to ease implementation of this and other features (e.g., that of Cheng et al. (2023)).

5.3 Parameters estimated outside of the assessment model

5.3.1 Natural mortality and maturity at age

The M23 model specification used constant natural mortality rates at age ($M=0.9, 0.45$, and 0.3 for ages 1, 2, and 3+ respectively (Wespestad and Terry (1984)). When predation was explicitly considered estimates tended to be higher and more variable (Holsman et al. *this volume*; Holsman and Aydin (2015); Livingston and Methot (1998); Hollowed et al. (2000)). Clark et al. (1999) found that specifying a conservative (lower) natural mortality rate may be advisable when natural mortality rates are uncertain. More recent studies confirm this (e.g., Johnson et al. (2014)). In Ianelli and McGilliard (2024a) a research model with the estimated M at-age and year matrix was applied. The SSC noted that further refinements to the CEATTLE model may hold promise for future application and sensitivities.

As in past years the estimates indicate higher values than used here. In the 2018 assessment we evaluated natural mortality, and it was noted that the survey age compositions favored lower values of M while the fishery age composition favored higher values. This is consistent with the patterns seen in the BTS survey data as they show increased abundances of “fully selected” cohorts. Hence, given the model specification (asymptotic selectivity for the BTS age composition data), lower natural mortality rates would be consistent with those data. Given these trade-offs, structural model assumptions were held to be the same as previous years for consistency (i.e., the mortality schedule presented below).

Maturity-at-age values used for the EBS pollock assessment were originally based on Smith (1981) and were later reevaluated via histological methods (e.g., Stahl (2004); Stahl and Kruse (2008), Ianelli (2005)). These studies found year-class effects and some inter-annual variability but general consistency with the original schedule of proportion mature at age.

With respect to assumptions about natural mortality, we evaluated applying results from an adjacent stock (Ianelli and McKelvey (2022)) in the 2022 assessment. We found the results were consistent with past assumptions therefore again applied the following age-specific values for M (Smith (1981)) and maturity-at-age:

| Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|-----------|------|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| M | 0.90 | 0.45 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| P_{mat} | 0.00 | 0.008 | 0.29 | 0.64 | 0.84 | 0.90 | 0.95 | 0.96 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

5.3.2 Length and weight-at-age

Age determination methods have been validated for pollock (Kimura et al. (1992), Kimura et al. (2006), and Kastelle and Kimura (2006)). EBS pollock size-at-age show important differences in growth with differences by area, year, and year class. Pollock in the northwest area are typically smaller at age than pollock in the southeast area. The differences in average

weight-at-age are taken into account by stratifying estimates of catch-at-age by year, area, season, and weighting estimates proportional to catch.

The assessment model for EBS pollock accounts for numbers of individuals in the population. As noted above, management recommendations are based on allowable catch levels expressed as tons of fish. While estimates of pollock catch-at-age are based on large data sets, the data are only available up until the most recent completed calendar year of fishing (e.g., 2022 for this year). Consequently, estimates of weight-at-age in the current year are required to map total catch biomass (typically equal to the quota) to numbers of fish caught (in the current year). Therefore, if there are errors (or poorly accounted uncertainty) in the current and future mean weight-at-age, this can translate directly into errors between the expected fishing mortality and what mortality occurs. For example, if the mean weight-at-age is biased high, then an ABC (and OFL) value will result in greater numbers of fish being caught (and fishing mortality being higher due to more fish fitting within the ABC).

As in previous assessments, we explored patterns in size-at-age and fish condition. Using the NMFS fishery observer data on weight given length we:

1. extracted all data where non-zero measurements of pollock length and weight were available between the lengths of 35 and 60 cm for the EBS region
2. computed the mean value of body mass (weight) for each cm length bin over all areas and time
3. divided each weight measurement by that mean cm-specific value (the “standardization” step)
4. plotted these standardized values by different areas, years, months etc. to evaluate condition differences (pooling over ages is effective as there were no size-specific biases apparent)

In the first instance, the overarching seasonal pattern in body mass relative to the mean shows that as the winter progresses prior to peak spawning, pollock are generally skinnier than average whereas in July, the median is about average (Figure 25). As the summer/fall progresses, fish were at their heaviest given length (Figure 25). This is also apparent when the data are aggregated by A- and B-seasons (and by east and west of 170°W; referred to as SE and NW respectively) when plotted over time (Figure 26, where stratum 1 = A season, stratum 2 = B season SE, and stratum 3 = B season NW). Combining across seasons, the fishery data shows that recent years were below average weight given length (Figure 27 ; note that the anomalies are based on the period 1991-2023).

Examining the weight-at-age, there are also patterns of variability that vary due to environmental conditions in addition to spatial and temporal patterns of the fishery. Based on the bootstrap distributions and large sample sizes, the within-year sampling variability for pollock is small. However, the between-year variability in mean weights-at-age is relatively high (Table 20). The coefficients of variation between years are on the order of 6% to 9% (for

the ages that are targeted) whereas the sampling variability is generally around 1% or 2%. The approach to account for the identified mean weight-at-age having clear year and cohort effects was continued (e.g., Figure 28). Details were provided in appendix 1A of Ianelli et al. (2016). The results from this method showed the relative variability between years and cohorts and provide estimates for 2024–2026 (Table 20). How these fishery weights-at-age estimates can be supplemented using survey weights-at-age is further illustrated in Figure 29.

In the 2020 and 2021 fishery, the average weight-at-age for ages 6–8 (the 2012–2014 year classes) was below the time series average. These cohorts have fluctuated around their means in recent years (Figure 28). To examine this more closely, we split the bootstrap results into area-season strata and were able to get an overall picture of the pattern by strata (Figure 30 and Figure 31). This showed that the mean weight-at-age is higher in the the B-season in the area east of 170°W compared to the A-season and B-season in the area west of 170°W.

5.4 Parameters estimated within the assessment model

For the selected model, 1366 parameters were estimated conditioned on data and model assumptions. Initial age composition, subsequent recruitment, and stock- recruitment parameters account for 80 parameters. This includes vectors describing the initial age composition (and deviation from the equilibrium expectation) in the first year (as ages 2–15 in 1964) and the recruitment mean and deviations (at age 1) from 1964–2024 and projected recruitment variability (using the variance of past recruitments) for five years (2025–2030). The two- parameter stock-recruitment curve (see Section 14) is included in addition to a term that allows the average recruitment before 1964 (that comprises the initial age composition in that year) to have a mean value different from subsequent years. Note that the stock-recruit relationship is fit only to stock and recruitment estimates from 1979 year-class through to the 2022 year-class.

Fishing mortality is parameterized to be semi-separable with year and age (selectivity) components. The age component is allowed to vary over time; changes are allowed in each year. The mean value of the age component is constrained to equal one and the last 5 age groups (ages 11–15) are specified to be equal. This latter specification feature is intended to reduce the number of parameters while acknowledging that pollock in this age-range are likely to exhibit similar life-history characteristics (i.e., unlikely to change their relative availability to the fishery with age). The annual components of fishing mortality result in 61 parameters and the age-time selectivity schedule forms a 10x61 matrix of 610 parameters bringing the total fishing mortality parameters to 671. The rationale for including time- varying selectivity has recently been supported as a means to improve retrospective patterns (Szuwalski et al. (2018)) and as best practice (Martell and Stewart (2013)).

For surveys and indices, the treatment of the catchability coefficient, and interactions with age-specific selectivity require consideration. For the BTS index, selectivity-at-age is estimated with a logistic curve in which year specific deviations in the parameters is allowed. Such

time-varying survey selectivity is estimated to account for changes in the availability of pollock to the survey gear and is constrained by pre-specified variance terms. Presently, these variance terms have been set based on balancing input data-based variances and are somewhat subjective. For the AT survey, which originally began in 1979 (the current series including data down to 0.5 m from bottom begins in 1994), optional parameters to allow for age and time-varying patterns exist but for this assessment and other recent assessments, ATS selectivity is constant over time. Overall, four catchability coefficients were estimated: one each for the early fishery catch-per-unit effort (CPUE) data (from Low and Ikeda, 1980), the VAST combined bottom trawl survey index, the AT survey data, and the AVO data. An uninformative prior distribution is used for all of the indices. The selectivity parameters for the 2 main indices (BTS and ATS) total 336 (the CPUE and AVO data mirror the fishery and AT survey selectivities, respectively).

Additional fishing mortality rates used for recommending harvest levels are estimated conditionally on other outputs from the model. For example, the values corresponding to the $F_{40\%}$, $F_{35\%}$ and F_{MSY} harvest rates are found by satisfying the constraint that, given age-specific population parameters (e.g., selectivity, maturity, mortality, weight-at-age), unique values exist that correspond to these fishing mortality rates. The likelihood components that are used to fit the model can be categorized as:

- Total catch biomass (log-normal, $\sigma = 0.05$)
- Log-normal indices of pollock biomass; bottom trawl surveys assume annual estimates of sampling error, as represented in Figure 15 along with the covariance matrices (for the density-dependent and VAST index series); for the AT index the annual errors were specified to have a mean CV of 0.20; while for the AVO data, a value a mean CV was tuned for consistency with other data and resulted in a value of 23%).
- Fishery and survey proportions-at-age estimates (multinomial with effective sample sizes presented Table 19).
- Age 1 index from the AT survey (CV set equal to 30% as in prior assessments).
- Selectivity constraints: penalties/priors on age-age variability, time changes, and decreasing (with age) patterns.
- Stock-recruitment: penalties/priors involved with fitting a stochastic stock-recruitment relationship within the integrated model.
- “Fixed effects” terms accounting for cohort and year sources of variability in fishery mean weights-at-age estimated based on available data from 1991-2023 from the fishery (and 1982-2024 for the bottom-trawl survey data) and externally estimated variance terms as described in Appendix 1A of Ianelli et al. (2016; see Figure 29).

Work evaluating temperature and predation-dependent effects on the stock- recruitment estimates continues (Spencer et al. (2016)) and was presented in the [Sept. 2024 document](#). This approach modified the estimation of the stock-recruitment relationship by including the effect of temperature and predation mortality. A relationship between recruitment residuals and temperature was noted (similar to that found in Mueter et al. (2011) and subsequently noted in Thorson et al. (2020b)) and lower pollock recruitment during warmer conditions

might be expected. Similar results relating summer temperature conditions to subsequent pollock recruitment for recent years were also found by Yasumiishi et al. (2015) where research suggests that summer warmth is associated with earlier diapause of copepods (Thorson et al. (2020a)), such that a fall (but not spring) survey of copepod densities is also associated with cold conditions and elevated recruitment (Eisner et al. (2020)).

5.4.1 Fishery selectivity for projections

The SSC requested a clear development on the assumptions of what selectivity estimates should be used for projections. The model estimates vary by year and this can affect recommendations for ABC and OFL. For example, in 2021, the selectivity estimates shifted dramatically towards younger fish due to the appearance of two-year old pollock in 2020. In such cases, the estimate of F_{MSY} (or proxy) will generally be lower since the basis is on the conservation of reproductive biomass. To evaluate the impact of choice in selecting the selectivity estimates to use for projection purposes, we tested the following scenarios:

1. The selectivity estimates from the most recent year was used for projections. (**most-recent**)
2. The selectivity estimates from the most recent 2-year mean was used for projections. (**2-yr-avg**)
3. The selectivity estimates from the most recent 3-year mean was used for projections. (**3-yr-avg**)
4. The selectivity estimates from the most recent 4-year mean was used for projections. (**4-yr-avg**)
5. The selectivity estimates from the most recent 5-year mean was used for projections. (**5-yr-avg**)

To judge which of these is most appropriate, we compute Mohn's ρ and compare the projected $F_{35\%}$ rate with the annual estimates in later years. For example, in the terminal (retrospective) year 2015 we have estimates of $F_{35\%}$ based on the 2016 expected selectivity (using the above scenarios). We can then compare the “final” estimate of the 2016 selectivity as estimated this year (2024) and go back and compute the $F_{35\%}$ using that year’s selectivity. We do that for each retrospective projection $\sum(F_{35\%}^{proj,i} - F_{35\%}^{full,i})^2$ given each of the five scenarios outlined above.

calculations so far incomplete...

6 Results

The input sample size (as tuned in 2016 using “Francis Weights”) can be evaluated visually for consistency with expectations of mean annual age for the different gear types (Figure 37; Francis (2011)). The estimated selectivity pattern changes over time and reflects to some degree the extent to which the fishery is focused on particularly prominent year-classes (Figure 38). The model fits the fishery age-composition data quite well under this form of selectivity (Figure 39).

Bottom-trawl survey selectivity estimates are shown in Figure 40. The pattern of bottom trawl survey age composition data in recent years shows a decline in the abundance of age 10+ pollock since 2011 (Figure 41). Through the time series of the available data, the model predicted proportions of the 2012 and 2013 year classes varied in terms of under- and over-estimates as the 2013 year-class became more common in the data (Figure 41). The ATS selectivity varies slightly among ages and years (Figure 42). This enhances the fit to the age composition data while still tracking the large year classes through the population (Figure 43).

As in past assessments, we evaluated the multivariate posterior distribution using Monte-Carlo Markov chain (MCMC) simulation methods. This year we adopted the no-turn sampling approach from ADMB but upgraded and packaged within R (adnuts, Monnahan and Kristensen (2018)). This allowed thorough sampling diagnostics and was able to sample the posterior efficiently within a few hours (or less). This new package also demonstrated that the asymptotic parameter standard deviations were reasonable approximations of the marginal densities from the integrated posterior distribution (Figure 47). As before, we evaluated how selected parameters relate by doing a pairwise (along with their marginal distributions; Figure 48). This illustrates how key parameters relate to management parameters of interest. For example, the stock recruitment steepness is negatively correlated to the resulting B_{MSY} estimate. We also compare the point estimates (highest posterior density) with the mean of the posterior marginal distribution of the 2024 spawning biomass. This showed that the point estimate was similar to the mean of the marginal posterior distribution (Figure 49). As an additional part of the Tier 1 consideration, we evaluated the posterior density of F_{MSY} and is provided in Figure 50 for reference.

We added code for producing posterior predictive distributions (e.g., for the two acoustic indices in Figure 51. Additionally, we developed some preliminary diagnostics to evaluate how the model’s posterior components affect key parameters of interest. For example, it is useful to know the relative impact of the 2018 year-class on the next year’s spawning biomass (Figure 52).

6.1 Evaluation of Model(s) and Associated Uncertainty

6.1.1 Sensitivity to model specification

In the [September 2024 assessment evaluation](#) a detailed set of sensitivities were presented regarding assumptions about the stock-recruitment relationship (SRR), an alternative natural mortality-at-age and year matrix (from the CEATTLE model results),

A sequential sensitivity of available new data showed that adding the new data from 2024 had very minor changes and impact on the spawning biomass estimates (Figure 32; top panel). The largest effect on all the changes arose from the revision to the mean body weight-at-age used for the spawning biomass calculations (Figure 32; bottom panel). This was shown in Ianelli (2023). Nonetheless, diagnostics of all the changes relative to model fits are given in Table 21 and a comparison of management quantities for the final base model is given in Table 22).

In the 2020 assessment, SRR evaluations related to Tier 1 classification showed that dropping the influence of the 1978 year-class in the estimation lowered the steepness of the curve and that when the influence of the prior distribution was removed the residual pattern for estimates near the origin was particularly bad (all below the curve). From those results we conclude that the prior specification was appropriate because we place priority on fitting estimated recruits near the slope at the origin better. In the 2021 assessment we showed that conditioning the SRR to fit the condition of having the “actual” F_{MSY} equal some F_{MSY} proxies (e.g., equal $F_{35\%}$) resulted in more conservative ABCs due to shallower initial slopes. A conclusion from these exercises was that the SPR proxy for F_{MSY} implies a reasonable “shape” to the SRR.

The fit to the early Japanese fishery CPUE data (Low and Ikeda 1980) was consistent with the estimated population trends for this period (Figure 33). The model fits the fishery-independent index from the 2006–2023 AVO data well through most of the period but the model predicts

lower biomass than the index data indicate in 2023 (Figure 34). The model fits to the bottom-trawl survey biomass (the density-dependent corrected series) were reasonable and within the observation error bounds (Figure 35). The model fit to the BTS biomass index predicts fewer pollock than observed in the 2014 and 2015 survey but then varied in subsequent years (Figure 35). The fit to the acoustic-trawl survey biomass series (including the USV data from 2020) was consistent with the specified observation uncertainty (Figure 36).

The estimated parameters and standard errors are provided [online](#). The code for the model (with dimensions and links to parameter names) and input files are available [here](#).

6.1.2 Convergence status and criteria

Convergence status was based on the maximum gradient being less than 1e-3 and evaluated using MCMC criteria for finding the modes for key parameters. The MCMC results indicated that all of the Rhat<1.01 and ESS>400 using the R package ‘adnuts’ were satisfactory (Monnahan (2024)).

6.1.3 Likelihood profile

Near term stock projection magnitude depends largely on the estimate of the 2018 year class. As such we profiled model fits for 33 fixed values of that year-class and examined the negative log-likelihood components (Figure 46). Most of the data components were consistent with global estimate of the 2018 year-class.

6.1.4 Retrospective analysis (within model)

We ran a twenty-year retrospective analysis by sequential removal of all data annually beginning with 2024 and ending in 2005 (Figure 53). While variable, the confidence bounds of the retrospective patterns overlapped in all years reflecting the general model uncertainty rather than a consistent retrospective pattern. In 2023, the lower than expected survey biomass estimate followed by lower acoustic estimates in 2024 has created a significant retrospective pattern (Mohn's ρ equal to 0.388 for the 10 year retrospective). This pattern can be explained by the very optimistic estimates of the 2018 year class which has declined somewhat.

For the recruitment side, the retrospective pattern shows two key results. First, the 2018 year-class (age 1 recruits in 2019) shows up as a big estimate just this year (Figure 54). Second, the retrospective pattern shows how an equally abundant year-class occurred from the 2012 year-class for three years (with data terminating in 2016, 2017, and 2018). Then, in 2019 and in subsequent years that estimate dropped by over 10% and became the 2012 and the 2013 year-class. In the 2022 assessment we adjusted the value downwards to be equal to the mean of some earlier year classes. This year, we simply accepted the estimate for projections given a better confirmation on the magnitude of the 2018 year class.

Related to this issue of consistency in year-class estimation, and in response to an SSC request, we evaluated how the influence of additional years of data affected year-class estimates.

Figure 55 and Figure 56 illustrate how year-class estimates can vary for retrospective analyses.

These figures show some of the change in relative abundance between the 2012 and 2013 year-classes and how the 2008 year estimate dissipated some as more data became available.

In response to previous SSC requests to evaluate how selectivity is used for ABC and catch advice, we used the retrospective runs to show how the “projected” selectivity compared with subsequent estimates which had the benefit of more data (Figure 57). To explain this figure, and taking the 2023 panel as an example, the blue line in that panel represents the projected estimate from the 2022 “peel” (the current model projecting to 2023 using only data up until 2022). The dots represent estimates from each “peel” and the dots in the 2022 panel are based on this year’s estimated selectivity. In general, the projected selectivity conformed reasonably well with subsequent estimates. To further summarize these results, we also computed a summary statistic as the mean age of selection (independent of any age-specific stock size):

$$\bar{a} = \frac{\sum S_a a}{\sum S_a}$$

where S_a is the selectivity at age (ages 1 to 11). This statistic showed that recently the projection was biased towards younger pollock but earlier on, the bias was toward older fish (Figure 58).

Since selectivity varies over time, and the fact that fishing mortality rates for management advice depend on the assumed future selectivity, we evaluate the pattern of F_{MSY} rates given different selectivity assumptions (i.e., Figure 38). In the 2020 and 2021 assessment, because of the indications of small pollock being unusually present in the fishery, we chose a selectivity pattern from history that reflected tendency towards younger fish (specifically, that from 2005).

Using the statistic on mean selected age, we found that the corresponding F_{MSY} showed a correlation (Figure 59). This figure reveals how shifts in the relative age of fish selected impact F_{MSY} estimates.

The time series of begin-year biomass estimates (ages 3 and older) suggests that the abundance of Eastern Bering Sea pollock remained at a high level from 1982–88, with estimates ranging from 8 to 12 million t (Chapter 12). Historically, biomass levels increased from 1979 to the mid-1980s due to the strong 1978 and relatively strong 1982 and 1984 year classes recruiting to the fishable population. The stock is characterized by peaks in the mid-1980s, the mid-1990s and again appears to be increasing to a peak of more than 12 million t in 2016 following the low in 2008 of 4.35 million t. The estimate for 2024 is trending downward and at 9.41 million t with 2025 estimated at 8.53 million t.

6.1.5 Historical retrospectives

The estimates of age 3+ pollock biomass showed a large drop last year compared to several of the earlier years but this has reversed in the current assessment (Figure 60, Chapter 12).

6.2 Population trends

6.2.1 Fishing intensity

The level of fishing relative to biomass estimates shows that the spawning exploitation rate (SER, defined as the percent removal of egg production in each spawning year) has been mostly below 20% since 1980 (Figure 61). During 2006 and 2007 the rate averaged more than 20% and the average fishing mortality increased during the period of stock decline. The estimate for 2009 through 2018 was below 20% due to the reductions in TACs relative to the maximum permissible ABC values and increases in the spawning biomass. The fishing mortality has fluctuated since 2010–2015 but, unlike last year's upward trend, the improved spawning biomass condition has held this rate tending toward lower levels. Age specific fishing mortality rates reflect these patterns and show some increases in the oldest ages from 2011–2013 but relatively stable (Figure 62).

Estimated numbers-at-age are presented in (Chapter 12) and estimated catch-at-age values are presented in (Chapter 12). Estimated summary biomass (age 3+), female spawning biomass, and age-1 recruitment are given in (Table 26).

To evaluate past management and assessment performance it can be useful to examine estimated fishing mortality relative to reference values. For EBS pollock, we computed the reference fishing mortality from Tier 1 (unadjusted) and recalculated the historical values for F_{MSY} (since selectivity has changed over time). Since 1977 the current estimates of fishing mortality suggest that during the early period, harvest rates were above F_{MSY} until about 1980. Since that time, the levels of fishing mortality have averaged about 35% of the F_{MSY} level (Figure 63). Projections of spawning stock biomass given the 2025 estimate of fishing mortality rate given catches equal to the 2024 values shows a decline through 2021 and then an increase after; albeit with considerable uncertainty due to uncertainty in recruitment (Figure 64).

6.2.2 Recruitment

Model estimates indicate that the 2008, 2012, 2013, and the 2018 year classes are above average (Figure 65). The 2018 year class is nearly 4 times bigger than average with a CV of about 10%. The stock-recruitment curve as fit within the integrated model shows the variability of the estimated curve (Figure 66). Note that the 2022 and 2023 year classes (as age 1 recruits in 2023 and 2024) were excluded from the stock-recruitment curve estimation as per convention and guidance from NPFMC. Separate from fitting the stock-recruit relationship within the model, examining the estimated recruits-per-spawning biomass shows variability over time but seems to lack trend and also is consistent with the Ricker stock- recruit relationship used within the model (Figure 67).

Environmental factors affecting recruitment are considered important and contribute to the variability. Previous studies linked strong Bering Sea pollock recruitment to years with warm sea temperatures and northward transport of pollock eggs and larvae (Wespestad et al. (2000); Mueter et al. (2006)). As part of the Bering-Aleutian Salmon International Survey (BASIS) project research has also been directed toward the relative density and quality (in terms of condition for survival) of young-of-year pollock. For example, Moss et al. (2009) found age-0 pollock were very abundant and widely distributed to the north and east on the Bering Sea shelf during 2004 and 2005 (warm sea temperature; high water column stratification) indicating high northern transport of pollock eggs and larvae during those years. Mueter et al. (2011) found that warmer conditions tended to result in lower pollock recruitment in the EBS. This is consistent with the hypothesis that when sea temperatures on the eastern Bering Sea shelf are warm and the water column is highly stratified during summer, age-0 pollock appear to allocate more energy to growth than to lipid storage (presumably due to a higher metabolic rate), leading to low energy density prior to winter. This then may result in increased over-winter mortality (Swartzman et al. (2005), Winter et al. (2005)). Ianelli et al. (2011) evaluated the consequences of current harvest policies in the face of warmer conditions with

the link to potentially lower pollock recruitment and noted that the current management system is likely to face higher chances of ABCs below the historical average catches. Also, as part of the evaluation of stationarity given periods of “regimes”, we revisited estimated mean recruitment during different periods previously identified as being unique (Figure 68). This shows that given the revised estimate of the 2018 year class, the impact of the recent warm conditions suggest that the recent period (2000-present) is similar to the mean since 1977.

7 Harvest recommendations

7.1 Status summary

The estimate of B_{MSY} is 2,318 kt (with a CV of 31%) which is less than the projected 2025 spawning biomass of 3,000 kt; (Table 27). For 2025, the estimates put the stock in Tier 1a.

The corresponding maximum permissible ABC would thus be 3,107,000 t with a fishable biomass estimated at around 7,643 kt (Table 28). For the current year spawning biomass this corresponds to 146% of the B_{MSY} level. A diagnostic (see Section 14) on the impact of fishing shows that the 2024 spawning stock size is about 61% of the predicted value had no fishing occurred since 1978 (Table 27).

The probability that the current stock size is below 20% of B_0 (a level important for additional management measures related to Steller sea lion recovery) is <0.1% for 2025 and 2026.

In response to the SSC, we include results from projections based on Tier 2. We report the “standard” Tier 2 ABC calculation using the point estimate (the mean of the posterior distribution) of F_{MSY} . Therefore, for 2025 the Tier 2a ABC would be 2,831,000 t. Since we have estimates of the harmonic mean (from Tier 1 calculations) an alternative Tier 2 estimate using that in place of the arithmetic mean F_{MSY} results in an ABC of 2,448,000 t.

In summary, the criterion for Tier 1 depends on a reliable estimate of F_{MSY} and the uncertainty (the PDF). Tier 2 also requires a reliable estimate of F_{MSY} (without the PDF requirement). Given the seemingly reasonable posterior marginal density for F_{MSY} , it seems if Tier 1 criterion is unmet, then so would the requirement for Tier 2. Given the priors assumed for the SRR, and the fact that the results are largely similar to the Tier 3 proxy for F_{MSY} (i.e., the $F_{SPR\%}$ at F_{MSY} is close to $F_{35\%}$), **we recommend adopting Tier 3 for this stock until a more detailed management strategy evaluation can be pursued.** As noted below in the section on risk evaluations, there are reasons for increased concerns. However, these seem to be unrelated to overall stock productivity as relates to the SRR and estimates of F_{MSY} .

7.2 Amendment 56 Reference Points

Amendment 56 to the BSAI Groundfish Fishery Management Plan (FMP) defines overfishing level (OFL), the fishing mortality rate used to set OFL (FOFL), the maximum permissible ABC, and the fishing mortality rate used to set the maximum permissible ABC. The fishing mortality rate used to set ABC (F_{ABC}) may be less than this maximum permissible level, but not greater. Estimates of reference points related to maximum sustainable yield (MSY) are currently available. However, we present both reference points for pollock in the BSAI to retain the option for consideration of either Tier 1, 2, or Tier 3 values from the harvest control rules provided in Amendment 56. These Tiers require reference point estimates for biomass level determinations. Consistent with other groundfish stocks, the following values are based on recruitment estimates from post-1976 spawning events (recognizing the the 1978 year class is excluded from the MSY calculations but included in the SPR calculations):

| | |
|-------------|------------------------------------|
| B_{MSY} | = 2,318 kt female spawning biomass |
| B_0 | = 5,975 kt female spawning biomass |
| $B_{100\%}$ | = 5,902 kt female spawning biomass |
| $B_{40\%}$ | = 2,361 kt female spawning biomass |
| $B_{35\%}$ | = 2,066 kt female spawning biomass |

7.3 Specification of OFL and Maximum Permissible ABC

Under Amendment 56 of the [BSAI Groundfish FMP](#), the SSC has historically qualified this stock as satisfying the Tier 1 conditions. As such, the harmonic mean value of F_{MSY} —here computed as an exploitation rate—is applied to the fishable biomass for computing ABC levels. For details on the risk-averse properties of this approach see Thompson (1996). For a future year, the fishable biomass is defined as the sum over ages of predicted begin-year numbers multiplied by age specific fishery selectivity and estimated mean body mass-at-age. The uncertainty in the average weights-at-age projected for the fishery and “future selectivity” has been demonstrated to affect the buffer between ABC and OFL (computed as 1-ABC/OFL) for Tier 1 maximum permissible ABC (Ianelli et al. (2015)). The uncertainty in future mean weights-at-age had a relatively large impact as did the selectivity estimation (see the section above on retrospective behavior and Figure 59).

Since the 2025 female spawning biomass is estimated to be above the B_{MSY} level (2,318 kt) and above the $B_{40\%}$ value (2,361 kt) in 2025 and if the 2024 catch is as specified above, then the OFL and maximum permissible ABC values by the different Tier categorizations would be:

| Tier | Year | MaxABC | OFL |
|------|------|-----------|-----------|
| 1a | 2025 | 3,107,000 | 3,593,000 |
| 1a | 2026 | 2,960,000 | 3,423,000 |
| 2a | 2025 | 2,830,760 | 3,593,000 |
| 2a | 2026 | 2,696,890 | 3,423,000 |
| 3a | 2025 | 2,146,000 | 2,603,000 |
| 3a | 2026 | 1,964,000 | 2,377,000 |

Note that the values presented for 2026 assumed a catch of 1,350,000 t in 2025.

7.4 Standard Harvest Scenarios and Projection Methodology

A standard set of projections is required for each stock managed under Tiers 1, 2, or 3 of

Amendment 56 to the FMP. This set of projections encompasses seven harvest scenarios designed to satisfy the requirements of Amendment 56, the National Environmental Policy Act, and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). While

EBS pollock is generally considered to fall within Tier 1, the standard projection model requires knowledge of future uncertainty in F_{MSY} . Since this would require a number of additional assumptions that presume future knowledge about stock-recruit uncertainty, the projections in this subsection are based on Tier 3.

For each scenario, the projections begin with the vector of 2024 numbers at age estimated in the assessment. This vector is then projected forward to the beginning of 2025 using the schedules of natural mortality and selectivity described in the assessment and the best available estimate of total (year-end) catch assumed for 2024. In each subsequent year, the fishing mortality rate is prescribed on the basis of the spawning biomass in that year and the respective harvest scenario. Annual recruits are simulated from an inverse Gaussian distribution whose parameters consist of maximum likelihood estimates determined from the estimated age-1 recruits. Spawning biomass is computed in each year based on the time of peak spawning and the maturity and weight schedules described in the assessment. Total catch is assumed to equal the catch associated with the respective harvest scenario in all years. This projection scheme is run 1,000 times to obtain distributions of possible future stock sizes and catches under alternative fishing mortality rate scenarios.

Five of the seven standard scenarios support the alternative harvest strategies analyzed in the Alaska Groundfish Harvest Specifications Final Environmental Impact Statement. These five scenarios, which are designed to provide a range of harvest alternatives that are likely to bracket the final TAC for 2025, are as follows (“ $\max FABC$ ” refers to the maximum permissible value of FABC under Amendment 56):

Scenario 1: In all future years, F is set equal to $\max FABC$. (Rationale: Historically, TAC has been constrained by ABC, so this scenario provides a likely upper limit on future TACs).

Scenario 2: In 2025 and 2026 the catch is set equal to 1.30 million t and in future years F is set equal to the Tier 3 estimate (Rationale: this has been about equal to the catch level in recent years).

Scenario 3: In all future years, F is set equal to the 2023 average F . (Rationale: For some stocks, TAC can be well below ABC, and recent average F may provide a better indicator of F_{TAC} than F_{ABC} .)

Scenario 4: In all future years, F is set equal to $F_{60\%}$. (Rationale: This scenario provides a likely lower bound on F_{ABC} that still allows future harvest rates to be adjusted downward when stocks fall below reference levels.

Scenario 5: In all future years, F is set equal to zero. (Rationale: In extreme cases, TAC may be set at a level close to zero.)

Scenario 6: In all future years, F is set equal to F_{OFL} . (Rationale: This scenario determines whether a stock is overfished. If the stock is expected to be 1) below its MSY level in 2024 or 2) below half of its MSY level in 2024 or below its MSY level in 2034 under this scenario, then the stock is overfished.)

Scenario 7: In 2025 and 2026, F is set equal to $\max F_{ABC}$, and in all subsequent years, F is set equal to F_{OFL} . (Rationale: This scenario determines whether a stock is approaching an overfished condition. If the stock is 1) below its MSY level in 2026 or 2) below 1/2 of its MSY level in 2026 and expected to be below its MSY level in 2036 under this scenario, then the stock is approaching an overfished condition).

The latter two scenarios are needed to satisfy the MSFCMA's requirement to determine whether a stock is currently in an overfished condition or is approaching an overfished condition (for Tier 3 stocks, the MSY level is defined as $B_{35\%}$).

7.5 Projections and status determination

For the purposes of these projections, we present results based on selecting the $F_{40\%}$ harvest rate as the F_{ABC} value and use $F_{35\%}$ as a proxy for F_{MSY} . Scenarios 1 through 7 were projected 14 years from 2024 (Table 32 for Model 23.0—including the 1978 year-class as is convention for Tier 3 estimates). Under catches set to Tier 3 ABC estimates, the expected spawning biomass is well above $B_{35\%}$ and is expected to drop below $B_{40\%}$ by 2026 (given mean recruitment; Figure 69 and assuming catches >2 million t in 2025).

Any stock that is below its minimum stock size threshold (MSST) is defined to be overfished. Any stock that is expected to fall below its MSST in the next two years is defined to be approaching an overfished condition. Harvest scenarios 6 and 7 are used in these determinations as follows:

Is the stock overfished? This depends on the stock's estimated spawning biomass in 2024:

- If spawning biomass for 2024 is estimated to be below $1/2 B_{35\%}$ the stock is below its MSST.
- If spawning biomass for 2024 is estimated to be above $B_{35\%}$, the stock is above its MSST.
- If spawning biomass for 2024 is estimated to be above $1/2 B_{35\%}$ but below $B_{35\%}$, the stock's status relative to MSST is determined by referring to harvest scenario 6 (Table 29 through Table 32). If the mean spawning biomass for 2034 is below $B_{35\%}$, the stock is below its MSST. Otherwise, the stock is above its MSST.

Is the stock approaching an overfished condition? This is determined by referring to harvest Scenario 7:

- If the mean spawning biomass for 2024 is below $1/2 B_{35\%}$, the stock is approaching an overfished condition.
- If the mean spawning biomass for 2024 is above $B_{35\%}$, the stock is not approaching an overfished condition.
- If the mean spawning biomass for 2026 is above $1/2 B_{35\%}$ but below $B_{35\%}$, the determination depends on the mean spawning biomass for 2036. If the mean spawning biomass for 2036 is below $B_{35\%}$, the stock is approaching an overfished condition. Otherwise, the stock is not approaching an overfished condition.

For scenarios 6 and 7, we conclude that pollock is above MSST for the year 2024, and it is expected to be above the “overfished condition” based on Scenario 7 (the mean spawning biomass in 2024 is between the $1/2 B_{35\%}$ and $B_{35\%}$ estimate but by 2036 the stock is above $B_{35\%}$; (Table 32)). Based on this, the EBS pollock stock is being fished below the overfishing level and is not approaching an overfished condition.

To fulfill reporting requirements for [NOAA’s Species Information System](#), we computed the average fishing mortality rate corresponding to the specified OFL for the last complete year (2023). This hypothetical 2023 F_{OFL} from this year’s model was estimated to be XXX0.262XXX for EBS pollock (assuming this year’s estimated 2023 selectivity and weight-at-age).

7.6 ABC Recommendation

ABC levels are affected by estimates of F_{MSY} which depend principally on the estimated stock-recruitment steepness parameter, demographic schedules such as selectivity-at-age, maturity, and growth. The current stock size (both spawning and fishable) is estimated to be above average levels and projections indicate the potential for further declines. Updated data and analysis result in an estimate of 2024 spawning biomass (3,390 kt) which is about 146% of B_{MSY} (2,318 kt). This follows a short period of decline from 2017-2020 followed by a previously unexpected increase due to revised estimates of the 2018 year class. Treating all

new data the same way as in the past, this estimate suggests that it would be the biggest year-class on record (81,100 age 1 numbers), but with considerable uncertainty.

Given the same estimated aggregate fishing effort as in 2024, the stock trend would be stable and yield about 1.3 million t (Table 34).

7.6.1 Should the ABC be reduced below the maximum permissible ABC?

The SSC in its September 2018 minutes recommended that assessment authors and Plan Teams use the risk table below when determining whether to recommend an ABC lower than the maximum permissible. The details of the risk table are provided below. Given the concerns listed there, we recommend adopting Tier 3 projections for management until a full management procedure evaluation can be undertaken.

| Considerations | | | | |
|-------------------------|---|--|--|--|
| | Assessment-related | Population dynamics | Environmental & ecosystem | Fishery performance |
| Level 1 No concern | Typical to moderately increased uncertainty & minor unresolved issues in assessment | Stock trends are typical for the stock; recent recruitment is within normal range. | No apparent environmental & ecosystem concerns | No apparent fishery/resource-use performance and/or behavior concerns |
| Level 2 Major Concern | Major problems with the stock assessment, very poor fits to data, high level of uncertainty, strong retrospective bias. | Stock trends are highly unusual; very rapid changes in stock abundance, or highly atypical recruitment patterns. | Multiple indicators showing consistent adverse signals a) across the same trophic level, and/or b) up or down trophic levels (i.e., predators and prey of stock) | Multiple indicators showing consistent adverse signals a) across different sectors, and/or b) different gear types |
| Level 3 Extreme concern | Severe problems with the stock assessment, severe retrospective bias. Assessment considered unreliable. | Stock trends are unprecedented. More rapid changes in stock abundance than have ever been seen previously, or a very long stretch of poor recruitment compared to previous patterns. | Extreme anomalies in multiple ecosystem indicators that are highly likely to impact the stock. Potential for cascading effects on other ecosystem components | Extreme anomalies in multiple performance indicators that are highly likely to impact the stock. |

The table is applied by evaluating the severity of four types of considerations that could be used to support a scientific recommendation to reduce the ABC from the maximum permissible. Examples of the types of concerns that might be relevant include the following (as identified by the work-group):

1. Assessment considerations

- *Data-inputs*: biased ages, skipped surveys, lack of fishery-independent trend data
- *Model fits*: poor fits to fits to fishery or survey data, inability to simultaneously fit multiple data inputs.
- *Model performance*: poor model convergence, multiple minima in the likelihood surface, parameters hitting bounds.
- *Estimation uncertainty*: poorly-estimated but influential year classes.
- Retrospective bias in biomass estimates.

2. Population dynamics considerations—decreasing biomass trend, poor recent recruitment, inability of the stock to rebuild, abrupt increase or decrease in stock abundance.

3. Environmental/ecosystem considerations—trends in environmental/ecosystem indicators, ecosystem model results, decreases in ecosystem productivity, decreases in prey abundance or availability, increases or increases in predator abundance or productivity.

4. Fisheries considerations—fishery CPUE is showing a contrasting pattern from the stock biomass trend, unusual spatial pattern of fishing, changes in the percent of TAC taken, changes in the duration of fishery openings.”

Assessment considerations

The EBS pollock assessment model has appeared to track the stock from year-to-year based on retrospective analysis in previous assessments. In 2024 two surveys showed decreases from the previous estimates (the ATS and AVO indices). The BTS index showed a substantive increase from 2023 estimate. For the three new age-composition estimates available this year, they all indicated persistence in the 2018 year class. While the stock trends and age composition seems to be robustly estimated, we note that in the analyses presented in Sept 2024 (Ianelli and McGilliard (2024a)), the robustness of stock-productivity estimates was questioned, especially for the stock-recruitment relationship. **Therefore we rated the assessment-related concern as Level 2, Major concern (if Tier 1), Level 1, no concern (if Tier 3).**

Population dynamics considerations

The age structure of EBS pollock has exhibited some peculiarities over time. On the positive side, some strong year-classes appear to have increased in abundance based on the bottom-trawl survey data (e.g., the 1992, 2012, 2013 and 2018 year classes). Conversely, the period from 2000–2007 had relatively poor year-class strengths which resulted in declines in stock below B_{msy} and reduced TACs due to lower ABC values. Given new support for the strong year-class strength from 2018, it appears that the mean recruitment since 2000 has been nearly average but with greater variability than earlier years (Figure 68). The stock is estimated to be above B_{msy} at present, and projections indicate increases given recent catch levels. Recruitment in the near term is about average and highly uncertain. Additional age-specific aspects of the spawning population indicate that the stock has increased from a low diversity of ages (for both the population and the mean age of the spawning stock weighted by spawning output Figure 71). **We therefore rated the population-dynamics concern as level 1, No Concern**

Environmental/Ecosystem considerations

Summary for Environmental/Ecosystem considerations The following summarizes “Environmental/Ecosystem” considerations (see Section 15 for details):

- **Environment:** The EBS shelf experienced oceanographic conditions that were largely average based on historical time series of multiple metrics over the past year (August 2023 - August 2024).

- **Prey:** Trends of prey for pollock were mostly low in 2024, with prey conditions over the SEBS shelf being potentially more limiting while prey conditions over the NBS shelf appear limiting for age-0 and juvenile pollock, but sufficient for adult fish. The spatial distribution of adult pollock appears to have overlapped with large ‘oceanic’ copepods, while rates of cannibalism indicate reduced overlap with juvenile pollock.
- **Competitors:** Trends in potential competitors were mixed over the shelf, with pollock representing the greatest increase in biomass and potential competitive pressure.
- **Predators:** Trends in potential predators increased over the shelf, though spatial mismatch may mitigate realized predation pressure. Rates of cannibalism remained low in 2024.

Together, the most recent data available suggest an ecosystem risk Level 1 – Normal: “*No apparent ecosystem concerns related to biological status (e.g., environment, prey, competition, predation), or minor concerns with uncertain impacts on the stock.*”

Fishery performance

As noted above, the 2024 fishery again experienced good nominal fishing rates though dropped slightly from the 2023 indicator. The 2024 fishery seemed to have generally smaller-than-expected pollock in the fishery and there was indications that the fish were unusually skinny given their length. The fleet dispersion (the relative distance or spread of the fishery in space) as shown in the past has indicated that the seasonal dispersion levels increased slightly but was still relatively low (indicating relatively good fishing; Figure 9).

The CPUE of PSC species and other bycatch declined in 2024. Sablefish, herring and Chinook salmon bycatch rates (per hour of fishing) continued to decrease from 2021 (except for a slight increase in herring CPUE during the B season from low levels; Figure 2).

The way the ABC control rule interacts with actual fishing is worth considering. Specifically, given the 2 million t OY cap for all of groundfish, when the EBS pollock stock is above target levels, the fishing effort is lower (a lower F). As it approaches the target (B_{MSY}), it increases and then when it drops below, the fishing mortality rate is ratcheted downwards rapidly. This can be exacerbated when there are sudden unanticipated changes in survey estimates (like what was apparently the case in 2021 which caused the retrospective pattern to degrade). The mean weight-at-age for the 2021 B-season was near average, but in general, pollock were skinny given their length. However, concerns over the amount of 2-year old pollock in the 2020 fishery data has been ameliorated with continued positive signs of that year-class which is projected to be an abundant number of 5-year olds in 2023. For this reason, we **conclude that that the fishery performance warrants a score of 1, No Concern.**

These results are summarized as:

| Considerations | | | |
|--|---------------------|-------------------------|---------------------|
| Assessment-related | Population dynamics | Environmental ecosystem | Fisheries |
| Level 2: Major concern (contingent on Tier designation) | Level 1: No concern | Level 1: No concern | Level 1: No concern |

We generally strive to present two key types of information within a fisheries stock assessment.

First, we compile all available fishery dependent and fishery independent data to evaluate trends in stock biomass and abundance. Second, we attempt to provide stock productivity estimates. For the latter, age-specific biological data are used to estimate growth, mortality, and reproductive potential. Such information provides guidelines to avoid growth overfishing. An added productivity estimate, that following estimates of the stock recruitment relationship (SRR), can contribute to advice that avoids so called “recruitment” overfishing. This latter point is a key contrast that distinguishes Tiers 1 and 2 within our FMP system from Tier 3 stock classifications.

In the past, the SSC has considered factors similar to those presented above and selected an ABC based on Tier 3 estimates. Last year the SSC requested examining Tier 2 values as an alternative. Unlike Tier 3, using Tier 2 would have a constant buffer relative to the Tier 1 value (at about 11%). Setting the ABC to Tier 3 levels provides a very large buffer but one that could be warranted given that the impact on subsequent spawning biomass levels will be much more variable and have a high probability of dropping below the target stock size and result in much reduced future ABCs under the current FMP. It is worth noting that fishing at the full Tier 1 ABC would imply a more than doubling of effort and well exceed the 2 million t groundfish catch limit. Even fishing at a full Tier 3 ABC shows there is a relatively high probability of falling below B_{MSY} values or proxies thereof. Under our standard scenarios, Alternative 3 shows trajectories if fishing effort is held equal to the recent 5-year average. It is noteworthy that this provides stock sizes that have a good probability of being above targets and avoiding drastic reductions in yield (lower overall variability in ABC/yields; Figure 70).

The SSC has requested “an explicit set of concerns that explain the ABC adjustment.” In response, we direct attention to the decision table (??) and the fact that the biological basis for the continued stock productivity has most to do with the OY constraint which has effectively maintained fishery production at around 1.3 million t since 1990. Demonstrations that would allow fishing to near F_{MSY} catch quantities would show that catch variability would be extremely high (and unrealistic given current capacity and OY limits for combined BSAI groundfish; Ianelli (2005)). Furthermore, the frequency of being at much lower spawning stock sizes would be much higher, and would likely be riskier and fishing effort would need to be much higher. While the biological basis for ABC setting is founded in sound conservation of spawning biomass, the history of the current fishery productivity should inform desirable biomass. In only 6 of the 41 years since 1981 has the stock been below the B_{MSY} level (15% of the years). The mean spawning biomass over this period has averaged about 18% higher than

the estimated B_{MSY} . In terms of an actual “management target”, Punt et al. (2013) developed some robust estimators for B_{MEY} (Maximum Economic Yield) noting that a typical target would be $1.2 \times B_{MSY}$ or about -2% lower than the mean value or a target female spawning biomass at 2.781 million t. It therefore seems worth considering developing an explicit harvest control rule that achieves the level of productivity observed over the past 30 years.

In recent years when the pollock biomass was estimated to be well above average, the catch was constrained by other factors. Specifically, the 2 million t BSAI groundfish catch limit and bycatch avoidance measures has an impact on the potential for large increases in catch. As the stock is presently estimated to be below B_{MSY} , the maximum permissible ABC under the FMP can become the limiting factor for TAC specification. Unfortunately, this ABC can ratchet down quickly because as the stock declines further below this target stock size, the ABC fishing mortality rate is adjusted downwards nearly proportionately. This part of the FMP control rule can create high variability in the TAC. Less variability in the catch, accordingly, would also result in less spawning stock variability and reduce risks to the fishery should the period of poor recruitment continue.

To more fully evaluate these considerations performance indicators as modified from Ianelli et al. (2012) were developed to evaluate some near-term risks given alternative 2025 catch values. These indicators and rationale for including them are summarized in Table 33). Model 23 (the “base”) results for these indicators are provided in Table 34. Each column of this table uses a fixed 2025 catch and assumes the same effort for the four additional projection years (2026–2029). Given this specification, there is a low probability that any of the catches shown in the first row would exceed the F_{MSY} level. Also, in the near term it appears unlikely that the spawning stock will be below B_{MSY} (rows 3 and 4). Relative to the historical mean spawning biomass, by 2025 it is more likely than not that the spawning biomass will be lower than the historical mean (fifth row). The range of catches examined have relatively small or no impact on the age diversity indicators. The table indicates that for the 2024 catch to equal the 2023 value, about the same level of fishing effort would be required. In terms of catch advice, the results presented in the decision table indicates that catches above 1.3 million t will very likely result in 2026 spawning stock estimates being below the long term mean (but above B_{MSY}).

In the past, another approach/rationale for stabilizing effort by setting the fishing mortality equal to the current year. Doing so this year suggests setting the fishing mortality to 2024 levels results in a catch of 975,000 t. Given the revisions to last year’s model results and the positive increases in stock size, maintaining a constant fishing mortality rate seems unnecessary at this time.

8 Additional ecosystem considerations

In general, a number of key issues for ecosystem conservation and management can be highlighted. These include:

- Preventing overfishing;
- Avoiding habitat degradation;
- Minimizing incidental bycatch;
- Monitoring bycatch and the level of discards; and
- Considering multi-species trophic interactions relative to harvest policies.

For the case of pollock in the Eastern Bering Sea, the NPFMC and NMFS continue to manage the fishery on the basis of these issues in addition to the single- species harvest approach (Hollowed et al. 2011). The prevention of overfishing is clearly set out as the main guideline for management. Habitat degradation has been minimized in the pollock fishery by converting the industry to pelagic-gear only. Bycatch in the pollock fleet is closely monitored by the NMFS observer program and managed on that basis. Discard rates of many species have been reduced in this fishery and efforts to minimize bycatch continue.

In comparisons of the Western Bering Sea (WBS) with the Eastern Bering Sea using mass-balance food-web models based on 1980–85 summer diet data, Aydin et al. (2002) found that the production in these two systems is quite different. On a per-unit-area measure, the western Bering Sea has higher productivity than the EBS. Also, the pathways of this productivity are different with much of the energy flowing through epifaunal species (e.g., sea urchins and brittlestars) in the WBS whereas for the EBS, crab and flatfish species play a similar role. In both regions, the keystone species in 1980–85 were pollock and Pacific cod. This study showed that the food web estimated for the EBS ecosystem appears to be relatively mature due to the large number of interconnections among species. In a more recent study based on 1990–93 diet data, pollock remain in a central role in the ecosystem. The diet of pollock is similar between adults and juveniles with the exception that adults become more piscivorous (with consumption of pollock by adult pollock representing their third largest prey item).

Regarding specific small-scale ecosystems of the EBS, Ciannelli et al. (2004a, 2004b) presented an application of an ecosystem model scaled to data available around the Pribilof Islands region. They applied bioenergetics and foraging theory to characterize the spatial extent of this ecosystem. They compared energy balance, from a food web model relevant to the foraging range of northern fur seals and found that a range of 100 nautical mile radius encloses the area of highest energy balance representing about 50% of the observed foraging range for lactating fur seals. This has led to a hypothesis that fur seals depend on areas outside the energetic balance region. This study develops a method for evaluating the shape and extent of

a key ecosystem in the EBS (i.e., the Pribilof Islands). Furthermore, the overlap of the pollock fishery and northern fur seal foraging habitat has been identified (see Sterling and Ream (2004), Zeppelin and Ream (2006)).

A brief summary of these two perspectives (ecosystem effects on pollock stock and pollock fishery effects on ecosystem) is given in (Table 39). Unlike the food-web models discussed above, examining predators and prey in isolation may overly simplify relationships. This table serves to highlight the main connections and the status of our understanding or lack thereof.

8.1 Ecosystem effects on the EBS pollock stock and fishery effects on the ecosystem.

These two topics are combined here noting that the presentation in Ianelli (2023) is unchanged and updated summary of current conditions is provided in an appendix. Relative to habitat, Hollowed et al. (2012) provided an extensive review of habitat and density for age-0 and age-1 pollock based on survey data. A separate section presented again this year updates a multispecies model with more recent data and is presented as a supplement to the BSAI SAFE report. This approach incorporates a number of simplifications for the individual species data and fisheries processes (e.g., constant fishery selectivity and the use of design-based survey indices for biomass). However, that model mimics the biomass levels and trends with the single species reasonably well. It also allows specific questions to be addressed regarding pollock TACs. For example, since predation (and cannibalism) is explicitly modeled, the impact of relative stock sizes on subsequent recruitment to the fishery can be now be directly estimated and evaluated (in the model presented here, cannibalism is explicitly accounted for in the assumed Ricker stock-recruit relationship).

xxx Since the pollock fishery is primarily pelagic in nature, the bycatch of non-target species is small relative to the magnitude of the fishery (Table 35). Jellyfish represent the largest component of the bycatch of non-target species and had averaged around 5–6 kt per year but more than doubled in 2014, then dropping again in 2015. The 2018 value was high, dropped and then was again high in 2021. The data on non-target species shows a high degree of inter-annual variability, which reflects the spatial variability of the fishery and high observation error. This variability may reduce the ability to detect significant trends for bycatch species.

The catch of other target species in the pollock fishery (defined as any trawl set where the catch represents more than 80% of the catch) represents about 1% of the total pollock catch. Incidental catch of Pacific cod has varied but after a period of low catch levels it increased to over 9,000 t in 2020 and 2021 but in 2022 was under 4 thousand t (Table 36). There has been a marked increase in the incidental catch of Pacific ocean perch in the since 2014 with a peak just under 8 thousand t in 2019. The incidental catch of sablefish peaked in 2020 at about 3.5 thousand t but was less than 300 t in 2022. The incidental catch of pollock in other target

fisheries is more than double the bycatch of target species in the pollock fishery with the largest pollock catches in the yellowfin sole and Pacific cod fisheries (Table 37).

The number of non-Chinook salmon (nearly all made up of chum salmon) taken incidentally varies considerably over time. The bycatch increased since 2014 with the 2017 number in excess of 465 thousand fish, the third highest non-Chinook salmon bycatch that's been observed since 1991. Since then, 7 of the top 10 highest bycatch years have occurred with nearly 550 thousand taken in 2021 (Table 38). Chinook salmon bycatch has varied (42% CV since 2011) and averaged just under 19 thousand fish from 2011-2023 (Table 38). After a recent high bycatch of over 32,000 fish in 2020, the 2022 and 2023 bycatch was 6,415 and 11,750 Chinook salmon, respectively. Ianelli and Stram (2014) provided estimates of the bycatch impact on Chinook salmon runs to the coastal west Alaska region and found that the peak bycatch levels exceeded 7% of the total run return. Since 2011, the impact has been estimated to be below 2%. Updated estimates given new genetic information and these levels of PSC as provided to the Council continue to suggest that the impact is low.

9 Data gaps and research priorities

We note that in early 2025, the AFSC has applied for a review of the EBS pollock assessment by the “Center for Independent Experts” NOAA Fisheries (2024).

The available data for EBS pollock are extensive yet many processes behind the observed patterns continue to be poorly understood. The recent patterns of abundance observed in the northern Bering Sea provide an example. As such, we recommend the following research priorities:

- Support developing a team of analysts to evaluate all aspects of the current model against alternatives (e.g., Rceattle, WHAM, Stock Synthesis, etc.). *This work has progressed and presently, developments on the Gulf of Alaska assessment adopting WHAM appears promising.*
- Continue to investigate using spatial processes for estimation purposes (e.g., combining acoustic and bottom trawl survey data). The application of the geostatistical methods seems like a reasonable approach to statistically model disparate data sources for generating better abundance indices. Also, examine the potential to use pelagic samples from the BASIS survey to inform recruitment and subsequent spatial patterns. *Work on developing data from the BASIS survey to inform recruitment has not been pursued. The work to refine the AVO data has helped with information used in this assessment.*

- Develop methods to use spatio-temporal models to estimate composition information (specifically, weight-at-age in the survey). *Two papers, (Indivero et al. (2023)) and (Cheng et al. (2023)) have been published targeting this type of activity. The former is presently used in this assessment while the latter has yet to be applied.*
- Study the relationship between climate and recruitment and trophic interactions of pollock within the ecosystem. This would be useful for improving ways to evaluate the current and alternative fishery management systems. In particular, a careful re-evaluation of the current FMP harvest control rule should be undertaken. *As part of the ACLIM program, progress is being made. However, a full evaluation of the FMP control rules is pending.*
- Apply new technologies (e.g., bottom-moored echosounders) to evaluate pollock movement between regions and supplement this work with analytical approaches. *The data have been processed completely and a manuscript is being submitted. Next steps is to use this information to develop scenarios for flux over the maritime boundary and evaluate relative fishing effort impacts on either side.*
- Expand genetic sample collections for pollock (and process available samples) and apply high resolution genetic tools for stock structure analyses. *Additional analyses have been completed and are expected to lead to a publication in 2024.*

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11 References

Aydin, K.Y., Lapko, V.V., Radchenko, V.I., and Livingston, P.A. 2002. A comparison of the eastern Bering and western Bering Sea shelf and slope ecosystems through the use of mass-balance food web models. U.S. Department of Commerce.

- Bacheler, N.M., Ciannelli, L., Bailey, K.M., and Duffy-Anderson, J.T. 2010. Spatial and temporal patterns of walleye pollock (*Theragra chalcogramma*) spawning in the eastern Bering Sea inferred from egg and larval distributions. Fish. Oceanogr. **19**(2): 107–120.
- Bailey, K.M. 2000. Shifting control of recruitment of walleye pollock *Theragra chalcogramma* after a major climatic and ecosystem change. Mar. Ecol. Prog. Ser., **198**: 215–224. doi:[10.3354/meps198215](https://doi.org/10.3354/meps198215).
- Bailey, K.M., Quinn, T.J., Bentzen, P., and Grant, W.S. 1999. Population structure and dynamics of walleye pollock, *Theragra chalcogramma*. Advances in Mar. Biol. **37**: 179–255.
- Barbeaux, S.J., Gaichas, S., Ianelli, J.N., and Dorn, M.W. 2005. Evaluation of biological sampling protocols for at-sea groundfish observers in alaska. Alaska Fisheries Research Bulletin **11**(2): 82–101.
- Brodeur, R.D., Wilson, M.T., Ciannelli, L., Doyle, M.J., and Napp, J.M. 2002. Interannual and regional variability in distribution and ecology of juvenile pollock and their prey in frontal structures of the bering sea. Deep-Sea Research II **49**: 6051–6067.
- Buckley, T.W., Greig, A., and Boldt, J.L. 2009. Describing summer pelagic habitat over the continental shelf in the eastern bering sea, 1982–2006. United States Department of Commerce, NOAA Technical Memorandum.
- Buckley, T.W., Ortiz, I., Kotwicki, S., and Aydin, K. 2015. Summer diet composition of walleye pollock and predator-prey relationships with copepods and euphausiids in the eastern bering sea, 1987–2011. Deep-Sea Research Part II: Topical Studies in Oceanography **134**: 302–311. Available from <http://doi.org/10.1016/j.dsr2.2015.10.009>.
- Butterworth, D.S., Ianelli, J.N., and Hilborn, R. 2003. A statistical model for stock assessment of southern bluefin tuna with temporal changes in selectivity. African Journal of Marine Science **25**(1): 331–361. doi:[10.2989/18142320309504021](https://doi.org/10.2989/18142320309504021).
- Canino, M.F., O'Reilly, P.T., Hauser, L., and Bentzen, P. 2005. Genetic differentiation in walleye pollock (*theragra chalcogramma*) in response to selection at the pantophysin (pan i) locus. Can. J. Fish. Aquat. Sci. **62**: 2519–2529.
- Cheng, M.L.H., Thorson, J.T., Ianelli, J.N., and Cunningham, C.J. 2023. Unlocking the triad of age, year, and cohort effects for stock assessment: Demonstration of a computationally efficient and reproducible framework using weight-at-age. Fisheries Research **266**: 106755. doi:<https://doi.org/10.1016/j.fishres.2023.106755>.
- Ciannelli, L., Brodeur, R.D., and Napp, J.M. 2004. Foraging impact on zooplankton by age-0 walleye pollock (*theragra chalcogramma*) around a front in the southeast bering sea. Marine Biology **144**: 515–525.
- Clark, W.G., Hare, S.R., Parma, A.M., Sullivan, P.J., and Trumble, R.J. 1999. Decadal changes in growth and recruitment of pacific halibut (**hippoglossus stenolepis**). **252**: 242–252.
- Dorn, M.W. 1992. Detecting environmental covariates of pacific whiting *merluccius productus* growth using a growth-increment regression model. Fish. Bull. **90**: 260–275.
- Duffy-Anderson, J.T., Barbeaux, S.J., Farley, E., Heintz, R., Horne, J.K., Parker-Stetter, S.L., and Smart, T.I. 2016. The critical first year of life of walleye pollock (*Gadus chalcogrammus*) in the eastern bering sea: Implications for recruitment and future research. Deep-Sea Research Part II: Topical Studies in Oceanography **134**: 283–301. Available from <http://doi.org/10.1016/j.dsr2.2015.02.001>.

- Eisner, L.B., Yasumiishi, E.M., Andrews, A.G., and O'Leary, C.A. 2020. Large copepods as leading indicators of walleye pollock recruitment in the southeastern bering sea: Sample-based and spatio-temporal model (VAST) results. *Fisheries Research* **232**: 105720.
- Fournier, D. a., Skaug, H.J., Ancheta, J., Magnusson, A., Maunder, M.N., Nielsen, A., Sibert, J., Ianelli, J., Magnusson, A., Maunder, M.N., Nielsen, A., and Sibert, J. 2012. AD Model Builder: Using automatic differentiation for statistical inference of highly parameterized complex nonlinear models. *Optimization Methods and Software* **27**(2): 233–249. doi:[10.1080/10556788.2011.597854](https://doi.org/10.1080/10556788.2011.597854).
- Fournier, D., and Archibald, C. 1982. A general theory for analyzing catch at age data. *Canadian Journal of Fisheries and Aquatic Sciences* Available from <http://www.nrcresearchpress.com/doi/abs/10.1139/f82-157>.
- Fournier, D.A., Sibert, J.R., Majkowski, J., and Hampton, J. 1990. MULTIFAN a likelihood-based method for estimating growth parameters and age composition from multiple length frequency samples with an application to southern bluefin tuna (*thunnus maccoyii*). *Can. J. Fish. Aquat. Sci.* **47**: 301–317.
- Francis, R.I.C.C. 1992. Use of risk analysis to assess fishery management strategies: A case study using orange roughy (*hoplostethus atlanticus*) on the chatham rise, new zealand. *Can. J. Fish. Aquat. Sci.* **49**: 922–930.
- Francis, R.I.C.C. 2011. Data weighting in statistical fisheries stock assessment models. *Canadian Journal of Fisheries and Aquatic Sciences* **68**(11): 1124–1138. Elsevier B.V. doi:[10.1139/f2011-165](https://doi.org/10.1139/f2011-165).
- Gann, J.C., Eisner, L.B., Porter, S., Watson, J.T., Cieciel, K.D., Mordy, C.W., and Farley, E.V. 2015. Possible mechanism linking ocean conditions to low body weight and poor recruitment of age-0 walleye pollock (*Gadus chalcogrammus*) in the southeast bering sea during 2007. *Deep Sea Research Part II: Topical Studies in Oceanography* **134**: 1–13. Available from <http://doi.org/10.1016/j.dsr2.2015.07.010>.
- Greiwank, A., and Corliss, G.F. (Editors). 1991. Automatic differentiation of algorithms: Theory, implementation and application. Soc. Indust. And Applied Mathematics, Philadelphia.
- Grüss, A., Thorson, J.T., Stawitz, C.C., Reum, J.C.P., Rohan, S.K., and Barnes, C.L. 2021. Synthesis of interannual variability in spatial demographic processes supports the strong influence of cold-pool extent on eastern bering sea walleye pollock (*Gadus chalcogrammus*). *Progress in Oceanography* **194**: 102569.
- Haynie, A.C. 2014. Changing usage and value in the western alaska community development quota (CDQ) program. *Fisheries Science* **80**(2): 181–191. doi:[10.1007/s12562-014-0723-0](https://doi.org/10.1007/s12562-014-0723-0).
- Heintz, R.a., Siddon, E.C., Farley, E.V., and Napp, J.M. 2013. Correlation between recruitment and fall condition of age-0 pollock (*Theragra chalcogramma*) from the eastern bering sea under varying climate conditions. *Deep Sea Research Part II: Topical Studies in Oceanography* **94**: 150–156. doi:[10.1016/j.dsr2.2013.04.006](https://doi.org/10.1016/j.dsr2.2013.04.006).
- Hilborn, R., and Walters, C.J. 1992. Quantitative fisheries stock assessment. Springer US. doi:[10.1007/978-1-4615-3598-0](https://doi.org/10.1007/978-1-4615-3598-0).
- Hollowed, A.B., Barbeaux, S.J., Cokelet, E.D., Farley, E., Kotwicki, S., Ressler, P.H., and Wilson, C.D. 2012. Effects of climate variations on pelagic ocean habitats and their role in structuring forage fish distributions in the bering sea. *Deep Sea Research Part II: Topical*

- Studies in Oceanography **65-70**: 230–250. doi:[10.1016/j.dsr2.2012.02.008](https://doi.org/10.1016/j.dsr2.2012.02.008).
- Hollowed, A.B., Ianelli, J.N., and Livingston, P.A. 2000. Including predation mortality in stock assessments: A case study involving Gulf of Alaska walleye pollock. ICES Journal of Marine Science **57**: 279–293.
- Holsman, K.K., and Aydin, K. 2015. Comparative methods for evaluating climate change impacts on the foraging ecology of alaskan groundfish. **521**: 217–235. doi:[10.3354/meps11102](https://doi.org/10.3354/meps11102).
- Honkalehto, T., and McCarthy, A. 2015. Results of the acoustic-trawl survey of walleye pollock (*Gaddus chalcogrammus*) on the u.s. And russia bering sea shelf in june - august 2014. AFSC Processed Rep. 2015-07, 62 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115. Available from <http://www.afsc.noaa.gov/Publications/ProcRpt/PR2015-07.pdf>.
- Honkalehto, T., Ressler, P.H., Towler, R., and Wilson, C.D. 2011. Using acoustic data from fishing vessels to estimate walleye pollock abundance in the eastern bering sea. Can. J. Fish. Aquat. Sci. **68**: 1231–1242.
- Hulson, P.-J.F., Williams, B.C., Siskey, M.R., Bryan, M.D., and Conner, J. 2023. Bottom trawl survey age and length composition input sample sizes for stocks assessed with statistical catch-at-age assessment models at the alaska fisheries science center. Alaska Fisheries Science Center (U.S.); Auke Bay Laboratories (Juneau, Alaska); Alaska Fisheries Science Center (U.S.). Resource Assessment; Conservation Engineering Division.; Alaska Fisheries Science Center (U.S.). Resource Ecology; Fisheries Management Division.; Washington (State). Department of Fish; Wildlife. doi:[10.25923/8pxq-bs48](https://doi.org/10.25923/8pxq-bs48).
- Hulson, P., and Williams, B. 2024. afscISS: Retrieve composition data ISS. <https://github.com/afsc-assessments/afscISS>. Available from <https://github.com/afsc-assessments/afscISS/>.
- Hunt Jr., G.L., Coyle, K.O., Eisner, L.B., Farley, E.V., Heintz, R.A., Mueter, F., Napp, J.M., Overland, J.E., Ressler, P.H., Salo, S., and Stabeno, P.J. 2011. Climate impacts on eastern bering sea foodwebs: A synthesis of new data and an assessment of the oscillating control hypothesis. ICES J. Mar. Sci. **68**(6): 1230–1243. Available from <http://dx.doi.org/10.1093/icesjms/fsr036>.
- Ianelli, J. 2023. Eastern bering sea pollock stock assessment model evaluations. Online; North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. Available from https://meetings.npfmc.org/CommentReview/DownloadFile?p=e5b7b3df-2682-4a1a-aa57-61ce951c50e5.pdf&fileName=EBSPollock_September2023.pdf.
- Ianelli, James N., and McKelvey, D. 2022. Assessment of the walleye pollock stock in the bogoslof islands region. (December). North Pacific Fishery Management Council, Anchorage, Alaska.
- Ianelli, James., Taina Honkalehto, and Williamson, N. 2007. Chapter 1 : Assessment of the walleye pollock stock in the eastern Bering Sea. North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. Available from <https://apps-afsc.fisheries.noaa.gov/refm/docs/2007/EBSPollok.pdf>.
- Ianelli, J., Honkalehto, T., Allen-Akselrud, C., Stienessen, S., and Siddon, E. 2021. Chapter 1 : Assessment of the walleye pollock stock in the eastern Bering Sea. North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. Available from https://apps-afsc.fisheries.noaa.gov/Plan_Team/2021/EBSPollok.pdf.

- Ianelli, J., Honkalehto, T., Wasserman S., Lauffenburger, N., McGilliard, C., and Siddon, E. 2023. Chapter 1 : Assessment of the walleye pollock stock in the eastern Bering Sea. North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. Available from https://apps-afsc.fisheries.noaa.gov/Plan_Team/2023/EBSPollock.pdf.
- Ianelli, J., Kotwicki, S., and Honkalehto, T. 2015. Chapter 1 : Assessment of the walleye pollock stock in the eastern bering sea. (December). North Pacific Fishery Management Council, Anchorage, Alaska.
- Ianelli, J., and McGilliard, C. 2024b. Eastern bering sea pollock stock assessment model evaluations. Online; North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501. Available fromhttps://afsc-assessments.github.io/ebs_pollock_safe/doc/sept.html.
- Ianelli, J., and McGilliard, C. 2024a. Eastern bering sea pollock SAFE report - september 2024 update. https://afsc-assessments.github.io/ebs_pollock_safe/doc/sept.html. Available from https://afsc-assessments.github.io/ebs_pollock_safe/doc/sept.html.
- Ianelli, J.N. 2005. Assessment and fisheries management of eastern bering sea walleye pollock: Is sustainability luck. Bulletin of Marine Science **76**(2): 321–336.
- Ianelli, J.N., and Fournier, D.A. 1998. Alternative age-structured analyses of the NRC simulated stock assessment data. NOAA Tech. Memo., NOAA.
- Ianelli, J.N., Hollowed, A.B., Haynie, A.C., Mueter, F.J., and Bond, N.A. 2011. Evaluating management strategies for eastern bering sea walleye pollock (*Theragra chalcogramma*) in a changing environment. ICES Journal of Marine Science. doi:[10.1093/icesjms/fsr010](https://doi.org/10.1093/icesjms/fsr010).
- Ianelli, J.N., and Stram, D.L. 2014. Estimating impacts of the pollock fishery bycatch on western alaska chinook salmon. ICES Journal of Marine Science. doi:[10.1093/icesjms/fsu173](https://doi.org/10.1093/icesjms/fsu173).
- Ianelli, S.B., James N., and Williamson, N. 2001. Chapter 1 : Assessment of the walleye pollock stock in the eastern bering sea. (December). North Pacific Fishery Management Council, Anchorage, Alaska.
- Indivero, J., Essington, T.E., Ianelli, J.N., and Thorson, J.T. 2023. Incorporating distribution shifts and spatio-temporal variation when estimating weight-at-age for stock assessments: a case study involving the Bering Sea pollock (*Gadus chalcogrammus*). ICES Journal of Marine Science **80**(2): 258–271. doi:[10.1093/icesjms/fsac236](https://doi.org/10.1093/icesjms/fsac236).
- Johnson, K.F., Monnahan, C.C., McGilliard, C.R., Vert-Pre, K.A., Anderson, S.C., Cunningham, C.J., Hurtado-Ferro, F., Licandeo, R.R., Muradian, M.L., Ono, K., Szuwalski, C.S., Valero, J.L., Whitten, A.R., and Punt, A.E. 2014. Time-varying natural mortality in fisheries stock assessment models: Identifying a default approach. In ICES Journal of Marine Science. pp. 137–150. doi:[10.1093/icesjms/fsu055](https://doi.org/10.1093/icesjms/fsu055).
- Jost, L. 2006. Entropy and diversity. Oikos **113**(2): 363–375. Wiley Online Library. doi:[10.1111/j.2006.0030-1299.14714.x](https://doi.org/10.1111/j.2006.0030-1299.14714.x).
- Kaskr, A. 2024. RTMB: Tools for random template model builder (TMB). <https://github.com/kaskr/RTMB>.
- Kastelle, C.R., and Kimura, D.K. 2006. Age validation of walleye pollock (*Theragra chalcogramma*) from the Gulf of Alaska using the disequilibrium of Pb-210 and Ra-226. ICES Journal of Marine Science **63**: 1520–1529.
- Kimura, D.K. 1989. Variability in estimating catch-in-numbers-at-age and its impact on cohort

- analysis. In Effects on ocean variability on recruitment and an evaluation of parameters used in stock assessment models. Edited by R.J. Beamish and G.A. McFarlane. Can. Spec. Publ. Fish. Aq. Sci. pp. 57–66.
- Kimura, D.K., Kastelle, C.R., Goetz, B.J., Gburski, C.M., and Buslov, A.V. 2006. Corroborating ages of walleye pollock (*Theragra chalcogramma*). Australian J. of Marine and Freshwater Research **57**: 323–332.
- Kimura, D.K., Lyons, J.J., MacLellan, S.E., and Goetz, B.J. 1992. Effects of year-class strength on age determination. Aust. J. Mar. Freshwater Res. **43**: 1221–1228.
- Kotwicki, S., Ianelli, J.N., and Punt, A.E. 2014. Correcting density-dependent effects in abundance estimates from bottom-trawl surveys. ICES Journal of Marine Science **71**: 1107–1116.
- Kotwicki, S., and Lauth, R.R. 2013. Detecting temporal trends and environmentally-driven changes in the spatial distribution of groundfishes and crabs on the eastern bering sea shelf. Deep-Sea Research Part II: Topical Studies in Oceanography **94**: 231–243.
- Lang, G.M., Brodeur, R.D., Napp, J.M., and Schabetsberger, R. 2000. Variation in groundfish predation on juvenile walleye pollock relative to hydrographic structure near the pribilof islands, alaska. ICES Journal of Marine Science **57**: 265–271.
- Lang, G.M., Livingston, P.A., and Dodd, K.A. 2005. Groundfish food habits and predation on commercially important prey species in the eastern bering sea from 1997 through 2001. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC. Available from <http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-158.pdf>.
- Lauffenburger, N., Honkalehto, T., Stienessen, S.C., and Stevenson, D. 2024. Acoustic vessel-of-opportunity (AVO) index for midwater bering sea walleye pollock: A new reanalysis including 2022-2024.
- Levine, M., and De Robertis, A. 2019. Don't work too hard: Subsampling leads to efficient analysis of large acoustic datasets. Fisheries Research **219**: 105323. doi:<https://doi.org/10.1016/j.fishres.2019.105323>.
- Li, B., Ianelli, J.N., Shertzer, K.W., Lynch, P.D., Legault, C.M., Williams, E.H., Methot, R.D., and others. 2021. A comparison of 4 primary age-structured stock assessment models used in the united states. Fishery Bulletin **119**(2-3): 149–67. doi:[10.7755/FB.119.2-3.5](https://doi.org/10.7755/FB.119.2-3.5).
- Livingston, P.A. 1991. Walleye pollock. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/NWC-207.
- Livingston, P.A., and Methot, R.D. 1998. Incorporation of predation into a population assessment model of eastern bering sea walleye pollock. In Fishery stock assessment models. Alaska Sea Grant Program, University of Alaska Fairbanks. pp. 663–678.
- Low, L.L., and Ikeda. 1980. Average density index of walleye pollock in the bering sea. NOAA Tech. Memo. SFRF743.
- Martell, S., and Stewart, I. 2013. Towards defining good practices for modeling time-varying selectivity. Fisheries Research: 1–12. Available from <http://doi.org/10.1016/j.fishres.2013.11.001>.
- McAllister, M.K., and Ianelli, J.N. 1997. Bayesian stock assessment using catch-age data and the sampling - importance resampling algorithm. Canadian Journal of Fisheries and Aquatic Sciences **54**(2): 284–300. doi:[10.1139/f96-285](https://doi.org/10.1139/f96-285).

- Methot, R.D. 1990. Synthesis model: An adaptable framework for analysis of diverse stock assessment data. In Proceedings of the symposium on applications of stock assessment techniques to gadids. Edited by L. Low. pp. 259–277.
- Miller, T.J. 2005. Estimation of catch parameters from a fishery observer program with multiple objectives. PhD thesis, University of Washington.
- Monnahan, C.C. 2024. Toward good practices for bayesian data-rich fisheries stock assessments using a modern statistical workflow. *Fisheries Research* **275**: 107024. doi:<https://doi.org/10.1016/j.fishres.2024.107024>.
- Monnahan, C.C., and Kristensen, K. 2018. No-u-turn sampling for fast bayesian inference in ADMB and TMB: Introducing the adnuts and tmstan r packages. *PLOS ONE* **13**: e0197954.
- Monnahan, C.C., Thorson, J.T., Kotwicki, S., Lauffenburger, N., Ianelli, J.N., and Punt, A.E. 2021. Incorporating vertical distribution in index standardization accounts for spatiotemporal availability to acoustic and bottom trawl gear for semi-pelagic species. *ICES Journal of Marine Science*. doi:[10.1093/icesjms/fsab085](https://doi.org/10.1093/icesjms/fsab085).
- Moss, J.H., Farley, E.V.Jr., Feldmann, A.M., and Ianelli, J.N. 2009. Spatial distribution, energetic status, and food habits of eastern bering sea age-0 walleye pollock. *Transactions of the American Fisheries Society*.
- Mueter, F.J., Bond, N.A., Ianelli, J.N., and Hollowed, A.B. 2011. Expected declines in recruitment of walleye pollock (*Theragra chalcogramma*) in the eastern bering sea under future climate change. *ICES Journal of Marine Science*.
- Mueter, F.J., Ladd, C., Palmer, M.C., and Norcross, B.L. 2006. Bottom-up and top-down controls of walleye pollock (*Theragra chalcogramma*) on the eastern bering sea shelf. *Progress in Oceanography* **68**: 152–183.
- Mueter, F.J., and Litzow, M. 2008. Sea ice retreat alters the biogeography of the bering sea continental shelf. *Ecological Applications* **18**: 309–320.
- NOAA Fisheries. 2024. CIE peer reviews. <https://www.st.nmfs.noaa.gov/science-quality-assurance/cie-peer-reviews/index>.
- O’Leary, C.A., DeFilippo, L.B., Thorson, J.T., Kotwicki, S., Hoff, G.R., Kulik, V.V., Ianelli, J.N., and Punt, A.E. 2022. Understanding transboundary stocks’ availability by combining multiple fisheries-independent surveys and oceanographic conditions in spatiotemporal models. *ICES Journal of Marine Science* **79**(4): 1063–1074. doi:[10.1093/icesjms/fsac046](https://doi.org/10.1093/icesjms/fsac046).
- O’Leary, C.A., Thorson, J.T., Ianelli, J.N., Kotwicki, S., Hoff, G.R., Kulik, V.V., Lauth, R.R., Nichol, D.G., Conner, J., and Punt, A.E. 2021. Estimating spatiotemporal availability of transboundary fishes to fishery-independent surveys. *J Appl Ecol* **58**: 2146–2157.
- Parma, A.M. 1993. Retrospective catch-at-age analysis of pacific halibut: Implications on assessment of harvesting policies. In Proceedings of the international symposium on management strategies of exploited fish populations. Alaska Sea Grant Rep. No. 93-02. Univ. Alaska Fairbanks.
- Petitgas, P. 1993. Geostatistics for fish stock assessments: A review and an acoustic application. *ICES J. Mar. Sci.* **50**: 285–298.
- Press, W.H., Teukolsky, S.A., Vetterling, W.T., and Flannery, B.P. 1992. Numerical recipes in c. Cambridge University Press.

- Rohan, S.K., Barnett, L.A.K., and Charriere, N. 2022. Evaluating approaches to estimating mean temperatures and cold pool area from AFSC bottom trawl surveys of the eastern bering sea. NOAA Technical Memorandum, U.S. Department of Commerce, NOAA. doi:[10.25923/1wwh-q418](https://doi.org/10.25923/1wwh-q418).
- Schnute, J.T. 1994. A general framework for developing sequential fisheries models. *Can. J. Fish. Aquat. Sci.* **51**: 1676–1688.
- Schnute, J.T., and Richards, L.J. 1995. The influence of error on population estimates from catch-age models. *Canadian Journal of Fisheries and Aquatic Sciences* **52**(10): 2063–2077. doi:[10.1139/f95-800](https://doi.org/10.1139/f95-800).
- Seung, C., and Ianelli, J. 2016. Regional economic impacts of climate change: A computable general equilibrium analysis for an alaskan fishery. *Natural Resource Modeling* **29**: 289–333. Available from <http://doi.org/10.1111/nrm.12092>.
- Smith, G.B. 1981. The eastern bering sea shelf: Oceanography and resources. U.S. Dep. Comm., NOAA/OMP.
- Spencer, P.D., Holsman, K.K., Zador, S., Bond, N.A., Mueter, F.J., Hollowed, A.B., and Ianelli, J.N. 2016. Modelling spatially dependent predation mortality of eastern Bering Sea walleye pollock, and its implications for stock dynamics under future climate scenarios. *ICES Journal of Marine Science: Journal du Conseil*: fsw040. Oxford University Press.
- Stahl, J. 2004. Maturation of walleye pollock, (*Theragra chalcogramma*) in the eastern bering sea in relation to temporal and spatial factors. Master's thesis, School of Fisheries; Ocean Sciences, Univ. Alaska Fairbanks, Juneau.
- Stahl, J.P., and Kruse, G.H. 2008. Spatial and temporal variability in size at maturity of walleye pollock in the eastern bering sea. *Transactions of the American Fisheries Society* **137**(5): 1543–1557. doi:[10.1577/T07-099.1](https://doi.org/10.1577/T07-099.1).
- Sterling, J.T., and Ream, R.R. 2004. At-sea behavior of juvenile male northern fur seals (*callorhinus ursinus*). *Canadian Journal of Zoology* **82**: 1621–1637. NRC Research Press.
- Stienessen, S.C., Honkalehto, T., Lauffenburger, N.E., Ressler, P.H., and Lauth, R.R. 2020. Acoustic vessel-of-opportunity (AVO) index for midwater bering sea walleye pollock, 2018–2019. *Alaska Fish. Sci. Cent.*, NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.
- Stram, D.L., and Ianelli, J.N. 2014. Evaluating the efficacy of salmon bycatch measures using fishery-dependent data. *ICES Journal of Marine Science* **3**(2). doi:[10.1093/icesjms/fsu168](https://doi.org/10.1093/icesjms/fsu168).
- Strong, J.W., and Criddle, K.R. 2014. A market model of eastern bering sea alaska pollock: Sensitivity to fluctuations in catch and some consequences of the american fisheries act. *North American Journal of Fisheries Management* **34**(6): 1078–1094. Available from <http://doi.org/10.1080/02755947.2014.944678>.
- Swartzman, G.L., Winter, A.G., Coyle, K.O., Brodeur, R.D., Buckley, T., Ciannelli, L., Hunt, Jr., G. L., Ianelli, J., and Macklin, S.A. 2005. Relationship of age-0 pollock abundance and distribution around the pribilof islands with other shelf regions of the eastern bering sea. *Fisheries Research* **74**: 273–287.
- Szuwalski, C.S., Ianelli, J.N., and Punt, A.E. 2018. Reducing retrospective patterns in stock assessment and impacts on management performance. *ICES Journal of Marine Science* **75**(2): 596–609. Available from <https://doi.org/10.1093/icesjms/fsx159>.

- Thorson, J.T. 2018. Three problems with the conventional delta-model for biomass sampling data, and a computationally efficient alternative. Canadian Journal of Fisheries and Aquatic Sciences **75**: 1369–1382. doi:[10.1139/cjfas-2017-0266](https://doi.org/10.1139/cjfas-2017-0266).
- Thorson, J.T. 2019. Guidance for decisions using the vector autoregressive spatio-temporal (VAST) package in stock, ecosystem, habitat and climate assessments. Fisheries Research **210**: 143–161. doi:[10.1016/j.fishres.2018.10.013](https://doi.org/10.1016/j.fishres.2018.10.013).
- Thorson, J.T., Adams, C.F., Brooks, E.N., Eisner, L.B., Kimmel, D.G., Legault, C.M., Rogers, L.A., and others. 2020a. Seasonal and interannual variation in spatio-temporal models for index standardization and phenology studies. ICES Journal of Marine Science **77**: 1879–1892.
- Thorson, J.T., Cheng, W., Hermann, A.J., Ianelli, J.N., Litzow, M.A., O’Leary, C.A., and Thompson, G.G. 2020b. Empirical orthogonal function regression: Linking population biology to spatial varying environmental conditions using climate projections. Global Change Biology **26**: 4638–4649.
- Thorson, J.T., Hicks, A.C., and Methot, R.D. 2015. Random effect estimation of time-varying factors in stock synthesis. ICES Journal of Marine Science: Journal du Conseil **72**: 178–185.
- Walline, P.D. 2007. Geostatistical simulations of eastern bering sea walleye pollock spatial distributions, to estimate sampling precision. ICES Journal of Marine Science **64**: 559–569.
- Wespestad, V.G., Fritz, L.W., Ingraham, W.J., and Megrey, B.A. 2000. On relationships between cannibalism, climate variability, physical transport, and recruitment success of bering sea walleye pollock (*Theragra chalcogramma*). ICES Journal of Marine Science **57**: 272–278.
- Wespestad, V.G., Ianelli, J., Fritz, L., Honkalehto, T., and Walters, G. 1996. Bering sea-aleutian islands walleye pollock assessment for 1997. North Pacific Fishery Management Council.
- Wespestad, V.G., and Terry, J.M. 1984. Biological and economic yields for eastern bering sea walleye pollock under differing fishing regimes. North American Journal of Fisheries Management **4**: 204–215.
- Williamson, N., and Traynor, J. 1996. Application of a one-dimensional geostatistical procedure to fisheries acoustic surveys of alaskan pollock. ICES Journal of Marine Science **53**: 423–428.
- Winter, A.G., Swartzman, G.L., and Ciannelli, L. 2005. Early- to late-summer population growth and prey consumption by age-0 pollock (*Theragra chalcogramma*) in two years of contrasting pollock abundance near the pribilof islands, bering sea. Fisheries Oceanography **14**(4): 307–320.
- Xu, H., Thorson, J.T., and Methot, R.D. 2020. Comparing the performance of three data-weighting methods when allowing for time-varying selectivity. Canadian Journal of Fisheries and Aquatic Sciences **77**: 247–263.
- Yasumiishi, E.M., Criddle, K.R., Hillgruber, N., Mueter, F.J., and Helle, J.H. 2015. Chum salmon (*Oncorhynchus keta*) growth and temperature indices as indicators of the year-class strength of age-1 walleye pollock (*Gadus chalcogrammus*) in the eastern bering sea. Fisheries Oceanography **24**: 242–256.
- Zeppelin, T.K., and Ream, R.R. 2006. Foraging habitats based on the diet of female northern fur seals (*callorhinus ursinus*) on the pribilof islands, alaska. Journal of Zoology **270**(4):

565–576.

12 Tables

Table 1: Pollock catch from the Eastern Bering Sea by area, and season (through October 25th 2024). The A season starts January 20th and B season starts on June 10th. The Southeast area refers to the EBS region east of 170W; the Northwest is west of 170W.

| Year | Northwest A | Northwest B | Southeast A | Southeast B | NW | SE | A | B | Total |
|------|-------------|-------------|-------------|-------------|---------|-----------|---------|---------|-----------|
| 1991 | 12,191 | 529,917 | 297,202 | 356,353 | 542,109 | 653,555 | 309,393 | 886,271 | 1,195,664 |
| 1992 | 101,597 | 458,143 | 454,947 | 375,612 | 559,741 | 830,559 | 556,544 | 833,755 | 1,390,299 |
| 1993 | 93,013 | 139,160 | 475,143 | 619,287 | 232,173 | 1,094,429 | 568,156 | 758,446 | 1,326,602 |
| 1994 | 11,026 | 165,751 | 586,105 | 566,470 | 176,777 | 1,152,575 | 597,131 | 732,221 | 1,329,352 |
| 1995 | 3,631 | 88,310 | 600,499 | 571,807 | 91,941 | 1,172,306 | 604,129 | 660,117 | 1,264,247 |
| 1996 | 1,804 | 104,135 | 549,297 | 537,545 | 105,939 | 1,086,843 | 551,101 | 641,680 | 1,192,781 |
| 1997 | 2,363 | 302,180 | 557,106 | 262,784 | 304,544 | 819,889 | 559,469 | 564,964 | 1,124,433 |
| 1998 | 1,508 | 131,007 | 476,214 | 410,353 | 132,515 | 886,567 | 477,722 | 541,360 | 1,019,082 |
| 1999 | 4,139 | 202,558 | 414,030 | 368,953 | 206,698 | 782,983 | 418,169 | 571,511 | 989,680 |
| 2000 | 19,363 | 274,170 | 439,023 | 400,154 | 293,532 | 839,177 | 458,386 | 674,324 | 1,132,710 |
| 2001 | 108,013 | 317,207 | 444,565 | 517,412 | 425,220 | 961,977 | 552,578 | 834,619 | 1,387,197 |
| 2002 | 36,693 | 283,749 | 561,061 | 599,272 | 320,442 | 1,160,334 | 597,754 | 883,022 | 1,480,776 |
| 2003 | 151,465 | 406,123 | 446,152 | 487,039 | 557,588 | 933,191 | 597,617 | 893,162 | 1,490,779 |
| 2004 | 50,661 | 339,883 | 556,469 | 533,538 | 390,544 | 1,090,008 | 607,130 | 873,422 | 1,480,552 |
| 2005 | 120,320 | 560,548 | 476,970 | 325,184 | 680,868 | 802,154 | 597,290 | 885,732 | 1,483,022 |
| 2006 | 18,789 | 642,034 | 585,507 | 241,700 | 660,824 | 827,207 | 604,297 | 883,734 | 1,488,031 |
| 2007 | 62,504 | 563,748 | 505,306 | 222,943 | 626,253 | 728,249 | 567,811 | 786,691 | 1,354,502 |
| 2008 | 44,801 | 463,079 | 358,936 | 123,762 | 507,880 | 482,698 | 403,738 | 586,840 | 990,578 |
| 2009 | 81,575 | 370,957 | 247,944 | 110,307 | 452,532 | 358,252 | 329,520 | 481,264 | 810,784 |
| 2010 | 199,011 | 356,061 | 124,670 | 130,443 | 555,072 | 255,114 | 323,681 | 486,505 | 810,186 |
| 2011 | 102,252 | 348,897 | 401,755 | 346,128 | 451,149 | 747,882 | 504,007 | 695,024 | 1,199,031 |
| 2012 | 104,926 | 481,418 | 380,373 | 238,497 | 586,344 | 618,870 | 485,299 | 719,915 | 1,205,214 |
| 2013 | 94,763 | 480,331 | 415,014 | 280,652 | 575,094 | 695,667 | 509,777 | 760,983 | 1,270,760 |
| 2014 | 50,465 | 388,712 | 469,973 | 388,267 | 439,177 | 858,240 | 520,438 | 776,979 | 1,297,417 |
| 2015 | 258,574 | 366,752 | 267,095 | 429,153 | 625,326 | 696,248 | 525,669 | 795,905 | 1,321,574 |
| 2016 | 81,531 | 104,078 | 458,044 | 709,028 | 185,609 | 1,167,072 | 539,576 | 813,106 | 1,352,681 |
| 2017 | 37,730 | 143,430 | 544,028 | 633,993 | 181,159 | 1,178,021 | 581,758 | 777,423 | 1,359,181 |
| 2018 | 3,842 | 326,753 | 598,533 | 450,160 | 330,595 | 1,048,692 | 602,375 | 776,913 | 1,379,288 |
| 2019 | 2,649 | 304,532 | 614,949 | 487,217 | 307,181 | 1,102,166 | 617,598 | 791,749 | 1,409,346 |
| 2020 | 85,717 | 421,102 | 560,438 | 299,978 | 506,820 | 860,416 | 646,156 | 721,080 | 1,367,236 |
| 2021 | 56,779 | 295,470 | 554,774 | 469,234 | 352,249 | 1,024,009 | 611,554 | 764,704 | 1,376,258 |
| 2022 | 9,018 | 197,610 | 487,216 | 411,573 | 206,629 | 898,790 | 496,235 | 609,184 | 1,105,419 |
| 2023 | 11,335 | 411,552 | 568,454 | 319,251 | 422,887 | 887,704 | 579,788 | 730,803 | 1,310,591 |
| 2024 | 51,606 | 353,141 | 523,585 | 330,355 | 404,747 | 853,940 | 575,191 | 683,496 | 1,258,687 |

Table 2: Time series of 1964–1976 catch (left) and ABC, TAC, and catch for EBS pollock, 1977–2024 in t. Source: compiled from NMFS Regional office web site and various NPFMC reports. Note that the 2024 value is based on catch reported to October 25th 2024 plus an added component due to bycatch of pollock in other fisheries.

| Year | Catch | Year | OFL | ABC | TAC | Catch |
|------|----------------|------|-----------|-----------|-----------|-----------|
| 1964 | 174,792 | 1977 | - | 950,000 | 950,000 | 978,370 |
| 1965 | 230,551 | 1978 | - | 950,000 | 950,000 | 979,431 |
| 1966 | 261,678 | 1979 | - | 1,100,000 | 950,000 | 935,714 |
| 1967 | 550,362 | 1980 | - | 1,300,000 | 1,000,000 | 958,280 |
| 1968 | 702,181 | 1981 | - | 1,300,000 | 1,000,000 | 973,502 |
| 1969 | 862,789 | 1982 | - | 1,300,000 | 1,000,000 | 955,964 |
| 1970 | 1,256,565 | 1983 | - | 1,300,000 | 1,000,000 | 981,450 |
| 1971 | 1,743,763 | 1984 | - | 1,300,000 | 1,200,000 | 1,092,055 |
| 1972 | 1,874,534 | 1985 | - | 1,300,000 | 1,200,000 | 1,139,676 |
| 1973 | 1,758,919 | 1986 | - | 1,300,000 | 1,200,000 | 1,141,993 |
| 1974 | 1,588,390 | 1987 | - | 1,300,000 | 1,200,000 | 859,416 |
| 1975 | 1,356,736 | 1988 | - | 1,500,000 | 1,300,000 | 1,228,721 |
| 1976 | 1,177,822 | 1989 | - | 1,340,000 | 1,340,000 | 1,229,600 |
| | | 1990 | - | 1,450,000 | 1,280,000 | 1,455,193 |
| | | 1991 | - | 1,676,000 | 1,300,000 | 1,195,664 |
| | | 1992 | 1,770,000 | 1,490,000 | 1,300,000 | 1,390,299 |
| | | 1993 | 1,340,000 | 1,340,000 | 1,300,000 | 1,326,602 |
| | | 1994 | 1,590,000 | 1,330,000 | 1,330,000 | 1,329,352 |
| | | 1995 | 1,500,000 | 1,250,000 | 1,250,000 | 1,264,247 |
| | | 1996 | 1,460,000 | 1,190,000 | 1,190,000 | 1,192,781 |
| | | 1997 | 1,980,000 | 1,130,000 | 1,130,000 | 1,124,433 |
| | | 1998 | 2,060,000 | 1,110,000 | 1,110,000 | 1,102,159 |
| | | 1999 | 1,720,000 | 992,000 | 992,000 | 989,680 |
| | | 2000 | 1,680,000 | 1,139,000 | 1,139,000 | 1,132,710 |
| | | 2001 | 3,536,000 | 1,842,000 | 1,400,000 | 1,387,197 |
| | | 2002 | 3,530,000 | 2,110,000 | 1,485,000 | 1,480,776 |
| | | 2003 | 3,530,000 | 2,330,000 | 1,491,760 | 1,490,779 |
| | | 2004 | 2,740,000 | 2,560,000 | 1,492,000 | 1,480,552 |
| | | 2005 | 2,100,000 | 1,960,000 | 1,478,500 | 1,483,022 |
| | | 2006 | 2,090,000 | 1,930,000 | 1,485,000 | 1,488,031 |
| | | 2007 | 1,640,000 | 1,394,000 | 1,394,000 | 1,354,502 |
| | | 2008 | 1,440,000 | 1,000,000 | 1,000,000 | 990,578 |
| | | 2009 | 977,000 | 815,000 | 815,000 | 810,784 |
| | | 2010 | 918,000 | 813,000 | 813,000 | 810,206 |
| | | 2011 | 2,450,000 | 1,270,000 | 1,252,000 | 1,199,041 |
| | | 2012 | 2,474,000 | 1,220,000 | 1,200,000 | 1,205,293 |
| | | 2013 | 2,550,000 | 1,375,000 | 1,247,000 | 1,270,827 |
| | | 2014 | 2,795,000 | 1,369,000 | 1,267,000 | 1,297,849 |
| | | 2015 | 3,330,000 | 1,637,000 | 1,310,000 | 1,322,317 |
| | | 2016 | 3,910,000 | 2,090,000 | 1,340,000 | 1,353,686 |
| | | 2017 | 3,640,000 | 2,800,000 | 1,345,000 | 1,359,367 |
| | | 2018 | 4,797,000 | 2,592,000 | 1,364,341 | 1,379,301 |
| | | 2019 | 3,914,000 | 2,163,000 | 1,397,000 | 1,409,235 |
| | | 2020 | 4,085,000 | 2,043,000 | 1,425,000 | 1,325,792 |
| | | 2021 | 2,594,000 | 1,626,000 | 1,375,000 | 1,339,000 |
| | | 2022 | 1,469,000 | 1,111,000 | 1,111,000 | 1,105,677 |
| | | 2023 | 3,381,000 | 1,910,000 | 1,300,000 | 1,310,716 |
| | | 2024 | 3,162,000 | 2,313,000 | 1,300,000 | 1,300,000 |
| | 1977–2024 mean | | 2,489,455 | 1,512,708 | 1,222,888 | 1,206,496 |

Table 3: Estimates of discarded and retained pollock (t) for the Northwest and Southeastern Bering Sea, 1991–2024. SE represents the EBS east of 170W, NW is the EBS west of 170W, source: NMFS Blend and catch-accounting system database. 2024 data are preliminary.

| Year | NW Discarded | SE Discarded | NW Retained | SE Retained | Total | Discarded % |
|------|--------------|--------------|-------------|-------------|-----------|-------------|
| 1991 | 48,257 | 66,792 | 493,852 | 586,763 | 1,195,664 | 9.6% |
| 1992 | 57,578 | 71,194 | 502,163 | 759,365 | 1,390,299 | 9.3% |
| 1993 | 26,100 | 83,986 | 206,073 | 1,010,443 | 1,326,602 | 8.3% |
| 1994 | 16,084 | 88,098 | 160,693 | 1,064,476 | 1,329,352 | 7.8% |
| 1995 | 9,715 | 87,492 | 82,226 | 1,084,813 | 1,264,247 | 7.7% |
| 1996 | 4,838 | 71,368 | 101,100 | 1,015,474 | 1,192,781 | 6.4% |
| 1997 | 22,557 | 71,032 | 281,986 | 748,858 | 1,124,433 | 8.3% |
| 1998 | 1,581 | 14,291 | 130,934 | 872,276 | 1,019,082 | 1.6% |
| 1999 | 1,912 | 26,912 | 204,786 | 756,071 | 989,680 | 2.9% |
| 2000 | 1,942 | 19,678 | 291,591 | 819,499 | 1,132,710 | 1.9% |
| 2001 | 2,450 | 14,874 | 422,770 | 947,103 | 1,387,197 | 1.2% |
| 2002 | 1,441 | 19,430 | 319,002 | 1,140,904 | 1,480,776 | 1.4% |
| 2003 | 2,959 | 13,795 | 554,629 | 919,397 | 1,490,779 | 1.1% |
| 2004 | 2,781 | 20,380 | 387,763 | 1,069,628 | 1,480,552 | 1.6% |
| 2005 | 2,586 | 14,838 | 678,282 | 787,316 | 1,483,022 | 1.2% |
| 2006 | 3,677 | 11,877 | 657,147 | 815,330 | 1,488,031 | 1.0% |
| 2007 | 3,769 | 12,334 | 622,484 | 715,915 | 1,354,502 | 1.2% |
| 2008 | 1,643 | 5,968 | 506,237 | 476,730 | 990,578 | 0.8% |
| 2009 | 1,936 | 4,014 | 450,596 | 354,238 | 810,784 | 0.7% |
| 2010 | 1,270 | 2,490 | 553,802 | 252,623 | 810,186 | 0.5% |
| 2011 | 1,376 | 3,444 | 449,773 | 744,438 | 1,199,031 | 0.4% |
| 2012 | 1,190 | 4,080 | 585,154 | 614,791 | 1,205,214 | 0.4% |
| 2013 | 1,225 | 4,084 | 573,869 | 691,582 | 1,270,760 | 0.4% |
| 2014 | 1,786 | 12,556 | 437,391 | 845,684 | 1,297,417 | 1.1% |
| 2015 | 2,418 | 7,055 | 622,907 | 689,193 | 1,321,574 | 0.7% |
| 2016 | 1,036 | 8,124 | 184,574 | 1,158,948 | 1,352,681 | 0.7% |
| 2017 | 1,356 | 6,848 | 179,803 | 1,171,173 | 1,359,181 | 0.6% |
| 2018 | 2,005 | 9,170 | 328,590 | 1,039,523 | 1,379,288 | 0.8% |
| 2019 | 1,979 | 7,126 | 305,202 | 1,095,040 | 1,409,346 | 0.6% |
| 2020 | 2,450 | 9,363 | 504,370 | 851,053 | 1,367,236 | 0.9% |
| 2021 | 1,534 | 12,379 | 350,715 | 1,011,629 | 1,376,258 | 1.0% |
| 2022 | 3,538 | 9,899 | 203,091 | 888,891 | 1,105,419 | 1.2% |
| 2023 | 4,685 | 10,218 | 418,201 | 877,486 | 1,310,591 | 1.1% |
| 2024 | 3,809 | 12,090 | 400,938 | 841,850 | 1,258,687 | 1.3% |
| Mean | 7,323 | 25,006 | 386,417 | 844,747 | 1,263,493 | 2.6% |

Table 4: Highlights of some management measures affecting the pollock fishery.

| Year | Management |
|------|--|
| 1977 | Preliminary BSAI FMP implemented with several closure areas |
| 1982 | FMP implement for the BSAI |
| 1982 | Chinook salmon bycatch limits established for foreign trawlers |
| 1984 | 2 million t groundfish OY limit established |
| 1984 | Limits on Chinook salmon bycatch reduced |
| 1990 | New observer program established along with data reporting |
| 1992 | Pollock CDQ program commences |
| 1994 | NMFS adopts minimum mesh size requirements for trawl codends |
| 1994 | Voluntary retention of salmon for foodbank donations |
| 1994 | NMFS publishes individual vessel bycatch rates on internet |
| 1995 | Trawl closures areas and trigger limits established for chum and Chinook salmon |
| 1998 | Improved utilization and retention in effect (reduced discarded pollock) |
| 1998 | American Fisheries Act (AFA) passed |
| 1999 | The AFA was implemented for catcher/processors |
| 1999 | Additional critical habitat areas around sea lion haulouts in the GOA and Eastern Bering Sea are closed. |
| 2000 | AFA implemented for remaining sectors (catcher vessel and motherships) |
| 2001 | Pollock industry adopts voluntary rolling hotspot program for chum salmon |
| 2002 | Pollock industry adopts voluntary rolling hotspot program for Chinook salmon |
| 2005 | Rolling hotspot program adopted in regulations to exempt fleet from triggered time/area closures for Chinook and chum salmon |
| 2011 | Amendment 91 enacted, Chinook salmon management under hard limits |
| 2015 | Amendment 110 (BSAI) Salmon prohibited species catch management in the Bering Sea pollock fishery (additional measures that change limits depending on Chinook salmon run-strength indices) and includes additional provisions for reporting requirements (see https://alaskafisheries.noaa.gov/fisheries/chinook-salmon-bycatch-management for update and general information) |
| 2016 | Measures of amendment 110 go into effect for 2017 fishing season; Chinook salmon runs above the 3-run index value so bycatch limits stay the same |
| 2017 | Due to amendment 110 about 45% of the TAC is taken in the A-season (traditionally only 40% was allowed). |
| 2018 | In-river estimates of Chinook salmon (three river index) fell below the threshold and therefore a lower PSC limit applies (from a performance standard of 47,491 to 33,318 and a PSC limit from 60,000 to 45,000 Chinook salmon overall). Additionally, squid have been recategorized as an ecosystem component. |
| 2019 | Some pollock sectors experienced high bycatch levels for chum and Chinook salmon and also for sablefish. |
| 2020 | Bycatch rates unusually high again for sablefish. Herring PSC occurred in the A season and triggered area closures that will persist into 2021. Salmon bycatch rates (relative to hours fished) was lower than last year for both chum and Chinook. |
| 2021 | Bycatch rates for sablefish and herring moderate (but above average). Chinook salmon bycatch rates (relative to hours fished) was lower than last year but there was a marked increase in the rate for chum salmon (2nd highest since 1991). In-river estimates of Chinook salmon (three river index) fell below the threshold and therefore a lower PSC limit applies (from a performance standard of 47,491 to 33,318 and a PSC limit from 60,000 to 45,000 Chinook salmon overall). |
| 2022 | Chum and Chinook salmon bycatch dropped by more than half of the 2021 levels while the rate (salmon per ton of pollock) were about 59% of the 2021 rates. |
| 2023 | The Council initiated and review preliminary analyses on the feasibility of proposed alternatives for additional management measures to minimize chum salmon bycatch in the Bering Sea. |
| 2024 | The Council received analyses on alternatives for additional management measures to minimize chum salmon bycatch in the Bering Sea. |

Table 5: Eastern Bering Sea pollock catch at age estimates based on observer data, 1979–2023.
Units are in millions of fish.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Sum |
|------|-------|-------|----------|----------|--------|-------|-------|-------|-------|-------|-------|------|------|------|---------|
| 1979 | 101.4 | 543 | 719.8 | 420.1 | 392.5 | 215.5 | 56.3 | 25.7 | 35.9 | 27.5 | 17.6 | 7.9 | 3 | 1.1 | 2,567 |
| 1980 | 9.8 | 462.2 | 822.9 | 443.3 | 252.1 | 210.9 | 83.7 | 37.6 | 21.7 | 23.9 | 25.4 | 15.9 | 7.7 | 3.7 | 2,421 |
| 1981 | 0.6 | 72.2 | 1,012.70 | 637.9 | 227 | 102.9 | 51.7 | 29.6 | 16.1 | 9.3 | 7.5 | 4.6 | 1.5 | 1 | 2,175 |
| 1982 | 4.7 | 25.3 | 161.4 | 1,172.20 | 422.3 | 103.7 | 36 | 36 | 21.5 | 9.1 | 5.4 | 3.2 | 1.9 | 1 | 2,004 |
| 1983 | 5.1 | 118.6 | 157.8 | 312.9 | 816.8 | 218.2 | 41.4 | 24.7 | 19.8 | 11.1 | 7.6 | 4.9 | 3.5 | 2.1 | 1,745 |
| 1984 | 2.1 | 45.8 | 88.6 | 430.4 | 491.4 | 653.6 | 133.7 | 35.5 | 25.1 | 15.6 | 7.1 | 2.5 | 2.9 | 3.7 | 1,938 |
| 1985 | 2.6 | 55.2 | 381.2 | 121.7 | 365.7 | 321.5 | 443.2 | 112.5 | 36.6 | 25.8 | 24.8 | 10.7 | 9.4 | 9.1 | 1,920 |
| 1986 | 3.1 | 86 | 92.3 | 748.6 | 214.1 | 378.1 | 221.9 | 214.3 | 59.7 | 15.2 | 3.3 | 2.6 | 0.3 | 1.2 | 2,041 |
| 1987 | - | 19.8 | 111.5 | 77.6 | 413.4 | 138.8 | 122.4 | 90.6 | 247.2 | 54.1 | 38.7 | 21.4 | 28.9 | 14.1 | 1,379 |
| 1988 | - | 10.7 | 454 | 421.6 | 252.1 | 544.3 | 224.8 | 104.9 | 39.2 | 96.8 | 18.2 | 10.2 | 3.8 | 11.7 | 2,192 |
| 1989 | - | 4.8 | 55.1 | 149 | 451.1 | 166.7 | 572.2 | 96.3 | 103.8 | 32.4 | 129 | 10.9 | 4 | 8.5 | 1,784 |
| 1990 | 1.3 | 33 | 57 | 219.5 | 200.7 | 477.7 | 129.2 | 368.4 | 65.7 | 101.9 | 9 | 60.1 | 8.5 | 13.9 | 1,746 |
| 1991 | 0.7 | 112.9 | 43.8 | 90.3 | 153.9 | 184.4 | 497.5 | 78.1 | 288.0 | 28.9 | 144.1 | 18.7 | 91.2 | 22.8 | 1,755 |
| 1992 | 1.1 | 84.7 | 675.8 | 130.1 | 79.6 | 108.7 | 133.8 | 253.6 | 102.3 | 147.0 | 58.0 | 46.3 | 13.4 | 43.8 | 1,878 |
| 1993 | 0.1 | 7.4 | 260.5 | 1146.7 | 103.0 | 66.2 | 66.4 | 56.5 | 86.2 | 21.2 | 32.7 | 12.4 | 13.5 | 6.8 | 1,879 |
| 1994 | 0.7 | 30.2 | 55.1 | 361.2 | 1059.7 | 175.7 | 53.5 | 19.1 | 13.1 | 20.2 | 9.7 | 9.4 | 7.6 | 4.0 | 1,819 |
| 1995 | 0.0 | 0.5 | 72.9 | 146.8 | 395.5 | 761.1 | 136.3 | 34.6 | 12.3 | 7.5 | 17.5 | 5.0 | 5.8 | 1.7 | 1,597 |
| 1996 | 0.0 | 21.7 | 48.1 | 71.8 | 161.0 | 361.9 | 481.7 | 184.6 | 33.6 | 13.4 | 7.9 | 8.8 | 4.3 | 5.8 | 1,405 |
| 1997 | 1.0 | 77.7 | 40.3 | 119.0 | 455.1 | 289.0 | 256.4 | 198.6 | 64.0 | 13.3 | 6.0 | 4.6 | 2.9 | 4.8 | 1,533 |
| 1998 | 0.3 | 42.0 | 84.5 | 70.5 | 153.4 | 702.8 | 199.6 | 131.7 | 110.7 | 27.8 | 6.1 | 5.6 | 2.6 | 2.5 | 1,540 |
| 1999 | 0.2 | 10.3 | 298.7 | 225.0 | 103.0 | 157.0 | 469.7 | 131.0 | 56.5 | 33.2 | 4.0 | 2.2 | 0.9 | 0.5 | 1,492 |
| 2000 | 0.0 | 16.1 | 82.4 | 428.5 | 346.5 | 106.7 | 168.4 | 357.7 | 84.9 | 29.7 | 22.0 | 5.2 | 1.4 | 0.6 | 1,650 |
| 2001 | 0.0 | 3.2 | 42.8 | 154.5 | 581.0 | 415.0 | 137.2 | 129.0 | 157.2 | 57.9 | 33.6 | 16.2 | 5.5 | 3.1 | 1,736 |
| 2002 | 0.8 | 47.0 | 108.1 | 217.8 | 287.6 | 606.3 | 268.0 | 98.5 | 85.9 | 93.9 | 34.6 | 14.4 | 11.0 | 3.0 | 1,877 |
| 2003 | 0.0 | 14.5 | 411.8 | 324.1 | 360.4 | 301.5 | 337.6 | 158.6 | 49.4 | 39.3 | 35.7 | 22.9 | 6.6 | 3.6 | 2,066 |
| 2004 | 0.0 | 0.5 | 89.6 | 831.1 | 480.6 | 236.8 | 169.3 | 156.3 | 65.0 | 16.1 | 17.1 | 25.3 | 9.4 | 5.9 | 2,103 |
| 2005 | 0.0 | 4.8 | 52.2 | 392.9 | 863.8 | 484.6 | 159.5 | 68.1 | 66.6 | 30.1 | 10.0 | 9.1 | 3.2 | 2.5 | 2,147 |
| 2006 | 0.0 | 9.9 | 84.2 | 295.8 | 619.6 | 597.6 | 278.6 | 107.3 | 48.0 | 38.4 | 17.7 | 8.2 | 8.3 | 5.3 | 2,119 |
| 2007 | 1.7 | 15.7 | 59.2 | 139.2 | 389.4 | 512.0 | 300.8 | 137.1 | 47.6 | 27.5 | 21.9 | 8.9 | 6.5 | 3.4 | 1,671 |
| 2008 | 0.0 | 25.2 | 58.8 | 79.2 | 147.0 | 309.7 | 242.3 | 148.7 | 84.3 | 22.2 | 17.6 | 14.4 | 8.6 | 2.8 | 1,161 |
| 2009 | 0.0 | 1.3 | 175.5 | 200.6 | 82.6 | 114.4 | 124.3 | 104.3 | 66.6 | 40.2 | 23.5 | 7.6 | 7.5 | 2.7 | 951 |
| 2010 | 1.1 | 26.5 | 31.8 | 559.4 | 220.5 | 54.7 | 43.0 | 57.7 | 51.8 | 31.8 | 16.0 | 8.6 | 6.0 | 4.4 | 1,113 |
| 2011 | 0.4 | 10.4 | 193.3 | 115.4 | 809.2 | 284.7 | 63.6 | 37.5 | 38.5 | 41.4 | 25.8 | 12.5 | 1.8 | 4.0 | 1,638 |
| 2012 | 0.0 | 22.3 | 116.7 | 946.7 | 172.8 | 432.6 | 141.6 | 36.7 | 17.4 | 14.6 | 15.9 | 13.5 | 7.4 | 6.1 | 1,944 |
| 2013 | 1.8 | 1.0 | 64.0 | 342.4 | 955.9 | 194.4 | 156.5 | 70.0 | 20.7 | 12.8 | 12.8 | 10.9 | 7.8 | 4.8 | 1,856 |
| 2014 | 0.0 | 39.2 | 31.0 | 167.8 | 399.3 | 751.8 | 210.2 | 86.2 | 29.8 | 9.0 | 4.5 | 4.5 | 4.6 | 2.8 | 1,741 |
| 2015 | 0.0 | 15.5 | 632.4 | 196.4 | 228.6 | 384.3 | 510.1 | 88.8 | 42.1 | 17.7 | 2.9 | 2.1 | 3.1 | 2.7 | 2,127 |
| 2016 | 0.0 | 0.5 | 90.6 | 1390.3 | 159.9 | 174.5 | 174.8 | 224.7 | 34.1 | 13.8 | 8.0 | 0.5 | 1.2 | 0.7 | 2,273 |
| 2017 | 0.0 | 2.2 | 28.2 | 549.1 | 899.0 | 215.5 | 147.6 | 122.1 | 97.3 | 21.8 | 7.2 | 5.6 | 0.5 | 0.2 | 2,096 |
| 2018 | 0.0 | 1.3 | 13.8 | 115.0 | 1216.1 | 506.6 | 104.8 | 82.0 | 60.6 | 25.9 | 4.3 | 1.1 | 0.4 | 0.6 | 2,132 |
| 2019 | 0.7 | 10.9 | 12.3 | 18.4 | 157.6 | 916.8 | 422.5 | 93.2 | 52.1 | 53.0 | 10.1 | 2.9 | 0.8 | 0.0 | 1,751 |
| 2020 | 3.5 | 247.7 | 85.5 | 101.1 | 135.2 | 551.1 | 597.8 | 124.0 | 52.8 | 38.6 | 27.3 | 6.8 | 1.8 | 1.1 | 1,974 |
| 2021 | 0.0 | 111.5 | 1297.0 | 144.2 | 110.1 | 107.2 | 309.6 | 296.0 | 72.1 | 26.5 | 16.2 | 8.5 | 2.1 | 0.0 | 2,501 |
| 2022 | 0.0 | 62.3 | 174.5 | 1035.4 | 183.7 | 70.4 | 79.5 | 141.9 | 81.1 | 16.3 | 11.3 | 4.1 | 6.0 | 1.0 | 1,867 |
| 2023 | 0.0 | 25.2 | 86.6 | 263.0 | 1473.1 | 227.2 | 29.4 | 45.4 | 63.6 | 42.6 | 18.8 | 5.4 | 8.6 | 2.6 | 2,292 |
| Mean | 3.4 | 57.3 | 215.9 | 367.2 | 409.8 | 331.0 | 213.1 | 116.3 | 65.1 | 33.3 | 22.1 | 10.8 | 7.5 | 5.1 | 1,857.7 |

Table 6: Numbers of pollock NMFS observer samples measured for fishery catch length frequency (by sex and strata), 1977–2023.

| Year | Length Frequency samples | | | | | | |
|------|--------------------------|---------|-------------|---------|-------------|---------|---------|
| | A Season | | B Season SE | | B Season NW | | |
| | Males | Females | Males | Females | Males | Females | Total |
| 1977 | 26,411 | 25,923 | 4,301 | 4,511 | 29,075 | 31,219 | 121,440 |
| 1978 | 25,110 | 31,653 | 9,829 | 9,524 | 46,349 | 46,072 | 168,537 |
| 1979 | 59,782 | 62,512 | 3,461 | 3,113 | 62,298 | 61,402 | 252,568 |
| 1980 | 42,726 | 42,577 | 3,380 | 3,464 | 47,030 | 49,037 | 188,214 |
| 1981 | 64,718 | 57,936 | 2,401 | 2,147 | 53,161 | 53,570 | 233,933 |
| 1982 | 74,172 | 70,073 | 16,265 | 14,885 | 181,606 | 163,272 | 520,273 |
| 1983 | 94,118 | 90,778 | 16,604 | 16,826 | 193,031 | 174,589 | 585,946 |
| 1984 | 158,329 | 161,876 | 106,654 | 105,234 | 243,877 | 217,362 | 993,332 |
| 1985 | 119,384 | 109,230 | 96,684 | 97,841 | 284,850 | 256,091 | 964,080 |
| 1986 | 186,505 | 189,497 | 135,444 | 123,413 | 164,546 | 131,322 | 930,727 |
| 1987 | 373,163 | 399,072 | 14,170 | 21,162 | 24,038 | 22,117 | 853,722 |
| - | - | - | - | - | - | - | - |
| 1991 | 155,876 | 143,625 | 148,385 | 132,539 | 123,516 | 122,241 | 826,182 |
| 1992 | 152,566 | 148,024 | 150,829 | 152,003 | 93,073 | 94,701 | 791,196 |
| 1993 | 136,211 | 126,635 | 145,280 | 137,384 | 24,797 | 26,057 | 596,364 |
| 1994 | 138,179 | 146,067 | 154,311 | 148,497 | 26,431 | 26,380 | 639,865 |
| 1995 | 128,719 | 125,847 | 175,115 | 150,323 | 16,142 | 16,327 | 612,473 |
| 1996 | 147,992 | 139,905 | 193,493 | 149,814 | 18,101 | 18,288 | 667,593 |
| 1997 | 123,454 | 102,619 | 114,846 | 106,001 | 58,492 | 51,498 | 556,910 |
| 1998 | 135,136 | 109,119 | 205,282 | 174,676 | 31,968 | 39,475 | 695,656 |
| 1999 | 36,035 | 32,407 | 38,229 | 35,084 | 16,258 | 18,321 | 176,334 |
| 2000 | 64,430 | 58,030 | 63,746 | 41,027 | 40,839 | 39,105 | 307,177 |
| 2001 | 79,190 | 75,491 | 54,037 | 51,179 | 44,232 | 45,766 | 349,895 |
| 2002 | 71,502 | 69,467 | 65,299 | 64,243 | 37,661 | 39,285 | 347,457 |
| 2003 | 74,902 | 77,533 | 49,307 | 52,899 | 51,764 | 53,435 | 359,840 |
| 2004 | 75,208 | 75,811 | 63,146 | 61,957 | 47,261 | 44,220 | 367,603 |
| 2005 | 75,784 | 68,665 | 43,271 | 33,917 | 68,831 | 63,022 | 353,490 |
| 2006 | 72,543 | 63,349 | 35,378 | 27,939 | 77,620 | 67,219 | 344,048 |
| 2007 | 66,533 | 63,969 | 38,104 | 29,558 | 76,755 | 70,504 | 345,423 |
| 2008 | 51,303 | 46,296 | 23,467 | 20,462 | 64,126 | 60,678 | 266,332 |
| 2009 | 43,476 | 41,540 | 17,343 | 16,148 | 45,418 | 47,926 | 211,851 |
| 2010 | 41,019 | 39,495 | 20,577 | 19,194 | 40,914 | 40,449 | 201,648 |
| 2011 | 62,295 | 58,481 | 65,057 | 60,208 | 48,055 | 50,927 | 345,023 |
| 2012 | 57,946 | 53,557 | 46,942 | 45,024 | 53,243 | 49,968 | 306,680 |
| 2013 | 62,148 | 51,984 | 44,582 | 37,307 | 49,649 | 49,161 | 294,831 |
| 2014 | 58,066 | 55,954 | 51,743 | 46,568 | 46,067 | 46,642 | 305,040 |
| 2015 | 56,419 | 55,646 | 43,601 | 46,853 | 41,183 | 45,117 | 288,819 |
| 2016 | 58,915 | 57,478 | 69,654 | 72,973 | 9,015 | 10,264 | 278,299 |
| 2017 | 64,693 | 55,965 | 65,982 | 70,285 | 14,125 | 15,871 | 286,921 |
| 2018 | 64,628 | 57,156 | 49,653 | 56,243 | 32,796 | 35,811 | 296,287 |
| 2019 | 64,665 | 49,191 | 54,927 | 59,416 | 27,753 | 34,955 | 290,907 |
| 2020 | 65,609 | 60,018 | 47,791 | 53,161 | 48,459 | 53,985 | 329,023 |
| 2021 | 75,561 | 59,580 | 53,205 | 61,208 | 27,641 | 30,833 | 308,028 |
| 2022 | 57,459 | 46,843 | 43,299 | 47,450 | 16,811 | 18,006 | 229,868 |
| 2023 | xxxxxx9 | 46,843 | 43,299 | 47,450 | 16,811 | 18,006 | 229,868 |

Table 7: Number of EBS pollock measured for weight and length by sex and strata as collected by the NMFS observer program, 1977-2023

| | Weight-length samples | | | | | | |
|------|-----------------------|---------|-------------|---------|-------------|---------|--------|
| | A Season | | B Season SE | | B Season NW | | Total |
| | Males | Females | Males | Females | Males | Females | |
| 1977 | 1,222 | 1,338 | 137 | 166 | 1,461 | 1,664 | 5,988 |
| 1978 | 1,991 | 2,686 | 409 | 516 | 2,200 | 2,623 | 10,425 |
| 1979 | 2,709 | 3,151 | 152 | 209 | 1,469 | 1,566 | 9,256 |
| 1980 | 1,849 | 2,156 | 99 | 144 | 612 | 681 | 5,541 |
| 1981 | 1,821 | 2,045 | 51 | 52 | 1,623 | 1,810 | 7,402 |
| 1982 | 2,030 | 2,208 | 181 | 176 | 2,852 | 3,043 | 10,490 |
| 1983 | 1,199 | 1,200 | 144 | 122 | 3,268 | 3,447 | 9,380 |
| 1984 | 980 | 1,046 | 117 | 136 | 1,273 | 1,378 | 4,930 |
| 1985 | 520 | 499 | 46 | 55 | 426 | 488 | 2,034 |
| 1986 | 689 | 794 | 518 | 501 | 286 | 286 | 3,074 |
| 1987 | 1,351 | 1,466 | 25 | 33 | 72 | 63 | 3,010 |
| - | - | - | - | - | - | - | - |
| 1991 | 2,893 | 2,791 | 1,209 | 1,116 | 2,536 | 2,408 | 12,953 |
| 1992 | 1,605 | 1,537 | 556 | 600 | 2,003 | 1,940 | 8,241 |
| 1993 | 1,278 | 1,205 | 451 | 437 | 1,412 | 1,459 | 6,242 |
| 1994 | 1,638 | 1,553 | 174 | 166 | 1,591 | 1,584 | 6,706 |
| 1995 | 1,258 | 1,220 | 232 | 223 | 1,352 | 1,331 | 5,616 |
| 1996 | 2,165 | 2,117 | - | - | 1,393 | 1,421 | 7,096 |
| 1997 | 629 | 630 | 552 | 536 | 674 | 620 | 3,641 |
| 1998 | 1,958 | 1,865 | 357 | 335 | 936 | 982 | 6,433 |
| 1999 | 4,813 | 5,337 | 3,767 | 3,546 | 7,182 | 7,954 | 32,599 |
| 2000 | 11,346 | 12,457 | 7,736 | 7,991 | 7,800 | 12,463 | 59,793 |
| 2001 | 14,411 | 14,965 | 9,064 | 8,803 | 10,460 | 10,871 | 68,574 |
| 2002 | 13,564 | 14,098 | 7,648 | 7,213 | 13,004 | 12,988 | 68,515 |
| 2003 | 15,535 | 14,857 | 10,272 | 10,031 | 10,111 | 9,437 | 70,243 |
| 2004 | 7,924 | 7,742 | 4,318 | 4,617 | 6,868 | 6,850 | 38,319 |
| 2005 | 7,039 | 7,428 | 6,426 | 6,947 | 4,114 | 5,139 | 37,093 |
| 2006 | 6,566 | 7,381 | 6,442 | 7,406 | 3,045 | 4,006 | 34,846 |
| 2007 | 6,640 | 6,695 | 7,081 | 7,798 | 3,202 | 4,305 | 35,721 |
| 2008 | 4,501 | 4,865 | 5,855 | 6,264 | 2,236 | 2,624 | 26,345 |
| 2009 | 4,033 | 4,382 | 4,655 | 4,511 | 1,723 | 1,934 | 21,238 |
| 2010 | 4,258 | 4,536 | 3,883 | 4,125 | 2,012 | 2,261 | 21,075 |
| 2011 | 5,845 | 6,388 | 4,954 | 4,647 | 5,929 | 6,456 | 34,219 |
| 2012 | 5,494 | 5,979 | 4,923 | 5,346 | 4,507 | 4,774 | 31,023 |
| 2013 | 5,689 | 6,525 | 4,844 | 4,920 | 3,599 | 4,313 | 29,890 |
| 2014 | 5,675 | 5,871 | 4,785 | 4,652 | 4,753 | 5,180 | 30,916 |
| 2015 | 5,310 | 5,323 | 4,648 | 4,194 | 4,365 | 4,064 | 27,904 |
| 2016 | 5,312 | 5,725 | 1,077 | 909 | 6,872 | 6,635 | 26,530 |
| 2017 | 5,238 | 6,047 | 1,586 | 1,343 | 6,575 | 6,254 | 27,043 |
| 2018 | 5,583 | 6,174 | 3,430 | 3,172 | 5,506 | 4,850 | 28,715 |
| 2019 | 4,513 | 6,086 | 3,594 | 2,953 | 5,809 | 5,499 | 28,454 |
| 2020 | 6,116 | 6,846 | 5,325 | 4,815 | 5,376 | 4,900 | 33,378 |
| 2021 | 5,852 | 7,368 | 6,247 | 5,468 | 2,886 | 2,698 | 30,519 |
| 2022 | 4,862 | 5,817 | 2,240 | 1,858 | 531 | 506 | 15,814 |
| 2023 | xxxxx | 5,817 | 2,240 | 1,858 | 531 | 506 | 15,814 |

Table 8: Numbers of pollock fishery samples used for age determination estimates by sex and strata, 1977–2023, as sampled by the NMFS observer program.

| | A Season | | B Season SE | | B Season NW | | Total |
|------|----------|---------|-------------|---------|-------------|---------|--------|
| | Males | Females | Males | Females | Males | Females | |
| 1977 | 1,229 | 1,344 | 137 | 166 | 1,415 | 1,613 | 5,904 |
| 1978 | 1,992 | 2,686 | 407 | 514 | 2,188 | 2,611 | 10,398 |
| 1979 | 2,647 | 3,088 | 152 | 209 | 1,464 | 1,561 | 9,121 |
| 1980 | 1,854 | 2,158 | 93 | 138 | 606 | 675 | 5,524 |
| 1981 | 1,819 | 2,042 | 51 | 52 | 1,620 | 1,807 | 7,391 |
| 1982 | 2,030 | 2,210 | 181 | 176 | 2,865 | 3,062 | 10,524 |
| 1983 | 1,200 | 1,200 | 144 | 122 | 3,249 | 3,420 | 9,335 |
| 1984 | 980 | 1,046 | 117 | 136 | 1,272 | 1,379 | 4,930 |
| 1985 | 520 | 499 | 46 | 55 | 426 | 488 | 2,034 |
| 1986 | 689 | 794 | 518 | 501 | 286 | 286 | 3,074 |
| 1987 | 1,351 | 1,466 | 25 | 33 | 72 | 63 | 3,010 |
| - | - | - | - | - | - | - | - |
| 1991 | 439 | 431 | 367 | 349 | 263 | 289 | 2,138 |
| 1992 | 399 | 396 | 178 | 180 | 391 | 375 | 1,919 |
| 1993 | 476 | 445 | 122 | 124 | 496 | 507 | 2,170 |
| 1994 | 201 | 200 | 142 | 132 | 574 | 571 | 1,820 |
| 1995 | 313 | 299 | 131 | 123 | 420 | 439 | 1,725 |
| 1996 | 465 | 479 | - | - | 436 | 443 | 1,823 |
| 1997 | 437 | 434 | 343 | 341 | 313 | 286 | 2,154 |
| 1998 | 663 | 595 | 237 | 222 | 311 | 316 | 2,344 |
| 1999 | 506 | 541 | 298 | 308 | 748 | 750 | 3,151 |
| 2000 | 629 | 667 | 293 | 254 | 596 | 847 | 3,286 |
| 2001 | 563 | 603 | 205 | 178 | 697 | 736 | 2,982 |
| 2002 | 672 | 663 | 247 | 202 | 890 | 839 | 3,513 |
| 2003 | 653 | 588 | 274 | 262 | 701 | 671 | 3,149 |
| 2004 | 547 | 561 | 221 | 245 | 698 | 600 | 2,872 |
| 2005 | 599 | 617 | 420 | 422 | 490 | 614 | 3,162 |
| 2006 | 528 | 609 | 507 | 568 | 367 | 459 | 3,038 |
| 2007 | 627 | 642 | 552 | 568 | 485 | 594 | 3,468 |
| 2008 | 513 | 497 | 538 | 650 | 342 | 368 | 2,908 |
| 2009 | 404 | 484 | 440 | 432 | 240 | 299 | 2,299 |
| 2010 | 545 | 624 | 413 | 466 | 418 | 505 | 2,971 |
| 2011 | 581 | 808 | 404 | 396 | 582 | 660 | 3,431 |
| 2012 | 517 | 571 | 485 | 579 | 480 | 533 | 3,165 |
| 2013 | 666 | 703 | 525 | 568 | 401 | 518 | 3,381 |
| 2014 | 609 | 629 | 413 | 407 | 475 | 553 | 3,086 |
| 2015 | 653 | 642 | 511 | 493 | 508 | 513 | 3,320 |
| 2016 | 488 | 599 | 157 | 125 | 929 | 969 | 3,267 |
| 2017 | 604 | 778 | 179 | 163 | 777 | 753 | 3,254 |
| 2018 | 569 | 662 | 366 | 358 | 621 | 591 | 3,167 |
| 2019 | 552 | 778 | 387 | 332 | 558 | 531 | 3,138 |
| 2020 | 757 | 899 | 405 | 420 | 450 | 408 | 3,339 |
| 2021 | 760 | 910 | 588 | 542 | 270 | 256 | 3,326 |
| 2022 | 608 | 776 | 616 | 558 | 209 | 211 | 2,978 |
| 2023 | xxx | 776 | 616 | 558 | 209 | 211 | 2,978 |

Table 9: NMFS total pollock research catch by year in t, 1964–2023.

| Year | Bering Sea | Year | Bering Sea | Year | Bering Sea |
|------|------------|------|------------|------|------------|
| 1964 | 0 | 1983 | 508 | 2002 | 440 |
| 1965 | 18 | 1984 | 208 | 2003 | 285 |
| 1966 | 17 | 1985 | 435 | 2004 | 363 |
| 1967 | 21 | 1986 | 163 | 2005 | 87 |
| 1968 | 7 | 1987 | 174 | 2006 | 251 |
| 1969 | 14 | 1988 | 467 | 2007 | 333 |
| 1970 | 9 | 1989 | 393 | 2008 | 168 |
| 1971 | 16 | 1990 | 369 | 2009 | 156 |
| 1972 | 11 | 1991 | 465 | 2010 | 226 |
| 1973 | 69 | 1992 | 156 | 2011 | 1322 |
| 1974 | 83 | 1993 | 221 | 2012 | 219 |
| 1975 | 197 | 1994 | 267 | 2013 | 183 |
| 1976 | 122 | 1995 | 249 | 2014 | 308 |
| 1977 | 35 | 1996 | 206 | 2015 | 256 |
| 1978 | 94 | 1997 | 262 | 2016 | 198 |
| 1979 | 458 | 1998 | 121 | 2017 | 363 |
| 1980 | 139 | 1999 | 299 | 2018 | 269 |
| 1981 | 466 | 2000 | 313 | 2019 | 338 |
| 1982 | 682 | 2001 | 241 | 2020 | 13 |
| | | | | 2021 | 898 |
| | | | | 2022 | 246 |
| | | | | 2023 | xxx |
| | | | | 2024 | xxx |

Table 10: Survey biomass estimates (age 1+, t) of Eastern Bering Sea pollock based on design-based area-swept expansion methods from NMFS bottom trawl surveys 1982–2024 .

| Year | Survey biomass | | | |
|---------|----------------|------------|-----------|-------|
| | Strata 1-6 | Strata 8-9 | Total | %NW |
| 1982 | 2,854,067 | 54,333 | 2,908,400 | 1.9% |
| 1983 | 5,910,351 | - | 5,910,351 | |
| 1984 | 4,538,253 | - | 4,538,253 | |
| 1985 | 4,543,845 | 1,388,121 | 5,931,966 | 23.4% |
| 1986 | 4,830,239 | - | 4,830,239 | |
| 1987 | 5,101,495 | 386,312 | 5,487,807 | 7.0% |
| 1988 | 6,988,785 | 179,531 | 7,168,316 | 2.5% |
| 1989 | 5,891,474 | 642,812 | 6,534,286 | 9.8% |
| 1990 | 7,086,231 | 189,055 | 7,275,286 | 2.6% |
| 1991 | 5,060,594 | 62,291 | 5,122,885 | 1.2% |
| 1992 | 4,310,567 | 208,971 | 4,519,538 | 4.6% |
| 1993 | 5,196,757 | 98,257 | 5,295,014 | 1.9% |
| 1994 | 4,974,941 | 49,563 | 5,024,503 | 1.0% |
| 1995 | 5,408,305 | 68,377 | 5,476,682 | 1.2% |
| 1996 | 2,988,107 | 143,394 | 3,131,501 | 4.6% |
| 1997 | 2,866,779 | 692,854 | 3,559,633 | 19.5% |
| 1998 | 2,141,303 | 550,487 | 2,691,790 | 20.5% |
| 1999 | 3,592,006 | 199,345 | 3,791,350 | 5.3% |
| 2000 | 4,981,435 | 118,285 | 5,099,720 | 2.3% |
| 2001 | 4,141,748 | 51,030 | 4,192,778 | 1.2% |
| 2002 | 4,744,887 | 197,356 | 4,942,242 | 4.0% |
| 2003 | 8,107,657 | 285,661 | 8,393,318 | 3.4% |
| 2004 | 3,745,935 | 118,370 | 3,864,305 | 3.1% |
| 2005 | 4,723,494 | 137,326 | 4,860,820 | 2.8% |
| 2006 | 2,842,370 | 199,328 | 3,041,698 | 6.6% |
| 2007 | 4,152,074 | 179,550 | 4,331,625 | 4.1% |
| 2008 | 2,829,351 | 188,832 | 3,018,183 | 6.3% |
| 2009 | 2,226,322 | 51,057 | 2,277,379 | 2.2% |
| 2010 | 3,542,594 | 186,598 | 3,729,191 | 5.0% |
| 2011 | 2,942,823 | 166,349 | 3,109,172 | 5.4% |
| 2012 | 3,280,469 | 205,701 | 3,486,170 | 5.9% |
| 2013 | 4,286,060 | 276,788 | 4,562,848 | 6.1% |
| 2014 | 6,549,316 | 876,186 | 7,425,501 | 11.8% |
| 2015 | 5,943,128 | 449,089 | 6,392,217 | 7.0% |
| 2016 | 4,698,980 | 211,474 | 4,910,454 | 4.3% |
| 2017 | 4,690,053 | 125,651 | 4,815,704 | 2.6% |
| 2018 | 3,016,181 | 97,024 | 3,113,204 | 3.1% |
| 2019 | 4,968,072 | 483,937 | 5,452,009 | 8.9% |
| 2020 | | | | |
| 2021 | 3,210,402 | 416,291 | 3,626,694 | 11.5% |
| 2022 | 5,286,911 | 167,616 | 5,454,528 | 3.1% |
| 2023 | 3,748,408 | 140,380 | 3,888,788 | 3.6% |
| 2024 | 7,885,512 | 73,237 | 7,958,749 | 0.9% |
| Average | 4,543,531 | 264,534 | 4,789,169 | 5.5% |

Table 11: Sampling effort for pollock in the EBS from the NMFS bottom trawl survey 1982–2024.

| Year | Number of Hauls | Lengths | Aged | Year | Number of Hauls | Lengths | Aged |
|------|-----------------|---------|-------|------|-----------------|---------|-------|
| 1982 | 329 | 40,001 | 1,611 | 1999 | 373 | 32,532 | 1,385 |
| 1983 | 354 | 78,033 | 1,931 | 2000 | 372 | 41,762 | 1,545 |
| 1984 | 355 | 40,530 | 1,806 | 2001 | 375 | 47,335 | 1,641 |
| 1985 | 434 | 48,642 | 1,913 | 2002 | 375 | 43,361 | 1,695 |
| 1986 | 354 | 41,101 | 1,344 | 2003 | 376 | 46,480 | 1,638 |
| 1987 | 356 | 40,144 | 1,607 | 2004 | 375 | 44,102 | 1,660 |
| 1988 | 373 | 40,408 | 1,173 | 2005 | 373 | 35,976 | 1,676 |
| 1989 | 373 | 38,926 | 1,227 | 2006 | 376 | 39,211 | 1,573 |
| 1990 | 371 | 34,814 | 1,257 | 2007 | 376 | 29,679 | 1,484 |
| 1991 | 371 | 43,406 | 1,083 | 2008 | 375 | 24,635 | 1,251 |
| 1992 | 356 | 34,024 | 1,263 | 2009 | 375 | 24,819 | 1,342 |
| 1993 | 375 | 43,278 | 1,385 | 2010 | 376 | 23,142 | 1,385 |
| 1994 | 375 | 38,901 | 1,141 | 2011 | 376 | 36,227 | 1,734 |
| 1995 | 376 | 25,673 | 1,156 | 2012 | 376 | 35,782 | 1,785 |
| 1996 | 375 | 40,789 | 1,387 | 2013 | 376 | 35,908 | 1,847 |
| 1997 | 376 | 35,536 | 1,193 | 2014 | 376 | 43,042 | 2,099 |
| 1998 | 375 | 37,673 | 1,261 | 2015 | 376 | 54,241 | 2,320 |
| | | | | 2016 | 376 | 50,857 | 1,766 |
| | | | | 2017 | 376 | 47,873 | 1,623 |
| | | | | 2018 | 376 | 48,673 | 1,486 |
| | | | | 2019 | 376 | 42,382 | 1,519 |
| | | | | — | — | — | — |
| | | | | 2021 | 376 | 53,545 | 1,528 |
| | | | | 2022 | 376 | 36,687 | 1,578 |
| | | | | 2023 | 376 | xx,xxx | x,xxx |
| | | | | 2024 | 376 | xx,xxx | x,xxx |

Table 12: Bottom-trawl survey estimated numbers (in tens of millions) at age used for the stock assessment model. Note that in 1982–84 and 1986 only strata 1–6 were surveyed. Note these estimates are based on VAST estimation procedures.

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Total |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|-----|-----|-----|--------|
| 1982 | 1,095 | 2,766 | 3,222 | 4,353 | 1,475 | 197 | 127 | 61 | 38 | 24 | 15 | 9 | 3 | 1 | 1 | 13,388 |
| 1983 | 4,535 | 1,072 | 2,920 | 4,557 | 9,382 | 2,708 | 459 | 208 | 95 | 85 | 61 | 22 | 8 | 7 | 3 | 26,124 |
| 1984 | 481 | 395 | 798 | 2,244 | 2,485 | 5,288 | 936 | 200 | 91 | 31 | 21 | 8 | 5 | 6 | 3 | 12,993 |
| 1985 | 4,933 | 790 | 3,899 | 1,380 | 4,540 | 2,795 | 1,848 | 351 | 86 | 73 | 25 | 8 | 8 | 1 | 1 | 20,738 |
| 1986 | 2,949 | 977 | 791 | 3,351 | 1,708 | 2,579 | 2,140 | 1,787 | 532 | 82 | 37 | 16 | 1 | 5 | 2 | 16,957 |
| 1987 | 490 | 688 | 1,175 | 924 | 5,568 | 1,456 | 1,329 | 516 | 1,611 | 254 | 78 | 30 | 6 | 3 | 3 | 14,130 |
| 1988 | 1,572 | 777 | 2,431 | 4,764 | 2,054 | 6,339 | 1,698 | 1,203 | 668 | 1,610 | 155 | 91 | 20 | 24 | 14 | 23,422 |
| 1989 | 905 | 545 | 959 | 3,053 | 6,767 | 1,276 | 4,503 | 632 | 700 | 262 | 820 | 140 | 125 | 59 | 92 | 20,838 |
| 1990 | 2,223 | 276 | 110 | 1,139 | 2,570 | 8,317 | 1,530 | 3,632 | 344 | 591 | 89 | 832 | 72 | 52 | 72 | 21,850 |
| 1991 | 3,230 | 928 | 357 | 140 | 984 | 842 | 2,514 | 875 | 1,691 | 427 | 570 | 117 | 343 | 52 | 59 | 13,128 |
| 1992 | 1,559 | 438 | 2,930 | 436 | 526 | 851 | 757 | 1,055 | 454 | 839 | 289 | 359 | 153 | 121 | 97 | 10,862 |
| 1993 | 2,683 | 443 | 1,151 | 5,126 | 1,066 | 811 | 405 | 531 | 673 | 411 | 355 | 258 | 205 | 112 | 136 | 14,365 |
| 1994 | 1,630 | 725 | 532 | 2,064 | 6,011 | 977 | 235 | 181 | 196 | 362 | 221 | 305 | 116 | 114 | 192 | 13,862 |
| 1995 | 1,617 | 216 | 477 | 2,004 | 2,928 | 5,104 | 1,872 | 405 | 235 | 148 | 272 | 110 | 202 | 82 | 130 | 15,801 |
| 1996 | 1,951 | 428 | 200 | 409 | 1,137 | 1,509 | 1,290 | 425 | 103 | 111 | 74 | 142 | 48 | 85 | 123 | 8,036 |
| 1997 | 2,332 | 406 | 220 | 269 | 3,078 | 1,412 | 829 | 1,066 | 184 | 93 | 67 | 72 | 123 | 39 | 147 | 10,337 |
| 1998 | 871 | 688 | 371 | 267 | 557 | 3,058 | 784 | 474 | 360 | 93 | 41 | 14 | 32 | 34 | 83 | 7,726 |
| 1999 | 991 | 1,113 | 1,297 | 1,234 | 685 | 1,260 | 2,949 | 757 | 360 | 333 | 124 | 53 | 22 | 32 | 115 | 11,324 |
| 2000 | 1,045 | 376 | 691 | 2,150 | 2,160 | 1,199 | 954 | 2,895 | 1,096 | 572 | 245 | 157 | 49 | 22 | 99 | 13,709 |
| 2001 | 1,987 | 1,222 | 726 | 703 | 1,689 | 1,656 | 690 | 335 | 996 | 711 | 271 | 211 | 73 | 30 | 81 | 11,381 |
| 2002 | 1,364 | 395 | 795 | 1,240 | 1,368 | 1,772 | 884 | 428 | 572 | 1,068 | 532 | 245 | 146 | 46 | 54 | 10,908 |
| 2003 | 574 | 166 | 1,066 | 1,828 | 2,160 | 1,800 | 2,258 | 1,166 | 486 | 635 | 1,237 | 560 | 232 | 95 | 102 | 14,366 |
| 2004 | 397 | 266 | 189 | 1,614 | 1,589 | 1,178 | 657 | 694 | 344 | 217 | 217 | 398 | 176 | 46 | 38 | 8,020 |
| 2005 | 401 | 148 | 220 | 1,104 | 3,239 | 2,179 | 1,141 | 455 | 387 | 270 | 78 | 160 | 266 | 106 | 114 | 10,267 |
| 2006 | 816 | 75 | 113 | 519 | 1,400 | 1,645 | 967 | 440 | 244 | 204 | 98 | 61 | 87 | 118 | 121 | 6,908 |
| 2007 | 2,734 | 68 | 221 | 707 | 2,218 | 2,508 | 1,673 | 1,166 | 462 | 198 | 174 | 157 | 72 | 87 | 180 | 12,625 |
| 2008 | 503 | 123 | 136 | 264 | 784 | 1,553 | 1,132 | 708 | 431 | 156 | 128 | 96 | 43 | 24 | 158 | 6,238 |
| 2009 | 842 | 211 | 433 | 490 | 332 | 502 | 708 | 538 | 385 | 176 | 110 | 35 | 35 | 18 | 79 | 4,895 |
| 2010 | 480 | 135 | 305 | 4,051 | 1,669 | 469 | 374 | 383 | 384 | 263 | 224 | 81 | 49 | 29 | 67 | 8,960 |
| 2011 | 1,292 | 136 | 342 | 426 | 2,153 | 1,043 | 295 | 160 | 243 | 240 | 204 | 157 | 68 | 32 | 95 | 6,887 |
| 2012 | 1,297 | 209 | 493 | 4,249 | 965 | 1,444 | 459 | 172 | 115 | 157 | 127 | 110 | 94 | 34 | 64 | 9,989 |
| 2013 | 1,252 | 133 | 272 | 1,131 | 5,459 | 1,232 | 751 | 263 | 89 | 80 | 104 | 79 | 76 | 44 | 61 | 11,024 |
| 2014 | 2,538 | 488 | 279 | 494 | 2,300 | 7,748 | 3,821 | 802 | 436 | 158 | 62 | 88 | 92 | 45 | 136 | 19,486 |
| 2015 | 1,457 | 929 | 2,767 | 741 | 1,516 | 2,736 | 5,151 | 1,522 | 385 | 191 | 27 | 26 | 49 | 30 | 68 | 17,595 |
| 2016 | 794 | 493 | 728 | 4,023 | 1,699 | 1,200 | 1,768 | 2,692 | 542 | 222 | 80 | 18 | 18 | 7 | 14 | 14,299 |
| 2017 | 784 | 321 | 545 | 2,648 | 3,496 | 1,597 | 1,231 | 1,155 | 1,476 | 424 | 163 | 55 | 8 | 5 | 16 | 13,923 |
| 2018 | 1,129 | 473 | 251 | 364 | 2,502 | 1,538 | 533 | 388 | 398 | 327 | 91 | 14 | 2 | 0 | 6 | 8,016 |
| 2019 | 2,680 | 713 | 593 | 615 | 1,760 | 6,277 | 2,507 | 596 | 430 | 254 | 134 | 61 | 24 | 7 | 3 | 16,652 |
| 2020 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2021 | 1,032 | 798 | 1,964 | 753 | 689 | 502 | 1,279 | 1,477 | 392 | 152 | 127 | 83 | 18 | 13 | 4 | 9,284 |
| 2022 | 812 | 351 | 600 | 4,006 | 1,872 | 730 | 811 | 1,142 | 856 | 272 | 116 | 97 | 37 | 21 | 2 | 11,726 |
| 2023 | 1,114 | 382 | 342 | 636 | 2,750 | 808 | 445 | 443 | 703 | 497 | 106 | 44 | 27 | 11 | 12 | 8,320 |
| 2024 | 1,626 | 1,096 | 975 | 662 | 2,078 | 6,804 | 1,509 | 470 | 443 | 399 | 273 | 103 | 32 | 12 | 4 | 16,487 |
| Mean | 1,548 | 557 | 926 | 1,741 | 2,413 | 2,307 | 1,386 | 830 | 493 | 325 | 196 | 135 | 78 | 41 | 68 | 13,044 |

Table 13: Mean EBS pollock body mass (kg) at age as estimated for the summer NMFS bottom trawl survey, 1982–2024.

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15+ |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1982 | 0.026 | 0.077 | 0.180 | 0.367 | 0.540 | 0.891 | 1.204 | 1.365 | 1.503 | 1.670 | 1.821 | 1.872 | 2.152 | 1.825 | 2.663 |
| 1983 | 0.016 | 0.105 | 0.185 | 0.361 | 0.521 | 0.716 | 1.020 | 1.307 | 1.511 | 1.578 | 1.631 | 1.571 | 1.813 | 1.556 | 1.986 |
| 1984 | 0.016 | 0.068 | 0.196 | 0.307 | 0.485 | 0.598 | 0.930 | 1.378 | 1.514 | 1.731 | 1.870 | 1.852 | 1.970 | 1.745 | 2.125 |
| 1985 | 0.017 | 0.082 | 0.213 | 0.336 | 0.473 | 0.681 | 0.891 | 1.232 | 1.649 | 1.608 | 1.721 | 2.016 | 2.105 | 1.802 | 2.490 |
| 1986 | 0.013 | 0.063 | 0.145 | 0.327 | 0.420 | 0.611 | 0.819 | 1.030 | 1.310 | 1.625 | 1.735 | 1.940 | 2.221 | 2.282 | 2.431 |
| 1987 | 0.026 | 0.106 | 0.246 | 0.294 | 0.426 | 0.523 | 0.692 | 0.826 | 0.974 | 1.181 | 1.494 | 1.517 | 1.928 | 2.229 | 2.373 |
| 1988 | 0.016 | 0.095 | 0.275 | 0.323 | 0.426 | 0.501 | 0.661 | 0.877 | 0.890 | 1.108 | 1.344 | 1.384 | 1.905 | 1.160 | 1.744 |
| 1989 | 0.019 | 0.090 | 0.168 | 0.305 | 0.391 | 0.505 | 0.710 | 0.804 | 1.100 | 1.089 | 1.226 | 1.312 | 1.290 | 1.290 | 1.481 |
| 1990 | 0.014 | 0.171 | 0.181 | 0.352 | 0.433 | 0.545 | 0.623 | 0.762 | 0.896 | 1.105 | 1.142 | 1.311 | 1.376 | 1.487 | 1.778 |
| 1991 | 0.021 | 0.136 | 0.199 | 0.354 | 0.564 | 0.638 | 0.720 | 0.817 | 0.982 | 1.080 | 1.328 | 1.414 | 1.571 | 1.815 | 1.980 |
| 1992 | 0.017 | 0.130 | 0.300 | 0.409 | 0.505 | 0.589 | 0.778 | 0.870 | 0.972 | 1.080 | 1.226 | 1.472 | 1.676 | 1.730 | 1.693 |
| 1993 | 0.012 | 0.103 | 0.289 | 0.470 | 0.525 | 0.645 | 0.739 | 0.866 | 1.062 | 1.099 | 1.293 | 1.408 | 1.608 | 1.689 | 1.811 |
| 1994 | 0.018 | 0.089 | 0.228 | 0.414 | 0.573 | 0.709 | 0.747 | 1.087 | 1.303 | 1.236 | 1.346 | 1.440 | 1.492 | 1.671 | 1.743 |
| 1995 | 0.017 | 0.063 | 0.145 | 0.340 | 0.480 | 0.657 | 0.680 | 0.897 | 1.075 | 1.363 | 1.308 | 1.401 | 1.517 | 1.511 | 1.766 |
| 1996 | 0.019 | 0.080 | 0.151 | 0.300 | 0.509 | 0.634 | 0.780 | 0.871 | 1.027 | 1.167 | 1.387 | 1.503 | 1.664 | 1.692 | 1.822 |
| 1997 | 0.015 | 0.083 | 0.201 | 0.300 | 0.370 | 0.606 | 0.750 | 0.868 | 1.144 | 1.217 | 1.349 | 1.532 | 1.602 | 1.622 | 1.796 |
| 1998 | 0.015 | 0.076 | 0.195 | 0.316 | 0.457 | 0.525 | 0.840 | 0.939 | 1.012 | 1.087 | 1.263 | 1.397 | 1.519 | 1.897 | 1.909 |
| 1999 | 0.013 | 0.091 | 0.206 | 0.363 | 0.420 | 0.572 | 0.685 | 0.900 | 1.109 | 1.161 | 1.301 | 1.374 | 1.823 | 1.790 | 2.086 |
| 2000 | 0.012 | 0.090 | 0.231 | 0.432 | 0.472 | 0.567 | 0.706 | 0.800 | 0.947 | 1.194 | 1.428 | 1.470 | 1.714 | 1.767 | 2.016 |
| 2001 | 0.015 | 0.076 | 0.180 | 0.375 | 0.549 | 0.692 | 0.805 | 0.873 | 0.958 | 1.099 | 1.323 | 1.535 | 1.615 | 1.814 | 1.969 |
| 2002 | 0.013 | 0.094 | 0.259 | 0.387 | 0.533 | 0.679 | 0.746 | 0.920 | 1.033 | 1.127 | 1.146 | 1.445 | 1.631 | 1.796 | 1.979 |
| 2003 | 0.021 | 0.114 | 0.288 | 0.451 | 0.645 | 0.754 | 0.837 | 0.964 | 1.039 | 1.211 | 1.219 | 1.401 | 1.592 | 1.528 | 1.868 |
| 2004 | 0.019 | 0.104 | 0.281 | 0.450 | 0.592 | 0.725 | 0.847 | 0.966 | 1.076 | 1.147 | 1.192 | 1.305 | 1.507 | 1.807 | 1.827 |
| 2005 | 0.020 | 0.107 | 0.238 | 0.412 | 0.554 | 0.670 | 0.843 | 0.958 | 1.019 | 1.082 | 1.336 | 1.280 | 1.305 | 1.483 | 1.604 |
| 2006 | 0.009 | 0.100 | 0.189 | 0.438 | 0.612 | 0.689 | 0.824 | 0.901 | 1.049 | 1.177 | 1.260 | 1.378 | 1.448 | 1.436 | 1.509 |
| 2007 | 0.013 | 0.103 | 0.290 | 0.515 | 0.639 | 0.803 | 0.905 | 1.028 | 1.122 | 1.392 | 1.349 | 1.385 | 1.699 | 1.594 | 1.658 |
| 2008 | 0.013 | 0.061 | 0.255 | 0.474 | 0.610 | 0.742 | 0.864 | 0.995 | 1.066 | 1.200 | 1.478 | 1.431 | 1.650 | 1.792 | 1.877 |
| 2009 | 0.011 | 0.066 | 0.250 | 0.504 | 0.697 | 0.791 | 0.994 | 1.107 | 1.179 | 1.443 | 1.525 | 1.687 | 1.943 | 2.227 | 2.317 |
| 2010 | 0.018 | 0.084 | 0.266 | 0.519 | 0.690 | 0.888 | 1.084 | 1.181 | 1.224 | 1.311 | 1.431 | 1.599 | 1.818 | 2.139 | 2.444 |
| 2011 | 0.015 | 0.082 | 0.230 | 0.512 | 0.662 | 0.775 | 0.924 | 1.097 | 1.232 | 1.277 | 1.426 | 1.489 | 1.611 | 1.757 | 2.058 |
| 2012 | 0.013 | 0.079 | 0.202 | 0.421 | 0.611 | 0.774 | 0.921 | 1.133 | 1.309 | 1.379 | 1.418 | 1.481 | 1.544 | 1.839 | 2.071 |
| 2013 | 0.015 | 0.081 | 0.212 | 0.505 | 0.582 | 0.736 | 0.977 | 1.164 | 1.324 | 1.415 | 1.515 | 1.542 | 1.693 | 1.913 | 1.996 |
| 2014 | 0.017 | 0.114 | 0.258 | 0.451 | 0.582 | 0.729 | 0.803 | 1.114 | 1.246 | 1.462 | 1.706 | 1.619 | 1.712 | 1.933 | 1.997 |
| 2015 | 0.017 | 0.087 | 0.332 | 0.449 | 0.590 | 0.689 | 0.795 | 0.922 | 1.216 | 1.243 | 1.584 | 1.527 | 1.493 | 1.555 | 1.811 |
| 2016 | 0.022 | 0.082 | 0.299 | 0.530 | 0.605 | 0.701 | 0.779 | 0.836 | 0.941 | 1.000 | 1.214 | 1.594 | 1.401 | 1.682 | 1.471 |
| 2017 | 0.021 | 0.104 | 0.254 | 0.472 | 0.634 | 0.673 | 0.757 | 0.821 | 0.904 | 0.922 | 1.077 | 1.031 | 1.274 | 1.148 | 1.549 |
| 2018 | 0.022 | 0.095 | 0.226 | 0.435 | 0.600 | 0.696 | 0.777 | 0.826 | 0.937 | 0.958 | 1.084 | 0.936 | 1.507 | 1.215 | 1.519 |
| 2019 | 0.022 | 0.113 | 0.297 | 0.501 | 0.637 | 0.741 | 0.831 | 0.946 | 0.960 | 1.044 | 1.012 | 1.056 | 1.042 | 1.283 | 1.451 |
| 2020 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 2021 | 0.022 | 0.102 | 0.239 | 0.447 | 0.585 | 0.713 | 0.804 | 0.856 | 0.980 | 1.150 | 1.065 | 1.151 | 1.313 | 1.026 | 1.382 |
| 2022 | 0.017 | 0.117 | 0.267 | 0.443 | 0.591 | 0.709 | 0.781 | 0.881 | 0.976 | 1.070 | 1.327 | 1.305 | 1.356 | 1.239 | 1.862 |
| 2023 | 0.016 | 0.117 | 0.271 | 0.417 | 0.533 | 0.660 | 0.803 | 0.935 | 0.963 | 1.010 | 1.150 | 1.140 | 1.463 | 1.893 | 1.507 |
| 2024 | 0.018 | 0.095 | 0.329 | 0.476 | 0.578 | 0.619 | 0.704 | 0.945 | 1.005 | 1.041 | 1.138 | 1.206 | 1.314 | 1.436 | 1.791 |
| Mean | 0.017 | 0.095 | 0.234 | 0.411 | 0.545 | 0.675 | 0.819 | 0.973 | 1.113 | 1.227 | 1.362 | 1.445 | 1.616 | 1.669 | 1.886 |

Table 14: Biomass (age 1+) of Eastern Bering Sea pollock as estimated by surveys 1982–2024 (thousands of t). Note that the bottom-trawl survey data only represent biomass from the survey strata (1–6) areas in 1982–1984, and 1986. For all other years the estimates include strata 8–9. DDC indicates the values obtained from the Kotwicki et al. Density-dependence correction method and the VAST column is for the standard survey area including the Northern Bering Sea extension and uses the cold pool as a covariate. BTS=Bottom trawl survey, DB=Design-based, ATS=acoustic trawl survey. The ATS estimate from 2020 arises from data collected aboard uncrewed sailing vessels with acoustic backscatter scaled to be consistent with previous years. BTS estimates include northern Bering Sea extensions.

| Year | DB.BTS | DDC | VAST | ATS |
|------|--------|--------|--------|-------|
| 1982 | 2,614 | 4,359 | 3,872 | |
| 1983 | 5,910 | 8,393 | 8,929 | |
| 1984 | 4,538 | 6,405 | 6,594 | |
| 1985 | 5,932 | 8,225 | 7,522 | |
| 1986 | 4,830 | 6,818 | 7,242 | |
| 1987 | 5,488 | 7,875 | 7,598 | |
| 1988 | 7,168 | 11,062 | 11,808 | |
| 1989 | 6,534 | 9,770 | 9,944 | |
| 1990 | 7,275 | 11,864 | 11,591 | |
| 1991 | 5,123 | 7,383 | 7,140 | |
| 1992 | 4,520 | 6,201 | 6,658 | |
| 1993 | 5,295 | 7,092 | 7,860 | |
| 1994 | 5,025 | 7,093 | 7,107 | 3,629 |
| 1995 | 5,477 | 9,103 | 6,614 | |
| 1996 | 3,132 | 4,089 | 3,953 | 2,945 |
| 1997 | 3,560 | 5,016 | 4,381 | 3,591 |
| 1998 | 2,692 | 3,515 | 3,426 | |
| 1999 | 3,791 | 5,442 | 5,621 | 4,141 |
| 2000 | 5,100 | 7,347 | 7,251 | 3,626 |
| 2001 | 4,193 | 5,434 | 6,080 | |
| 2002 | 4,942 | 6,754 | 6,756 | 4,306 |
| 2003 | 8,393 | 13,516 | 11,270 | |
| 2004 | 3,864 | 5,109 | 5,492 | 4,010 |
| 2005 | 4,861 | 6,685 | 6,986 | |
| 2006 | 3,042 | 3,881 | 4,193 | 1,873 |
| 2007 | 4,332 | 6,137 | 6,783 | 2,278 |
| 2008 | 3,018 | 3,987 | 4,295 | 1,406 |
| 2009 | 2,277 | 2,983 | 2,825 | 1,325 |
| 2010 | 3,750 | 5,141 | 5,287 | 2,642 |
| 2011 | 3,109 | 3,945 | 4,510 | |
| 2012 | 3,486 | 4,614 | 5,159 | 2,296 |
| 2013 | 4,563 | 6,098 | 6,740 | |
| 2014 | 7,426 | 10,329 | 11,648 | 4,730 |
| 2015 | 6,392 | 8,584 | 11,235 | |
| 2016 | 4,910 | 6,611 | 8,282 | 4,829 |
| 2017 | 6,135 | 7,922 | 8,874 | |
| 2018 | 3,113 | 4,186 | 4,258 | 2,499 |
| 2019 | 6,619 | 8,767 | 9,288 | |
| 2020 | — | — | — | 3,605 |
| 2021 | 3,505 | 4,154 | 4,886 | |
| 2022 | 4,549 | 5,891 | 6,532 | 3,834 |
| 2023 | 3,519 | 4,279 | 4,934 | |
| Avg. | 4,732 | 6,636 | 6,864 | 3,198 |

Table 15: Number of (age 1+) hauls and sample sizes for EBS pollock collected by the AT surveys. Sub-headings E and W represent collections east and west of 170W (within the US EEZ) and US represents the US sub-total and RU represents the collections from the Russian side of the surveyed region.

| Year | Hauls | | | | Lengths | | | | Otoliths | | | | Number aged | | | |
|------|-------|----|-----|----|---------|--------|--------|-------|----------|-------|-------|-------|-------------|-------|-------|-------|
| | E | W | US | RU | E | W | US | RU | E | W | US | RU | E | W | US | RU |
| 1979 | | | 25 | | | | 7,722 | | | | 0 | | | | | 2,610 |
| 1982 | 13 | 31 | 48 | | 1,725 | 6,689 | 8,687 | | 840 | 2,324 | 3,164 | | 783 | 1,958 | 2,741 | |
| 1985 | | | 73 | | | | 19,872 | | | | 2,739 | | | | | 2,739 |
| 1988 | | | 25 | | | | 6,619 | | | | 1,471 | | | | | 1,471 |
| 1991 | | | 62 | | | | 16,343 | | | | 2,062 | | | | | 1,663 |
| 1994 | 25 | 51 | 76 | 19 | 4,553 | 21,011 | 25,564 | 8,930 | 1,560 | 3,694 | 4,966 | 1,270 | 612 | 932 | 1,770 | 455 |
| 1996 | 15 | 42 | 57 | | 3,551 | 13,273 | 16,824 | | 669 | 1,280 | 1,949 | | 815 | 1,111 | 1,926 | |
| 1997 | 25 | 61 | 86 | | 6,493 | 23,043 | 29,536 | | 966 | 2,669 | 3,635 | | 936 | 1,349 | 2,285 | |
| 1999 | 41 | 77 | 118 | | 13,841 | 28,521 | 42,362 | | 1,945 | 3,001 | 4,946 | | 946 | 1,500 | 2,446 | |
| 2000 | 29 | 95 | 124 | | 7,721 | 36,008 | 43,729 | | 850 | 2,609 | 3,459 | | 850 | 1,403 | 2,253 | |
| 2002 | 47 | 79 | 126 | | 14,601 | 25,633 | 40,234 | | 1,424 | 1,883 | 3,307 | | | 1,000 | 1,200 | 2,200 |
| 2004 | 33 | 57 | 90 | 15 | 8,896 | 18,262 | 27,158 | 5,893 | 1,167 | 2,002 | 3,169 | 461 | 798 | 1,192 | 2,351 | 461 |
| 2006 | 27 | 56 | 83 | | 4,939 | 19,326 | 24,265 | | 822 | 1,871 | 2,693 | | 822 | 1,870 | 2,692 | |
| 2007 | 23 | 46 | 69 | 4 | 5,492 | 14,863 | 20,355 | 1,407 | 871 | 1,961 | 2,832 | 319 | 823 | 1,737 | 2,560 | 315 |
| 2008 | 9 | 53 | 62 | 6 | 2,394 | 15,354 | 17,748 | 1,754 | 341 | 1,698 | 2,039 | 177 | 338 | 1,381 | 1,719 | 176 |
| 2009 | 13 | 33 | 46 | 3 | 1,576 | 9,257 | 10,833 | 282 | 308 | 1,210 | 1,518 | 54 | 306 | 1,205 | 1,511 | 54 |
| 2010 | 11 | 48 | 59 | 9 | 2,432 | 20,263 | 22,695 | 3,502 | 653 | 1,868 | 2,521 | 381 | 652 | 1,598 | 2,250 | 379 |
| 2012 | 17 | 60 | 77 | 14 | 4,422 | 23,929 | 28,351 | 5,620 | 650 | 2,045 | 2,695 | 418 | 646 | 1,483 | 2,129 | 416 |
| 2014 | 52 | 87 | 139 | 3 | 28,857 | 8,645 | 37,502 | 747 | 1,739 | 849 | 2,588 | 72 | 845 | 1,735 | 2,580 | 72 |
| 2016 | 37 | 71 | 108 | | 10,912 | 24,134 | 35,046 | | 880 | 1,514 | 2,394 | | | 876 | 1,513 | 2,388 |
| 2018 | 36 | 64 | 100 | | 11,031 | 21,173 | 32,204 | | 1,105 | 1,750 | 2,855 | | 1,100 | 1,743 | 2,843 | |
| 2022 | 26 | 36 | 62 | | 4,954 | 11,994 | 16,948 | | 671 | 1,691 | 2,362 | | 668 | 1,688 | 2,356 | |
| 2024 | 13 | 41 | 55 | | 4,954 | 11,994 | 16,948 | | 671 | 1,691 | 2,362 | | 668 | 1,688 | 2,356 | |

Table 16: Mid-water pollock biomass (millions of t; near surface down to 0.5m from the bottom) by area as estimated from summer acoustic-trawl surveys on the U.S. EEZ portion of the Bering Sea shelf, 1994–2024 (Honkalehto et al. 2015, McCarthy et al. 2020, and De Robertis et al. 2021). Note that in 2020 the survey was carried out by uncrewed sailing vessels.

| Year | Date | Area (nmi) ² | Biomass | | | | | | Rel. Error | CV |
|------|-----------------|----------------------------|---------|----------|-------|------|-------|-------|------------|----|
| | | | SCA | E170-SCA | W170 | 0.5m | Total | | | |
| 1994 | 9 Jul - 19 Aug | 78,251 | 0.378 | 0.656 | 2.595 | | 3.629 | 0.040 | 19% | |
| 1996 | 20 Jul - 30 Aug | 93,810 | 0.272 | 0.49 | 2.182 | | 2.944 | 0.032 | 15% | |
| 1997 | 17 Jul - 4 Sept | 102,770 | 0.274 | 0.853 | 2.463 | | 3.59 | 0.029 | 14% | |
| 1999 | 7 Jun - 5 Aug | 103,670 | 0.323 | 0.758 | 3.06 | | 4.141 | 0.044 | 20% | |
| 2000 | 7 Jun - 2 Aug | 106,140 | 0.457 | 0.717 | 2.452 | | 3.626 | 0.028 | 13% | |
| 2002 | 4 Jun - 30 Jul | 99,526 | 0.755 | 0.946 | 2.605 | | 4.306 | 0.027 | 12% | |
| 2004 | 4 Jun - 29 Jul | 99,659 | 0.550 | 0.918 | 2.528 | | 3.996 | 0.031 | 14% | |
| 2006 | 3 Jun - 25 Jul | 89,550 | 0.147 | 0.340 | 1.387 | | 1.874 | 0.033 | 16% | |
| 2007 | 2 Jun - 30 Jul | 92,944 | 0.136 | 0.245 | 1.899 | | 2.280 | 0.038 | 18% | |
| 2008 | 2 Jun - 31 Jul | 95,374 | 0.122 | 0.087 | 1.196 | | 1.404 | 0.056 | 26% | |
| 2009 | 9 Jun - 7 Aug | 91,414 | 0.156 | 0.058 | 1.117 | | 1.331 | 0.069 | 32% | |
| 2010 | 5 Jun - 7 Aug | 92,849 | 0.098 | 0.193 | 2.345 | | 2.636 | 0.054 | 25% | |
| 2012 | 7 Jun - 10 Aug | 96,852 | 0.196 | 0.319 | 1.764 | | 2.279 | 0.034 | 16% | |
| 2014 | 12 Jun - 13 Aug | 94,361 | 0.571 | 1.458 | 2.714 | | 4.743 | 0.034 | 16% | |
| 2016 | 12 Jun - 17 Aug | 100,674 | 0.542 | 1.268 | 3.028 | | 4.838 | 0.019 | 9% | |
| 2018 | 12 Jun - 22 Aug | 92,283 | 0.234 | 0.510 | 1.753 | | 2.497 | 0.039 | 18% | |
| 2020 | 4 Jul - 20 Aug | 102,320 | 0.398 | 0.531 | 2.688 | | 3.617 | 0.096 | 45% | |
| 2022 | 1 Jun - 5 Aug | 103,942 | 0.538 | 0.826 | 2.470 | | 3.834 | 0.068 | 32% | |
| 2024 | 11 Jun- 19 Jul | xxx,942 | 0.488 | 0.583 | 1.799 | | 2.871 | 0.056 | 26% | |

Table 17: AT survey estimates of EBS pollock abundance-at-age (millions), 1979–2024. Age-1s were modeled as a separate index, ages 2+ modeled as proportions at age.

| Year | Age | | | | | | | | | | Age | | |
|--------|--------|--------|-------|-------|-------|-------|-------|-----|-----|-----|--------|---------|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10+ | 2+ | Total | |
| 1979 | 69,110 | 41,132 | 3,884 | 413 | 534 | 128 | 30 | 4 | 28 | 161 | 46,314 | 115,424 | |
| 1982 | 108 | 3,401 | 4,108 | 7,637 | 1,790 | 283 | 141 | 178 | 90 | 177 | 17,805 | 17,913 | |
| 1985 | 2,076 | 929 | 8,149 | 898 | 2,186 | 1,510 | 1,127 | 130 | 21 | 15 | 14,965 | 17,041 | |
| 1988 | 11 | 1,112 | 3,586 | 3,864 | 739 | 1,882 | 403 | 151 | 130 | 414 | 12,280 | 12,292 | |
| 1991 | 639 | 5,942 | 967 | 215 | 224 | 133 | 120 | 39 | 37 | 53 | 7,730 | 8,369 | |
| 1994 | 1,140 | 4,969 | 1,424 | 1,819 | 2,252 | 389 | 109 | 96 | 56 | 221 | 11,335 | 12,475 | |
| 1996 | 1,800 | 567 | 552 | 2,741 | 915 | 634 | 585 | 142 | 39 | 165 | 6,338 | 8,139 | |
| 1997 | 13,227 | 2,881 | 440 | 536 | 2,330 | 546 | 313 | 290 | 75 | 220 | 7,633 | 20,860 | |
| 1999 | 607 | 1,780 | 3,717 | 1,810 | 652 | 398 | 1,548 | 526 | 180 | 249 | 10,859 | 11,466 | |
| 2000 | 460 | 1,322 | 1,230 | 2,588 | 1,012 | 327 | 308 | 950 | 278 | 252 | 8,266 | 8,726 | |
| 2002 | 796 | 4,944 | 3,385 | 1,295 | 661 | 935 | 538 | 140 | 162 | 493 | 12,554 | 13,351 | |
| 2004 | 83 | 313 | 1,217 | 3,123 | 1,634 | 567 | 288 | 283 | 121 | 265 | 7,811 | 7,894 | |
| 2006 | 525 | 217 | 291 | 654 | 783 | 659 | 390 | 145 | 75 | 171 | 3,386 | 3,910 | |
| 2007 | 5,775 | 1,041 | 345 | 478 | 794 | 729 | 407 | 241 | 98 | 135 | 4,267 | 10,042 | |
| 2008 | 71 | 2,915 | 1,047 | 166 | 161 | 288 | 235 | 136 | 102 | 120 | 5,169 | 5,240 | |
| 2009 | 5,197 | 816 | 1,734 | 281 | 77 | 94 | 129 | 111 | 77 | 114 | 3,433 | 8,630 | |
| 2010 | 2,568 | 6,404 | 984 | 2,295 | 446 | 73 | 33 | 37 | 38 | 91 | 10,400 | 12,968 | |
| 2012 | 177 | 1,989 | 1,693 | 2,710 | 280 | 367 | 113 | 36 | 25 | 103 | 7,315 | 7,492 | |
| 2014 | 4,751 | 8,655 | 969 | 1,161 | 1,119 | 1,770 | 740 | 170 | 79 | 99 | 14,762 | 19,513 | |
| 2016 | 174 | 1,038 | 4,496 | 4,476 | 715 | 348 | 392 | 420 | 96 | 64 | 12,046 | 12,220 | |
| 2018 | 450 | 517 | 249 | 621 | 2,268 | 944 | 198 | 112 | 107 | 104 | 5,120 | 5,570 | |
| 2022 | 142 | 332 | 975 | 6,578 | 819 | 211 | 133 | 239 | 166 | 79 | 9,533 | 9,674 | |
| 2024 | 5,075 | 1,146 | 681 | 379 | 820 | 2,485 | 450 | 110 | 86 | 127 | 6,284 | 11,359 | |
| Mean | 2,390 | 2,325 | 1,413 | 1,873 | 985 | 653 | 384 | 232 | 103 | 171 | 8,139 | 10,529 | |
| Median | 702 | 1,234 | 1,015 | 1,552 | 807 | 472 | 311 | 143 | 91 | 131 | 7,722 | 9,858 | |

Table 18: An abundance index derived from acoustic data collected opportunistically aboard bottom-trawl survey vessels (AVO index; Stienessen et al. 2022 and updated in Ianelli et al. 2023). Relative error developed from 1-D geostatistical estimates of sampling variability (Petitgas 1993). See Honkalehto et al. 2011 for the derivation of these estimates. The column “ CV_{AVO} ” was based on consistency of model fits through an iterative re-weighting process.

| Year | AT scaled biomass index | AVO index | Relative error | CV_{AVO} |
|------|-------------------------|-----------|----------------|------------|
| 2006 | 1.8729 | 1.741 | 0.0510 | 23% |
| 2007 | 2.2779 | 2.002 | 0.0865 | 40% |
| 2008 | 1.4056 | 0.992 | 0.0643 | 30% |
| 2009 | 1.3248 | 0.695 | 0.1222 | 56% |
| 2010 | 2.6423 | 1.922 | 0.0656 | 30% |
| 2011 | —no survey— | 1.704 | 0.0572 | 26% |
| 2012 | 2.2958 | 1.521 | 0.0532 | 24% |
| 2013 | —no survey— | 2.178 | 0.0390 | 18% |
| 2014 | 4.73 | 3.077 | 0.0411 | 19% |
| 2015 | —no survey— | 3.593 | 0.0246 | 11% |
| 2016 | 4.829 | 2.832 | 0.0291 | 13% |
| 2017 | —no survey— | 2.263 | 0.0305 | 14% |
| 2018 | 2.4994 | 2.084 | 0.0266 | 12% |
| 2019 | —no survey— | 2.829 | 0.0489 | 22% |
| 2020 | 3.62 | | | |
| 2021 | —no survey— | 2.410 | 0.0479 | 22% |
| 2022 | 3.834 | 2.903 | 0.0341 | 16% |
| 2023 | —no survey— | 2.481 | 0.0294 | 14% |
| 2024 | 2.87 | 2.007 | 0.0272 | 13% |
| Mean | 2.850 | 2.180 | 5% | 23% |

Table 19: Pollock sample sizes assumed for the age-composition data likelihoods from the fishery, bottom-trawl survey, and AT surveys, 1964–‘r thisyr’. Note fishery sample size for 1964–1977 was fixed at 10 and that the fishery mean sample size is from 1991–2023.

| Year | Fishery | BTS | ATS |
|------|---------|-----|-----|
| 1978 | 39 | | |
| 1979 | 39 | | |
| 1980 | 39 | | |
| 1981 | 39 | | |
| 1982 | 39 | 162 | |
| 1983 | 39 | 131 | |
| 1984 | 39 | 63 | |
| 1985 | 39 | 74 | |
| 1986 | 39 | 152 | |
| 1987 | 39 | 61 | |
| 1988 | 39 | 82 | |
| 1989 | 39 | 53 | |
| 1990 | 39 | 48 | |
| 1991 | 260 | 79 | |
| 1992 | 228 | 85 | |
| 1993 | 344 | 92 | |
| 1994 | 286 | 87 | 43 |
| 1995 | 257 | 105 | |
| 1996 | 189 | 226 | 32 |
| 1997 | 319 | 73 | 49 |
| 1998 | 355 | 65 | |
| 1999 | 476 | 95 | 67 |
| 2000 | 482 | 91 | 70 |
| 2001 | 328 | 183 | |
| 2002 | 487 | 186 | 72 |
| 2003 | 441 | 126 | |
| 2004 | 391 | 189 | 51 |
| 2005 | 494 | 194 | |
| 2006 | 506 | 330 | 47 |
| 2007 | 500 | 193 | 39 |
| 2008 | 524 | 235 | 35 |
| 2009 | 420 | 145 | 26 |
| 2010 | 549 | 108 | 34 |
| 2011 | 728 | 165 | |
| 2012 | 607 | 107 | 44 |
| 2013 | 753 | 67 | |
| 2014 | 606 | 118 | 79 |
| 2015 | 821 | 104 | |
| 2016 | 704 | 123 | 61 |
| 2017 | 607 | 235 | |
| 2018 | 668 | 158 | 50 |
| 2019 | 701 | 121 | |
| 2020 | 565 | | |
| 2021 | 818 | 149 | |
| 2022 | 641 | 173 | 52 |
| 2023 | 443 | 127 | |
| 2024 | | 64 | 79 |
| Mean | 500 | 139 | 52 |

Table 20: Mean weight-at-age (kg) estimates from the fishery (1991–2021; plus projections 2024–2026) showing the between-year variability (bottom row).

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1964– | | | | | | | | | | | | | | | |
| 1990 | 0.007 | 0.17 | 0.303 | 0.447 | 0.589 | 0.722 | 0.84 | 0.942 | 1.029 | 1.102 | 1.163 | 1.212 | 1.253 | 1.286 | 1.312 |
| 1991 | 0.007 | 0.15 | 0.285 | 0.482 | 0.604 | 0.73 | 0.844 | 0.882 | 1.02 | 1.123 | 1.135 | 1.237 | 1.236 | 1.296 | 1.247 |
| 1992 | 0.007 | 0.179 | 0.397 | 0.465 | 0.651 | 0.714 | 0.819 | 0.986 | 1.03 | 1.2 | 1.236 | 1.269 | 1.193 | 1.357 | 1.431 |
| 1993 | 0.007 | 0.331 | 0.495 | 0.612 | 0.652 | 0.775 | 0.934 | 1.062 | 1.198 | 1.24 | 1.423 | 1.54 | 1.576 | 1.609 | 1.508 |
| 1994 | 0.007 | 0.233 | 0.4 | 0.652 | 0.732 | 0.746 | 0.727 | 1.07 | 1.38 | 1.325 | 1.335 | 1.409 | 1.397 | 1.278 | 1.37 |
| 1995 | 0.007 | 0.153 | 0.386 | 0.505 | 0.729 | 0.843 | 0.847 | 0.97 | 1.232 | 1.296 | 1.401 | 1.402 | 1.392 | 1.095 | 1.306 |
| 1996 | 0.007 | 0.293 | 0.336 | 0.445 | 0.684 | 0.797 | 0.948 | 0.956 | 1.025 | 1.1 | 1.418 | 1.489 | 1.521 | 1.702 | 1.602 |
| 1997 | 0.007 | 0.187 | 0.327 | 0.477 | 0.559 | 0.748 | 0.889 | 1.074 | 1.095 | 1.236 | 1.287 | 1.4 | 1.561 | 1.363 | 1.338 |
| 1998 | 0.007 | 0.191 | 0.369 | 0.589 | 0.618 | 0.622 | 0.78 | 1.04 | 1.169 | 1.276 | 1.316 | 1.428 | 1.448 | 1.437 | 1.528 |
| 1999 | 0.007 | 0.188 | 0.404 | 0.507 | 0.643 | 0.702 | 0.729 | 0.894 | 1.038 | 1.253 | 1.224 | 1.422 | 0.995 | 1.402 | 1.239 |
| 2000 | 0.007 | 0.218 | 0.353 | 0.526 | 0.63 | 0.732 | 0.78 | 0.807 | 0.968 | 1.015 | 1.253 | 1.286 | 1.108 | 1.084 | 1.359 |
| 2001 | 0.006 | 0.227 | 0.329 | 0.505 | 0.668 | 0.786 | 0.964 | 0.986 | 1.061 | 1.133 | 1.32 | 1.411 | 1.568 | 1.472 | 1.495 |
| 2002 | 0.007 | 0.231 | 0.385 | 0.51 | 0.667 | 0.799 | 0.911 | 1.026 | 1.113 | 1.102 | 1.284 | 1.442 | 1.579 | 1.29 | 1.568 |
| 2003 | 0.006 | 0.276 | 0.489 | 0.549 | 0.652 | 0.769 | 0.863 | 0.953 | 1.086 | 1.202 | 1.212 | 1.194 | 1.374 | 1.355 | 1.709 |
| 2004 | 0.007 | 0.135 | 0.408 | 0.584 | 0.641 | 0.76 | 0.888 | 0.924 | 1.036 | 1.176 | 1.127 | 1.167 | 1.31 | 1.254 | 1.185 |
| 2005 | 0.007 | 0.283 | 0.351 | 0.508 | 0.641 | 0.742 | 0.88 | 0.96 | 1.062 | 1.074 | 1.216 | 1.268 | 1.217 | 1.075 | 1.342 |
| 2006 | 0.007 | 0.174 | 0.306 | 0.448 | 0.606 | 0.755 | 0.858 | 0.959 | 1.06 | 1.117 | 1.19 | 1.218 | 1.28 | 1.384 | 1.417 |
| 2007 | 0.007 | 0.155 | 0.349 | 0.507 | 0.642 | 0.783 | 0.961 | 1.1 | 1.192 | 1.266 | 1.327 | 1.488 | 1.444 | 1.729 | 1.512 |
| 2008 | 0.007 | 0.208 | 0.328 | 0.519 | 0.653 | 0.774 | 0.9 | 1.054 | 1.117 | 1.289 | 1.452 | 1.528 | 1.56 | 1.874 | 1.645 |
| 2009 | 0.007 | 0.136 | 0.34 | 0.525 | 0.705 | 0.879 | 0.999 | 1.13 | 1.398 | 1.479 | 1.558 | 1.576 | 1.807 | 2.026 | 2.222 |
| 2010 | 0.05 | 0.175 | 0.381 | 0.49 | 0.668 | 0.909 | 1.114 | 1.277 | 1.374 | 1.586 | 1.679 | 1.923 | 1.948 | 2.077 | 2.271 |
| 2011 | 0.031 | 0.205 | 0.29 | 0.508 | 0.666 | 0.809 | 0.971 | 1.224 | 1.342 | 1.513 | 1.582 | 1.623 | 2.08 | 1.707 | 2.242 |
| 2012 | 0.029 | 0.142 | 0.271 | 0.409 | 0.643 | 0.824 | 0.974 | 1.17 | 1.303 | 1.509 | 1.599 | 1.637 | 1.68 | 2.031 | 2.062 |
| 2013 | 0.095 | 0.144 | 0.29 | 0.442 | 0.564 | 0.781 | 1.13 | 1.281 | 1.44 | 1.685 | 1.827 | 1.786 | 1.934 | 2.159 | 2.182 |
| 2014 | 0.014 | 0.193 | 0.319 | 0.454 | 0.617 | 0.751 | 0.894 | 1.156 | 1.307 | 1.386 | 1.669 | 1.773 | 1.704 | 1.623 | 2.215 |
| 2015 | 0.025 | 0.181 | 0.404 | 0.462 | 0.571 | 0.69 | 0.786 | 0.887 | 1.141 | 1.195 | 1.315 | 1.671 | 1.389 | 1.559 | 2.6 |
| 2016 | 0.025 | 0.181 | 0.409 | 0.531 | 0.557 | 0.646 | 0.732 | 0.8 | 0.941 | 1.043 | 1.178 | 0.788 | 0.911 | 1.684 | 1.429 |
| 2017 | 0.025 | 0.191 | 0.408 | 0.499 | 0.65 | 0.694 | 0.752 | 0.827 | 0.894 | 0.911 | 1.028 | 0.961 | 1.359 | 0.701 | 1.54 |
| 2018 | 0.025 | 0.186 | 0.377 | 0.467 | 0.573 | 0.734 | 0.809 | 0.853 | 0.906 | 1.039 | 0.936 | 1.11 | 1.359 | 1.402 | 1.13 |
| 2019 | 0.025 | 0.186 | 0.422 | 0.565 | 0.643 | 0.759 | 0.878 | 0.962 | 1.007 | 1.065 | 1.035 | 1.182 | 0.754 | 1.402 | 1.54 |
| 2020 | 0.025 | 0.186 | 0.387 | 0.522 | 0.632 | 0.716 | 0.799 | 0.955 | 1.006 | 1.04 | 1.189 | 1.072 | 1.208 | 0.961 | 1.54 |
| 2021 | 0.025 | 0.186 | 0.393 | 0.48 | 0.574 | 0.69 | 0.757 | 0.841 | 1.011 | 1.13 | 1.16 | 1.269 | 1.214 | 1.402 | 1.54 |
| 2022 | 0.025 | 0.186 | 0.44 | 0.506 | 0.574 | 0.724 | 0.837 | 0.883 | 0.984 | 0.972 | 1.271 | 1.044 | 1.235 | 0.91 | 1.54 |
| 2023 | 0.025 | 0.186 | 0.492 | 0.482 | 0.524 | 0.606 | 0.796 | 0.92 | 0.955 | 1.046 | 1.088 | 1.267 | 1.355 | 1.325 | 0.951 |
| 2024 | 0.025 | 0.186 | 0.401 | 0.667 | 0.663 | 0.72 | 0.791 | 0.905 | 1.009 | 1.061 | 1.138 | 1.257 | 1.267 | 1.29 | 1.368 |
| 2025 | - | - | 0.382 | 0.526 | 0.796 | 0.791 | 0.845 | 0.912 | 1.02 | 1.117 | 1.161 | 1.231 | 1.342 | 1.344 | 1.36 |
| 2026 | - | - | 0.382 | 0.506 | 0.654 | 0.924 | 0.917 | 0.966 | 1.027 | 1.128 | 1.217 | 1.254 | 1.315 | 1.419 | 1.414 |
| Mean | 0.007 | 0.18 | 0.318 | 0.462 | 0.603 | 0.731 | 0.844 | 0.954 | 1.052 | 1.126 | 1.195 | 1.249 | 1.285 | 1.307 | 1.33 |
| CV | - | - | 18% | 13% | 8% | 9% | 12% | 13% | 14% | 16% | 17% | 19% | 22% | 25% | 28% |

Table 21: Goodness-of-fit measures to primary data for different assessment model configurations. RMSE=root-mean square log errors, NLL=negative log-likelihood, SDNR=standard deviation of normalized residuals, Eff. N=effective sample size for composition data). See text for incremental model descriptions.

| Component | Model 23 | Drop new BTS | and ATS | and AVO |
|-----------------|----------|--------------|---------|---------|
| RMSE BTS | 0.16 | 0.16 | 0.16 | 0.16 |
| RMSE ATS | 0.18 | 0.18 | 0.18 | 0.18 |
| RMSE AVO | 0.23 | 0.23 | 0.23 | 0.23 |
| RMSE CPUE | 0.09 | 0.09 | 0.09 | 0.09 |
| SDNR BTS | 0.95 | 0.98 | 0.98 | 0.98 |
| SDNR ATS | 1.00 | 1.00 | 1.02 | 1.02 |
| SDNR AVO | 0.98 | 0.97 | 0.97 | 0.99 |
| Eff. N Fishery | 1181.83 | 1199.44 | 1198.62 | 1198.98 |
| Eff. N BTS | 247.73 | 248.25 | 250.86 | 251.14 |
| Eff. N ATS | 268.76 | 268.12 | 258.78 | 259.11 |
| Catch NLL | 3.13 | 2.98 | 2.94 | 2.95 |
| BTS NLL | 30.74 | 30.83 | 30.87 | 30.89 |
| ATS NLL | 8.86 | 8.78 | 8.66 | 8.71 |
| AVO NLL | 8.70 | 8.57 | 8.55 | 8.34 |
| Fish Age NLL | 167.30 | 166.18 | 166.31 | 166.20 |
| BTS Age NLL | 194.12 | 191.91 | 190.91 | 190.75 |
| ATS Age NLL | 30.33 | 30.55 | 29.90 | 30.00 |
| NLL selectivity | 196.16 | 193.34 | 193.10 | 193.00 |
| NLL Priors | 20.17 | 20.16 | 20.17 | 20.18 |
| Data NLL | 465.36 | 461.71 | 459.35 | 459.16 |
| Total NLL | 717.52 | 711.20 | 708.02 | 707.67 |

Table 22: Summary of different model results and the stock condition for EBS pollock. Biomass units are thousands of t.

| Component | Last year | Model 23 |
|--------------------------------------|-----------|----------|
| B_{2025} | 3,500 | 3,000 |
| $CV_{B_{2025}}$ | 0.14 | 0.14 |
| B_{MSY} | 2,689 | 2,318 |
| $CV_{B_{MSY}}$ | 0.2 | 0.31 |
| B_{2025}/B_{MSY} | 131% | 128% |
| B_0 | 6,728 | 5,975 |
| $B_{35\%}$ | 2,060 | 2,066 |
| SPR rate at F_{MSY} | 34% | 32% |
| Steepness | 0.6 | 0.62 |
| Est. $B_{2024}/B_{2024, no fishing}$ | 0.58 | 0.61 |
| B_{2024}/B_{MSY} | 137% | 146% |

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Table 23: Estimates of begin-year age 3 and older biomass (thousands of tons) and coefficients of variation (CV) for the current assessment compared to 2016–2023 assessments for EBS pollock.

| Year | Current | CV | 2023 | CV | 2022 | CV | 2021 | CV | 2020 | CV | 2019 | CV |
|------|---------|----|--------|----|--------|----|--------|----|--------|----|--------|----|
| 1964 | 1,777 | 21 | 1,749 | 21 | 1,691 | 21 | 1,659 | 21 | 1,855 | 22 | 1,866 | 22 |
| 1965 | 2,159 | 19 | 2,127 | 19 | 2,056 | 19 | 2,021 | 20 | 2,256 | 20 | 2,270 | 20 |
| 1966 | 2,311 | 19 | 2,277 | 19 | 2,215 | 19 | 2,188 | 19 | 2,419 | 19 | 2,433 | 19 |
| 1967 | 3,562 | 16 | 3,524 | 17 | 3,436 | 17 | 3,416 | 17 | 3,679 | 17 | 3,695 | 17 |
| 1968 | 4,072 | 17 | 4,035 | 17 | 3,950 | 17 | 3,943 | 17 | 4,201 | 17 | 4,217 | 17 |
| 1969 | 5,171 | 15 | 5,141 | 16 | 5,039 | 16 | 5,045 | 16 | 5,297 | 15 | 5,316 | 15 |
| 1970 | 5,580 | 14 | 5,559 | 14 | 5,693 | 15 | 5,713 | 15 | 5,937 | 14 | 5,957 | 14 |
| 1971 | 6,174 | 13 | 6,166 | 13 | 6,144 | 13 | 6,173 | 13 | 6,367 | 13 | 6,390 | 13 |
| 1972 | 5,907 | 12 | 5,911 | 12 | 5,838 | 12 | 5,873 | 12 | 6,038 | 12 | 6,063 | 12 |
| 1973 | 4,816 | 13 | 4,826 | 13 | 4,674 | 13 | 4,719 | 13 | 4,855 | 13 | 4,880 | 13 |
| 1974 | 3,619 | 16 | 3,631 | 16 | 3,425 | 16 | 3,481 | 16 | 3,594 | 16 | 3,619 | 16 |
| 1975 | 3,934 | 12 | 3,959 | 13 | 3,519 | 12 | 3,592 | 12 | 3,710 | 12 | 3,740 | 12 |
| 1976 | 3,778 | 10 | 3,822 | 10 | 3,428 | 9 | 3,534 | 10 | 3,670 | 10 | 3,708 | 10 |
| 1977 | 4,112 | 9 | 4,206 | 9 | 3,317 | 8 | 3,470 | 9 | 3,646 | 9 | 3,690 | 9 |
| 1978 | 3,569 | 8 | 3,694 | 9 | 3,122 | 8 | 3,333 | 8 | 3,564 | 8 | 3,607 | 8 |
| 1979 | 3,342 | 8 | 3,521 | 8 | 2,935 | 7 | 3,221 | 8 | 3,557 | 8 | 3,595 | 8 |
| 1980 | 4,341 | 6 | 4,488 | 7 | 3,594 | 6 | 4,039 | 7 | 4,537 | 6 | 4,578 | 6 |
| 1981 | 7,632 | 4 | 7,841 | 5 | 6,738 | 4 | 7,493 | 5 | 8,422 | 4 | 8,451 | 4 |
| 1982 | 8,350 | 5 | 8,301 | 5 | 7,791 | 4 | 8,541 | 5 | 9,542 | 4 | 9,569 | 4 |
| 1983 | 10,491 | 4 | 10,244 | 5 | 8,968 | 4 | 9,615 | 5 | 10,807 | 4 | 10,832 | 4 |
| 1984 | 9,922 | 4 | 9,574 | 4 | 8,967 | 5 | 9,516 | 5 | 10,622 | 4 | 10,645 | 4 |
| 1985 | 13,125 | 3 | 12,622 | 3 | 11,304 | 4 | 11,658 | 4 | 12,566 | 3 | 12,592 | 3 |
| 1986 | 11,045 | 3 | 10,547 | 3 | 10,796 | 4 | 10,997 | 4 | 11,766 | 3 | 11,790 | 3 |
| 1987 | 11,607 | 3 | 11,218 | 3 | 11,510 | 3 | 11,499 | 3 | 12,114 | 2 | 12,143 | 2 |
| 1988 | 10,237 | 2 | 9,919 | 2 | 10,913 | 3 | 10,828 | 3 | 11,217 | 2 | 11,245 | 2 |
| 1989 | 8,294 | 2 | 8,026 | 3 | 9,247 | 3 | 9,103 | 3 | 9,344 | 2 | 9,370 | 2 |
| 1990 | 6,994 | 3 | 6,759 | 3 | 7,400 | 3 | 7,232 | 3 | 7,406 | 3 | 7,431 | 3 |
| 1991 | 5,950 | 3 | 5,760 | 3 | 5,862 | 4 | 5,706 | 4 | 5,818 | 3 | 5,841 | 3 |
| 1992 | 8,227 | 2 | 8,034 | 2 | 9,121 | 3 | 8,953 | 3 | 9,252 | 2 | 9,286 | 2 |
| 1993 | 9,766 | 2 | 9,519 | 2 | 11,257 | 2 | 11,098 | 2 | 11,552 | 2 | 11,599 | 2 |
| 1994 | 10,136 | 2 | 9,788 | 2 | 11,042 | 2 | 10,883 | 2 | 11,296 | 2 | 11,342 | 2 |
| 1995 | 11,479 | 2 | 11,167 | 2 | 12,625 | 2 | 12,488 | 2 | 12,886 | 2 | 12,926 | 2 |
| 1996 | 10,023 | 2 | 9,742 | 2 | 10,996 | 2 | 10,866 | 2 | 11,257 | 2 | 11,292 | 2 |
| 1997 | 9,019 | 2 | 8,744 | 2 | 9,468 | 2 | 9,350 | 2 | 10,042 | 3 | 10,074 | 3 |
| 1998 | 8,079 | 2 | 7,866 | 2 | 9,435 | 2 | 9,316 | 2 | 9,712 | 2 | 9,738 | 2 |
| 1999 | 9,072 | 2 | 8,934 | 2 | 10,337 | 2 | 10,238 | 2 | 10,652 | 2 | 10,673 | 2 |

| 2000 | 8,107 | 2 | 8,020 | 2 | 9,495 | 2 | 9,420 | 2 | 9,796 | 2 | 9,821 | 2 |
|------|--------|----|--------|----|--------|----|--------|----|--------|----|--------|----|
| 2001 | 8,214 | 2 | 8,148 | 2 | 9,205 | 2 | 9,147 | 2 | 9,527 | 2 | 9,559 | 2 |
| 2002 | 8,224 | 2 | 8,199 | 2 | 9,478 | 2 | 9,448 | 2 | 9,829 | 2 | 9,877 | 2 |
| 2003 | 9,169 | 2 | 9,169 | 2 | 11,419 | 2 | 11,397 | 2 | 11,779 | 2 | 11,816 | 2 |
| 2004 | 9,534 | 2 | 9,565 | 2 | 10,749 | 2 | 10,731 | 2 | 11,087 | 2 | 11,121 | 2 |
| 2005 | 7,724 | 2 | 7,746 | 2 | 8,967 | 2 | 8,958 | 2 | 9,271 | 2 | 9,302 | 2 |
| 2006 | 6,685 | 2 | 6,714 | 2 | 6,838 | 2 | 6,837 | 2 | 7,108 | 2 | 7,135 | 2 |
| 2007 | 5,282 | 2 | 5,306 | 2 | 5,495 | 2 | 5,495 | 2 | 5,753 | 3 | 5,782 | 3 |
| 2008 | 4,354 | 2 | 4,381 | 3 | 4,452 | 3 | 4,455 | 3 | 4,699 | 3 | 4,733 | 3 |
| 2009 | 5,609 | 2 | 5,613 | 2 | 5,574 | 2 | 5,562 | 2 | 5,883 | 3 | 5,941 | 3 |
| 2010 | 5,068 | 2 | 5,095 | 2 | 5,890 | 3 | 5,849 | 3 | 6,272 | 3 | 6,356 | 3 |
| 2011 | 7,382 | 2 | 7,446 | 2 | 8,342 | 2 | 8,169 | 2 | 9,001 | 3 | 9,176 | 3 |
| 2012 | 8,079 | 2 | 8,111 | 2 | 8,372 | 2 | 8,124 | 2 | 9,111 | 3 | 9,248 | 3 |
| 2013 | 8,255 | 2 | 8,232 | 2 | 8,273 | 3 | 7,963 | 3 | 9,130 | 4 | 9,225 | 4 |
| 2014 | 7,878 | 3 | 7,822 | 3 | 7,666 | 3 | 7,324 | 3 | 8,622 | 4 | 8,624 | 4 |
| 2015 | 9,227 | 2 | 9,183 | 2 | 9,870 | 3 | 9,521 | 3 | 12,073 | 5 | 11,801 | 5 |
| 2016 | 10,314 | 2 | 10,231 | 2 | 12,681 | 3 | 11,967 | 3 | 15,486 | 7 | 14,558 | 6 |
| 2017 | 10,381 | 2 | 10,256 | 3 | 11,840 | 3 | 10,782 | 4 | 13,794 | 7 | 12,963 | 7 |
| 2018 | 8,762 | 3 | 8,618 | 3 | 9,343 | 4 | 8,373 | 5 | 10,964 | 8 | 10,484 | 8 |
| 2019 | 8,322 | 4 | 8,217 | 4 | 8,497 | 5 | 7,413 | 6 | 9,892 | 10 | 9,864 | 9 |
| 2020 | 6,909 | 5 | 6,778 | 6 | 7,299 | 7 | 6,111 | 9 | 8,693 | 10 | 9,128 | 10 |
| 2021 | 10,759 | 7 | 10,194 | 9 | 12,867 | 12 | 6,811 | 11 | 8,145 | 11 | NA | NA |
| 2022 | 11,494 | 8 | 10,798 | 11 | 13,393 | 12 | 6,839 | 14 | NA | NA | NA | NA |
| 2023 | 9,695 | 9 | 10,801 | 11 | 12,389 | 13 | NA | NA | NA | NA | NA | NA |
| 2024 | 9,415 | 11 | 10,184 | 12 | NA | NA | NA | NA | NA | NA | NA | NA |

Table 24: Estimated billions of EBS pollock at age (columns 2–11) from the current assessment model.

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10+ |
|------|-------|-------|-------|------|------|------|------|------|------|------|
| 1964 | 6.36 | 3.40 | 2.10 | 0.45 | 0.20 | 0.39 | 0.18 | 0.06 | 0.04 | 0.22 |
| 1965 | 20.92 | 2.58 | 2.14 | 1.48 | 0.28 | 0.12 | 0.24 | 0.11 | 0.04 | 0.16 |
| 1966 | 15.02 | 8.49 | 1.62 | 1.50 | 0.91 | 0.17 | 0.08 | 0.15 | 0.07 | 0.13 |
| 1967 | 25.46 | 6.09 | 5.33 | 1.14 | 0.95 | 0.58 | 0.11 | 0.05 | 0.10 | 0.13 |
| 1968 | 22.07 | 10.31 | 3.78 | 3.48 | 0.65 | 0.54 | 0.33 | 0.06 | 0.03 | 0.13 |
| 1969 | 26.10 | 8.93 | 6.37 | 2.46 | 2.01 | 0.38 | 0.32 | 0.19 | 0.04 | 0.09 |
| 1970 | 23.46 | 10.55 | 5.49 | 4.03 | 1.44 | 1.18 | 0.22 | 0.19 | 0.11 | 0.08 |
| 1971 | 14.39 | 9.45 | 6.34 | 3.27 | 2.29 | 0.79 | 0.65 | 0.12 | 0.10 | 0.10 |
| 1972 | 11.75 | 5.78 | 5.53 | 3.55 | 1.71 | 1.13 | 0.39 | 0.32 | 0.05 | 0.08 |
| 1973 | 26.72 | 4.72 | 3.28 | 2.87 | 1.71 | 0.80 | 0.53 | 0.18 | 0.14 | 0.06 |
| 1974 | 19.45 | 10.76 | 2.60 | 1.57 | 1.27 | 0.74 | 0.35 | 0.23 | 0.07 | 0.07 |
| 1975 | 16.41 | 7.84 | 5.70 | 1.10 | 0.66 | 0.53 | 0.31 | 0.14 | 0.09 | 0.05 |
| 1976 | 12.62 | 6.63 | 4.41 | 2.52 | 0.49 | 0.30 | 0.24 | 0.14 | 0.06 | 0.06 |
| 1977 | 13.29 | 5.11 | 3.82 | 2.16 | 1.16 | 0.23 | 0.14 | 0.11 | 0.07 | 0.05 |
| 1978 | 24.35 | 5.39 | 2.97 | 2.06 | 1.07 | 0.56 | 0.11 | 0.07 | 0.06 | 0.06 |
| 1979 | 57.03 | 9.87 | 3.16 | 1.60 | 1.01 | 0.50 | 0.26 | 0.05 | 0.03 | 0.05 |
| 1980 | 27.26 | 23.14 | 5.95 | 1.79 | 0.80 | 0.45 | 0.22 | 0.11 | 0.02 | 0.03 |
| 1981 | 31.89 | 11.07 | 14.32 | 3.70 | 0.93 | 0.36 | 0.20 | 0.09 | 0.05 | 0.03 |
| 1982 | 18.24 | 12.95 | 6.95 | 9.68 | 2.16 | 0.47 | 0.18 | 0.10 | 0.05 | 0.04 |
| 1983 | 51.08 | 7.41 | 8.19 | 4.94 | 6.22 | 1.26 | 0.27 | 0.10 | 0.06 | 0.05 |
| 1984 | 14.02 | 20.76 | 4.69 | 5.89 | 3.33 | 3.88 | 0.75 | 0.16 | 0.06 | 0.06 |
| 1985 | 32.53 | 5.70 | 13.16 | 3.38 | 4.02 | 2.08 | 2.35 | 0.46 | 0.10 | 0.07 |
| 1986 | 12.52 | 13.22 | 3.61 | 9.43 | 2.32 | 2.61 | 1.25 | 1.42 | 0.28 | 0.10 |
| 1987 | 7.07 | 5.09 | 8.39 | 2.59 | 6.45 | 1.53 | 1.62 | 0.76 | 0.88 | 0.23 |
| 1988 | 5.42 | 2.88 | 3.23 | 6.05 | 1.82 | 4.38 | 1.00 | 1.06 | 0.49 | 0.71 |
| 1989 | 11.37 | 2.20 | 1.83 | 2.26 | 4.15 | 1.18 | 2.76 | 0.61 | 0.65 | 0.74 |
| 1990 | 49.40 | 4.62 | 1.40 | 1.30 | 1.53 | 2.68 | 0.73 | 1.64 | 0.37 | 0.85 |
| 1991 | 26.39 | 20.08 | 2.93 | 1.00 | 0.84 | 0.89 | 1.52 | 0.40 | 0.89 | 0.68 |
| 1992 | 22.65 | 10.73 | 12.73 | 2.11 | 0.67 | 0.51 | 0.51 | 0.78 | 0.21 | 0.80 |
| 1993 | 44.72 | 9.21 | 6.79 | 8.84 | 1.40 | 0.41 | 0.27 | 0.23 | 0.34 | 0.44 |
| 1994 | 15.21 | 18.18 | 5.85 | 4.83 | 5.61 | 0.92 | 0.24 | 0.14 | 0.12 | 0.41 |
| 1995 | 10.64 | 6.18 | 11.57 | 4.28 | 3.28 | 3.28 | 0.54 | 0.14 | 0.08 | 0.31 |
| 1996 | 22.04 | 4.32 | 3.93 | 8.49 | 3.05 | 2.09 | 1.77 | 0.30 | 0.08 | 0.22 |
| 1997 | 29.73 | 8.96 | 2.74 | 2.87 | 6.16 | 2.08 | 1.21 | 0.87 | 0.15 | 0.16 |
| 1998 | 14.52 | 12.09 | 5.67 | 2.00 | 2.04 | 4.19 | 1.29 | 0.66 | 0.45 | 0.16 |
| 1999 | 15.78 | 5.90 | 7.67 | 4.11 | 1.41 | 1.38 | 2.52 | 0.78 | 0.37 | 0.33 |
| 2000 | 24.29 | 6.41 | 3.75 | 5.46 | 2.86 | 0.95 | 0.89 | 1.49 | 0.46 | 0.42 |
| 2001 | 34.20 | 9.87 | 4.08 | 2.71 | 3.68 | 1.82 | 0.61 | 0.52 | 0.82 | 0.52 |
| 2002 | 22.71 | 13.91 | 6.28 | 2.97 | 1.86 | 2.21 | 0.99 | 0.33 | 0.29 | 0.77 |

| | | | | | | | | | | |
|------|-------|-------|-------|-------|------|------|------|------|------|------|
| 2003 | 14.10 | 9.23 | 8.84 | 4.55 | 2.01 | 1.13 | 1.10 | 0.50 | 0.17 | 0.59 |
| 2004 | 6.34 | 5.73 | 5.87 | 6.23 | 3.07 | 1.18 | 0.58 | 0.52 | 0.24 | 0.42 |
| 2005 | 4.46 | 2.58 | 3.65 | 4.25 | 3.90 | 1.84 | 0.66 | 0.29 | 0.26 | 0.37 |
| 2006 | 11.23 | 1.81 | 1.64 | 2.65 | 2.81 | 2.12 | 0.96 | 0.35 | 0.16 | 0.36 |
| 2007 | 24.50 | 4.56 | 1.15 | 1.16 | 1.71 | 1.56 | 1.03 | 0.48 | 0.18 | 0.28 |
| 2008 | 13.01 | 9.96 | 2.90 | 0.81 | 0.74 | 0.95 | 0.73 | 0.50 | 0.24 | 0.24 |
| 2009 | 48.56 | 5.29 | 6.34 | 2.09 | 0.53 | 0.42 | 0.44 | 0.34 | 0.24 | 0.24 |
| 2010 | 22.41 | 19.74 | 3.37 | 4.55 | 1.37 | 0.32 | 0.21 | 0.21 | 0.17 | 0.23 |
| 2011 | 13.62 | 9.11 | 12.57 | 2.46 | 2.89 | 0.82 | 0.18 | 0.11 | 0.11 | 0.21 |
| 2012 | 11.80 | 5.54 | 5.80 | 9.14 | 1.70 | 1.42 | 0.38 | 0.09 | 0.05 | 0.15 |
| 2013 | 42.75 | 4.80 | 3.52 | 4.20 | 5.96 | 1.10 | 0.66 | 0.18 | 0.04 | 0.09 |
| 2014 | 49.04 | 17.38 | 3.05 | 2.55 | 2.81 | 3.57 | 0.65 | 0.34 | 0.08 | 0.06 |
| 2015 | 21.23 | 19.94 | 11.06 | 2.22 | 1.74 | 1.73 | 1.98 | 0.32 | 0.17 | 0.07 |
| 2016 | 8.02 | 8.63 | 12.70 | 7.67 | 1.46 | 1.08 | 0.95 | 0.99 | 0.16 | 0.11 |
| 2017 | 8.02 | 3.26 | 5.50 | 9.31 | 4.48 | 0.92 | 0.65 | 0.55 | 0.52 | 0.14 |
| 2018 | 16.50 | 3.26 | 2.08 | 4.04 | 6.40 | 2.49 | 0.51 | 0.36 | 0.30 | 0.35 |
| 2019 | 81.11 | 6.71 | 2.08 | 1.53 | 2.89 | 3.71 | 1.39 | 0.29 | 0.20 | 0.37 |
| 2020 | 20.41 | 32.98 | 4.27 | 1.53 | 1.11 | 2.00 | 1.95 | 0.64 | 0.14 | 0.31 |
| 2021 | 11.33 | 8.30 | 20.83 | 3.08 | 1.05 | 0.71 | 1.04 | 0.94 | 0.32 | 0.22 |
| 2022 | 11.49 | 4.61 | 5.21 | 14.33 | 2.13 | 0.68 | 0.43 | 0.53 | 0.45 | 0.28 |
| 2023 | 16.76 | 4.67 | 2.90 | 3.70 | 9.72 | 1.42 | 0.43 | 0.25 | 0.29 | 0.41 |
| 2024 | 18.29 | 6.81 | 2.95 | 2.07 | 2.51 | 5.93 | 0.87 | 0.27 | 0.15 | 0.41 |

Table 25: Estimated millions of EBS pollock caught at age (columns 2–11) from the current assessment model.

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10+ |
|------|--------|---------|---------|---------|---------|--------|--------|--------|--------|--------|
| 1964 | 8.47 | 38.31 | 89.73 | 63.17 | 27.13 | 51.85 | 22.58 | 6.97 | 4.28 | 24.62 |
| 1965 | 28.54 | 29.80 | 93.75 | 211.22 | 39.46 | 16.86 | 32.04 | 14.05 | 4.39 | 18.84 |
| 1966 | 20.40 | 101.49 | 77.32 | 196.46 | 117.20 | 21.49 | 9.20 | 17.74 | 7.95 | 13.86 |
| 1967 | 64.36 | 140.34 | 550.11 | 219.00 | 185.44 | 110.88 | 21.10 | 9.26 | 18.29 | 23.43 |
| 1968 | 63.37 | 262.82 | 392.87 | 669.11 | 123.30 | 100.01 | 60.87 | 11.72 | 5.22 | 24.16 |
| 1969 | 90.33 | 256.77 | 807.94 | 452.47 | 362.79 | 67.65 | 56.79 | 36.64 | 7.19 | 18.36 |
| 1970 | 139.98 | 492.33 | 938.72 | 813.29 | 319.48 | 261.65 | 52.51 | 48.31 | 30.48 | 21.34 |
| 1971 | 120.53 | 624.24 | 1352.81 | 841.54 | 672.25 | 229.97 | 193.13 | 41.26 | 34.96 | 35.97 |
| 1972 | 87.98 | 516.51 | 1446.48 | 1077.21 | 542.54 | 357.89 | 126.55 | 115.98 | 21.35 | 33.54 |
| 1973 | 177.38 | 529.38 | 1011.31 | 1008.56 | 622.99 | 294.53 | 194.38 | 73.88 | 58.51 | 24.39 |
| 1974 | 112.48 | 1475.19 | 977.51 | 599.51 | 492.17 | 286.15 | 133.73 | 95.36 | 32.42 | 32.91 |
| 1975 | 62.94 | 745.46 | 2006.58 | 376.79 | 221.66 | 176.86 | 102.98 | 50.65 | 33.71 | 20.73 |
| 1976 | 35.09 | 521.13 | 1309.94 | 840.77 | 159.70 | 94.79 | 76.03 | 45.26 | 21.96 | 21.16 |
| 1977 | 26.93 | 358.79 | 907.07 | 617.47 | 352.19 | 68.95 | 41.74 | 33.84 | 20.86 | 17.97 |
| 1978 | 41.64 | 348.29 | 712.41 | 601.51 | 353.40 | 182.70 | 36.69 | 22.47 | 19.23 | 20.06 |
| 1979 | 80.58 | 437.01 | 645.09 | 446.24 | 353.15 | 179.31 | 92.67 | 18.50 | 11.73 | 18.48 |
| 1980 | 27.29 | 550.09 | 831.60 | 468.20 | 273.30 | 164.33 | 77.25 | 40.28 | 8.05 | 12.28 |
| 1981 | 18.54 | 138.06 | 1077.24 | 682.19 | 255.54 | 104.72 | 56.00 | 26.74 | 14.05 | 7.05 |
| 1982 | 5.68 | 89.21 | 241.35 | 1113.92 | 395.53 | 93.90 | 35.78 | 19.35 | 9.28 | 7.38 |
| 1983 | 10.83 | 44.69 | 207.39 | 389.65 | 858.56 | 211.32 | 44.54 | 17.11 | 9.36 | 8.15 |
| 1984 | 2.40 | 99.67 | 117.13 | 403.93 | 452.09 | 608.97 | 120.08 | 25.49 | 9.95 | 10.14 |
| 1985 | 4.68 | 27.98 | 368.38 | 210.07 | 431.34 | 341.59 | 380.99 | 73.33 | 15.62 | 12.31 |
| 1986 | 1.40 | 57.40 | 99.63 | 629.13 | 225.00 | 368.04 | 189.59 | 203.51 | 41.28 | 15.80 |
| 1987 | 0.48 | 14.62 | 187.48 | 115.03 | 460.25 | 152.31 | 164.61 | 91.05 | 104.33 | 26.94 |
| 1988 | 0.42 | 10.22 | 156.83 | 386.00 | 199.57 | 565.64 | 156.28 | 156.68 | 72.20 | 101.40 |
| 1989 | 0.75 | 7.24 | 60.61 | 168.69 | 469.06 | 163.28 | 482.07 | 98.75 | 98.12 | 110.28 |
| 1990 | 3.98 | 20.83 | 47.09 | 141.32 | 283.99 | 540.27 | 170.99 | 380.10 | 80.35 | 181.99 |
| 1991 | 2.05 | 94.87 | 71.45 | 83.29 | 132.99 | 177.34 | 410.39 | 93.60 | 233.35 | 194.28 |
| 1992 | 2.05 | 64.54 | 688.22 | 184.43 | 102.09 | 127.86 | 172.86 | 281.65 | 78.97 | 291.99 |
| 1993 | 2.31 | 22.38 | 236.76 | 1102.25 | 145.75 | 71.65 | 69.61 | 60.89 | 87.87 | 106.77 |
| 1994 | 0.56 | 33.55 | 71.50 | 347.58 | 1031.25 | 157.54 | 49.65 | 28.32 | 23.57 | 77.77 |
| 1995 | 0.35 | 12.42 | 95.82 | 143.04 | 396.15 | 776.40 | 117.06 | 28.93 | 16.21 | 56.88 |
| 1996 | 0.77 | 16.09 | 47.60 | 143.51 | 200.03 | 396.33 | 522.22 | 91.23 | 20.42 | 49.02 |
| 1997 | 1.01 | 52.34 | 43.05 | 103.22 | 441.33 | 300.25 | 276.43 | 220.96 | 43.07 | 40.68 |
| 1998 | 0.38 | 41.55 | 101.29 | 78.39 | 152.82 | 678.34 | 207.85 | 140.34 | 109.80 | 34.56 |
| 1999 | 0.31 | 12.03 | 269.03 | 219.71 | 106.48 | 157.30 | 448.19 | 131.03 | 61.79 | 53.92 |
| 2000 | 0.47 | 12.21 | 83.28 | 423.92 | 348.10 | 119.06 | 166.75 | 332.63 | 84.84 | 70.18 |
| 2001 | 0.69 | 16.55 | 62.28 | 169.93 | 609.14 | 423.27 | 137.10 | 113.47 | 164.98 | 95.23 |
| 2002 | 0.51 | 33.21 | 123.83 | 218.85 | 297.43 | 630.73 | 279.76 | 90.40 | 70.26 | 159.73 |

| 2003 | 0.32 | 17.48 | 376.07 | 348.16 | 363.39 | 303.92 | 348.56 | 151.99 | 45.79 | 123.06 | |
|------|------|--------|---------|---------|---------|--------|--------|--------|--------|--------|--|
| 2004 | 0.12 | 8.20 | 113.58 | 836.21 | 505.27 | 257.06 | 163.15 | 145.40 | 59.89 | 78.88 | |
| 2005 | 0.08 | 3.74 | 66.66 | 398.47 | 897.36 | 474.49 | 161.02 | 67.27 | 59.12 | 65.92 | |
| 2006 | 0.22 | 3.68 | 66.23 | 290.56 | 612.80 | 641.38 | 275.55 | 97.60 | 40.84 | 81.85 | |
| 2007 | 0.48 | 10.14 | 46.80 | 136.30 | 377.57 | 496.11 | 315.82 | 133.71 | 47.10 | 68.85 | |
| 2008 | 0.25 | 20.73 | 69.30 | 84.44 | 153.63 | 312.11 | 237.16 | 153.84 | 73.18 | 66.90 | |
| 2009 | 0.85 | 7.25 | 169.15 | 209.64 | 90.61 | 121.61 | 128.02 | 99.70 | 67.80 | 70.45 | |
| 2010 | 0.32 | 23.70 | 39.98 | 562.35 | 223.18 | 61.82 | 48.05 | 56.52 | 44.25 | 59.39 | |
| 2011 | 0.25 | 13.42 | 201.11 | 140.46 | 848.31 | 270.30 | 58.24 | 37.13 | 36.61 | 69.22 | |
| 2012 | 0.22 | 10.14 | 113.67 | 950.71 | 193.82 | 465.02 | 124.93 | 29.39 | 17.65 | 50.30 | |
| 2013 | 0.73 | 6.53 | 64.53 | 353.62 | 988.91 | 195.09 | 178.43 | 59.59 | 13.40 | 31.30 | |
| 2014 | 0.79 | 26.26 | 51.39 | 179.54 | 407.54 | 784.85 | 186.34 | 96.92 | 24.67 | 19.18 | |
| 2015 | 0.38 | 20.45 | 613.89 | 211.09 | 241.53 | 392.14 | 553.04 | 91.98 | 51.58 | 23.57 | |
| 2016 | 0.11 | 5.52 | 117.35 | 1407.89 | 192.17 | 182.64 | 183.37 | 257.13 | 39.01 | 27.57 | |
| 2017 | 0.11 | 2.28 | 36.12 | 577.26 | 971.14 | 201.39 | 143.20 | 126.73 | 132.91 | 35.17 | |
| 2018 | 0.19 | 2.23 | 11.78 | 119.35 | 1207.39 | 542.49 | 103.52 | 75.37 | 60.65 | 67.28 | |
| 2019 | 1.11 | 10.92 | 14.99 | 26.36 | 165.64 | 935.01 | 458.68 | 83.58 | 51.44 | 80.26 | |
| 2020 | 0.57 | 254.26 | 102.25 | 94.46 | 132.42 | 517.82 | 601.36 | 176.49 | 43.91 | 86.79 | |
| 2021 | 0.32 | 104.31 | 1282.87 | 167.59 | 116.56 | 114.73 | 288.77 | 292.30 | 92.58 | 59.76 | |
| 2022 | 0.24 | 50.62 | 181.63 | 1051.93 | 193.43 | 79.48 | 76.12 | 121.38 | 90.13 | 52.53 | |
| 2023 | 0.34 | 34.71 | 90.91 | 269.14 | 1483.99 | 208.04 | 57.18 | 48.23 | 55.07 | 78.23 | |
| 2024 | 0.40 | 54.73 | 100.11 | 182.48 | 362.90 | 848.14 | 123.82 | 54.62 | 29.01 | 85.83 | |

Table 26: Estimated EBS pollock age 3+ biomass, female spawning biomass, and age 1 recruitment for 1964–2024. Biomass units are thousands of t, age-1 recruitment is in millions of pollock.

| Year | SSB | CV.SSB | Recruit | CV.Rec | Age.3..B | CV.. |
|------|-------|--------|---------|--------|----------|------|
| 1964 | 530 | 27 | 6,362 | 38 | 1,777 | 22 |
| 1965 | 621 | 22 | 20,924 | 25 | 2,159 | 20 |
| 1966 | 718 | 21 | 15,021 | 32 | 2,311 | 19 |
| 1967 | 903 | 19 | 25,464 | 26 | 3,562 | 17 |
| 1968 | 1,120 | 19 | 22,070 | 28 | 4,072 | 17 |
| 1969 | 1,371 | 19 | 26,095 | 26 | 5,171 | 16 |
| 1970 | 1,530 | 18 | 23,463 | 27 | 5,580 | 15 |
| 1971 | 1,673 | 17 | 14,389 | 33 | 6,174 | 13 |
| 1972 | 1,590 | 17 | 11,752 | 33 | 5,907 | 12 |
| 1973 | 1,364 | 18 | 26,724 | 19 | 4,816 | 14 |
| 1974 | 1,026 | 22 | 19,449 | 19 | 3,619 | 16 |
| 1975 | 966 | 21 | 16,414 | 18 | 3,934 | 13 |
| 1976 | 926 | 16 | 12,615 | 17 | 3,778 | 10 |
| 1977 | 1,111 | 13 | 13,292 | 15 | 4,112 | 9 |
| 1978 | 989 | 12 | 24,349 | 10 | 3,569 | 9 |
| 1979 | 906 | 11 | 57,027 | 6 | 3,342 | 8 |
| 1980 | 1,071 | 9 | 27,259 | 9 | 4,341 | 7 |
| 1981 | 1,653 | 6 | 31,885 | 8 | 7,632 | 5 |
| 1982 | 2,310 | 6 | 18,243 | 11 | 8,350 | 5 |
| 1983 | 3,121 | 5 | 51,081 | 6 | 10,491 | 5 |
| 1984 | 3,252 | 5 | 14,020 | 11 | 9,922 | 5 |
| 1985 | 3,778 | 5 | 32,534 | 7 | 13,125 | 4 |
| 1986 | 3,727 | 4 | 12,523 | 10 | 11,045 | 4 |
| 1987 | 3,794 | 4 | 7,072 | 11 | 11,607 | 3 |
| 1988 | 3,607 | 3 | 5,423 | 11 | 10,237 | 3 |
| 1989 | 3,130 | 3 | 11,365 | 8 | 8,294 | 3 |
| 1990 | 2,648 | 3 | 49,400 | 4 | 6,994 | 3 |
| 1991 | 2,119 | 4 | 26,389 | 5 | 5,950 | 4 |
| 1992 | 2,019 | 4 | 22,654 | 6 | 8,227 | 3 |
| 1993 | 2,682 | 3 | 44,718 | 4 | 9,766 | 3 |
| 1994 | 3,127 | 3 | 15,205 | 6 | 10,136 | 3 |
| 1995 | 3,344 | 3 | 10,637 | 7 | 11,479 | 3 |
| 1996 | 3,282 | 3 | 22,035 | 5 | 10,023 | 3 |
| 1997 | 3,185 | 3 | 29,734 | 4 | 9,019 | 3 |
| 1998 | 2,699 | 3 | 14,519 | 5 | 8,079 | 3 |
| 1999 | 2,821 | 3 | 15,776 | 5 | 9,072 | 3 |
| 2000 | 2,722 | 3 | 24,285 | 4 | 8,107 | 3 |
| 2001 | 2,762 | 3 | 34,202 | 3 | 8,214 | 3 |
| 2002 | 2,566 | 3 | 22,705 | 4 | 8,224 | 3 |
| 2003 | 2,602 | 3 | 14,098 | 5 | 9,169 | 2 |
| 2004 | 2,898 | 3 | 6,340 | 6 | 9,534 | 2 |
| 2005 | 2,551 | 3 | 4,462 | 7 | 7,724 | 2 |
| 2006 | 2,326 | 3 | 11,228 | 5 | 6,685 | 3 |
| 2007 | 1,893 | 3 | 24,504 | 4 | 5,282 | 3 |
| 2008 | 1,432 | 3 | 13,012 | 6 | 4,354 | 3 |
| 2009 | 1,515 | 3 | 48,558 | 3 | 5,609 | 3 |
| 2010 | 1,554 | 3 | 22,411 | 5 | 5,068 | 3 |
| 2011 | 1,916 | 3 | 13,623 | 6 | 7,382 | 3 |
| 2012 | 2,345 | 3 | 11,795 | 6 | 8,079 | 3 |
| 2013 | 2,675 | 3 | 42,753 | 3 | 8,255 | 3 |
| 2014 | 2,620 | 3 | 49,038 | 4 | 7,878 | 3 |
| 2015 | 2,447 | 3 | 21,229 | 6 | 9,227 | 3 |
| 2016 | 2,716 | 3 | 8,015 | 10 | 10,314 | 3 |
| 2017 | 3,165 | 3 | 8,016 | 12 | 10,381 | 3 |
| 2018 | 3,025 | 4 | 16,501 | 11 | 8,762 | 3 |
| 2019 | 2,938 | 4 | 81,112 | 10 | 8,322 | 4 |
| 2020 | 2,258 | 5 | 20,413 | 15 | 6,909 | 5 |
| 2021 | 2,464 | 7 | 11,331 | 20 | 10,759 | 8 |
| 2022 | 3,406 | 9 | 11,485 | 25 | 11,494 | 9 |
| 2023 | 3,333 | 10 | 16,759 | 29 | 9,695 | 10 |
| 2024 | 3,389 | 12 | 18,286 | 55 | 9,415 | 12 |

Table 27: Summary of model results and the stock condition for EBS pollock. Biomass units are thousands of t.

| Component | Model 23 |
|--------------------------------------|----------|
| B_{2025} | 3,000 |
| $CV_{B_{2025}}$ | 0.14 |
| B_{MSY} | 2,318 |
| $CV_{B_{MSY}}$ | 0.31 |
| B_{2025}/B_{MSY} | 128% |
| B_0 | 5,975 |
| $B_{35\%}$ | 2,066 |
| SPR rate at F_{MSY} | 32% |
| Steepness | 0.62 |
| Est. $B_{2024}/B_{2024, no fishing}$ | 0.61 |
| B_{2024}/B_{MSY} | 146% |

Table 28: Summary results of Tier 1 2024 yield projections for EBS pollock.

| Component | Model 23 |
|-------------------------------------|-----------|
| 2025 fishable biomass (GM) | 7,643,000 |
| Equilibrium fishable biomass at MSY | 5,056,000 |
| MSY R (HM) | 0.406 |
| 2025 Tier 1 ABC | 3,107,000 |
| 2025 Tier 1 F_{OFL} unadjusted | 0.47 |
| 2025 Tier 1 OFL | 3,593,000 |
| Recommended ABC | 2,146,000 |

Table 29: For the configuration named Model 23, Tier 3 projections of EBS pollock catch for the 7 scenarios.

| Catch | Scenario.1 | Scenario.2 | Scenario.3 | Scenario.4 | Scenario.5 | Scenario.6 | Scenario.7 |
|-------|------------|------------|------------|------------|------------|------------|------------|
| 2025 | 1,350 | 1,350 | 1,350 | 1,350 | 1,350 | 1,350 | 1,350 |
| 2026 | 1,350 | 1,350 | 1,350 | 1,350 | 1,350 | 2,377 | 1,964 |
| 2027 | 1,793 | 1,793 | 1,123 | 812 | 0 | 1,648 | 1,556 |
| 2028 | 1,614 | 1,614 | 1,120 | 846 | 0 | 1,609 | 1,825 |
| 2029 | 1,604 | 1,604 | 1,214 | 943 | 0 | 1,682 | 1,761 |
| 2030 | 1,570 | 1,570 | 1,247 | 992 | 0 | 1,669 | 1,697 |
| 2031 | 1,591 | 1,591 | 1,292 | 1,046 | 0 | 1,696 | 1,704 |
| 2032 | 1,598 | 1,598 | 1,318 | 1,083 | 0 | 1,700 | 1,702 |
| 2033 | 1,587 | 1,587 | 1,320 | 1,094 | 0 | 1,682 | 1,682 |
| 2034 | 1,581 | 1,581 | 1,323 | 1,103 | 0 | 1,674 | 1,674 |
| 2035 | 1,567 | 1,567 | 1,314 | 1,101 | 0 | 1,658 | 1,658 |
| 2036 | 1,560 | 1,560 | 1,311 | 1,102 | 0 | 1,649 | 1,649 |
| 2037 | 1,555 | 1,555 | 1,308 | 1,100 | 0 | 1,646 | 1,646 |
| 2038 | 1,551 | 1,551 | 1,303 | 1,097 | 0 | 1,643 | 1,643 |

Table 30: For the configuration named Model 23, Tier 3 projections of EBS pollock ABC for the 7 scenarios. Note: scenario 2 results for 2025 and 2026 are conditioned on catches in that scenario listed in Table 29).

| ABC | Scenario.1 | Scenario.2 | Scenario.3 | Scenario.4 | Scenario.5 | Scenario.6 | Scenario.7 |
|------|------------|------------|------------|------------|------------|------------|------------|
| 2025 | 2,145 | 2,145 | 1,352 | 980 | 0 | 2,603 | 2,603 |
| 2026 | 1,964 | 1,964 | 1,243 | 903 | 0 | 2,377 | 2,377 |
| 2027 | 1,793 | 1,793 | 1,123 | 812 | 0 | 1,648 | 1,871 |
| 2028 | 1,614 | 1,614 | 1,120 | 846 | 0 | 1,609 | 1,825 |
| 2029 | 1,604 | 1,604 | 1,214 | 943 | 0 | 1,682 | 1,761 |
| 2030 | 1,570 | 1,570 | 1,247 | 992 | 0 | 1,669 | 1,697 |
| 2031 | 1,591 | 1,591 | 1,292 | 1,046 | 0 | 1,696 | 1,704 |
| 2032 | 1,598 | 1,598 | 1,318 | 1,083 | 0 | 1,700 | 1,702 |
| 2033 | 1,587 | 1,587 | 1,320 | 1,094 | 0 | 1,682 | 1,682 |
| 2034 | 1,581 | 1,581 | 1,323 | 1,103 | 0 | 1,674 | 1,674 |
| 2035 | 1,567 | 1,567 | 1,314 | 1,101 | 0 | 1,658 | 1,658 |
| 2036 | 1,560 | 1,560 | 1,311 | 1,102 | 0 | 1,649 | 1,649 |
| 2037 | 1,555 | 1,555 | 1,308 | 1,100 | 0 | 1,646 | 1,646 |
| 2038 | 1,551 | 1,551 | 1,303 | 1,097 | 0 | 1,643 | 1,643 |

Table 31: For the configuration named Model 23, Tier 3 projections of EBS pollock fishing mortality for the 7 scenarios.

| F | Scenario.1 | Scenario.2 | Scenario.3 | Scenario.4 | Scenario.5 | Scenario.6 | Scenario.7 |
|------|------------|------------|------------|------------|------------|------------|------------|
| 2025 | 0.213 | 0.213 | 0.213 | 0.213 | 0.213 | 0.213 | 0.213 |
| 2026 | 0.235 | 0.235 | 0.235 | 0.235 | 0.235 | 0.463 | 0.364 |
| 2027 | 0.364 | 0.364 | 0.214 | 0.150 | 0.000 | 0.407 | 0.349 |
| 2028 | 0.362 | 0.362 | 0.214 | 0.150 | 0.000 | 0.420 | 0.444 |
| 2029 | 0.347 | 0.347 | 0.214 | 0.150 | 0.000 | 0.413 | 0.420 |
| 2030 | 0.339 | 0.339 | 0.214 | 0.150 | 0.000 | 0.406 | 0.408 |
| 2031 | 0.337 | 0.337 | 0.214 | 0.150 | 0.000 | 0.405 | 0.405 |
| 2032 | 0.335 | 0.335 | 0.214 | 0.150 | 0.000 | 0.404 | 0.404 |
| 2033 | 0.334 | 0.334 | 0.214 | 0.150 | 0.000 | 0.401 | 0.401 |
| 2034 | 0.333 | 0.333 | 0.214 | 0.150 | 0.000 | 0.399 | 0.399 |
| 2035 | 0.333 | 0.333 | 0.214 | 0.150 | 0.000 | 0.399 | 0.399 |
| 2036 | 0.332 | 0.332 | 0.214 | 0.150 | 0.000 | 0.398 | 0.397 |
| 2037 | 0.331 | 0.331 | 0.214 | 0.150 | 0.000 | 0.397 | 0.397 |
| 2038 | 0.331 | 0.331 | 0.214 | 0.150 | 0.000 | 0.396 | 0.396 |

Table 32: For the configuration named Model 23, Tier 3 projections of EBS pollock spawning biomass (kt) for the 7 scenarios.

| SSB | Scenario.1 | Scenario.2 | Scenario.3 | Scenario.4 | Scenario.5 | Scenario.6 | Scenario.7 |
|------|------------|------------|------------|------------|------------|------------|------------|
| 2025 | 2,955 | 2,955 | 2,955 | 2,955 | 2,955 | 2,955 | 2,955 |
| 2026 | 2,635 | 2,635 | 2,635 | 2,635 | 2,635 | 2,484 | 2,548 |
| 2027 | 2,483 | 2,483 | 2,568 | 2,604 | 2,694 | 2,103 | 2,274 |
| 2028 | 2,469 | 2,469 | 2,781 | 2,931 | 3,339 | 2,186 | 2,329 |
| 2029 | 2,483 | 2,483 | 2,934 | 3,172 | 3,878 | 2,239 | 2,296 |
| 2030 | 2,488 | 2,488 | 3,019 | 3,329 | 4,319 | 2,251 | 2,271 |
| 2031 | 2,496 | 2,496 | 3,075 | 3,440 | 4,691 | 2,257 | 2,262 |
| 2032 | 2,504 | 2,504 | 3,111 | 3,517 | 5,004 | 2,260 | 2,261 |
| 2033 | 2,504 | 2,504 | 3,125 | 3,560 | 5,252 | 2,258 | 2,257 |
| 2034 | 2,486 | 2,486 | 3,112 | 3,566 | 5,422 | 2,240 | 2,240 |
| 2035 | 2,474 | 2,474 | 3,100 | 3,565 | 5,550 | 2,230 | 2,230 |
| 2036 | 2,460 | 2,460 | 3,084 | 3,556 | 5,644 | 2,217 | 2,217 |
| 2037 | 2,453 | 2,453 | 3,073 | 3,548 | 5,712 | 2,213 | 2,213 |
| 2038 | 2,466 | 2,466 | 3,082 | 3,559 | 5,777 | 2,227 | 2,227 |

Table 33: Details and explanation of the decision table factors selected in response to the Plan Team requests (as originally proposed in the 2012 assessment).

| Term | Description | Rationale |
|-----------------------------------|--|--|
| $P[F_{2025} > F_{MSY}]$ | Probability that the fishing mortality in 2025 exceeds F_{MSY} | OFL definition is based on F_{MSY} |
| $P[B_{2026} < B_{MSY}]$ | Probability that the spawning biomass in 2026 is less than B_{MSY} | B_{MSY} is a reference point target and biomass in 2021 provides an indication of the impact of 2025 fishing |
| $P[B_{2027} < B_{MSY}]$ | Probability that the spawning biomass in 2027 is less than B_{MSY} | B_{MSY} is a reference point target and biomass in 2024 provides an indication of the impact of fishing in 2025 and 2026 |
| $P[B_{2026} < \bar{B}]$ | Probability that the spawning biomass in 2026 is less than the 1978–2024 mean | To provide some perspective of what the stock condition might be relative to historical estimates after fishing in 2025. |
| $P[B_{2029} < \bar{B}]$ | Probability that the spawning biomass in 2029 is less than the long term mean | To provide some perspective of what the stock condition might be relative to historical estimates after fishing in 2025. |
| $P[B_{2029} < B_{2025}]$ | Probability that the spawning biomass in 2029 is less than that estimated for 2025 | To provide a medium term expectation of stock status relative to 2025 levels |
| $P[B_{2027} < B_{20\%}]$ | Probability that the spawning biomass in 2027 is less than $B_{20\%}$ | $B_{20\%}$ had been selected as a Steller Sea Lion lower limit for allowing directed fishing |
| $P[p_{a_5,2027} > \bar{p}_{a_5}]$ | Probability that in 2027 the proportion of age 1–5 pollock in the population exceeds the long-term mean | To provide some relative indication of the age composition of the population relative to the long term mean. |
| $P[D_{2026} < D_{1994}]$ | Probability that the diversity of ages represented in the spawning biomass (by weight) in 2026 is less than the value estimated for 1994 | To provide a relative index on the abundance of different age classes in the 2026 population relative to 1994 (a year identified as having low age composition diversity) |
| $P[D_{2029} < D_{1994}]$ | Probability that the diversity of ages represented in the spawning biomass (by weight) in 2029 is less than the value estimated for 1994 | To provide a medium-term relative index on the abundance of different age classes in the population relative to 1994 (a year identified as having low age composition diversity) |
| $P[E_{2025} > E_{2024}]$ | Probability that the theoretical fishing effort in 2025 will be greater than that estimated in 2024. | To provide the relative effort that is expected (and hence some idea of costs). |

Table 34: Outcomes of decision (expressed as chances out of 100) given different 2025 catches (first row, in kt). Note that for the 2022 and later year-classes average values were assumed. Constant Fs based on the 2025 catches were used for subsequent years.

| | 2600 | 325 | 650 | 10 | 975 | 1300 | 1625 | 1950 |
|------------------------------------|------|-----|-----|----|-----|------|------|------|
| $P[F_{2025} > F_{MSY}]$ | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| $P[B_{2026} < B_{MSY}]$ | 60 | 21 | 24 | 34 | 29 | 34 | 40 | 46 |
| $P[B_{2027} < B_{MSY}]$ | 70 | 16 | 21 | 34 | 27 | 34 | 43 | 52 |
| $P[B_{2026} < \bar{B}]$ | 87 | 8 | 16 | 40 | 27 | 40 | 54 | 67 |
| $P[B_{2029} < \bar{B}]$ | 60 | 5 | 10 | 24 | 16 | 24 | 33 | 42 |
| $P[B_{2029} < B_{2023}]$ | 70 | 12 | 19 | 36 | 28 | 36 | 46 | 54 |
| $P[B_{2027} < B_{20\%}]$ | 14 | 1 | 2 | 4 | 3 | 4 | 5 | 8 |
| $P[p_{a_5, 2027} > \bar{p}_{a_5}]$ | 82 | 31 | 44 | 64 | 56 | 64 | 71 | 76 |
| $P[D_{2026} < D_{1994}]$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $P[D_{2029} < D_{1994}]$ | 45 | 1 | 2 | 10 | 5 | 10 | 16 | 24 |
| $P[E_{2025} > E_{2024}]$ | 93 | 0 | 0 | 48 | 14 | 48 | 71 | 83 |

Table 35: Bycatch estimates (t) of non-target species caught in the BSAI directed pollock fishery, 2003–2024 based on observer data as processed through the catch accounting system (NMFS Regional Office, Juneau, Alaska).

| Year | Jellies | MiscFish | SeaStar | Osmerid | Grenadier | Eelpouts | Sea.pen | Anemone | Snails | Other |
|------|---------|----------|---------|---------|-----------|----------|---------|---------|--------|-------|
| 2003 | 5,643 | 101 | 89 | 20 | 9 | 7 | 0 | 0 | 1 | 1 |
| 2004 | 6,590 | 89 | 7 | 14 | 21 | 0 | 1 | 0 | 0 | 0 |
| 2005 | 5,196 | 157 | 9 | 14 | 12 | 1 | 1 | 0 | 6 | 2 |
| 2006 | 2,716 | 154 | 11 | 15 | 99 | 21 | 1 | 0 | 0 | 15 |
| 2007 | 2,397 | 204 | 5 | 27 | 138 | 118 | 3 | 0 | 0 | 12 |
| 2008 | 4,183 | 120 | 19 | 27 | 4 | 8 | 1 | 0 | 1 | 8 |
| 2009 | 8,115 | 135 | 9 | 4 | 5 | 4 | 2 | 1 | 1 | 3 |
| 2010 | 2,516 | 149 | 12 | 2 | 0 | 0 | 2 | 2 | 1 | 9 |
| 2011 | 8,232 | 277 | 27 | 1 | 1 | 1 | 2 | 1 | 1 | 8 |
| 2012 | 3,518 | 142 | 7 | 2 | 1 | 1 | 3 | 1 | 1 | 3 |
| 2013 | 5,294 | 121 | 15 | 0 | 0 | 1 | 2 | 2 | 0 | 9 |
| 2014 | 12,767 | 44 | 29 | 10 | 1 | 7 | 3 | 1 | 1 | 8 |
| 2015 | 4,950 | 90 | 41 | 4 | 24 | 10 | 2 | 2 | 1 | 4 |
| 2016 | 2,203 | 75 | 54 | 4 | 5 | 22 | 1 | 0 | 0 | 3 |
| 2017 | 6,152 | 48 | 12 | 2 | 3 | 18 | 0 | 1 | 0 | 1 |
| 2018 | 8,251 | 52 | 24 | 9 | 0 | 4 | 0 | 0 | 0 | 3 |
| 2019 | 3,889 | 73 | 50 | 8 | 0 | 2 | 0 | 0 | 0 | 5 |
| 2020 | 3,149 | 93 | 61 | 42 | 1 | 6 | 1 | 5 | 0 | 26 |
| 2021 | 7,829 | 35 | 19 | 54 | 0 | 0 | 1 | 3 | 1 | 3 |
| 2022 | 7,609 | 22 | 184 | 9 | 0 | 0 | 1 | 1 | 0 | 9 |
| 2023 | 7,007 | 35 | 27 | 86 | 0 | 0 | 1 | 3 | 1 | 5 |

Table 36: Bycatch estimates (t) of other target species caught in the BSAI directed pollock fishery, 1991–2024 based on then NMFS Alaska Regional Office reports from observers (2024 data are preliminary).

| Year | P.cod | Rock.Sole | Flathead | Arrowtooth | POP | Yellowfin | Sablefish | Shark | Atka.Mkrl | Skates | Other |
|------|--------|-----------|----------|------------|-------|-----------|-----------|-------|-----------|--------|--------|
| 1991 | 3,018 | 207 | 0 | 455 | 53 | 38 | 1 | NA | 0 | 0 | 1,719 |
| 1992 | 14,313 | 3,485 | 2 | 2,917 | 143 | 247 | 7 | NA | 242 | 0 | 10,624 |
| 1993 | 8,632 | 2,089 | 0 | 557 | 184 | 579 | 0 | NA | 34 | 0 | 5,033 |
| 1994 | 8,131 | 329 | 0 | 992 | 76 | 147 | 1 | NA | 40 | 0 | 2,204 |
| 1995 | 10,105 | 422 | 1,131 | 558 | 128 | 160 | 10 | NA | 94 | 0 | 863 |
| 1996 | 9,297 | 676 | 1,879 | 1,105 | 267 | 936 | 3 | NA | 72 | 0 | 1,278 |
| 1997 | 5,962 | 919 | 1,774 | 611 | 334 | 85 | 2 | NA | 56 | 0 | 1,887 |
| 1998 | 5,334 | 194 | 1,466 | 887 | 571 | 798 | 2 | NA | 5 | 0 | 1,105 |
| 1999 | 3,076 | 757 | 1,792 | 252 | 94 | 134 | 5 | NA | 7 | 0 | 963 |
| 2000 | 3,066 | 1,411 | 2,158 | 910 | 7 | 714 | 12 | NA | 1 | 0 | 1,137 |
| 2001 | 3,550 | 1,313 | 1,814 | 433 | 462 | 158 | 17 | NA | 40 | 0 | 2,800 |
| 2002 | 5,741 | 1,720 | 1,715 | 504 | 539 | 411 | 26 | NA | 221 | 0 | 2,327 |
| 2003 | 5,772 | 1,338 | 1,414 | 550 | 691 | 149 | 47 | NA | 378 | 0 | 932 |
| 2004 | 6,166 | 2,299 | 2,021 | 541 | 331 | 650 | 14 | NA | 408 | 0 | 1,293 |
| 2005 | 6,391 | 1,034 | 2,079 | 550 | 503 | 17 | 10 | NA | 210 | 0 | 1,128 |
| 2006 | 6,867 | 1,178 | 2,643 | 952 | 422 | 165 | 7 | NA | 154 | 0 | 2,136 |
| 2007 | 5,274 | 409 | 3,732 | 2,279 | 459 | 21 | 11 | NA | 105 | 0 | 1,842 |
| 2008 | 5,841 | 1,355 | 3,223 | 1,043 | 190 | 124 | 0 | NA | 14 | 0 | 2,763 |
| 2009 | 4,168 | 1,789 | 2,171 | 993 | 66 | 96 | 0 | NA | 4 | 0 | 2,000 |
| 2010 | 4,422 | 622 | 2,220 | 555 | 147 | 380 | 0 | NA | 5 | 0 | 1,339 |
| 2011 | 6,776 | 3,076 | 2,927 | 974 | 435 | 361 | 0 | 63 | 99 | 1,206 | 433 |
| 2012 | 6,160 | 2,805 | 2,281 | 469 | 272 | 566 | 0 | 53 | 73 | 1,198 | 657 |
| 2013 | 5,932 | 1,921 | 1,591 | 370 | 410 | 538 | 0 | 42 | 3 | 936 | 289 |
| 2014 | 4,100 | 2,469 | 1,950 | 477 | 1,088 | 748 | 0 | 74 | 19 | 670 | 1,409 |
| 2015 | 7,410 | 1,103 | 1,948 | 328 | 1,983 | 498 | 0 | 50 | 179 | 769 | 1,858 |
| 2016 | 4,459 | 750 | 1,232 | 153 | 2,082 | 557 | 17 | 58 | 53 | 373 | 1,254 |
| 2017 | 5,157 | 1,478 | 799 | 90 | 3,026 | 367 | 75 | 89 | 48 | 408 | 1,703 |
| 2018 | 3,974 | 1,004 | 902 | 167 | 2,649 | 354 | 360 | 59 | 251 | 469 | 1,537 |
| 2019 | 5,749 | 960 | 962 | 248 | 4,974 | 107 | 1,087 | 97 | 174 | 446 | 252 |
| 2020 | 7,697 | 468 | 1,491 | 312 | 3,365 | 215 | 2,867 | 108 | 182 | 682 | 290 |
| 2021 | 6,371 | 491 | 1,209 | 193 | 1,863 | 78 | 984 | 168 | 261 | 631 | 106 |
| 2022 | 3,362 | 546 | 802 | 105 | 1,062 | 320 | 189 | 54 | 39 | 501 | 38 |
| 2023 | 3,345 | 264 | 633 | 141 | 909 | 20 | 377 | 268 | 17 | 323 | 50 |

Table 37: Bycatch estimates (t) of pollock caught in the other non-pollock EBS directed fisheries, 1991–2024 based on then NMFS Alaska Regional Office reports from observers.

| Year | Atka.Mackerel | NRock.sole | Other.flats | Other.spp | P.cod | Yellowfin.sole |
|------|---------------|------------|-------------|-----------|--------|----------------|
| 1991 | 129 | 9,711 | 7,992 | 661,886 | 10,695 | NA |
| 1992 | 108 | 9,824 | 1,371 | 520 | 20,778 | 13,100 |
| 1993 | 18 | 18,582 | 2,581 | 604 | 31,292 | 15,253 |
| 1994 | 0 | 15,784 | 6,770 | 89 | 26,594 | 33,200 |
| 1995 | NA | 7,766 | 5,211 | 63 | 25,691 | 27,041 |
| 1996 | 60 | 7,698 | 5,456 | 744 | 22,382 | 22,254 |
| 1997 | NA | 9,123 | 3,480 | 14 | 33,658 | 24,100 |
| 1998 | 58 | 3,960 | 3,011 | 882 | 10,468 | 15,339 |
| 1999 | 246 | 5,207 | 4,771 | 951 | 21,131 | 8,701 |
| 2000 | 16 | 5,480 | 7,068 | 503 | 14,508 | 13,425 |
| 2001 | 238 | 4,577 | 4,739 | 249 | 11,570 | 16,502 |
| 2002 | 2 | 9,942 | 2,220 | 49 | 15,255 | 14,489 |
| 2003 | 92 | 4,924 | 3,672 | 167 | 15,926 | 11,578 |
| 2004 | 117 | 8,975 | 6,396 | 80 | 18,650 | 10,383 |
| 2005 | 195 | 7,235 | 5,057 | 25 | 14,109 | 10,312 |
| 2006 | 121 | 6,986 | 3,826 | 21 | 15,168 | 5,966 |
| 2007 | 147 | 3,245 | 4,353 | 128 | 20,319 | 4,020 |
| 2008 | 1 | 4,930 | 4,822 | 15 | 9,533 | 9,827 |
| 2009 | 7 | 6,171 | 3,505 | 6 | 7,875 | 7,036 |
| 2010 | NA | 6,074 | 3,316 | 85 | 6,575 | 5,179 |
| 2011 | 144 | 6,931 | 2,301 | 157 | 8,981 | 8,673 |
| 2012 | 41 | 6,703 | 1,751 | 371 | 8,377 | 11,197 |
| 2013 | 9 | 7,326 | 4,048 | 228 | 9,801 | 20,171 |
| 2014 | NA | 11,258 | 6,404 | 202 | 11,502 | 24,712 |
| 2015 | 19 | 9,386 | 4,993 | 410 | 9,062 | 21,281 |
| 2016 | 1 | 11,850 | 3,687 | 448 | 9,071 | 22,306 |
| 2017 | 13 | 5,616 | 3,613 | 494 | 8,319 | 23,414 |
| 2018 | 137 | 5,182 | 3,525 | 819 | 8,008 | 28,235 |
| 2019 | 54 | 3,176 | 7,972 | 1,311 | 7,593 | 23,153 |
| 2020 | 57 | 6,401 | 2,374 | 668 | 5,512 | 31,651 |
| 2021 | 53 | 2,398 | 5,131 | 1,328 | 4,316 | 24,844 |
| 2022 | 602 | 2,976 | 5,505 | 2,023 | 6,260 | 26,514 |
| 2023 | 383 | 11,047 | 4,590 | 2,688 | 7,181 | 22,347 |
| 2024 | 41 | 15,035 | 4,208 | 1,426 | 5,117 | 13,179 |

Table 38: Bycatch estimates of prohibited species caught in the BSAI directed pollock fishery, 1997–2023 based on the AKFIN (NMFS Regional Office) reports from observers. Herring and halibut units are in t, all others represent numbers of individuals caught. Data for 2023 are preliminary.

| Year | Bairdi | Chinook | Halib | Halib.M | Herring | NonChin | Snow Crab | Red King | Blue King | Goldn King |
|------|-----------|---------|-------|---------|---------|---------|-----------|----------|-----------|------------|
| 1991 | 1,397,836 | 36,348 | 2,156 | NA | 3,158 | 28,658 | 4,378,008 | 17,777 | NA | NA |
| 1992 | 1,500,765 | 33,672 | 2,220 | NA | 647 | 40,187 | 4,569,662 | 43,874 | NA | NA |
| 1993 | 1,649,087 | 36,615 | 1,326 | NA | 527 | 241,972 | 738,250 | 58,140 | NA | NA |
| 1994 | 371,214 | 31,880 | 963 | 689 | 1,627 | 91,764 | 811,734 | 42,361 | NA | NA |
| 1995 | 153,993 | 13,403 | 492 | 397 | 905 | 17,755 | 206,651 | 4,644 | NA | NA |
| 1996 | 89,416 | 55,468 | 382 | 321 | 1,242 | 77,174 | 63,398 | 5,934 | NA | NA |
| 1997 | 17,046 | 44,313 | 257 | 200 | 1,135 | 65,415 | 216,152 | 137 | NA | NA |
| 1998 | 57,071 | 51,245 | 353 | 278 | 801 | 60,677 | 123,758 | 14,287 | NA | NA |
| 1999 | 7,549 | 11,978 | 154 | 125 | 800 | 45,169 | 20,386 | 92 | NA | NA |
| 2000 | 1,517 | 4,961 | 110 | 91 | 483 | 58,568 | 6,580 | 0 | NA | NA |
| 2001 | 5,146 | 33,441 | 243 | 200 | 225 | 57,002 | 5,709 | 106 | NA | NA |
| 2002 | 2,172 | 34,474 | 165 | 138 | 109 | 80,630 | 2,908 | 20 | NA | NA |
| 2003 | 771 | 45,661 | 89 | 74 | 967 | 188,339 | 750 | 52 | 8 | NA |
| 2004 | 1,139 | 51,751 | 96 | 82 | 1,096 | 442,148 | 712 | 27 | 4 | 1 |
| 2005 | 631 | 68,126 | 120 | 100 | 594 | 703,080 | 2,260 | 0 | NA | 1 |
| 2006 | 1,345 | 82,653 | 132 | 111 | 434 | 305,793 | 2,796 | 289 | NA | 3 |
| 2007 | 1,497 | 121,956 | 312 | 270 | 352 | 86,380 | 3,165 | 8 | NA | 3 |
| 2008 | 9,179 | 21,242 | 373 | 312 | 128 | 15,133 | 9,327 | 676 | 8 | 33 |
| 2009 | 6,204 | 12,731 | 541 | 436 | 65 | 45,960 | 7,392 | 1,137 | 19 | NA |
| 2010 | 12,846 | 9,835 | 335 | 267 | 349 | 13,734 | 10,291 | 1,124 | 28 | NA |
| 2011 | 10,986 | 25,499 | 460 | 378 | 377 | 193,754 | 6,584 | 577 | 25 | NA |
| 2012 | 5,621 | 11,343 | 463 | 388 | 2,353 | 22,297 | 6,250 | 344 | NA | NA |
| 2013 | 12,427 | 13,091 | 334 | 272 | 959 | 125,525 | 8,704 | 508 | 34 | 107 |
| 2014 | 12,522 | 15,135 | 239 | 200 | 160 | 219,837 | 19,455 | 368 | NA | NA |
| 2015 | 8,872 | 18,329 | 152 | 130 | 1,487 | 237,776 | 8,339 | 0 | NA | NA |
| 2016 | 2,295 | 22,204 | 121 | 103 | 1,431 | 343,208 | 1,166 | 440 | NA | 26 |
| 2017 | 7,270 | 30,079 | 97 | 89 | 964 | 467,750 | 3,407 | 203 | 0 | 67 |
| 2018 | 2,249 | 13,726 | 75 | 62 | 474 | 295,818 | 5,143 | 565 | - | 53 |
| 2019 | 3,146 | 25,038 | 134 | 113 | 1,102 | 348,631 | 6,228 | 453 | 99 | 445 |
| 2020 | 10,749 | 32,204 | 128 | 102 | 3,861 | 343,625 | 40,005 | 479 | 1 | 522 |
| 2021 | 8,417 | 13,852 | 145 | 131 | 1,709 | 546,472 | 4,668 | 52 | - | 115 |
| 2022 | 4,758 | 6,415 | 170 | 156 | 1,708 | 242,375 | 1,952 | 311 | 59 | 88 |
| 2023 | 11,997 | 11,874 | 88 | 67 | 3,087 | 112,512 | 4,100 | 54 | - | 132 |
| 2024 | 9,744 | 7,948 | 77 | 6,281 | 1,281 | 35,117 | 9,275 | 230 | 1 | 4 |

Table 39: Ecosystem considerations for BSAI pollock and the pollock fishery.

| Indicator | Observation | Interpretation | Evaluation |
|---|--|--|---|
| Ecosystem effects on EBS pollock | | | |
| <i>Prey availability or abundance trends</i> | | | |
| Zooplankton | Stomach contents, AT and ichthyoplankton surveys, changes mean wt-at-age | Data improving, indication of increases from 2004–2009 and subsequent decreases (for euphausiids in 2012 and 2014) | Variable abundance indicates important recruitment (for prey) |
| <i>Predator population trends</i> | | | |
| Marine mammals | Fur seals declining, Steller sea lions increasing slightly | Possibly lower mortality on pollock | Probably no concern |
| Birds | Stable, some increasing some decreasing | Affects young-of-year mortality | Probably no concern |
| Fish (Pollock, Pacific cod, halibut) | Stable to increasing | Possible increases to pollock mortality | |
| <i>Changes in habitat quality</i> | | | |
| Temperature regime | Cold years pollock distribution towards NW on average | Likely to affect surveyed stock | Some concern, the distribution of pollock availability to different surveys may change systematically |
| Winter-spring environmental conditions | Affects pre-recruit survival | Probably a number of factors | Causes natural variability |
| Production | Fairly stable nutrient flow from upwelled BS Basin | Inter-annual variability low | No concern |
| Fishery effects on ecosystem | | | |
| <i>Fishery contribution to bycatch</i> | | | |
| Prohibited species | Stable, heavily monitored | Likely to be safe | No concern |
| Forage (including herring, Atka mackerel, cod, and pollock) | Stable, heavily monitored | Likely to be safe | No concern |
| HAPC biota | Likely minor impact | Likely to be safe | No concern |
| Marine mammals and birds | Very minor direct-take | Safe | No concern |
| Sensitive non-target species | Likely minor impact | Data limited, likely to be safe | No concern |
| Fishery concentration in space and time | Generally more diffuse | Mixed potential impact (fur seals vs Steller sea lions) | Possible concern |
| Fishery effects on amount of large size target fish | Depends on highly variable year-class strength | Natural fluctuation | Probably no concern |
| Fishery contribution to discards and offal production | Decreasing | Improving, but data limited | Possible concern |
| Fishery effects on age-at-maturity and fecundity | Maturity study (gonad collection) continues | NA | Possible concern |

13 Figures

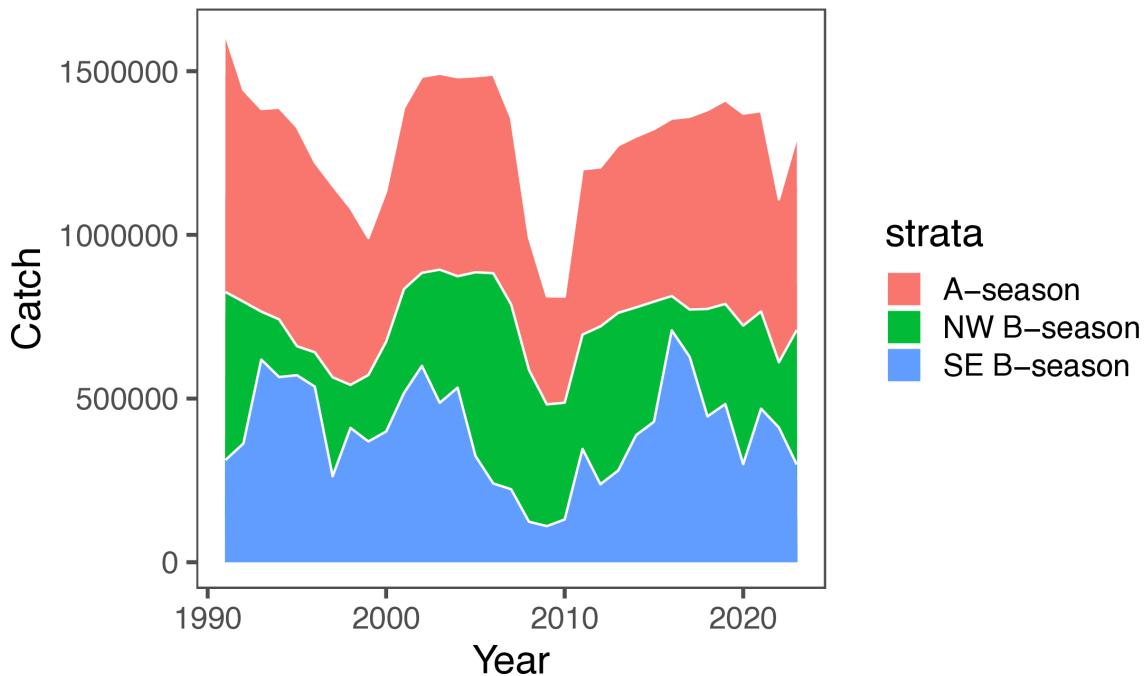


Figure 1: Pollock catch estimates (t) from the Eastern Bering Sea by season and region. The A-season is defined as from Jan-May and B-season from June-October.

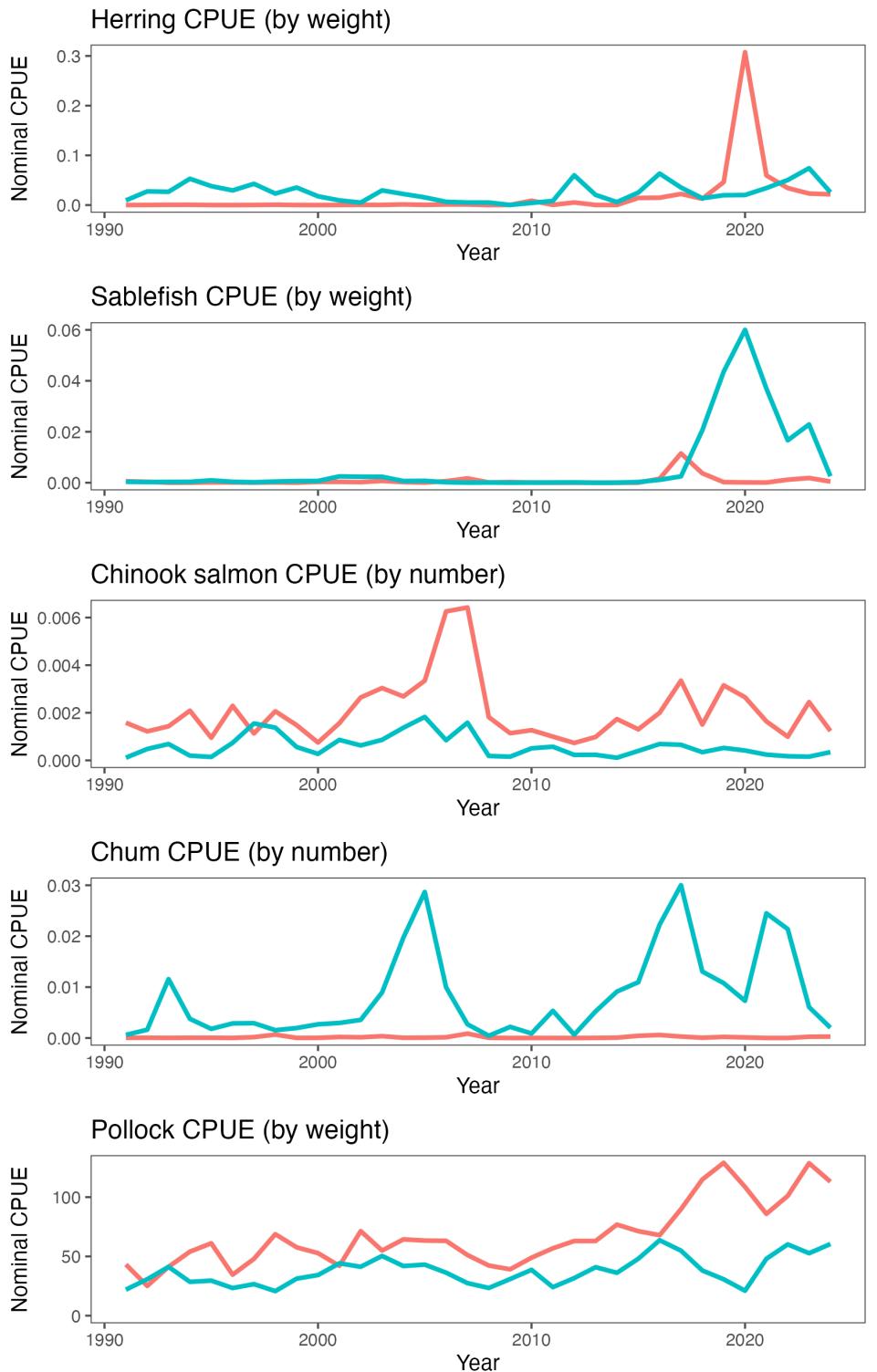


Figure 2: Nominal catch divided by effort (hours towed) for some bycatch species and pollock for the EBS pollock fleet (sectors combined) 2000-2024.

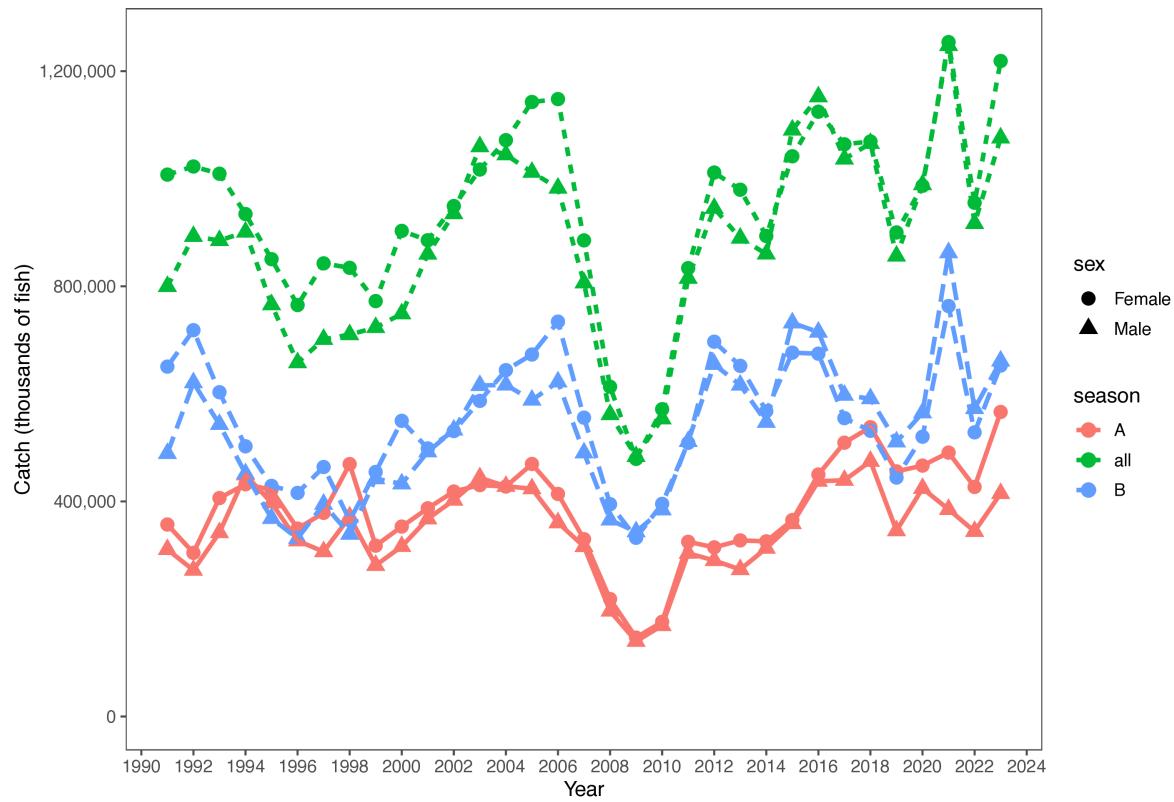


Figure 3: Estimate of EBS pollock catch numbers by sex for the A season (January-May) and B seasons (June-October) and total.

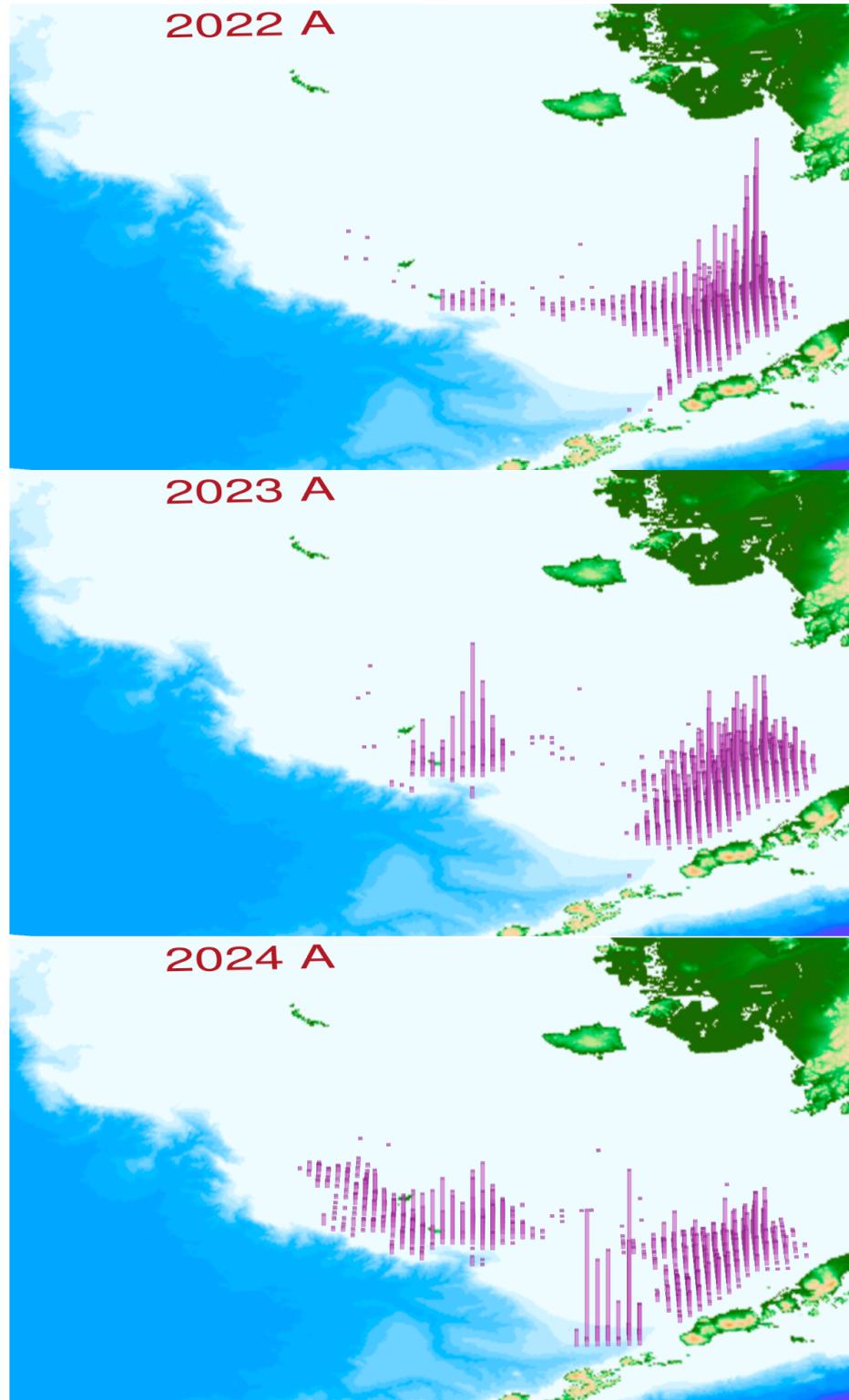


Figure 4: EBS pollock catch distribution during A-season, 2022–2024. Column height is proportional to total catch.

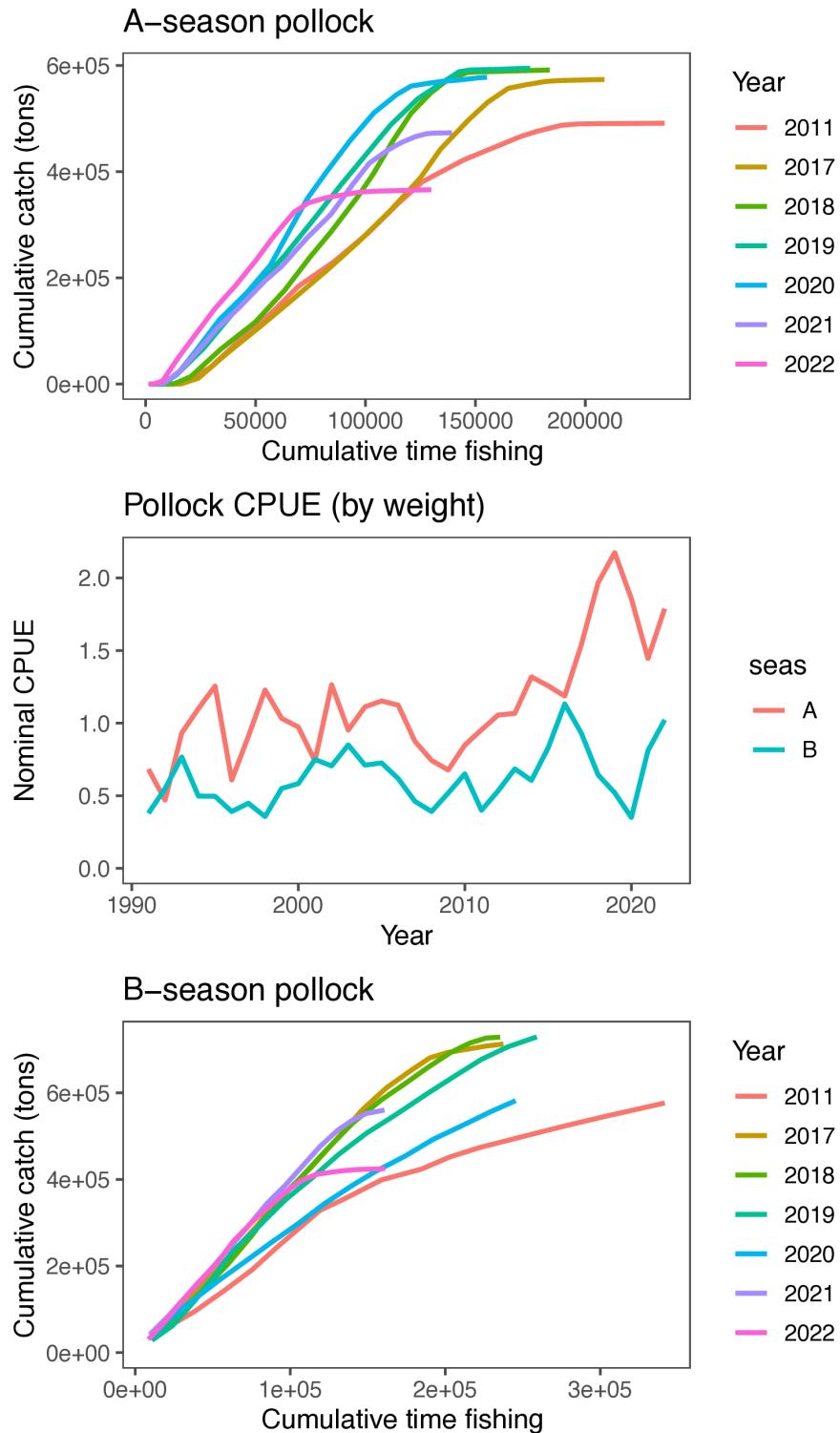


Figure 5: A-season (top) and B-season (bottom) EBS fleet-wide cumulative catch by hours observed fishing and relative pollock catch per hour of fishing (by sector)

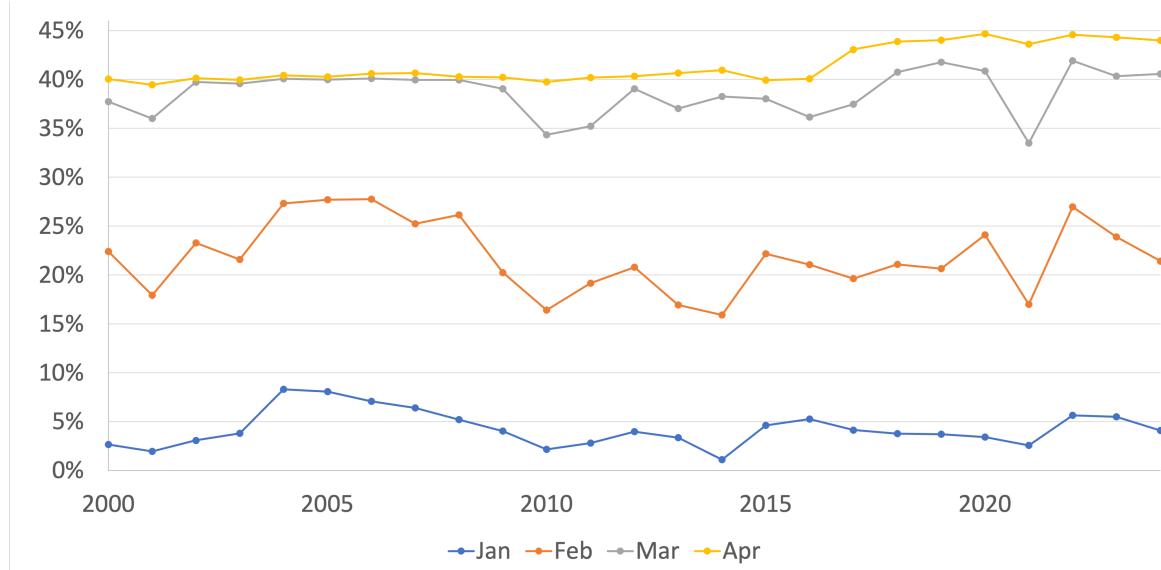


Figure 6: Proportion of the annual EBS pollock TAC by month during the A-season, 2000–2024. The higher value observed since 2017 was due to Amendment 110 of the FMP to allow greater flexibility to avoid Chinook salmon.

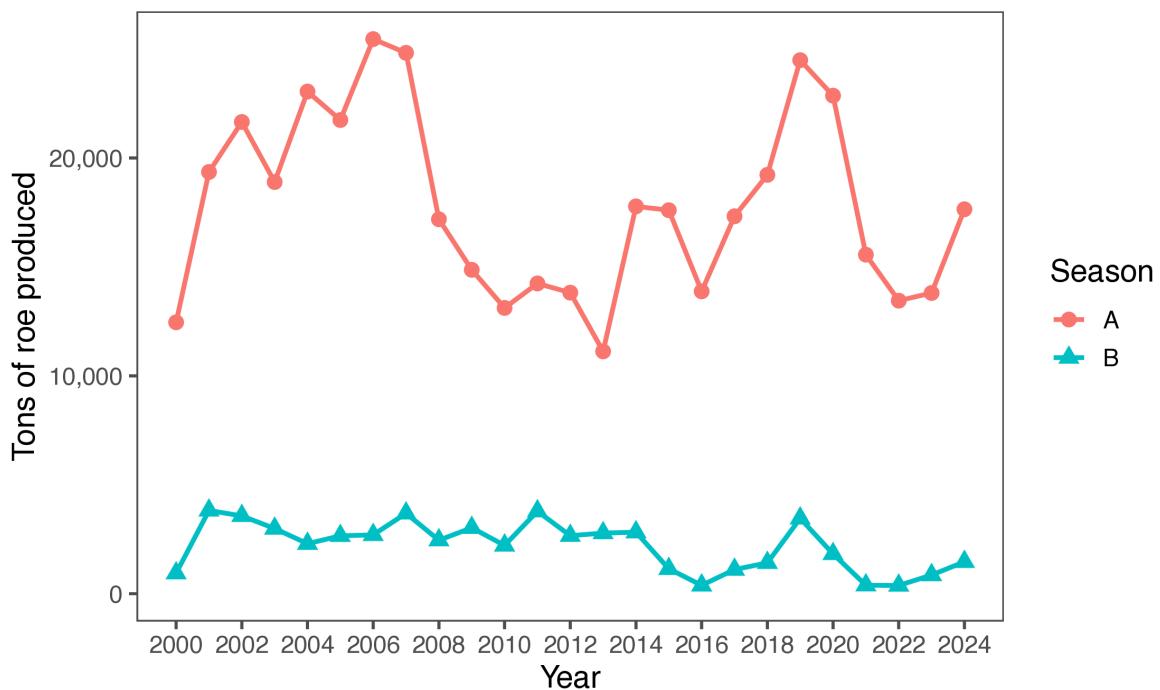


Figure 7: EBS pollock roe production in A and B seasons, 2000-2024.

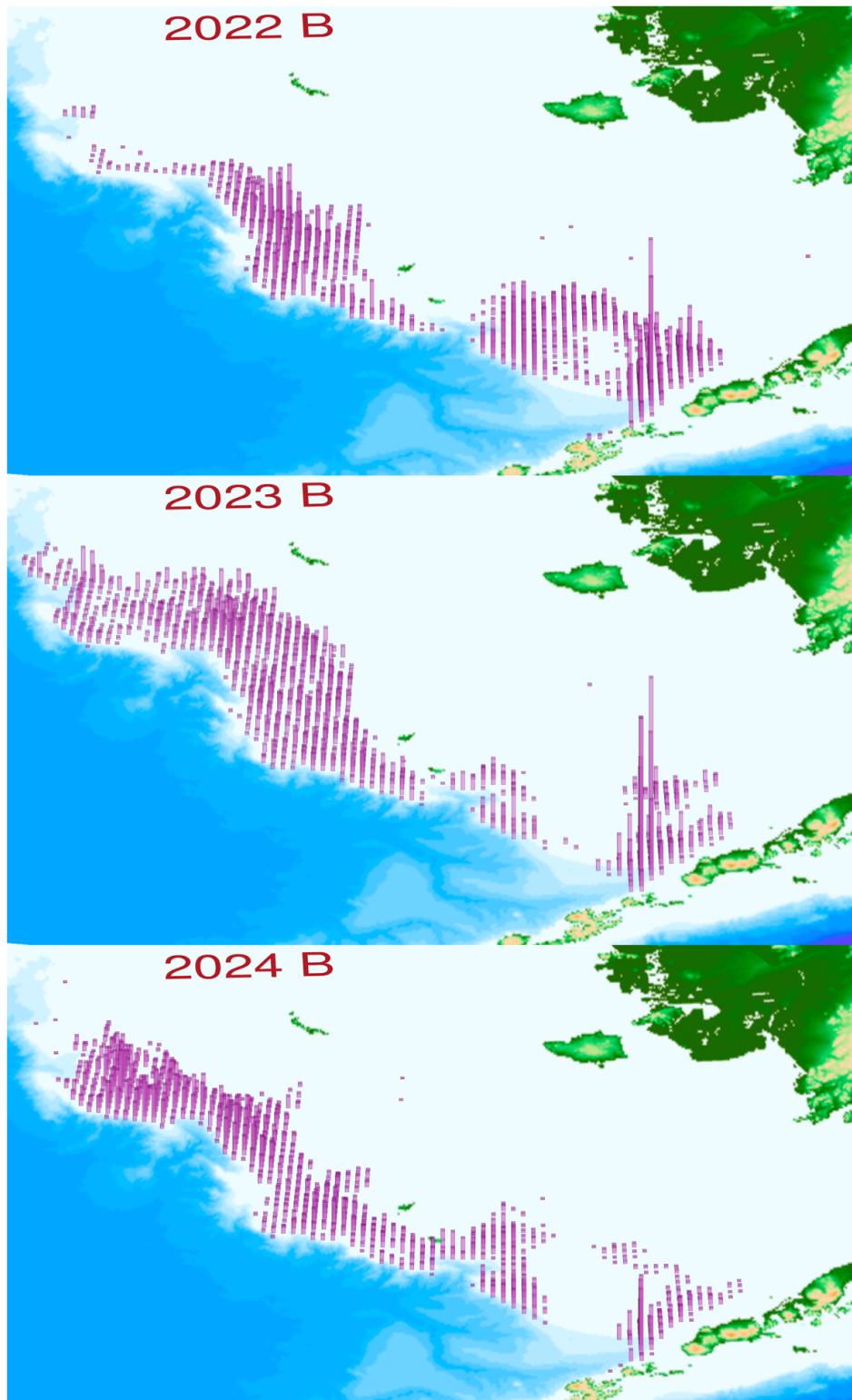


Figure 8: EBS pollock catch distribution during B-season, 2022–2024. Column height is proportional to total catch. Note that directed fishery for pollock generally is finished prior to October; the labels are indicative full-year catches.

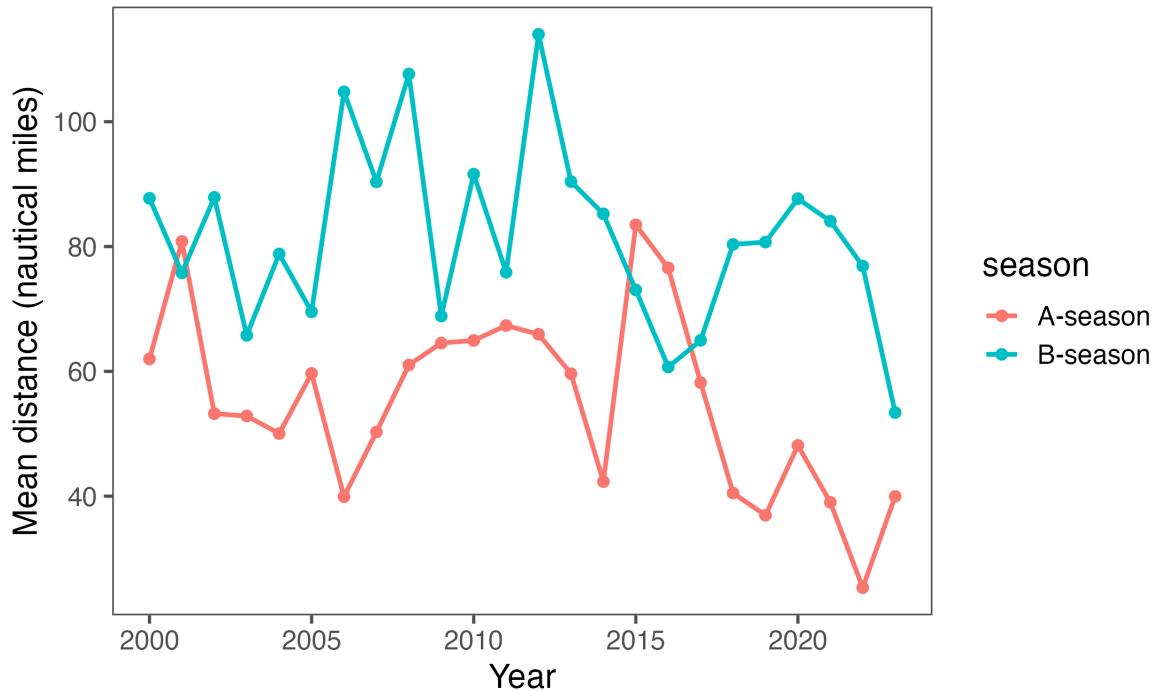


Figure 9: Estimated mean daily distance between operations, 2000-2024.

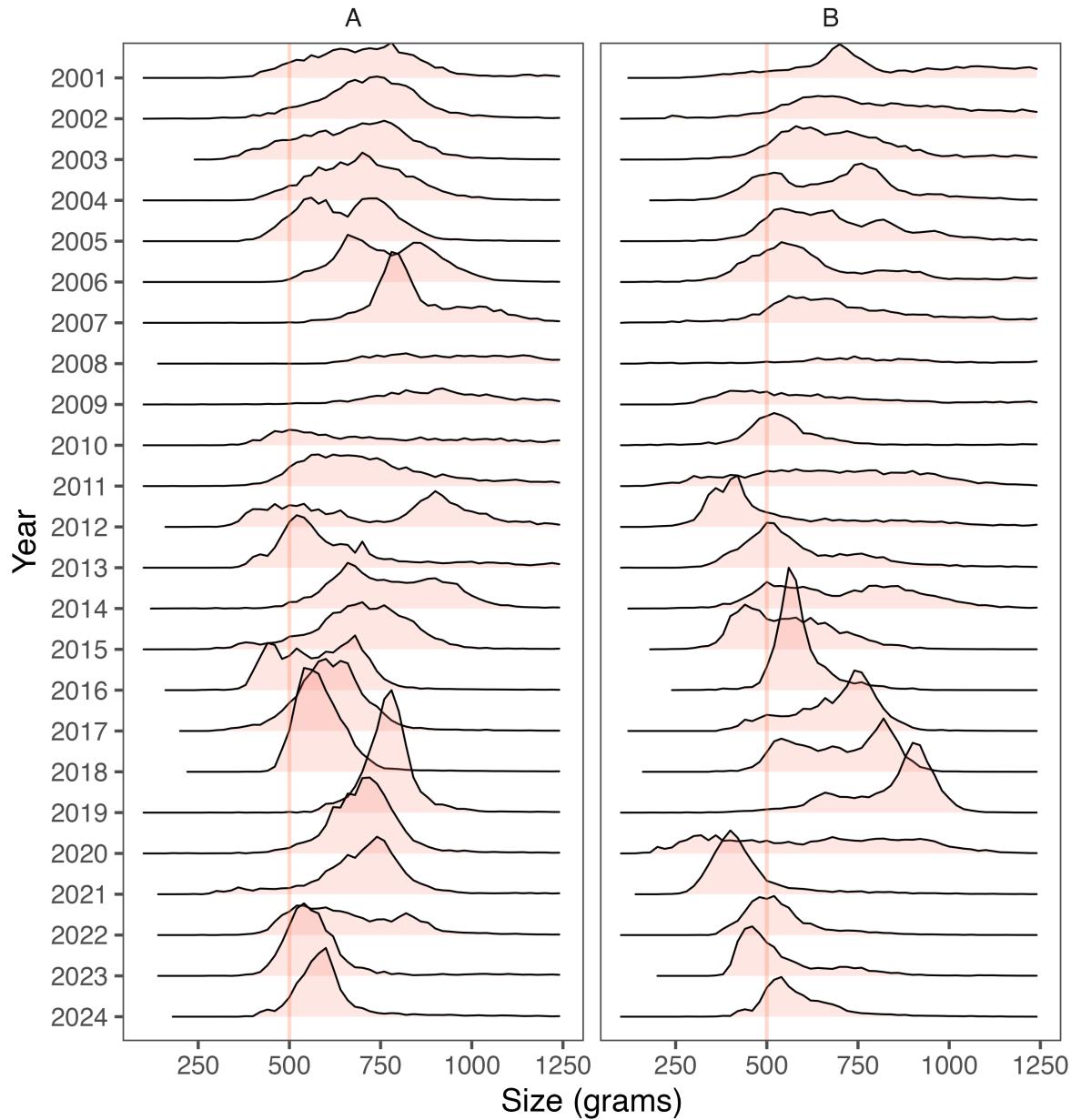


Figure 10: Pollock fishery data showing the frequency of mean pollock weight within a tow (in 50 g increments) by year and season.

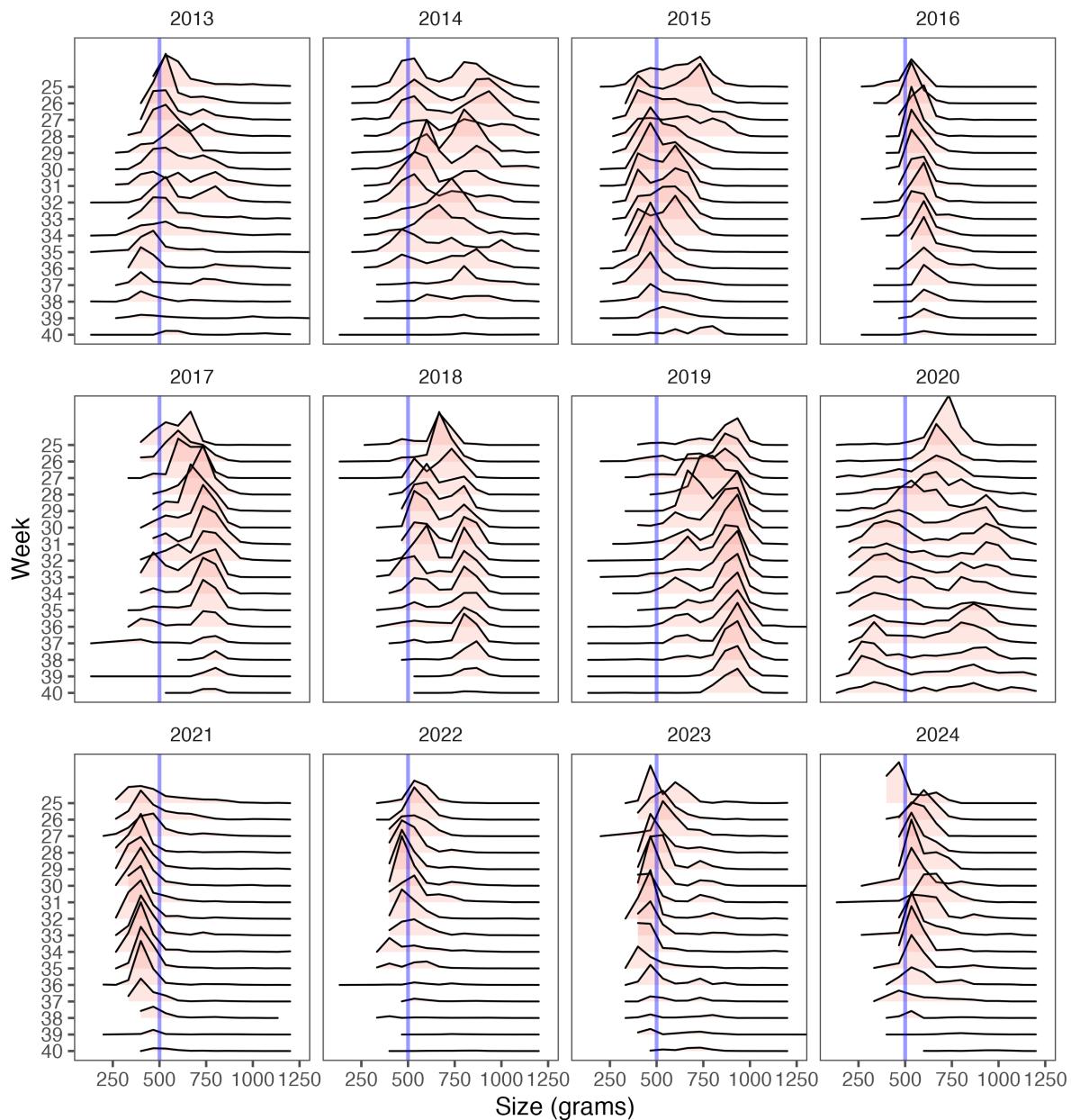


Figure 11: Pollock fishery data showing the frequency of mean pollock weight within a tow (in 50 g increments) by recent years and weeks of the B-season.

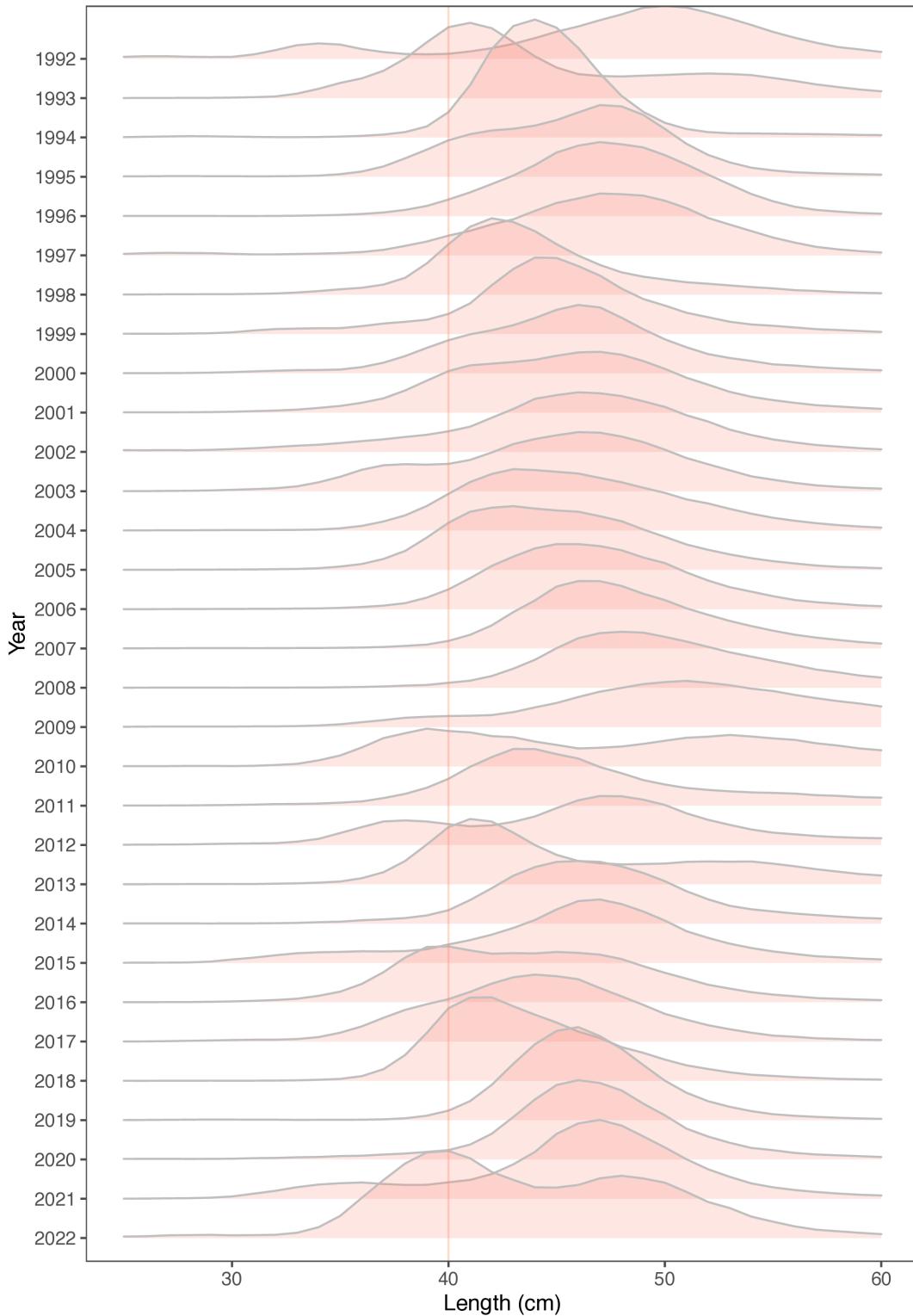


Figure 12: Fishery catch-at-length (cm) by the pollock fishery, 1992-2024.

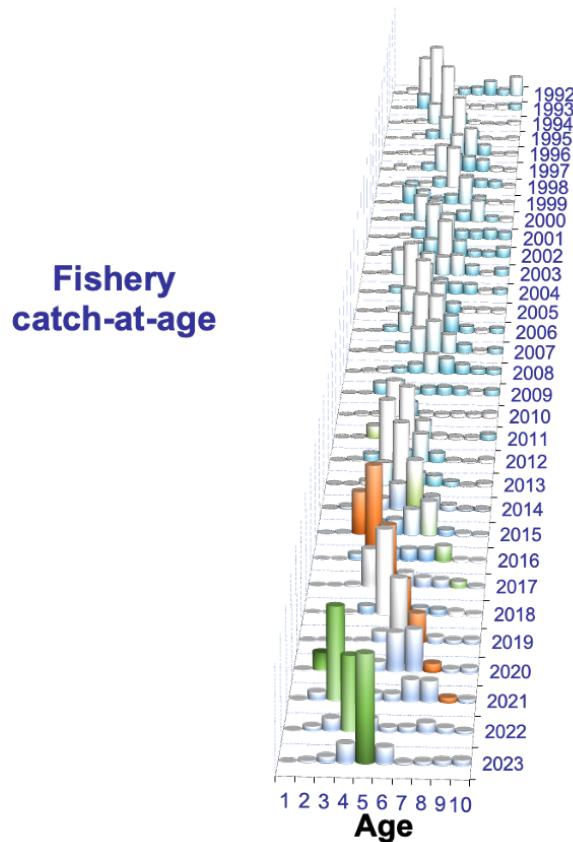


Figure 13: EBS pollock fishery estimated catch-at-age data (in number) for 1992–2023. Age 10 represents pollock age 10 and older. The 2012 year-class is shaded in orange.

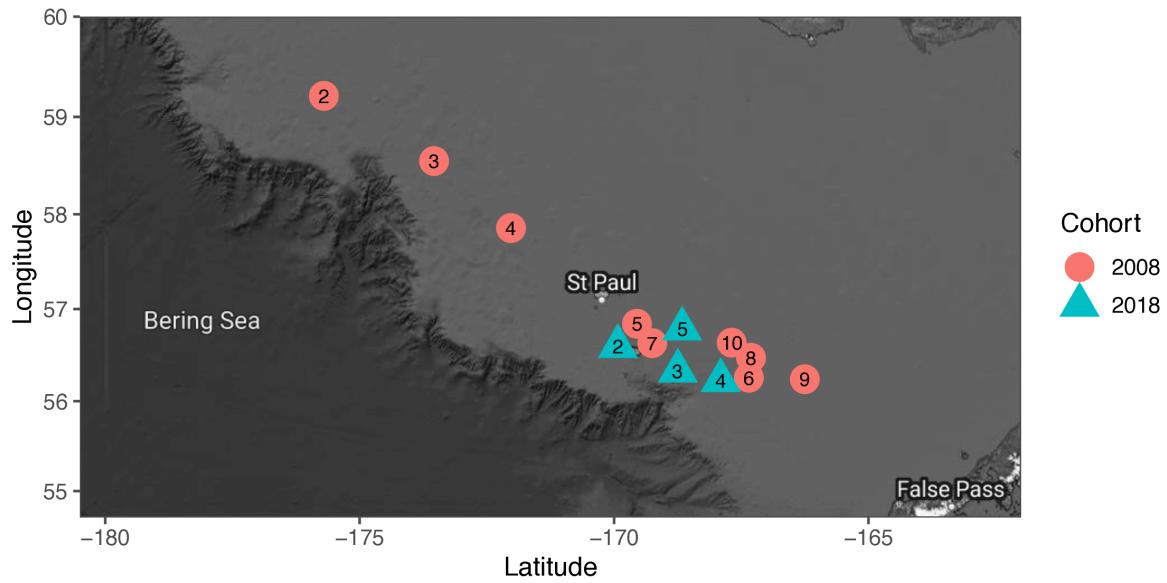


Figure 14: Pollock age sample mean locales for two cohorts representing the 2008 and 2018 year-classes (from data through 2023).

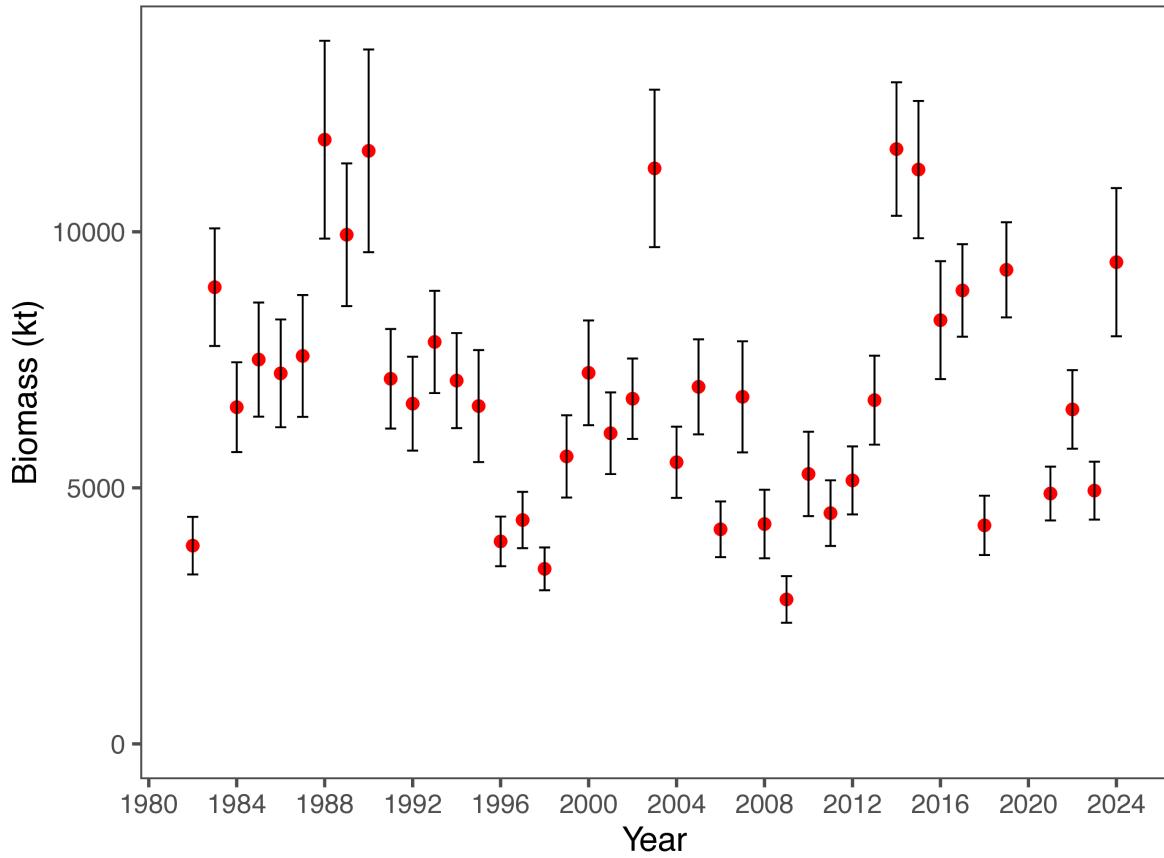


Figure 15: Bottom-trawl survey biomass estimates with error bars representing 95% confidence intervals for the VAST model-based methods for EBS pollock.

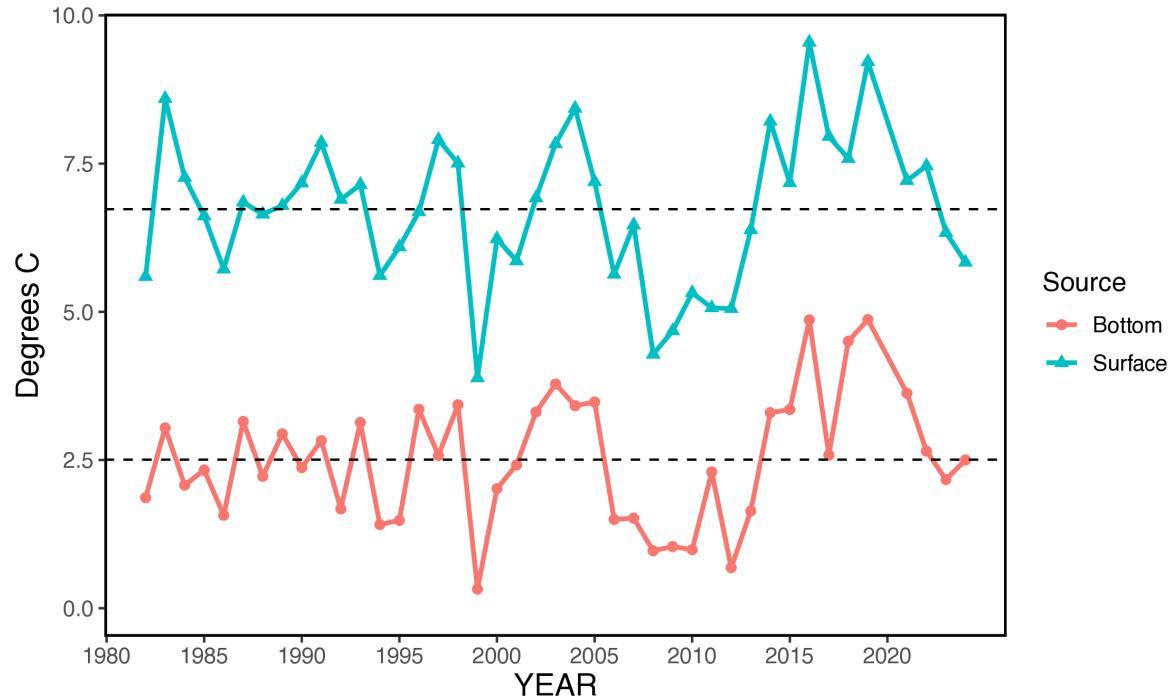


Figure 16: Bottom and surface temperatures for the Bering Sea from the NMFS summer bottom-trawl surveys (1982–2019, 2021–2024). Dashed lines represent mean values.

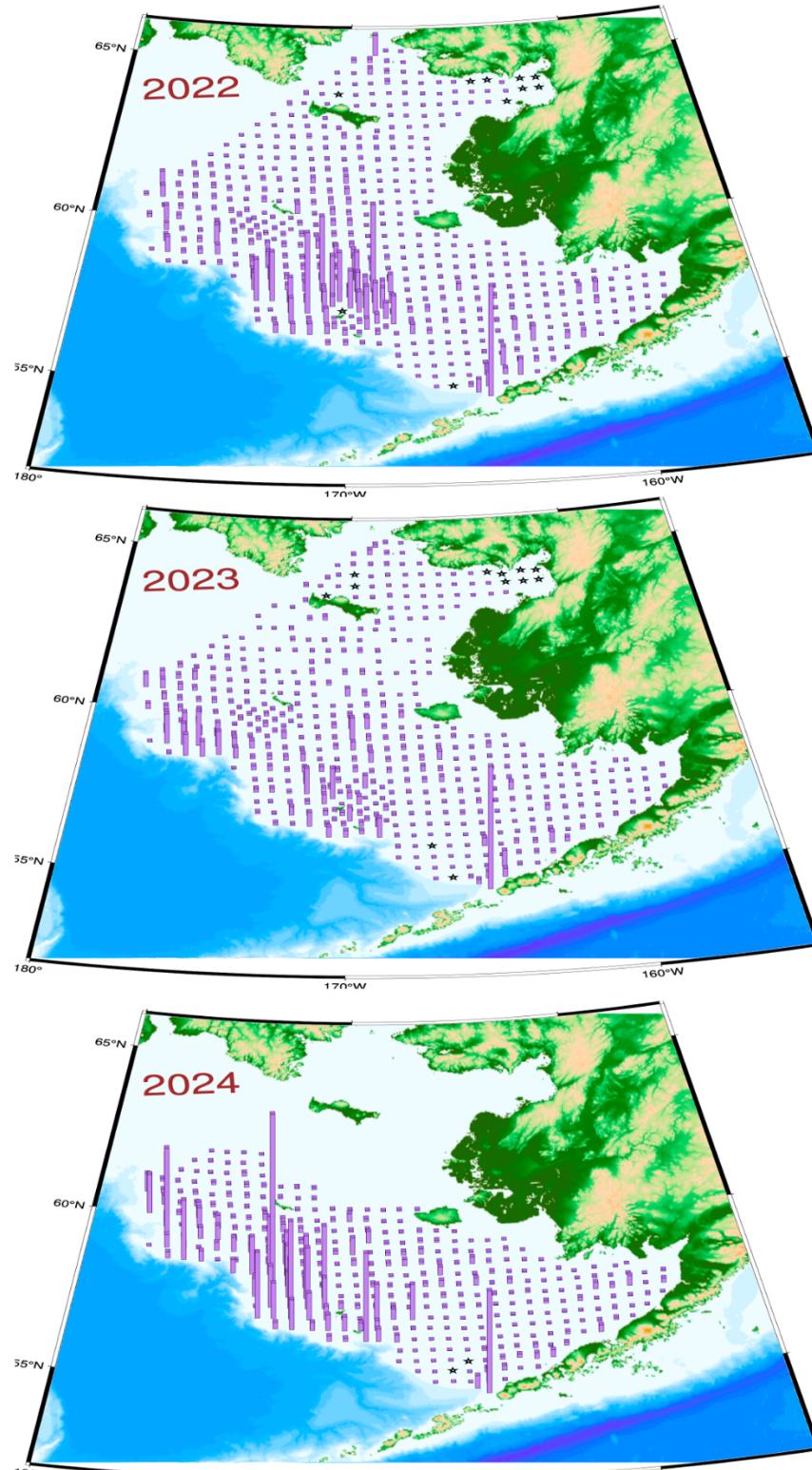


Figure 17: Bottom trawl survey pollock catch in kg per hectare for 2021-2024. Height of vertical lines are proportional to station-specific pollock densities by weight (kg per hectare) with constant scales for all years (red stars indicate tows where pollock were absent from the catch).

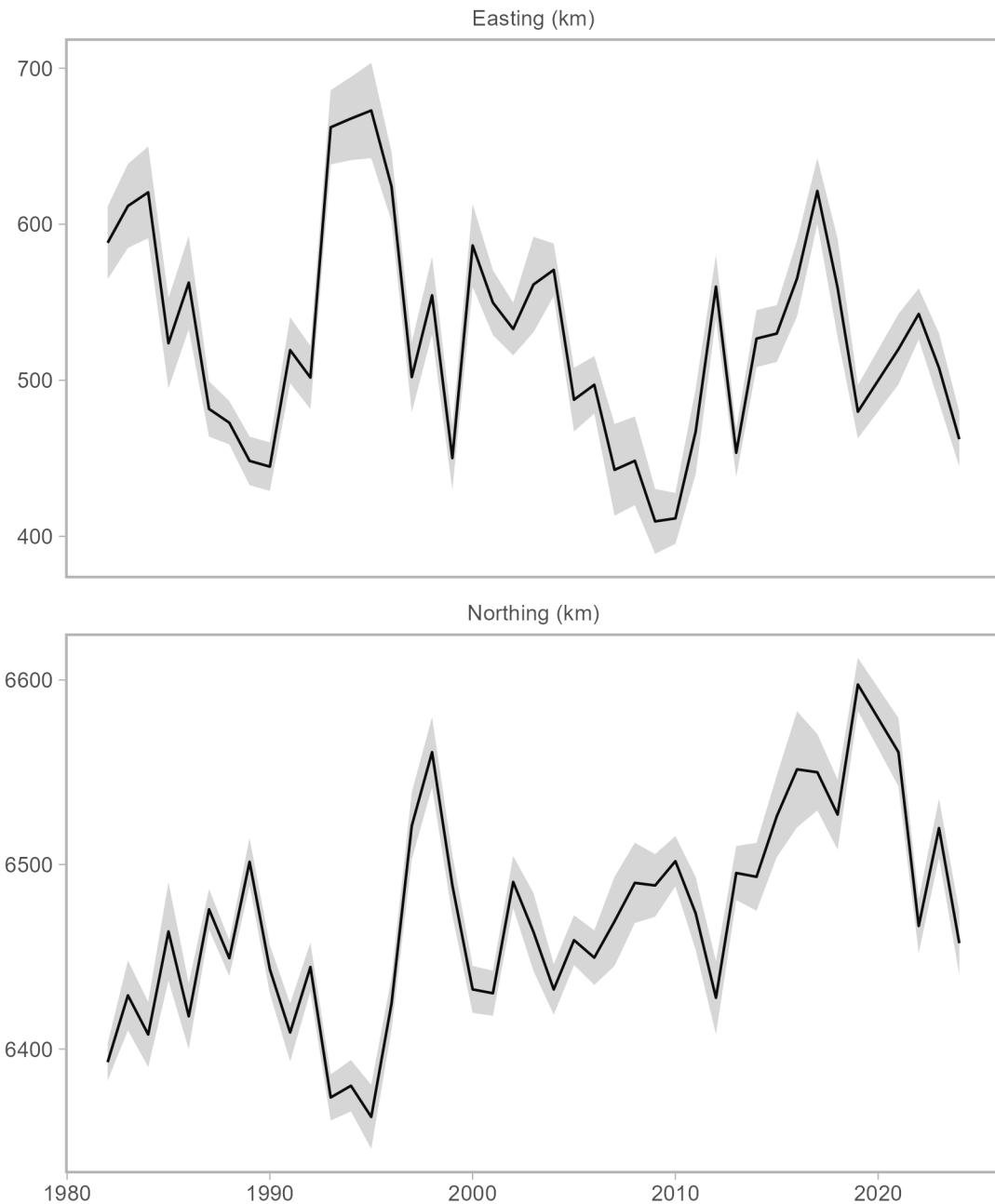


Figure 18: The EBS pollock stock center of gravity as estimated over time using VAST

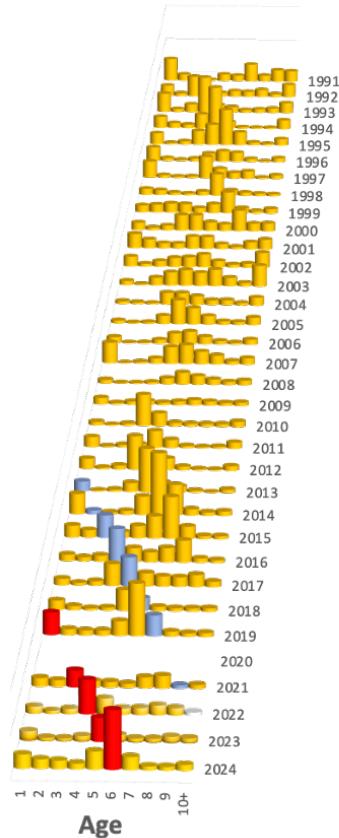


Figure 19: Pollock abundance levels by age and year as estimated directly from the NMFS bottom-trawl surveys (1990–2019, 2021–2024). The 2012 and 2018 year-classes are shaded differently.

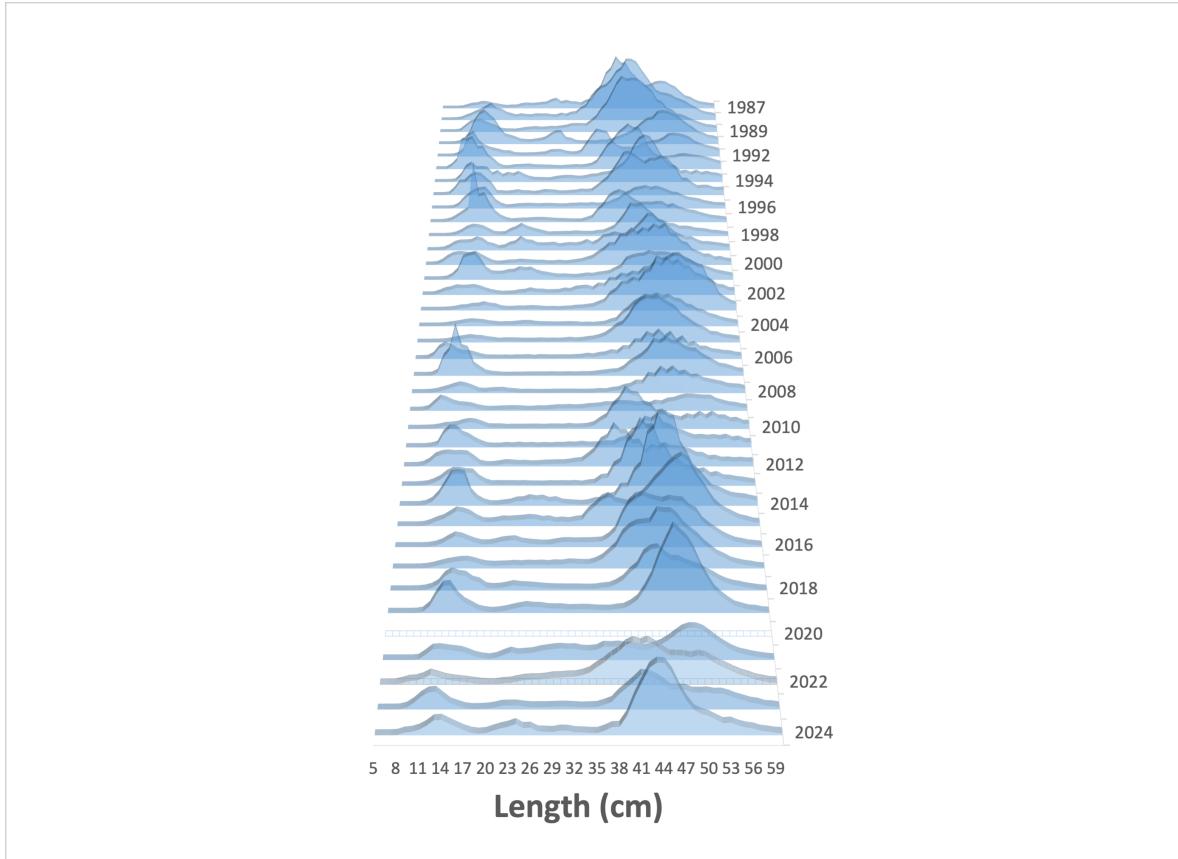


Figure 20: Pollock abundance levels by size and year as estimated from the NMFS bottom-trawl surveys (1990–2019 and 2021–2024).

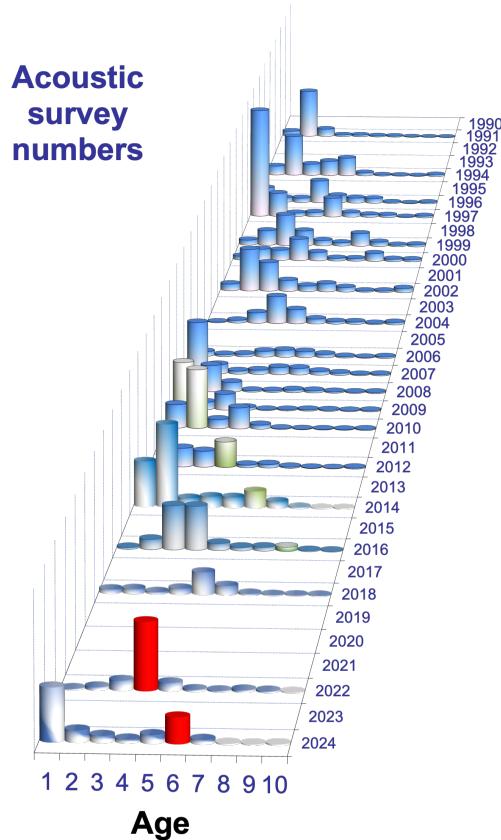


Figure 21: Acoustic-trawl survey pollock numbers-at-age estimates, 1991-2022. Note that the series used in the model starts in 1994.

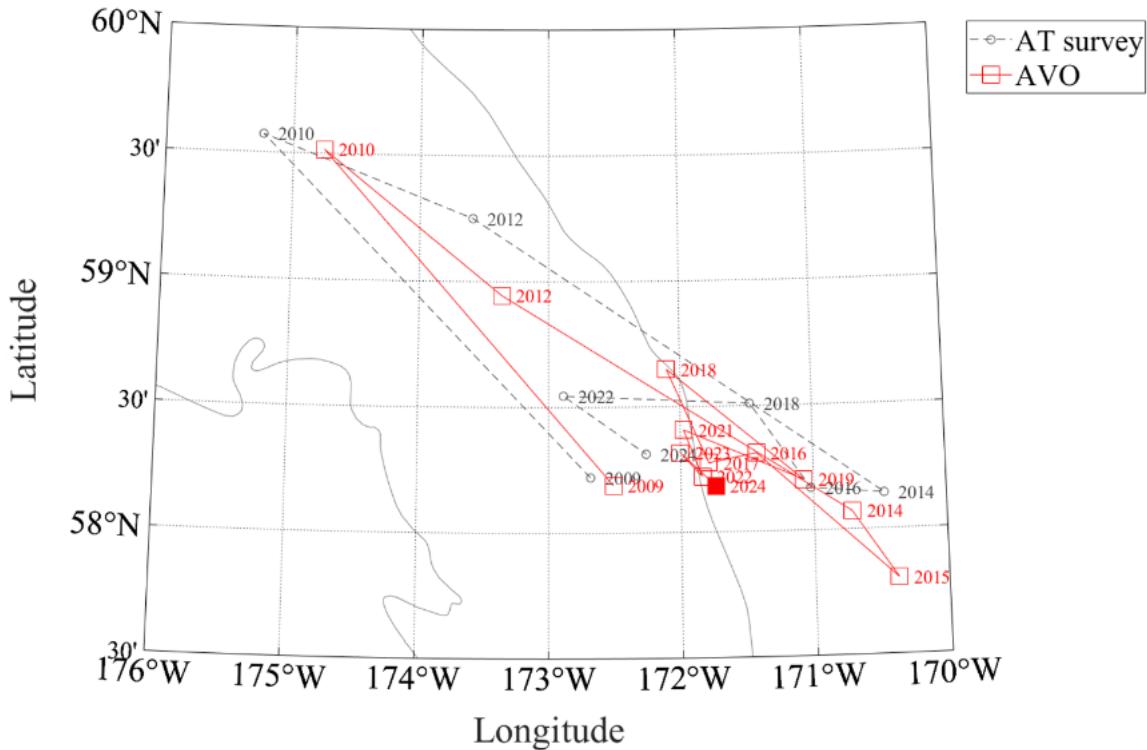


Figure 22: Geographic center of gravity estimates derived from pollock sA ($\text{m}^2 \text{ nmi}^{-2}$) from acoustic-trawl (AT) survey (gray circles) and the new acoustic vessel-of-opportunity index (red squares). The point with a filled red square is to highlight the new AVO estimate (2024). The 100 and 200 m bathymetric contours are indicated in gray. The 2018 AT survey did not complete the last 3 transects (i.e., the western-most transects) due to vessel mechanical problems, and the omission of sA from this area will bias the 2018 AT data point to the southeast.

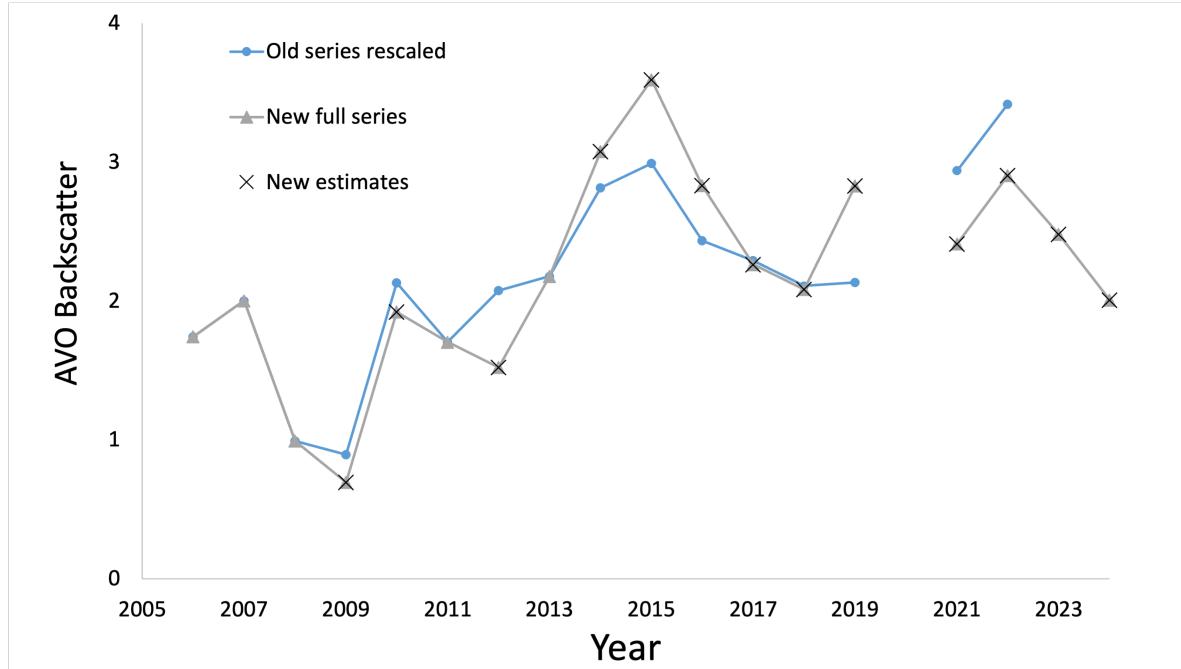


Figure 23: Time series of EBS pollock data from the acoustic vessels of opportunity (AVO) showing the years of new data compared to previous series and the full series.

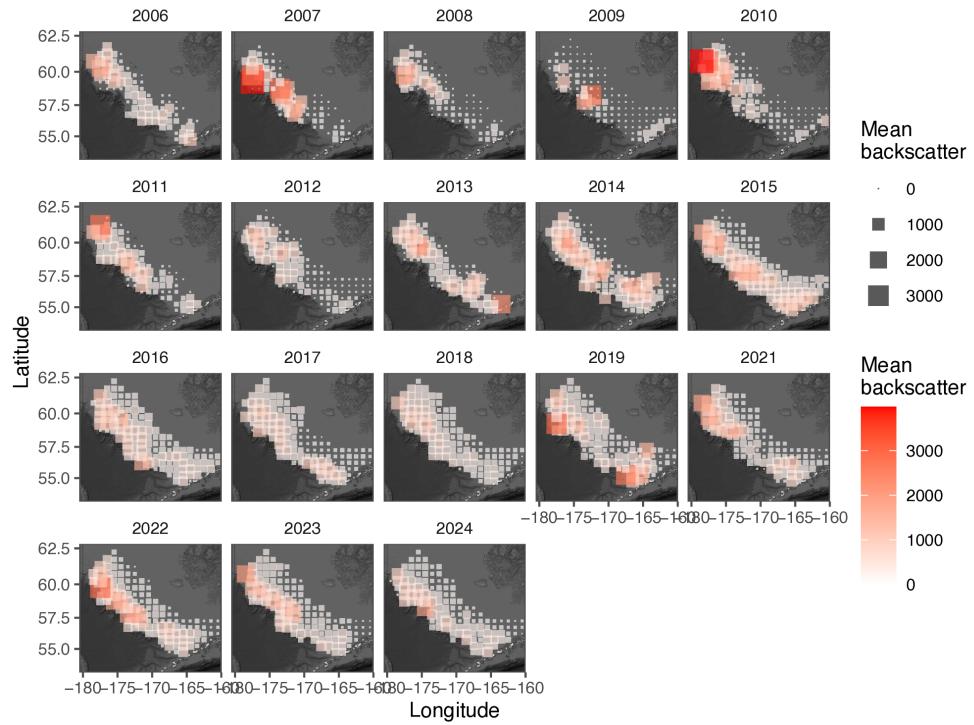


Figure 24: Maps of acoustic vessel-of-opportunity (AVO) index data 2006-2024. Grid cell size and shading is proportional to pollock backscatter.

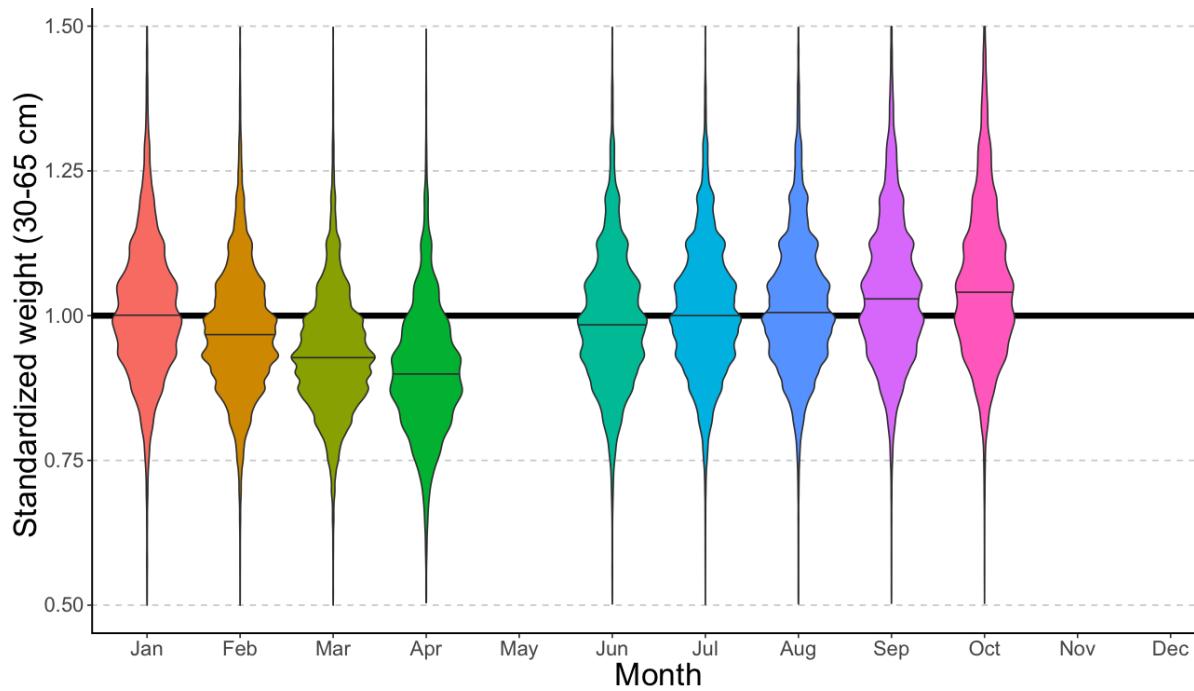


Figure 25: EBS pollock fishery body mass (given length) anomaly (standardized by overall mean body mass at each length) by month based on some over 700 thousand fish measurements from 1991–2024.

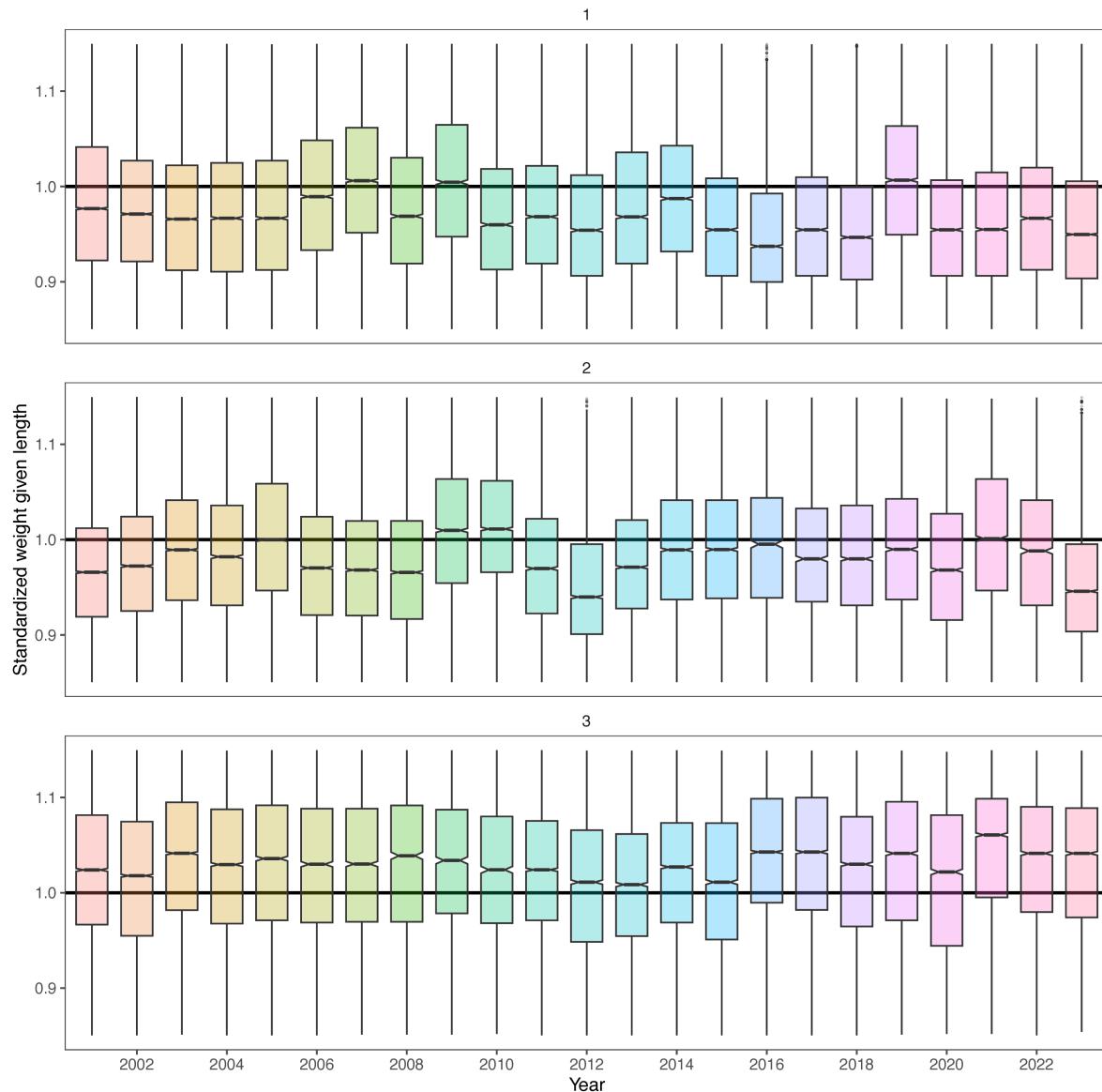


Figure 26: EBS pollock fishery body mass (given length) anomaly (standardized by overall mean body mass at each length) by year and season/area strata, 1991–2024. Strata are defined as A-season (top), and B-season west of 170W (middle) and east of 170W (bottom)

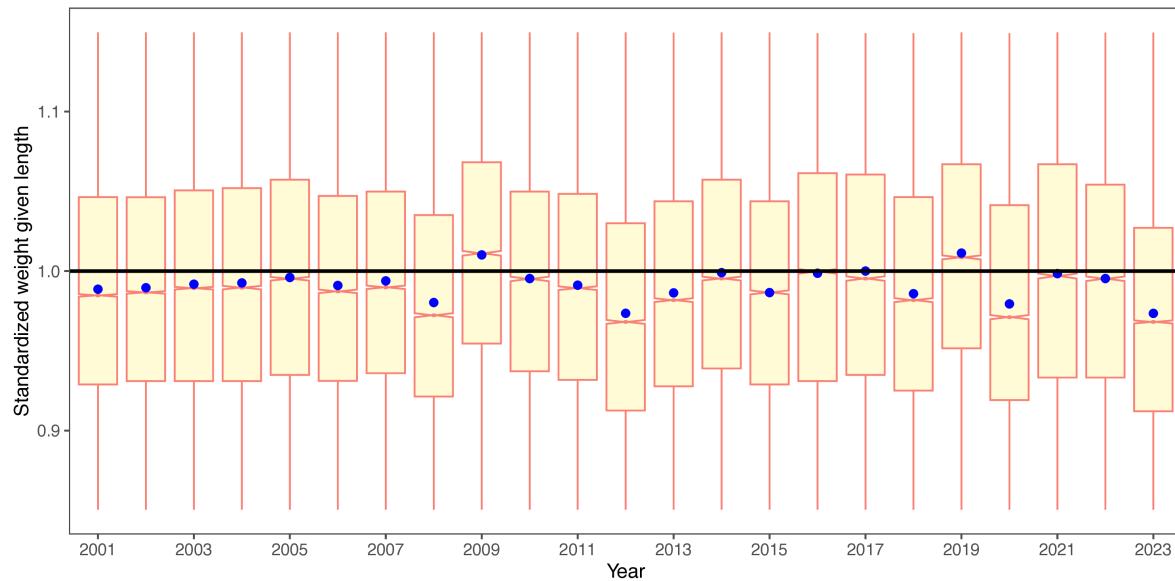


Figure 27: EBS pollock body mass (given length) anomaly (standardized by overall mean body mass at each length) by year, 1991–2024.

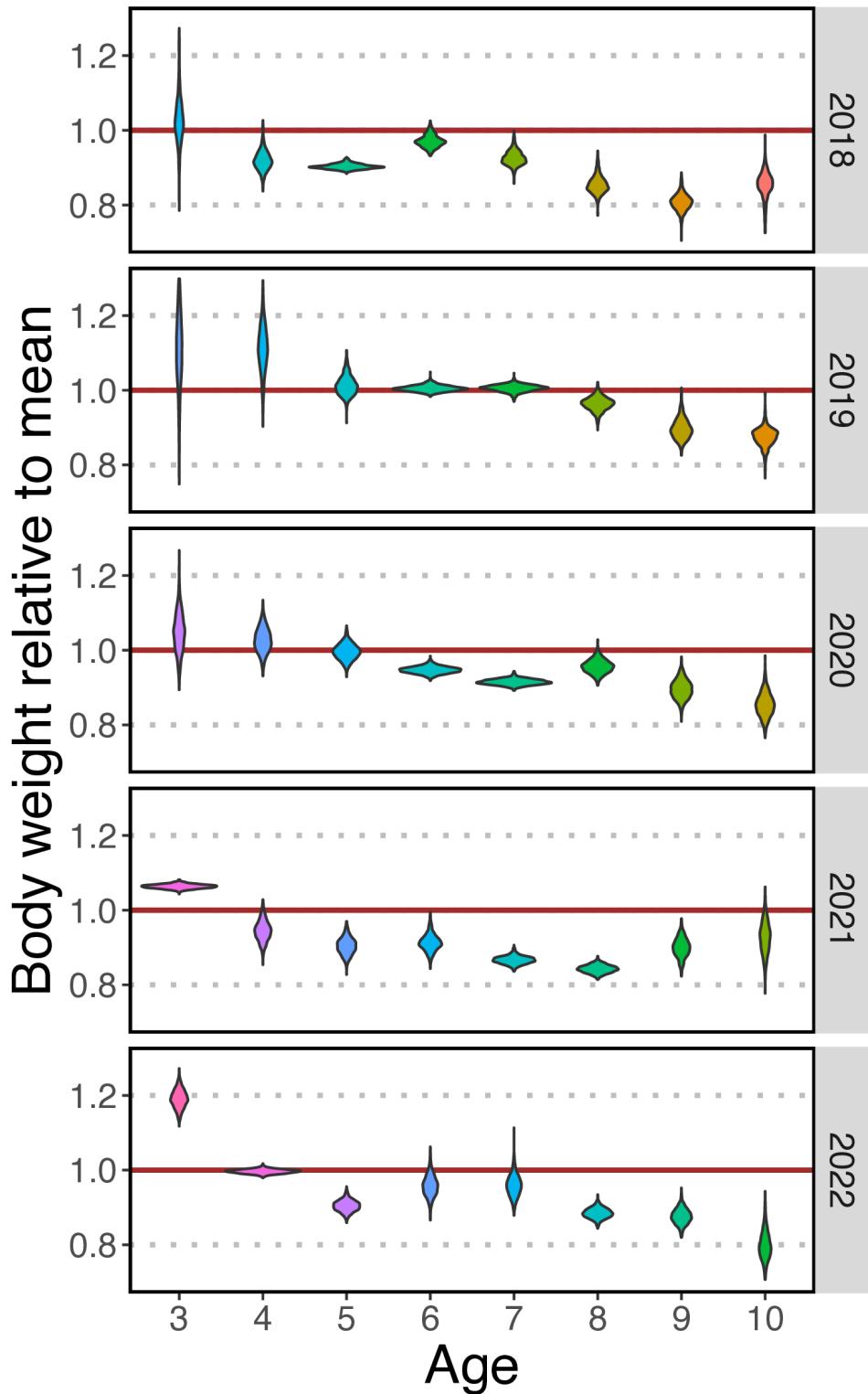


Figure 28: Recent fishery average weight-at-age anomaly (relative to the mean) by strata for ages 3–10, 2019–2023. Vertical shape reflects uncertainty in the data (wider shapes being more precise), colors are consistent with cohorts.

Fishery body-weight-at-age

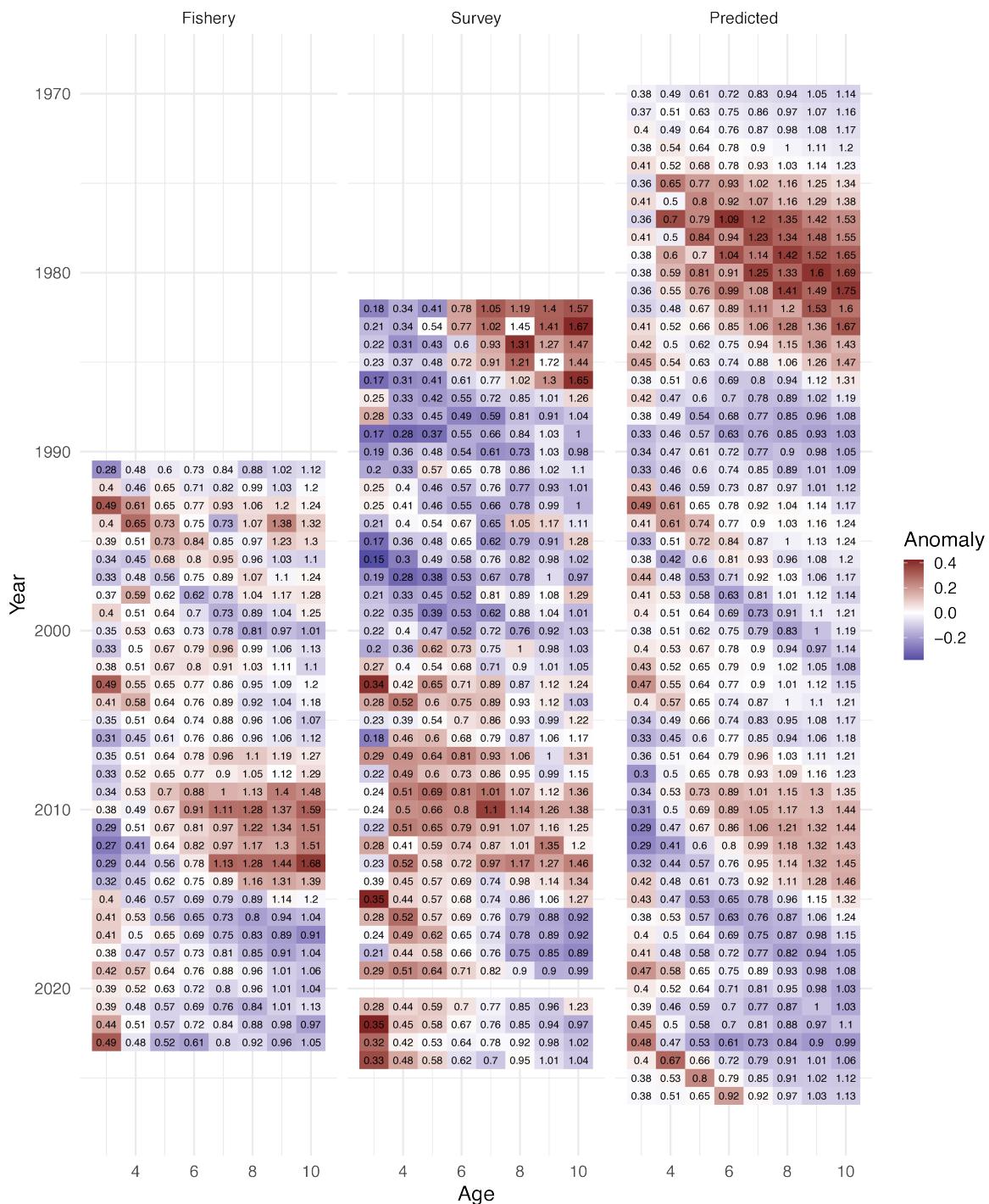


Figure 29: Data input and model predictions for the weight-at-age random-effects model fit separately to obtain variance estimates for cohort and year effect contributions to changes in incremental growth from one age to the next. Shadings reflect the anomaly from the mean while the numbers are the weight-at-age in kg.

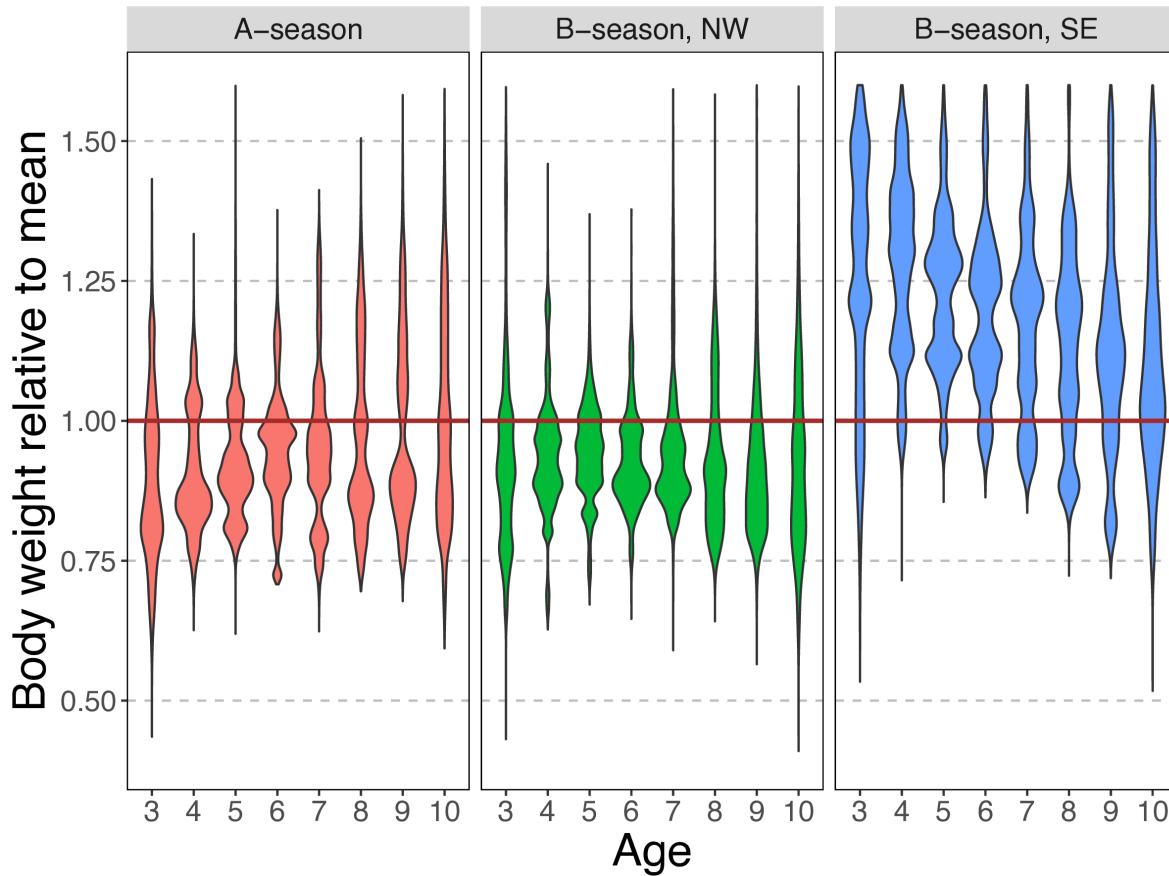


Figure 30: Fishery average weight-at-age anomaly (relative to the mean) across strata and combined for all ages (3–10), and available years (1991–2023). Vertical shape reflects uncertainty in the data (wider shapes being more precise), colors are consistent with cohorts.

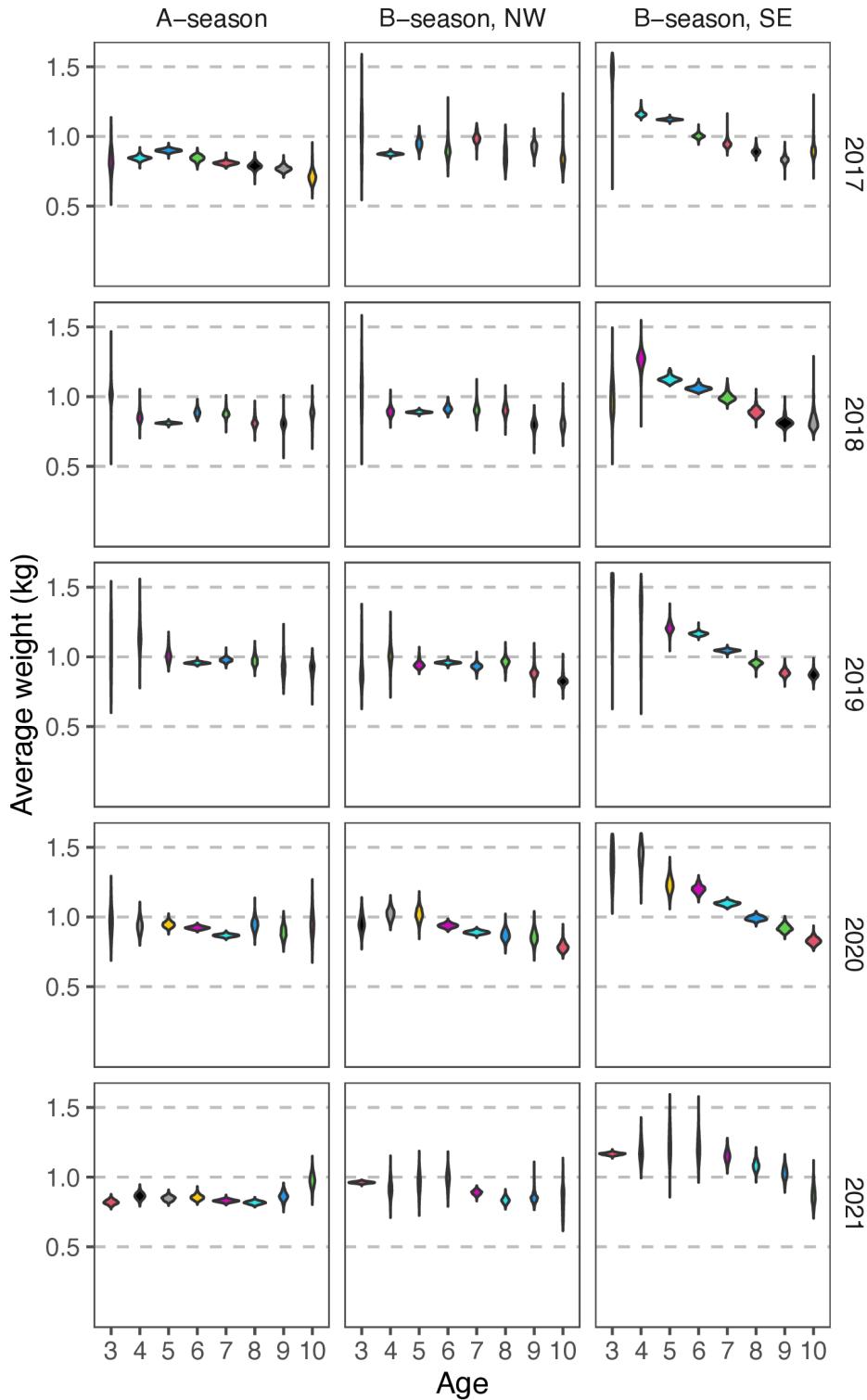


Figure 31: Recent fishery average weight-at-age anomaly (relative to the mean) by strata for ages 3–10, 2019–2023. Vertical shape reflects uncertainty in the data (wider shapes being more precise), colors are consistent with cohorts.

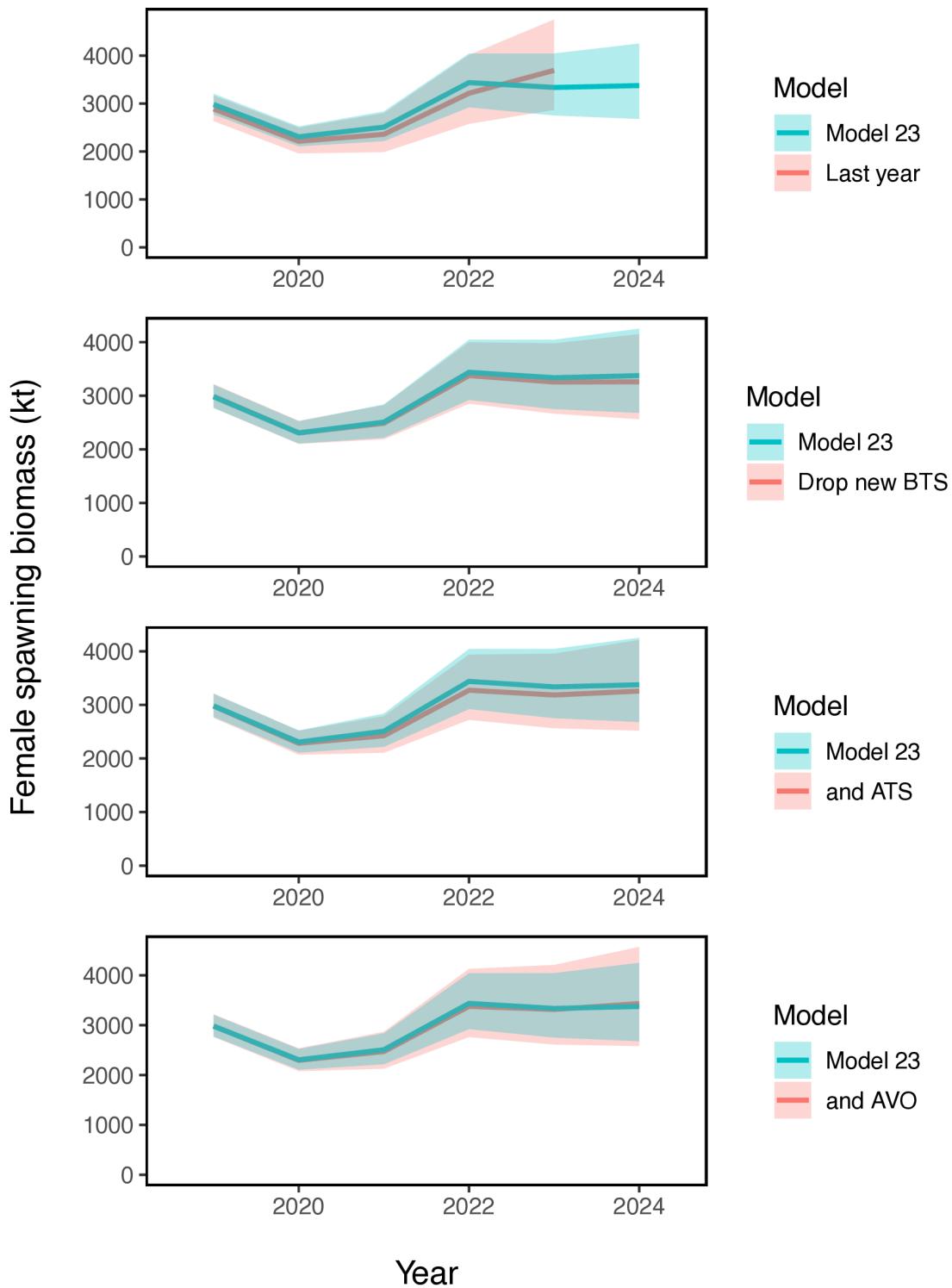


Figure 32: Model runs comparing last year's assessment with all the data updated in 2024 (top). Subsequent panels (from 2nd to bottom) illustrate the cumulative impact of removing new 2024 data. The second panel shows the impact of removing the 2024 bottom trawl survey (BTS) data, then the acoustic-trawl (ATS) and finally the AVO data.

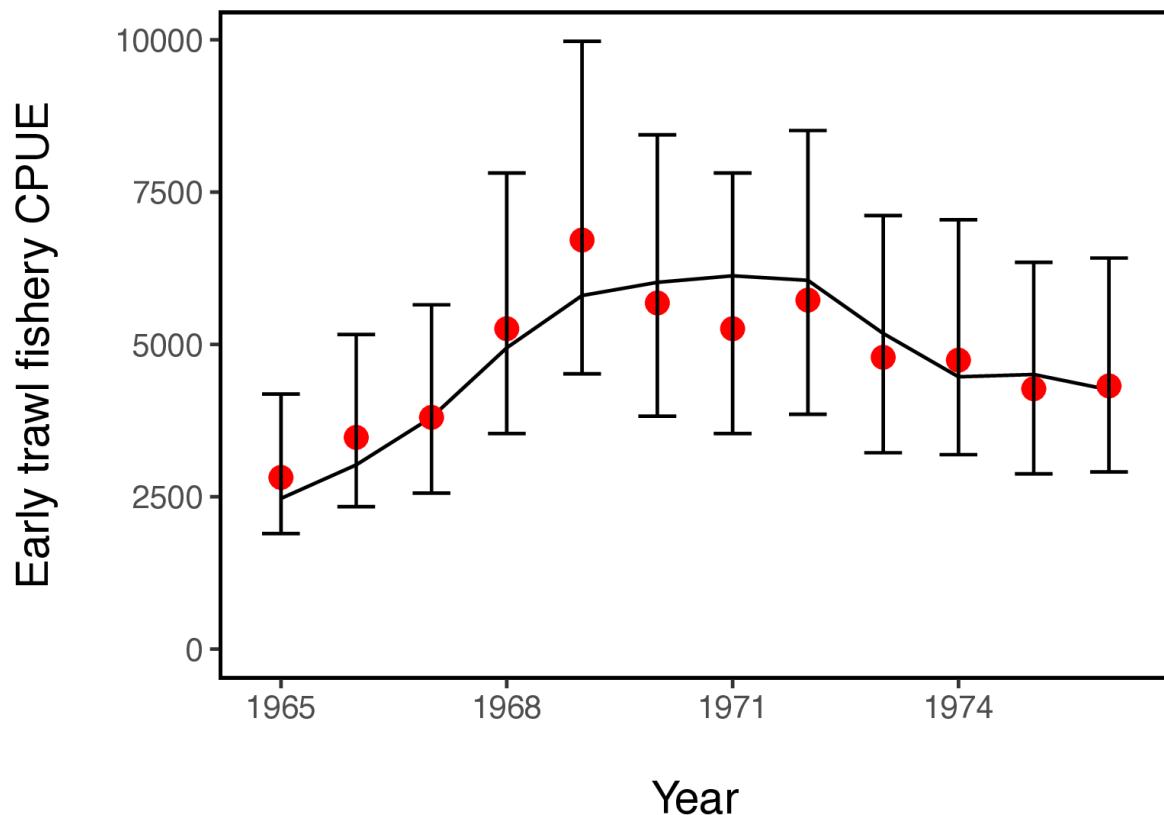


Figure 33: EBS pollock model fits to the Japanese fishery CPUE.

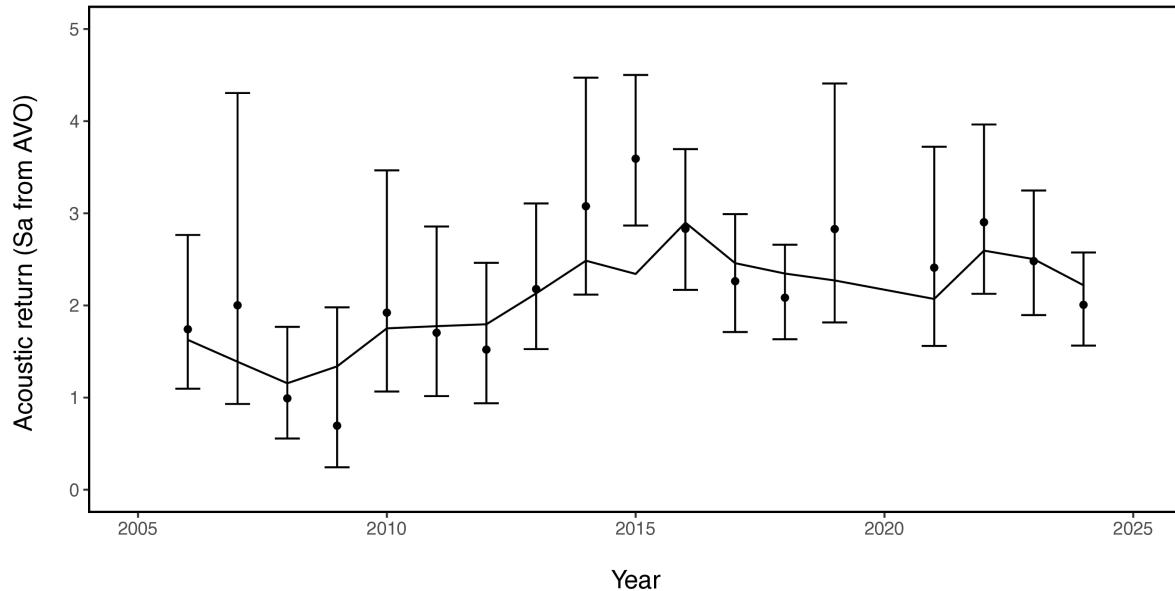


Figure 34: Model results of predicted and observed AVO index. Error bars represent assumed 95% confidence bounds of the input series.

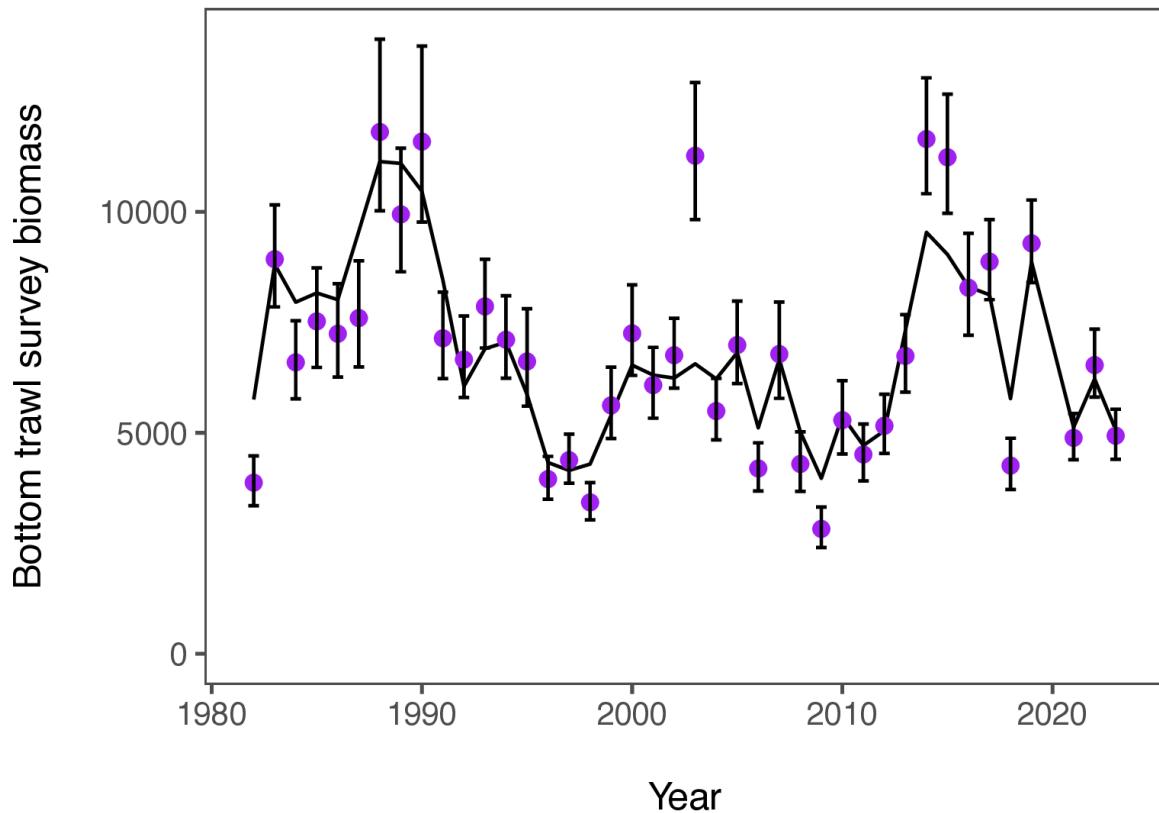


Figure 35: EBS pollock model fit to the BTS survey data (VAST estimates based on density dependence-corrected CPUE by station), 1982–2019, 2021–2024. Units are relative biomass.

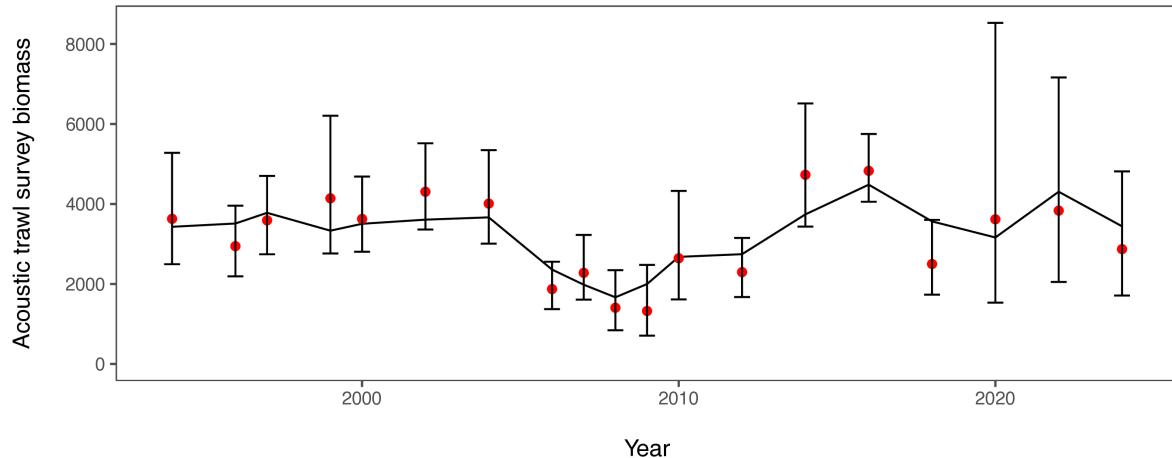


Figure 36: EBS pollock model fit to the ATS biomass index, 1994–2024.

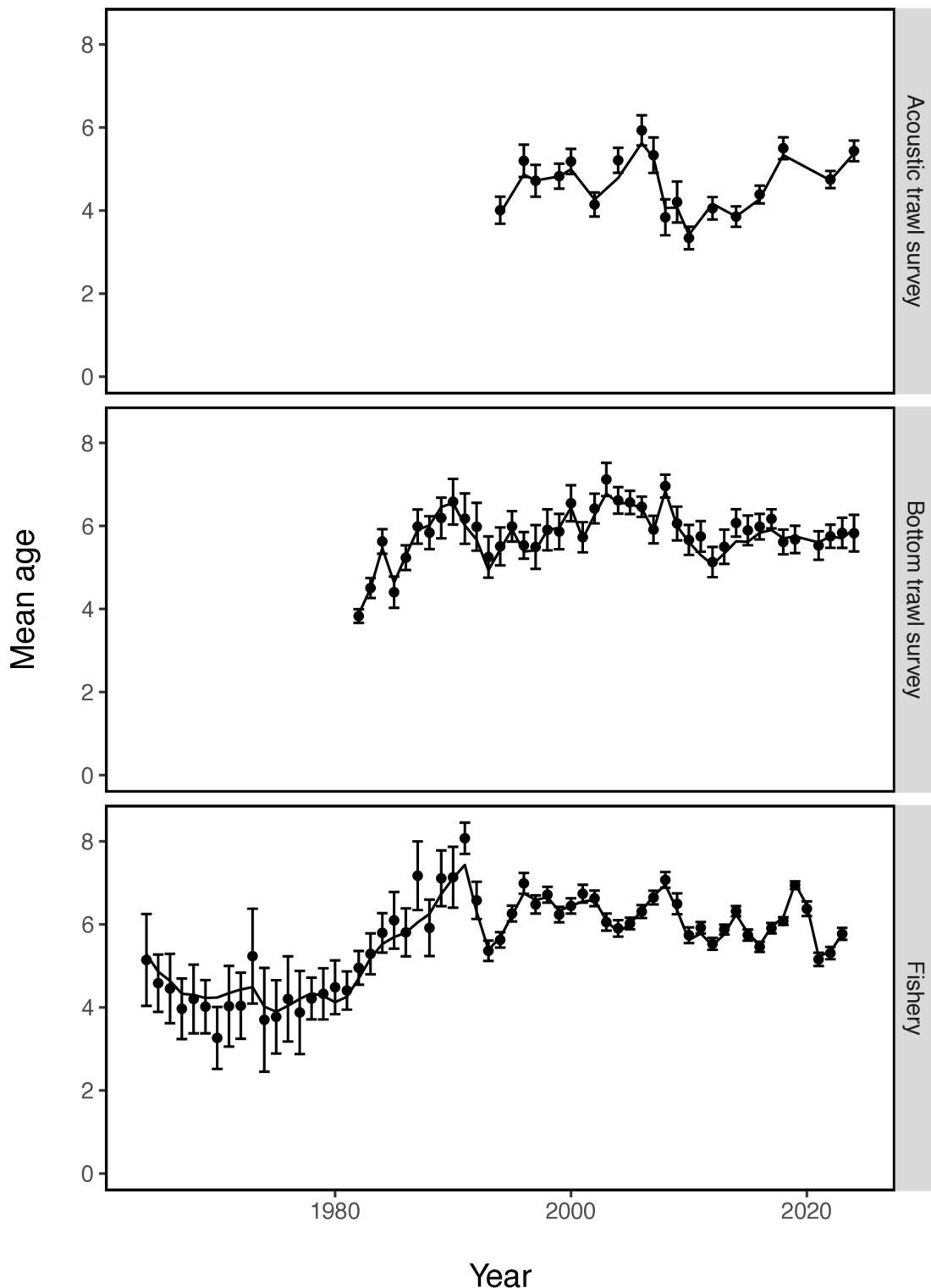


Figure 37: EBS pollock model fits to observed mean age for the Acoustic trawl survey (top), the bottom trawl survey (middle) and fishery (bottom)

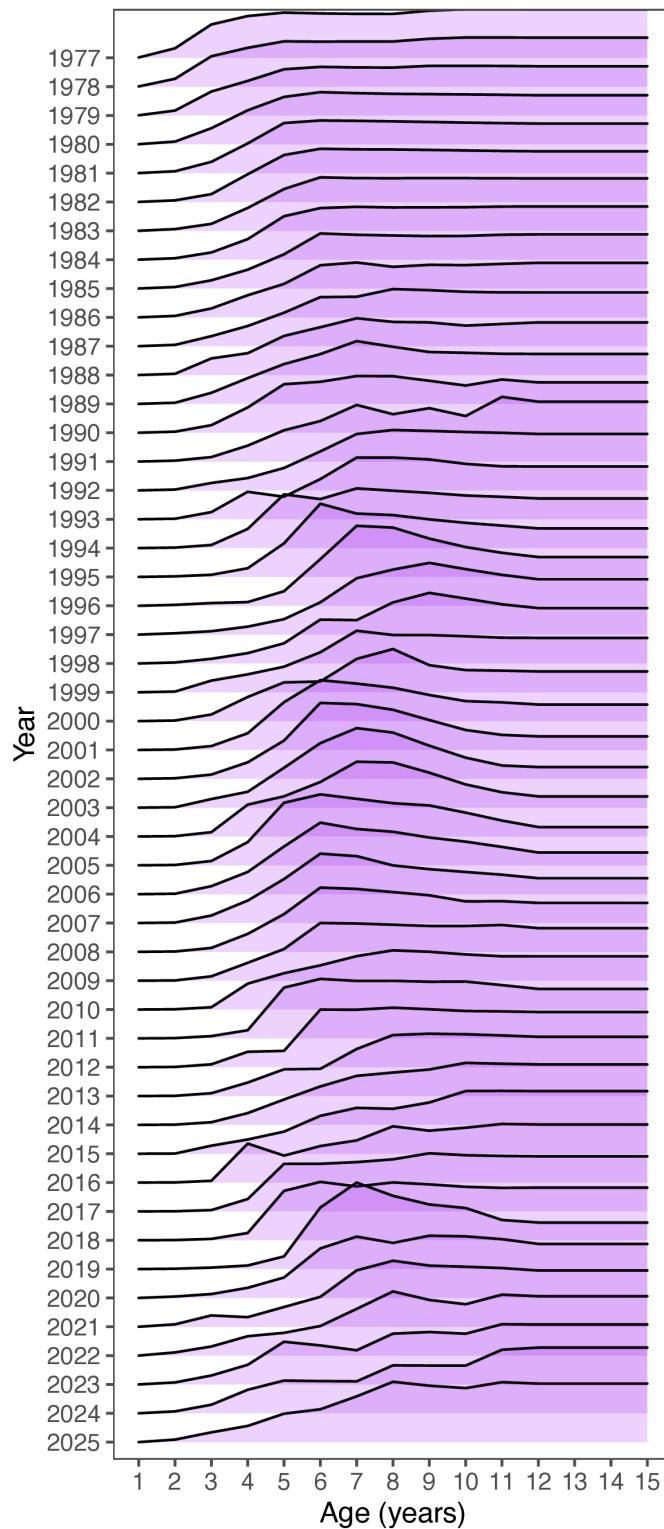


Figure 38: Selectivity at age estimates for the EBS pollock fishery; note that the values for the terminal year is used for ABC and OFL projections.

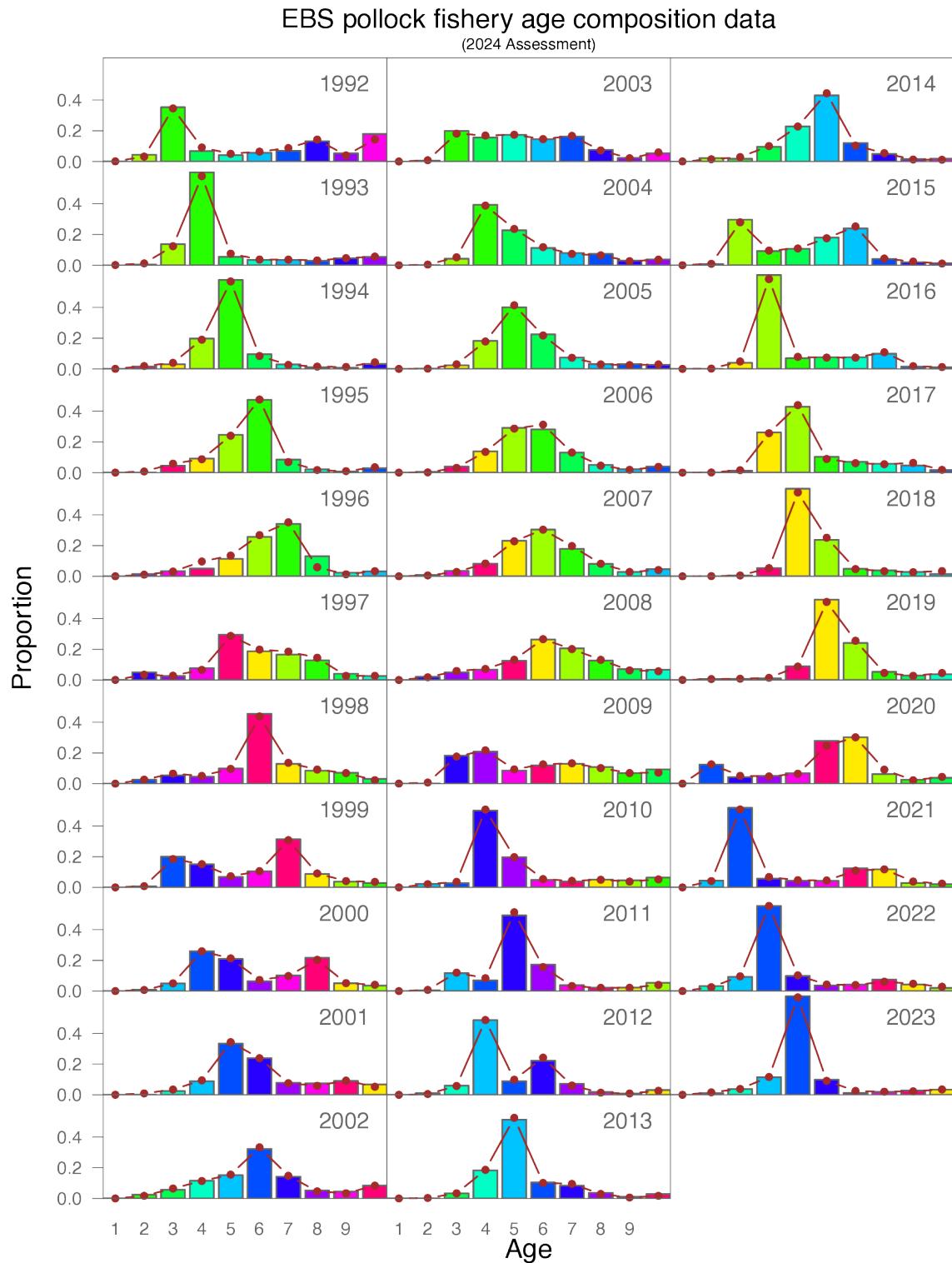


Figure 39: Model fit (dots) to the EBS pollock fishery proportion-at-age data (columns; 1992–2023). The 2023 data are new to this year's assessment. Colors coincide with cohorts progressing through time.

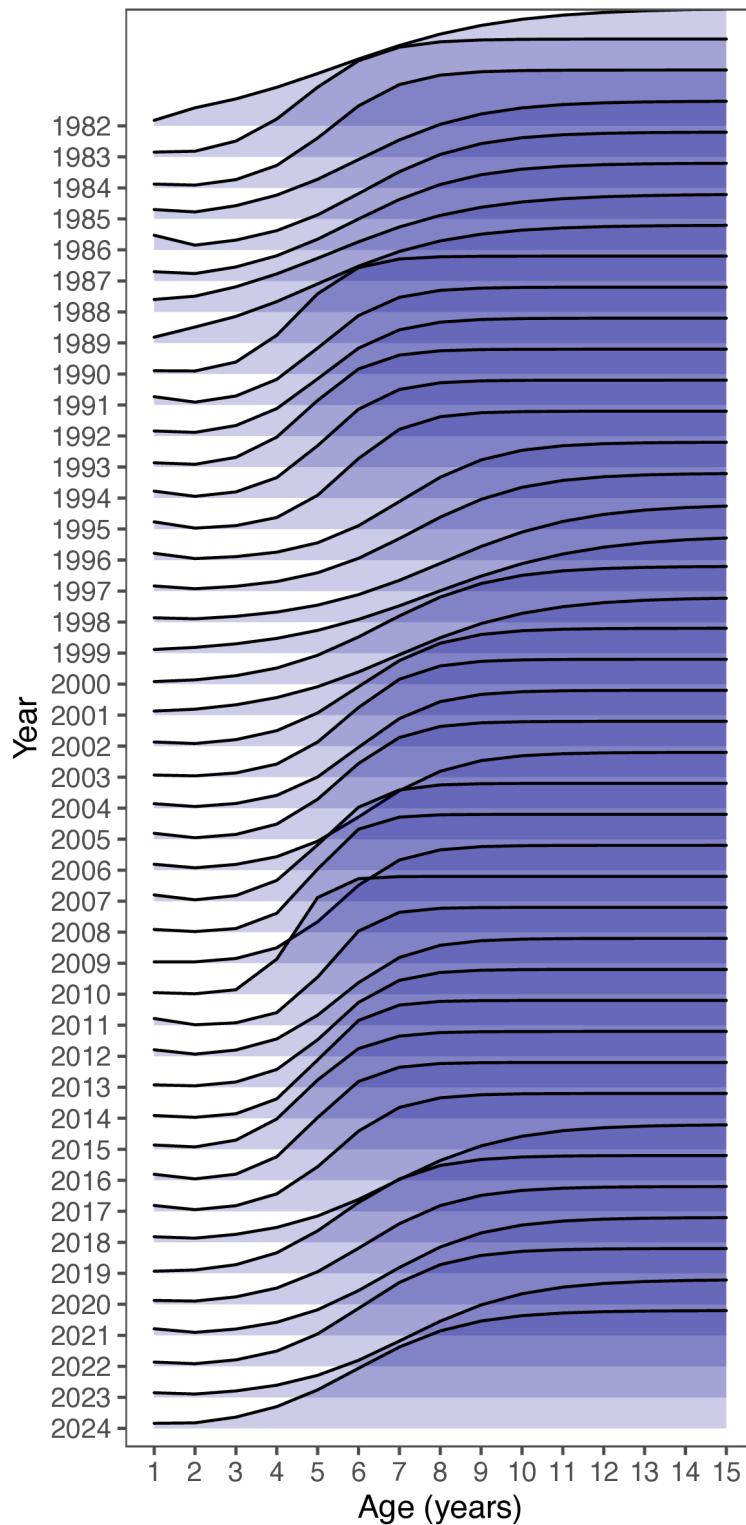


Figure 40: Model estimates of bottom-trawl survey selectivity, 1982–2024.

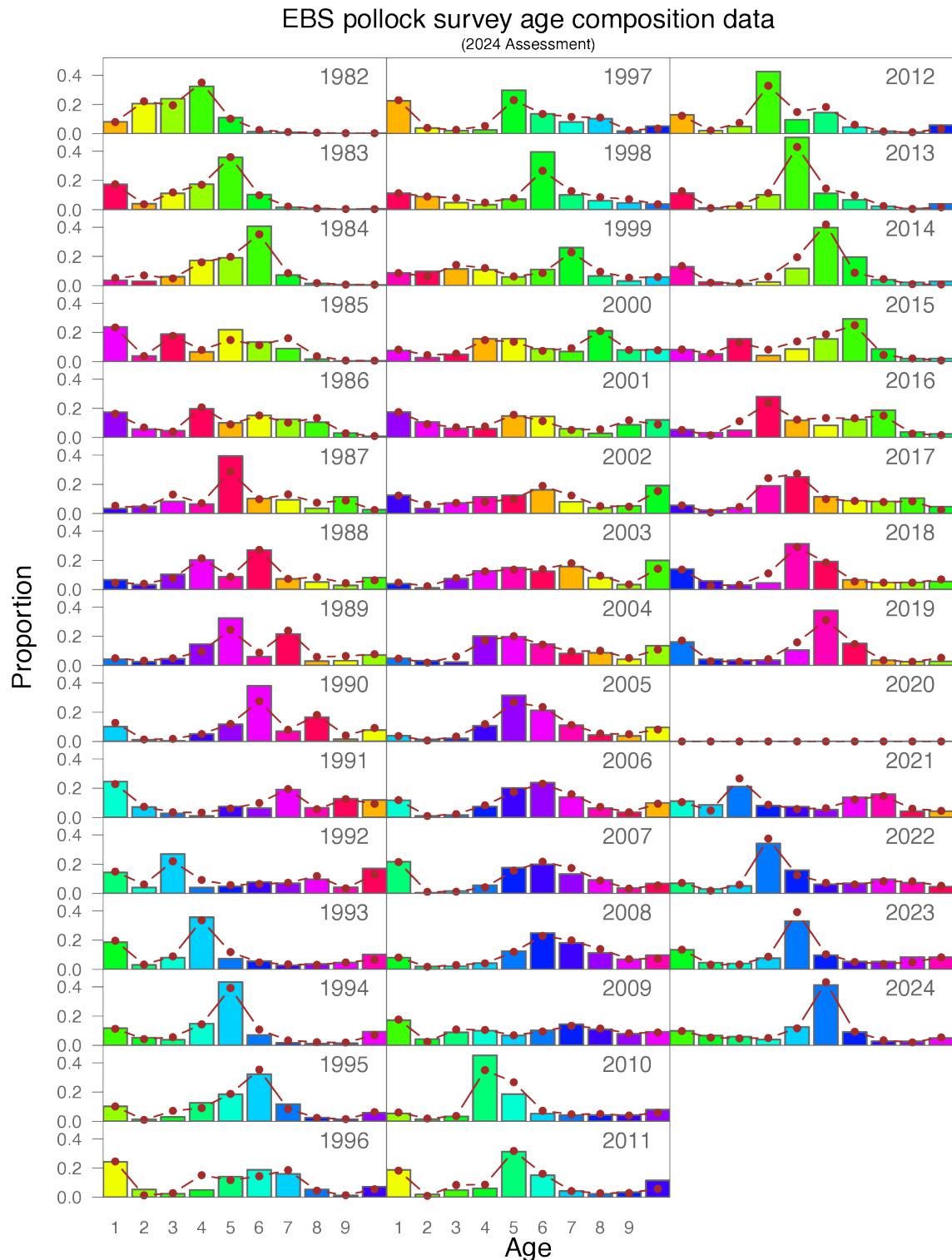


Figure 41: Model fit (dots) to the bottom trawl survey proportion-at-age composition data (columns) for EBS pollock. Colors correspond to cohorts over time.

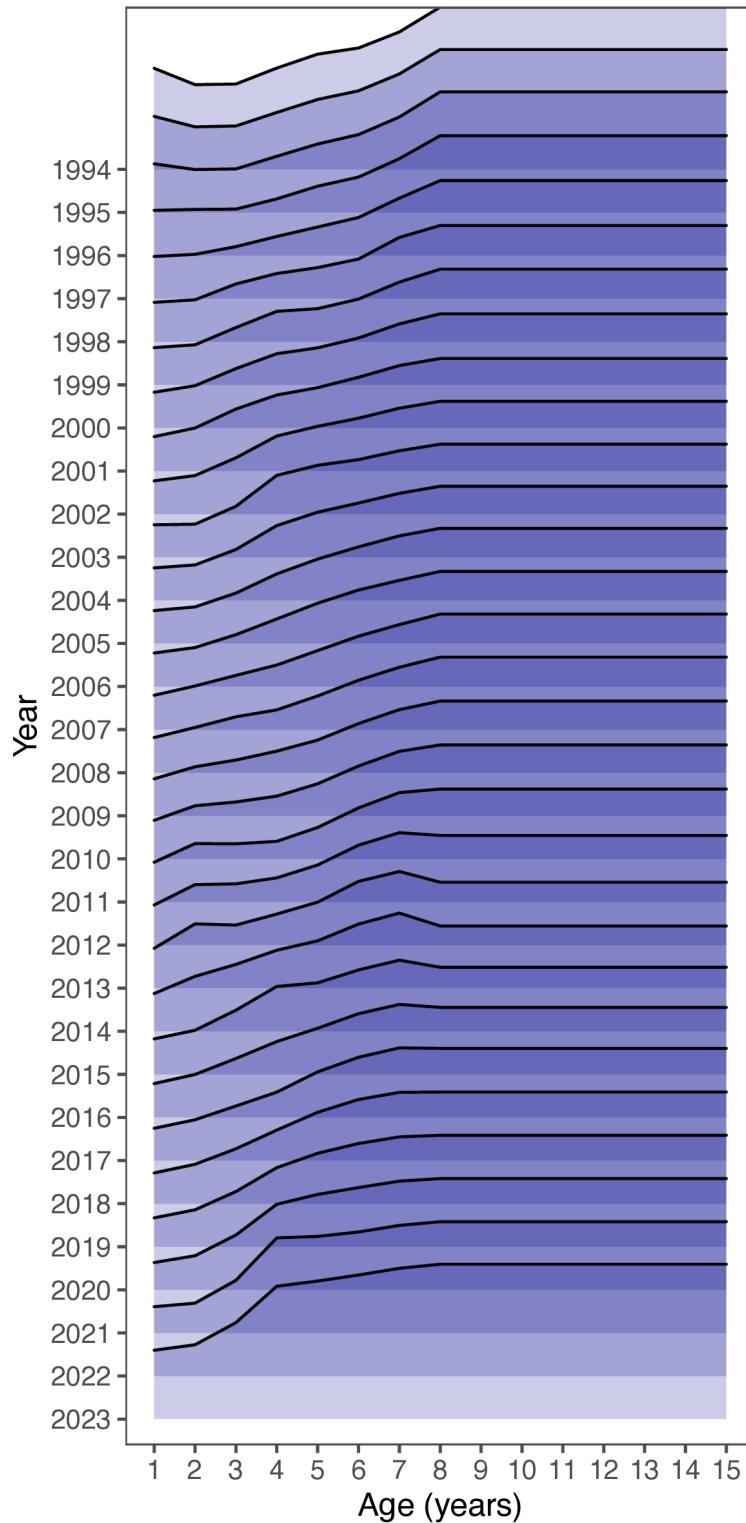


Figure 42: Estimates of AT survey numbers selectivity-at-age (with mean value equal to 1.0) over time for EBS pollock age 2 and older.

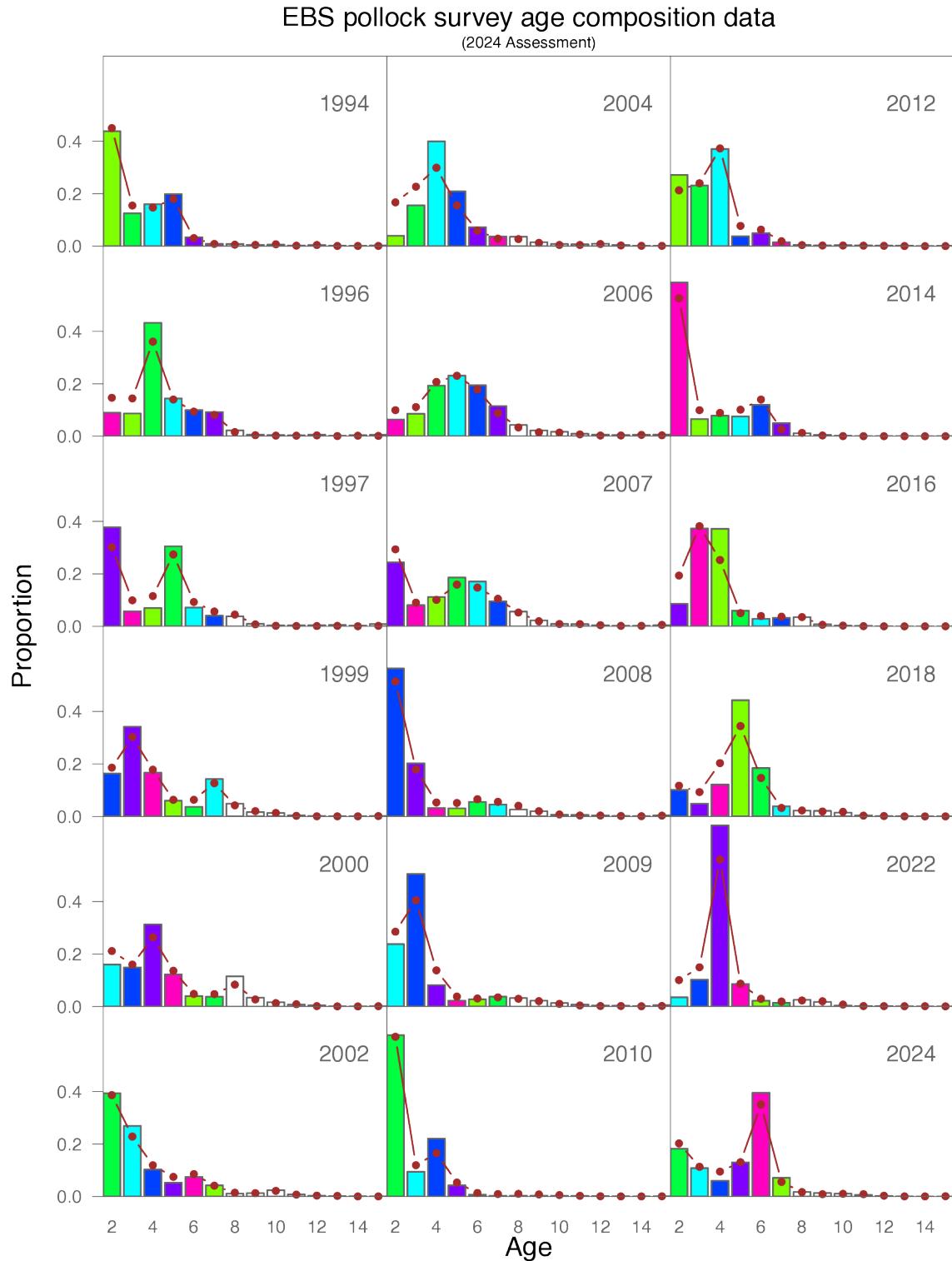


Figure 43: Model fit (dots) to the acoustic-trawl survey proportion-at-age composition data (columns) for EBS pollock. Colors correspond to cohorts over time (for years with consecutive surveys).

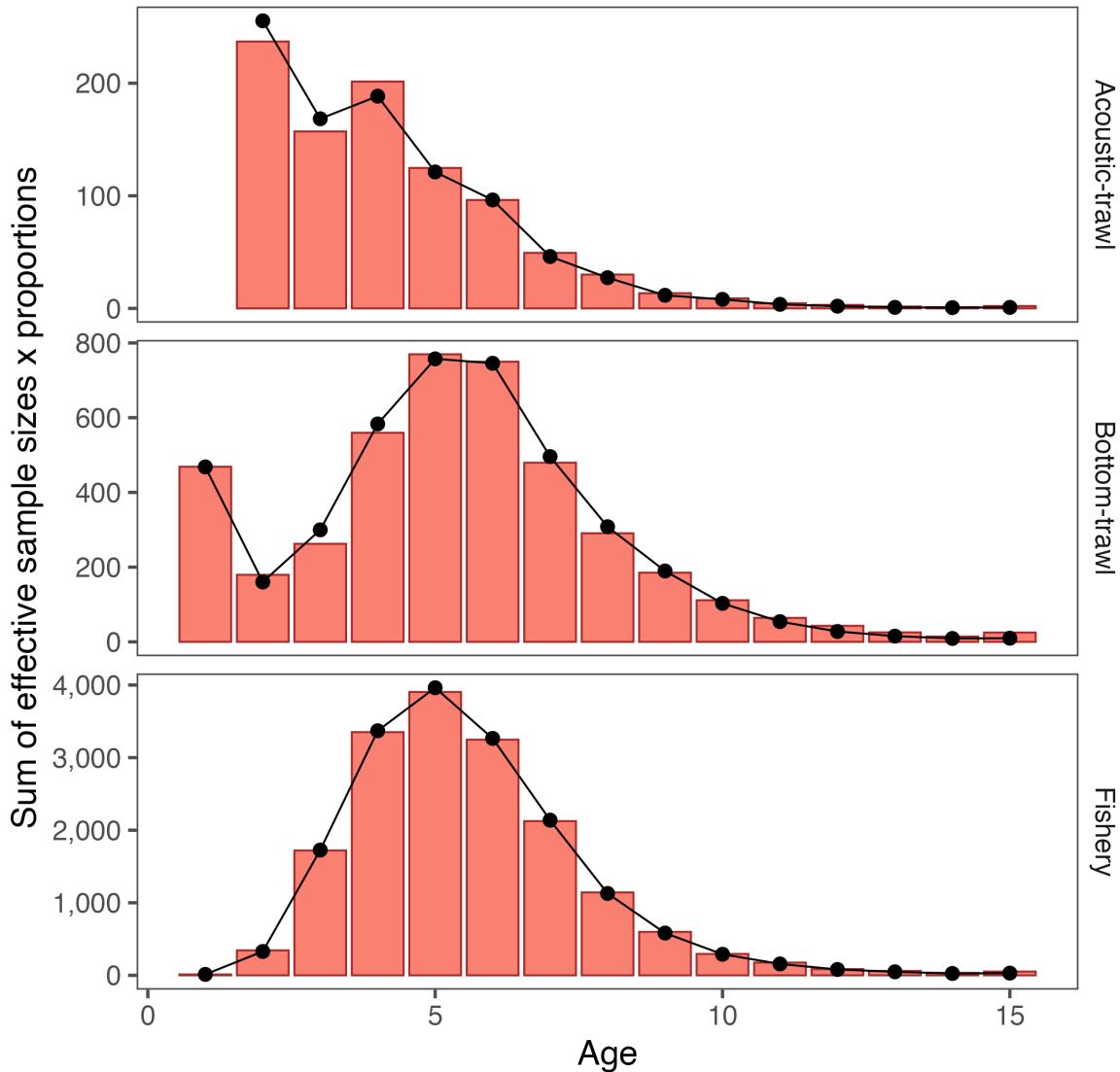


Figure 44: Aggregate fit to composition data where the columns represent the sum over years of the observed proportions multiplied by the effective sample size whereas the lines with dots are the model predictions by different gear types.

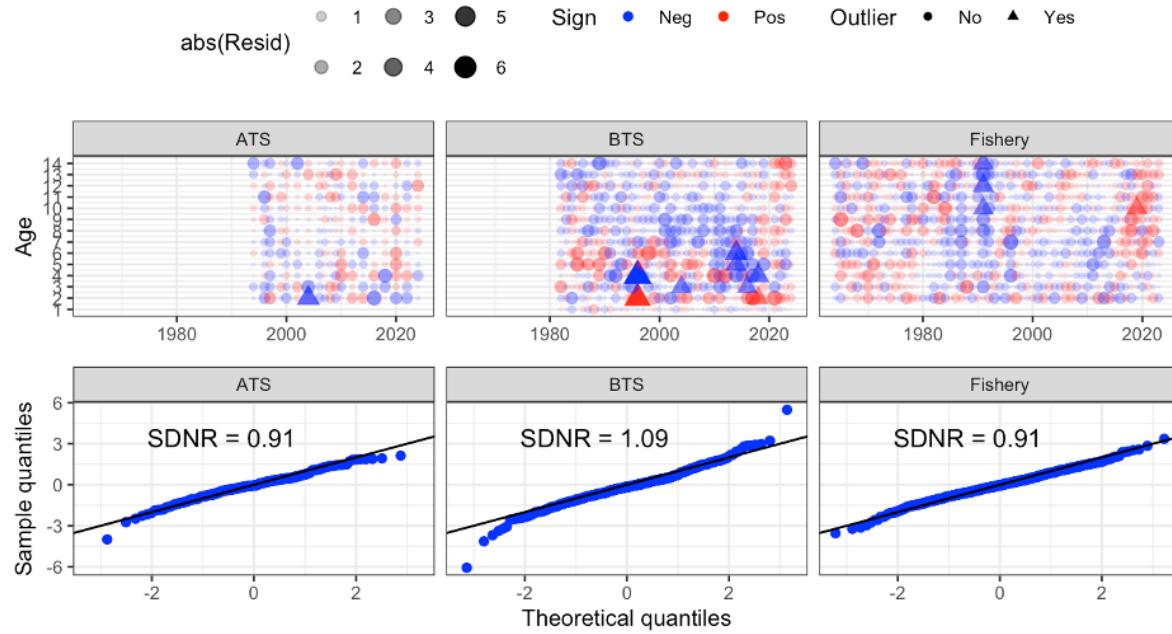


Figure 45: One-step-ahead residual plots (top row) and Q-Q plots of residuals (showing the standard-deviation of normalized residuals—SDNR; bottom row) for the fishery, acoustic-trawl survey (ATS) and bottom trawl survey (BTS) age composition data for EBS pollock

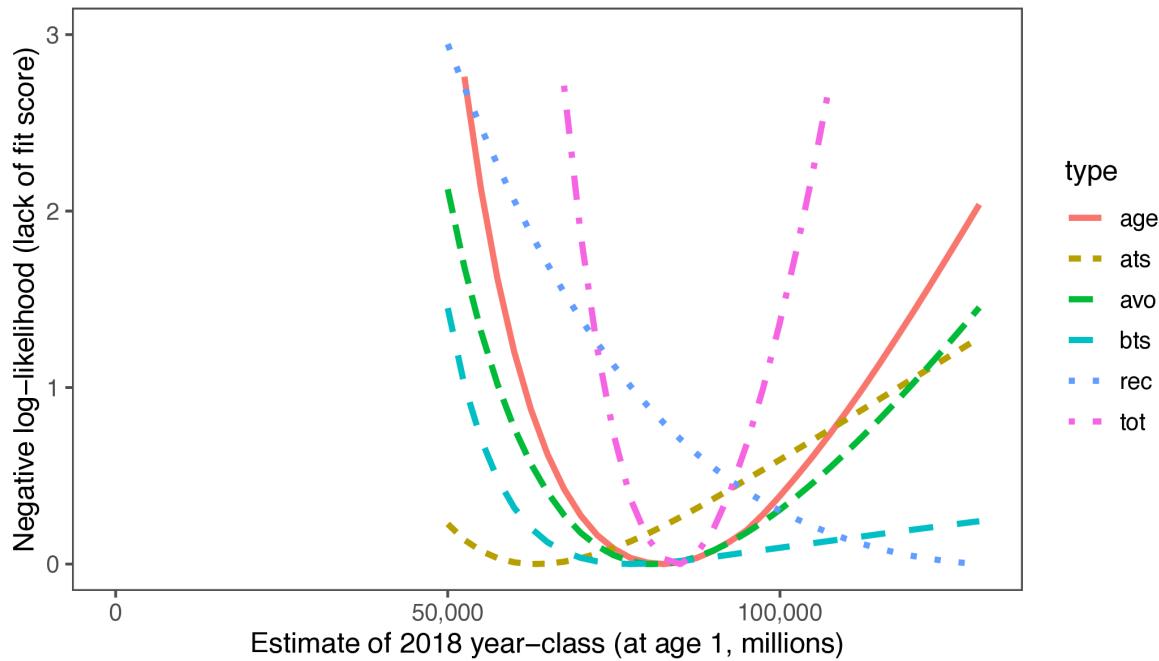


Figure 46: Profile-likelihood depicting the sources of uncertainty in the 2018 year-class. Likelihood component abbreviations: age, ats, avo, bts, rec, and tot represent respectively all the age composition data from the survey and fishery, the three indices, the stock-recruitment relationship, and total negative log-likelihoods, respectively.

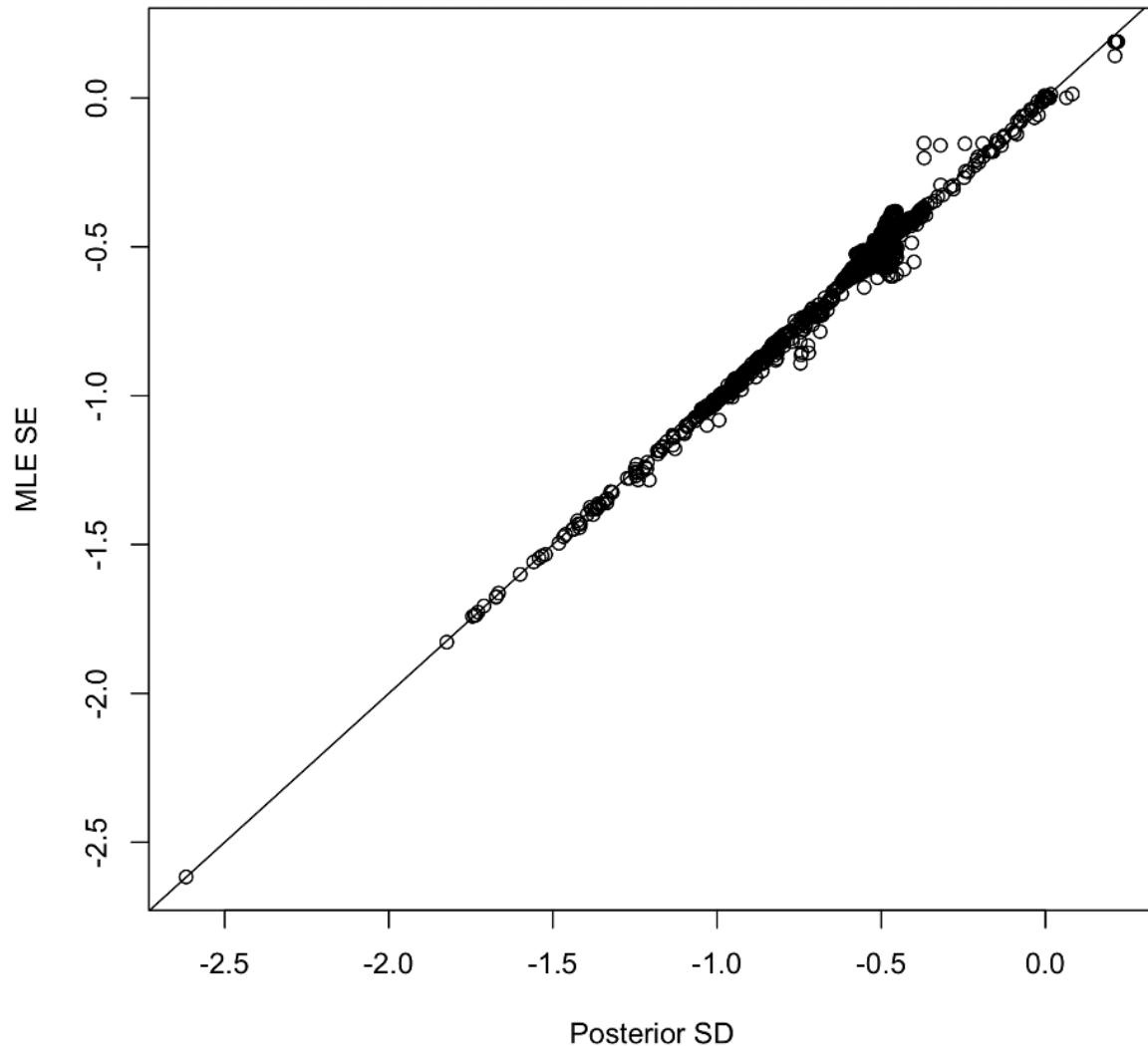
Comparing Bayesian vs frequentist uncertainty estimates

Figure 47: Comparison of the asymptotic parameter standard errors (from inverting the Hessian; vertical axis) with the marginals from the MCMC draws (horizontal axis).

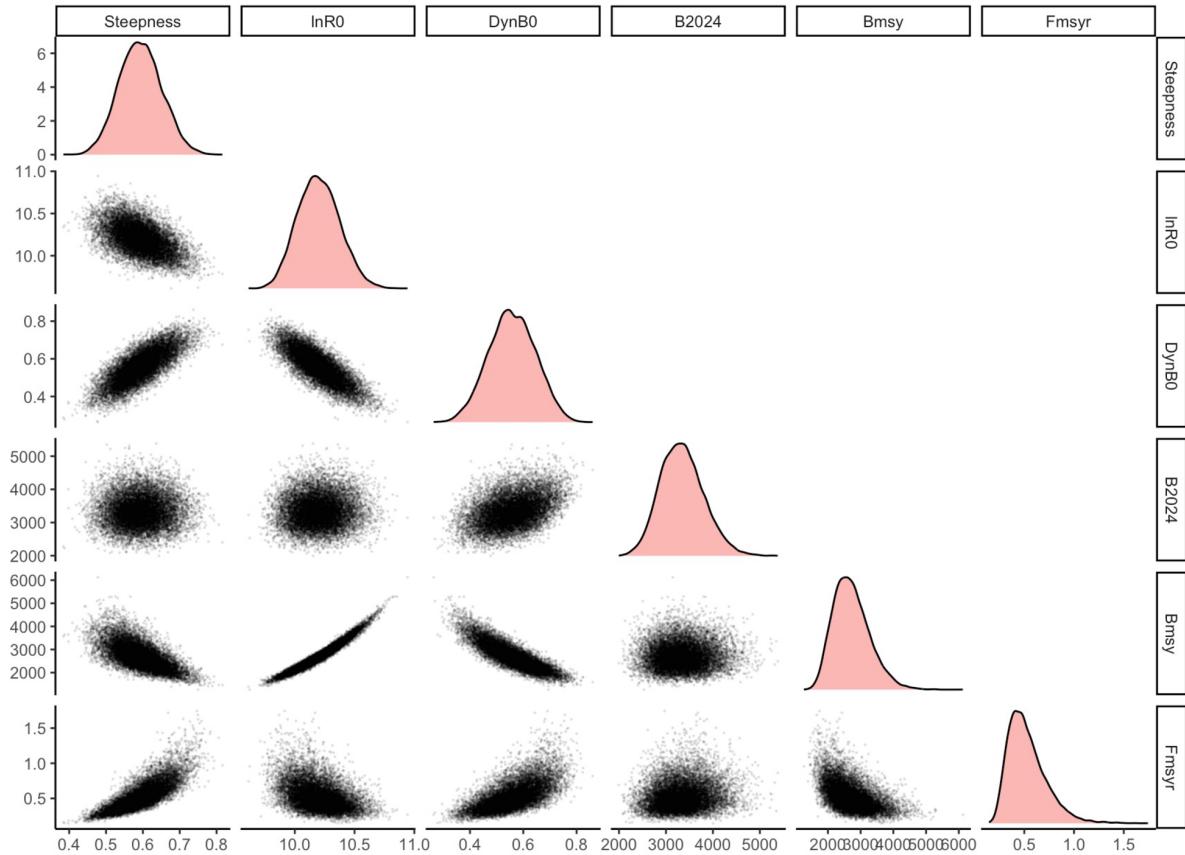


Figure 48: Pairwise plot of selected EBS pollock parameters and output from MCMC to approximate the multivariate posterior distribution. Note that the figures on the diagonal represent the marginal posterior distributions. Key: steepness and lnR0 are stock-recruitment parameters, DynB0 is the ratio of spawning biomass estimated for in 2024 over the value estimated that would occur if there had been no fishing, B2025 is the spawning biomass in 2025 and Fmsyr is the rate at which MSY would be achieved on average.

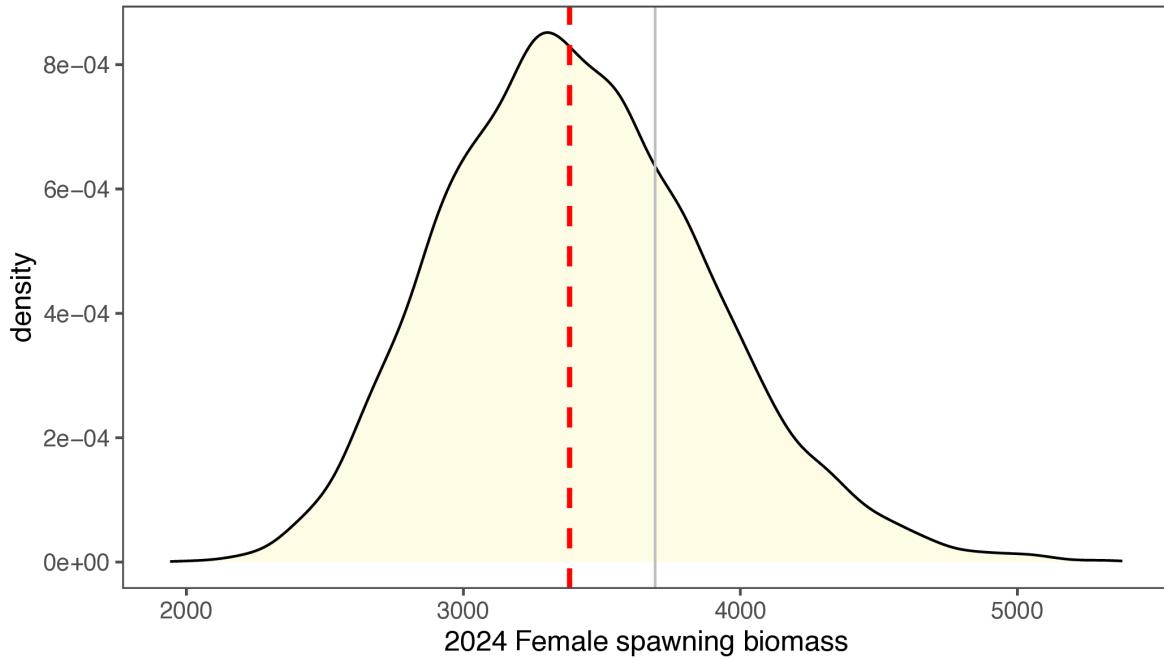


Figure 49: Integrated marginal posterior density (based on MCMC results) for the 2024 EBS pollock female spawning biomass compared to the point estimate (grey line).

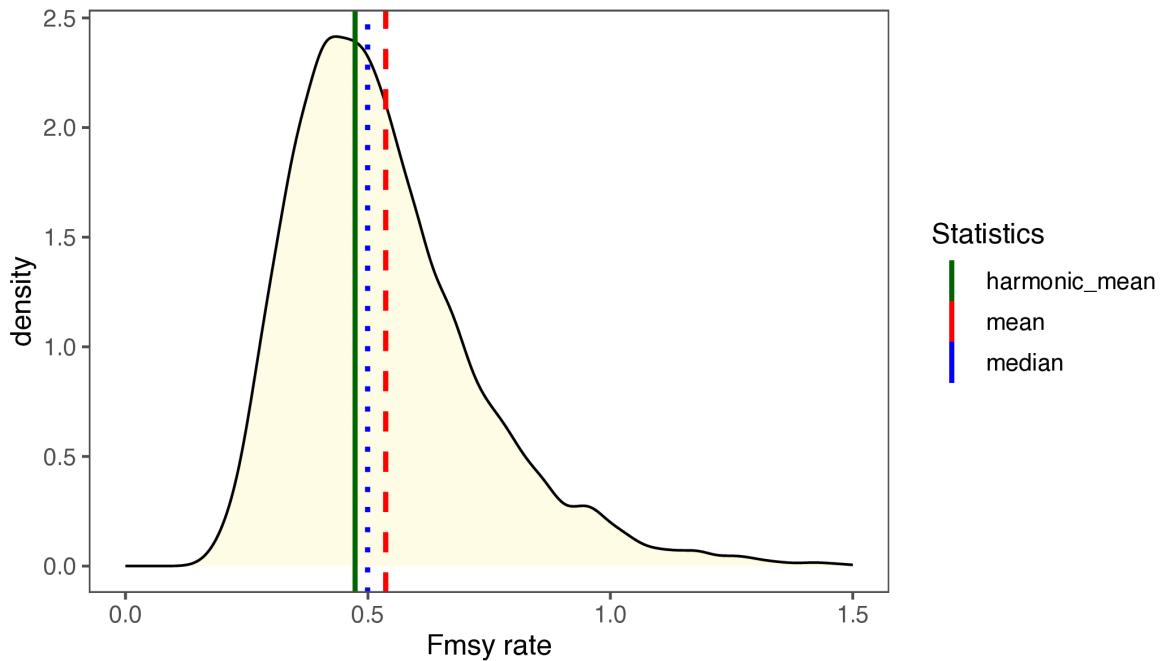


Figure 50: Integrated marginal posterior density (based on MCMC results) for the F_{MSY} for EBS pollock and different central tendency values.

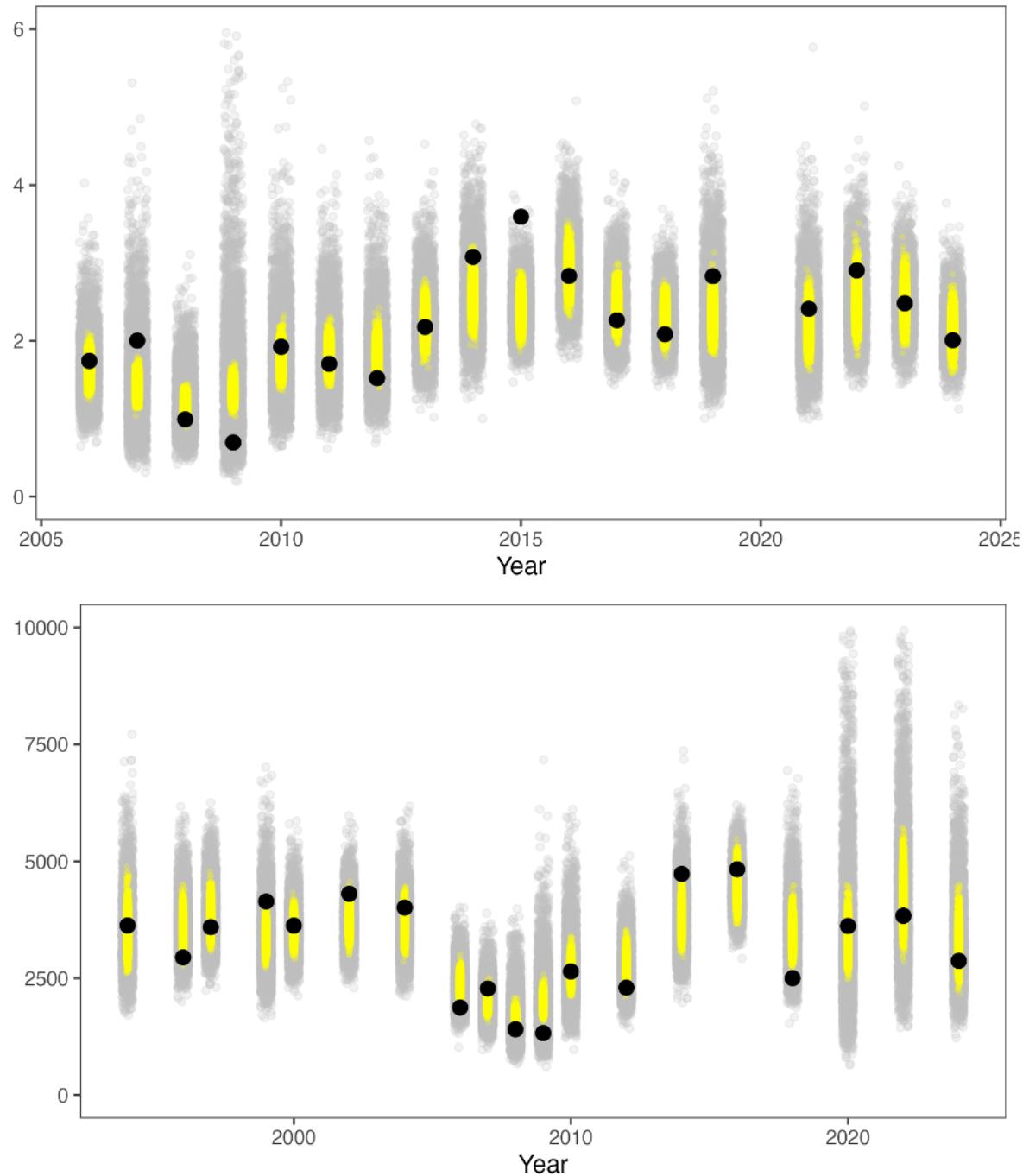


Figure 51: Plot of the observed index values (solid line) for the AVO (top) and ATS (bottom), the distribution of the expected value (yellow dots) and the posterior predictive distribution (grey points).

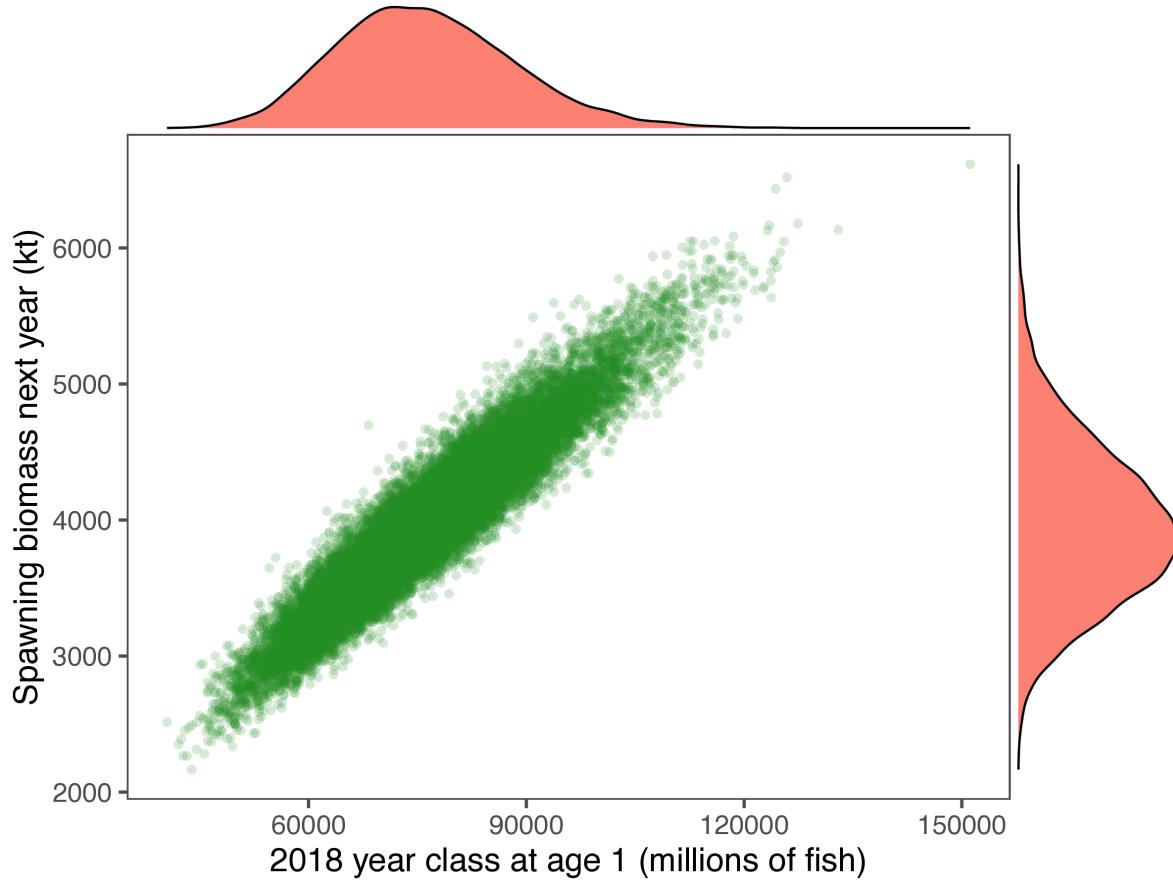


Figure 52: Plot of a representation of the posterior marginal distributions of spawning biomass in 2025 (vertical scale and right-side distribution) versus the size of the 2018 year-class (horizontal scale and the top distribution).

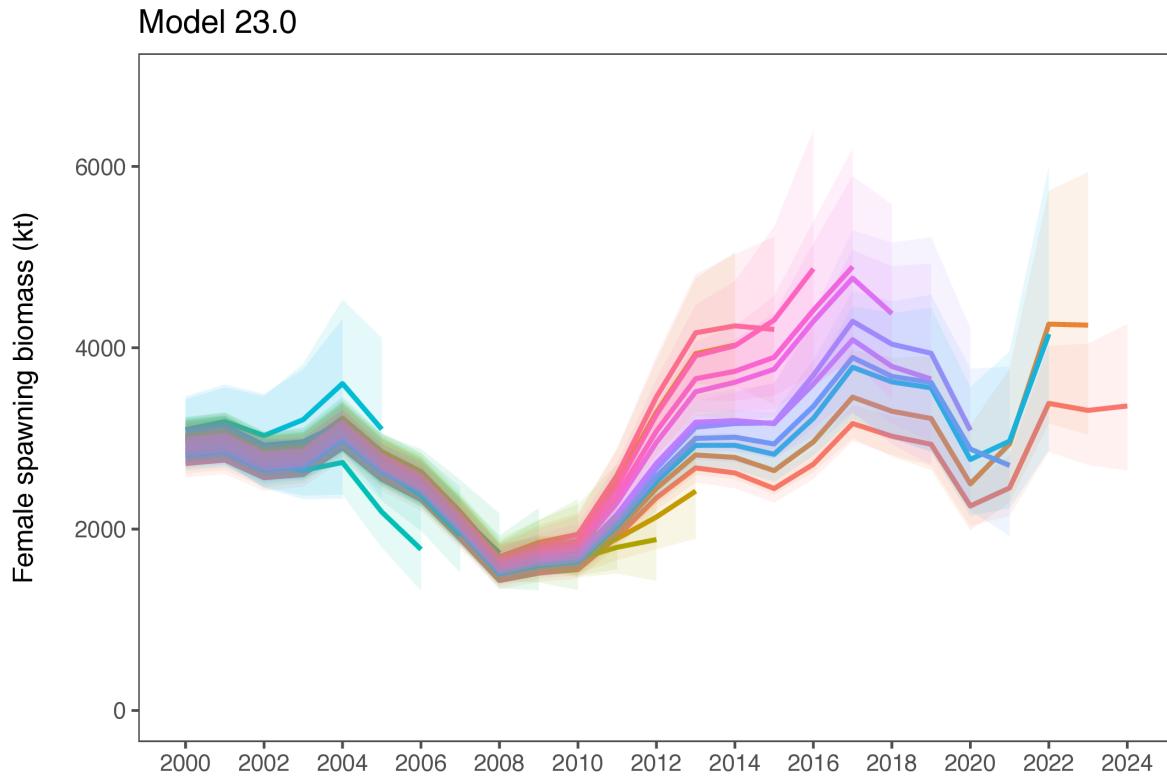


Figure 53: Retrospective patterns for EBS pollock spawning biomass showing the point estimates relative to the terminal year (top panel) and approximate confidence bounds on absolute scale (+2 standard deviations).

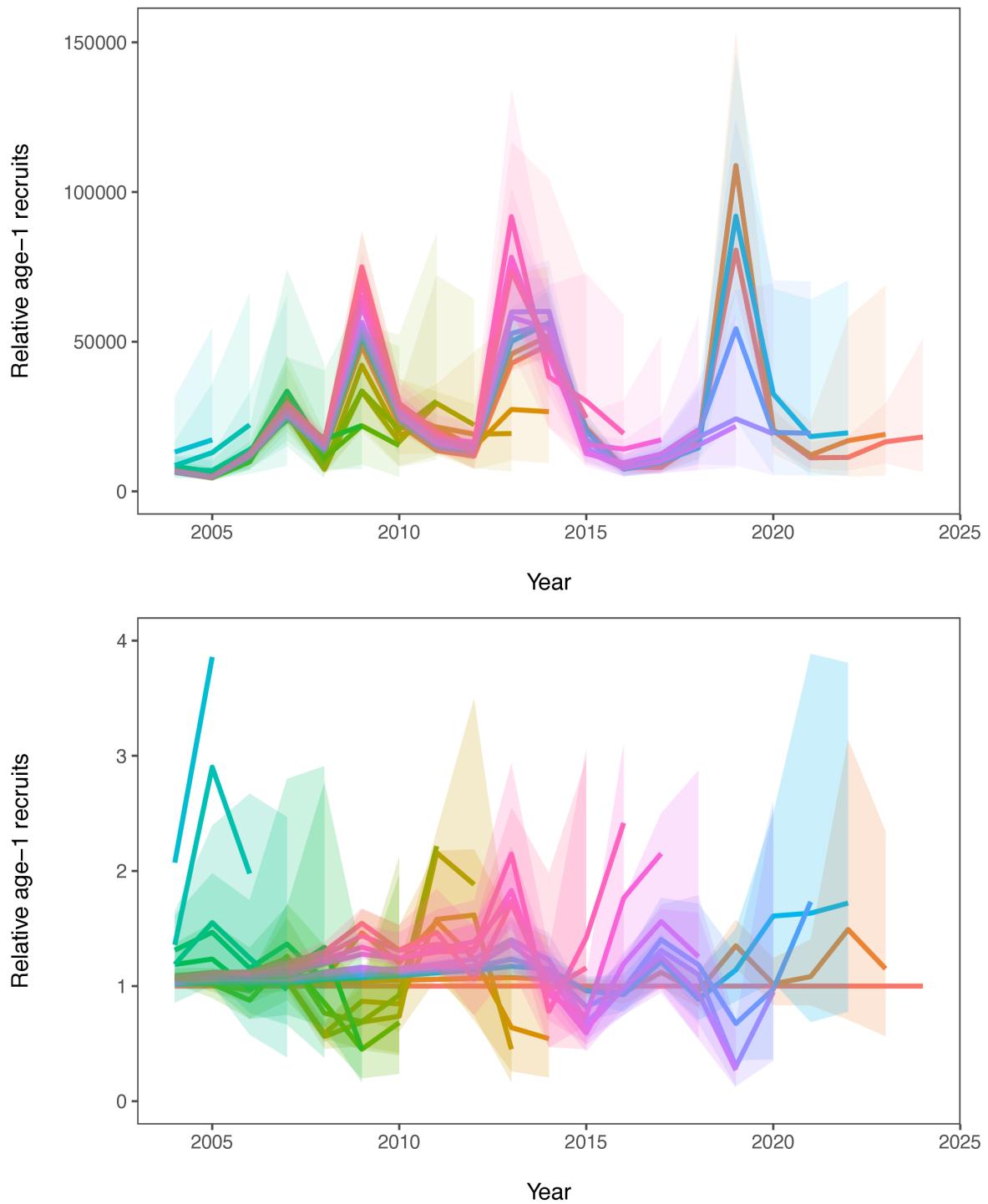


Figure 54: Retrospective patterns for EBS pollock recruitment showing the point estimates relative to the terminal year (top panel) and approximate confidence bounds on absolute scale (+2 standard deviations).

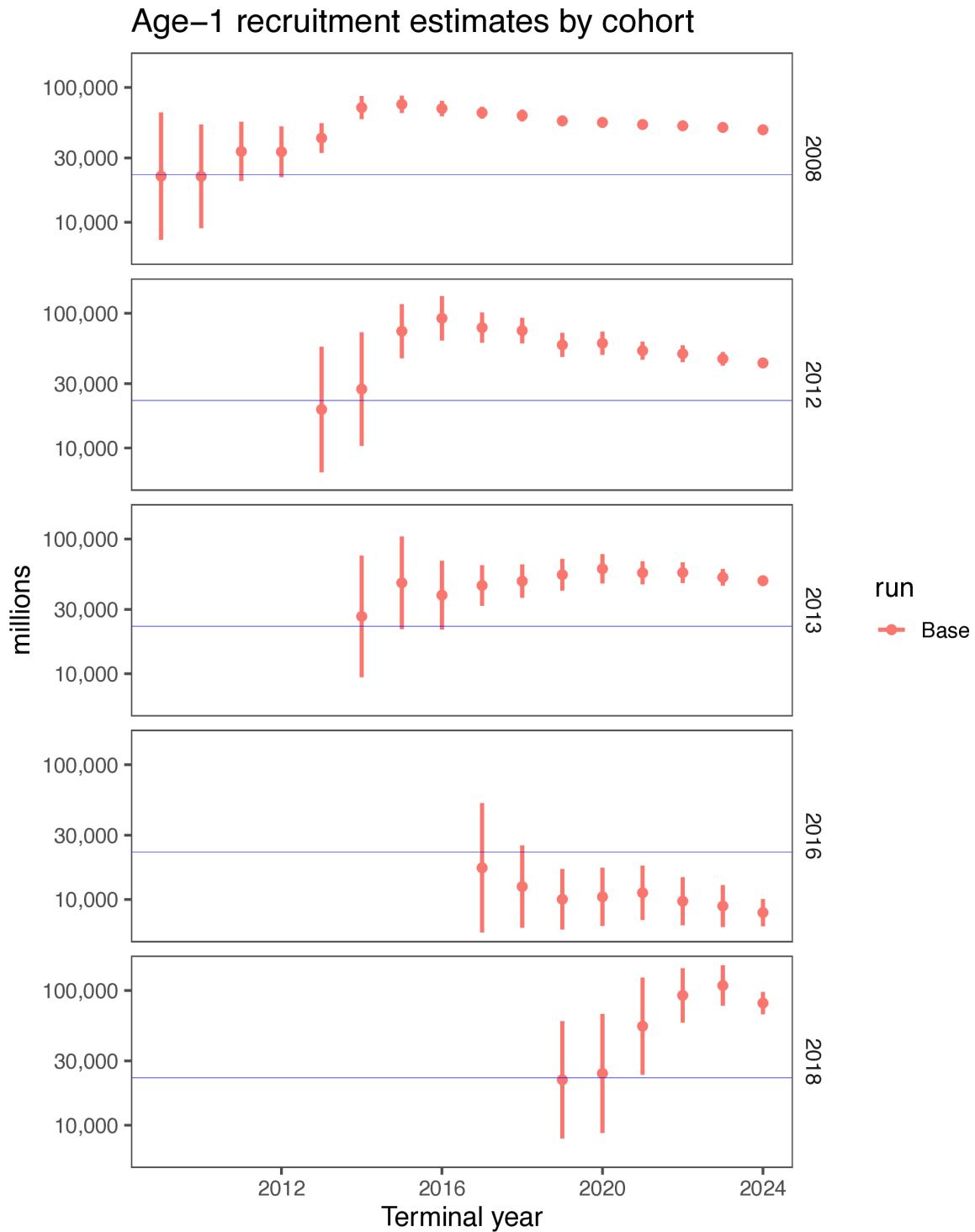


Figure 55: Retrospective evolution of EBS pollock selected year-class estimates as a function of the terminal year of data used in the model (based on retrospectives of Model 23.0).

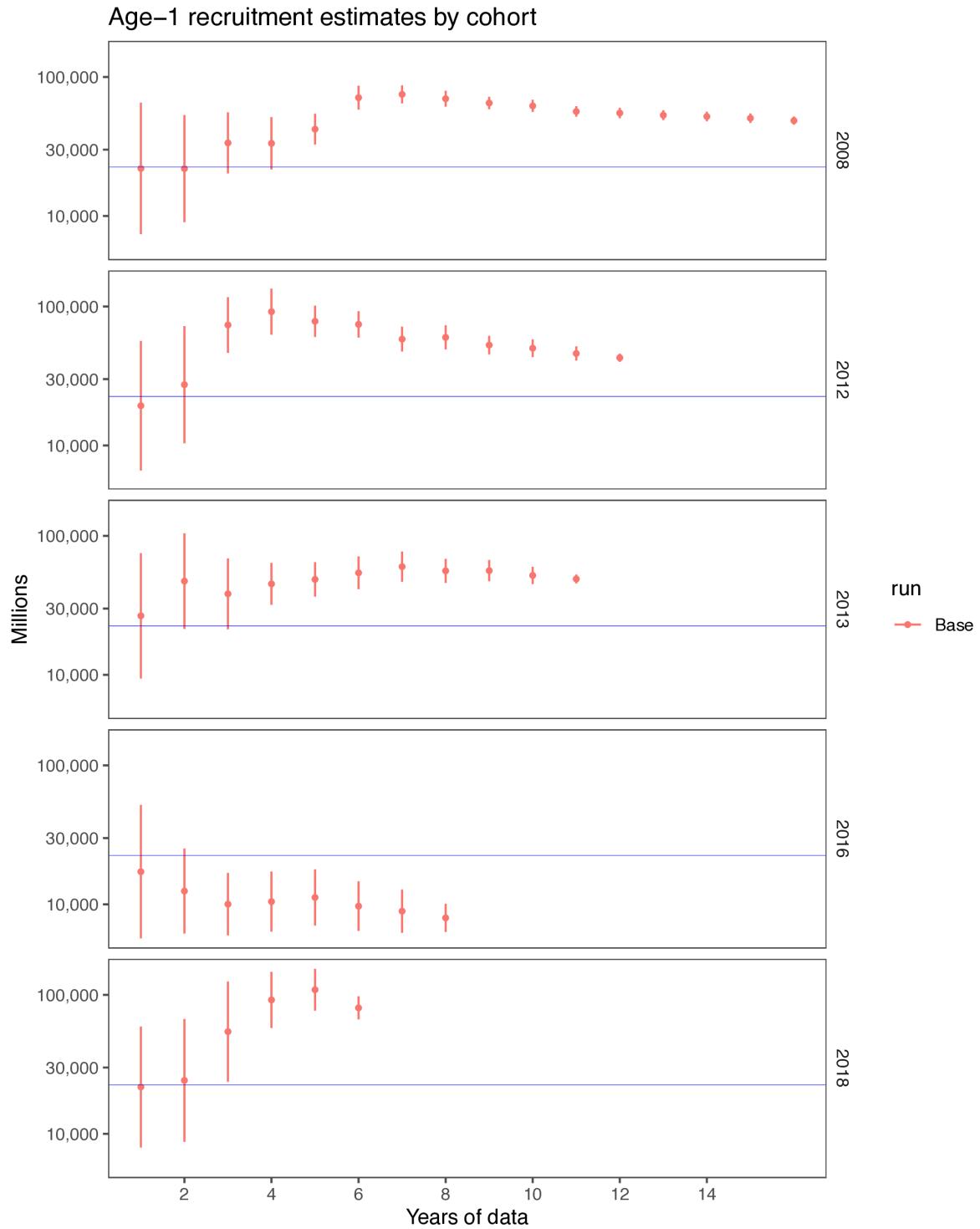


Figure 56: Retrospective evolution of EBS pollock selected year-class estimates as a function of the the number of years the year-class has been in the model (based on retrospectives of Model 23.0).

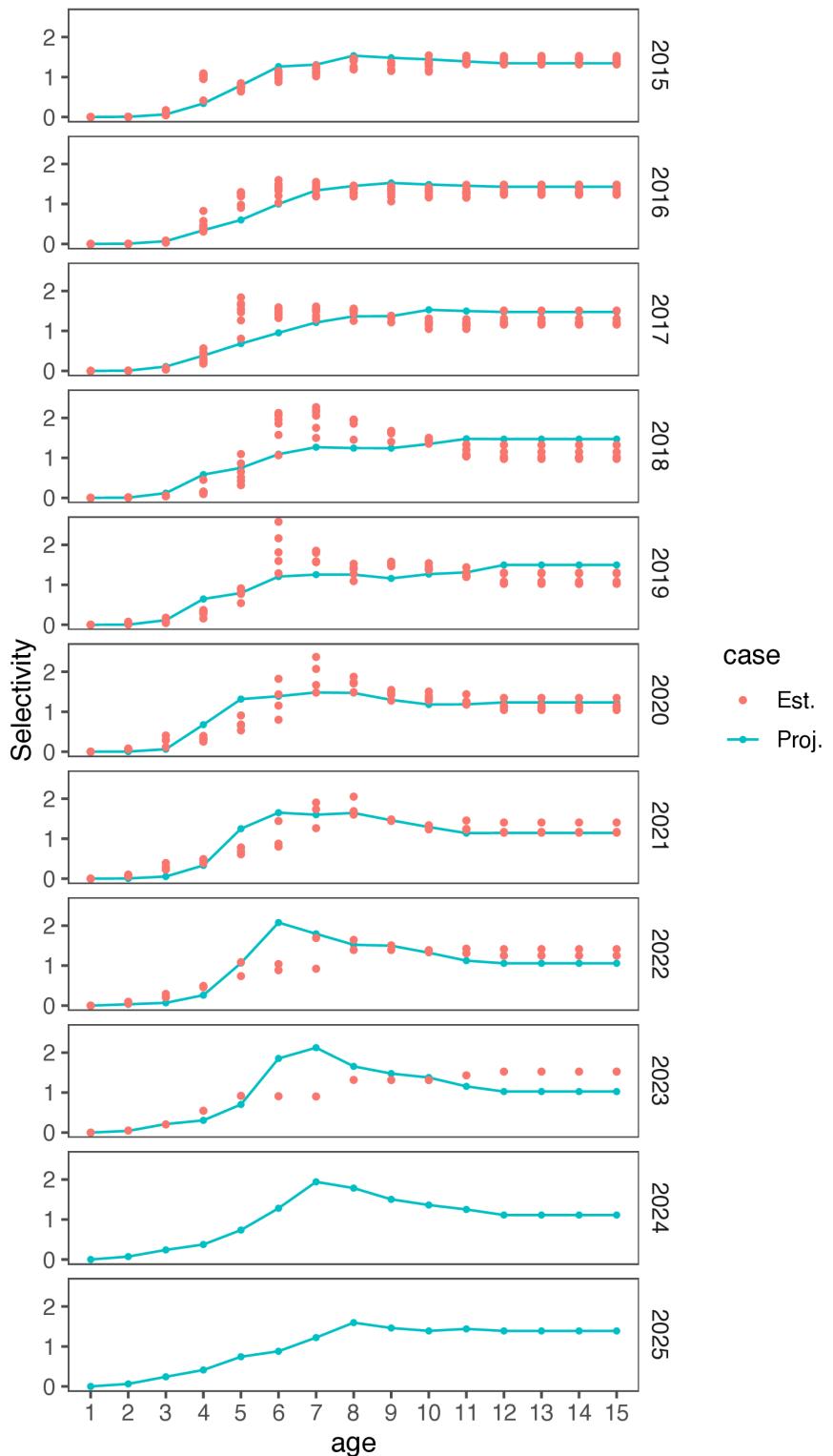


Figure 57: Retrospective pattern for estimated EBS pollock fishery selectivity (dots) compared to the projected selectivity from the year prior (solid line).

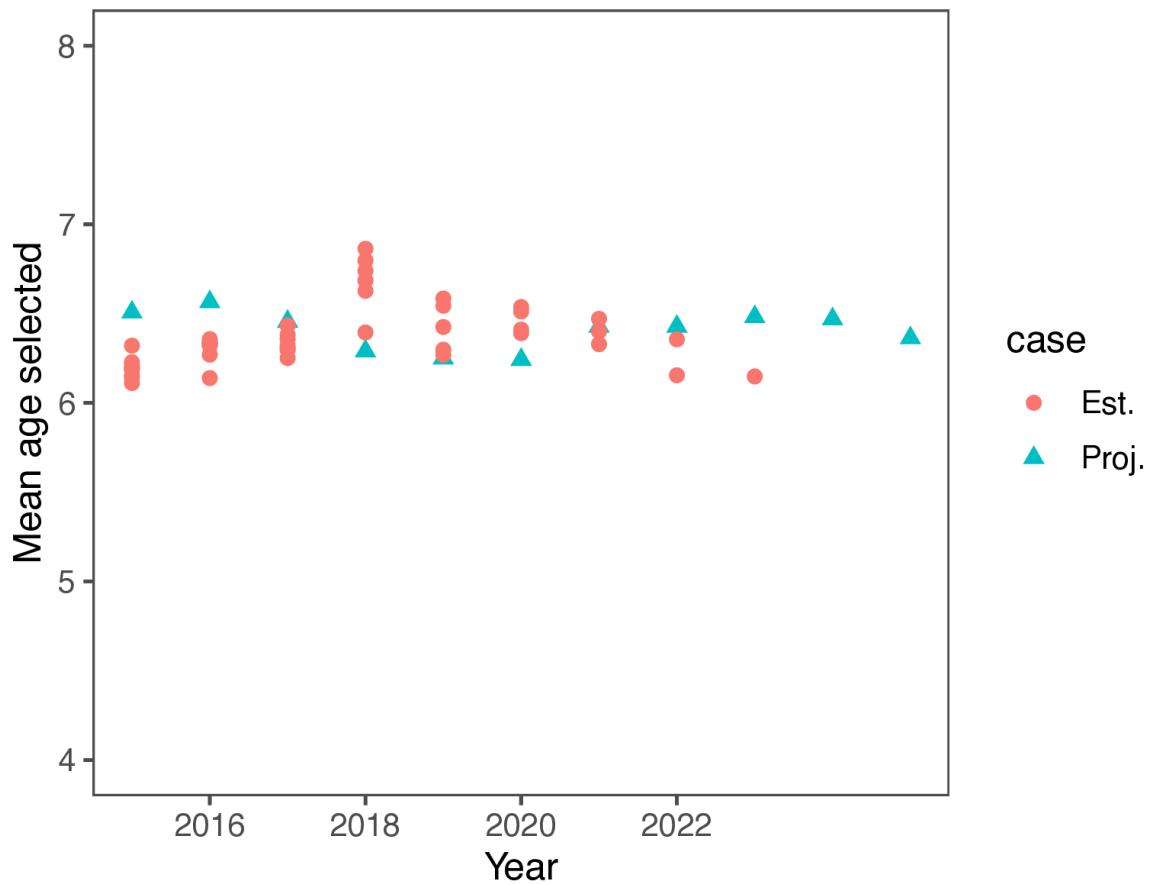


Figure 58: Retrospective pattern for the mean selected age (ages 1-8) based on estimated EBS pollock fishery selectivity compared to the projected selectivity from the year prior.

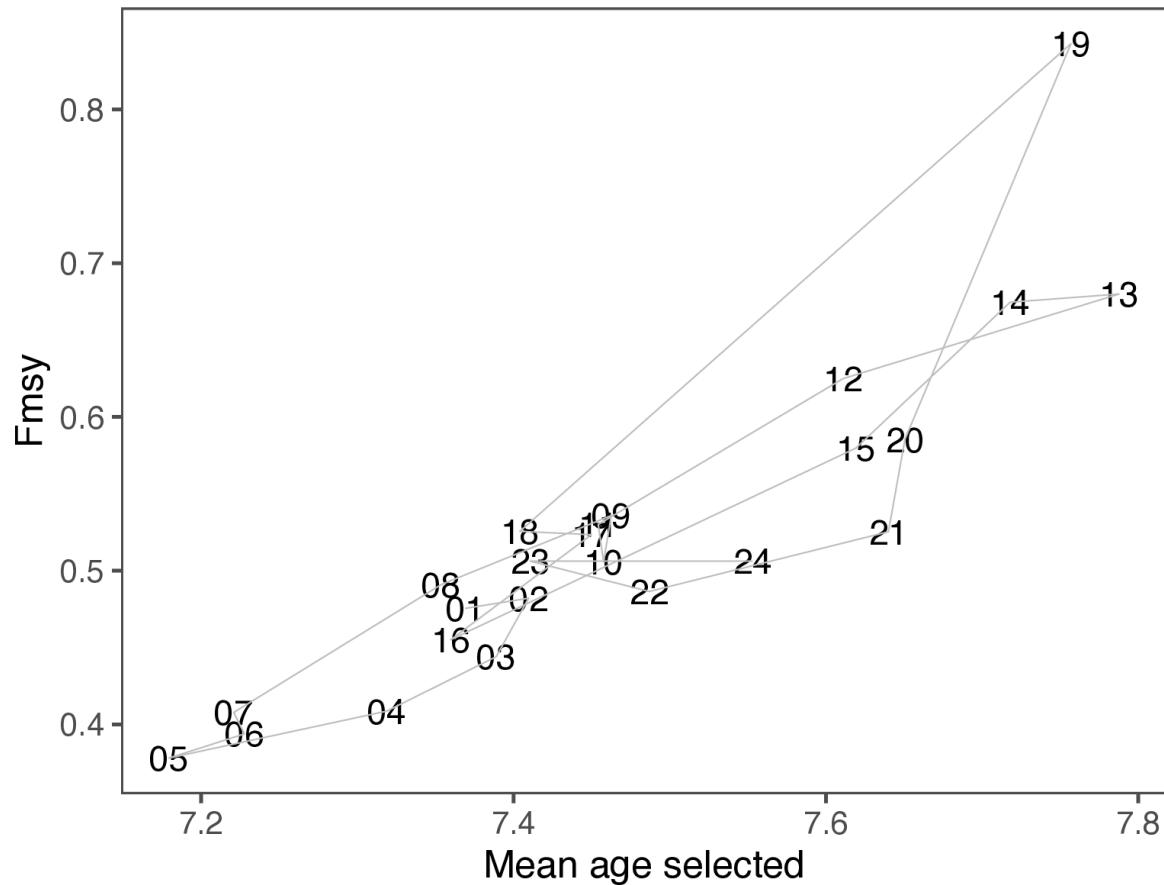


Figure 59: Comparison of F_{MSY} and mean selected age. The horizontal axis is a way to summarize if selectivity tends towards younger or older fish. Labels indicate the year that demographic parameters (weight-at-age, selectivity-at-age) were used to compute F_{MSY} .

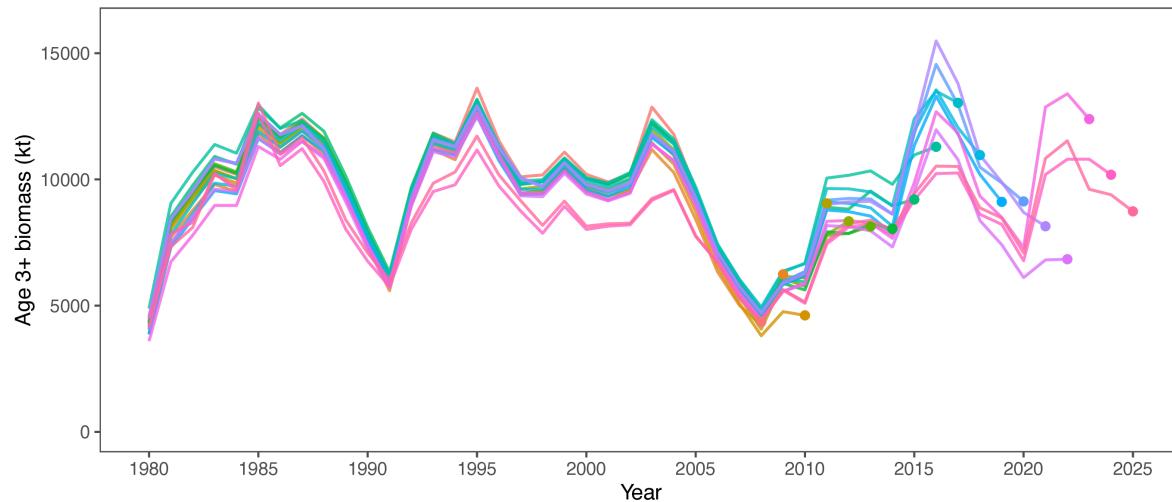


Figure 60: Comparison of the current assessment results with past assessments of begin-year EBS age-3+ pollock biomass.

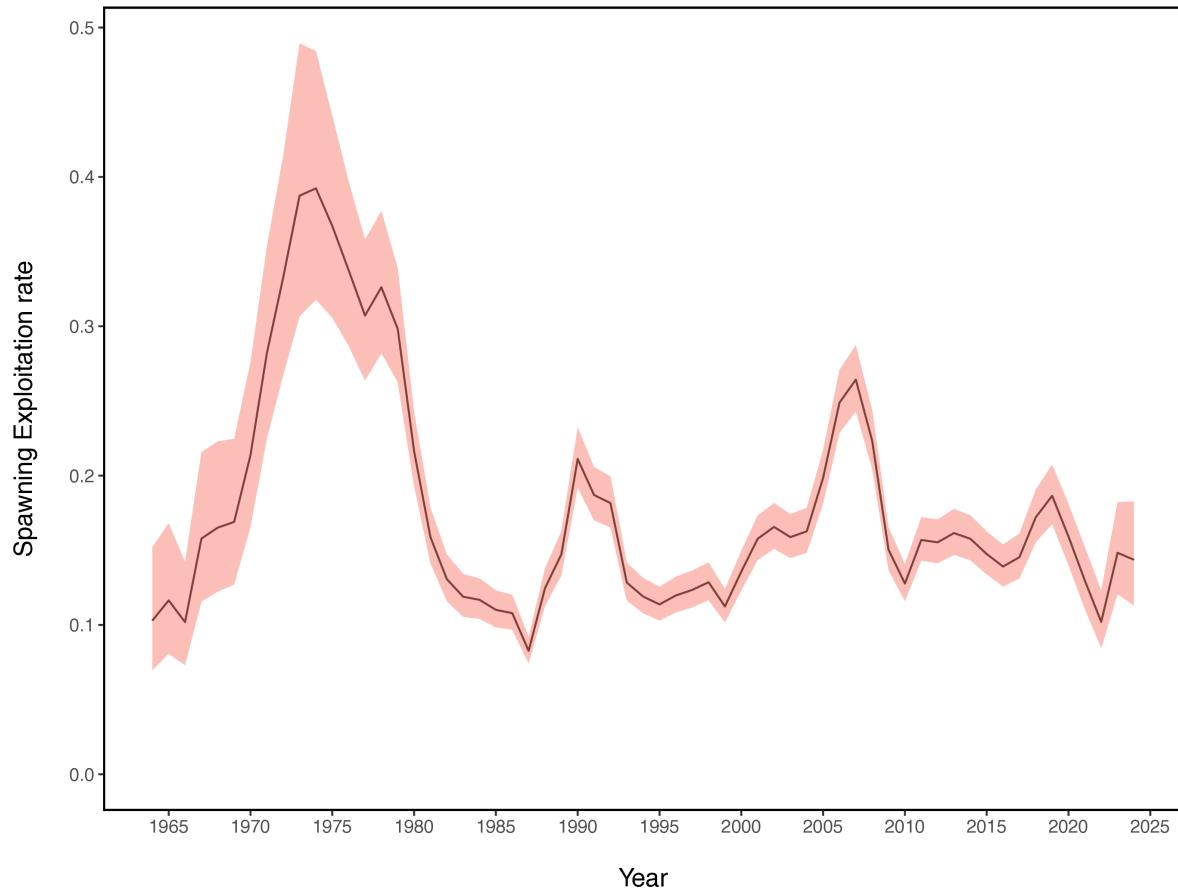


Figure 61: Estimated spawning exploitation rate (defined as the percent removal of egg production in a given spawning year).

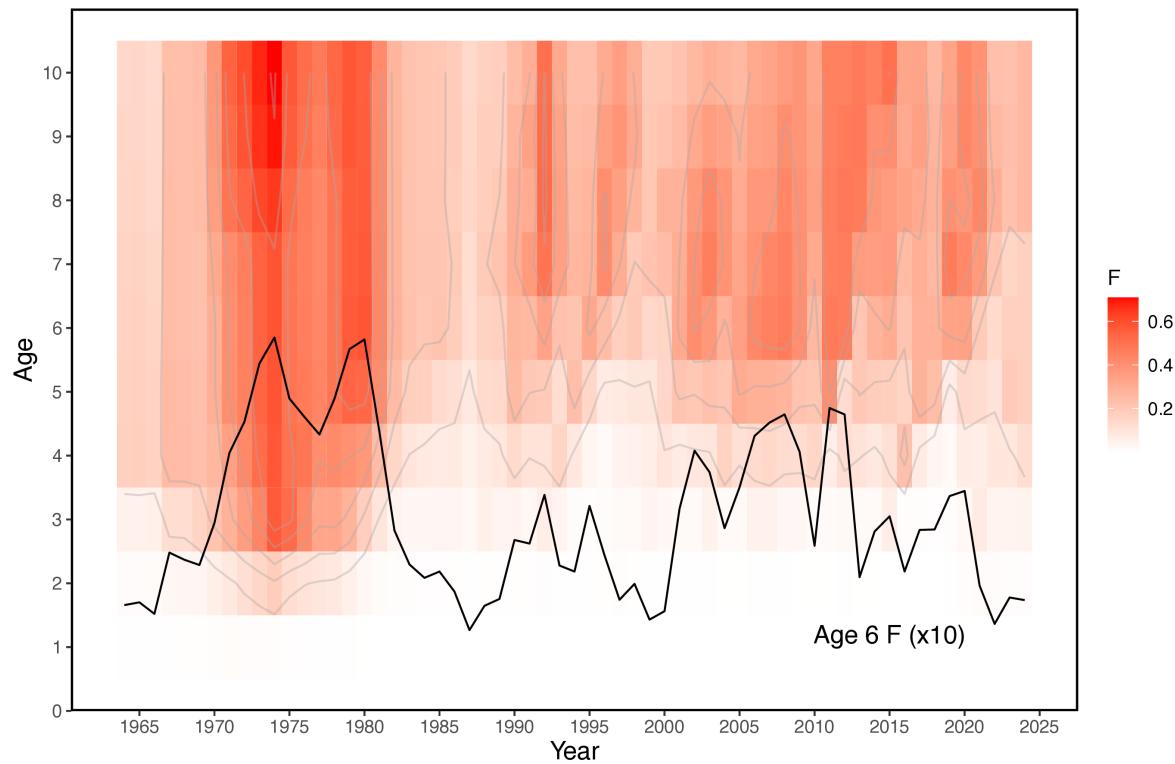


Figure 62: Estimated instantaneous age-specific fishing mortality rates for EBS pollock.

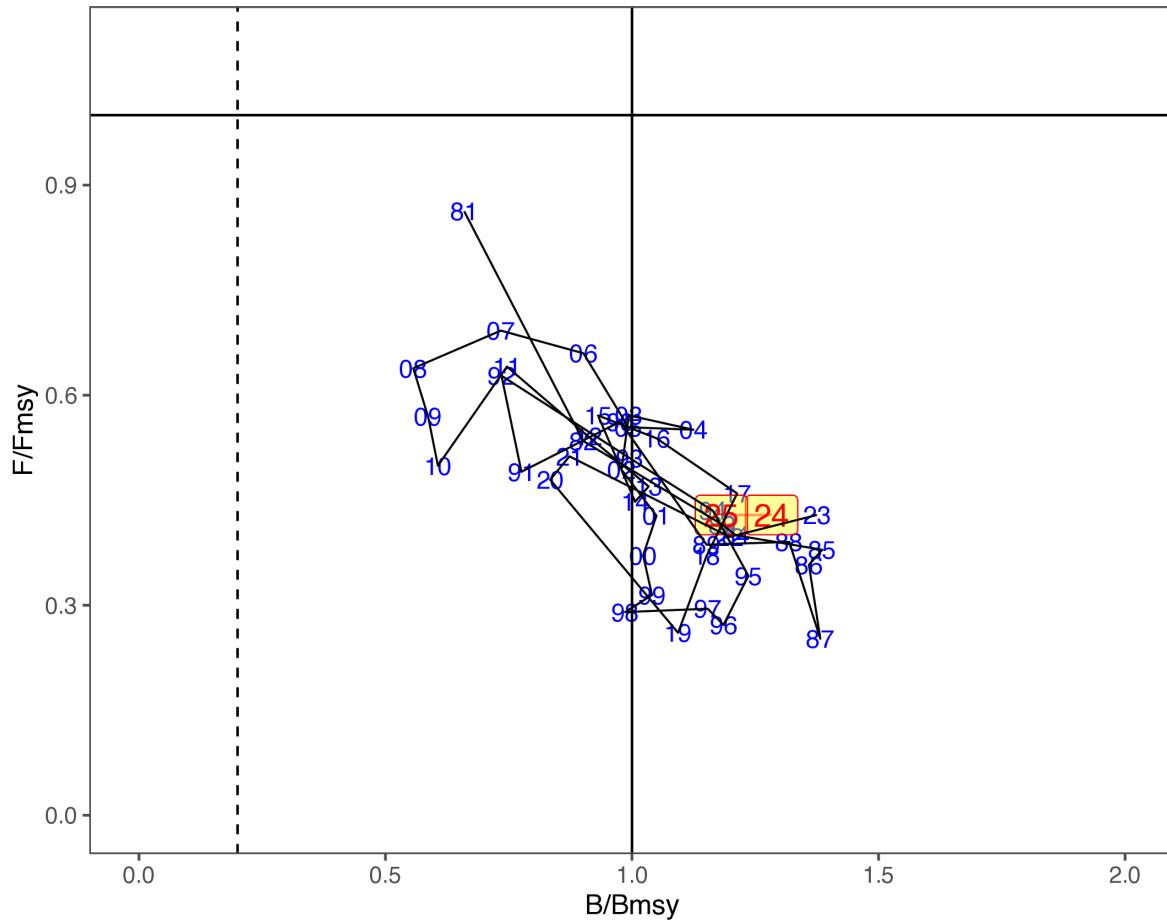


Figure 63: Estimated spawning biomass relative to annually estimated F_{MSY} values and fishing mortality rates for EBS pollock. Two projection years are shaded in yellow.

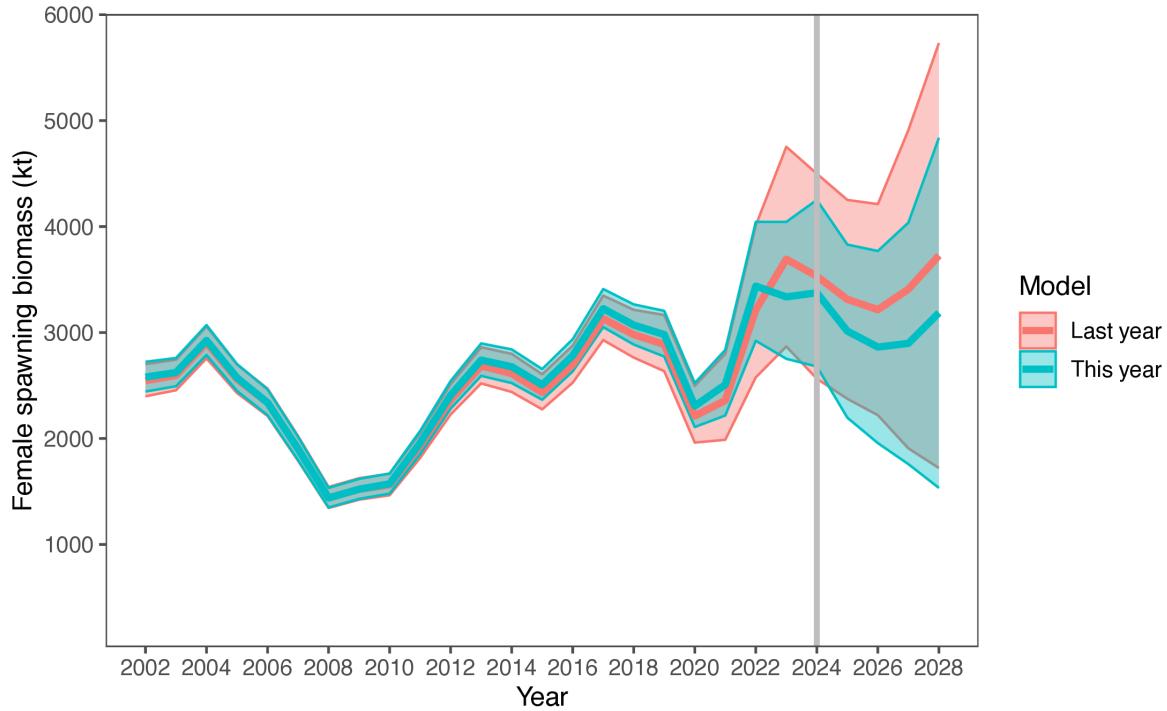


Figure 64: The estimated EBS pollock spawning stock biomass for model 23 last year and this with projections equal to the estimated fishing mortality from 2024.

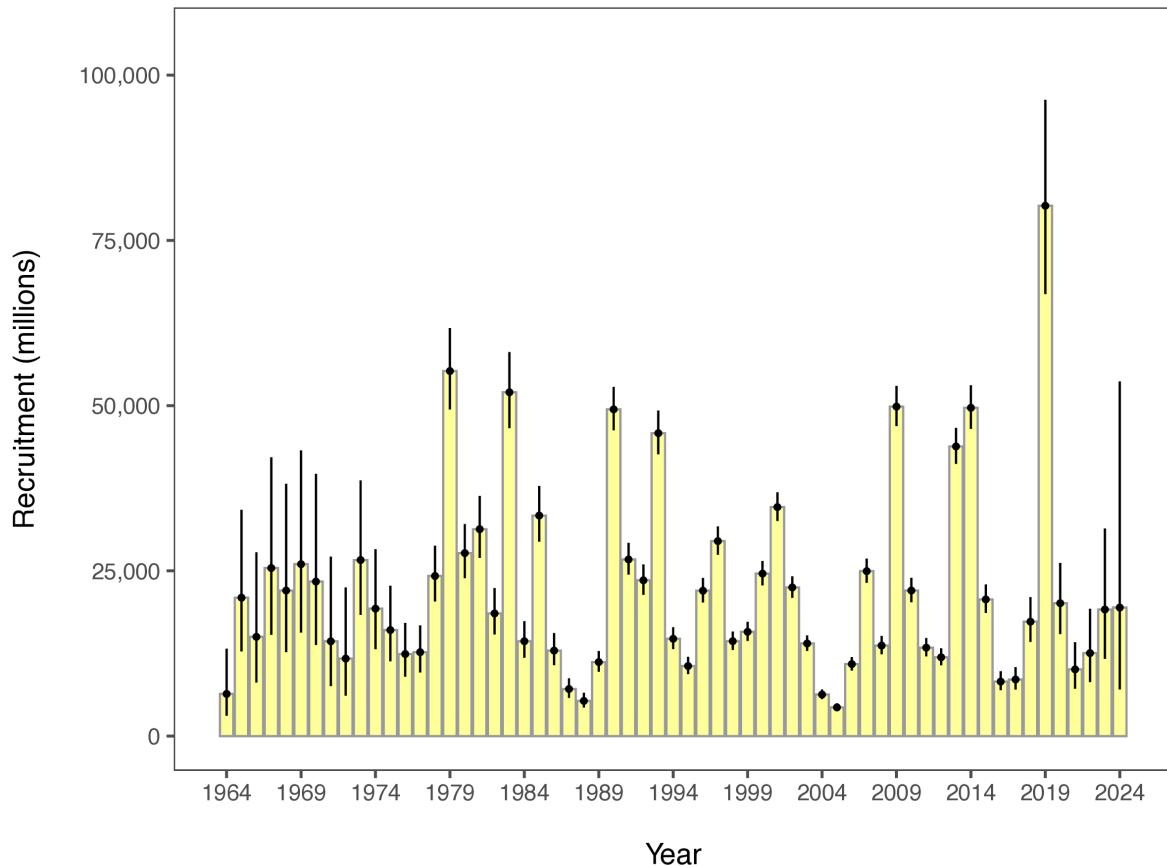


Figure 65: Recruitment estimates (age-1 recruits) for EBS pollock for all years since 1964 (1963–2023 year classes) for Model 23. Error bars reflect 90% credible intervals based on model estimates of uncertainty.

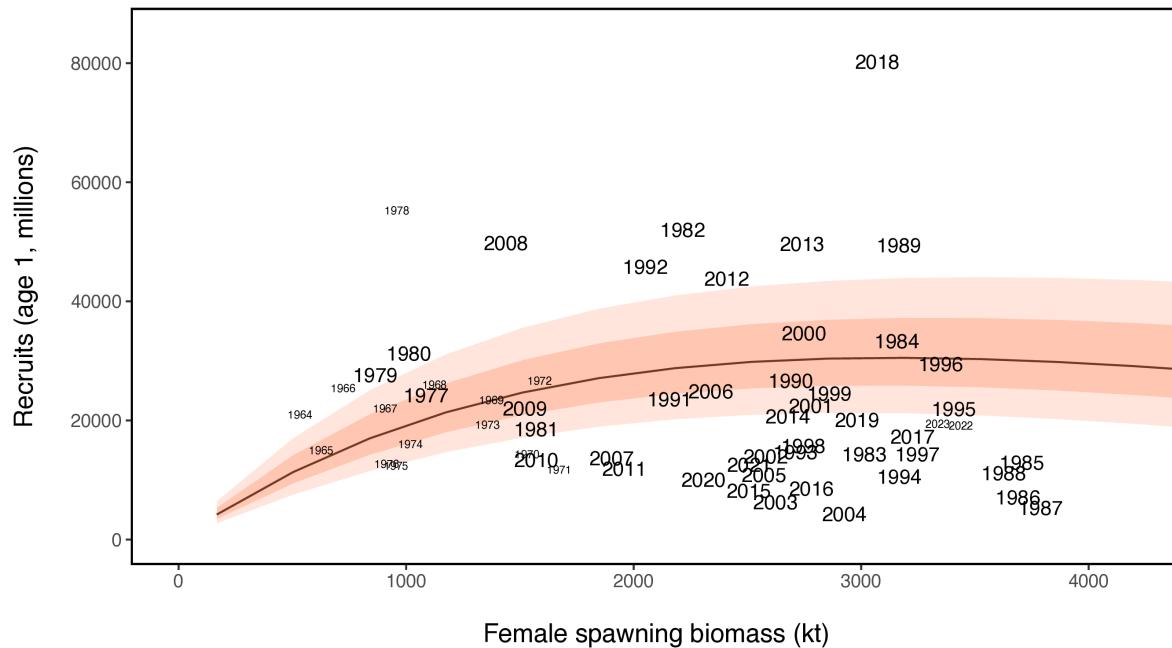


Figure 66: Stock-recruitment estimates (shaded represents structural uncertainty) and age-1 EBS pollock estimates labeled by year-classes.

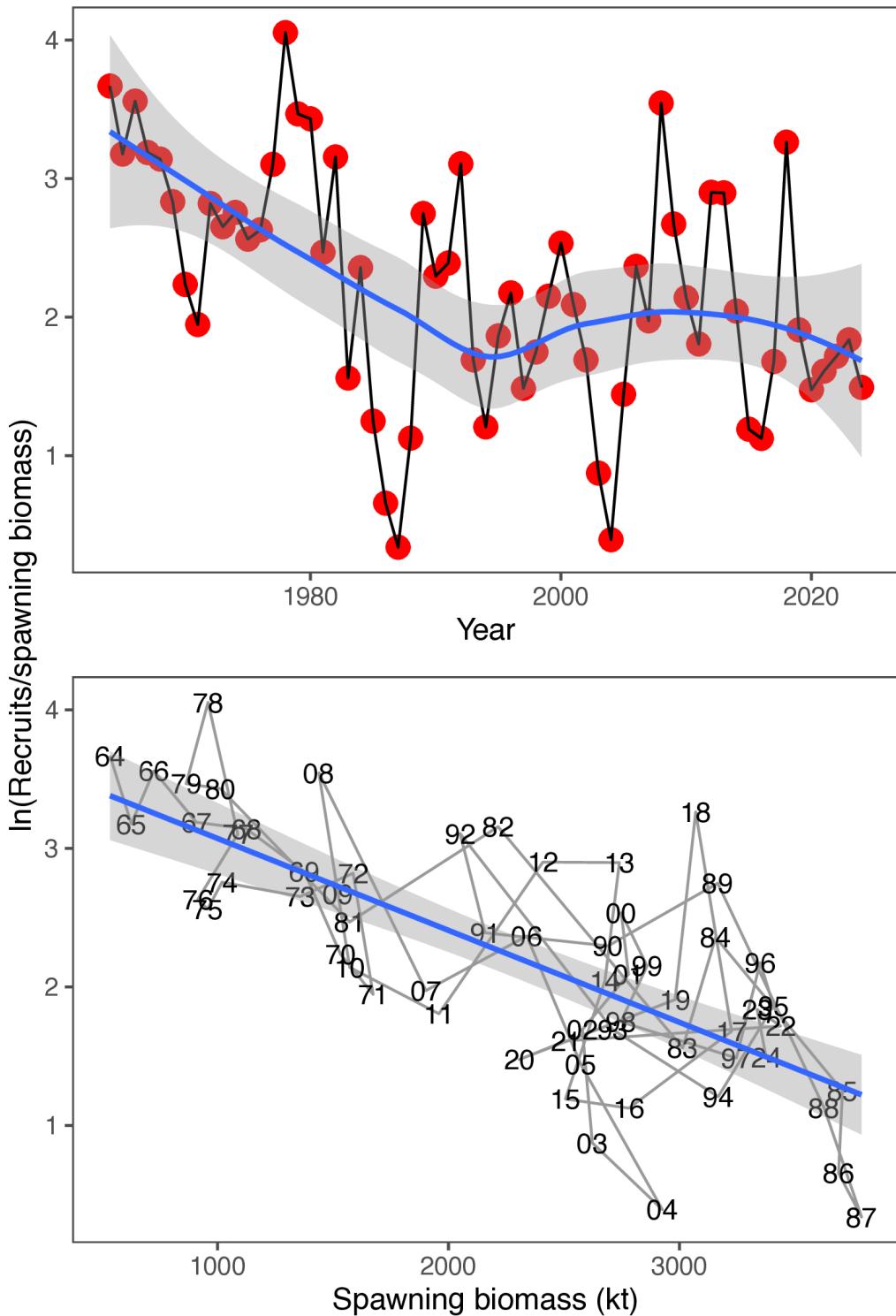


Figure 67: EBS pollock productivity as measured by logged recruits per spawning biomass, $\ln(R/S)$, as a function of spawning biomass with a linear fit (bottom) and over time, 1964–2024 (top).

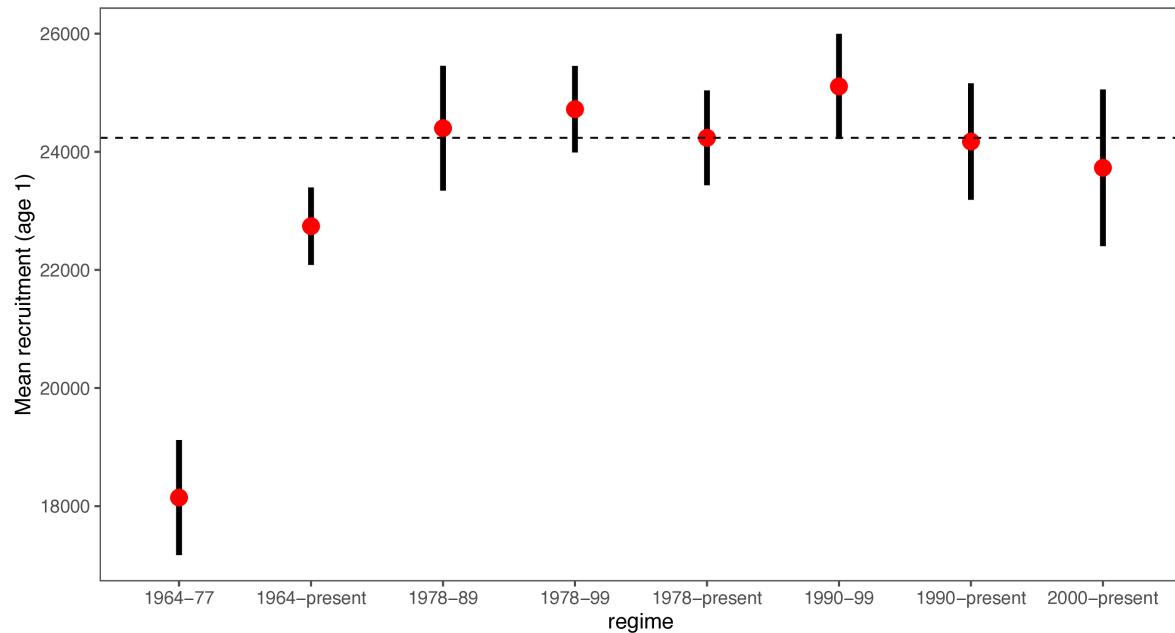


Figure 68: Mean recruitment estimates (age-1) for EBS pollock for different periods with error bars representing 95% credible intervals.

Alternative 1

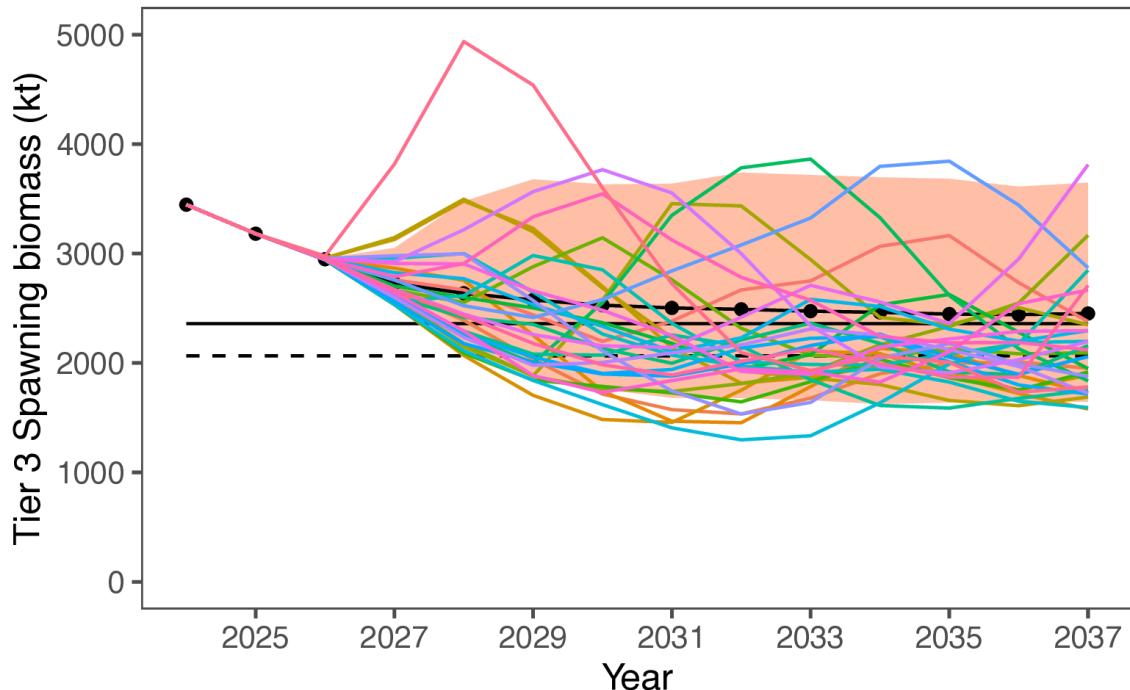
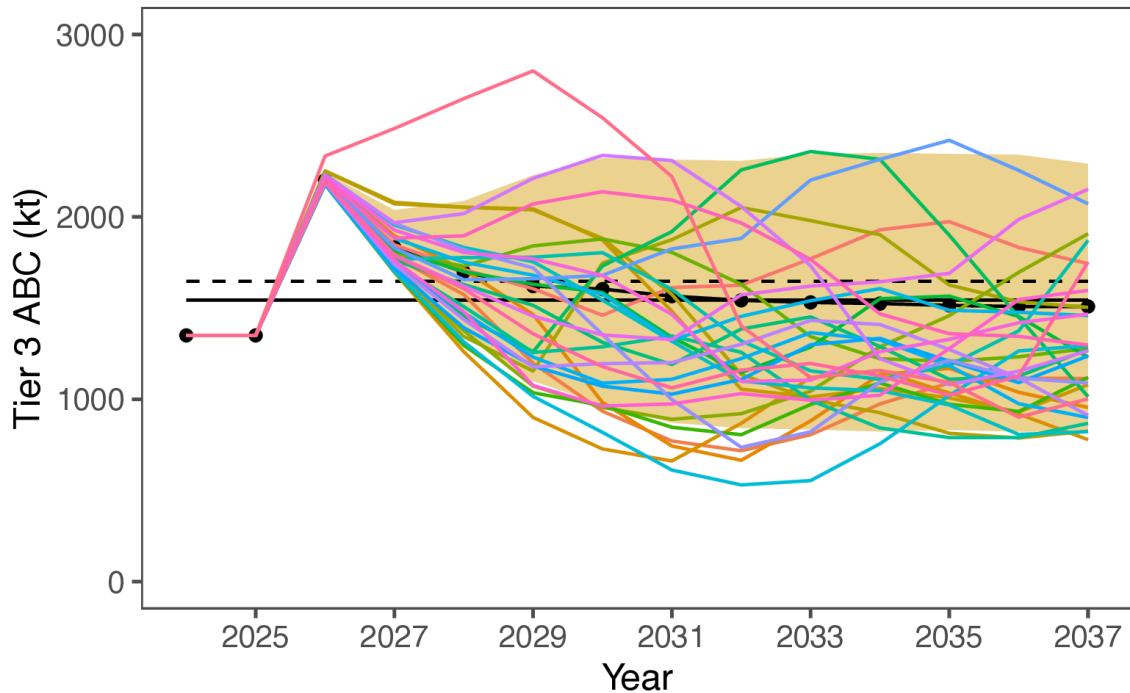


Figure 69: Projected EBS Tier 3 pollock yield (top) and female spawning biomass (bottom) relative to the long-term expected values under $F_{35\%}$ and $F_{40\%}$ (horizontal lines). $B_{40\%}$ is computed from average recruitment from 1978–2020. Future harvest rates follow the guidelines specified under Tier 3 Scenario 1.

Alt 3, mean F

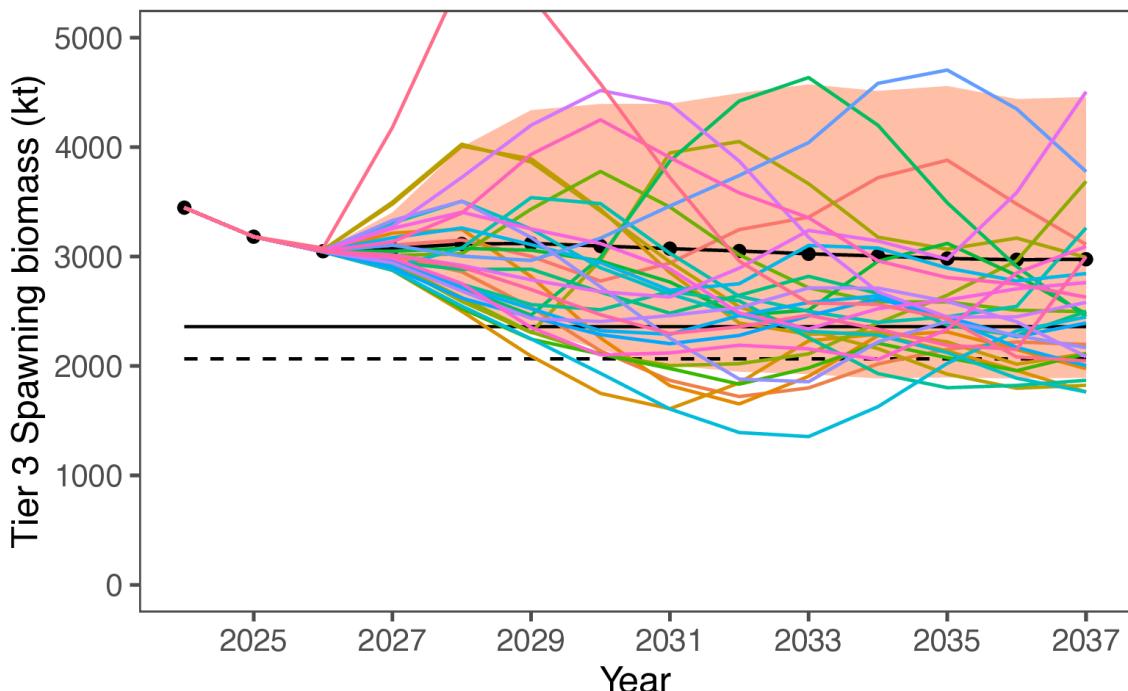
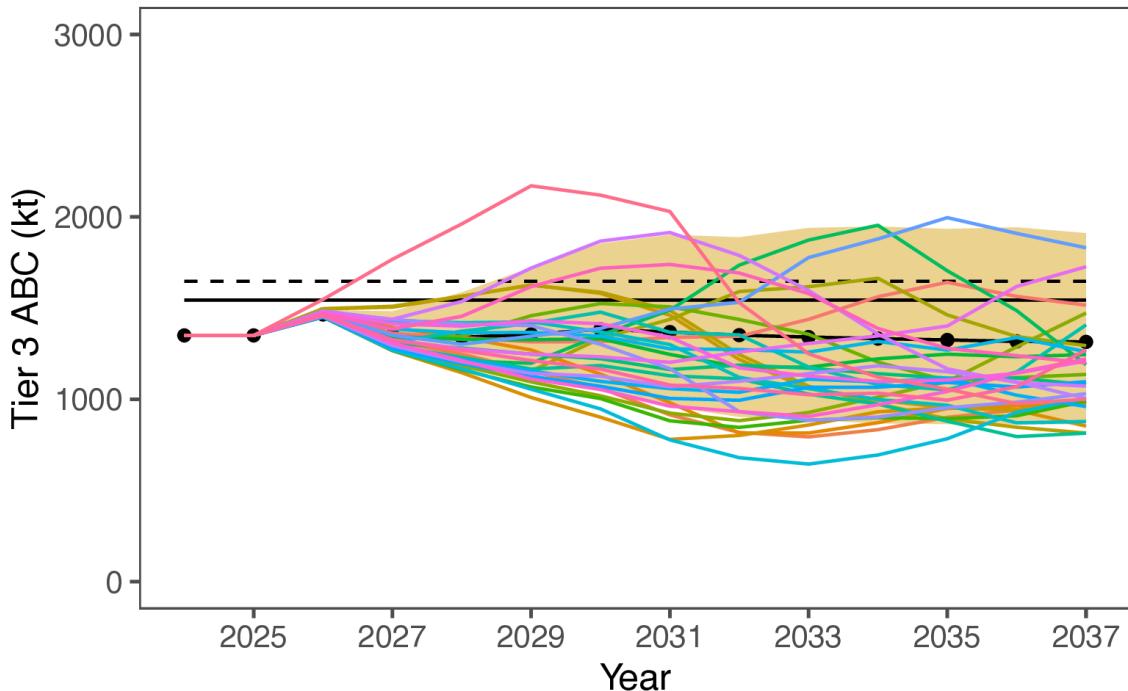


Figure 70: Projected pollock yield (top) and female spawning biomass (bottom) under Alternative 3—fishing under the recent 5-year average fishing mortality. The long-term expected values under $F_{35\%}$ and $F_{40\%}$ (horizontal lines) $B_{40\%}$ are computed from average recruitment from 1978–2020.

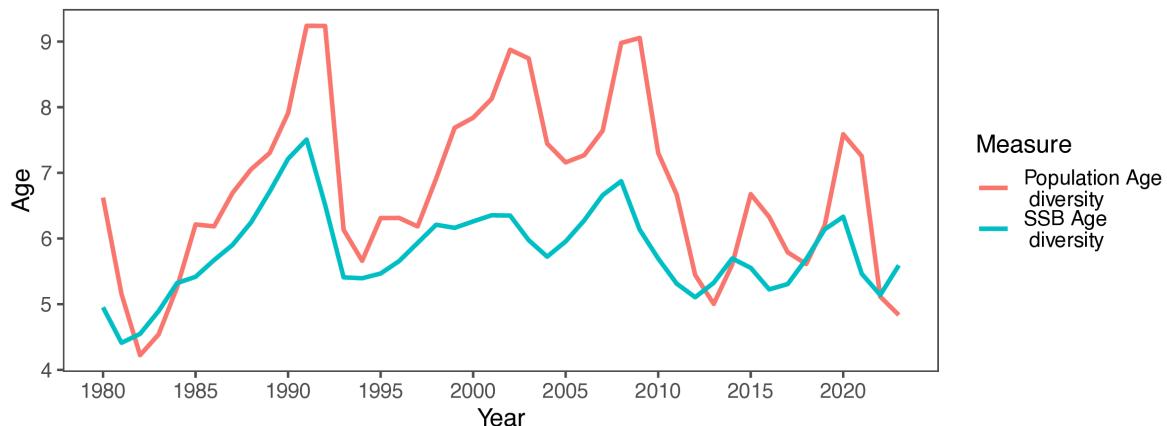


Figure 71: For the mature component of the EBS pollock stock, time series of estimated average age and diversity of ages (using the Shannon-Wiener H statistic), 1980–2024.

14 Appendix EBS Pollock Model Description

14.1 Dynamics

This assessment is based on a statistical age-structured model with the catch equation and population dynamics model as described in Fournier and Archibald (1982) and elsewhere (e.g., Hilborn and Walters (1992), Schnute and Richards (1995), McAllister and Ianelli (1997)). The catch in numbers at age in year t ($C_{t,a}$) and total catch biomass (Y_t) can be described as:

$$C_{t,a} = \frac{F_{t,a}}{Z_{t,a}} (1 - e^{-Z_{t,a}}) N_{t,a}, \quad 1 \leq t \leq T, 1 \leq a \leq A \quad (14.1)$$

$$N_{t+1,a+1} = N_{t,a-1} e^{-Z_{t,a-1}} \quad 1 \leq t \leq T, 1 \leq a < A \quad (14.2)$$

$$N_{t+1,A} = N_{t,A-1} e^{-Z_{t,A-1}} + N_{t,A} e^{-Z_{t,A}}, \quad 1 \leq t \leq T \quad (14.3)$$

$$Z_{t,a} = F_{t,a} + M_{t,a} \quad (14.4)$$

$$C_{t,.} = \sum_{a=1}^A C_{t,a} \quad (14.5)$$

$$p_{t,a} = \frac{C_{t,a}}{C_{t,.}} \quad (14.6)$$

$$Y_t = \sum_{a=1}^A w_{t,a} C_{t,a} \quad (14.7)$$

$$(14.8)$$

where

| | |
|-----------|---|
| T | is the number of years, |
| A | is the number of age classes in the population, |
| $N_{t,a}$ | is the number of fish age a in year t , |
| $C_{t,a}$ | is the catch of age class a in year t , |
| $p_{t,a}$ | is the proportion of the total catch in year t , that is in age class a , |
| C_t | is the total catch in year t , |
| w_a | is the mean body weight (kg) of fish in age class a , |
| Y_t | is the total yield biomass in year t , |
| $F_{t,a}$ | is the instantaneous fishing mortality for age class a , in year t , |
| $M_{t,a}$ | is the instantaneous natural mortality in year t for age class a , and |
| $Z_{t,a}$ | is the instantaneous total mortality for age class a , in year t . |

Fishing mortality ($F_{t,a}$) is specified as being semi-separable and non-parametric in form with restrictions on the variability following Butterworth et al. (2003) :

$$F_{t,a} = s_{t,a} \mu^f e^{\epsilon_t}, \quad \epsilon_t \sim \mathcal{N}(0, \sigma_E^2) \quad (14.9)$$

$$s_{t+1,a} = s_{t,a} e^{\gamma_t}, \quad \gamma_t \sim \mathcal{N}(0, \sigma_s^2) \quad (14.10)$$

where $s_{t,a}$ is the selectivity for age class a in year t , and μ^f is the median fishing mortality rate over time.

If the selectivities ($s_{t,a}$) are constant over time then fishing mortality rate decomposes into an age component and a year component. A curvature penalty on the selectivity coefficients using the squared second-differences to provide smoothness between ages.

Bottom-trawl survey selectivity was set to be asymptotic yet retain the properties desired for the characteristics of this gear. Namely, that the function should allow flexibility in selecting age 1 pollock over time. The functional form of this selectivity was:

$$s_{t,a} = [1 + e^{-\alpha_t a - \beta_t}]^{-1}, \quad a > 1 \quad (14.11)$$

$$s_{t,a} = \mu_s e^{-\delta_t^\mu}, \quad a = 1 \quad (14.12)$$

$$\alpha_t = \bar{\alpha} e^{\delta_t^\alpha}, \quad (14.13)$$

$$\beta_t = \bar{\beta} e^{\delta_t^\beta}, \quad (14.14)$$

where the parameters of the selectivity function follow a random walk process as in Dorn et al. (2000):

$$\delta_t^\mu - \delta_{t+1}^\mu \sim \mathcal{N}(0, \sigma_{\delta^\mu}^2) \quad (14.15)$$

$$(14.16)$$

$$\alpha_t^\mu - \alpha_{t+1}^\mu \sim \mathcal{N}(0, \sigma_{\alpha^\mu}^2) \quad (14.17)$$

$$\beta_t^\mu - \beta_{t+1}^\mu \sim \mathcal{N}(0, \sigma_{\beta^\mu}^2) \quad (14.18)$$

The parameters to be estimated in this part of the model are thus for t=1982 through to 2024.

The variance terms for these process error parameters were specified to be 0.04.

In this assessment, the random-walk deviation penalty was optionally shifted to the changes in log-selectivity. that is, for the BTS estimates, the process error was applied to the logistic parameters as above, but the lognormal penalty was applied to the resulting selectivities-at-age directly. The extent of this variability was evaluated in the context of the impact on age-specific survey catchability/availability and contrasted with an independent estimate of pollock availability to the bottom trawl survey.

$$\ln(s_{t,a}) - \ln(s_{t+1,a}) \sim \mathcal{N}(0, \sigma_{sel}^2) \quad (14.19)$$

$$(14.20)$$

In 2008 the AT survey selectivity approach was modified. As an option, the age one pollock observed in this trawl can be treated as an index and are not considered part of the age composition (which then ranges from age 2-15). This was done to improve some interaction with the flexible selectivity smoother that is used for this gear and was compared. Additionally, the annual specification of input observation variance terms was allowed for the AT data.

A diagnostic approach to evaluate input variance specifications (via sample size under multinomial assumptions) was added in the 2018 assessment. This method uses residuals from mean ages together with the concept that the sample variance of mean age (from a given annual data set) varies inversely with input sample size. It can be shown that for a given set of input proportions at age (up to the maximum age A) and sample size N_t for year t , an adjustment factor ν for input sample size can be computed when compared with the assessment model predicted proportions at age (\hat{p}_{ta}) and model predicted mean age ($\hat{\bar{a}}_t$):

$$\nu = \text{var} \left(r_t^a \sqrt{\frac{N_t}{\kappa_t}} \right)^{-1} \quad (14.21)$$

$$r_t^a = \bar{a}_t - \hat{\bar{a}}_t \quad (14.22)$$

$$\kappa_t = \left[\sum_a^A \bar{a}_t - \hat{\bar{a}}_t \right]^{0.5} \quad (14.23)$$

where r_t^a is the residual of mean age and

$$\hat{a}_t = \sum_a^A a \hat{p}_{ta} \quad (14.24)$$

$$\bar{a}_t = \sum_a^A a p_{ta} \quad (14.25)$$

Based on previous analyses, we used the above relationship as a diagnostic for evaluating input sample sizes by comparing model predicted mean ages with observed mean ages and the implied 95% confidence bands. This method provided support for modifying the frequency of allowing selectivity changes.

14.2 Recruitment

In these analyses, recruitment (R_t) represents numbers of age-1 individuals modeled as a stochastic function of spawning stock biomass.

$$R_t = f(B_{t-1}) \quad (14.26)$$

with mature spawning biomass during year t was defined as:

$$B_t = \sum_{a=1}^A w_{t,a} \phi_a N_{t,a} \quad (14.27)$$

and, ϕ_a is the proportion of mature females at age a as shown in the sub-section titled Natural mortality and maturity at age under “Parameters estimated independently” above.

A reparameterized form for the stock-recruitment relationship following Francis (1992) was used. For the optional Beverton-Holt form (the Ricker form presented in Eq. 12 was adopted for this assessment) we have:

$$R_t = \frac{B_{t-1} e^{\varepsilon_t}}{\alpha + \beta B_{t-1}} \quad (14.28)$$

where

- R_t is recruitment at age 1 in year t ,
- B_t is the biomass of mature spawning females in year t ,
- ε_t is the recruitment anomaly for year t , ($\varepsilon_t \sim \mathcal{N}(0, \sigma_R^2)$)
- α, β are stock recruitment parameters.

Values for the stock-recruitment function parameters and are calculated from the values of (the number of 0-year-olds in the absence of exploitation and recruitment variability) and the steepness of the stock-recruit relationship (h). The steepness is the fraction of R_0 to be expected (in the absence of recruitment variability) when the mature biomass is reduced to 20% of its pristine level Francis (1992) , so that:

$$\alpha = \tilde{B}_0 \frac{1-h}{4h} \quad (14.29)$$

$$\beta = \frac{5h-1}{4hR_0} \quad (14.30)$$

where \tilde{B}_0 is the total egg production (or proxy, e.g., female spawning biomass) in the absence of exploitation (and recruitment variability) expressed as a fraction of R_0 .

Some interpretation and further explanation follows. For steepness equal 0.2, then recruits are a linear function of spawning biomass (implying no surplus production). For steepness equal to 1.0, then recruitment is constant for all levels of spawning stock size. A value of $h = 0.9$ implies that at 20% of the unfished spawning stock size will result in an expected value of 90% unfished recruitment level. Steepness of 0.7 is a commonly assumed default value for the Beverton-Holt form (e.g., Kimura (1989)). The prior distribution for steepness used a beta distribution as in Ianelli et al. (2016). The prior on steepness was specified to be a symmetric form of the Beta distribution with $\alpha = \beta = 14.93$ implying a prior mean of 0.5 and CV of 12% (implying that there is about a 14% chance that the steepness is greater than 0.6). This conservative prior is consistent with previous years' application and serves to constrain the stock-recruitment curve from favoring steep slopes (uninformative priors result in F_{MSY} values near an F_{SPR} of about $F_{18\%}$ a value considerably higher than the default proxy of $F_{35\%}$). The residual pattern for the post-1977 recruits used in fitting the curve with a more diffuse prior resulted in all estimated recruits being below the curve for stock sizes less than B_{MSY} (except for the 1978 year class). We believe this to be driven primarily by the apparent negative-slope for recruits relative to stock sizes above B_{MSY} and as such, provides a potentially unrealistic estimate of productivity at low stock sizes. This prior was elicited from the rationale that residuals should be reasonably balanced throughout the range of spawning stock sizes.

Whereas this is somewhat circular (i.e., using data for prior elicitation), the point here is that residual patterns (typically ignored in these types of models) were qualitatively considered.

In model 16.1 (from the 2019 assessment), a Beverton Holt stock recruitment form was implemented using the prior value of 0.67 for steepness and a CV of 0.17. This resulted in beta distribution parameters (for the prior) at $\alpha = 6.339$ and $\beta = 4.293$.

The value of σ_R was set at 1.0 to accommodate additional uncertainty in factors affecting recruitment variability.

To have the critical value for the stock-recruitment function (steepness, h) on the same scale for the Ricker model, we begin with the parameterization of Kimura (1989) :

$$R_t = \frac{B_{t-1} e^{\alpha(1-B_{t-1}\frac{R_0}{\psi_0})}}{\psi_0} \quad (14.31)$$

It can be shown that the Ricker parameter α maps to steepness as:

$$h = \frac{e^\alpha}{e^\alpha + 4} \quad (14.32)$$

so that the prior used on h can be implemented in both the Ricker and Beverton-Holt stock-recruitment forms. Here the term ψ_0 represents the equilibrium unfished spawning biomass per-recruit.

14.3 Diagnostics

In 2006 a replay feature was added where the time series of recruitment estimates from a particular model is used to compute the subsequent abundance expectation had no fishing occurred. These recruitments are adjusted from the original estimates by the ratio of the expected recruitment given spawning biomass (with and without fishing) and the estimated stock-recruitment curve. I.e., the recruitment under no fishing is modified as:

$$R'_t = \hat{R}_t \frac{f(B'_{t-1})}{f(B_{t-1})}$$

where R_t is the original recruitment estimate in year t with B'_{t-1} and B_{t-1} representing the stock-recruitment function given spawning biomass under no fishing and under the estimated fishing intensity, respectively.

The assessment model code allows retrospective analyses (e.g., Parma (1993), and Ianelli and Fournier (1998)). This was designed to assist in specifying how spawning biomass patterns (and uncertainty) have changed due to new data. The retrospective approach simply uses the current model to evaluate how it may change over time with the addition of new data based on the evolution of data collected over the past several years.

To provide a diagnostic for diversity in the age structure of the spawning biomass, we computed the Shannon entropy in exponential form. Following Jost (2006), and substituting the population's mature age structure in place of species, this provides an estimate of the effective number of ages. This is computed for each year as a measure of different age groups contributing to the spawning population as:

$$H_i = \exp(-\sum p_a \cdot \log(p_a))$$

where p_a is the proportion of mature fish biomass-at-age a in year i .

14.4 Parameter estimation

The objective function was simply the sum of the negative log-likelihood function and logs of the prior distributions. To fit large numbers of parameters in nonlinear models it is useful to be able to estimate certain parameters in different stages. The ability to estimate stages is also important in using robust likelihood functions since it is often undesirable to use robust objective functions when models are far from a solution. Consequently, in the early stages of estimation we use the following log- likelihood function for the survey and fishery catch at age data (in numbers):

$$nll(i) = n \sum_{t,a} p_{ta} \ln \hat{p}_{ta} \quad (14.33)$$

$$p_{ta} = \frac{O_{ta}}{\sum_a O_{ta}} \quad \hat{p}_{ta} = \frac{\hat{C}_{ta}}{\sum_a \hat{C}_{ta}} \quad (14.34)$$

$$\mathbf{C} = \mathbf{CE} \quad (14.35)$$

$$\mathbf{E} = \begin{matrix} b_{1,1} & b_{1,2} & \dots & b_{1,15} \\ b_{2,1} & b_{2,2} & & b_{2,15} \\ \vdots & & \ddots & \vdots \\ b_{15,1} & b_{15,2} & \dots & b_{15,15} \end{matrix} \quad (14.36)$$

where A , and T , represent the number of age classes and years, respectively, n is the sample size, and represent the observed and predicted numbers at age in the catch. The elements $b_{i,j}$ represent ageing mis-classification proportions are based on independent agreement rates between otolith age readers. For the models presented this year, the option for including aging errors was re-evaluated.

Sample size values were revised and are shown in the main document. Strictly speaking, the amount of data collected for this fishery indicates higher values might be warranted. However, the standard multinomial sampling process is not robust to violations of assumptions (Fournier et al. (1990)). Consequently, as the model fit approached a solution, we invoke a robust likelihood function which fit proportions at age as:

$$\prod_{a=1}^A \prod_{t=1}^T \left[\left(\exp \left(-\frac{(p_{ta} - \hat{p}_{ta})^2}{2(\eta_{ta} + 0.1/A) \tau_t^2} \right) + 0.01 \right) \times \frac{1}{\sqrt{2\pi(\eta_{ta} + 0.1/A) \tau_t}} \right] \quad (14.37)$$

Taking the logarithm we obtain the log-likelihood function for the age composition data:

$$nll(i) = -0.5 \sum_{a=1}^A \sum_{t=1}^T \ln 2\pi (\eta_{ta} + 0.1/A) - \sum_t^T A \ln \tau_t + \sum_{a=1}^A \sum_{t=1}^T \ln \left\{ \exp \left(-\frac{(p_{ta} - \hat{p}_{ta})^2}{(2\eta_{ta} + 0.1/A) \tau_t^2} \right) + 0.01 \right\} \quad (14.38)$$

where

$$\eta_{ta} = p_{ta}(1 - p_{ta}) \quad (14.39)$$

$$\text{and} \quad (14.40)$$

$$\tau_t^2 = 1/n_t \quad (14.41)$$

which gives the variance for p_{ta}

$$(\eta_{ta} + 0.1/A)\tau_t^2 \quad (14.42)$$

Completing the estimation in this fashion reduces the model sensitivity to data that would otherwise be considered outliers.

Within the model, predicted survey abundance accounted for within-year mortality since surveys occur during the middle of the year. As in previous years, we assumed that removals by the survey were insignificant (i.e., the mortality of pollock caused by the survey was considered insignificant). Consequently, a set of analogous catchability and selectivity terms were estimated for fitting the survey observations as:

$$\hat{N}_{ta}^s = e^{-0.5Z_{ta}} N_{ta} q_t^s s_{ta}^S \quad (14.43)$$

where the superscript s indexes the type of survey (AT or BTS). For the option to use the survey predictions in biomass terms instead of just abundance, the above was modified to include observed survey biomass weights-at-age:

$$\hat{N}_{ta}^s = e^{-0.5Z_{ta}} w_{ta} N_{ta} q_t^s s_{ta}^S \quad (14.44)$$

For the AVO index, the values for selectivity were assumed to be the same as for the AT survey and the mean weights at age over time was also assumed to be equal to the values estimated for the AT survey.

For these analyses we chose to keep survey catchabilities constant over time (though they are estimated separately for the AVO index and for the AT and bottom trawl surveys). The contribution to the negative log-likelihood function (ignoring constants) from the surveys is given by either the lognormal distribution:

$$nll(i) = \sum_t \frac{\ln(u_t^s/\hat{N}_t^s)^2}{2\sigma_{s,t}^2} \quad (14.45)$$

where u_t^s is the total (numerical abundance or optionally biomass) estimate with variance $\sigma_{s,t}$ from survey s in year t or optionally, the normal distribution can be selected:

$$nll(i) = \sum_t \frac{(u_t^s - \hat{N}_t^s)^2}{2\sigma_{s,t}^2}. \quad (14.46)$$

(14.47)

The AT survey and AVO index is modeled using a lognormal distribution whereas for the BTS survey, a normal distribution was applied.

For model configurations in which the BTS data are corrected for estimated efficiency, a multivariate lognormal distribution was used. For the negative- log likelihood component this was modeled as

$$nll_i = 0.5\mathbf{X}\Sigma^{-1}\mathbf{X}' \quad (14.48)$$

where \mathbf{X} is a vector of observed minus model predicted values for this index and Σ is the estimated covariance matrix provided from the method provided in Kotwicki et al. (2014). For the VAST estimates, the supplied covariance matrix was used in the same way.

The contribution to the negative log-likelihood function for the observed total catch biomass (C_b^{obs}, \hat{C}_b) by the fishery is given by

$$nll_i = 0.5 \sum_t \frac{\ln(C_b^{obs}/\hat{C}_b)^2}{2\sigma_{C_b,t}^2} \quad (14.49)$$

where $\sigma_{C_b,t}$ is pre-specified (set to 0.05) reflecting the accuracy of the overall observed catch in biomass. Similarly, the contribution of prior distributions (in negative log-density) to the log-likelihood function include $\lambda_\varepsilon \sum_t \varepsilon_t^2 + \lambda_\gamma \sum_{ta} \gamma^2 + \lambda_\delta \sum_t \delta_t^2$ where the size of the 's represent prior assumptions about the variances of these random variables. Most of these parameters are associated with year-to- year and age specific deviations in selectivity coefficients. For a presentation of this type of Bayesian approach to modeling errors-in-variables, the reader is referred to Schnute (1994). To facilitate estimating such a large number of parameters, automatic differentiation software extended from Griewank and Corliss (1991) and developed into C++ class libraries was used. This software provided the derivative calculations needed for finding the posterior mode via a quasi-Newton function minimization routine (e.g., Press et al. (1992)). The model implementation language (ADModel Builder) gave simple and rapid access to these routines and provided the ability estimate the variance-covariance matrix for all dependent and independent parameters of interest.

14.5 Uncertainty in mean body mass

The approach we use to solve for F_{MSY} and related quantities (e.g., $B_{MSY} MSY$) within a general integrated model context was shown in Ianelli and Williamson (2001). In 2007 this was modified to include uncertainty in weight-at-age as an explicit part of the uncertainty for F_{MSY} calculations. This involved estimating a vector of parameters (w_{ta}^{future}) on current (2024) and future mean weights for each age i , $i = (1, 2, \dots, 15)$, given actual observed mean and variances in weight-at-age over the period 1991-2023. The values of based on available data and (if this option is selected) estimates the parameters subject to the natural constraint:

$$w_{ta}^{future} \sim \mathcal{N}(\bar{w}_a, \sigma_{w_a}^2)$$

Note that this converges to the mean values over the time series of data (no other likelihood component within the model is affected by future mean weights-at-age) while retaining the natural uncertainty that can propagate through estimates of F_{MSY} uncertainty. This latter point is essentially a requirement of the Tier 1 categorization.

Subsequently, this method was refined to account for current-year survey data and both cohort and year effects. The model for this is:

$$\hat{w}_{ta} = \bar{w}_a e^{v_t} \quad a = 1, t \geq 1964 \quad (14.50)$$

$$\hat{w}_{ta} = \hat{w}_{t-1,a-1} + \Delta_a e^{\psi_t} \quad a > 1, t > 1964 \quad (14.51)$$

$$\Delta_a = \bar{w}_{a+1} - \bar{w}_a \quad a < A \quad (14.52)$$

$$\bar{w}_a = \alpha \left\{ L_1 + (L_2 - L_1) \left(\frac{1 - K^{a-1}}{1 - K^{A-1}} \right) \right\}^3 \quad (14.53)$$

$$(14.54)$$

where the fixed effects parameters are L_1 , L_2 , K , and α while the random effects parameters are v_t and ψ_t .

14.6 Tier 1 projections

Tier 1 projections were calculated two ways. First, for 2025 and 2026 ABC and *OFL* levels, the harmonic mean F_{MSY} value was computed and the analogous harvest rate (u_{HM}^-) applied

to the estimated geometric mean fishable biomass at B_{MSY} :

$$ABC_t = B_{GM,t}^f \hat{u}_{HM} \zeta_t \quad (14.55)$$

$$B_{GM,t}^f = e^{\ln \hat{B}_t^f - 0.5\sigma_{B^f}^2} \quad (14.56)$$

$$u_{HM,t}^f = e^{\ln \hat{u}_{MSY,t} - 0.5\sigma_{u_{MSY}}^2} \quad (14.57)$$

$$\zeta_t = \frac{B_t / B_{MSY} - 0.05}{1 - 0.05} \quad B_t < B_{MSY} \quad (14.58)$$

$$\zeta_t = 1.0 \quad B_t \geq B_{MSY} \quad (14.59)$$

where \hat{B}_t^f is the point estimate of the fishable biomass defined (for a given year): $\sum_a N_a s_{ta} w_{ta}$ with N_{ta} , s_{ta} , and w_{ta} the estimated population numbers (begin year), selectivity and weights-at-age, respectively. B_{MSY} and B_t are the point estimates spawning biomass levels at equilibrium F_{MSY} and in year t (at time of spawning). For these projections, catch must be specified (or solved for if in the current year when $B_t < B_{MSY}$). For longer term projections a form of operating model (as has been presented for the evaluation of $B_{20\%}$) with feedback (via future catch specifications) using the control rule and assessment model would be required.

15 Appendix 1. Risk Table information for Environmental/Ecosystem considerations

Provided by: Elizabeth Siddon, NOAA/AFSC

15.1 Environmental processes

The eastern Bering Sea (EBS) experienced a prolonged period of above-average thermal conditions from 2014 through 2021. Since 2021, and continuing from August 2023–August 2024, thermal conditions in the EBS have been close to historical baselines of many metrics. There have been no sustained marine heatwaves over the southeastern or northern Bering Sea shelves since January 2021 (Callahan and Lemagie, 2024), and observed (Rohan and Barnett, 2024) and modeled (Kearney, 2024) bottom temperatures were mostly near-normal over the past year. Sea surface temperatures (SSTs) and bottom temperatures were near the long-term means in all regions by summer 2024. Notable deviations include (i) warm SSTs in the outer domain from fall 2023 through spring 2024 and (ii) unusually warm bottom temperatures in the northern outer domain since spring 2024 that may indicate an intrusion of shelf water (Callahan et al., 2024).

Age-0 fish experiencing warm temperatures during late summer followed by relatively cooler temperatures in spring of age-1 are thought to have below average survival. Based on this Temperature Change index, the 2023 year class of pollock experienced average late summer temperatures in 2023 during the age-0 stage and cooler spring temperatures in 2024 during the age-1 stage indicating average conditions for the overwintering survival from age-0 to age-1 (Yasumiishi, 2024).

Atmospheric conditions are one of the primary drivers that impact the oceanographic setting in the EBS. Both the North Pacific Index (NPI) and Aleutian Low Index (ALI) provide complementary views of the atmospheric pressure system in the North Pacific. During winter 2023-2024, the NPI was average (Siddon, 2024) and the strength and location of the Aleutian Low Pressure System were both near climatological averages (Overland and Wang, 2024). Thus, despite delayed formation of sea ice in fall 2023 (Thoman, 2024), cold winds from the Arctic helped advance sea ice to near-normal extent by mid-winter. Near-normal sea ice extent and thickness (Thoman, 2024b, 2024c) may have contributed to a cold pool (<2°C water) of average spatial extent (Siddon, 2024), though the footprint of the coldest waters (<0°C) in 2024 was 75% smaller than in 2023 (Rohan and Barnett, 2024b).

December 2023 had significant along-shelf winds (to the southeast) that could have driven offshore Ekman transport. Weaker, but more sustained winds that also favored offshore transport occurred from March to May 2024 (Hennon, 2024). Beginning in May and continuing through summer 2024, persistent storms resulted in a deeper mixed layer, which entrained deeper, cooler water, such that SSTs remained cooler through at least August 2024 (Stabeno, 2024). During the fall BASIS survey, age-0 pollock were found shallower in the water column, more comparable to a warm year (Spear and Andrews, 2024).

For projections into 2025, the National Multi-Model Ensemble (NMME) predicts that SSTs over the EBS are expected to be near normal (anomalies within $<0.5^{\circ}\text{C}$ of the 1982–2010 baseline) (Lemagie, 2024). With the expected transition to La Niña, cooler conditions in the EBS may follow. Relatively cool SSTs may contribute to earlier formation of sea ice than has been observed over the last several years (Thoman, 2024b).

15.2 Prey

Metrics of ocean acidification include Ωarag and pH. Ωarag is important for shell formation in pollock prey items like pteropods. Summer 2024 bottom water Ωarag conditions were similar to 2023; bottom waters remain near threshold levels of biological significance with the most corrosive bottom waters found in slope waters and over the northwest shelf (Pilcher et al., 2024).

Small copepods form the prey base for larval to early juvenile pollock during spring. Late juvenile pollock feed on a variety of planktonic crustaceans, including large calanoid copepods and euphausiids. The Rapid Zooplankton Assessment in the southeastern Bering Sea (SEBS) in spring noted moderate abundance of small copepods, but low abundance of large copepods along the middle shelf (higher in the outer shelf) and near-zero abundance of euphausiids in the RZA, which is typical for the spring. In summer, small copepods remained abundant throughout the region. Large copepods remained in low abundance while euphausiids increased, especially towards the northern portion of the SEBS. Euphausiid density during the summer acoustic survey declined in 2024 to the second-lowest value in the time series (Levine and Ressler, 2024). In fall, both small and large copepods as well as euphausiids were in low abundance, but increased towards the north. In the northern Bering Sea (NBS) in fall, small copepods had moderate and consistent abundances throughout the sampling grid, large copepods were patchy with the highest values north and south of St. Lawrence Island, and euphausiids were very low (Kimmel et al., 2024).

Based on Food Habits Lab stomach content analysis, pollock consumption of copepods increased from 2023 to 2024, replacing euphausiids as the greatest percent by weight in the diets (K. Aydin, pers comm). This may be explained by the spatial distribution of the pollock stock in 2024, which was concentrated over the northwest outer domain (L. Barnett, pers comm), where large ‘oceanic’ copepods occur (euphausiids mainly occur over the middle

domain). Additionally, rates of cannibalism have been low between 2021-2024; the lowest year for cannibalism on record was 2018 (K. Aydin, pers comm).

The estimated abundance of larval pollock sampled in spring increased from near the end of the last cold stanza (2012) through the warm stanza (2014, 2016, 2018) to a time-series maximum in 2024 (Rogers et al., 2024). The condition of those larval pollock was highest over the southeastern shelf and lowest to the northwest of the Pribilof Islands (Porter et al., 2024). By late summer, age-0 pollock CPUE estimates in the middle domain of the SEBS and NBS regions were lower than estimates from the recent warm period (2014–2021) but slightly higher than estimates from the cold period (2007–2013) (Andrews et al., 2024). In the inner domain, pollock were the most numerous non-salmonid species collected in the ADF&G nearshore survey (Garcia et al., 2024). In the NBS, CPUE estimates have remained low compared to the SEBS (Andrews et al., 2024). Since 2022, with cooler SSTs, pollock weights and energy density have been low while % lipid has been average (Page et al., 2024).

In the SEBS, juvenile (100-250 mm) fish condition has shown a declining trend since 2021 while adult (>250 mm) fish condition increased from 2023 to 2024, but remains below the long-term mean. In the NBS (data through 2023), juvenile fish condition has also declined since 2021, but adult fish condition increased since 2021 and was above average in 2023 (Prohaska et al., 2024). The availability of surface silicate, a proxy for phytoplankton growth, serves as an indicator of age-0 pollock condition. Low silicate availability and significant declines in pollock weight observed in 2022 may signal poorer recruitment to age-1 for the 2022 year class (Gann and Eisner, 2024).

15.3 Competitors

Jellyfish feed primarily on zooplankton and small fish, and therefore may compete for prey resources for both juvenile and adult life stages of pollock. The biomass of jellyfish over the southeastern shelf in 2024 remained low (Yasumiishi et al., 2024) to average (Buser and Rohan, 2024) while biomass remained high in the NBS (Yasumiishi et al., 2024). The 2024 forecast for Togiak herring was the fifth highest on record, but was 32% lower than the 2023 forecast (Dressel et al., 2024).

Western Alaska chum salmon showed trends of increasing adult returns, juvenile abundance, and above-average to average juvenile condition in recent years, which indicates potential signs of recovery for these populations. In contrast, western Alaska Chinook salmon do not appear to show signs of recovery in response to the recent cooler conditions observed since 2021. The abundance of Bristol Bay sockeye salmon peaked in 2021-2022, but cooler conditions since then have resulted in run sizes closer to the long-term average in 2023-2024 (DeFilippo, 2024). The condition (based on energy density anomalies) of juvenile pink, chum, coho, and Chinook salmon in the SEBS indicated lower energy stores and reduced capacity for overwinter survival. Juvenile salmon in the NBS had average to positive energy stores, which may contribute to higher overwinter survival (Fergusson et al., 2024).

The biomass of pelagic foragers measured during the standard bottom trawl survey (Jun-Aug; 1982–2024) increased 71% from 2023 to 2024 to just above their long-term mean. The trend is largely driven by pollock, which increased 78% from 2023. Pacific herring decreased 5% from 2023, but remain above their long-term mean (Siddon, 2024). The impacts of recent large year classes of sablefish to the EBS ecosystem (as prey, predators, and competitors) remain largely unknown at this time, but may compete with pollock for prey resources as juveniles.

15.4 Predators

Pollock are cannibalistic and rates of cannibalism might be expected to increase as the biomass of older, larger fish increases (i.e., the aging of the large 2018 year class). However, rates of cannibalism have been low between 2021-2024 (K. Aydin, pers comm). In 2024, with an average cold pool extent over the shelf, predation pressure from cannibalism may have been mitigated by this thermal barrier as adult pollock tend to avoid the cold bottom waters.

Other potential predators of juvenile pollock include arrowtooth flounder, jellyfish and chum salmon. In the SEBS, the biomass of apex predators, which includes arrowtooth flounder, in 2024 remained just below the long term mean of that guild. Within that guild, however, arrowtooth flounder increased 26% from 2023 to 2024 (Siddon, 2024). Arrowtooth were distributed over the southern outer domain while pollock were distributed over the northern outer domain. As stated above, jellyfish biomass in the SEBS in 2024 remained low (Yasumiishi et al., 2024) to average (Buser and Rohan, 2024) while biomass was high in the NBS (Yasumiishi et al., 2024). Western Alaska chum salmon showed trends of increasing adult returns (DeFilippo, 2024).

15.5 Summary for Environmental/Ecosystem considerations:

- **Environment:** The EBS shelf experienced oceanographic conditions that were largely average based on historical time series of multiple metrics over the past year (August 2023 - August 2024).
- **Prey:** Trends of prey for pollock were mostly low in 2024, with prey conditions over the SEBS shelf being potentially more limiting while prey conditions over the NBS shelf appear limiting for age-0 and juvenile pollock, but sufficient for adult fish. The spatial distribution of adult pollock appears to have overlapped with large ‘oceanic’ copepods, while rates of cannibalism indicate reduced overlap with juvenile pollock.
- **Competitors:** Trends in potential competitors were mixed over the shelf, with pollock representing the greatest increase in biomass and potential competitive pressure.

- **Predators:** Trends in potential predators increased over the shelf, though spatial mismatch may mitigate realized predation pressure. Rates of cannibalism remained low in 2024.

Together, the most recent data available suggest an ecosystem risk Level 1 – Normal: “*No apparent ecosystem concerns related to biological status (e.g., environment, prey, competition, predation), or minor concerns with uncertain impacts on the stock.*”

15.6 Additional references

- Andrews, A., E. Yasumiishi, A. Spear, J. Murphy, and A. Dimond. 2024. Catch Estimates of Age-0 Walleye Pollock from Surface Trawl Surveys, 2003–2024. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Buser, T., and S. Rohan. 2024. Eastern Bering Sea – Jellyfishes. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Callahan, M., and E. Lemagie. 2024. Bering Sea SST anomalies. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Callahan, M., K. Kearney, and E. Lemagie. 2024. Bering Sea SST and Bottom Temperature Trends. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- DeFilippo, L. 2024. 2024 Salmon Summary and Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Dressel, S., S. Miller, C. Brown, and J. Erickson. 2024. Togiak Herring Population Trends. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Fergusson, E., R. Suryan, T. Miller, J. Murphy, and A. Andrews. 2024. Juvenile Salmon Condition Trends in the Eastern Bering Sea. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

- Gann, J., and L. Eisner. 2024. Implications for Pollock Recruitment to Age-1 Based on Late Summer Surface Silicic Acid and Age-0 Pollock Weights. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Garcia, S., K. Howard, and B. Gray. 2024. Alaska Department of Fish & Game Nearshore Survey. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Hennon, T. 2024. Winds at the Shelf Break. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Kearney, K. 2024. Cold Pool Extent - ROMS. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Kimmel, D., K. Axler, D. Crouser, H.W. Fennie, A. Godersky, J. Lamb, J. Murphy, S. Porter, and B. Snyder. 2024. Current and Historical Trends for Zooplankton in the Bering Sea. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Lemagie, E. 2024. Seasonal Projections from the National Multi-Model Ensemble (NMME). In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Levine, M., and P. Ressler. 2024. Eastern Bering Sea Euphausiids ('Krill'). In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Overland, J. and M. Wang. 2024. Wintertime Aleutian Low Index. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.
- Page, J., J. Maselko, R. Suryan, T. Miller, E. Siddon, E. Ferguson, C. Mattson, A. Masterman, and B. Cormack. 2024. Fall Condition of Young-Of-The-Year Walleye Pollock in the Southeastern and Northern Bering Sea, 2002–2024. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Pilcher, D., J. Cross, N. Monacci, E. Kennedy, E. Siddon, and W.C. Long. 2024. Ocean Acidification. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Porter, S., K. Axler, W. Fennie, D. Kimmel, L. Nave-Powers, N. Roberson, L. Rogers, and B. Snyder. 2024. Morphometric Condition of Walleye Pollock Larvae. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Prohaska, B., R. Howard, and S. Rohan. 2024. Eastern and Northern Bering Sea Groundfish Condition. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Rogers, L., K. Axler, W. Fennie, L. Nave-Powers, B. Snyder, and N. Roberson. 2024. Abundance and Distribution of Larval Fishes in the Southeastern Bering Sea 2012–2024. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Rohan, S., and L. Barnett. 2024. Summer Temperatures. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Rohan, S., and L. Barnett. 2024b. Cold Pool Extent - AFSC Bottom Trawl Survey. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Siddon, E. 2024. Southeastern Bering Sea Report Card. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Spear, A., and A. Andrews. 2024. Vertical Distribution of Age-0 Pollock in the Southeastern Bering Sea. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Stabeno, P. 2024. Mixed Layer Depth at Mooring M2. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Thoman, R.. 2024. Early Season Ice Extent. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Thoman, R. 2024b. Bering Sea Daily Ice Extent. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Thoman, R. 2024c. Sea Ice Thickness. In: Physical Environment Synthesis. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Yasumiishi, E. 2024. Pre- and Post-Winter Temperature Change Index and the Recruitment of Bering Sea Pollock. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

Yasumiishi, E., A. Andrews, J. Murphy, and A. Dimond. 2024. Jellyfish from Surface Trawl Surveys, 2004–2024. In: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

16 Appendix on model-based methods on bottom-trawl survey biomass trends

16.1 Overview

These applications of VAST were configured to model NMFS/AFSC bottom trawl survey (BTS) data and for acoustic backscatter data (next section). For the BTS, the station-specific CPUEs (kg per hectare) for pollock were compiled from 1982–2023. Further details can be found at the [GitHub repo](#) mainpage, wiki, and glossary. The R help files, e.g., `?make_data` for explanation of data inputs, or `?make_settings` for explanation of settings.

The software versions of dependent programs used to generate VAST estimates were:

- R (4.3.0)
- MKL libraries via Microsoft R Open (4.0.2)
- INLA (21.11.22)
- Matrix (1.4-0)
- TMB (1.9.6)
- TMBhelper (1.4.0)
- VAST (3.10.1)
- FishStatsUtils (2.12.1)

For these model-based index time series, we used the same VAST model run settings.

16.2 Spatio-temporal treatment of survey data on pollock density

For EBS pollock we used data on biomass per unit area from all grid cells and corner stations in the 83–112 bottom trawl survey of the EBS, 1982–2023, including exploratory northern extension samples in 2001, 2005, and 2006, as well as 83–112 samples available in the NBS in 1982, 1985, 1988, 1991, 2010, and 2017–2023 (except 2020). NBS samples collected prior to 2010 and in 2018 did not follow the 20 nautical mile sampling grid used in 2010, 2017, 2019, 2021, and 2023–2019, 2021–2023 surveys. Assimilating these data therefore required extrapolating into unsampled areas. As before, we included a spatially varying covariate of the cold-pool extent (Thorson 2019, (O’Leary et al. 2020)). All environmental data used as covariates were computed within the R package `coldpool` (Rohan et al., 2022).

We used a Poisson-link delta-model (Thorson 2018) involving two linear predictors and a gamma distribution to model positive catch rates. We extrapolated population density to the entire EBS and NBS in each year, using extrapolation grids that are available within [FishStatsUtils] (<https://github.com/James-Thorson-NOAA/FishStatsUtils>). These extrapolation grids were defined using 3705 m (2 nmi) \times 3705 m (2 nmi) cells; this results in 36,690 extrapolation-grid cells for the eastern Bering Sea and 15,079 in the northern Bering Sea. We used bilinear interpolation to interpolate densities from 750 “knots” to these extrapolation grid cells; knots were approximately evenly distributed over space, in proportion to the dimensions of the extrapolation grid. We estimated geometric anisotropy (how spatial autocorrelation declines with differing rates over distance in some cardinal directions than others), and included a spatial and spatio-temporal term for both linear predictors. To facilitate interpolation of density between unsampled years, we specified that the spatio-temporal fields were structured over time as an AR(1) process (where the magnitude of autocorrelation was estimated as a fixed effect for each linear predictor). However, we did not include any temporal correlation for intercepts, which we treated as fixed effects for each linear predictor and year. Finally, we used epsilon bias-correction to correct for retransformation bias (Thorson and Kristensen 2016).

We checked model fits for evidence of non-convergence by confirming that (1) the derivative of the marginal likelihood with respect to each fixed effect was sufficiently small (less than ~ 0.001) and (2) that the Hessian matrix was positive definite. We then checked for evidence of model fit by computing Dunn-Smyth randomized quantile residuals (Dunn and Smyth 1996) and visualizing these using a quantile-quantile plot within the DHARMA R package. We also evaluated the distribution of these residuals over space in each year, and inspected them for evidence of residual spatio-temporal patterns.

16.3 Spatio-temporal treatment of survey age composition data

For model-based estimation of age compositions in the Bering Sea, we fitted observations of numerical abundance-at-age at each sampling location. This was made possible by applying a year-specific, region-specific (EBS and NBS) age-length key to records of numerical abundance and length-composition. We computed these estimates in VAST, assuming a Poisson-link delta-model (Thorson 2018) involving two linear predictors, and a gamma distribution to model positive catch rates. We did not include any density covariates in estimation of age composition for consistency with models used in the previous assessment, and due to computational limitations. We used the same extrapolation grid as implemented for abundance indices, but here we modeled spatial and spatiotemporal fields with a mesh with coarser spatial resolution than the index model, here using 50 “knots”. This reduction in the spatial resolution of the model, relative to that used abundance indices, was necessary due to the increased computational load of fitting multiple age categories and using epsilon bias-correction. We implemented the same diagnostics to check convergence and model fit as those used for abundance indices.

16.3.1 Densities and biomass estimates

Relative densities over time suggests that the biomass of pollock can reflect abundances in the NBS even in years where samples are unavailable (all years except 2010, 2017–2019 and 2021–2023; (Figure 72). Index values and error terms (based on diagonal of covariance matrix over time) are shown in Figure 73.

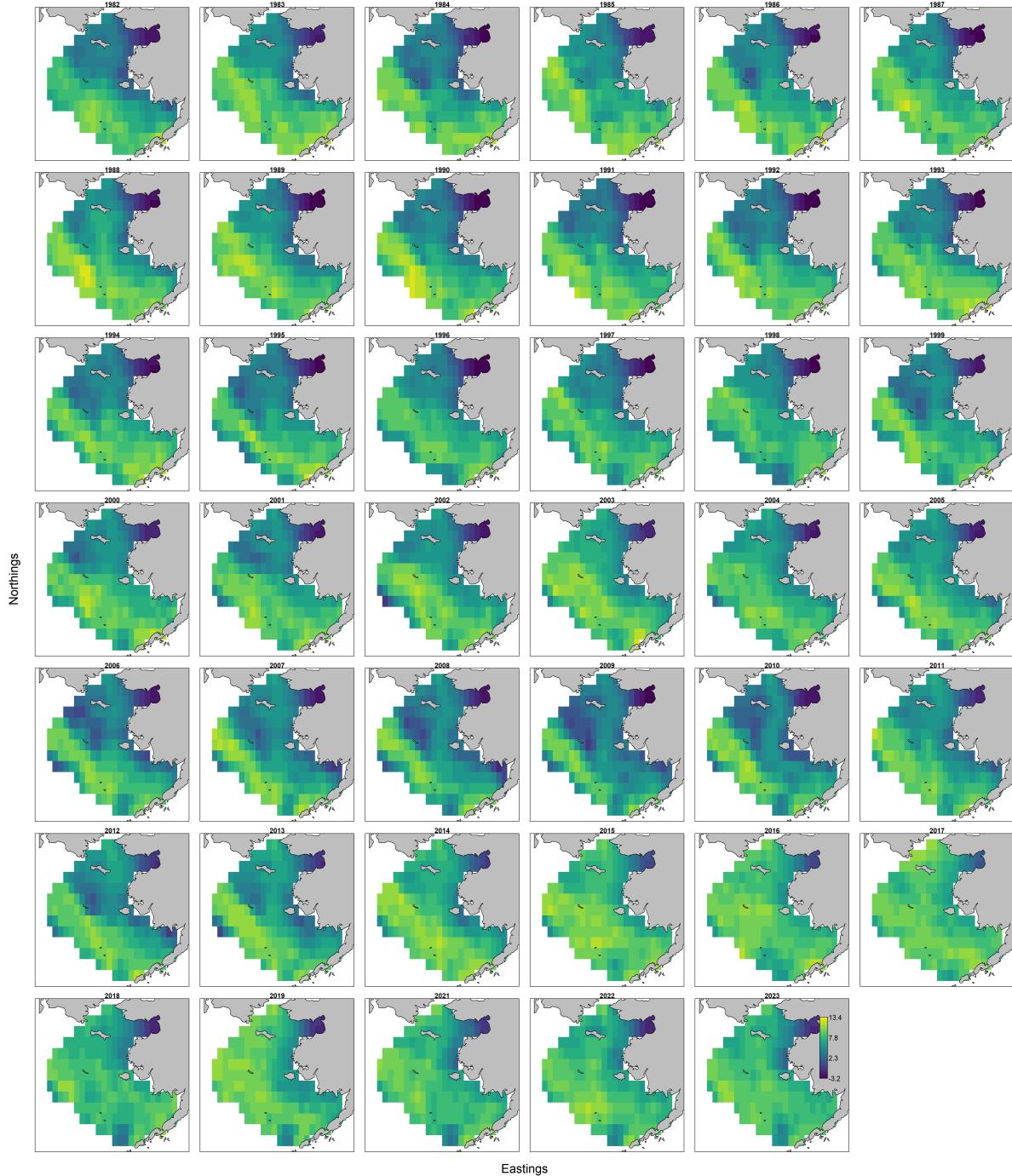


Figure 72: Pollock log density maps of the BTS data using the VAST model approach, 1982-2019, 2021-2023.

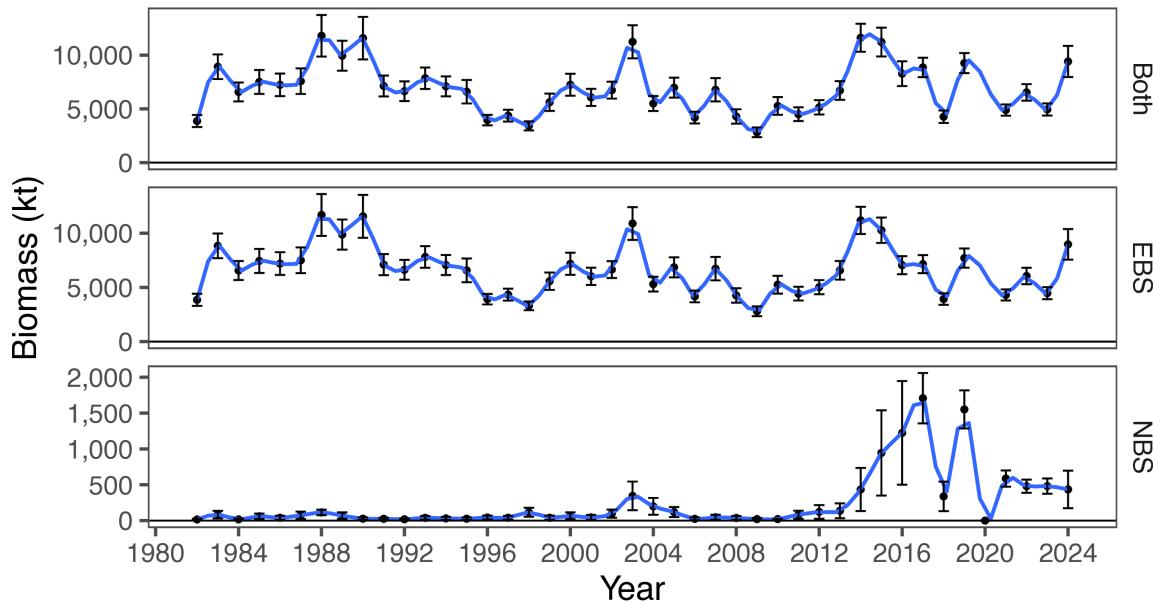


Figure 73: Pollock index values for the standard survey region, the NBS, and combined based on the VAST application to density-dependent corrected CPUE values from the BTS data, 1982–2019, 2021–2024.

16.4 Additional references

- Dunn, K.P., and Smyth, G.K. 1996. Randomized quantile residuals. *Journal of Computational and Graphical Statistics* 5, 1-10.
- Hartig, F. 2021. DHARMA: Residual Diagnostics for Hierarchical (Multi-Level / Mixed) Regression Models. R package version 0.4.0. <http://florianhartig.github.io/DHARMA/>
- O’Leary, C.A., Thorson, J.T., Ianelli, J.N. and Kotwicki, S., 2020. Adapting to climate-driven distribution shifts using model-based indices and age composition from multiple surveys in the walleye pollock (*Gadus chalcogrammus*) stock assessment. *Fisheries Oceanography*, 29(6), pp.541-557.
- Rohan, S.K., Barnett L.A.K., and Charriere, N. 2022. Evaluating approaches to estimating mean temperatures and cold pool area from AFSC bottom trawl surveys of the eastern Bering Sea. U.S. Dep. Commer., NOAA Tech. Mem. NMFS-AFSC-456, 42 p. <https://doi.org/10.25923/1wwh-q418>
- Thorson, J.T., 2019. Measuring the impact of oceanographic indices on species distribution shifts: The spatially varying effect of cold-pool extent in the eastern Bering Sea. *Limnology and Oceanography*, 64(6), pp.2632-2645.

Thorson, J.T., and Kristensen, K., 2016. Implementing a generic method for bias correction in statistical models using random effects, with spatial and population dynamics examples. *Fisheries Research*, 175, pp.66-74.

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