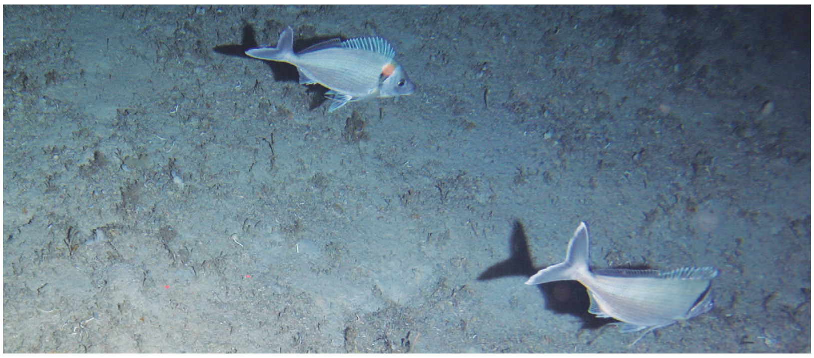
Cite as:

Burch, P., Day, J. and Castillo-Jordán, C. (2018) Silver Warehou (*Seriolella punctata*) stock assessment based on data up to 2017 – development of a preliminary base case. pp 353 - 392 *in* Tuck, G.N. (ed.) 2020. *Stock Assessment for the Southern and Eastern Scalefish and Shark Fishery 2018 and 2019*. Part 1, 2018. Australian Fisheries Management Authority and CSIRO Oceans and Atmosphere, Hobart. 526p.

Australian Government
Australian Fisheries Management Authority

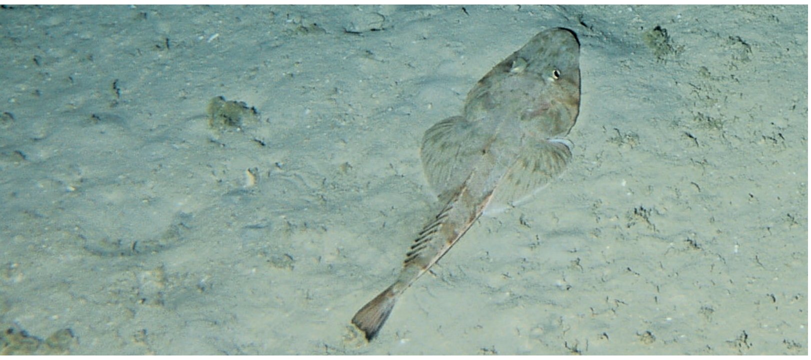
2017/0824 June 2020

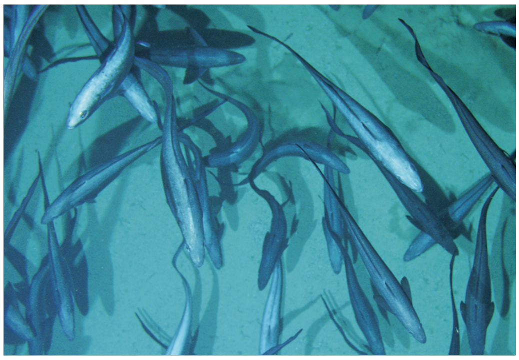
Stock Assessment for the Southern and Eastern Scalefish and Shark Fishery: 2018 and 2019

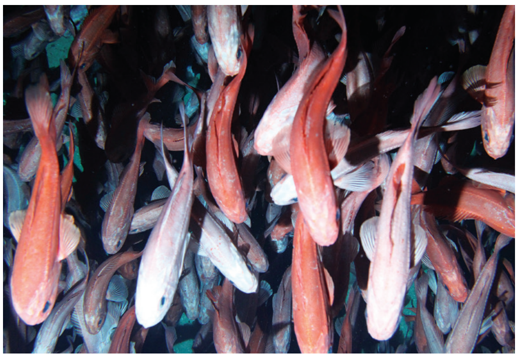


PART 1

2018







Principal investigator **G.N. Tuck**

CSIRO

www.afma.gov.au

Protecting our fishing future

Box 7051, Canberra Business Centre, ACT 2610 Tel **(02) 6225 5555** Fax (02) 6225 5500 **AFMA Direct 1300 723 621**

Stock Assessment for the southern and eastern scalefish and shark fishery 2018 and 2019. Report ref# 2017/0824. By PI: Tuck, G.N. June 2020 - ONLINE

ISBN 978-1-925994-07-0

Preferred way to cite this report

Tuck, G.N. (ed.) 2020. Stock Assessment for the Southern and Eastern Scalefish and Shark Fishery 2018 and 2019. Part 1, 2018. Australian Fisheries Management Authority and CSIRO Oceans and Atmosphere, Hobart. 526p.

Acknowledgements

All authors wish to thank the science, management and industry members of the south east, GAB and shark resource assessment groups for their contributions to the work presented in this report. Authors also acknowledge support from Fish Ageing Services (for fish ageing data) and AFMA (for the on-board and port length-frequencies, and in particular John Garvey, for the log book data). Toni Cracknell is greatly thanked for her assistance with the production of this report.

Cover photographs

Front cover, jackass morwong, orange roughy, blue grenadier, and flathead.

Report structure

Part 1 of this report describes the Tier 1 assessments of 2018. Part 2 describes the Tier 3 and Tier 4 assessments, catch rate standardisations and other work contributing to the assessment and management of SESSF stocks in 2018.

Stock Assessment for the Southern and Eastern Scalefish and Shark Fishery 2018 and 2019

Part 1: 2018

G.N. Tuck
June 2020
Report 2017/0824

Australian Fisheries Management Authority

Stock Assessment for the Southern and Eastern Scalefish and Shark Fishery: 2018

TABLE OF CONTENTS

11. Silver warehou (*Seriolella punctate*) stock assessment based on data up to 2017 – development of a preliminary base case

Paul Burch, Jemery Day and Claudio Castillo-Jordán

CSIRO Oceans and Atmosphere, Castray Esplanade, Hobart 7000, Australia

11.1 Executive Summary

This document presents the preliminary base case for an updated quantitative Tier 1 assessment of silver warehou (*Seriolella punctata*) for presentation at the first SERAG meeting in 2018. The last full assessment was presented in Day et al. (2015). The preliminary base case has been updated by the inclusion of data up to the end of 2017, which entails an additional three years of catch, discard, CPUE, length-composition and conditional age-at-length data and ageing error updates and the inclusion of the 2016 east and west Fishery Independent Survey (FIS) indices. This document describes the process used to develop a preliminary base case for silver warehou through the sequential updating of recent data to the stock assessment, using the stock assessment package Stock Synthesis (SS-V3.30.12).

Changes to the last stock assessment include: the use of a re-estimated discards, the inclusion of age-at-length data for the western onboard trawl fleet and the use of an updated tuning method.

Results show good fits to the CPUE abundance index for the west trawl fleet. The fits to the CPUE of the eastern trawl fleet prior to 2001 are poor, however, from 2001 onwards they appear reasonable. The model fits are good to both the east and west FIS abundance indices, however, the width of the confidence intervals suggest this data provides little information to the model. The overall fits to the length and age-at-length data are reasonable with poor fits in some years.

This assessment estimates that the projected 2019 spawning stock biomass will be 33% of virgin stock biomass (projected assuming 2017 catches in 2018), however, it was predicted to be below 20% between 2013 and 2017. The previous assessment (Day et al., 2015) estimated depletion to be 40% at the start of 2016 and depletion had not dropped below 20% over the assessment period.

11.2 Introduction

11.2.1 *Bridging from 2015 to 2018 assessments*

The previous full quantitative assessment for silver warehou was performed in 2015 (Day et al., 2015) using Stock Synthesis (version SS-V3.24U; Methot 2015). The 2018 assessment uses the current version of Stock Synthesis (version SS-V3.30.12, Methot et al. 2018) which has had a number of changes from SS 3.24U. The main change to the assessment procedure and Stock Synthesis that relates to assessments in the SESSF is a revised tuning procedure. While the tuning procedure still uses Francis weighting for length and age data, the CPUE series are tuned within Stock Synthesis. There have also been improvements to the recruitment bias ramp adjustment.

As a first step in the process of bridging to a new model, the model was converted from version SS-V3.24U (Methot 2015) to version SS-V3.30.12 (Methot et. al, 2018) using the same data and model structure used in the 2015 assessment. Once this translation was complete, improved features unavailable in SS-V3.24U were incorporated into the SS-V3.30.12 assessment, these included allowing smaller lower bounds on minimum sample sizes and estimating additional standard deviation to abundance indices. Following this step the model was re-tuned using the most recent tuning protocols. These changes to software and tuning practices are likely to lead to changes to key model outputs, such as the spawning biomass trajectory and depletion estimates. This initial bridging phase (Bridge 1) highlights changes that have occurred since 2015 simply through changes to software and assessment practices. The subsequent bridging exercise (Bridge 2) then sequentially updates the model with new data through to 2017.

The second part of the bridging analysis includes updating of some historical data (up to 2014), followed by including the data from 2015-2017 into the model. These additional data included new catch, discard, CPUE, length-composition, age-at-length data, an updated ageing error matrix and additional CPUE indices for the trawl fisheries. Additionally, age-at-length data for the western trawl fleet was included, which was omitted in the 2015 assessment, the reason for omission of the western trawl age-at-length is currently being investigated. The last year of recruitment estimation was extended to 2015 (from 2012 in the 2015 assessment).

The use of updated software and tuning procedure along with the inclusion of additional data resulted in some differences in the fits to CPUE, age and length data. The usual process of bridging to a new model by adding new data piecewise and analysing which components of the data could be attributed to changes in the assessment outcome was conducted with the details outlined below.

11.2.2 *Update to Stock Synthesis SS-V3.30.12 (Bridge 1)*

The 2015 silver warehou assessment (spot2015_24U) was initially translated to the most recent version of the software, Stock Synthesis version SS-V3.30.12 (spot2015_30_12) and there were negligible differences between the two models (Figure 11.1 to Figure 11.3). Re-tuning using the latest tuning protocol (Section 11.2.2.1) led to some minor changes in estimated recruitments (Figure 11.3) along with an increase in virgin spawning biomass and the estimated spawning biomass from 1980 to the late 1990s (Figure 11.2). After the late 1990s this trend reverses and the estimated spawning biomass of the re-tuned model is lower than the base case from the 2015 assessment.

This process demonstrates the consistency between Stock Synthesis version SS-V3.24U and the latest version used for the 2018 preliminary base case assessment. This initial bridging step, Bridge 1, does not incorporate any new data after 2014 or any structural changes to the assessment.

The results of Bridge 1 suggest that the stock may have been more depleted in 2016 than the 2015 assessment indicated. This is almost entirely due to changes in parameters that are being tuned, including variances that can be estimated internally and in the tuning procedure itself, rather than changes to the data or to the software.

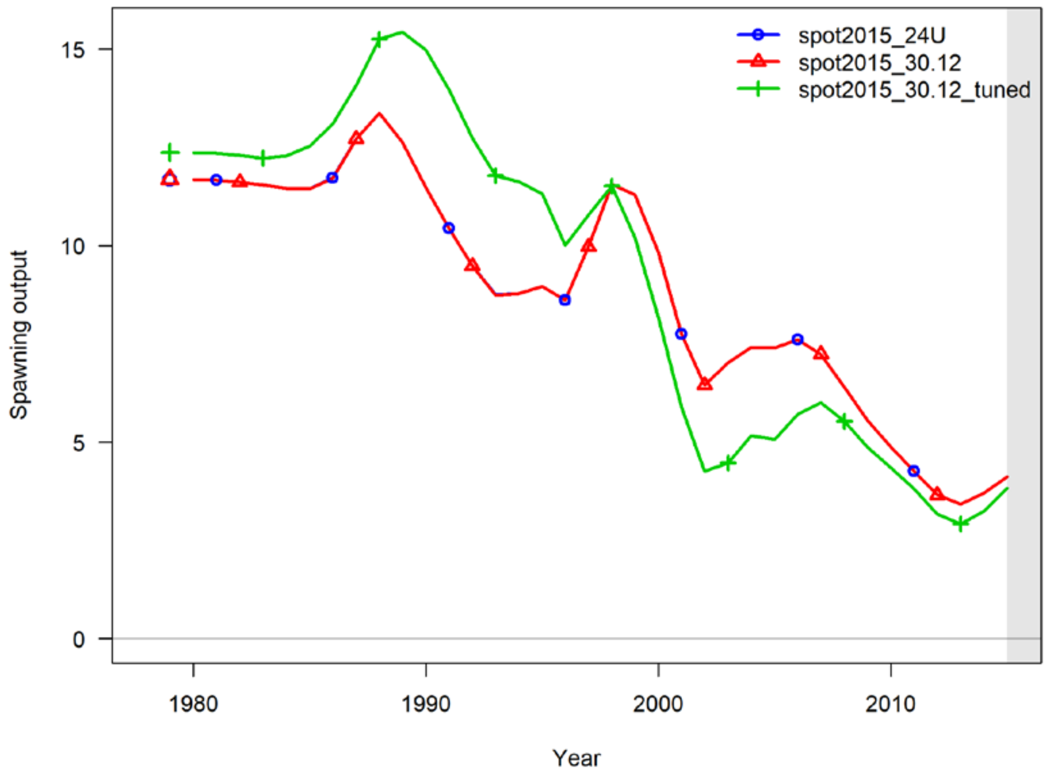


Figure 11.1. Comparison of the absolute spawning biomass time series for the 2015 assessment (spot2015_24U – in blue), and a model converted to SS-V3.30.12 (spot2015_30.12 in blue) and this same model tuned using the latest tuning procedures (spot2015_30.12_tuned – in green).

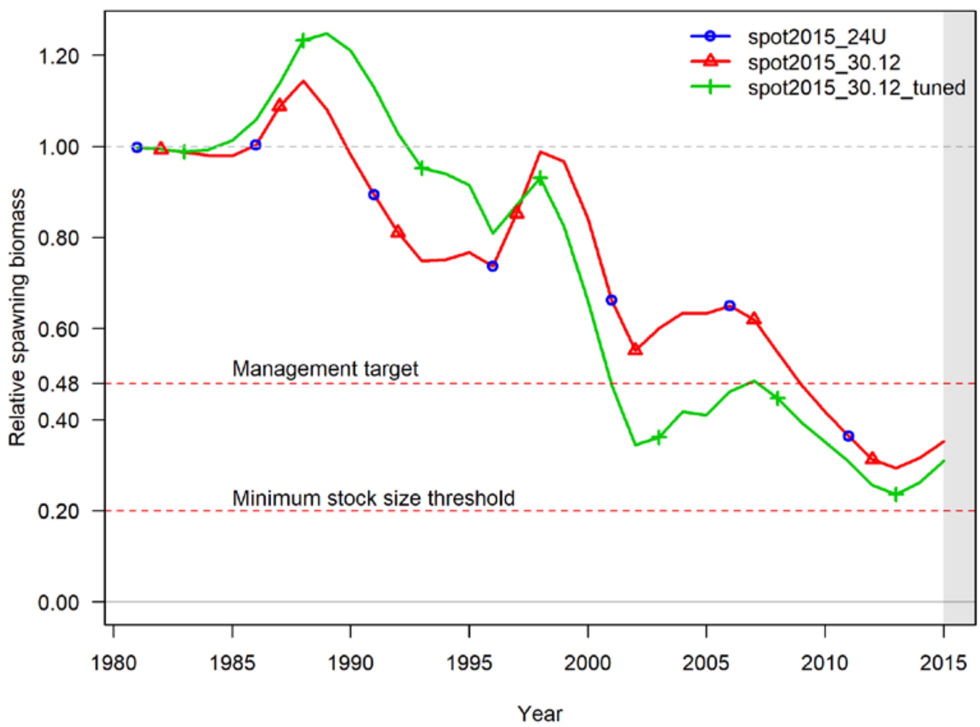


Figure 11.2. Comparison of the relative spawning biomass time series for the 2015 assessment (spot2015_24U – in blue), and a model converted to SS-V3.30.12 (spot2015_30.12 in blue) and this same model tuned using the latest tuning procedures (spot2015_30.12_tuned – in green).

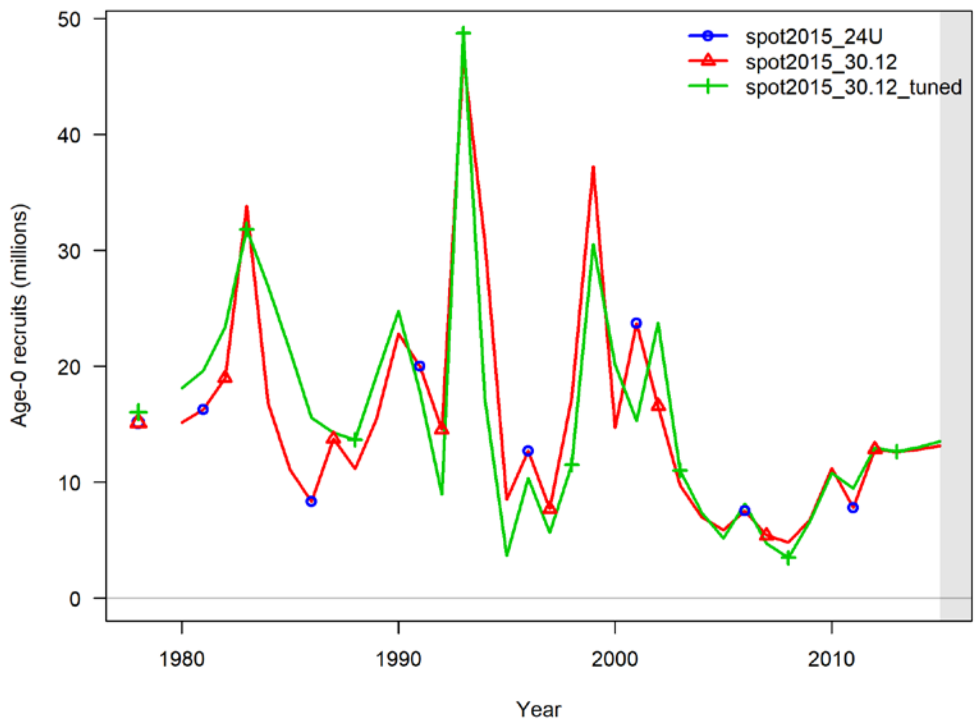


Figure 11.3. Comparison of the recruitment time series for the 2015 assessment (spot2015_24U – in blue), and a model converted to SS-V3.30.12 (spot2015_30.12 in blue) and this same model tuned using the latest tuning procedures (spot2015_30.12_tuned – in green).

11.2.2.1 Tuning method

Iterative rescaling (reweighting) of input and output CVs or input and effective sample sizes is a repeatable method for ensuring that the expected variation of the different data streams is comparable to what is input (Pacific Fishery Management Council, 2016). Most of the indices (CPUE, surveys and composition data) used in fisheries underestimate their true variance by only reporting measurement or estimation error and not including process error.

In iterative reweighting, the effective annual sample sizes are tuned/adjusted so that the input sample size is equal to the effective sample size calculated by the model. In SS-V3.30 it is possible to estimate an additional standard deviation parameter to add to the input CVs for the abundance indices (CPUE).

1. Set the standard error for the relative abundance indices (CPUE or FIS) to their estimated standard errors to the standard deviation of a loess curve fitted to the original data - which will provide a more realistic estimate to that obtained from the original statistical analysis. SS-V3.30 then allows an estimate to be made for an additional adjustment to the relative abundance variances appropriately.

An automated iterative tuning procedure was used for the remaining adjustments. For the recruitment bias adjustment ramps:

2. Adjust the maximum bias adjustment and the start and finish bias adjustment ramps as predicted by SS-V3.30 at each step.

For the age and length composition data:

3. Multiply the initial sample sizes by the sample size multipliers for the age composition data using Francis weights (Francis, 2011).
4. Similarly multiply the initial samples sizes by the sample size multipliers for the length composition data.
5. Repeat steps 2 - 4, until all are converged and stable (with proposed changes < 1 – 2%).

This procedure constitutes current best practice for tuning assessments.

11.2.3 *Inclusion of new data: 2015-2017*

Starting from the converted 2015 base case model, additional data from 2015-2018 were added sequentially to develop a preliminary base case for the 2018 assessment:

1. Change final assessment year to 2017, add trawl catches scaled to total CDR catch from 2015 to 2017 (add_Catch_2017). Changes in the catch time series before 2015 have not been examined here but will be considered as a sensitivity in the subsequent assessment report.
2. Add CPUE to 2017 (add_CPUE_2017) provided in Sporcic and Haddon (2018b).
3. Add the FIS index from 2016 (add_FIS_2016). The length frequency data from the FIS have not been included in the preliminary base case presented here, but will be considered as a sensitivity in the subsequent assessment report.
4. Add updated discard fraction estimates 1985 - 2017 (add_Discards_2017).
5. Add updated length frequency data to 2017 (add_Lengths_2017).
6. Add updated age error matrix and age-at-length data to 2017 (add_Ageing_2017).
7. Change the final year for which recruitments are estimated from 2012 to 2015 (extend_Rec_2015).
8. Re-tune using latest model tuning protocols, including Francis weighting on lengths and ages (preliminary_Basecase_2017).

Inclusion of three years of new catch data resulted in relatively small changes to the historical estimates of recruitment and the female spawning biomass (Figure 11.4 to Figure 11.6), with the most recent three years showing increases to spawning biomass. The inclusion of the new CPUE showed a large decline in spawning biomass prior to 2000, along with a moderate decline from the mid-2000s (Figure 11.4), while recruitment also fell prior to 1990 and after 2008 (Figure 11.6). The addition of the 2016 FIS biomass estimates had no impact on the assessment and are not shown. Adding the revised discard time series saw spawning biomass decline over the entire time series (Figure 11.4). Over most of the time series this decline was small, larger declines were seen between 1985 and 1998 and after 2014. Recruitment estimates were mostly unchanged (Figure 11.6), with small declines prior to 1988 and after 2009. Inclusion of the length-composition and conditional age-at-length data along with the retuning had minimal impact on either the magnitude or trend of spawning biomass or on recruitment (Figure 11.4 to Figure 11.6). Extending the period of estimated recruitment by 3 years, led to average recruitment in 2013 and 2014 and slightly above average recruitment in 2015 (Figure A 11.7). While the increase in estimated recent recruitment is welcome given the decade of below average recruitment for this species, they should be treated with some caution as recent recruitment events are often over-estimated in stock assessment models. Model diagnostics and residual plots for the preliminary base case assessment are provided in Appendix A.

This preliminary base case assessment estimates that the projected 2019 spawning stock biomass will be 33% of virgin stock biomass (projected assuming 2017 catches in 2018), however, it was predicted to be below 20% between 2013 and 2017. The previous assessment (Day et al., 2015) estimated depletion to be 40% at the start of 2016 and the trajectory of depletion did not drop below 20%. The female equilibrium spawning biomass in 1980 is estimated to be 9,672 t and in 2019 the female spawning biomass is projected to be 3,210 t. It should also be noted that the increase in spawning stock biomass observed since 2017 may be overly optimistic because the last two years of recruitment are not estimated in the model and instead mean recruitment used.

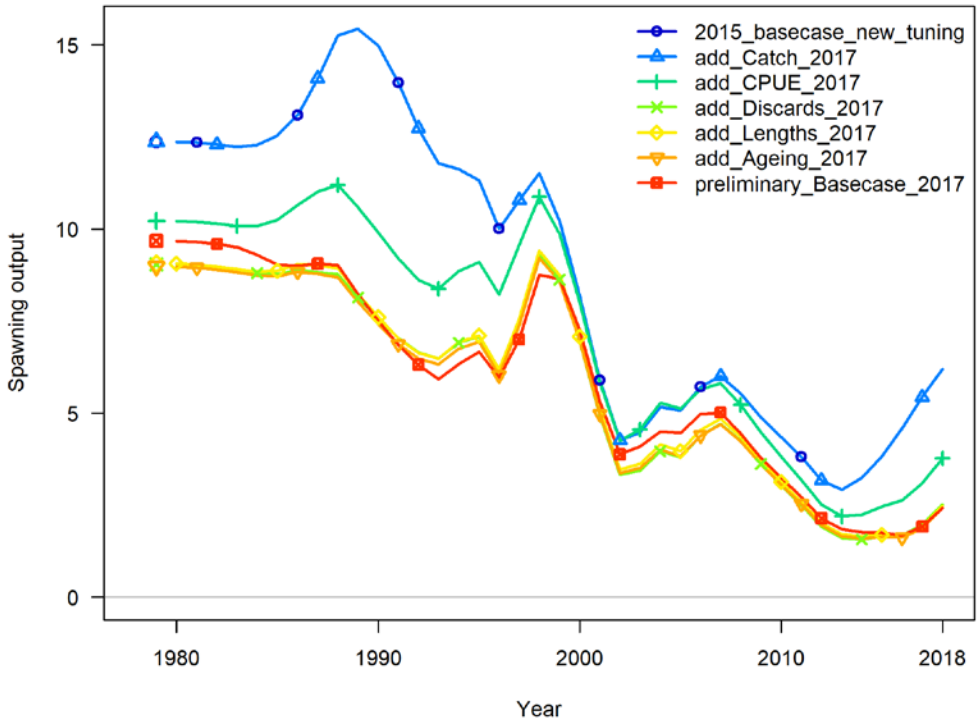


Figure 11.4. Comparison of the absolute spawning biomass time series for the 2015 assessment model converted to SS-V3.30.12 with various bridging models leading to a proposed 2018 tuned base case model (preliminary_Basecase_2017).

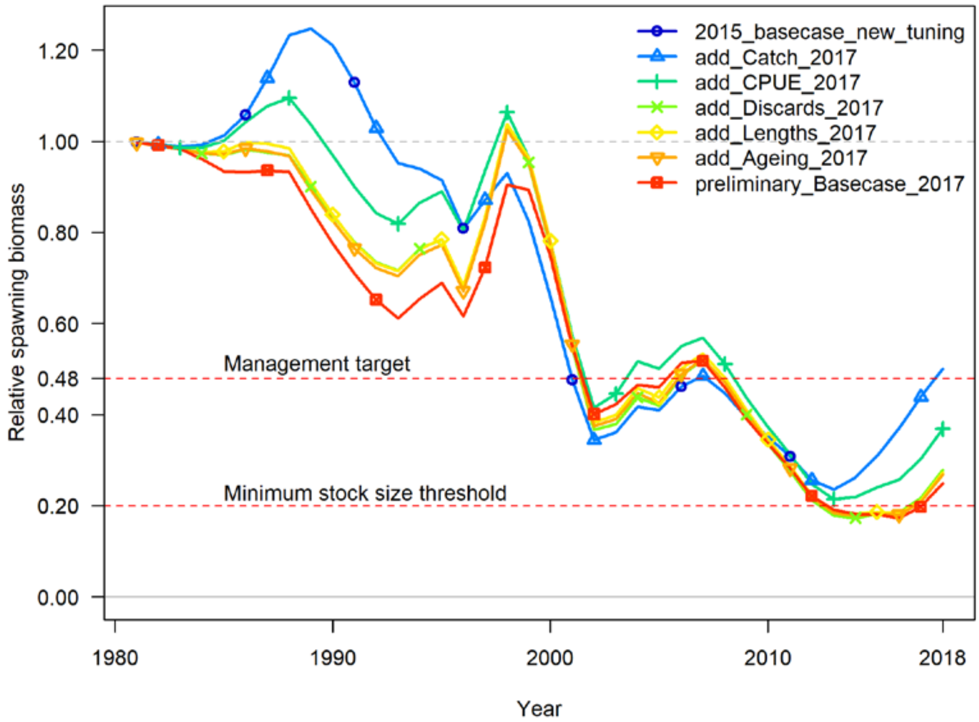


Figure 11.5. Comparison of the relative spawning biomass time series for the 2015 assessment model converted to SS-V3.30.12 with various bridging models leading to a proposed 2018 tuned base case model (preliminary_Basecase_2017).

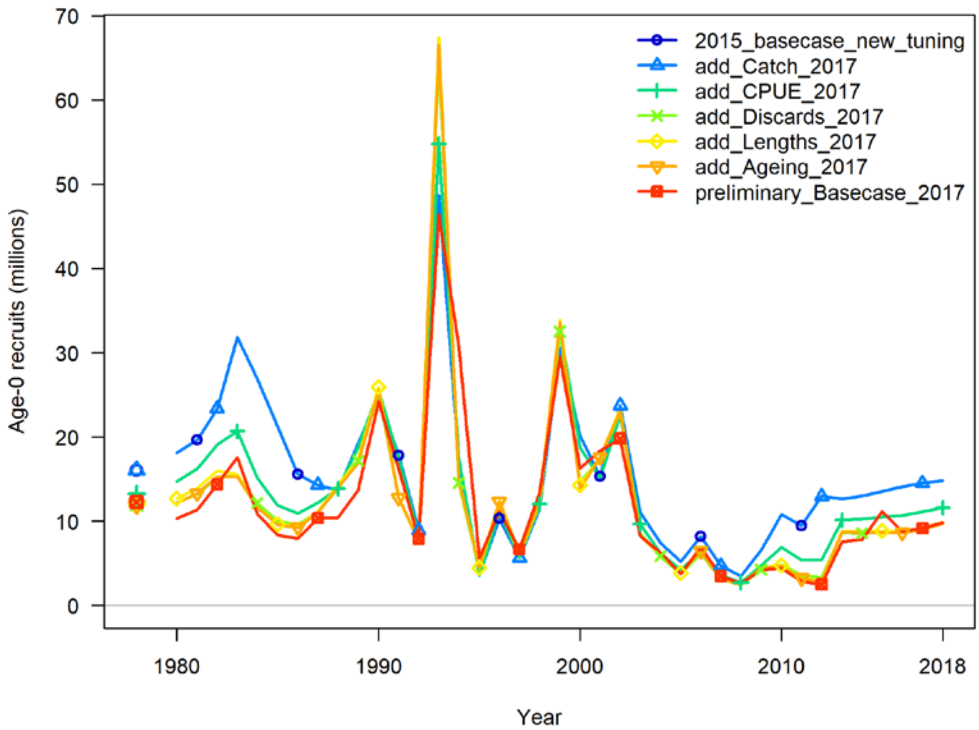


Figure 11.6. Comparison of the recruitment time series for the 2015 assessment model converted to SS-V3.30.12 with various bridging models leading to a proposed 2018 tuned base case model (preliminary_Basecase_2017).

11.2.4 *Likelihood profiles*

As stated by Punt (2018), likelihood profiles are a standard component of the toolbox of applied statisticians. They are most often used to obtain a 95% confidence interval. Many stock assessments "fix" key parameters such as *M* and steepness based on *a priori* considerations. Likelihood profiles can be used to evaluate whether there is evidence in the data to support fixing a parameter at a chosen value. If the parameter is within the entire range of the 95% confidence interval, this provides no support in the data to change the fixed value. If the fixed value is outside the 95% confidence interval, it would be reasonable for a review panel to ask why the parameter was fixed and not estimated, and if the value is to be fixed, on what basis and why should what amounts to inconsistency with the data be ignored. Integrated stock assessments include multiple data sources (e.g., commonly catch-rates, length-compositions, and age-compositions) that may be in conflict, due for example to inconsistencies in sampling, but more commonly owing to incorrect assumptions (e.g., assuming that catch-rates are linearly related to abundance), i.e. model-misspecification. Likelihood profiles can be used as a diagnostic to identify these data conflicts (Punt, 2018).

Standard parameters to consider are natural mortality (*M*), steepness (*h*) and the logarithm of the unfished recruitment ($\ln R_0$).

The silver Warehou assessment has used a fixed value for natural mortality (*M*) of 0.30 yr^{-1} since the 2007 assessment (Tuck and Punt 2017) when likelihood profiles showed that values for *M* larger than the base-case value of 0.25yr^{-1} were preferred. In August 2007, SlopeRAG endorsed a move to a natural mortality value of 0.30yr^{-1} for the base-case assessment. A likelihood profile on *M* was run for this assessment and is shown in Figure 11.7. While the optimal value of *M* from the profile likelihood is 0.38 yr^{-1}, the data sources provide little information about the most appropriate value of *M* so we suggest to keep *M* at 0.30yr^{-1} for the base case assessment of silver warehou in 2018.

The likelihood profile for steepness, *h*, (Figure 11.8) suggests that there is little information in the model that can be used to inform this parameter, which is fixed at 0.75 in the model. The length and discard data suggest a higher steepness while the other data sources suggest a lower value of *h*. We suggest retaining a fixed value of 0.75 for steepness in the base case model.

The likelihood profile for the logarithm of the unfished recruitment ($\ln R_0$; Figure 11.9) shows how the different data sources contribute to the estimated $\ln R_0$ of 9.41. The CPUE indices (labelled 'Survey' in Figure 11.9), along with the length composition prefer a lower value of $\ln R_0 = 9$. The age composition and discards are consistent with the estimated value while the recruitment prefers a higher value.

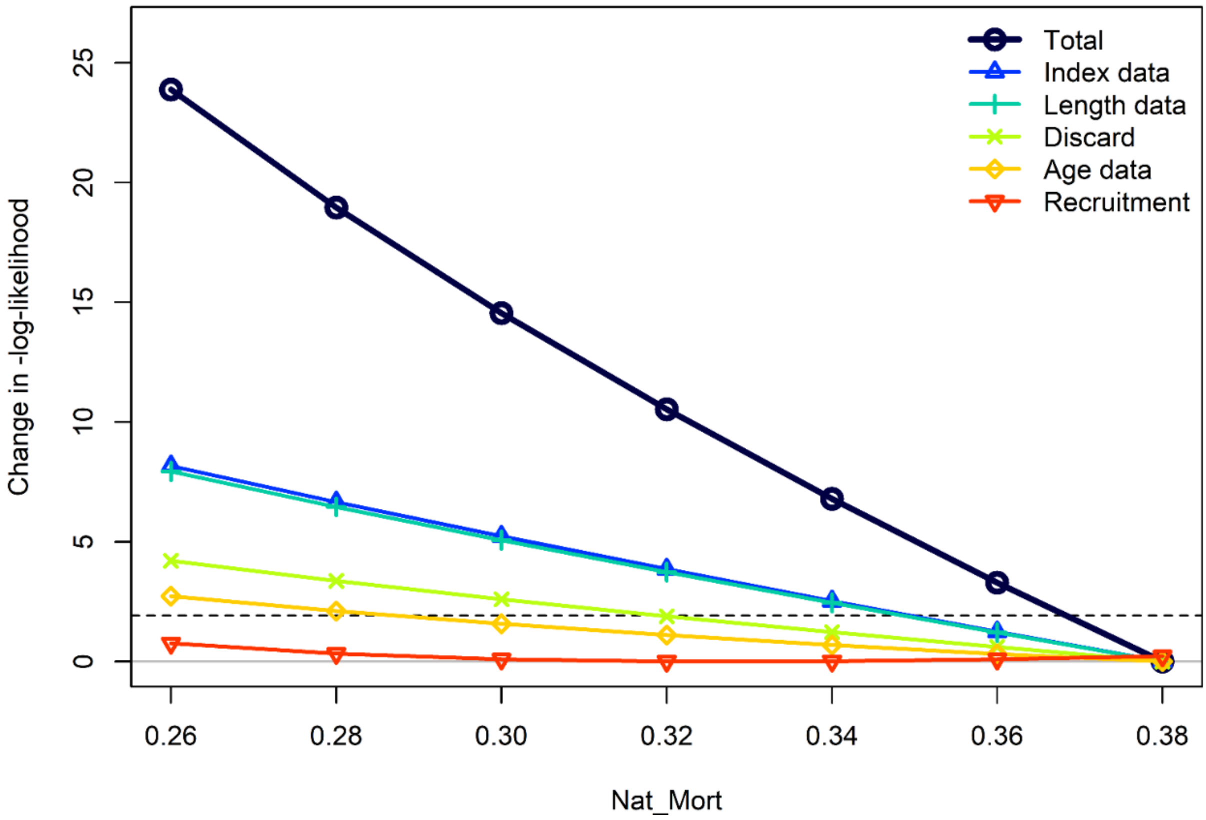


Figure 11.7. The likelihood profile for natural mortality. The fixed value for M is 0.30.

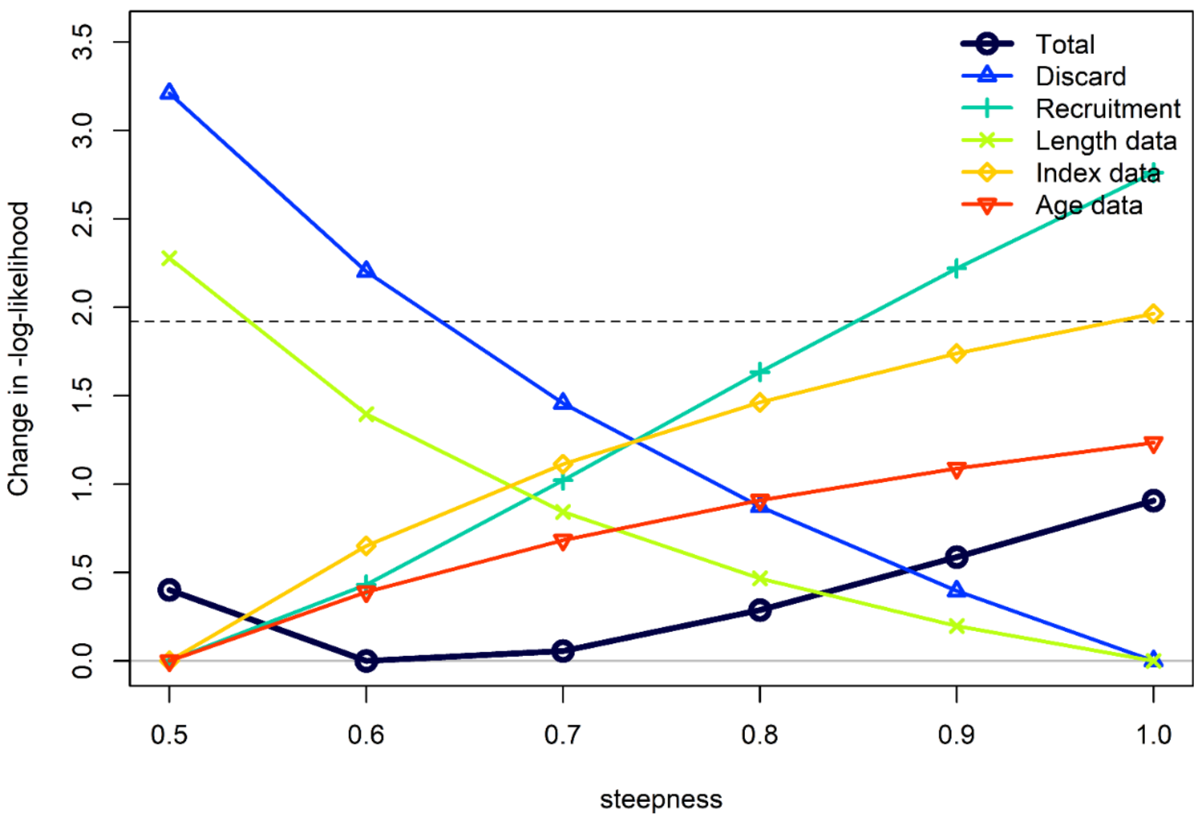


Figure 11.8. The likelihood profile for steepness. The fixed value for h is 0.75.

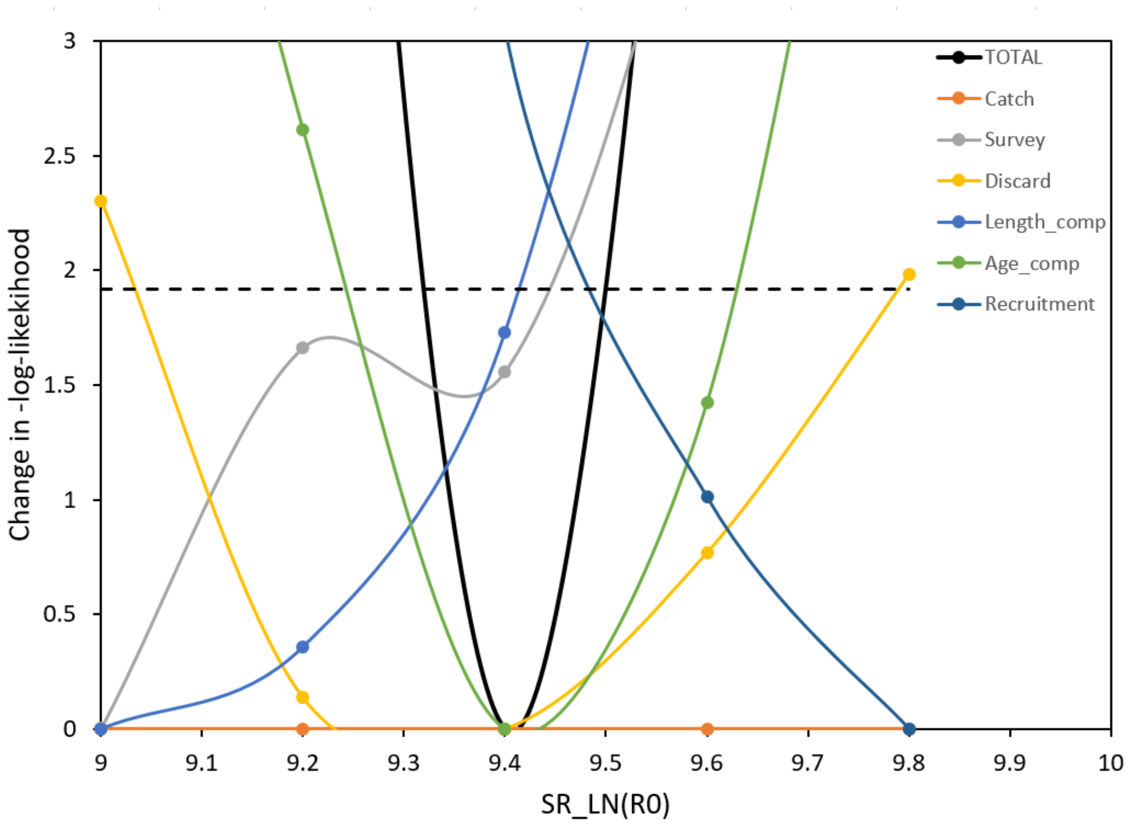


Figure 11.9. The likelihood profile for lnR_0. This parameter is estimated by the model to be 9.41.

11.2.5 *Future work and unresolved issues*

There is still the need to investigate the impact of the change in the discard estimation method and examine the influence of the revised time series of catches prior to 2015 (Thomson et al., 2018). Two other sensitivities relating to the Fishery Independent Survey (FIS) would also be useful (i) excluding all FIS data and (ii) including FIS length frequency data and estimating selectivity for the FIS fleet.

Potential problems with the CPUE series that provide abundance indices have been identified by Sporcic and Haddon (2018a). While the preliminary base case model fits to the indices of abundance are good, particularly in recent years, there are serious concerns about the reliability of the CPUE time-series in both the east and west. Sporcic and Haddon (2018a) note that:

… there have been transitional periods in the time-series of CPUE. This urgently needs more attention because this may imply that CPUE may no longer be acting as a valid index of relative abundance through time.

Given the potential bias in the abundance indices, results from this assessment should be treated with caution until the impacts of the transitional period in the time series of CPUE on the assessment has been evaluated.

11.3 Acknowledgments

Age data was provided by Kyne Krusic-Golub (Fish Ageing Services), ISMP and AFMA logbook and CDR data were provided by John Garvey (AFMA). Franzis Althaus, Mike Fuller and Roy Deng Claudio Castillo-Jordán (CSIRO) pre-processed the data. Andre Punt, Geoff Tuck, Sandra Curin-Osorio, Malcolm Haddon, Robin Thomson and Miriana Sporcic are thanked for helpful discussions on this work. Ian Taylor, Richard Methot and Chantel Wetzel (NOAA Fisheries) are thanked for all the Stock Synthesis support and advice. Malcolm Haddon provided useful code for auto-tuning, and Athol Whitten provided useful R code for organising plots.

11.4 References

Francis, R.I.C.C. 2011. Data weighting in statistical fisheries stock assessment models. Canadian Journal of Fisheries and Aquatic sciences. 68(6): 1124–1138.

Methot RD. 2015. User manual for Stock Synthesis. Model Version 3.24s. NOAA Fisheries Service, Seattle. 152 pp.

Methot RD, Wetzel CR, Taylor I. 2018. Stock Synthesis User Manual Version 3.30.12. NOAA Fisheries, Seattle, WA USA. 230pp.

Pacific Fishery Management Council. 2016. Terms of Reference for the Groundfish and Coastal Pelagic Species Stock Assessment Review Process for 2017-2018 http://www.pcouncil.org/wp-content/uploads/2017/01/Stock_Assessment_ToR_2017-18.pdf.

Punt AE. 2018. On the Use of Likelihood Profiles in Fisheries Stock Assessment. Technical paper for SESSFRAG, August 2018.

Sporcic, M., and Haddon, M. 2018a. Draft Statistical CPUE standardizations for selected SESSF species (data to 2017). CSIRO Oceans; Atmosphere, Castray Esplanade, Hobart, 12 p.

Sporcic M and Haddon M. 2018b. Draft CPUE standardizations for selected SESSF Species (data to 2017). CSIRO Oceans and Atmosphere, Hobart. 331 p.

Thomson, R., Fuller, M., Deng, R., Althaus, F., Burch, P., and Castillo-Jordan, C. (2018). Data summary for the Southern and Eastern Scalefish and Shark Fishery: Logbook, landings and observer data to 2017. Presented to the SERAG, Hobart, September, 2018.

Tuck, GN and Punt, AE 2007. Silver warehou (*Seriolella punctata*) stock assessment based upon data up to 2006. Technical report presented to the Slope RAG. 21-22 August, 2007.

11.5 Appendix A

A.1 Preliminary base case diagnostics

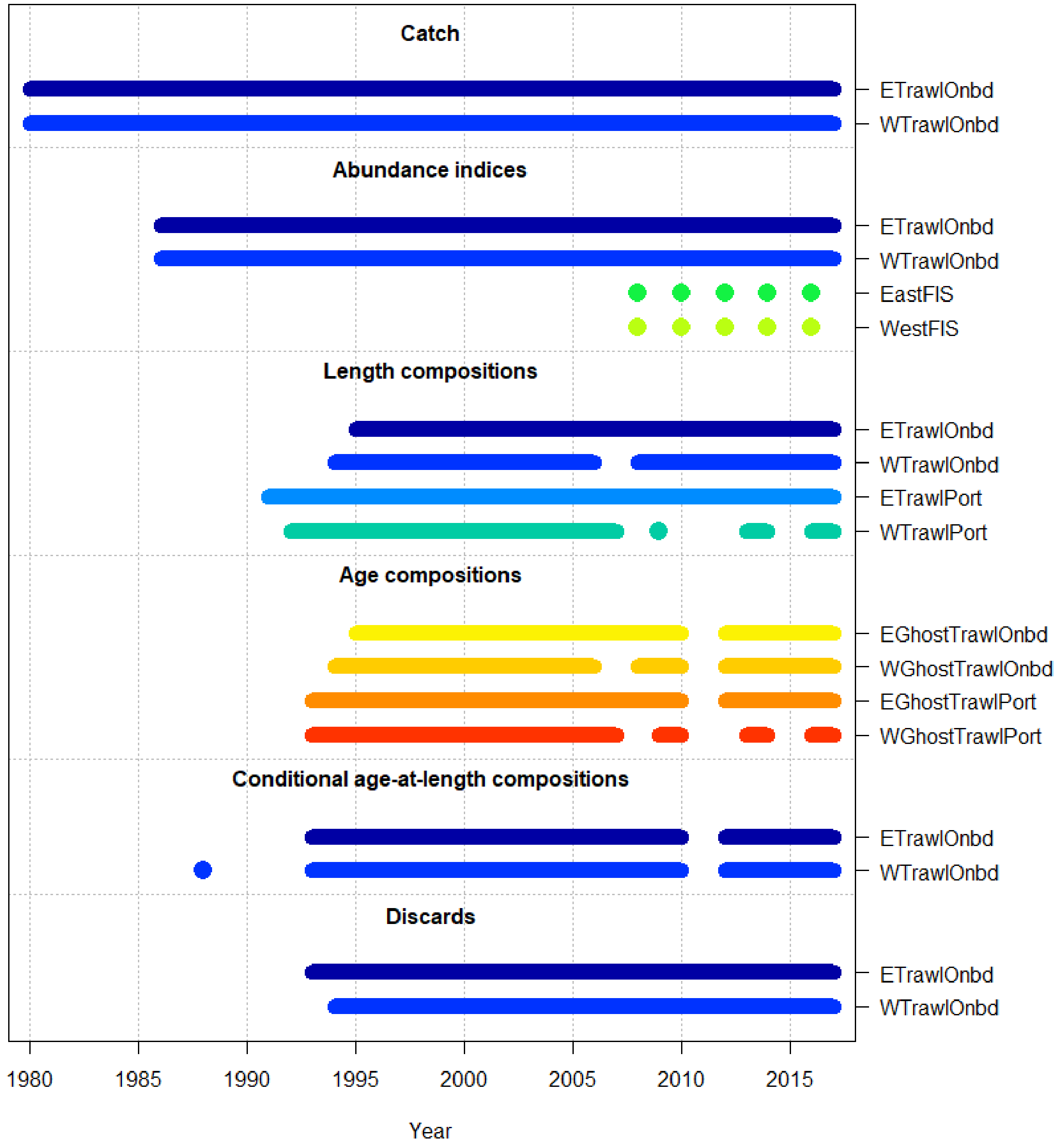


Figure A 11.1. Summary of data sources for silver warehou stock assessment.

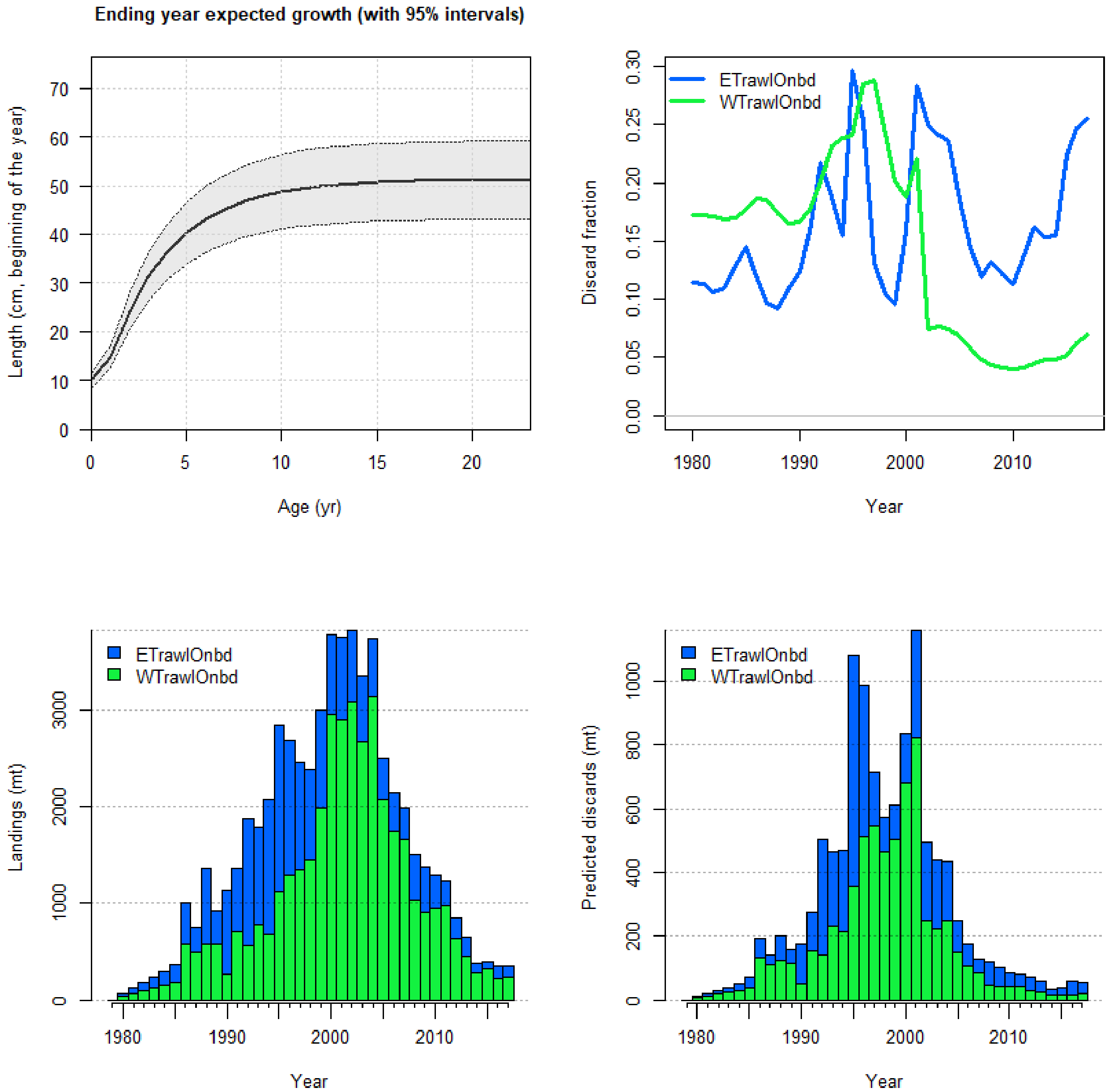


Figure A 11.2. Growth, discard fraction estimates, landings by fleet and predicted discards by fleet for silver warehou.

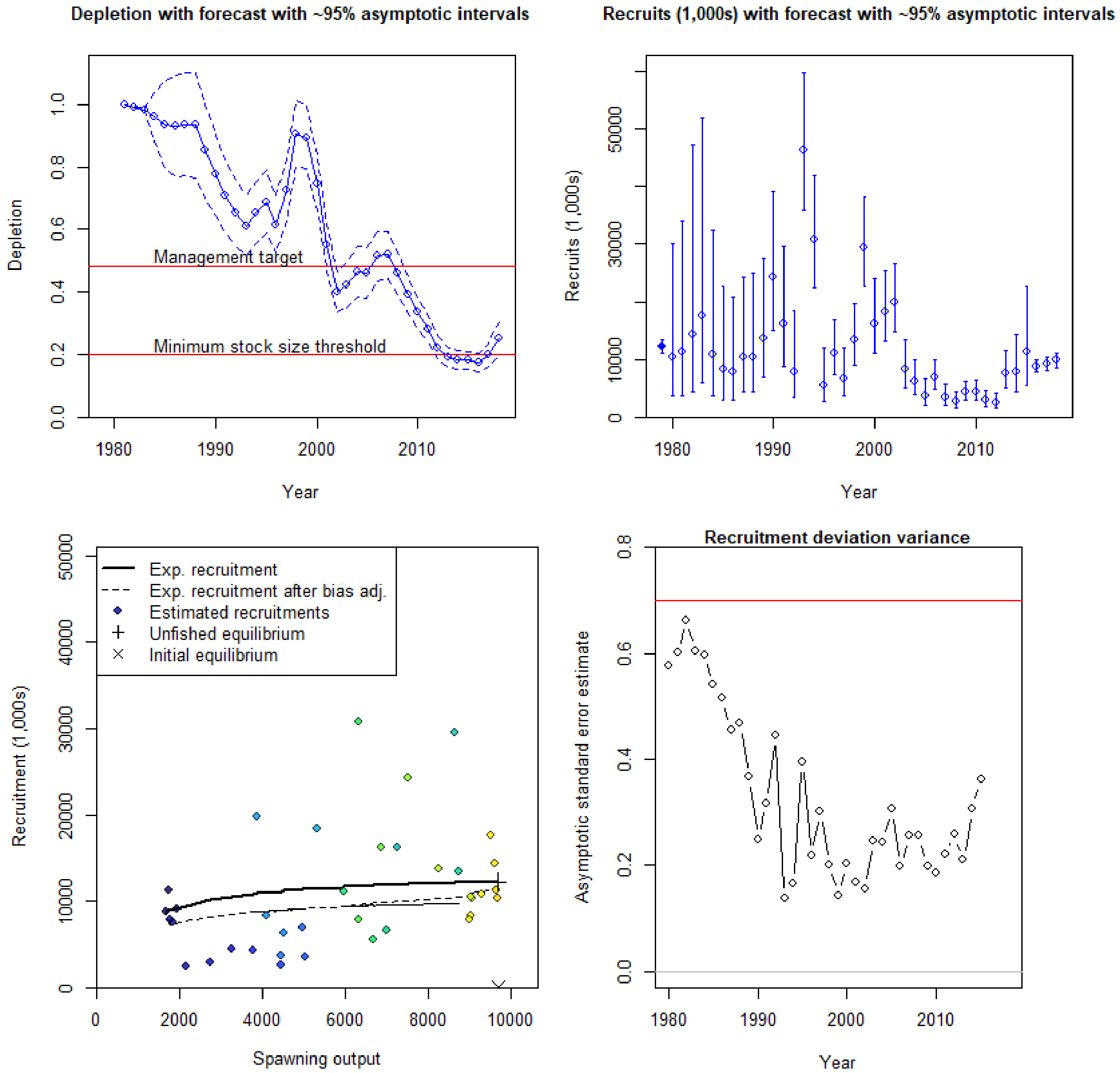
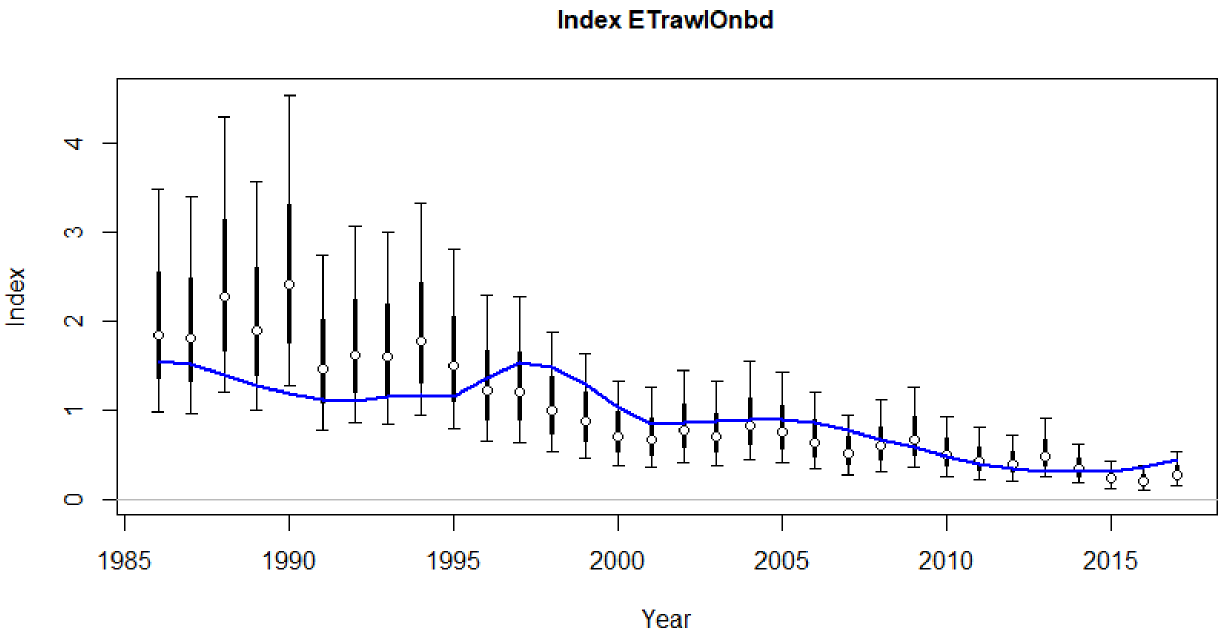


Figure A 11.3. Time series showing depletion of spawning biomass with confidence intervals, recruitment estimates with confidence intervals, stock recruitment curve and recruitment deviation variance check for silver warehou.



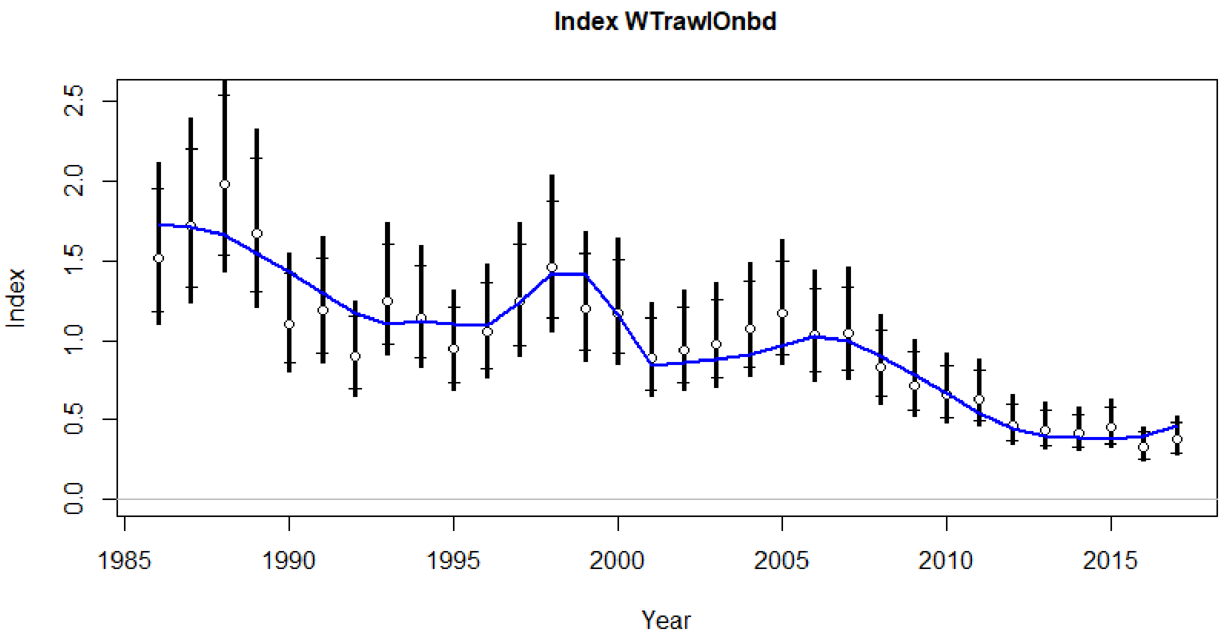


Figure A 11.4. Fits to CPUE by fleet for silver warehou: East and West trawl.

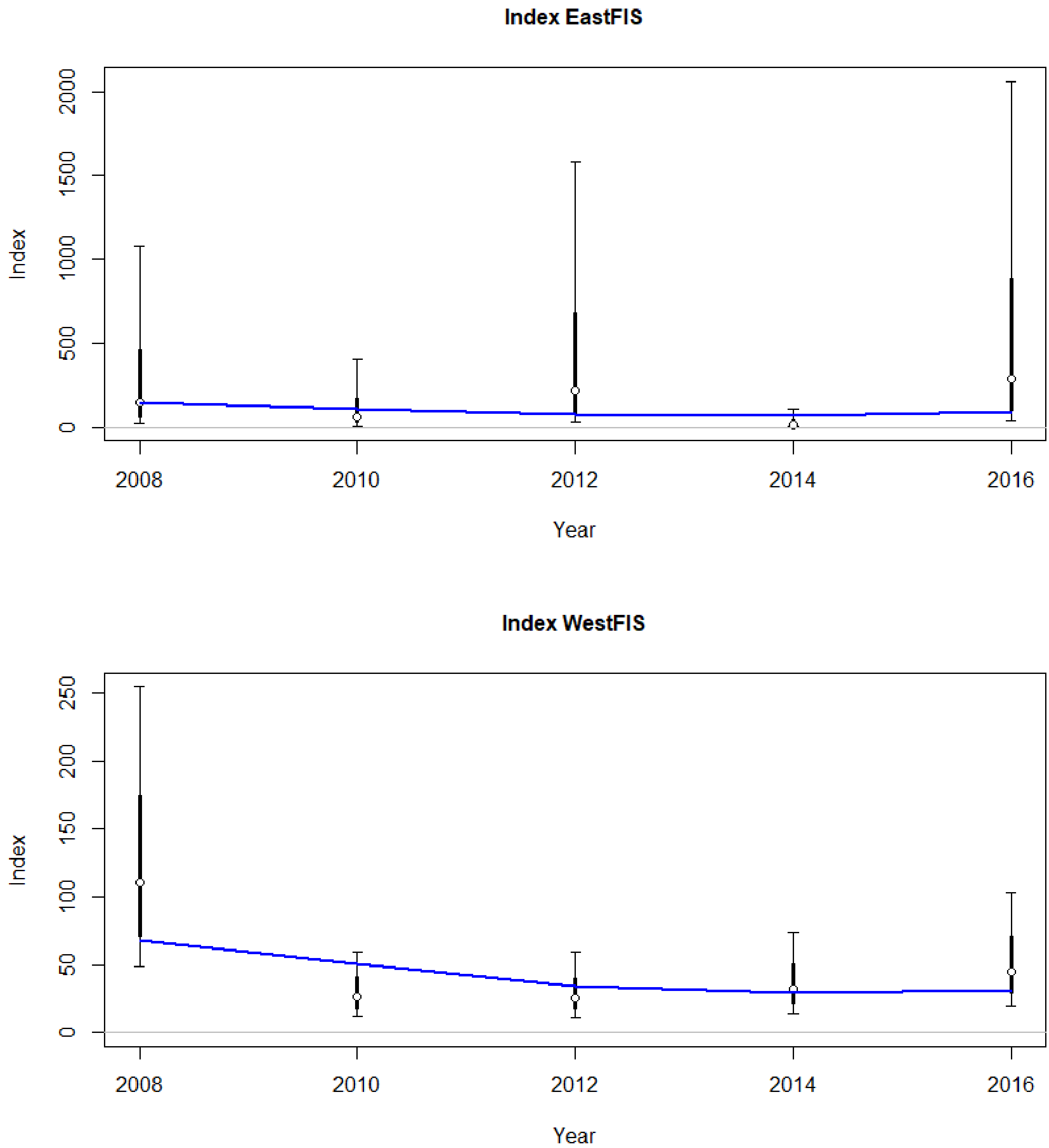


Figure A 11.5. Fits to CPUE from the FIS fleets for silver warehou.

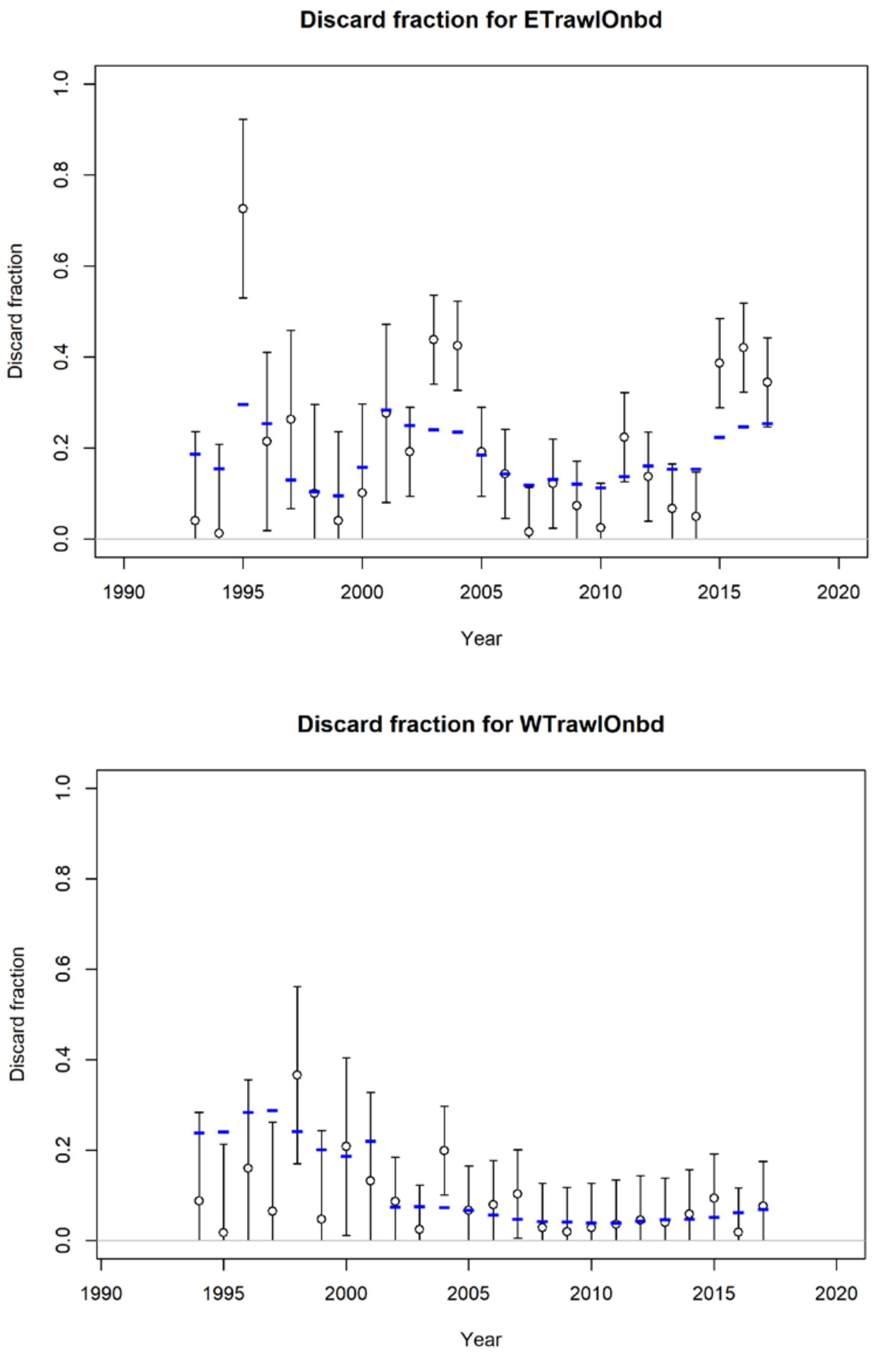


Figure A 11.6. Fits to discard rates for the east and west trawl fleets for silver warehou.

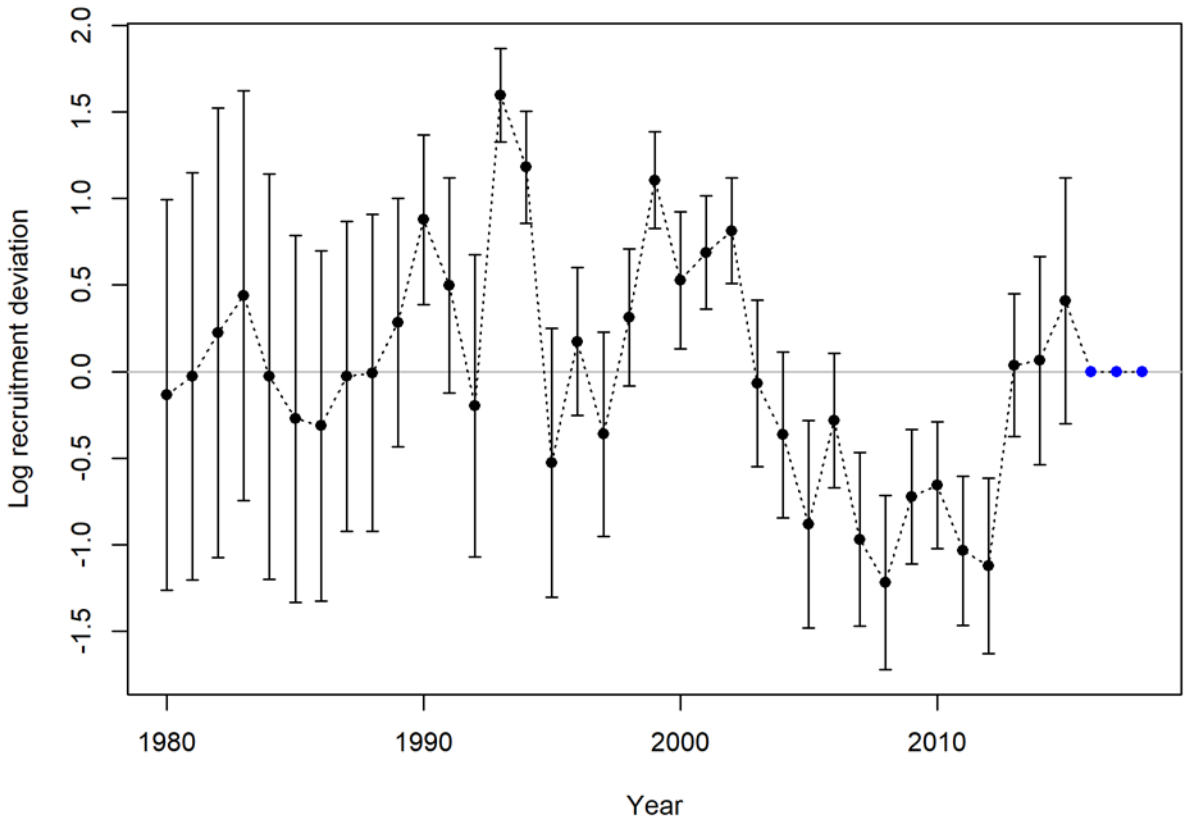


Figure A 11.7. Fits to discard rates (trawl) and recruitment deviations for silver warehou.

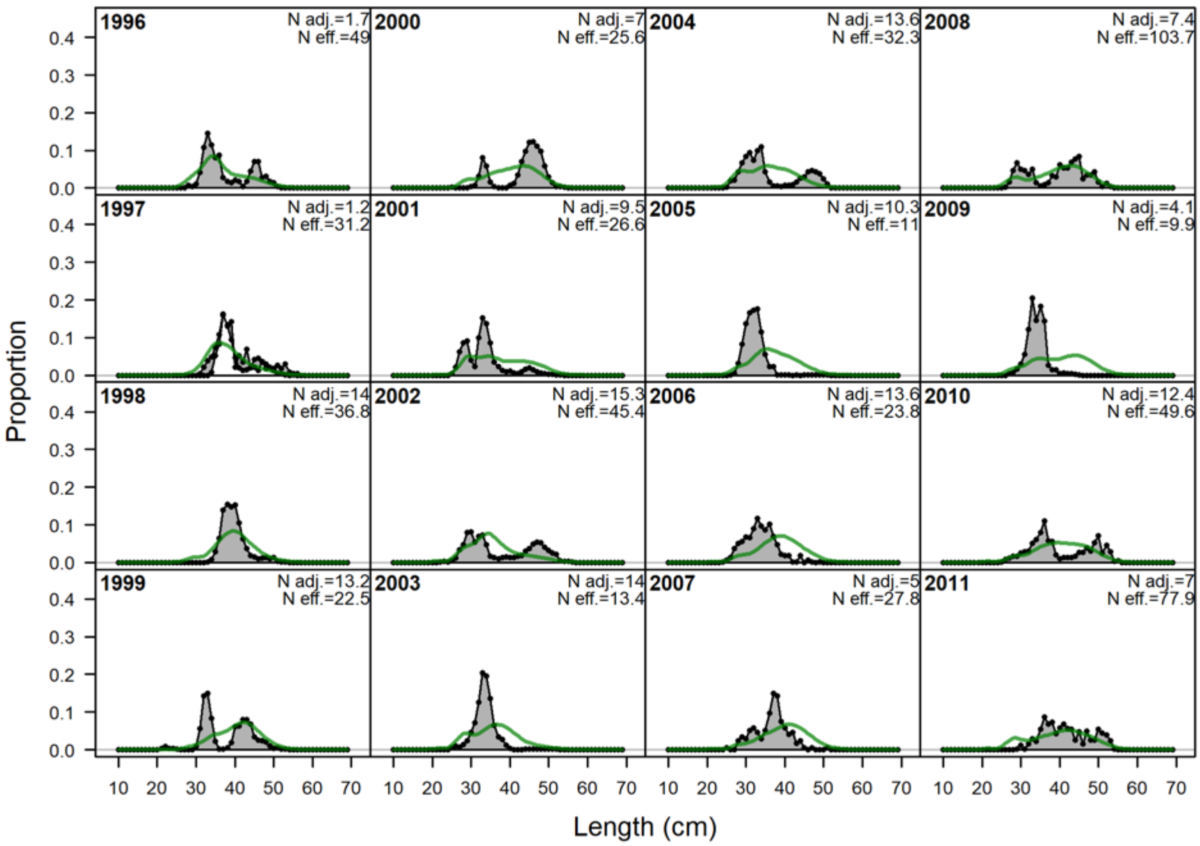


Figure A 11.8. Silver warehou length composition fits: east trawl onboard retained (page 1).

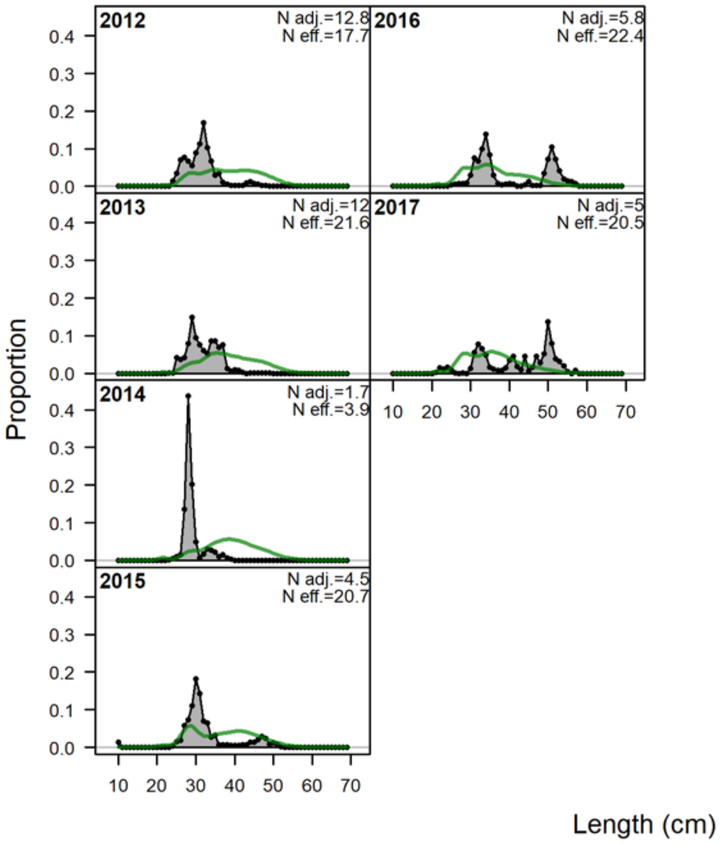


Figure A 11.9. Silver warehou length composition fits: east trawl onboard retained (page 2).

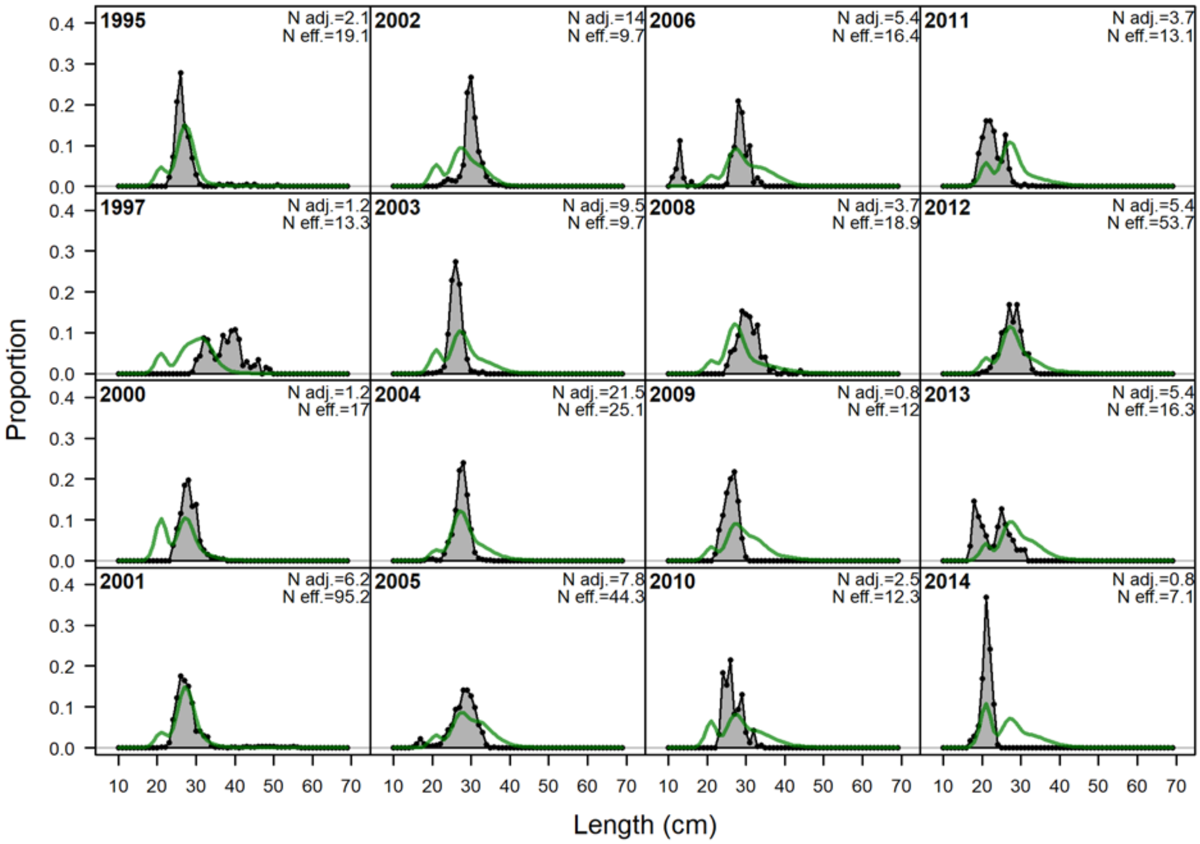


Figure A 11.10. Silver warehou length composition fits: east trawl onboard discarded (page 1).

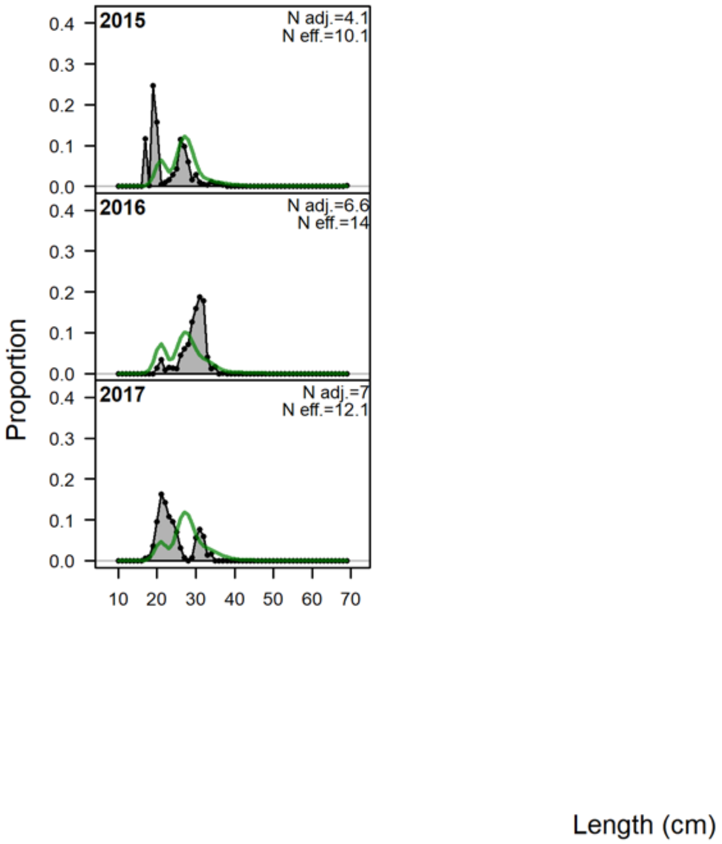


Figure A 11.11. Silver warehou length composition fits: east trawl onboard discarded (page 2).

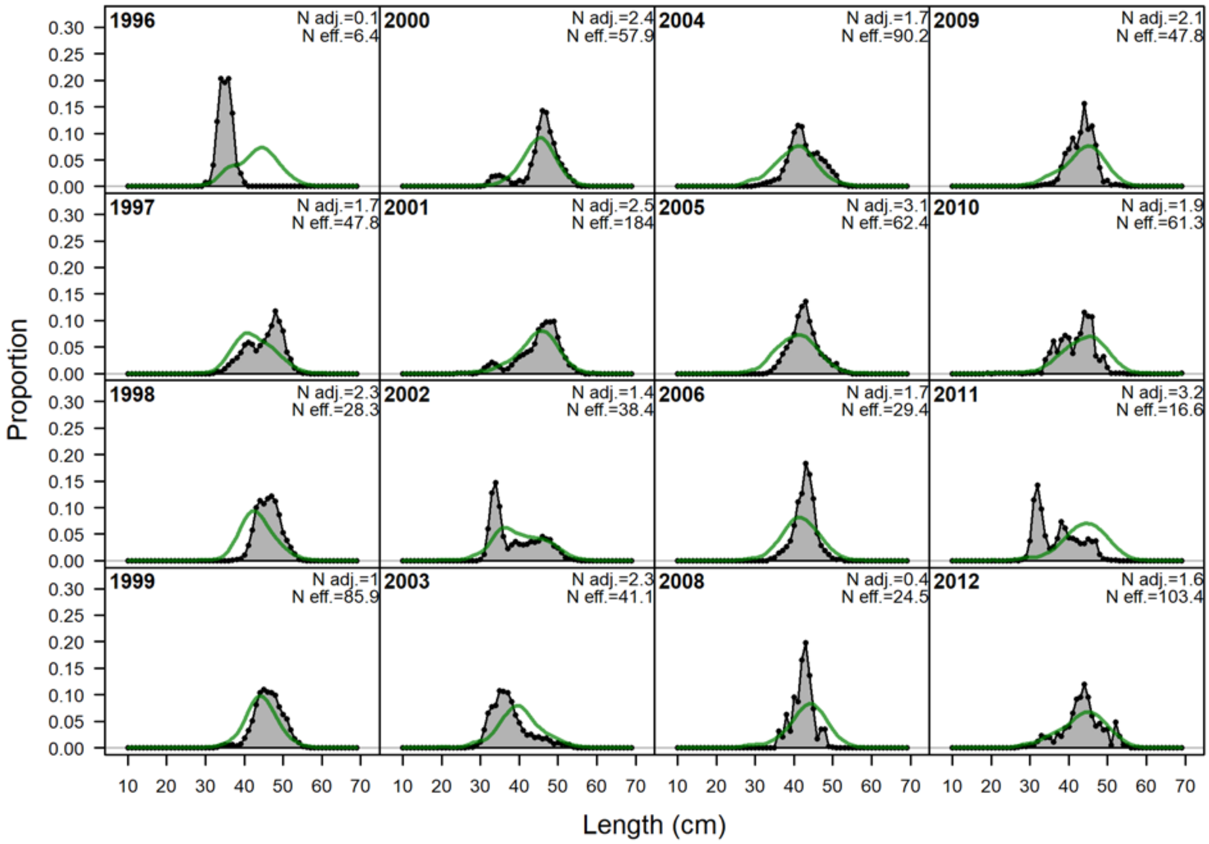


Figure A 11.12. Silver warehou length composition fits: west trawl onboard retained (page 1).

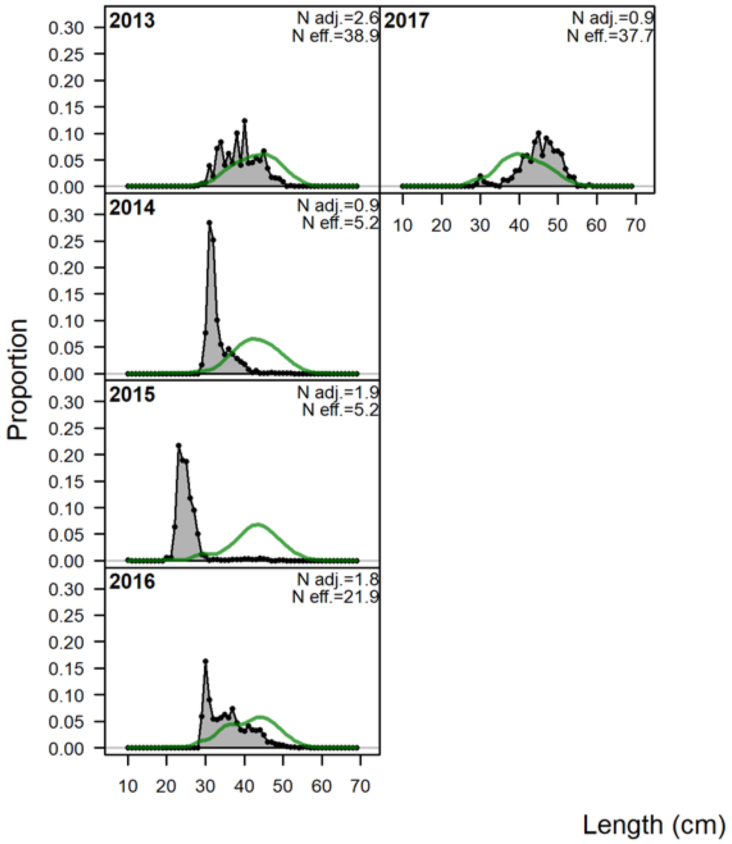


Figure A 11.13. Silver warehou length composition fits: west trawl onboard retained (page 2).

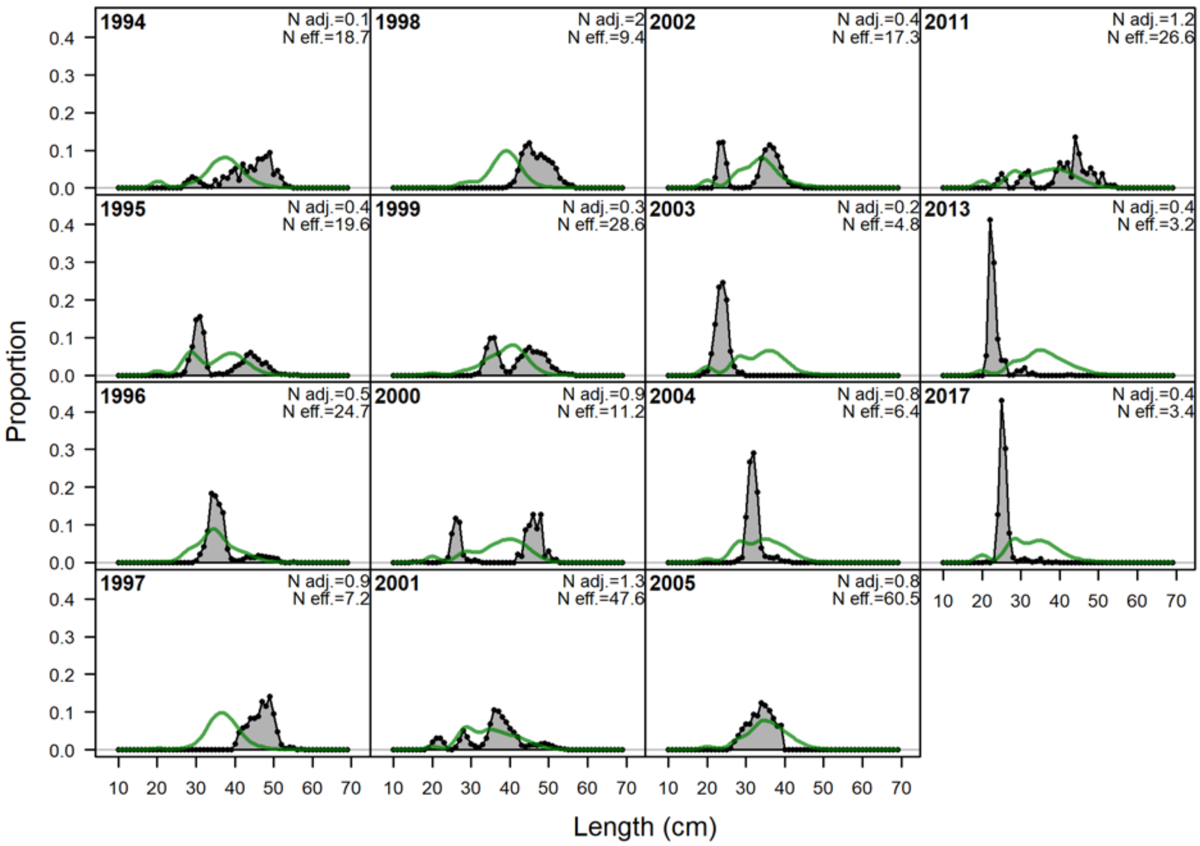


Figure A 11.14. Silver warehou length composition fits: west trawl onboard discarded.

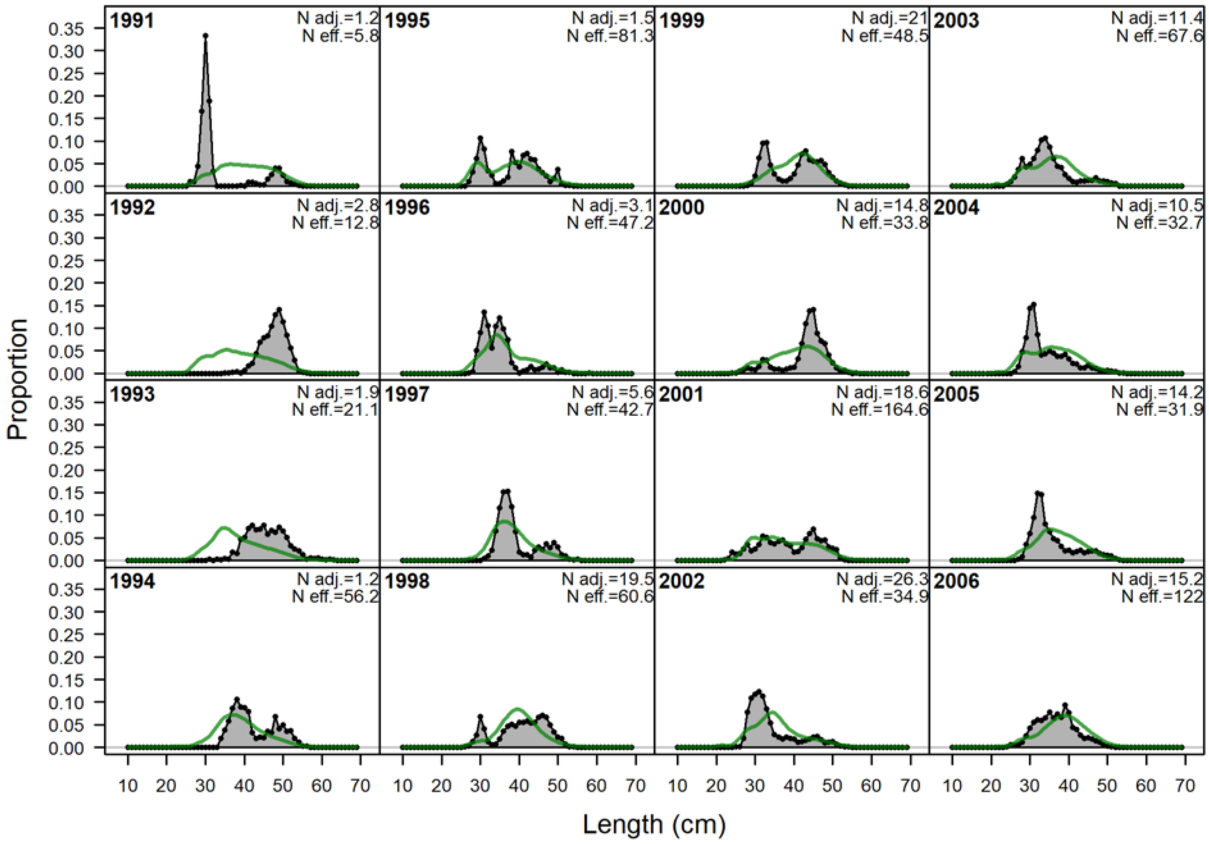


Figure A 11.15. Silver warehou length composition fits: east trawl port retained (page 1).

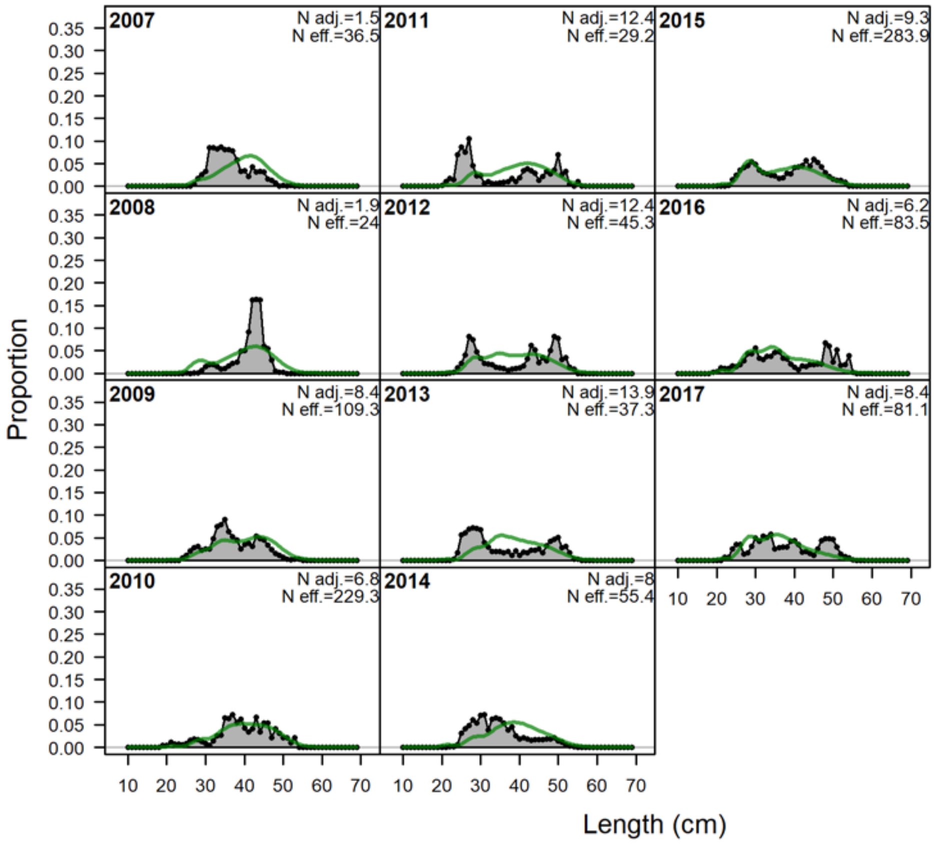


Figure A 11.16. Silver warehou length composition fits: east trawl port retained (page 2).

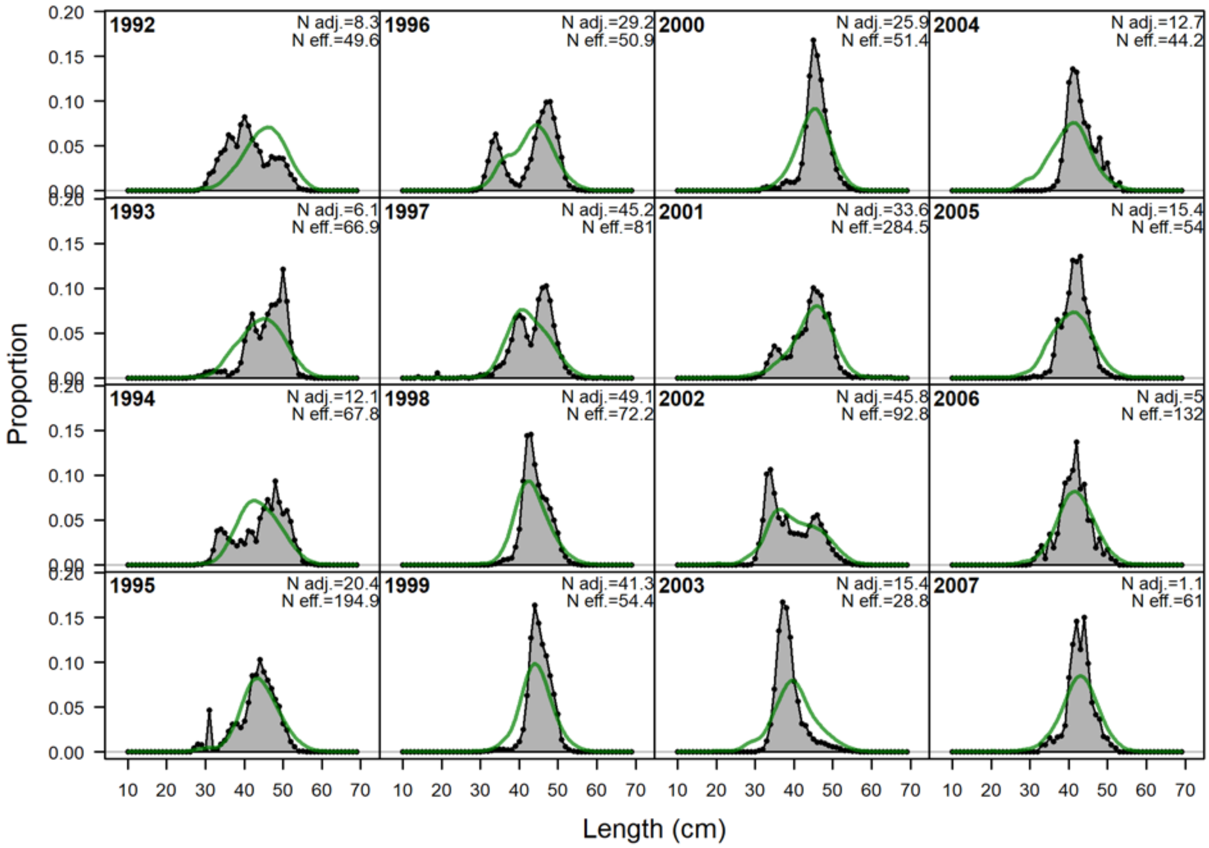


Figure A 11.17. Silver warehou length composition fits: west trawl port retained (page 1).

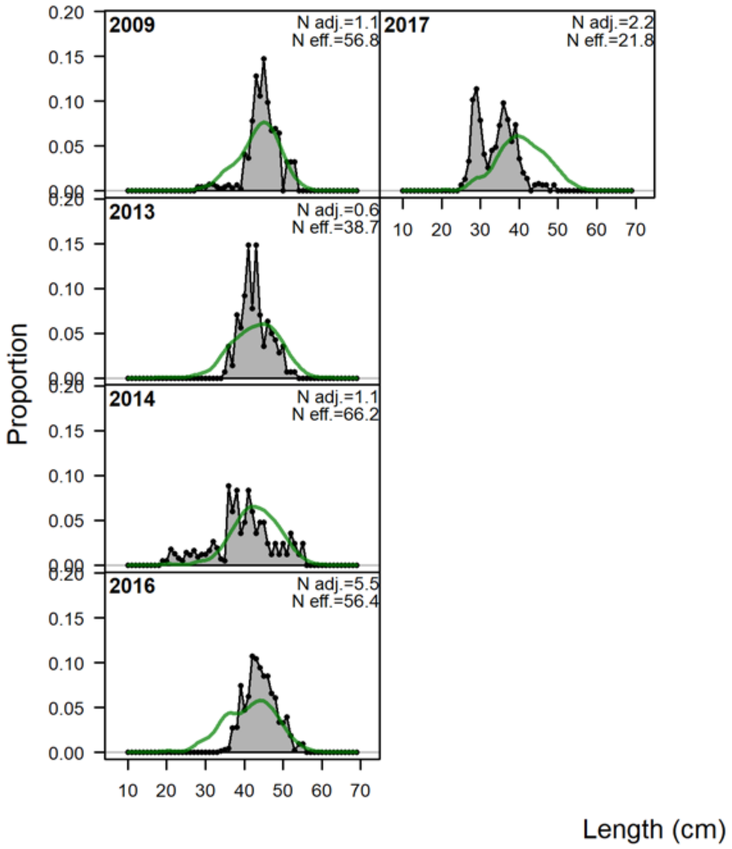


Figure A 11.18. Silver warehou length composition fits: west trawl port retained (page 2).

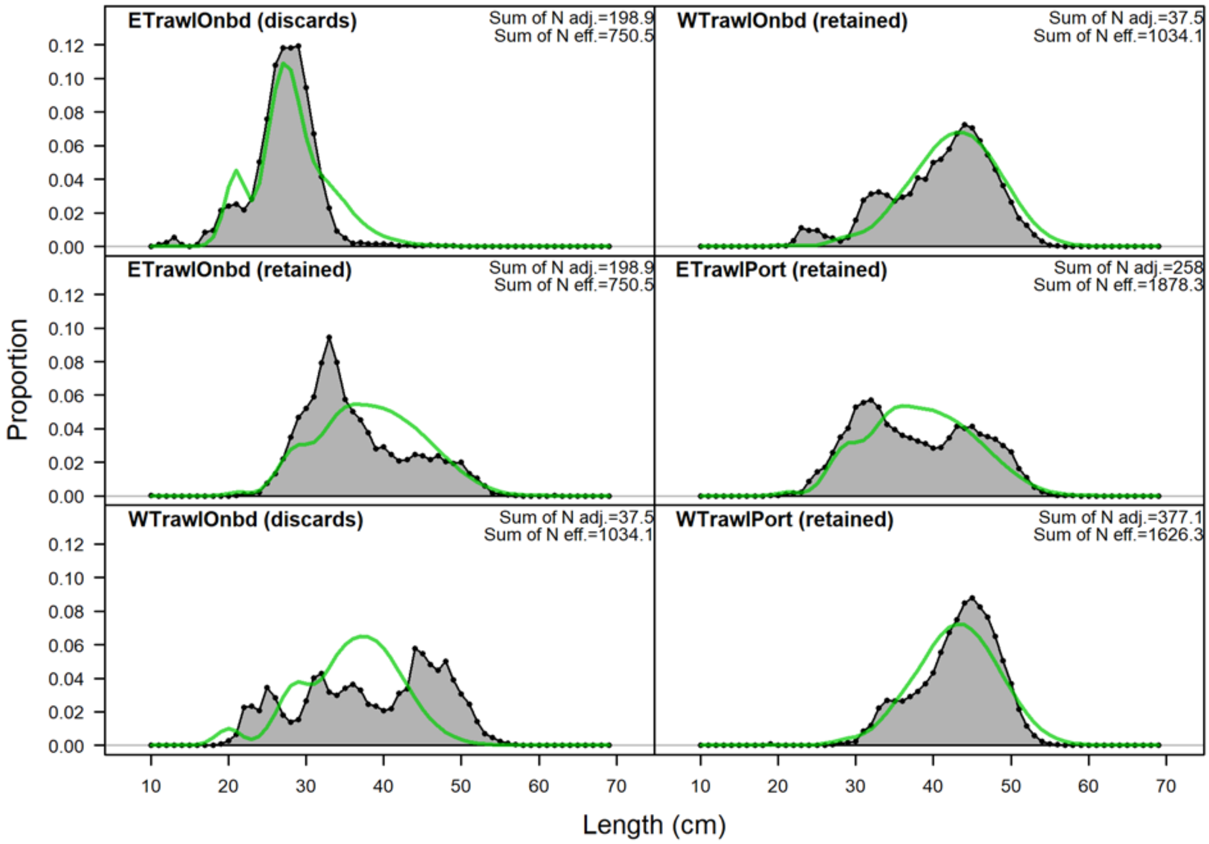


Figure A 11.19. Aggregated fits (over all years) to the length compositions for silver warehou displayed by fleet.

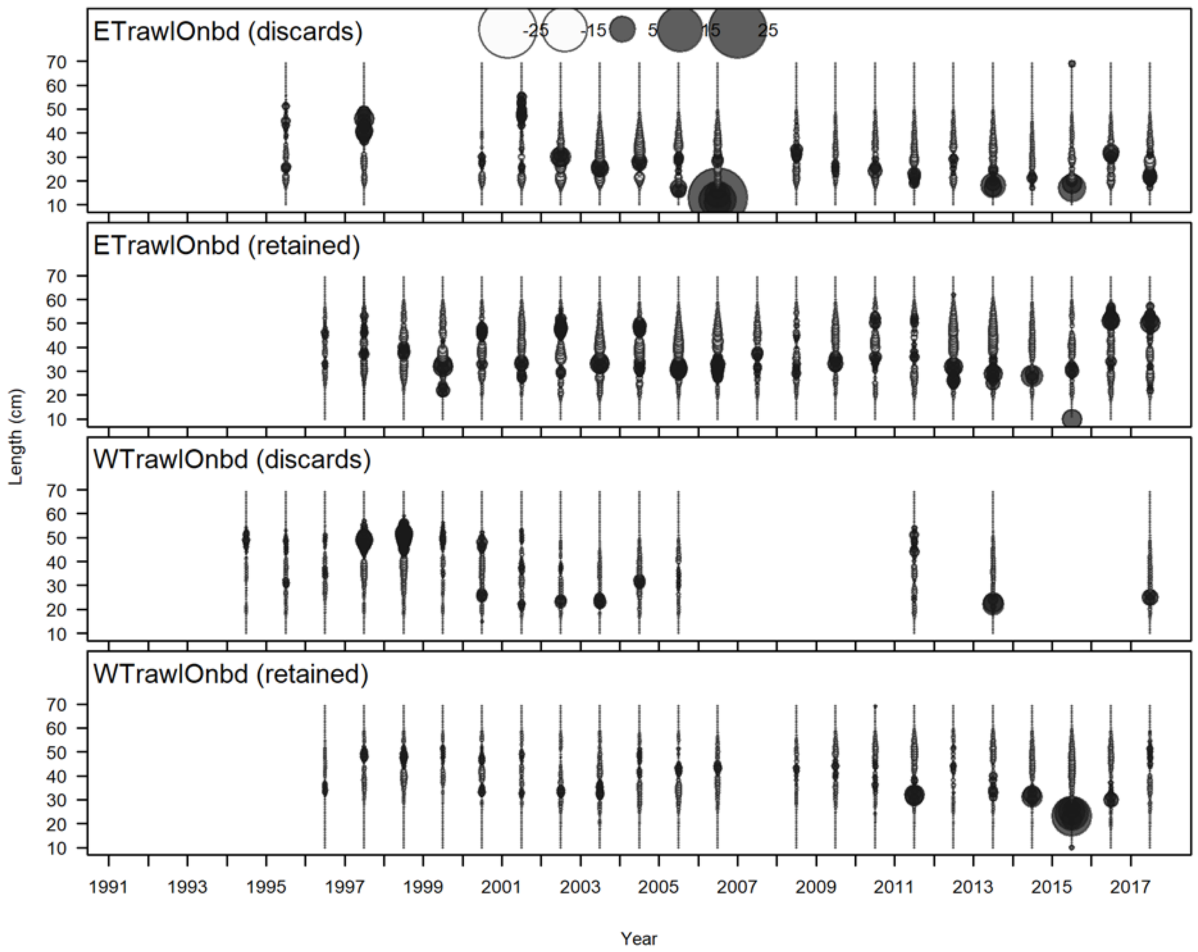


Figure A 11.20. Pearson residuals, comparing across fleets (page 1).

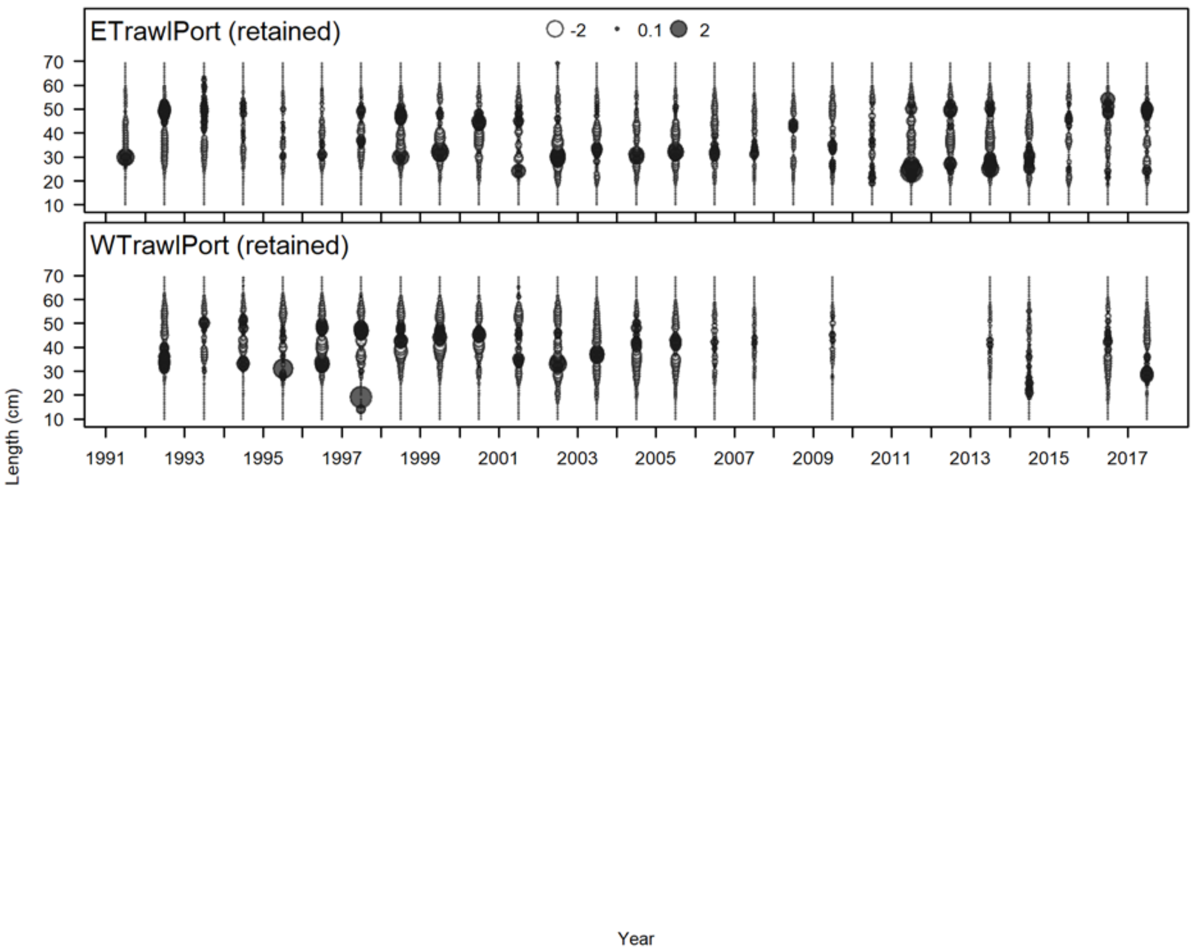


Figure A 11.21. Pearson residuals, comparing across fleets (page 2).

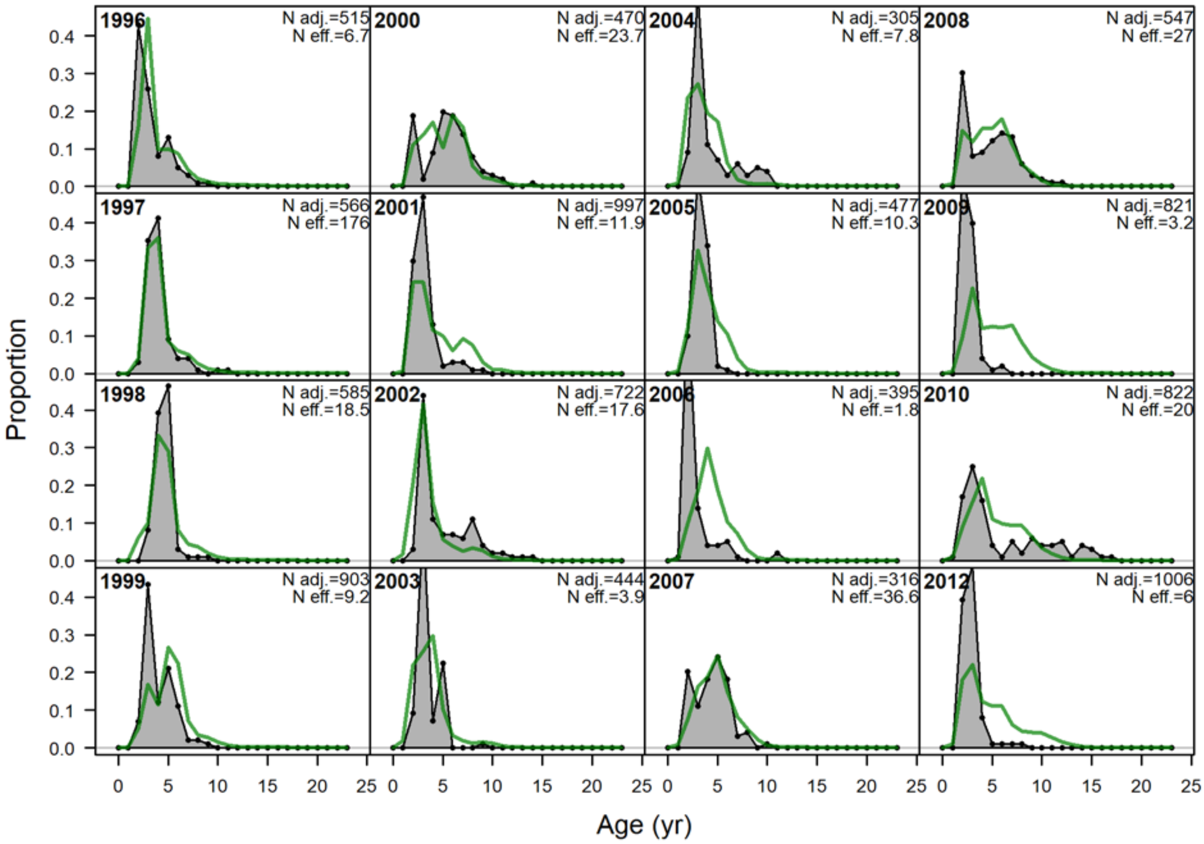


Figure A 11.22. Silver warehou implied fits to age: east ghost trawl onboard retained (page 1).

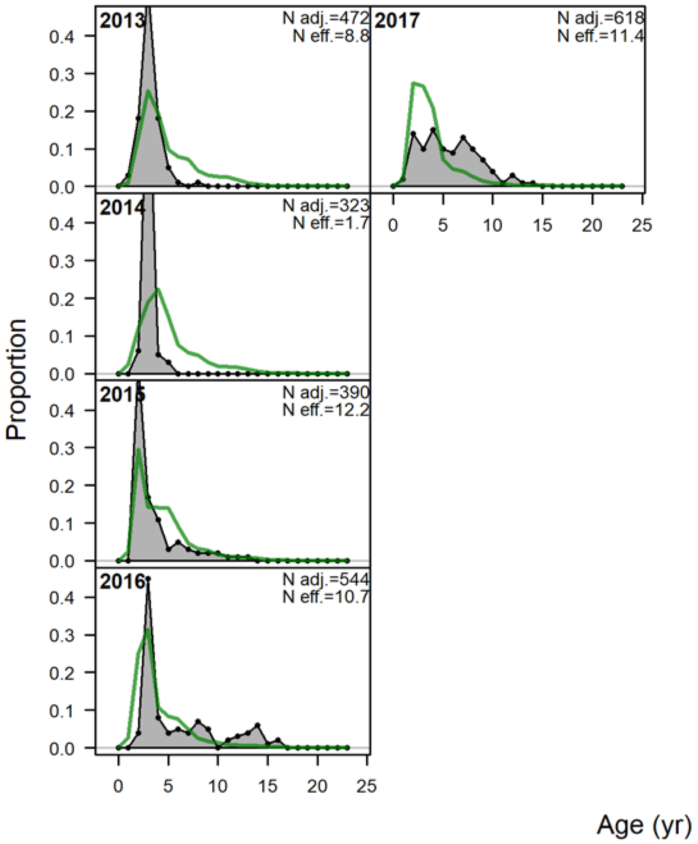


Figure A 11.23. Silver warehou implied fits to age: east ghost trawl onboard retained (page 2).

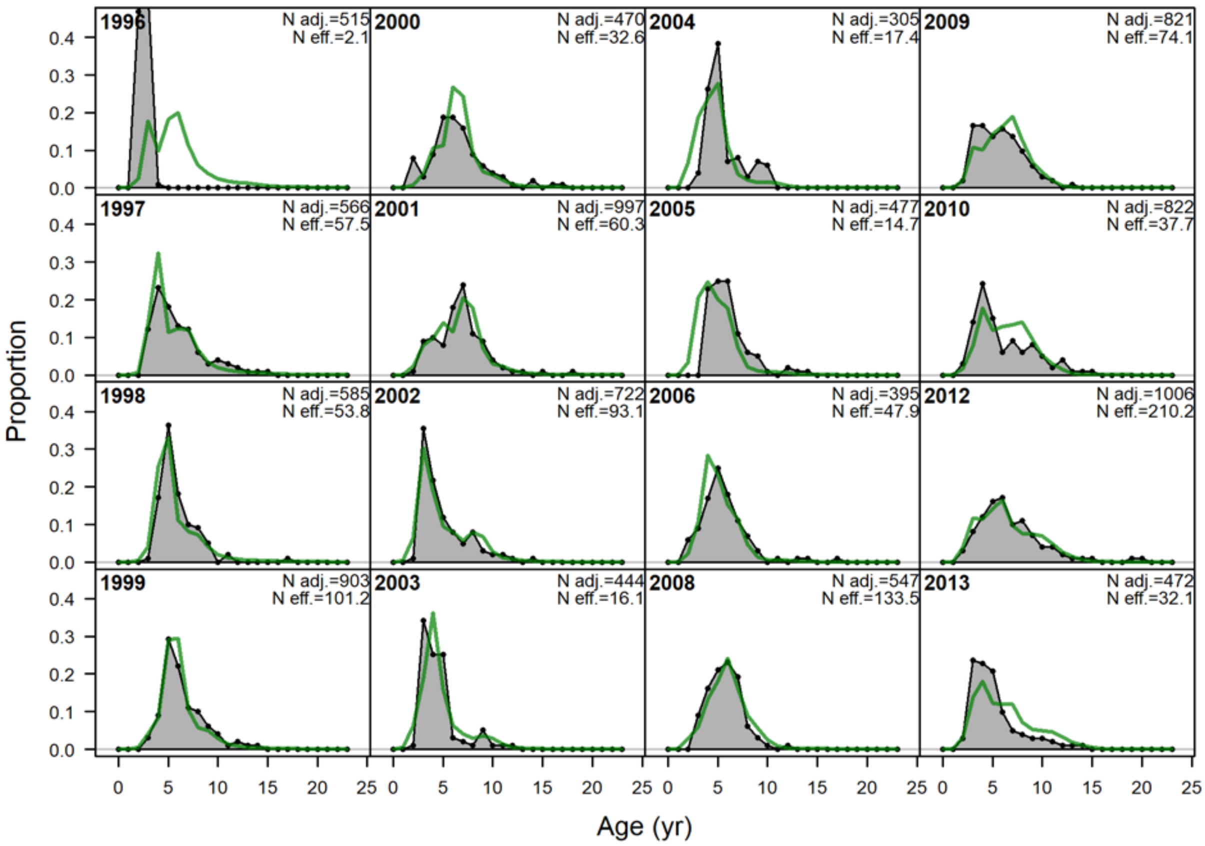


Figure A 11.24. Silver warehou implied fits to age: west ghost trawl onboard retained (page 1).

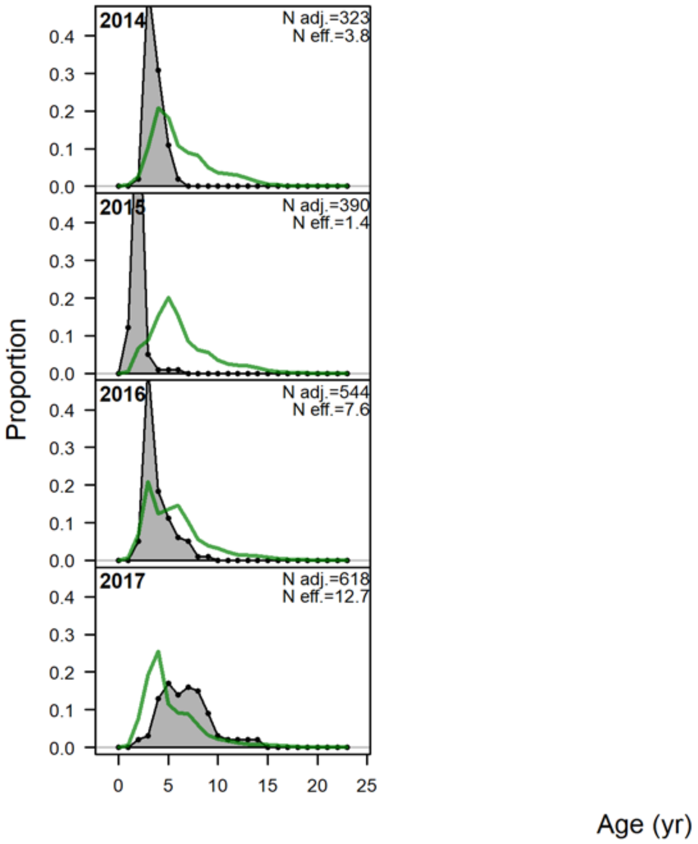


Figure A 11.25. Silver warehou implied fits to age: west ghost trawl onboard retained (page 2).

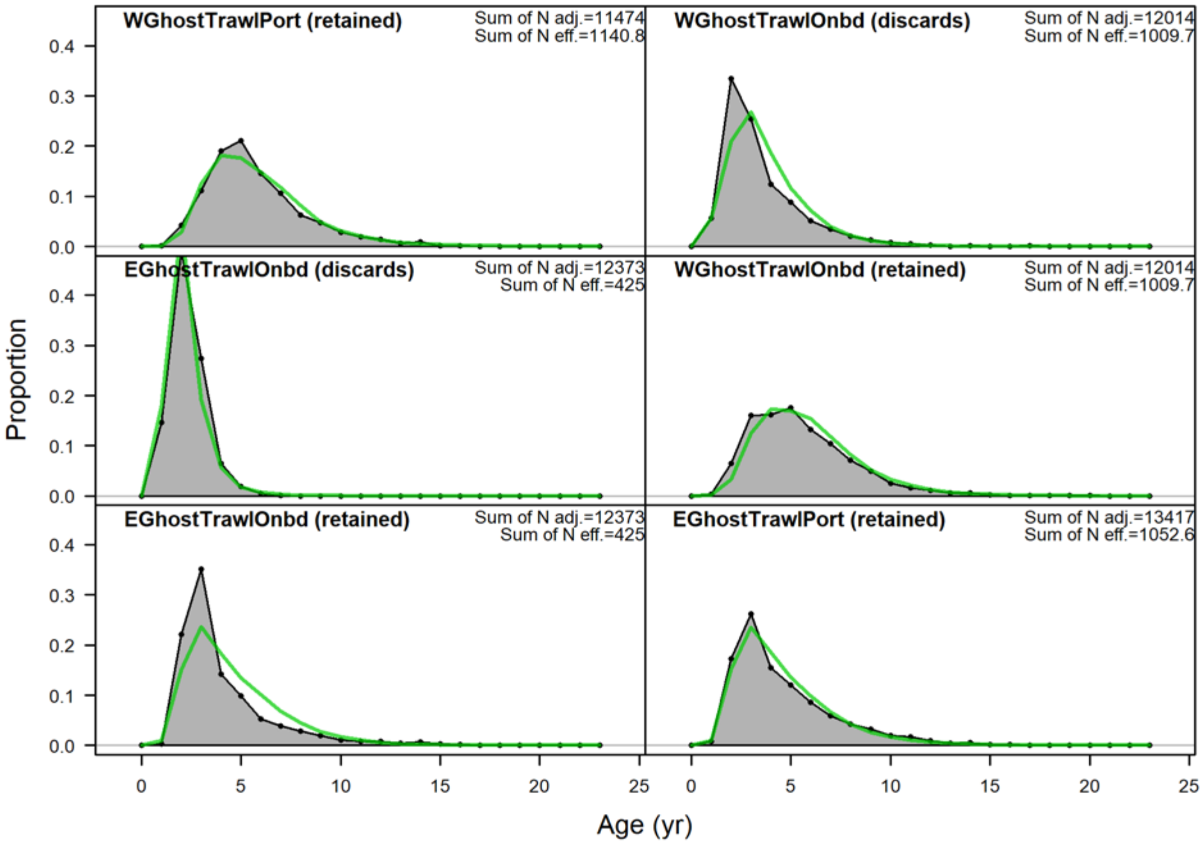


Figure A 11.26. Aggregated fits (over all years) to the implied age compositions for silver warehou displayed by fleet.

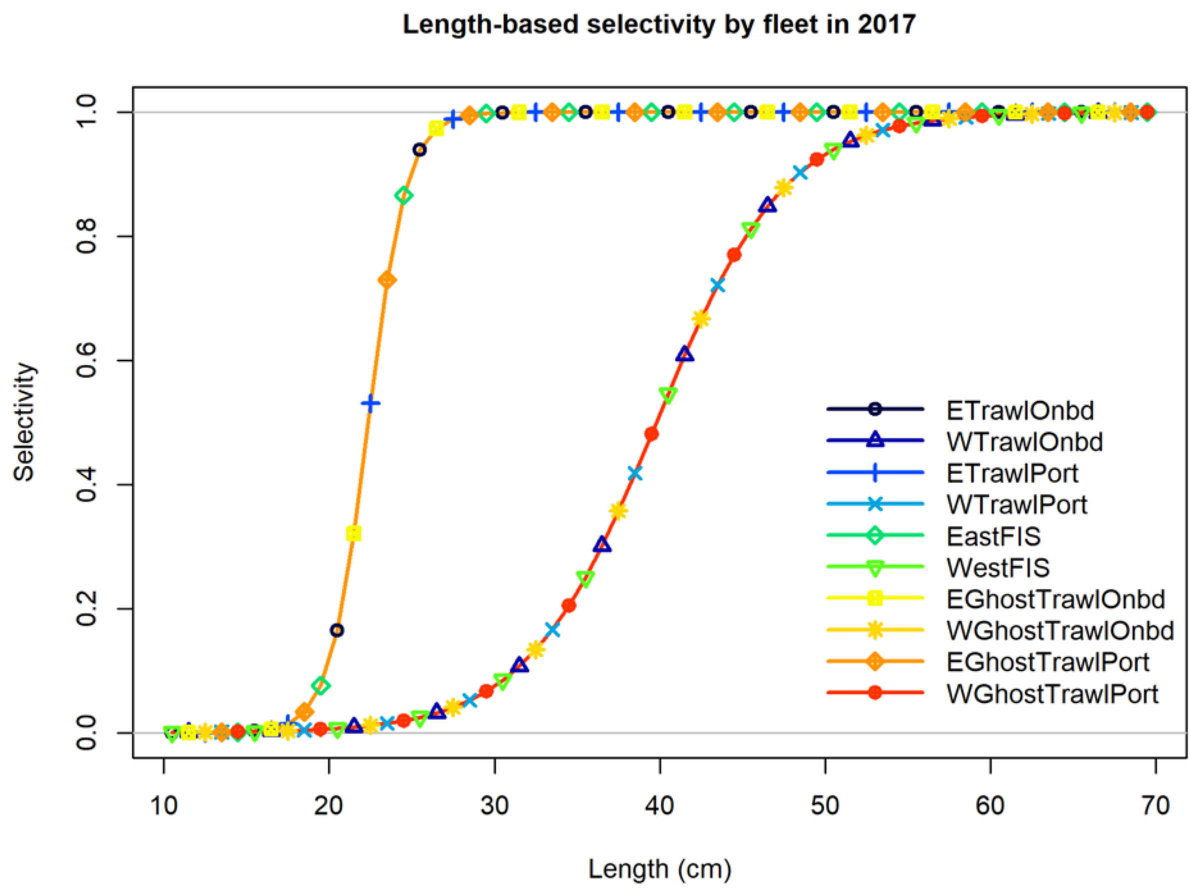


Figure A 11.27. Fits to selectivity for silver warehou fleets.

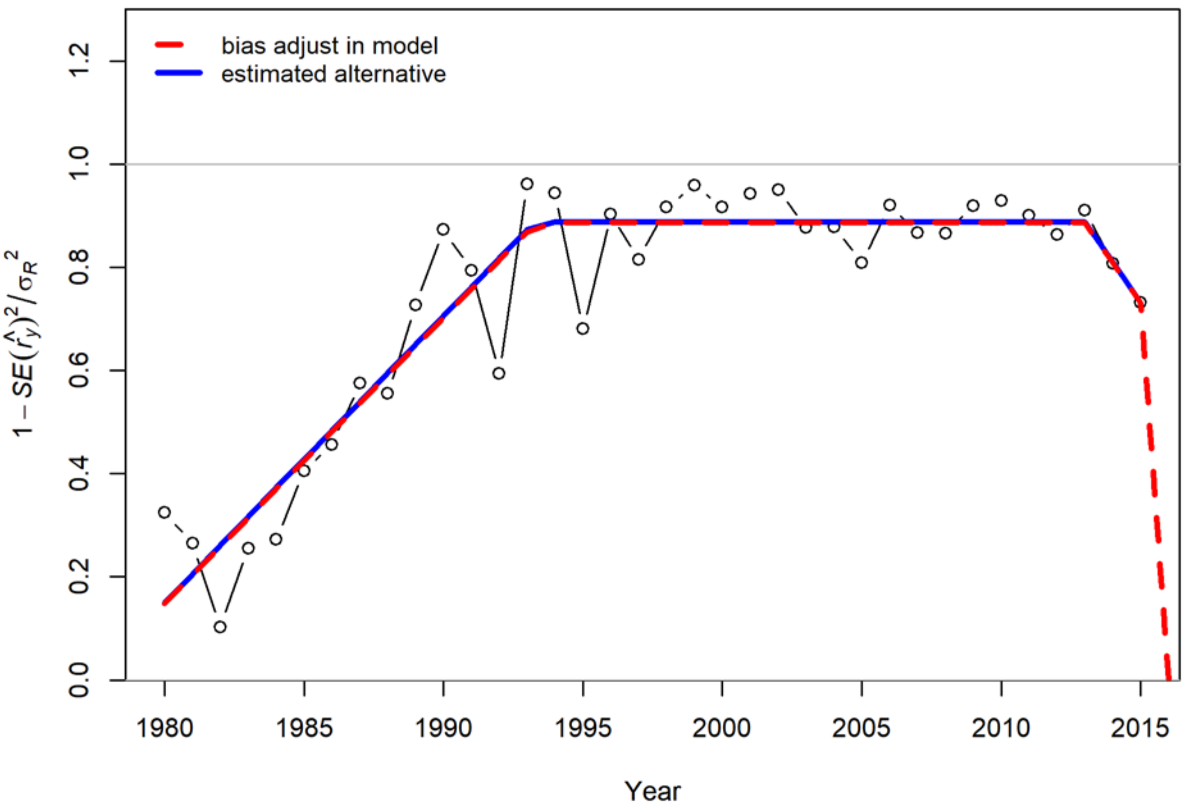


Figure A 11.28. Bias ramp adjustment for silver warehou.

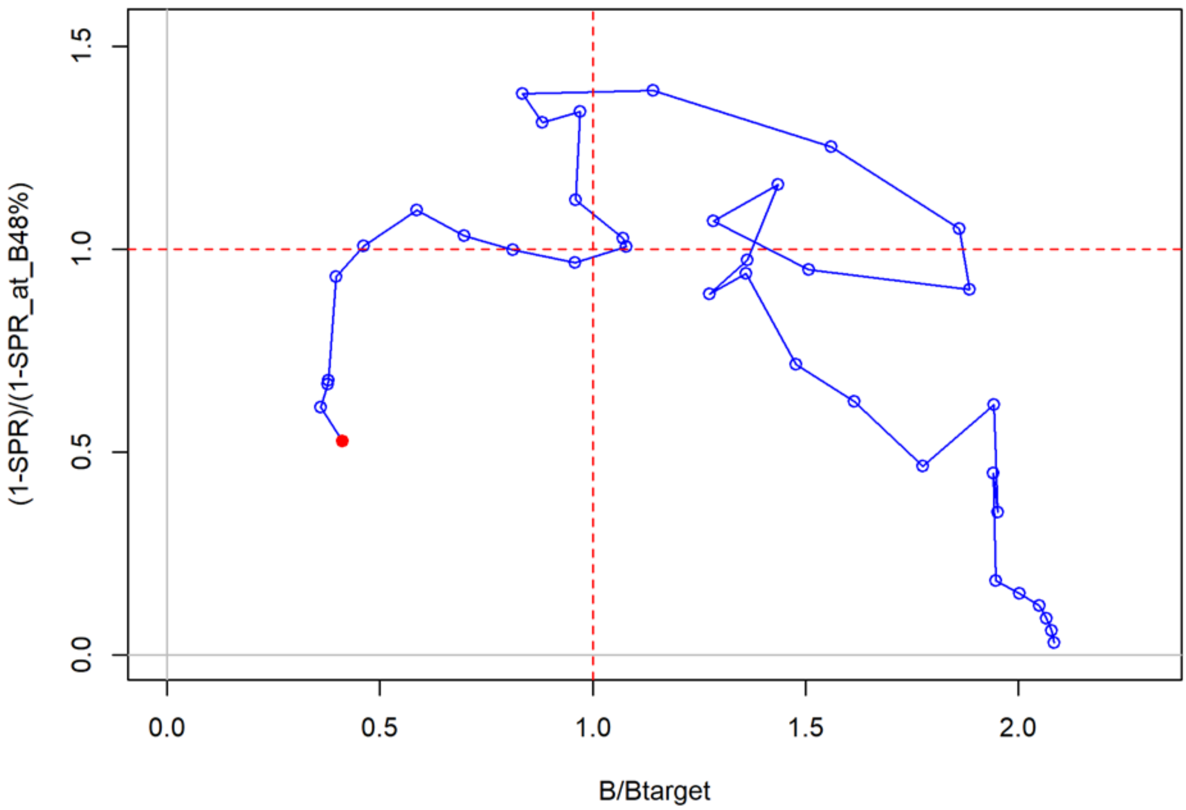


Figure A 11.29. Phase plot of biomass vs SPR ratio.