Status of the widow rockfish resource in 2011

Xi He, Donald E. Pearson, E.J. Dick, John C. Field,
Stephen Ralston, and Alec D. MacCall

National Marine Fisheries Service
Southwest Fisheries Science Center
Fisheries Ecology Division
110 Shaffer Road
Santa Cruz, CA 95060

Email: *xi.he@noaa.gov*

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Executive summary

Stock

This assessment applies to widow rockfish (*Sebastes entomelas*) located in the territorial waters of the U.S., including the Vancouver, Columbia, Eureka, Monterey, and Conception areas designated by the International North Pacific Fishery Commission (INPFC). The stock is assumed to be a single mixed stock and subject to five major fisheries.

Catches

The earliest records of landings of widow rockfish were in 1916. Major U.S. commercial catches of widow rockfish began in the late 1970s, reaching their peak of 29,068 mt in 1981 (Figure ES1). Since the 1981 peak there has been a steady decline in the landings of widow rockfish to 52 mt in 2003 and to 254 mt in 2006 (Table ES1). Catches were mostly from commercial fisheries. Catches from recreational fisheries ranged from less than 2 mt in 2003 to 375 mt in 1982, and has been minimal in recent years. The dominant gears historically have been midwater and bottom trawls. During the early 1990s, bottom trawl catches nearly matched the midwater trawl catches, but the midwater trawl has been the dominant gear in recent years.

Table ES1. Recent catches (mt) of widow rockfish by five fisheries from 2001 to 2010.

Year	Washington fishery	Oregon Midwater Trawl	Oregon Bottom Trawl	California (EM fishery)	At-sea whiting fishery (ASP)	Total
2001	349.5	1297.8	35.0	402.5	173.5	2258.3
2002	64.8	154.7	6.8	50.4	154.9	431.6
2003	14.4	7.6	1.7	4.8	14.5	43.0
2004	31.6	12.3	10.1	25.5	21.2	100.7
2005	42.8	59.0	5.6	11.9	80.1	199.4
2006	44.9	11.3	3.0	12.6	143.3	215.1
2007	37.1	44.6	9.7	19.4	147.7	258.5
2008	49.2	34.7	1.7	36.4	115.0	237.0
2009	105.2	52.8	2.4	8.2	26.0	194.6
2010	62.1	36.6	3.0	11.4	39.0	152.1

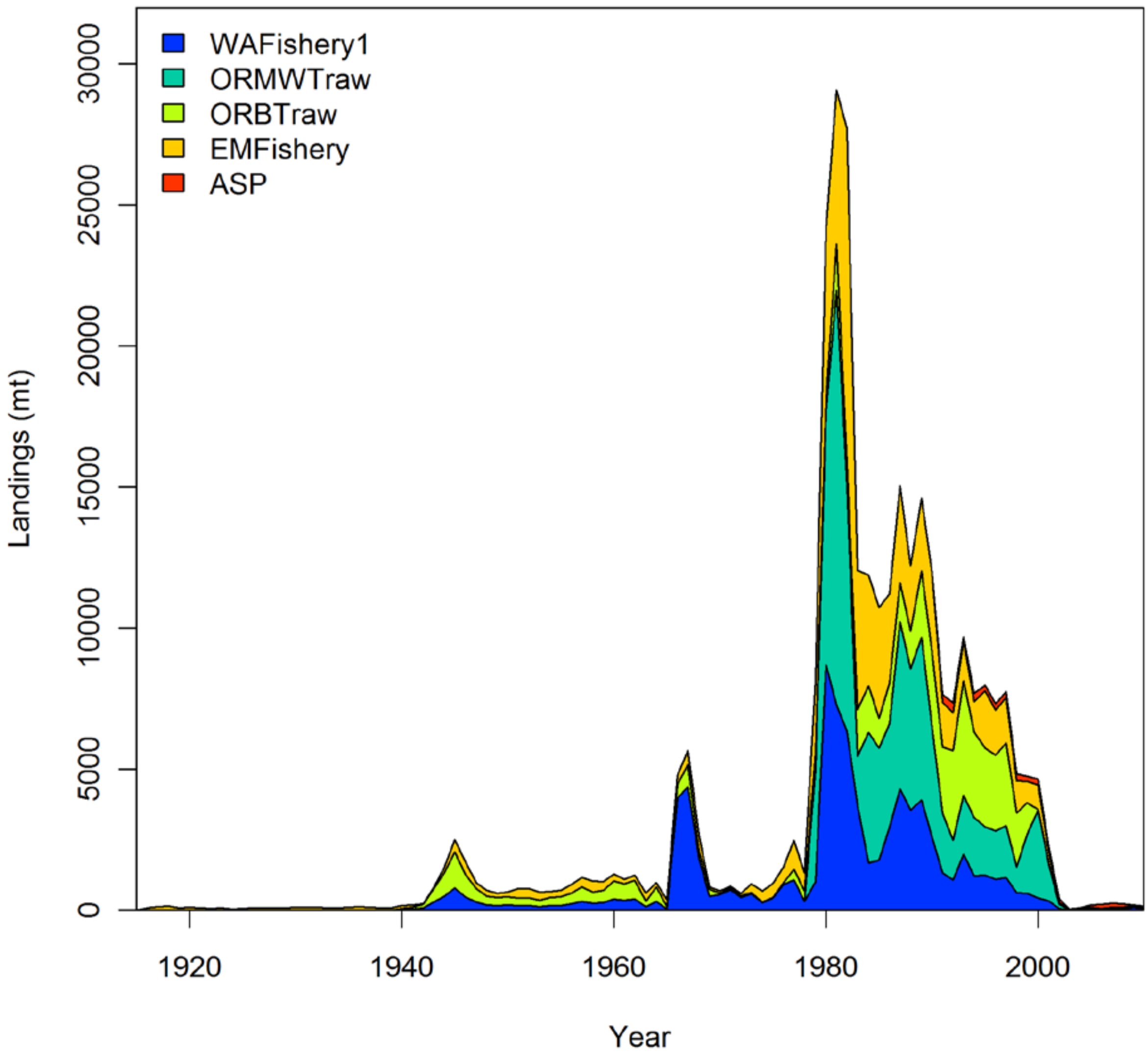

Figure ES1. Total catches of widow rockfish by five fisheries from 1916 to 2010.

Data and assessment

The last full assessment of widow rockfish was conducted in 2009 (He *et al*. 2009a) using the Stock Synthesis (SS) program. A new version (3.22b) of the SS (Methot 2011) was used in this assessment. All fishery data, including landings, length and age composition, and logbook catch rates, were downloaded from the PacFIN, CALCOM, and NORPAC databases, or provided by state and federal agencies. Survey data, including the Alaska Fisheries Science Center (AFSC) triennial survey, the Northwest Fisheries Science Center (NWFSC) trawl survey, and Southwest Fisheries Science Center (SWFSC) mid-water trawl pelagic juvenile survey were also used in the assessment. Catch data from at-sea processing vessels (ASP fishery) were also included in the assessment.

Stock spawning biomass

Stock spawning biomass has shown a steady decline between 1980 and 2001, soon after major commercial fisheries for widow rockfish began. Since 2002, stock spawning biomass has shown an increasing trend. Table ES2 and Figure ES2 show time series of estimated spawning biomass, depletion, and their 95% asymptotic intervals from the base assessment model.

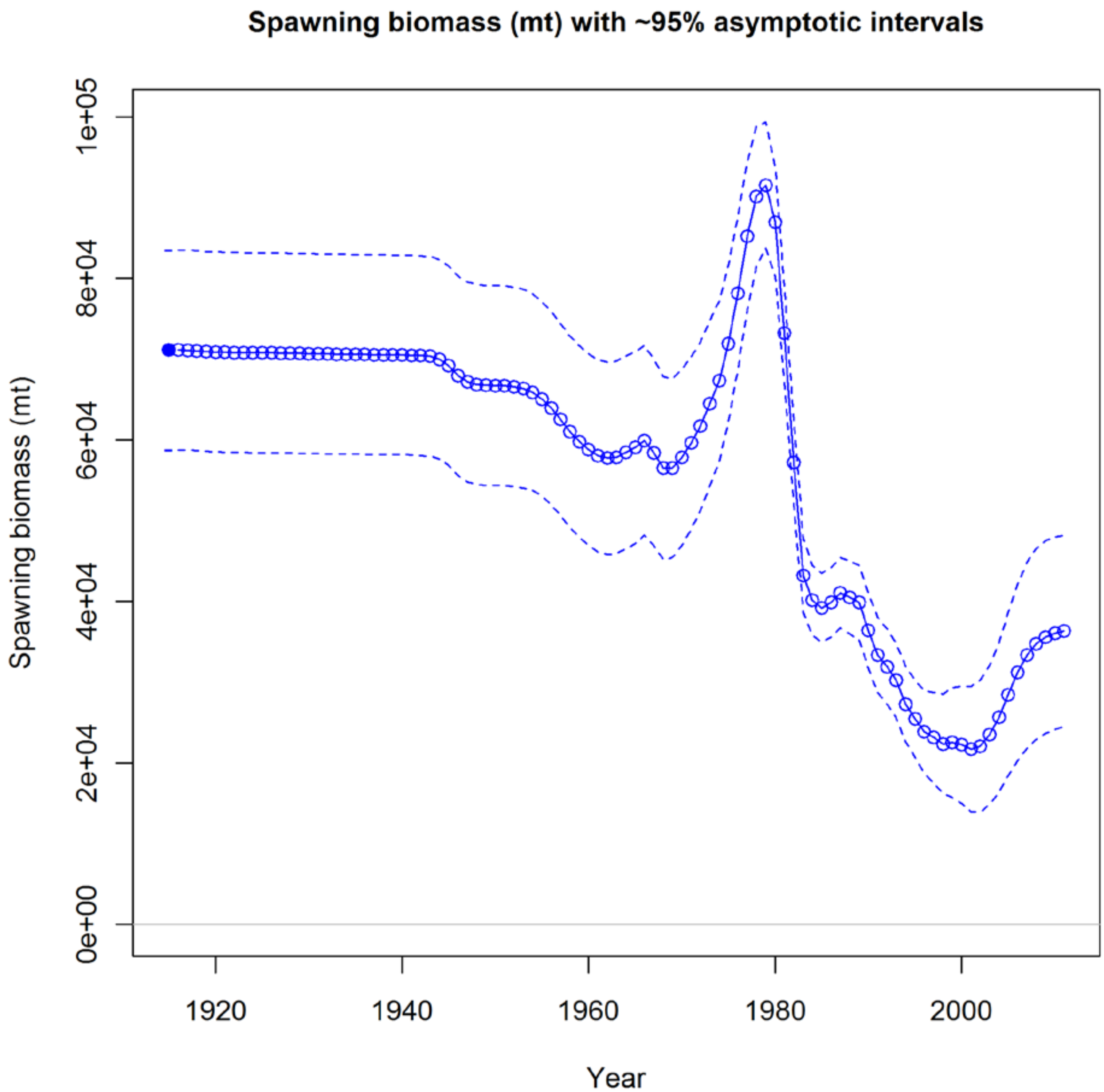

Figure ES2. Estimated spawning biomass of widow rockfish from 1916 to 2011 with 95% asymptotic intervals from the base model.

Table ES2. Estimated stock spawning biomass (mt) and depletion levels (%) of widow rockfish from 2001 to 2011 with 95% asymptotic intervals.

Year	Spawning output (SO)	95% asymptotic interval (SO)	Depletion	95% asymptotic interval (depletion)
2001	21732	±7767	30.6	±7.9
2002	22074	±8176	31.0	±8.2
2003	23491	±8625	33.0	±8.6
2004	25652	±9247	36.1	±9.0
2005	28441	±10085	40.0	±9.7
2006	31178	±10898	43.8	±10.3
2007	33350	±11494	46.9	±10.7
2008	34728	±11812	48.8	±10.8
2009	35545	±11921	50.0	±10.7
2010	36063	±11914	50.7	±10.4
2011	36342	±11814	51.1	±10.1

Recruitment

The model estimated time series of recruitment of age-0 fish from 1948 to 2009. The highest recruitment occurred in 1970 (Figure ES3). Recruitments remained generally low in the early 1990s and have been very low since 2001 as compared to the long-term average (Figure ES3). As in the past assessments, uncertainties in estimation of recruitment remain high.

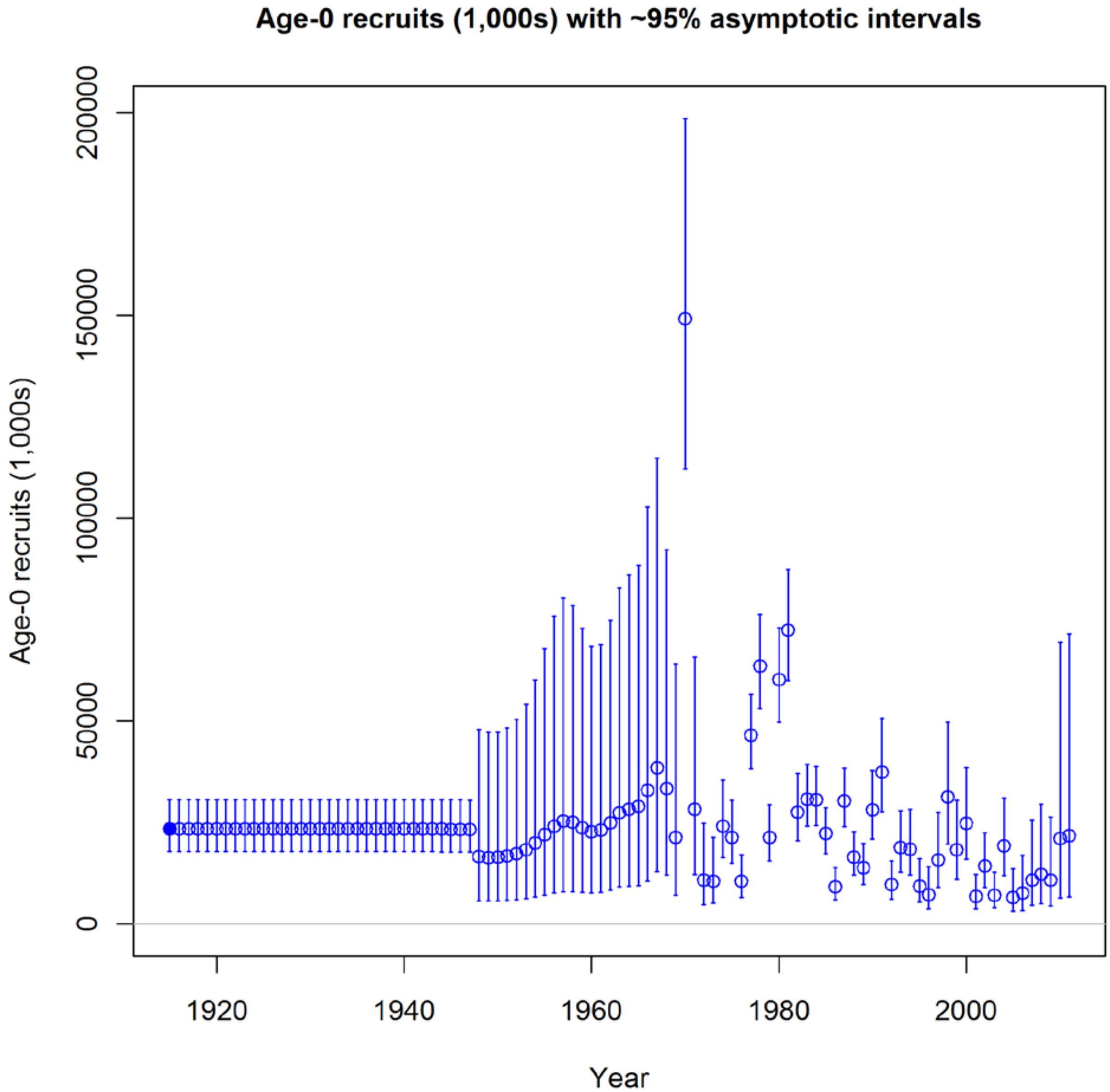

Figure ES3. Estimated recruitment of widow rockfish and 95% of asymptotic confidence intervals from 1916 to 2009.

Reference points

A stock that has declined to less than 25% of its unfished spawning biomass is considered "overfished" until it rebuilds to 40% of its unfished spawning biomass. Such a stock is managed under the rebuilding plan while it is in the precautionary zone and not under the normal control rules specified for a stock in the precautionary zone (i.e. the 40-10 rule).

The spawning biomass in 2011 as a percentage of unfished spawning biomass is the population status (depletion). The estimated depletion in 2011 is 51.1% with 95% of asymptotic intervals of 41.0% and 61.2% (Table ES2 and Figure ES4). The management target for widow rockfish is 40% of unfished spawning biomass. A summary of reference points is listed in Table ES4.

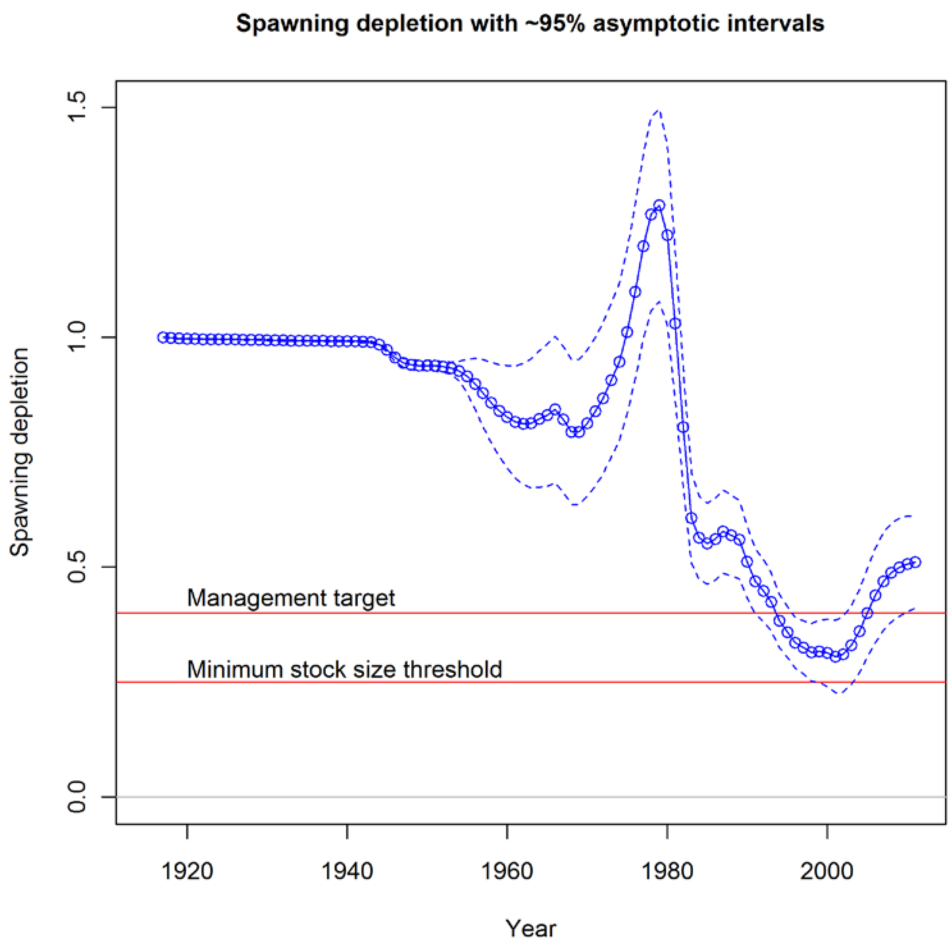

Figure ES4. Time series of depletion from 1916 to 2011 with 95% asymptotic intervals. Levels of management target and minimum stock size threshold are also shown.

Table ES4. Summary of reference points for widow rockfish from the base case model.

Reference term	Estimated value	Asymptotic interval (95%)
Unfished spawning biomass (mt)	71126	58761-83491
Unfished recruitment (*1000)	23392	17024-29760
Reference points based on $SB_{40\%}$		
MSY Proxy Spawning output ($SB_{40\%}$)	28451	23504-33396
SPR resulting in $B_{40\%}$ ($SPR_{SB40\%}$)	0.447	0.447-0.447
Exploitation rate resulting in $SB_{40\%}$	0.079	0.075-0.086
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	5077	4050-6130
Reference points based on SPR proxy for MSY		
Spawning biomass at SPR (SB_{SPR}) (mt)	32315	26862-38167
$SPR_{MSY-proxy}$	0.5	NA
Exploitation rate corresponding to SPR	0.067	0.063-0.071
Yield with $SPR_{MSY-proxy}$ at SB_{SPR} (mt)	4758	3797-5718
Reference points based on estimated MSY values		
Spawning biomass at *MSY* (SB_{MSY}) (mt)	18161	15030-21292
SPR_{MSY}	0.314	0.312-0.316
Exploitation Rate corresponding to SPR_{MSY}	0.121	0.115-0.128
MSY (mt)	5490	4374-6606

Exploitation status

This assessment indicates that the widow rockfish population is at 51.1% of virgin spawning biomass in 2010 with an exploitation rate below 1% (Table ES5) and an equilibrium SPR of 97.5% (Figure ES5). However, the population is considered to be rebuilt (Figures ES4 and ES6).

Table ES5. Time series of SPR (spawning potential ratio) and total exploitation rate of widow rockfish from 2001 to 2010.

Year	Spawning potential ratio (SPR)	Exploitation rate
2001	0.6081	0.0482
2002	0.8965	0.0089
2003	0.9888	0.0008
2004	0.9770	0.0018
2005	0.9589	0.0033
2006	0.9590	0.0034
2007	0.9543	0.0040
2008	0.9598	0.0036
2009	0.9676	0.0029
2010	0.9746	0.0022

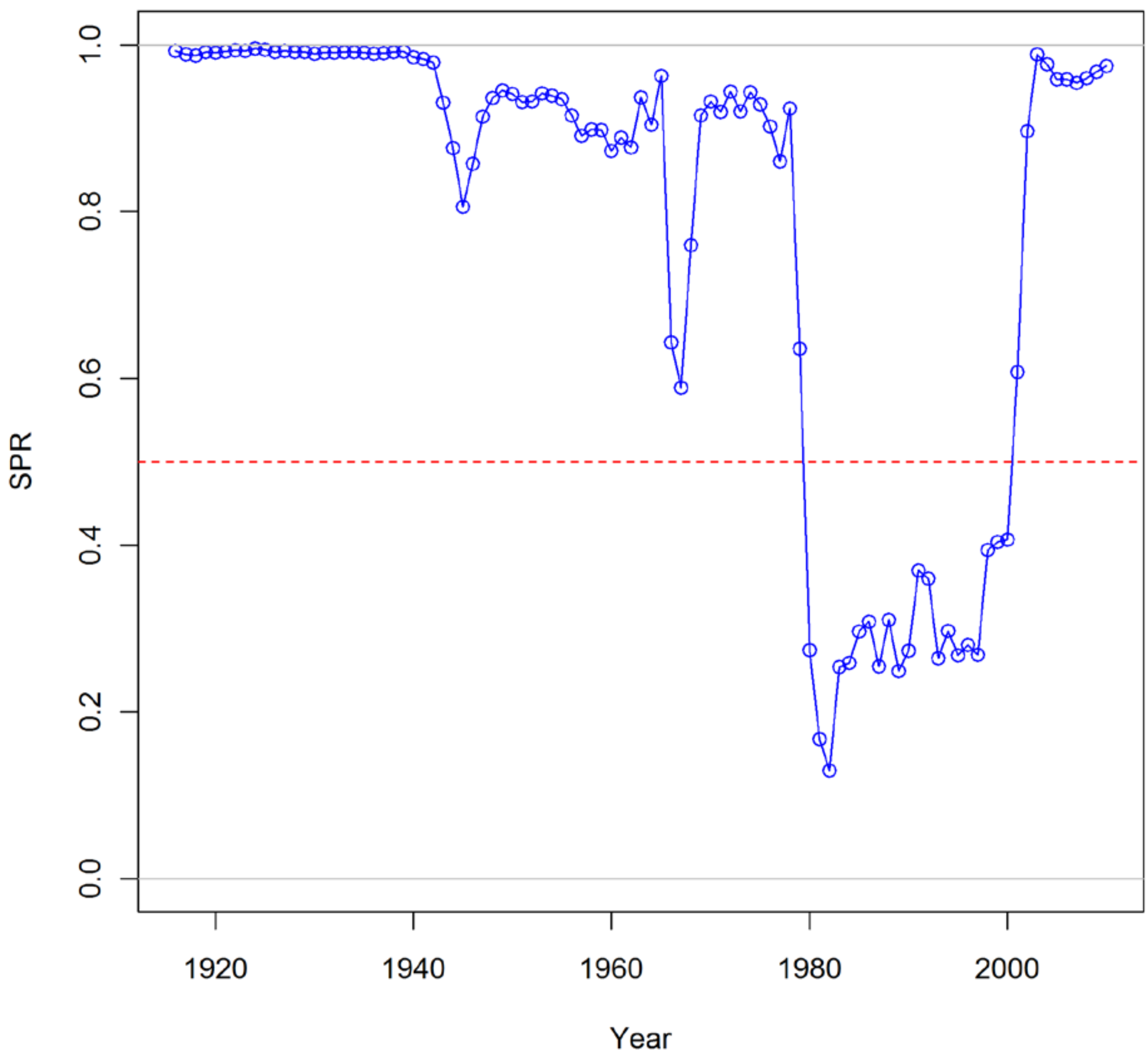

Figure ES5. Time series of estimated equilibrium spawning potential ratios (SPR) from 1916 to 2011. The target SPR level of 0.5 is also shown. Values below the target level indicate that overfishing occurred.

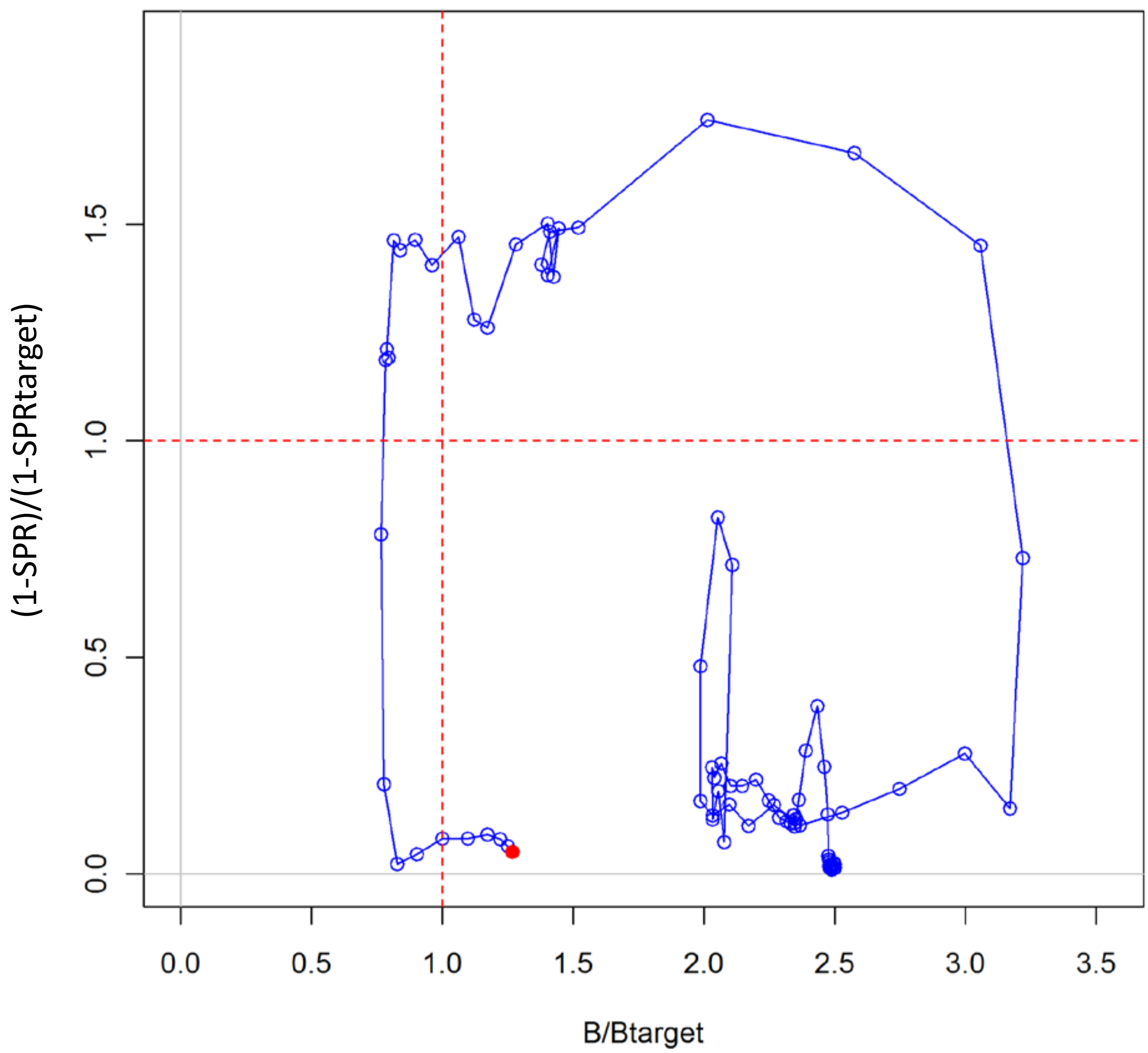

Figure ES6. Phase plot of estimated annual spawning potential ratios relative to the target of 0.5 and estimated spawning output relative to the target of SB40%. The last point on the lower-left quadrant corresponds to the estimated value in 2011 (red).

Management performance

Widow rockfish was declared overfished in 2001. Optimal yield (OY), allowable biological catch (ABC), and catches of recent years are listed in Table ES6.

Table ES6. Management performance in obtaining the harvest guideline for widow rockfish. Harvest guideline and allowable biological catch (ABC) are taken from Council documents.

Year	Harvest Guideline or OY (mt)	Allowable Biological Catch (mt)	Catches (mt)
1999	5,090	5,750	4,770
2000	5,090	5,750	4,661
2001	2,300	3,727	2,258
2002	856	3,727	432
2003	832	3,871	43
2004	284	3,460	101
2005	285	3,218	199
2006	289	3,059	215
2007	368	5,334	259
2008	368	5,144	237
2009	522	7,728	195
2010	509	6,937	152
2011	600	4,872	
2012	600	4,705	

Unresolved problems and major uncertainties

1. As in the past assessments, there exist great uncertainties in estimating the stock-recruitment relationship. The sensitivity analysis in this assessment shows that small changes in the steepness parameter (*h*) can lead to large changes in point estimates for stock status and management reference points.
2. Estimates of recruitment in recent years are highly uncertain and they are key factors in determining future trajectory of the stock (He *et al*. 2003a, 2006b, 2007b, 2009a).
3. The primary source of information on trends in abundance of widow rockfish is the Oregon bottom trawl logbook data, which is a questionable source of information for widow rockfish. In addition, no information after 1999 in the Oregon bottom trawl logbook data can be used in the assessment because the catch rates were very low due to trip limits and other management regulations. Based on a recommendation by the 2003 STAR panel, triennial survey indices have been used since 2005, but catches in the survey were low and the survey was discontinued in 2004. The NWFSC survey provided abundance indices in recent years, but the time series is short. Also, it is a bottom trawl survey, and does not adequately sample mid-water habitat of widow rockfish.

Forecasts

Widow rockfish was declared to be overfished in 2001. Forecasts based on uncertainties in stock-recruitment estimate and a set of future catch streams are provided in the next section (Decision Table).

Decision table

As in the past assessments, stock-recruit steepness is the single greatest source of uncertainty in the assessment. In the base model, steepness was fixed at the level of 0.76 (Dorn's prior). The decision table was developed to bracket model uncertainty in widow rockfish productivity with alternative values of steepness. The 12.5% and 87.5% quantiles from prior distribution on *h* translate into steepness of 0.54 and 0.95 respectively. This range was considered reasonable to account for uncertainty associated with steepness. It was, however, agreed to shift this range to lower steepness values to (a) take account of the data which, while not greatly informative, did provide some evidence for a lower steepness value, and (b) provide continuity by considering the value of steepness used in the 2009 assessment (0.41). As a result, steepness values of 0.41 and 0.90 were used for the low and high states of nature. Future catch scenarios at OFL and two catch streams between 2011 and 2022 were used as alternative management decisions (Table ES7). Constant catch streams requested by the GMT along with two states of nature were also presented (Table ES8).

Table ES7. Decision table based on three states of nature (determined by *h* values) and three catch streams.

			State of nature					
			h = 0.41		Base case (h=0.76)		*h* = 0.90	
Management decision	Year	Catch (mt)	Depletion (%)	Spawning biomass (mt)	Depletion (%)	Spawning biomass (mt)	Depletion (%)	Spawning biomass (mt)
40/10 adjustment (*h*=0.41)	2011	600	30.0	22765	51.1	36342	55.6	39240
	2012	600	29.4	22288	50.7	36053	55.2	38978
	2013	2584	28.6	21686	49.9	35514	54.5	38429
	2014	2280	26.4	19996	47.6	33847	52.0	36732
	2015	2072	24.8	18807	46.0	32742	50.4	35593
	2016	1985	23.9	18154	45.4	32277	49.7	35091
	2017	2008	23.8	18045	45.7	32515	50.0	35296
	2018	2096	24.2	18346	46.9	33339	51.1	36096
	2019	2200	24.8	18787	48.4	34420	52.7	37165
	2020	2289	25.3	19202	50.0	35562	54.3	38308
	2021	2354	25.7	19530	51.6	36696	55.9	39460
	2022	2394	26.0	19751	53.1	37779	57.5	40576
Constant catch (3500mt)	2011	600	30.0	22765	51.1	36342	55.6	39240
	2012	600	29.4	22288	50.7	36053	55.2	38978
	2013	3500	28.6	21686	49.9	35514	54.5	38429
	2014	3500	25.7	19472	46.8	33319	51.3	36204
	2015	3500	23.2	17618	44.3	31540	48.7	34389
	2016	3500	21.4	16233	42.6	30327	47.0	33137
	2017	3500	20.3	15407	41.9	29827	46.2	32601
	2018	3500	19.8	15050	42.1	29973	46.4	32721
	2019	3500	19.7	14910	42.8	30466	47.0	33201
	2020	3500	19.5	14815	43.7	31111	48.0	33853
	2021	3500	19.3	14675	44.7	31826	49.0	34596
	2022	3500	19.0	14439	45.8	32548	50.1	35370
OFL from base model	2011	600	30.0	22765	51.1	36342	55.6	39240
	2012	600	29.4	22288	50.7	36053	55.2	38978
	2013	4841	28.6	21686	49.9	35514	54.5	38429
	2014	4435	24.7	18704	45.8	32546	50.2	35429
	2015	4137	21.6	16363	42.6	30270	46.9	33117
	2016	3990	19.4	14702	40.4	28769	44.7	31575
	2017	3961	18.1	13716	39.5	28095	43.7	30863
	2018	4023	17.4	13227	39.5	28100	43.7	30842
	2019	4126	17.0	12916	40.0	28425	44.1	31156
	2020	4217	16.6	12576	40.6	28849	44.8	31591
	2021	4296	16.0	12108	41.2	29293	45.4	32075
	2022	4361	15.1	11468	41.8	29703	46.1	32553

Table ES8a. Decision table based on two states of nature (determined by *h* values) and four future catch streams requested by the GMT.

			State of nature			
			h = 0.41		Base case (*h*=0.76)	
Management decision	Year	Catch (mt)	Depletion (%)	Spawning biomass (mt)	Depletion (%)	Spawning biomass (mt)
Constant catch (1500mt)	2011	600	30.0	22765	51.1	36342
	2012	600	29.4	22288	50.7	36053
	2013	1500	28.6	21686	49.9	35514
	2014	1500	27.2	20619	48.5	34473
	2015	1500	26.1	19839	47.5	33785
	2016	1500	25.6	19443	47.2	33585
	2017	1500	25.7	19515	47.8	34014
	2018	1500	26.4	19993	49.2	35022
	2019	1500	27.2	20655	51.1	36325
	2020	1500	28.1	21354	53.1	37737
	2021	1500	29.0	22029	55.1	39182
	2022	1500	29.9	22648	57.1	40603
Constant catch (2000mt)	2011	600	30.0	22765	51.1	36342
	2012	600	29.4	22288	50.7	36053
	2013	2000	28.6	21686	49.9	35514
	2014	2000	26.8	20332	48.1	34184
	2015	2000	25.4	19283	46.7	33223
	2016	2000	24.6	18639	46.1	32770
	2017	2000	24.4	18486	46.3	32967
	2018	2000	24.7	18755	47.5	33759
	2019	2000	25.3	19217	49.0	34860
	2020	2000	26.0	19720	50.7	36082
	2021	2000	26.6	20197	52.5	37347
	2022	2000	27.2	20609	54.3	38596
Constant catch (2500mt)	2011	600	30.0	22765	51.1	36342
	2012	600	29.4	22288	50.7	36053
	2013	2500	28.6	21686	49.9	35514
	2014	2500	26.4	20046	47.7	33896
	2015	2500	24.7	18729	45.9	32663
	2016	2500	23.5	17838	44.9	31957
	2017	2500	23.0	17460	44.9	31922
	2018	2500	23.1	17520	45.7	32499
	2019	2500	23.4	17783	47.0	33398
	2020	2500	23.8	18089	48.4	34429
	2021	2500	24.2	18364	49.9	35513
	2022	2500	24.5	18565	51.4	36589

Table ES8b. Decision table based on two states of nature (determined by *h* values) and four future catch streams requested by the GMT.

			State of nature			
			h = 0.41		Base case (*h*=0.76)	
Management decision	Year	Catch (mt)	Depletion (%)	Spawning biomass (mt)	Depletion (%)	Spawning biomass (mt)
Constant catch (2000mt)	2011	600	30.0	22765	51.1	36342
	2012	600	29.4	22288	50.7	36053
	2013	3000	28.6	21686	49.9	35514
	2014	3000	26.0	19758	47.2	33607
	2015	3000	24.0	18171	45.1	32100
	2016	3000	22.4	17032	43.8	31140
	2017	3000	21.7	16430	43.4	30871
	2018	3000	21.5	16281	43.9	31232
	2019	3000	21.5	16341	44.9	31928
	2020	3000	21.7	16447	46.1	32765
	2021	3000	21.8	16516	47.3	33665
	2022	3000	21.7	16500	48.6	34565

Research and data needs

1. More studies on the feasibility of estimating stock-recruitment relationships for given model structures and data availability will be very beneficial.
2. The long-term recruitment index is a key time series in the stock assessment. Continuation of the NMFS/PWCC mid-water juvenile trawl survey should provide key information on the recruitment strength of widow rockfish.
3. Re-ageing of widow rockfish otoliths from California and possibly from Oregon and Washington fisheries in 1980’s and 1990's. The conditional age-at-length data from these fisheries showed that ages-at-length were highly variable in these years. For example, fish from the same length groups could range over 20 years in age. Re-ageing these data could improve the precision of growth estimates for assessment models. It will be useful to derive a separate ageing error vector from the re-aged data from the early years.
4. Additional research to determining the magnitude of spatial and temporal differences in biological traits (growth, maturity, fecundity, etc.)

1. Introduction

Widow rockfish (*Sebastes entomelas*) is an important commercial groundfish species belonging to the scorpionfish family (Scorpaenidae). It ranges from southeastern Alaska to northern Baja California, where it frequents rocky banks at depths of 25-370m (Eschemeyer *et al*. 1983, Wilkins 1986). In those habitats it feeds on small pelagic crustaceans and fishes, including especially *Sergestes similis*, myctophids, and euphausiids (Adams 1987). There is no evidence that separate genetic stocks of widow rockfish occur along the Pacific coast and the species has been treated as one stock with several separate fisheries (Hightower and Lenarz 1990; Rogers and Lenarz 1993; Ralston and Pearson 1997, Williams *et al*. 2000, Field and Ralston 2005).

A mid-water trawl fishery for widow rockfish developed in the late 1970s and increased rapidly in 1980-82 (Gunderson 1984, Quirollo 1987, Figure 1). Large concentrations of widow rockfish had evidently gone undetected because aggregations of this species form at night and disperse at dawn, an atypical pattern for rockfish. Since the fishery first developed, substantial landings of widow rockfish have been made in all three west-coast states.

Management of the fishery began in 1982 when 75,000 lbs. trip limits were introduced in an effort to curb the rapid expansion of the fishery (Appendix A). These were reduced to 30,000 lbs. in 1983 and the fishery was managed by altering trip limits within the fishing season. A 10,500 mt/yr Allowable Biological Catch (ABC) for widow rockfish was instituted in 1983, but no harvest guideline was established. This form of management continued with alterations in ABC and trip limits until 1989 when a 12,100 mt/yr harvest guideline was implemented (Appendix A). From 1994 to 1997 the harvest guideline was changed to 6,500 mt and then reduced to 5,090 mt for 1998 to 2000. Based on the 2000 stock assessment, the population was declared overfished (Williams *et al*. 2000), and a series of management actions were taken by the Pacific Fishery Management Council to protect the stock (Appendix A). As consequence, stock assessments for the population were conducted in 2002, 2004, 2006 and 2009 along with rebuilding analyses of the stock (He *et al*. 2003a, 2003b, 2006a, 2006b, 2007a, 2007b, 2009a, and 2009b). Table 1 shows the management performance and harvest guidelines for widow rockfish from 1989 to 2010.

This assessment employs an age-based population model similar to those used in previous assessments (Ralston and Pearson 1997, Williams *et al*. 2000, He *et al*. 2003b, He *et al*. 2006a, He *et al*. 2007a, He *et al.* 2009a). As in the 2009 assessment model, this assessment used the Stock Synthesis program developed by Richard Methot (V3.22b, Methot 8/3/2011).

This assessment employed major modifications of model structures and utilized new data that were not available or not used in the previous assessments. Unlike all previous assessments that used two-area assessment models, this assessment uses a one-area model by assuming that there are no significant differences in biological characteristics, such as growth, maturity, and fecundity, along the entire fishing region. A new fishery, the at-sea whiting processor (ASP) fishery whose catches were combined into other fisheries, is separated from other fisheries and treated as an independent fishery in this assessment because new age and length composition data become available recently. Inclusion of recently assembled length composition data also allows the assessment to internally estimate growth and natural mortality rates. Overall, modifications to this assessment result in a more parsimonious model with increased potential to utilize available data for future assessments.

2. Data

A summary of data available to the assessment is plotted in Figure 2, including all fisheries and surveys, time frames of annual catches, abundance indices, and length and age composition data.

2.1 Biological data and parameters

2.1.1 Growth and fecundity

Growth in length of widow rockfish has been described using von Bertalanffy growth equations in published papers by Lenarz (1987) and Pearson and Hightower (1991). In their analyses it was determined that females attain a larger size than males, and, therefore, we chose to use sex-specific estimates of length-at-age. The one-area base model assumes that sex-specific growth does not change from north to south. In all previous assessments, we chose to use the estimates listed in Pearson and Hightower (1991). The growth parameters were then transformed to the format of the Schnute parameterization, expressed as *L1*, *L2*, and *K*. In this assessment, growth parameters for both sexes, including growth CVs, were estimated internally in the assessment model. Estimated growth curves are presented in Figure 3.

Sex-specific weight-at-age estimates were computed using the length-at-age estimates above in combination with sex-specific length-weight regressions for widow rockfish that were developed by Barss and Echeverria (1987). The length-weight regression equation is $W = \alpha L^{\beta}$, where W is the weight (kg) and L is the length (cm) and is the same for both areas. The sex-specific parameter values used in this assessment are listed below:

Parameter	Females	Males
α	0.00000545	0.00001188
β	3.28781	3.06631

Estimates of maturity and fecundity of female widow rockfish were obtained from Barss and Echeverria (1987) and Boehlert *et al*. (1982), respectively. Age-specific maturity estimates were taken directly from the literature instead of fitting a parametric model (Figure 4). A recent meta-analysis of rockfish fecundity found no significant relationship between body weight and weight-specific fecundity in widow rockfish (Dick 2009). For this reason, this assessment used spawning biomass as measurement of stock abundance, which is different from spawning outputs (millions of eggs) that have been used in the past assessments. This measurement is more comparable to catch specifications that are used in the management decisions.

2.1.2 Natural mortality

In previous assessments, natural mortality (*M*) was assumed to be constant (0.125 yr^{-1} or 0.15 yr^{-1}) for both sexes and all ages in all years. Many test runs were conducted in an attempt to estimate *M* in the models in previous assessment and STAR Panel reviews. These runs, however, failed to adequately estimate *M*, probably due to dome-shaped selectivity functions that were implemented in the models. A recent study has shown that there is strong interaction between age-dependent *M* and dome-shaped selectivity functions in stock assessment models (He *et al*. 2011).

In this assessment, *M* is still assumed to be constant for all ages and all years, but it is assumed to be sex-specific and is estimated in the models. Internal estimation of *M* is feasible in this assessment because selectivity functions for one fishery and surveys are set to be asymptotic. Sex-specific prior distributions for *M* were provided by Owen Hamel (NWFSC, personal communication). The priors are derived from information on maximum ages, mean temperature where widow rockfish reside, and gonadosomatic indices. The estimated natural mortality values are 0.124 yr^{-1} for females and 0.129 yr^{-1} for males, respectively.

2.2 Fishery catches

In all previous assessments, four fisheries were identified and used in assessment models (Ralston and Pearson 1997, He *et al*. 2009a). They were: (1) Vancouver-Columbia fishery in Washington State (WAFishery1); (2) Oregon mid-water trawl (ORMWTraw); (3) Oregon bottom trawl (ORBTraw); and (4) Eureka, Monterey, and Conception (EMFishery). In this assessment, landings from the at-sea whiting fishery (at sea processor, ASP) was separated from these fisheries (primarily from the Oregon mid-water trawl fishery) and treated as a separated fishery. The main reason to separate the ASP fishery from other fisheries was that for the first time, age and length data from the at-sea whiting fishery (ASP) became available to the assessment.

Total fishery catches from 1916 to 2011 were presented in Figure 1 and Table 2. These catch statistics were derived from the following sources:

1. Landings from all fisheries, except the ASP fishery, between 1981 and 2001, and between 2008 and 2010, were extracted from the PacFIN database, and landings between 2002 and 2007 were the same as in the 2009 assessments, which were constructed from the West Coast Groundfish Observer Program.
2. The very small annual recreational catches of widow rockfish from 1980 to 2010 were extracted from the Marine Recreational Fishing Statistics Survey (MRFSS) database. Because there were no estimates in the database between 1990 and 1992, catches for these three years were linearly interpolated. These catches were lumped into another fisheries by state.
3. All foreign landings from 1966 to 1972, and some landings from 1973 to 1976 were taken directly from Rogers (2003), who compiled summaries of foreign catches in that period.
4. Some landings from 1973 to 1976 and all landings from 1977 to 1979 were directly copied from the 2000 assessment (Williams *et al*. 2000).
5. Historical California landing data from 1916 to 1968 recently reconstructed by Ralston *et al*. (2010).
6. Historical Oregon landing data from 1915 to 1986 were recently reconstructed by Gertseva *et al*. (2010).
7. Historical Washington landings before 1972 were assumed to be 72% of all Oregon historical catches. The 72% is an average ratio of Washington catches over all Oregon catches from 1981 to 2010.
8. Landings from the ASP fishery from 1991 to 2007 were provided by the NWFSC (Jim Hastie and Eliza Heery, personal communication), and landings from 2008 to 2010 were downloaded from the NWRO NOAA website (NWRO 2010).

The ASP fishery, which was folded into other fisheries in previous assessments, was treated as a distinct fishery in this assessment. In previous assessment, landing data from these fisheries were pooled over states into INPFC area blocks. These in turn were collapsed into northern and southern areas. Within the southern area, widow rockfish landings were further condensed by summing over gears (i.e., trawl, other commercial, and recreational), providing annual estimates of landings from the southern area fishery (EMFishery). In the northern area, however, landings were partitioned into three separate fisheries (in addition to the ASP fishery): the Oregon midwater trawl fishery (ORMWTraw), the Oregon bottom trawl fishery (ORBTraw), and the remaining catch of widow rockfish from the Washington fisheries (WAFishery1) in the Vancouver-Columbia area. In this assessment, because it is a one-area assessment model, allocations of these four fisheries and their landings were summarized by landing port in each state.

Oregon historical commercial groundfish landings were recently reconstructed by Gertseva *et al*. (2010), which included historical landings of widow rockfish from 1916 to 1986. Summaries of these landings were again grouped into two Oregon fisheries (mid-water and bottom trawl fisheries).

2.2 Fishery discards

The discards of widow rockfish are virtually unknown in most years. Age compositions of discards and landings can be very different (typically smaller fish are discarded) and can be important in determining discard rates (Williams *et al*. 1999). In past assessments, a value of 6% of total weight was assumed discarded for the years 1958-1982 and 16% of total weight for the years 1983-2006 (Hightower and Lenarz 1990, Williams *et al*. 2000, He *et al*. 2003b). The 16% estimate of discards is based on an outdated study by Pikitch *et al*. (1988), which indicated most of the discards of widow rockfish were induced by regulations. The earlier 6% estimated is based on an ad hoc adjustment of the 16% estimate by previous assessment authors (Hightower and Lenarz 1990). The 16% assumed discard rate has become more uncertain in recent years due to changes in regulations. Discard rates since 2007 are considered to be very low (WCGOP 2011). In the 2009 STAR meeting, it was agreed to use WCGOP total mortality estimates for the most recent years.

Total catches for all fisheries were the sum of total landings plus discards. One exception was for the foreign catches from 1966 to 1976 estimated by Rogers (2003), in which estimated catches were assumed to include discards. This was done in a consistent way with the previous assessment. Historical discard rates used in the previous assessments were also used in this assessment. Values of discard rates varied between years. The discard rates were set to be 0.06 between 1916 and 1983, and 0.16 between 1984 and 2006. WCGOP total mortality estimates were used for 2007-2010 period.

2.3 Abundance indices

Four fishery-dependent abundance indices (CPUE) and three fishery-independent survey indices were used in this assessment.

2.3.1 Oregon bottom trawl logbook

Oregon logbook data from 1984 to 1986 were provided by the Oregon Department of Fish and Wildlife, and data from 1987 to 2002 were extracted from the PacFIN database. Catch per unit effort (CPUE) was computed as pounds of fish caught per hour trawled. The data were filtered before the analysis. Only records meeting the following criteria were used in the analysis: (1) the fishing gear code corresponded to bottom trawl or roller gear, (2) hauls were conducted during the months of January, February, or March, and (3) the location of the reported haul fell in the range of 42^{o}30’ N to 46^{o}30’ N latitude and 124^{o}36’ W to 124^{o}54’ W longitude. In addition, records associated with any vessel code or spatial unit that had less than 1000 pounds of widow catch over the entire period (1984 to 2002) were also deleted. Data from 2000 to 2002 were not used in the analysis because widow catches in those three years were very low due to trip limits and other management regulations that had been implemented.

Annual CPUE indices were derived using the Delta-GLM (Generalized Linear Model) method with an additional factor (vessel) included:

$$\log(CPUE) = \mu + Y_i + V_j + L_k + \varepsilon_{ijkl}$$

where μ is the average $\log(CPUE)$, Y_i is a year effect, V_j is a vessel effect, L_k is a spatial (latitude and longitude) effect, and ε_{ijkl} is a normal error term with mean zero and variance σ_ε^2. The back-transformed year-specific CPUE, with bias-correction, was then calculated as:

$$CPUE_i = \exp\left(\mu + Y_i + \bar{V} + \bar{L} + \frac{\sigma_\varepsilon^2}{2}\right)\pi_i$$

where $\bar{V}$ and $\bar{L}$ are the mean effects of vessel and spatial unit, respectively, and π_i is the probability of a positive tow:

$$\pi_i = \frac{\exp(\mu' + y_i' + \bar{V}' + \bar{L})}{1 + \exp(\mu' + y_i' + \bar{V}' + \bar{L})}$$

where μ' is the average, y' is year effect, $\bar{V}'$ is average vessel effect, and $\bar{L}$ is average spatial effect. Derived annual CPUE indices are presented in Table 3, and are identical to those used in the past assessments. Time series of scaled CPUE index, along with the triennial survey indices, are presented in Figure 5. Because there were no new data since the 2003 assessment, the same Oregon bottom trawl logbook indices from the 2002 assessment are used in this assessment. Selectivity for this index was assumed to be same as the Oregon bottom trawl fishery.

2.3.2. Pacific whiting bycatch indices

As in previous assessments (Rogers and Lenarz 1993, Ralston and Pearson 1997, Williams et al. 2000), CPUE indices were computed that measured the incidental catch rate of widow rockfish in the at-sea Pacific whiting fishery. Data from the foreign fishery, joint-venture fishery and domestic fishery were extracted from the NORPAC database.

Full descriptions of how the CPUE indices were derived are in Appendix A of the 2005 Assessment (He *et al*. 2006a). An approach similar to the Delta-GLM analysis of Oregon bottom trawl logbook was used for estimation of the bycatch indices. Three annual CPUE indices for the whiting bycatch in the foreign fishery (ForWBycatch), joint-venture whiting fishery (JVWBycatch), and domestic whiting fisheries (DomWBycatch) were derived and are presented in Table 4. Time series of scaled CPUE index, along with the NWFSC survey indices, are presented in Figure 6. The indices used in this assessment were the same as in previous assessments (He *et al*. 2009a). As recommended by the 2003 STAR Panel, annual CPUE indices from the domestic fishery after 1998 were excluded from the analysis because changes in management measures are expected to have more influence on the CPUE statistic than changes in stock size. Selectivity functions for these three indices were assumed to be same as Oregon mid-water trawl fishery.

2.3.3 Midwater trawl pelagic juvenile survey (SCJuvSurvey)

Every year since 1983 the Groundfish Analysis Branch at NMFS Fisheries Ecology Division in Santa Cruz/Tiburon Laboratory has conducted a midwater trawl survey, which is designed to assess the reproductive success of rockfish spawning, including widow rockfish. Since 2001, the survey was expanded to a coast wide, combined industry and NMFS survey (PWCC/NWFSC: Pacific Whiting Conservation Cooperative and Northwest Fisheries Science Center) (Sakuma et al. 2006). An ANOVA analysis was used to fit all data from the combined survey (Steve Ralston, personal communication). Annual indices along with CVs from 2001 to 2009 are presented in Table 5. The index shows relatively high age-0 abundance in 2002 and 2004. No data from 2010 were available because the northern portion of the survey area was not sampled in that year.

2.3.4 NWFSC bottom trawl survey

Since 2003 the NWFSC has conducted an annual shelf and slope, combined trawl survey. Widow rockfish has rarely been caught in this survey. Total annual catches ranged from as low as 29kg in 2008 to high of 942 kg in 2003. Even so, the survey was kept in the assessment because it is the only available index since 1999 and it thus has potential in the future to detect stock recovery. The survey data were first used in the 2009 assessment, and were updated for this assessment. The survey is based on a stratified random-grid design, covering coastal waters from a depth of 55 m to 1,280 m from Washington to California. Detailed survey information can be found in Keller *et al*. (2007).

The analysis was conducted using a GLMM method developed by the NWFSC staff (John Wallace, personal communication). The CVs were generated from MCMC sampling. Derived index values and associated CVs are presented in Table 6. A time series of the scaled NWFSC survey index, along with other indices, is plotted in Figure 6. Summary of annual numbers of hauls, fish measured for length compositions and fish aged for age compositions from the survey is presented in Table 7.

2.3.5 Triennial bottom trawl survey

The AFSC/NWFSC triennial trawl survey index was not used in the 2003 assessment because of very limited widow catches taken in the survey and very poor fit of the index in the assessment model (He *et al*. 2003a). The 2003 STAR panel recommended the index be analyzed further and be considered for inclusion in the assessment. In the 2005 and 2007 assessments, the analysis of the triennial survey data uses the same Delta-GLM method as for the Pacific whiting bycatch indices. Detailed description of the analysis is in Appendix B of the 2005 assessment (He *et al*. 2006a). In the 2009 assessment, separate and distinct indices were developed for northern and southern areas, delineated by 43^{o} N latitude. In this assessment, because a one-area model was employed, the survey data were re-analyzed by pooling all data together. The analysis used a GLMM method developed by staff at the NWFSC (John Wallace, personal communication). The CVs were generated from MCMC sampling. The derived index values and associated CVs are presented in Table 8. Time series of scaled CPUE index, along with the Oregon bottom trawl logbook indices, are presented in Figure 5. Numbers of samples and fish measured for length compositions for the survey are presented in Table 9.

Although the mean dates of the triennial survey shifted from the middle of August (1980-1992) to the middle of July (1995-2004), this assessment assumed this change had no effect on the index, i.e., all data from 1980 to 2004 were treated collectively. This is because there is no evidence to support a seasonal migration of widow rockfish that would affect availability. In addition, too few data, both in catches and length compositions, would be available if the time series were broken in two.

2.4 Age and length composition data

2.4.1 Age composition data

Widow rockfish otolith samples have been collected coast wide since 1989 and aged at the NMFS SWFSC Fisheries Ecology Division in Santa Cruz (formerly the Tiburon Laboratory) using the break-and-burn aging method (Pearson and Hightower 1991). Most fish were aged by Fisheries Ecology Division staff (Don Pearson). Prior to 1989, the ages of all Vancouver-Columbia fish were obtained by researchers in the State of Washington, who used surface readings. Prior to 1982, Oregon widow rockfish were aged by investigators in Oregon, who used the break-and-burn ageing method. At the 2009 widow rockfish STAR Panel, it was requested that a comparison be conducted to see if significant bias exists between the break-and-burn and surface ageing methods. The study was completed in 2010, showing no significant bias between these two ageing methods (see report in Appendix B).

Age validation of widow rockfish was conducted by marginal increment analysis (Lenarz 1987). Hyaline-zone formation, the measure of annual growth, appears to occur between December and April (Pearson 1996). For consistency all widow rockfish are assumed to be born on January 1, which is early in the spawning season. Variation in the timing of hyaline-zone formation occurs between fish sampled from Washington and California, which could affect age determination. Knowledge of this timing variation can be used to avoid mis-ageing. Ultimately, variation in hyaline-zone formation is unlikely to result in major age discrepancies (Pearson 1996).

Washington provided ageing data from samples collected during commercial market sampling. The data were then expanded using relative catches from US Vancouver and Columbia areas. Oregon provided raw sample data which were expanded using methods described in Sampson and Crone (1997). California age data were extracted and expanded from the CALCOM database (Pearson and Erwin 1997). For the first time, otolith samples from the ASP fishery became available to the assessment. Otolith samples from 2008 and 2010 were aged using the same methods as the other fisheries, and age composition data were also similarly compiled. Complete age and length compositions of both sexes for the five fisheries from 1978 to 2010 are presented in Figures 8 to 20.

In the past assessments, ageing errors were determined by a simple method of determining age-reading agreements between age 5 and age 20 (Rogers and Lenarz 1993; Ralston and Pearson 1997; He *et al*. 2009a). Ageing errors for other age groups were then linearly interpolated. For this assessment, a new ageing error vector was developed using a recently developed program (Punt 2011). Two sets of double reads on otolith samples were conducted. The first set of double reads, with otoliths from the NWFSC bottom trawl survey from 2004 to 2008, was conducted between the NWFSC's Newport office (Patrick McDonald) and the SWFSC's Santa Cruz office (Don Pearson). The second set of double reads, with otoliths from the Oregon and California fisheries, was conducted between Don Pearson and an ageing technician at the SWFSC's Santa Cruz Lab (Lyndsey Lefebvre). A new ageing error vector was then computed using Punt's program (Punt *et al*. 2008, Punt 2011), which was used in this assessment (Table 10). Sensitivity runs from using this ageing error vector (with SD halved and doubled) were also conducted in this assessment.

The age and length data are modeled as multinomial random variables, with the year-specific sample sizes (N_{eff}) computed using a method developed by Ian Stewart of NWFSC that has been commonly used in west coast ground fish assessments. The computation used the following equations for fishery samples:

$$N_{eff} = N_{sample} + 0.138N_{fish} \qquad if \ \frac{N_{fish}}{N_{sample}} < 44$$

$$N_{eff} = 7.06N_{sample} \qquad if \ \frac{N_{fish}}{N_{sample}} \geq 44$$

and used the following equation for survey samples:

$$N_{eff} = N_{sample} + 0.0707N_{fish} \qquad if \ \frac{N_{fish}}{N_{sample}} < 55$$

$$N_{eff} = 4.89N_{sample} \qquad if \ \frac{N_{fish}}{N_{sample}} \geq 55$$

where N_{sample} is the number of samples or trips and N_{fish} is the number of fish that were aged or measured for length. The effective sample sizes for all fisheries and surveys that have age samples are presented in Table 11. Age composition data from three fisheries (Washington fishery, Oregon bottom trawl fishery, and ASP fishery) and from the NWFSC survey are plotted in Figures 7 to 10.

2.4.2 Conditional age-at-length composition data

Age and length data from two fisheries (Oregon mid-water trawl and California fisheries) were used to generate conditional age-at-length (CAAL) compositions by sex and by year. Ideally, CAAL data would be better if they were derived from a fishery-independent survey since survey season is usually shorter than that of any fishery. CAAL data from fishery are more variable because fishing season is long (typically last for more than 6 months) so within-year variations of growth are embedded in the data. Nevertheless, fishery CAAL data were used in this assessment because there were no sufficient survey data available.

In construction of the CAAL data, it was assumed that each fish sample was a random sample of the length group. Sample size for each length group was a proportion of number of fish in that length group divided by total number of fish that had length measurements in that year and then multiplied by N_{eff} of the sampling year. This approach was used instead of using total number of length measurements because it reduced effects of large numbers of length measurements. Conditional age-at-length data from the two fisheries by sex and by year are given in Figures 11 and 12.

2.4.3 Length composition data

Length composition data were compiled using the similar approach as in age composition data. In general, there were larger sample sizes in length composition data that those in age composition data. The annual effective sample sizes for each fishery and survey, which were calculated using the same method as in age composition data, are listed in Table 12. Length composition data from five fisheries and two surveys are plotted in Figures 13 to 19.

3. Stock assessment models

3.1 History of modeling approaches

Previous assessments of widow rockfish were performed in 1989, 1990, 1993, 1997, 2000, 2003, 2005, 2007, and 2009 (Hightower and Lenarz 1989, 1990; Rogers and Lenarz 1993; Ralston and Pearson 1997, Williams *et al.* 2000, He *et al*. 2003a, He *et al*. 2006a, He *et al*. 2007a, He *et al*. 2009a). In 1989 the assessment involved the use of both cohort analysis and the Stock Synthesis program (Methot 1998). In 1993 and 1997, the age-based version of the stock synthesis program was used to assess the status of widow rockfish. In 2000, 2003, and 2005, the assessment of widow rockfish was implemented using ADMB software (Otter Research, Ltd. 2001), and applied an age-based analysis of the population with methods very similar to those used in the Stock Synthesis program. A full description of the ADMB model can be found in the previous assessment documents (He *et al*. 2003a and He *et al*. 2006a). In 2007, an update of the 2005 assessment was conducted (He *et al*. 2007a). The 2009 assessment was implemented using the Stock Synthesis (SS) program (Version 3.03a).

In the 2000 assessment, a starting year of 1968 was chosen based on the assertion that the 1965 year class was the earliest recruitment which could be well estimated, given a starting year of 1980 for the age composition information. The model tracked numbers and catches of male and female widow rockfish in age classes 3-20 (age 20 is an age-plus group). In 2003, the assessment starting year was extended backward to 1958 because the new landing data from 1966 to 1972 were added. Recruitment estimates prior to 1958 are assumed equal to the 1958 estimate in the model, so that the model estimates recruitment at age 3 for the years 1958-1999. The same time frame was used in the 2005 and 2007 assessments. In the 2009 and in this assessment, the assessment starting year was extended backward to 1916 because historical catch estimates from Oregon and California became available.

3.2 Model description

3.2.1 General

In all previous assessments, the widow assessment models were assumed to be a two-area model (northern and southern areas delineated by the 43^o N. latitude line) (Ralston and Pearson 1997, Williams *et al*. 2000, He *et al*. 2009). The main reason for using two-area models were that growth, maturity, and fecundity were assumed different between the two areas. In all of these assessments, double-logistic (dome-shaped) age based selectivity function were used. Natural mortality was assumed to be constant for both sexes and for all ages. Annual recruitments for the population were estimated using pooled total biomass from both areas and then distributed proportionally to each area. Alternative definitions of periods of early recruitment and late recruitment were evaluated according to the guidelines recently developed by Methot and Taylor (Methot and Taylor 2011).

The initial assessment model (PreSTAR model) for the 2011 assessment cycle was completed in July 2011 and was submitted to the STAR Panel for review. During the STAR Panel review, it was recommended that more model evaluations be conducted, including using simple one-area assessment model and further evaluation of dome-shaped and asymptotic selectivity functions. After the STAR Panel review, a conference call was initiated by the SSC and procedures for modifications on the PreSTAR models were proposed. The procedures include the following steps:

1. One area model;
2. Length-based vs. age based selectivity;
3. Asymptotic vs. dome-shaped selectivity;
4. Compare model runs with and without the prior for natural mortality.

These steps were used as general guidelines for construction of new (post STAR) models. These models were reviewed again at the SSC's Groundfish Subcommittee meeting (a.k.a. Mop-up Panel) in September 2011. Details of these models and review results are in the Panel review report. One of the overall goals for these review processes is to construct assessment models that are more parsimonious (simple and stable) and that have high capacities to utilize available data for future assessments. The main structure of the current base model has the following characteristics: (1) one-area model; (2) length-based selectivity functions; and (3) inclusions of both asymptotic and dome-shaped selectivity functions with time varying final selectivity for fisheries.

3.2.2 Model tuning

Model tuning in this assessment included sequential and alternating estimation of key parameters, as well as iterative weighting of index CVs and composition data sample sizes. The key parameters considered in this procedure were natural mortality (*M*) and steepness (*h*). Early test runs indicated that it was impractical to estimate both *M* and *h* simultaneously in the current models. In the final base model for this assessment, two steps were used in the model tuning procedure: (1) *h* was fixed at the expectation of the prior distribution (h=0.76) while two *M* values (one for each sex) were estimated; and (2) the model was tuned by adding extra CVs to each index and by multiplying effective sample sizes for composition data by scalar values less than 1. Extra CVs for each index and down-weighting factors for each composition data were taken from the SS outputs in Step 1.

3.3 Model selection and evaluation

A wide range of model runs were explored for model selection and evaluation. These model runs were selected based on the recommendations of the STAR Panel and the SSC conference meeting (details see the STAR Panel report, the SSC meeting note, and the Mop-up Panel report). Our selection criteria for the models include that the model needs to be parsimonious and stable, and that the models have adequate flexibility to allow moderate structure changes while maintaining stability of model runs. Among key parameters (growth, natural mortality, and steepness) that are important in determining assessment outputs, steepness (*h*) is the most influential and yet most uncertain parameter. Model explorations indicated that simultaneously estimating all of these parameters were impractical with highly unstable results. We selected a model with *h* fixed at the expectation of the prior distribution while estimating both growth and natural mortality (*M*) (see Model tuning Section) as the base model for this assessment.

Shapes of selectivity functions are also important in determining model stability. Models with dome-shaped selectivity functions were less stable than those with asymptotic selectivity functions, but fitted composition data better than models with asymptotic selectivity functions. In the Mop-up Panel review, it was determined that fishery operations were markedly different from proceeding years as widow rockfish were declared to be overfished in 2001 and many fishery regulations were in place starting in 2003. Time varying selectivity was imposed on all fishery selectivity (except the ASP fishery) functions from 2003 to account for implementation of the Rockfish Conservation Area (RCA).Specifically, time varying function was placed on the final selectivity parameter for four fisheries (Washington, Oregon mid-water trawl, Oregon bottom trawl, and California).

3.4 Responses to STAR panel requests

3.4.1 Responses to the 2009 STAR Panel requests

1. Comparisons of two ageing methods (surface and break-burn). A study was conducted in 2010 to compare these two methods of otolith ageing for widow rockfish. It showed no significant difference between these two methods. A brief report describing this study is in Appendix B.
2. Comparisons of one- and two-area models. A simulation study was conducted in 2010 to compare widow rockfish-like assessment models with two different area configurations. Details of the methods and results are presented in Appendix E. The simulation models used in the study were similar to those used in the paper by He *et al*. (2011). The study showed that the assessment results were generally similar between the one- and two- area models, but the one-area model had higher (and somewhat unstable) estimates on spawning outputs in pre-fishing years (Appendix E). This study provided a base to use two-area models for the 2011 PreSTAR assessment. The results of the one-area model from this simulation study were not directly comparable to the one-area model in the current assessment because the operating model used in the simulation study was still based on a two-area population dynamics.
3. Assessment of uncertainties in key parameters using the delta method. A brief report on using the delta method (MacCall 2011) to evaluate uncertainties on key model parameter, such as h, M, and σ_R, are presented in Appendix E of the 2011 PreSTAR assessment report. Analysis using the Delta method was not conducted for the current assessment report because of limit of time available in preparing the assessment document.

3.4.2 Responses to the 2011 STAR Panel and the 2011 Mop-up Panel requests

Our current assessment was based on the recommendation from the 2011 STAR Panel and from the SSC conference meetings. Detailed responses to the 2011 STAR Panel and the SSC conference meeting are presented the draft version of the assessment submitted to the review by the SSC Mop-up Panel. Main responses to the 2011 STAR Panel and the SSC conference meeting include:

1. Evaluation and comparisons of the one-area and the two-area models. The one-area model was much more stable than the two-area model, and estimated virgin spawning outputs and selectivity functions were similar between the two models. One exception was that in the one-area model, the California fishery selected smaller fish than in the two-area model. It resulted in more small fish (faster growth fish from the southern area) were removed from the population in the one-area model, therefore potentially reduced the population production.
2. Comparison of length-based and age-based selectivity functions. The models with length-based selectivity function appeared to fit data better and be more stable than the models age-based models.
3. Comparison of asymptotic and dome-shaped selectivity functions. Models with dome-shaped selectivity functions fitted the composition data better than models

with asymptotic selectivity functions. However, they were less stable models with the steepness parameter estimated in the models. The results also showed that the stock was more depleted in the dome-shaped selectivity model than that in the asymptotic selectivity model, and estimated h value was lower in the dome-shaped selectivity model than that in the asymptotic selectivity model.

4. Comparison of model runs with and without the prior for natural mortality. The results showed that key parameters and model outputs between these two models were very small and insignificant.

Responses to the SSC Mop-up Panel requests are in the Mop-up Panel report. Main requests and responses during the SSC Mop-up Panel review include:

1. Comparisons of asymptotic and dome-shaped selectivity functions for four major fisheries. Results showed that models with dome shaped selectivity functions fit data better than those with asymptotic selectivity functions.
2. Change spawning stock abundance from spawning output (expressed in number of eggs) to spawning biomass (spawner biomass). This abundance indicator is more comparable to catch specifications used in management decision.
3. Removal of male offsets in selectivity functions. The pre-Mop-up report used male offset in selectivity function as they gave better fits to composition data. Since all selectivity functions are length-based, there are no strong biological or fisheries reasons for different length-based selectivity between two sexes.
4. Apply block functions on the final selectivity on four fisheries between 2002 and 2003. This allows the final selectivity for four fisheries to be estimated independent of the early time periods. The results showed that shapes of the selectivity functions for both Oregon fisheries were more asymptotic than dome-shaped.

4 Assessment results and uncertainty analysis

4.1 Base model results

The base model was from a two-step selection process (see Model tuning section). Comparisons of key parameter and time series of spawning outputs, recruits, and depletion, are presented in Table 13 and Figures 20 to 22. In the first step (*h* fixed at prior and *M* estimated), stock depletion was 50.8%. In the second step, the model was tuned and stock depletion increased slightly to 51.1% (Table 13). The model from the second step was selected as the base model for this assessment. Results from the base model run are presented in Tables 14 and 15 and Figures 23 to 63. Input files for the base model in the SS program are listed in Appendix D. Overall, time series patterns of biomass, spawning biomass, recruitment, and depletion are similar to those in the 2009 assessment. Spawning biomass showed a steep decline in the early 1980s and almost continuous decline until the early 2000s (Figure 23). However, spawning biomass has shown an increasing trend in recent years. Depletion estimates from the mid-1990s to mid-2000s indicated the stock was in the precautionary zone, and has been above 40% in recent years (Table 14 and Fig. 24).

The stock-recruit relationship, time series of recruitment and recruitment deviations are presented in Table 14 and Figures 25 to 27. The input value of the standard deviation of log recruitment (σ_R) is 0.65, which is slightly higher than the estimated RMSE value (=0.638) in the base model. Like many other rockfish species, recruitment of widow rockfish has been highly variable. It is also important to point out that recruitment of widow rockfish has been very low in recent years (Figure 26).

Time series of estimated SPR (spawning potential ratio) and a phase plot of relative exploitation rates versus relative spawning output are plotted in Figures 28 and 29. Model fits to indices are presented in Figures 30 to 36. The fits to these indices were generally acceptable. The CVs for most indices were large, suggesting that these indices were poor indicators of stock abundance.

Estimated selectivity curves for the five fisheries and all surveys are presented in Figures 37 to 42. For all years and fisheries that have composition data, expected numbers of fish, aggregated model fits to length and age compositions, length and age composition residuals, and residuals for the fits to age-at-length composition for both sexes, are presented in Figures 43 to 63. Detailed model fits to composition data by fishery and survey and by year are presented in Appendix C.

4.2 Profile and sensitivity analyses

A set of profile and sensitivity analyses was conducted to test model assumptions and to explore uncertainty in estimates of key model parameters. The analysis includes:

1. Profile analysis on fixed values of steepness from 0.25 to 0.95 while estimating natural mortality (Table 16 and Figures 64 and 65a). (Additional runs at finer *h* interval (0.02) were conducted after the Mop up Panel meeting were also conducted and presented in Figure 65b),
2. Profile analysis on fixed values of natural mortality from 0.09 to 0.15 while estimating steepness (Table 17 and Figures 66 to 67);
3. Profile analysis on steepness from 0.25 to 0.95 with natural mortality fixed at the base model values (Table 18 and Figures 68 to 69);
4. Profile analysis on natural mortality from 0.09 to 0.15 with steepness fixed at the base model value (Table 19 and Figures 70 to 71);
5. Profile analysis on natural mortality from 0.09 to 0.15 with steepness fixed at 0.41 (Table 20 and Figures 72 to 73);
6. Profile analysis on natural mortality from 0.09 to 0.16 with steepness fixed at 0.9 (Table 21 and Figures 74 to 75);
7. Profile analysis on steepness from 0.25 to 0.95 with natural mortality fixed at 0.11 (Tables 22 and Figures 76 and 77);
8. Profile analysis on steepness from 0.25 to 0.95 with natural mortality fixed at 0.13 (Table 23 and Figures 78 and 79);
9. Sensitivity analysis of ageing error vector with half and twice of inputted values (Table 24 and Figures 80 and 81).

In general, the analysis showed that the assessment results were highly sensitive to steepness and the current model structure and/or availability of data were probably not sufficient for estimating steepness.

The analysis showed that there were strong negative correlations between steepness and natural mortality (Tables 16 and 17), suggesting again that simultaneously estimating both parameters were very difficult in the assessment model. The analysis also showed that natural mortality was an important parameter in determining the stock depletion. If steepness is fixed, higher values of natural mortality results in less depleted stocks (Tables 19 and 20).

The sensitivity analysis on ageing error vector showed small effects of ageing errors on the assessment results (Table 24, Figures 81 and 81). Reduction of ageing errors by half had resulted in stock depletion changed from 51.1% to 49.3%, while increases of ageing errors by two times resulted in stock depletion changed from 51.1% to 50.6%.

4.3 Retrospective analysis

Retrospective analysis of the base model was performed by using the data only through 2009, 2008, and 2007, respectively (Table 25 and Figures 82 to 83). The results indicated that data from the most recent years (2009 and 2010) had a moderate effect on model outputs. If data from the last three years (2008, 2009 and 2010) were not used, the model would estimate that the population would be about 2.5% more depleted.

4.4 Comparisons between this assessment and the past assessments

Figures 84 and 85 compare time series of spawning output and recruitment between the base model from this assessment and the previous five assessments (2000, 2003, 2005, 2007, and 2009). Overall patterns of spawning outputs among all assessments were similar, which showed steep declines in early 1980s and increasing trends in recent years. One main difference between this assessment and the 2009 assessment was that estimated spawning outputs in recent years increased more than that in the 2009 assessment. Patterns of recruitments were, however, similar among all assessments (Figure 85).

5 Management references and research needs

5.1 Decision table

Two decision tables were presented in the Executive Summary Sections. As in the past assessments, stock-recruit steepness is the single greatest source of uncertainty in the assessment. In the base model, steepness was fixed at the level of 0.76 (Dorn's prior). The decision table was developed to bracket model uncertainty in widow rockfish productivity with alternative values of steepness. The 12.5% and 87.5% quantiles from prior distribution on h translate into steepness of 0.54 and 0.95 respectively. This range was considered reasonable to account for uncertainty associated with steepness. It was, however, agreed to shift this range to lower steepness values to (a) take account of the data which, while not greatly informative, did provide some evidence for a lower steepness value, and (b) provide continuity by considering the value of steepness used in the 2009 assessment (0.41). As a result, steepness values of 0.41 and 0.90 were used for the low and high states of nature. Future catch scenarios at OFL and two catch streams between 2011 and 2022 were used as alternative management decisions (Table ES7). Constant catch streams requested by the GMT along with two states of nature were also presented (Table ES8).

5.2 Research needs

1. More studies on the feasibility of estimating stock-recruitment relationships for given model structures and data availability will be very beneficial.
2. The long-term recruitment index is a key time series in the stock assessment. Continuation of the NMFS/PWCC mid-water juvenile trawl survey should provide key information on the recruitment strength of widow rockfish.
3. Re-ageing of widow rockfish otoliths from California and possibly from Oregon and Washington fisheries in 1980's and 1990's. The conditional age-at-length data from these

fisheries showed that ages-at-length were highly variable in these years. For example, fish from the same length groups could range over 20 years in age. Re-ageing these data could improve the precision of growth estimates for assessment models. It will be useful to derive a separate ageing error vector from the re-aged data from the early years.

4. Additional research to determining the magnitude of spatial and temporal differences in biological traits (growth, maturity, fecundity, etc.).

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8 Tables

Table 1. Management performance in obtaining the harvest guideline for widow rockfish. Harvest guideline and allowable biological catch (ABC) are taken from Council documents.

Year	Harvest Guideline or OY (mt)	Allowable Biological Catch (mt)	Catches (mt)
1989	12,100	12,400	14,610
1990	12,400	8,900	11,940
1991	7,000	7,000	7,660
1992	7,000	7,000	7,368
1993	7,000	7,000	9,706
1994	6,500	6,500	7,704
1995	6,500	7,700	7,977
1996	6,500	7,700	7,314
1997	6,500	7,700	7,761
1998	5,090	5,750	4,854
1999	5,090	5,750	4,770
2000	5,090	5,750	4,661
2001	2,300	3,727	2,258
2002	856	3,727	432
2003	832	3,871	43
2004	284	3,460	101
2005	285	3,218	199
2006	289	3,059	215
2007	368	5,334	259
2008	368	5,144	237
2009	522	7,728	195
2010	509	6,937	152
2011	600	4,872	
2012	600	4,705	

Table 2. U.S. total catches (mt) of widow rockfish by five fisheries from 1916 to 2010.

Year	Washington fishery	Oregon mid-water trawl	Oregon bottom trawl	California fishery (EMfishery)	At-sea whiting fishery (ASP)	Total
1916	0.2	0.0	0.3	82.7	0.0	83.2
1917	0.2	0.0	0.3	128.8	0.0	129.4
1918	0.2	0.0	0.3	148.1	0.0	148.7
1919	0.2	0.0	0.4	102.1	0.0	102.7
1920	0.2	0.0	0.4	104.5	0.0	105.1
1921	0.2	0.0	0.4	86.6	0.0	87.2
1922	0.3	0.0	0.4	75.1	0.0	75.8
1923	0.3	0.0	0.4	82.5	0.0	83.2
1924	0.3	0.0	0.4	52.8	0.0	53.5
1925	0.3	0.0	0.5	65.5	0.0	66.2
1926	0.3	0.0	0.5	99.9	0.0	100.6
1927	0.3	0.0	0.5	82.8	0.0	83.6
1928	0.5	0.0	0.8	95.0	0.0	96.3
1929	0.9	0.0	1.4	92.6	0.0	94.9
1930	0.8	0.0	1.2	120.2	0.0	122.2
1931	0.6	0.0	1.0	108.1	0.0	109.7
1932	0.5	0.0	0.7	109.3	0.0	110.5
1933	0.5	0.0	0.8	95.0	0.0	96.2
1934	0.4	0.0	0.6	101.3	0.0	102.2
1935	0.4	0.0	0.7	108.9	0.0	110.0
1936	1.2	0.0	1.9	121.2	0.0	124.4
1937	1.8	0.0	2.8	114.3	0.0	118.9
1938	0.9	0.0	1.4	94.9	0.0	97.2
1939	1.7	0.0	2.8	84.5	0.0	89.0
1940	29.6	0.0	48.1	89.2	0.0	167.0
1941	45.5	0.0	73.8	71.9	0.0	191.2
1942	84.4	0.0	137.0	21.6	0.0	243.1
1943	292.0	0.0	473.9	54.0	0.0	819.8
1944	504.6	0.0	819.0	201.7	0.0	1525.4
1945	788.7	0.0	1280.0	450.8	0.0	2519.5
1946	489.6	0.0	794.7	457.4	0.0	1741.7
1947	297.7	0.0	483.2	208.6	0.0	989.5
1948	195.8	0.0	317.8	205.2	0.0	718.7
1949	178.3	0.0	289.3	145.9	0.0	613.5
1950	188.2	0.0	305.4	166.8	0.0	660.4
1951	165.6	0.0	268.7	343.7	0.0	778.0
1952	173.0	0.0	280.7	317.5	0.0	771.2
1953	138.3	0.0	224.5	293.4	0.0	656.1
1954	174.8	0.0	283.7	216.4	0.0	674.9
1955	181.5	0.0	294.6	232.4	0.0	708.5
1956	236.2	0.0	383.3	294.8	0.0	914.3

Table 2 (continued). U.S. total catches (mt) of widow rockfish by five fisheries from 1916 to 2010.

Year	Washington fishery	Oregon mid-water trawl	Oregon bottom trawl	California fishery (EMfishery)	At-sea whiting fishery (ASP)	Total
1957	320.1	0.0	519.6	324.2	0.0	1163.9
1958	248.5	0.0	403.3	393.9	0.0	1045.7
1959	269.8	0.0	437.8	319.7	0.0	1027.3
1960	397.6	0.0	645.3	249.1	0.0	1292.0
1961	355.0	0.0	576.1	171.0	0.0	1102.1
1962	407.7	0.0	661.7	175.4	0.0	1244.8
1963	124.4	0.0	202.0	288.6	0.0	615.0
1964	315.3	0.0	511.7	154.9	0.0	981.9
1965	54.4	0.0	88.3	230.1	0.0	372.9
1966	3969.8	0.0	486.6	317.9	0.0	4774.3
1967	4389.1	0.0	793.9	495.0	0.0	5678.0
1968	1853.7	0.0	260.8	585.5	0.0	2700.1
1969	510.3	0.0	250.4	79.6	0.0	840.3
1970	576.1	0.0	35.8	74.8	0.0	686.7
1971	738.3	0.0	60.5	61.8	0.0	860.6
1972	457.5	0.0	65.9	88.6	0.0	612.1
1973	592.3	0.0	33.8	314.4	0.0	940.5
1974	277.0	0.0	20.5	393.5	0.0	691.1
1975	450.1	0.0	17.8	482.9	0.0	950.7
1976	911.6	0.0	68.9	555.1	0.0	1535.6
1977	1078.3	0.0	372.5	1046.6	0.0	2497.4
1978	312.3	0.0	384.5	632.7	0.0	1329.4
1979	1024.0	3970.7	582.9	2583.6	0.0	8161.2
1980	8705.7	8968.3	464.1	6006.0	0.0	24144.2
1981	7278.4	14693.6	1642.2	5453.8	0.0	29068.1
1982	6344.9	8675.5	846.1	11851.4	0.0	27717.8
1983	3728.1	1734.9	1646.0	4950.0	0.0	12059.0
1984	1685.1	4620.0	1664.4	3909.2	0.0	11878.6
1985	1783.0	3971.1	1045.0	3930.3	0.0	10729.5
1986	2959.9	3654.6	1441.5	3176.0	0.0	11232.0
1987	4306.0	5932.8	1387.4	3427.0	0.0	15053.2
1988	3569.6	4994.5	1339.8	2306.8	0.0	12210.7
1989	3916.1	5750.9	2355.3	2587.7	0.0	14609.9
1990	2588.8	3889.2	2670.0	2791.8	0.0	11939.8
1991	1332.4	2108.7	2343.1	1602.7	271.7	7658.6
1992	1085.4	1409.1	3175.0	1350.7	348.1	7368.3
1993	1993.3	2084.5	4070.6	1406.9	151.1	9706.4
1994	1234.0	2059.2	3035.3	1085.8	288.2	7702.5
1995	1255.6	1711.3	2780.5	2034.7	195.1	7977.0
1996	1109.0	1708.4	2679.5	1605.3	212.3	7314.5
1997	1166.8	1838.2	2927.4	1623.6	205.4	7761.5

Table 2 (continued). U.S. total catches (mt) of widow rockfish by five fisheries from 1916 to 2010.

Year	Washington fishery	Oregon mid-water trawl	Oregon bottom trawl	California fishery (EMfishery)	At-sea whiting fishery (ASP)	Total
1998	636.8	894.7	1935.7	1125.4	258.8	4851.3
1999	599.8	2088.7	1120.4	774.6	186.1	4769.6
2000	454.1	3103.8	28.2	868.1	207.3	4661.5
2001	349.5	1297.8	35.0	402.5	173.5	2258.3
2002	64.8	154.7	6.8	50.4	154.9	431.6
2003	14.4	7.6	1.7	4.8	14.5	43.0
2004	31.6	12.3	10.1	25.5	21.2	100.7
2005	42.8	59.0	5.6	11.9	80.1	199.4
2006	44.9	11.3	3.0	12.6	143.3	215.1
2007	37.1	44.6	9.7	19.4	147.7	258.5
2008	49.2	34.7	1.7	36.4	115.0	237.0
2009	105.2	52.8	2.4	8.2	26.0	194.6
2010	62.1	36.6	3.0	11.4	39.0	152.1

Table 3. Abundance indices for Oregon bottom trawl (ORBTrawCPUE) from 1984 to 1999.

Year	Index	Input CV
1984	331.47	0.2121
1985	100.88	0.1875
1986	227.08	0.2928
1987	169.08	0.2730
1988	93.97	0.2897
1989	164.10	0.1749
1990	78.49	0.1348
1991	73.59	0.1275
1992	83.16	0.1179
1993	53.58	0.1314
1994	100.34	0.1128
1995	109.96	0.1387
1996	94.81	0.1357
1997	97.23	0.1502
1998	56.56	0.1718
1999	84.46	0.1684

Table 4. Abundance indices of widow rockfish catches derived from bycatch in three sectors of the Pacific whiting fisheries.

Year	Index	Input CV
Foreign (ForWBycatch)		
1977	0.770	0.115
1978	1.205	0.112
1979	0.703	0.119
1980	1.993	0.131
1981	0.728	0.126
1982	0.243	0.247
1984	2.937	0.125
1985	0.407	0.107
1986	1.111	0.103
1987	0.390	0.088
1988	0.513	0.124
Joint venture (JVWBycatch)		
1983	2.889	0.120
1985	0.776	0.117
1986	0.823	0.081
1987	0.320	0.087
1988	0.659	0.077
1989	0.824	0.064
1990	0.710	0.074
Domestic (DomWBycatch)		
1991	1.264	0.125
1992	0.781	0.125
1993	0.801	0.104
1994	1.465	0.068
1995	0.455	0.106
1996	1.018	0.082
1997	0.886	0.077
1998	1.330	0.079

Table 5. Yearly indices from the pelagic juvenile trawl survey (SCJuvSurvey) from 2001 to 2009. No data from 2010 were available because survey area was not comparable to previous years. A fixed CV of 0.6 was used in the assessment model as in previous assessments.

Year	Index	Input CV
2001	4.97	0.6
2002	11.87	0.6
2003	5.81	0.6
2004	10.34	0.6
2005	4.79	0.6
2006	2.72	0.6
2007	2.72	0.6
2008	4.29	0.6
2009	3.44	0.6

Table 6. Abundance indices of widow rockfish catches derived from the NWFSC combo surveys from 2003 to 2010 for northern and southern areas.

Year	Index	Input CV
2003	8551.7	0.3563
2004	447.1	0.4666
2005	1404.0	0.3398
2006	1337.6	0.2869
2007	842.9	0.2870
2008	256.9	0.3926
2009	1306.3	0.2589
2010	2142.3	0.2819

Table 7. Summary of annual number of hauls, fish measured for length compositions and number of fish aged for age compositions from the NWFSC survey from 2003 to 2010. For age composition data, only data with number of fish aged > 30 in each year were used in the assessment model.

Year	Number of haul for length	Number of Length	Number of haul for age	Number of fish aged
2003	18	216	6	10
2004	12	84	12	58
2005	20	78	18	81
2006	26	172	26	89
2007	27	92	27	82
2008	17	26	15	20
2009	32	142	0	0
2010	28	240	0	0

Table 8. Abundance indices of widow rockfish catches derived from triennial surveys from 1980 to 2004 for northern and southern areas.

Year	Index	Input CV
1980	2808.2	0.2205
1983	4324.8	0.1652
1986	3891.0	0.2218
1989	11294.5	0.2304
1992	10337.8	0.1800
1995	3441.7	0.2178
1998	5152.7	0.1793
2001	286.3	0.2524
2004	1012.2	0.2487

Table 9. Numbers of samples and fish measured for length compositions from the triennial survey that were used in the assessment model.

	Number of sample	Number of fish
1980	40	166
1983	76	385
1986	46	317
1989	40	713
1992	57	713
1995	44	491
1998	70	912
2001	29	144
2004	36	214

Table 10. Vectors of ageing errors estimated using Punt's program.

Age	Ageing error (SD)
0.5	0.086
1.5	0.086
2.5	0.152
3.5	0.221
4.5	0.293
5.5	0.368
6.5	0.447
7.5	0.529
8.5	0.614
9.5	0.704
10.5	0.797
11.5	0.895
12.5	0.997
13.5	1.103
14.5	1.215
15.5	1.331
16.5	1.452
17.5	1.579
18.5	1.712
19.5	1.850
20.5	1.994
21.5	2.145
22.5	2.303
23.5	2.468
24.5	2.640
25.5	2.819
26.5	3.007
27.5	3.203
28.5	3.408
29.5	3.622
30.5	3.845
31.5	4.078
32.5	4.322
33.5	4.576
34.5	4.842
35.5	5.120

Table 11. Number of effective sample sizes of age samples for five fisheries and one survey used in the assessment. Effective sample sizes were calculated using Ian Stewart's equations.

Year	Vancouver, Columbia (WA fishery)	Oregon Midwater Trawl	Oregon Bottom Trawl	Eureka, Monterey (EM fishery)	At-sea whiting fishery (ASP)	NWFSC survey
1978				21.8		
1979				48.1		
1980	127.1			81.3		
1981	218.9			154.8		
1982	282.4			500.0		
1983	176.5			500.0		
1984	155.3	174.6	138.6	500.0		
1985	113.0	280.5	126.6	500.0		
1986	190.6	328.4	136.3	468.5		
1987	254.2	310.4	143.2	481.6		
1988	141.2	197.6	161.5	337.0		
1989	211.8	304.8	197.5	405.0		
1990	289.5	266.3	202.0	426.9		
1991	240.0	258.0	285.7	353.0		
1992	218.9	101.0	341.9	134.6		
1993	254.2	203.8	255.6	87.8		
1994	197.7	105.8	267.5	102.0		
1995	233.0	153.9	186.7	43.4		
1996	190.6	143.5	134.7	172.1		
1997	211.8	214.4	201.2	203.4		
1998	155.3	214.9	173.5	193.8		
1999	204.7	326.8	127.9	190.8		
2000	148.3	390.9		88.5		
2001	70.6	241.2		36.1		
2002	84.7	174.6		58.3		
2003	33.7			15.0		
2004	106.6	28.2		19.3		15.0
2005	73.0					22.6
2006	67.6	85.5				32.3
2007	103.9	42.4	48.6			32.9
2008	118.1	117.2	50.2	30.2	184.7	
2009	98.8	84.7	71.9	33.4	96.7	
2010	84.7	170.7	43.4		61.4	

Table 12. Number of effective sample sizes of length samples for five fisheries and two surveys used in the assessment. Effective sample sizes were calculated using Ian Stewart's equations.

Year	Vancouver, Columbia (WA fishery)	Oregon Midwater Trawl	Oregon Bottom Trawl	Eureka, Monterey (EM fishery)	At-sea whiting fishery (ASP)	NWFSC survey	Triennial survey
1978				102.7			
1979				93.4			
1980	127.1			193.5			51.7
1981	218.9			356.5			
1982	282.4			500.0			
1983	176.5			500.0			103.2
1984	155.3	240.0	190.6	500.0			
1985	113.0	402.4	176.5	500.0			
1986	190.6	395.4	155.3	500.0			68.4
1987	254.2	346.5	179.2	500.0			
1988	141.2	202.7	166.7	459.6			
1989	211.8	312.6	197.5	500.0			90.4
1990	289.5	267.2	202.7	500.0			
1991	240.0	262.0	286.1	466.9			
1992	218.9	266.9	359.7	460.6	187.6		107.4
1993	254.2	203.9	264.4	442.7	171.5		
1994	197.7	105.9	267.6	442.9	373.9		
1995	233.0	157.6	194.1	374.1	219.3		78.7
1996	190.6	148.1	138.2	353.5	271.7		
1997	211.8	240.5	214.6	458.2	304.9		
1998	155.3	215.1	178.1	351.9	235.3		134.5
1999	204.7	358.9	131.8	275.3	277.6		
2000	148.3	444.2		171.5	260.0		
2001	70.6	258.1		88.1	166.8		39.2
2002	84.7	68.5		78.9	112.1		
2003	35.3			43.1	65.5	33.3	
2004	87.7	28.2		22.8	147.8	17.9	51.1
2005	72.8			6.2	500.0	25.5	
2006	67.7	88.1		24.2	500.0	38.2	
2007	104.3	63.5	48.6	18.0	500.0	33.5	
2008	127.1	131.2	50.2	33.8	500.0	18.8	
2009	98.8	94.8	71.9	58.9	184.6	42.0	
2010	84.7	189.3	131.8	59.2	442.7	44.9	

Table 13. Comparisons of key parameters and model outputs between pre-weighted and weighted models. The weighted model is the base model for this assessment. Likelihood values are not directly comparable between these two models. Unit of B_0 is spawning biomass (mt).

Description	Pre-weighted	Weighted (Base)
Management quantities		
B_0	65319	71126
2011 depletion (%)	50.8	51.1
2010 SPR (%)	97.2	97.5
No. of parameters estimated	116	116
Negative log-likelihoods		
Total	8116.27	3560.10
Catch	6.93E-8	6.93E-8
Indices	433.448	-1.5550
Length composition	3042.77	1278.57
Age composition	4625.08	2274.02
Recruitment	14.9521	9.0522
Priors	0.00686	0.00591
Parameter soft bound	0.00680	0.00530
Other parameter values		
Steepness (*h*)	0.7600	0.7600
Steepness estimated	No	No
Female *M*	0.1195	0.1198
Male *M*	0.1295	0.1294
*M*s estimated	Yes	Yes

Table 14. Estimated age 1+ biomass, spawning outputs, recruits, total catch, depletion, and SPR 1916 to 2010 from the base assessment model.

Year	Total biomass (mt)	Spawning biomass (mt)	Recruit (*1000)	Total catch (mt)	Depletion (%)	SPR
1916	134050	71127	23392	83	100.0	0.9929
1917	133968	71082	23391	129	99.9	0.9890
1918	133846	71015	23390	149	99.8	0.9873
1919	133713	70941	23388	103	99.7	0.9912
1920	133635	70895	23386	105	99.7	0.9910
1921	133562	70852	23385	87	99.6	0.9925
1922	133513	70823	23385	76	99.6	0.9935
1923	133480	70803	23384	83	99.5	0.9929
1924	133444	70781	23383	54	99.5	0.9954
1925	133442	70778	23383	66	99.5	0.9943
1926	133427	70769	23383	101	99.5	0.9914
1927	133381	70743	23382	84	99.5	0.9928
1928	133355	70727	23382	96	99.4	0.9917
1929	133319	70706	23381	95	99.4	0.9919
1930	133288	70687	23381	122	99.4	0.9895
1931	133232	70655	23380	110	99.3	0.9906
1932	133193	70632	23380	111	99.3	0.9905
1933	133156	70611	23379	96	99.3	0.9917
1934	133137	70598	23379	102	99.3	0.9912
1935	133114	70584	23378	110	99.2	0.9906
1936	133085	70568	23378	124	99.2	0.9893
1937	133045	70545	23377	119	99.2	0.9898
1938	133014	70526	23377	97	99.2	0.9916
1939	133006	70520	23377	89	99.1	0.9923
1940	133008	70520	23377	167	99.1	0.9856
1941	132934	70478	23375	191	99.1	0.9834
1942	132842	70425	23374	243	99.0	0.9789
1943	132705	70345	23372	820	98.9	0.9311
1944	132013	69957	23362	1525	98.4	0.8766
1945	130674	69203	23341	2520	97.3	0.8059
1946	128449	67944	23306	1742	95.5	0.8573
1947	127133	67171	23284	990	94.4	0.9142
1948	126554	66865	16600	719	94.0	0.9365
1949	126200	66754	16422	614	93.9	0.9454
1950	125791	66731	16435	660	93.8	0.9414

Table 14. (continued). Estimated age 1+ biomass, spawning outputs, recruits, total catch, depletion, and SPR 1916 to 2010 from the base assessment model.

Year	Total biomass (mt)	Spawning biomass (mt)	Recruit (*1000)	Total catch (mt)	Depletion (%)	SPR
1951	125093	66688	16750	778	93.8	0.9318
1952	123975	66572	17343	771	93.6	0.9323
1953	122526	66335	18362	656	93.3	0.9418
1954	120875	65892	19946	675	92.6	0.9394
1955	119045	65068	21991	709	91.5	0.9352
1956	117205	63905	24089	914	89.8	0.9153
1957	115368	62516	25297	1164	87.9	0.8909
1958	113648	61033	25025	1046	85.8	0.8987
1959	112520	59770	23752	1027	84.0	0.8982
1960	111924	58781	22777	1292	82.6	0.8726
1961	111569	58006	23086	1102	81.6	0.8892
1962	111855	57749	24983	1245	81.2	0.8770
1963	112358	57803	27506	615	81.3	0.9373
1964	113735	58472	28309	982	82.2	0.9045
1965	114940	59044	28947	373	83.0	0.9629
1966	117000	59930	32914	4774	84.3	0.6433
1967	115086	58402	38577	5678	82.1	0.5888
1968	112834	56486	33422	2700	79.4	0.7599
1969	114048	56478	21314	840	79.4	0.9155
1970	119610	57837	149199	687	81.3	0.9324
1971	125301	59630	28281	861	83.8	0.9195
1972	132297	61697	10844	612	86.7	0.9443
1973	140343	64503	10479	941	90.7	0.9204
1974	148480	67315	24102	691	94.6	0.9435
1975	156799	71892	21361	951	101.1	0.9289
1976	163923	78168	10544	1536	109.9	0.9019
1977	168131	85235	46567	2497	119.8	0.8607
1978	169150	90150	63603	1330	126.7	0.9242
1979	169410	91555	21404	8161	128.7	0.6355
1980	162826	86939	60263	24144	122.2	0.2745
1981	141103	73220	72447	29068	102.9	0.1675
1982	116443	57224	27625	27718	80.5	0.1298
1983	96743.3	43208	30792	12059	60.7	0.2542
1984	95191.4	40132	30657	11879	56.4	0.2587
1985	94611.7	39207	22270	10729	55.1	0.2969

Table 14. (continued). Estimated age 1+ biomass, spawning outputs, recruits, total catch, depletion, and SPR 1916 to 2010 from the base assessment model.

Year	Total biomass (mt)	Spawning biomass (mt)	Recruit (*1000)	Total catch (mt)	Depletion (%)	SPR
1986	95223.3	39871	9139	11232	56.1	0.3085
1987	94838.9	41065	30350	15053	57.7	0.2547
1988	88896	40482	16520	12211	56.9	0.3104
1989	84081.1	39853	13824	14610	56.0	0.2493
1990	75746	36407	28153	11940	51.2	0.2734
1991	69340.4	33343	37388	7659	46.9	0.3696
1992	66572.7	31908	9694	7368	44.9	0.3603
1993	64277.1	30207	18881	9706	42.5	0.2643
1994	59646.4	27255	18482	7703	38.3	0.2972
1995	57027.8	25465	9269	7977	35.8	0.2679
1996	54218.5	23851	7239	7315	33.5	0.2803
1997	51937.1	23145	15792	7761	32.5	0.2687
1998	48890.2	22363	31276	4851	31.4	0.3942
1999	48250.5	22545	18250	4770	31.7	0.4039
2000	47640.6	22270	24765	4662	31.3	0.4068
2001	46845.2	21732	6805	2258	30.6	0.6081
2002	48671.1	22074	14301	432	31.0	0.8965
2003	52402.7	23491	7107	43	33.0	0.9888
2004	56651.5	25652	19301	101	36.1	0.9770
2005	60272.8	28441	6587	199	40.0	0.9589
2006	63185	31178	7577	215	43.8	0.9590
2007	65277.6	33350	10833	259	46.9	0.9543
2008	66634.7	34728	12194	237	48.8	0.9598
2009	67403.8	35545	10787	195	50.0	0.9676
2010	67937.4	36063	21124	152	50.7	0.9746
2011	68238.4	36342	21749		51.1	0.9054

Table 15. Fixed and estimated parameter values with standard deviations for the base model.

Parameter	Estimated (yes/no)	Value	Standard deviation
Natural mortality female	Yes	0.1197	0.0005
Female length at age 5	Yes	28.78	0.184
Female length at age 15	Yes	48.14	0.067
Female VB K	Yes	0.2087	0.0046
Female CV of length at young age	Yes	0.078	0.0029
Female CV of length at old age	Yes	0.044	0.0013
Natural mortality male	Yes	0.1294	0.0006
Male length at age 5	Yes	30.26	0.155
Male length at age 15	Yes	44.18	0.081
Male VB K	Yes	0.2326	0.0073
Male CV of length at young age	Yes	0.055	0.0021
Male CV of length at old age	Yes	0.054	0.0018
Female weight-length a	No	5.45E-06	NA
Female weight-length b	No	3.2878	NA
Maturity	No	Input vector	NA
Fecundity a	No	0	NA
Fecundity b	No	1	NA
Male weight-length a	No	1.19E-5	NA
Male weight-length b	No	3.0663	NA
R_0 (virgin recruit)	Yes	10.0602	0.1389
Steepness	No	0.76	NA
Sigma *R*	No	0.65	NA
Double normal selectivity (Washington fishery)			
Peak	Yes	39.08	0.260
Width of peak	Yes	-11.47	57.79
Ascending width	Yes	3.328	0.745
Descending with	Yes	2.33	0.367
Initial	No	-999	NA
Final	Yes	0.064	0.151
Block on final	Yes	0.066	0.052

Table 15 (continued). Fixed and estimated parameter values with standard deviations for the base model.

Parameter	Estimated (yes/no)	Value	Standard deviation
Double normal selectivity (Oregon mid-water trawl)			
Peak	Yes	39.08	0.298
Width of peak	Yes	-12.16	49.12
Ascending width	Yes	3.314	0.089
Descending with	Yes	3.167	0.271
Initial	No	-999	NA
Final	Yes	-1.420	0.302
Block on final	Yes	3.620	23.800
Double normal selectivity (Oregon mid-water trawl)			
Peak	Yes	40.09	0.336
Width of peak	Yes	-11.52	57.19
Ascending width	Yes	3.325	0.092
Descending with	Yes	2.431	0.578
Initial	No	-999	NA
Final	Yes	0.299	0.227
Block on final	Yes	3.823	21.253
Double normal selectivity (California fishery)			
Peak	Yes	41.04	0.366
Width of peak	Yes	-11.44	58.23
Ascending width	Yes	3.644	0.088
Descending with	Yes	4.233	0.171
Initial	No	-999	NA
Final	Yes	-8.345	32.06
Block on final	Yes	1.350	10.890

Table 15 (continued). Fixed and estimated parameter values with standard deviations for the base model.

Parameter	Estimated (yes/no)	Value	Standard deviation
Double normal selectivity (ASP, at-sea whiting processor)			
Peak	Yes	43.64	0.424
Width of peak	No	12	NA
Ascending width	Yes	3.879	0.085
Descending with	No	12	NA
Initial	No	-999	NA
Final	No	12	NA
Double normal selectivity (all surveys)			
Peak	Yes	46.66	1.571
Width of peak	No	12	NA
Ascending width	Yes	5.387	0.143
Descending with	No	12	NA
Initial	No	-999	NA
Final	No	12	NA

Table 16. Key parameters and model outputs for sensitivity analysis with steepness fixed from 0.25 to 0.95 whiling estimating *M*. The model with *h*=0.76 (bold) is the base model. Unit of B_0 is spawning biomass (mt).

Description	*h*=0.25	*h*=0.35	*h*=0.45	*h*=0.55	*h*=0.65	***h*=0.76**	*h*=0.85	*h*=0.95
Management quantities								
B_0	85669	78419	74689	72833	71811	**71126**	70742	70423
2011 depletion (%)	15.2	24.6	33.4	40.7	46.3	**51.1**	54.2	56.9
2010 SPR (%)	94.2	95.7	96.5	97.0	97.3	**97.5**	97.6	97.7
Negative log-likelihoods								
Total	3557.28	3557.09	3558.07	3558.95	3559.59	**3560.10**	3560.41	3560.68
Catch	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	**6.93E-8**	6.93E-8	6.93E-8
Indices	-0.4734	-0.9462	-1.2170	-1.3896	-1.4916	**-1.5550**	-1.5852	-1.6006
Length composition	1281.43	1279.52	1278.82	1278.61	1278.57	**1278.57**	1278.59	1278.62
Age composition	2270.22	2271.67	2272.65	2273.28	2273.70	**2274.02**	2274.21	2274.37
Recruitment	5.8562	6.9773	7.7946	8.4311	8.8059	**9.0522**	9.1832	9.2865
Priors	0.2406	0.0555	0.0124	0.0039	0.0038	**0.0059**	0.0080	0.0102
Parameter soft bound	0.0052	0.0053	0.0053	0.0053	0.0053	**0.0053**	0.0053	0.0053
Other parameter values								
Steepness (*h*)	0.25	0.35	0.45	0.55	0.76	**0.76**	0.85	0.95
Steepness estimated	No	No	No	No	No	**No**	No	No
Female *M*	0.1416	0.1307	0.1254	0.1226	0.1209	**0.1198**	0.1190	0.1185
Male *M*	0.1508	0.1399	0.1347	0.1320	0.1305	**0.1294**	0.1288	0.1283
*M*s estimated	Yes	Yes	Yes	Yes	Yes	**Yes**	Yes	Yes

Table 17. Key parameters and model outputs for sensitivity analysis on steepness with natural mortality fixed at a range of values from 0.09 to 0.15 while estimating steepness. The model with M=0.12 (bold) is the base model. Unit of B_0 is spawning biomass (mt).

Description	M=0.09	M=0.10	M=0.11	**M=0.12**	M=0.13	M=0.14	M=0.15
Management quantities							
B_0	66541	68491	69977	**71126**	78553	83749	90446
2011 depletion (%)	40.5	48.1	52.6	**51.1**	27.2	21.7	18.2
2010 SPR (%)	95.7	96.7	97.3	**97.5**	96.0	95.7	95.6
Negative log-likelihoods							
Total	3574.48	3566.05	3561.53	**3560.10**	3559.11	3559.72	3561.88
Catch	6.93E-8	6.93E-8	6.93E-8	**6.93E-8**	6.93E-8	6.93E-8	6.93E-8
Indices	-1.5590	-1.7917	-1.7564	**-1.5550**	-1.1333	-0.9725	-0.8568
Length composition	1277.21	1276.96	1277.66	**1278.57**	1280.11	1281.52	1283.00
Age composition	2278.54	2276.05	2274.55	**2274.02**	2271.53	2271.29	2271.98
Recruitment	20.5366	15.1073	11.3775	**9.0522**	6.7264	5.2235	4.1251
Priors	-0.2517	-0.2876	-0.3005	**0.0059**	1.7666	2.6451	3.6274
Parameter soft bound	0.0052	0.0052	0.0053	**0.0053**	0.0053	0.0053	0.0053
Other parameter values							
Steepness (h)	0.9871	0.9764	0.9379	**0.76**	0.3595	0.2956	0.2506
Steepness estimated	Yes	Yes	Yes	**No**	Yes	Yes	Yes
Female M	0.09	0.10	0.11	**0.1198**	0.13	0.14	0.15
Male M	0.10	0.11	0.12	**0.1294**	0.14	0.15	0.16
Ms estimated	No	No	No	**Yes**	No	No	No

Table 18. Key parameters and model outputs for sensitivity analysis on steepness with natural mortality fixed at the base model values. The model with *h*=0.76 (bold) is the base model. Unit of B_0 is spawning biomass (mt).

Description	*h*=0.25	*h*=0.35	*h*=0.45	*h*=0.55	*h*=0.65	***h*=0.76**	*h*=0.85	*h*=0.95
Management quantities								
B_0	74315	77111	74732	72917	71819	**71126**	70649	70305
2011 depletion (%)	8.9	19.3	30.3	39.2	45.8	**51.1**	54.4	57.3
2010 SPR (%)	89.9	94.0	96.0	96.8	97.2	**97.5**	97.6	97.7
Negative log-likelihoods								
Total	3568.09	3559.86	3558.75	3559.10	3559.61	**3560.10**	3560.42	3560.71
Catch	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	**6.93E-8**	6.93E-8	6.93E-8
Indices	1.6613	-0.5528	-1.1835	-1.4103	-1.5071	**-1.5550**	-1.5678	-1.5734
Length composition	1284.17	1279.40	1278.46	1278.36	1278.43	**1278.57**	1278.62	1278.70
Age composition	2267.63	2270.73	2272.24	2273.10	2273.64	**2274.02**	2274.29	2274.50
Recruitment	14.6188	10.2860	9.2255	9.0505	9.0403	**9.0522**	9.0690	9.0821
Priors	0	0	0	0	0	**0.0059**	0	0
Parameter soft bound	0.0051	0.0052	0.0053	0.0053	0.0053	**0.0053**	0.0053	0.0053
Other parameter values								
Steepness (*h*)	0.25	0.35	0.45	0.55	0.65	**0.76**	0.85	0.95
Steepness estimated	No	No	No	No	No	**No**	No	No
Female *M*	0.1198	0.1198	0.1198	0.1198	0.1198	**0.1198**	0.1198	0.1198
Male *M*	0.1294	0.1294	0.1294	0.1294	0.1294	**0.1294**	0.1294	0.1294
*M*s estimated	No	No	No	No	No	**Yes**	No	No

Table 19. Key parameters and model outputs for sensitivity analysis on natural mortality with steepness fixed at value from the base model (*h*=0.76). The model with *M*=0.12 (bold) is the base model. Unit of B_0 is spawning biomass (mt).

Description	*M*=0.09	*M*=0.10	*M*=0.11	***M*=0.12**	*M*=0.13	*M*=0.14	*M*=0.15
Management quantities							
B_0	67067	69236	70727	**71126**	72009	72322	72849
2011 depletion (%)	32.5	39.7	46.0	**51.1**	51.4	59.6	62.5
2010 SPR (%)	94.6	96.1	96.9	**97.5**	97.9	98.4	98.4
Negative log-likelihoods							
Total	3576.57	3567.05	3561.76	**3560.10**	3561.57	3565.62	3571.84
Catch	6.93E-8	6.93E-8	6.93E-8	**6.93E-8**	6.93E-8	6.93E-8	6.93E-8
Indices	-0.9915	-1.5153	-1.6633	**-1.5550**	-1.3334	-1.0365	-0.7076
Length composition	1278.01	1277.27	1277.67	**1278.57**	1280.78	1283.05	1285.61
Age composition	2277.98	2275.63	2274.18	**2274.02**	2274.60	2276.46	2279.29
Recruitment	21.5632	15.6680	11.5734	**9.0522**	7.5183	7.1415	7.6383
Priors	0	0	0	**0.0059**	0	0	0
Parameter soft bound	0.0052	0.0052	0.0053	**0.0053**	0.0053	0.0054	0.0054
Other parameter values							
Steepness (*h*)	0.76	0.76	0.76	**0.76**	0.76	0.76	0.76
Steepness estimated	Yes	No	No	**No**	No	No	No
Female *M*	0.09	0.10	0.11	**0.1198**	0.13	0.14	0.15
Male *M*	0.10	0.11	0.12	**0.1294**	0.14	0.15	0.16
*M*s estimated	No	No	No	**Yes**	No	No	No

Table 20. Key parameters and model outputs for sensitivity analysis on natural mortality (*M*) with steepness fixed at 0.41. The model with *M*=0.12 with *h*=0.76 (bold) is the base model. The likelihood values from the base model are not directly comparable to other models. Unit of B_0 is spawning biomass (mt).

Description	***M*=0.12**	*M*=0.09	*M*=0.10	*M*=0.11	*M*=0.12	*M*=0.13	*M*=0.14	*M*=0.15
Management quantities								
B_0	**71126**	37507	71155	74219	76210	76935	73311	75720
2011 depletion (%)	**51.1**	10.1	15.0	20.7	26.5	32.1	37.5	42.7
2010 SPR (%)	**97.5**	84.2	90.4	93.7	95.5	96.6	97.2	97.7
Negative log-likelihoods								
Total	**3560.10**	3589.55	3574.36	3564.32	3558.97	3557.83	3560.28	3565.70
Catch	**6.93E-8**	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8
Indices	**-1.5550**	2.02574	0.5907	-0.4963	-1.0791	-1.2289	-1.1079	-0.8523
Length composition	**1278.57**	1285.76	1281.45	1279.39	1279.11	1280.09	1281.92	1284.29
Age composition	**2274.02**	2274.37	2272.99	2271.96	2271.58	2272.19	2273.91	2776.69
Recruitment	**9.0522**	27.3954	19.3216	13.4577	9.3560	6.7733	5.5586	5.5664
Priors	**0.0059**	0	0	0	0	0	0	0
Parameter soft bound	**0.0053**	0.0051	0.0051	0.0052	0.0052	0.0053	0.0053	0.0054
Other parameter values								
Steepness (*h*)	**0.76**	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Steepness estimated	**No**	No	No	No	No	No	No	No
Female *M*	**0.1198**	0.09	0.10	0.11	0.12	0.13	0.14	0.15
Male *M*	**0.1294**	0.10	0.11	0.12	0.13	0.14	0.15	0.16
*M*s estimated	**Yes**	No	No	No	No	No	No	No

Table 21. Key parameters and model outputs for sensitivity analysis on natural mortality (*M*) with steepness fixed at 0.9. The model with *M*=0.12 with *h*=0.76 (bold) is the base model. The likelihood values from the base model are not directly comparable to other models. Unit of B_0 is spawning biomass (mt).

Description	***M*=0.12**	*M*=0.09	*M*=0.10	*M*=0.11	*M*=0.12	*M*=0.13	*M*=0.14	*M*=0.15
Management quantities								
B_0	**71126**	66720	38714	70108	70974	71528	72048	72819
2011 depletion (%)	**51.1**	38.7	45.5	51.4	56.3	60.2	63.4	65.8
2010 SPR (%)	**97.5**	95.4	96.5	97.2	97.7	98.0	98.3	98.4
Negative log-likelihoods								
Total	**3560.10**	3575.27	3566.52	3561.81	3560.58	3562.29	3566.49	3572.79
Catch	**6.93E-8**	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8
Indices	**-1.5550**	-1.3944	-1.7213	-1.7434	-1.5765	-1.3100	-0.9955	-0.6556
Length composition	**1278.57**	1277.43	1277.03	1277.65	1279.03	1280.95	1283.26	1285.85
Age composition	**2274.02**	2278.37	2275.93	2274.49	2274.17	2274.98	2276.87	2279.72
Recruitment	**9.0522**	20.8549	15.2651	11.4100	8.9502	7.6562	7.3491	7.8698
Priors	**0.0059**	0	0	0	0	0	0	0
Parameter soft bound	**0.0053**	0.0052	0.0052	0.0053	0.0053	0.0053	0.0054	0.0054
Other parameter values								
Steepness (*h*)	**0.76**	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Steepness estimated	**No**	No	No	No	No	No	No	No
Female *M*	**0.1198**	0.09	0.10	0.11	0.12	0.13	0.14	0.15
Male *M*	**0.1294**	0.10	0.11	0.12	0.13	0.14	0.15	0.16
*M*s estimated	**Yes**	No	No	No	No	No	No	No

Table 22. Key parameters and model outputs for sensitivity analysis on steepness with natural mortality fixed (M_{female}=0.11, M_{male}=0.12). The model with *M*=0.12 with *h*=0.76 (bold) is the base model. The likelihood values from the base model are not directly comparable to other models. Unit of B_0 is spawning biomass (mt).

Description	***h*=0.76**	*h*=0.25	*h*=0.35	*h*=0.45	*h*=0.55	*h*=0.65	*h*=0.76	*h*=0.85	*h*=0.95
Management quantities									
B_0	**71126**	69188	74501	73702	72397	71455	70727	70302	69939
2011 depletion (%)	**51.1**	6.2	14.7	24.4	33.0	39.7	45.4	49.0	53.0
2010 SPR (%)	**97.5**	82.3	91.3	94.6	95.9	96.5	96.9	97.1	97.3
Negative log-likelihoods									
Total	**3560.10**	3580.2	3567.27	3563.27	3562.13	3561.82	3561.76	3561.79	3561.84
Catch	**6.93E-8**	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8
Indices	**-1.5550**	3.1350	0.3047	-0.8285	-1.3049	-1.5345	-1.6633	-1.7215	-1.7601
Length composition	**1278.57**	1288.83	1281.18	1278.75	1278.00	1277.75	1277.67	1277.65	1277.66
Age composition	**2274.02**	2267.40	2270.85	2272.47	2273.31	2273.81	2274.18	2274.39	2274.57
Recruitment	**9.0522**	20.8381	14.9744	12.8739	12.1230	11.7839	11.5734	11.4594	11.3679
Priors	**0.0059**	0	0	0	0	0	0	0	0
Parameter soft bound	**0.0053**	0.0051	0.0051	0.0052	0.0052	0.0052	0.0053	0.0053	0.0053
Other parameter values									
Steepness (*h*)	**0.76**	0.25	0.35	0.45	0.55	0.65	0.76	0.85	0.95
Steepness estimated	**No**	No	No	No	No	No	No	No	No
Female *M*	**0.1198**	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Male *M*	**0.1294**	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
*M*s estimated	**Yes**		No	No	No	No	No	No	No

Table 23. Key parameters and model outputs for sensitivity analysis on steepness with natural mortality fixed (M_{female}=0.13, M_{male}=0.14). The model with *M*=0.12 with *h*=0.76 (bold) is the base model. The likelihood values from the base model are not directly comparable to other models. Unit of B_0 is spawning biomass (mt).

Description	***h*=0.76**	*h*=0.25	*h*=0.35	*h*=0.45	*h*=0.55	*h*=0.65	*h*=0.76	*h*=0.85	*h*=0.95
Management quantities									
B_0	**71126**	69762	76072	75691	73688	72655	72009	71672	71407
2011 depletion (%)	**51.1**	9.1	22.4	36.5	45.1	51.1	55.9	58.9	61.5
2010 SPR (%)	**97.5**	88.3	95.1	96.9	97.4	97.7	97.9	98.0	98.0
Negative log-likelihoods									
Total	**3560.10**	3575.36	3573.74	3558.41	3559.76	3560.77	3561.57	3562.06	3562.49
Catch	**6.93E-8**	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8	6.93E-8
Indices	**-1.5550**	2.1203	-0.7526	-1.2822	-1.3377	-1.3451	-1.3334	-1.3187	-1.3013
Length composition	**1278.57**	1285.58	1299.87	1280.15	1280.38	1280.59	1280.78	1280.90	1281.01
Age composition	**2274.02**	2277.12	2267.22	2272.70	2273.59	2274.17	2274.60	2274.86	2275.09
Recruitment	**9.0522**	10.5233	7.3982	6.8436	7.1247	7.3507	7.5183	7.6139	7.6927
Priors	**0.0059**	0	0	0	0	0	0	0	0
Parameter soft bound	**0.0053**	0.0054	0.0054	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Other parameter values									
Steepness (*h*)	**0.76**	0.25	0.35	0.45	0.55	0.65	0.76	0.85	0.95
Steepness estimated	**No**	No	No	No	No	No	No	No	No
Female *M*	**0.1198**	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Male *M*	**0.1294**	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
*M*s estimated	**Yes**	No	No	No	No	No	No	No	No

Table 24. Comparisons of key parameters and model outputs from the sensitivity analysis on ageing errors (age errors * 0.5 and 2.0, respectively). Likelihood values are not directly comparable among these three models because weighting factors were readjusted in the last two models. Unit of B_0 is spawning biomass (mt).

Description	Base model	Base model with ageing error*0.5	Base model with ageing error*2
Management quantities			
B_0	71126	73134	76041
2011 depletion (%)	51.1	49.3	50.6
2010 SPR (%)	97.5	97.5	97.7
Negative log-likelihoods			
Total	3560.10	3536.01	3882.58
Catch	6.93E-8	6.93E-8	6.93E-8
Indices	-1.5550	-2.1182	-1.1512
Length composition	1278.57	1276.08	1264.56
Age composition	2274.02	2258.19	2615.53
Recruitment	9.0522	3.8417	3.6125
Priors	0.0059	0.0060	0.0117
Parameter soft bound	0.0053	0.0055	0.0051
Other parameter values			
Steepness (h)	0.76	0.76	0.76
Steepness estimated	No	No	No
Female M	0.1198	0.1233	0.1248
Male M	0.1294	0.1330	0.1346
Ms estimated	Yes	Yes	Yes

Table 25. Comparisons of key parameters and model outputs from the retrospective analysis. Likelihood values are not directly comparable among these models. Unit of B_0 is spawning biomass (mt).

Description	Base model	Retro-1	Retro-2	Retro-3
Management quantities				
B_0	71126	72627	73840	74745
2011 depletion (%)	51.1	49.3	49.2	48.6
2010 SPR (%)	97.5	97.5	97.6	97.6
Negative log-likelihoods				
Total	3560.10	3447.88	3340.45	3204.71
Catch	6.93E-8	6.93E-8	6.93E-8	6.93E-8
Indices	-1.5550	-2.1868	-2.3805	-3.3396
Length composition	1278.57	1215.52	1173.66	1117.25
Age composition	2274.02	2227.34	2163.19	2084.98
Recruitment	9.0522	7.1907	5.9709	5.8079
Priors	0.0059	0.0049	0.0090	0.0110
Parameter soft bound	0.0053	0.0045	0.0047	0.0042
Other parameter values				
Steepness (*h*)	0.76	0.76	0.76	0.76
Steepness estimated	No	No	No	No
Female *M*	0.1198	0.1219	0.1238	0.1240
Male *M*	0.1294	0.1322	0.1340	0.1346
*M*s estimated	Yes	Yes	Yes	Yes

9 Figures

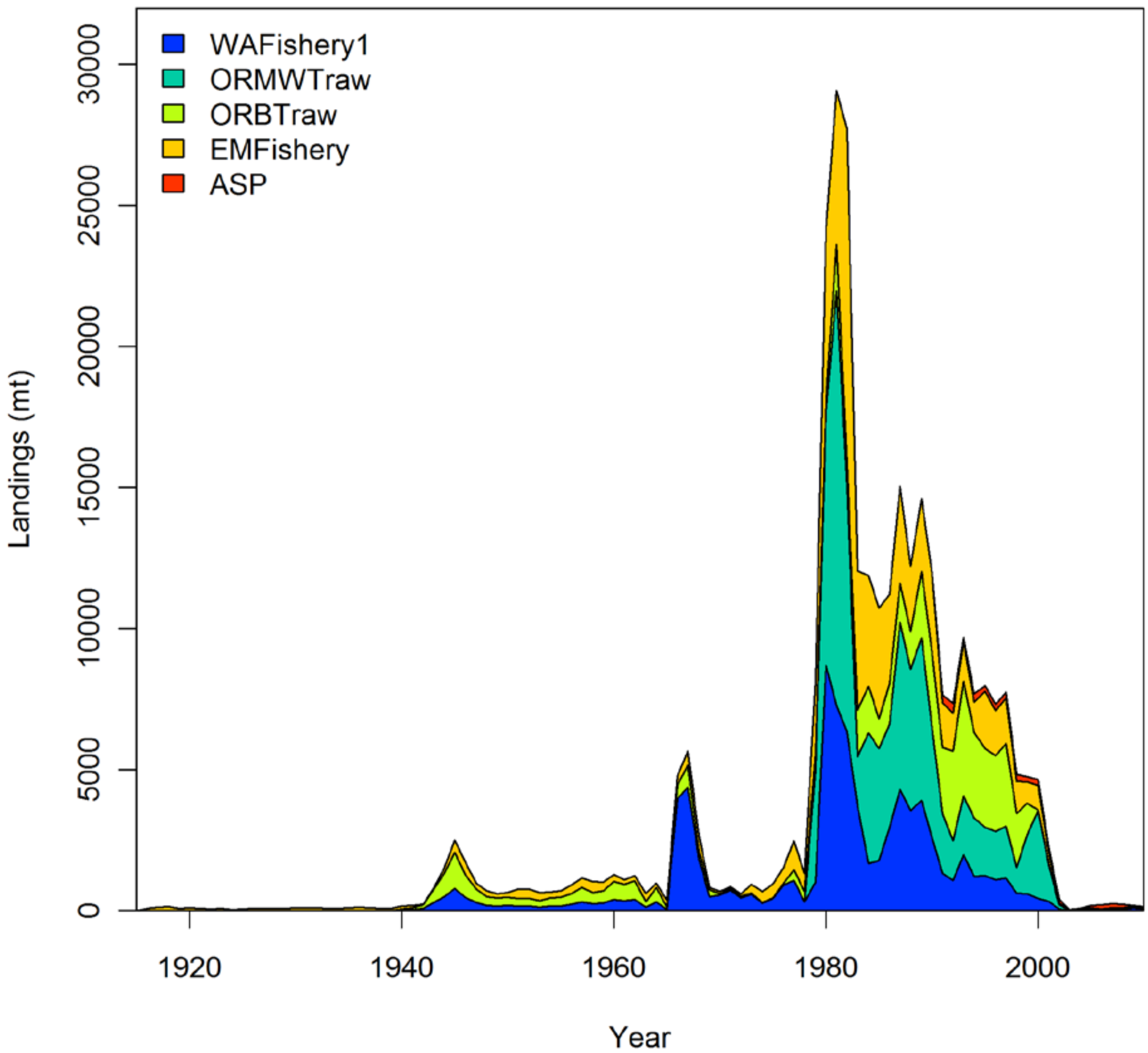


Figure 1. Landings of widow rockfish by five fisheries from 1916 to 2010. Detail numbers are presented in Table 1.

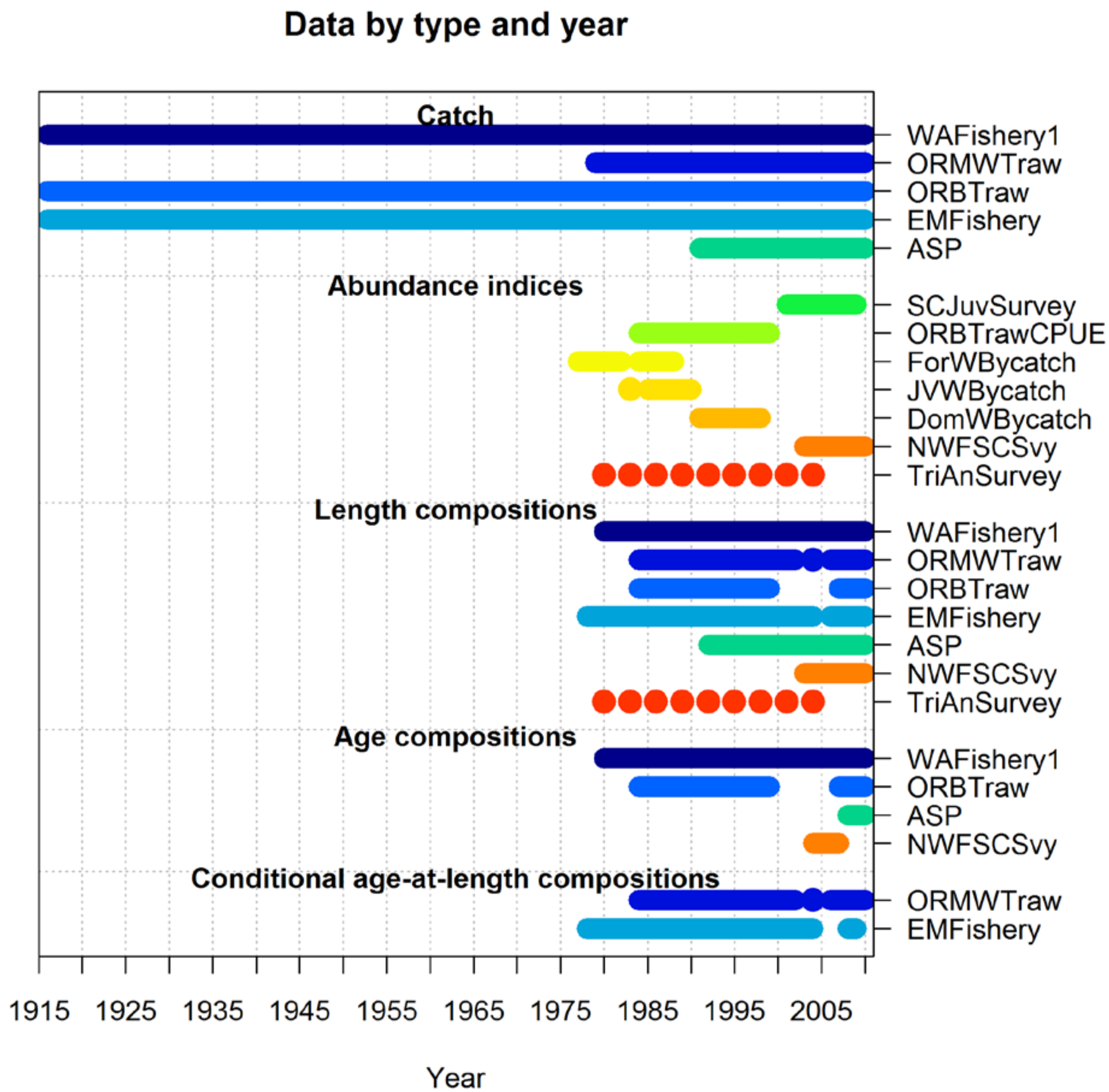


Figure 2. Ranges of annual catch, abundance index, length and age composition data used in the assessment models.

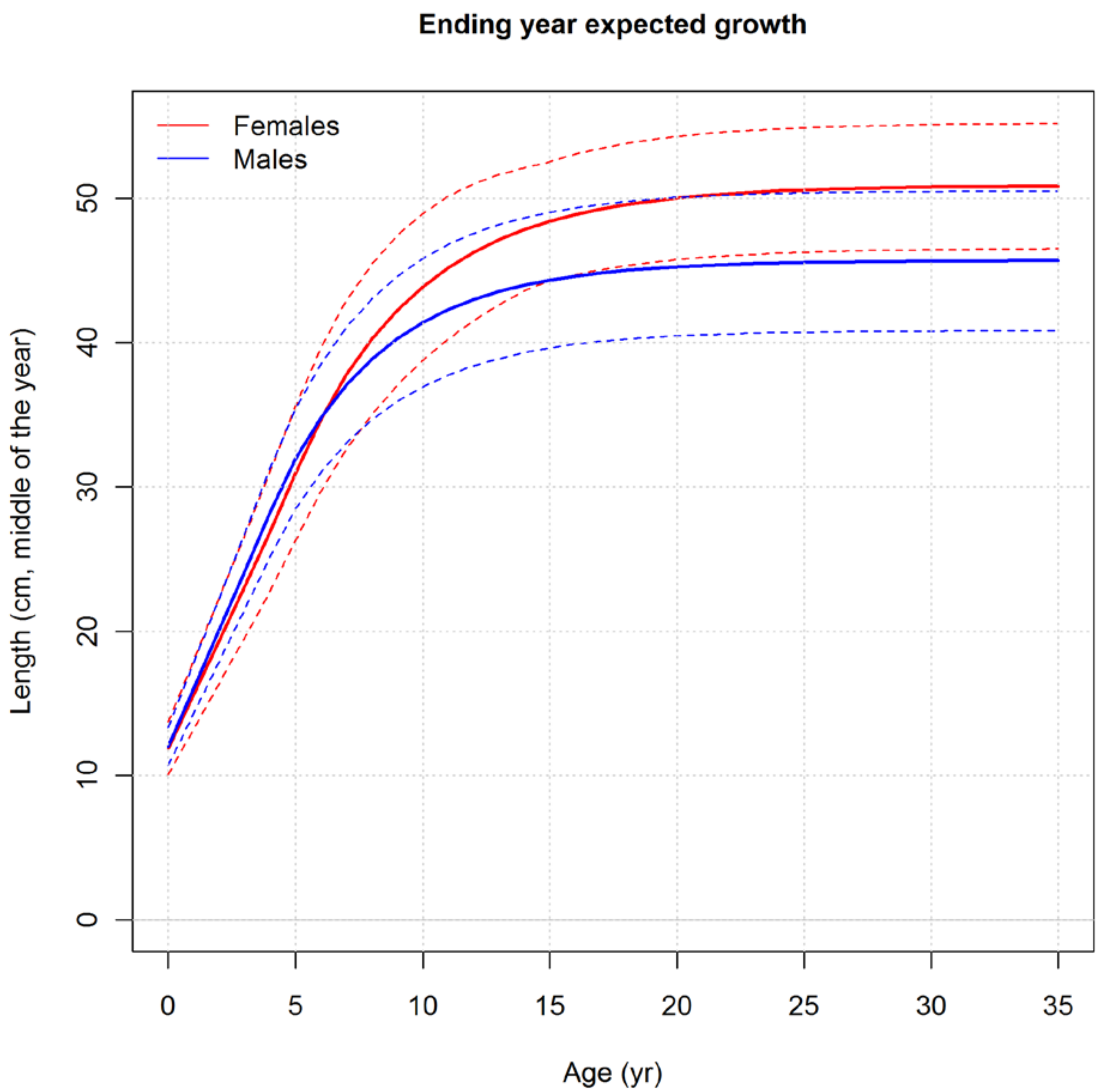


Figure 3. Estimated growth functions for both sexes of widow rockfish from the base model.

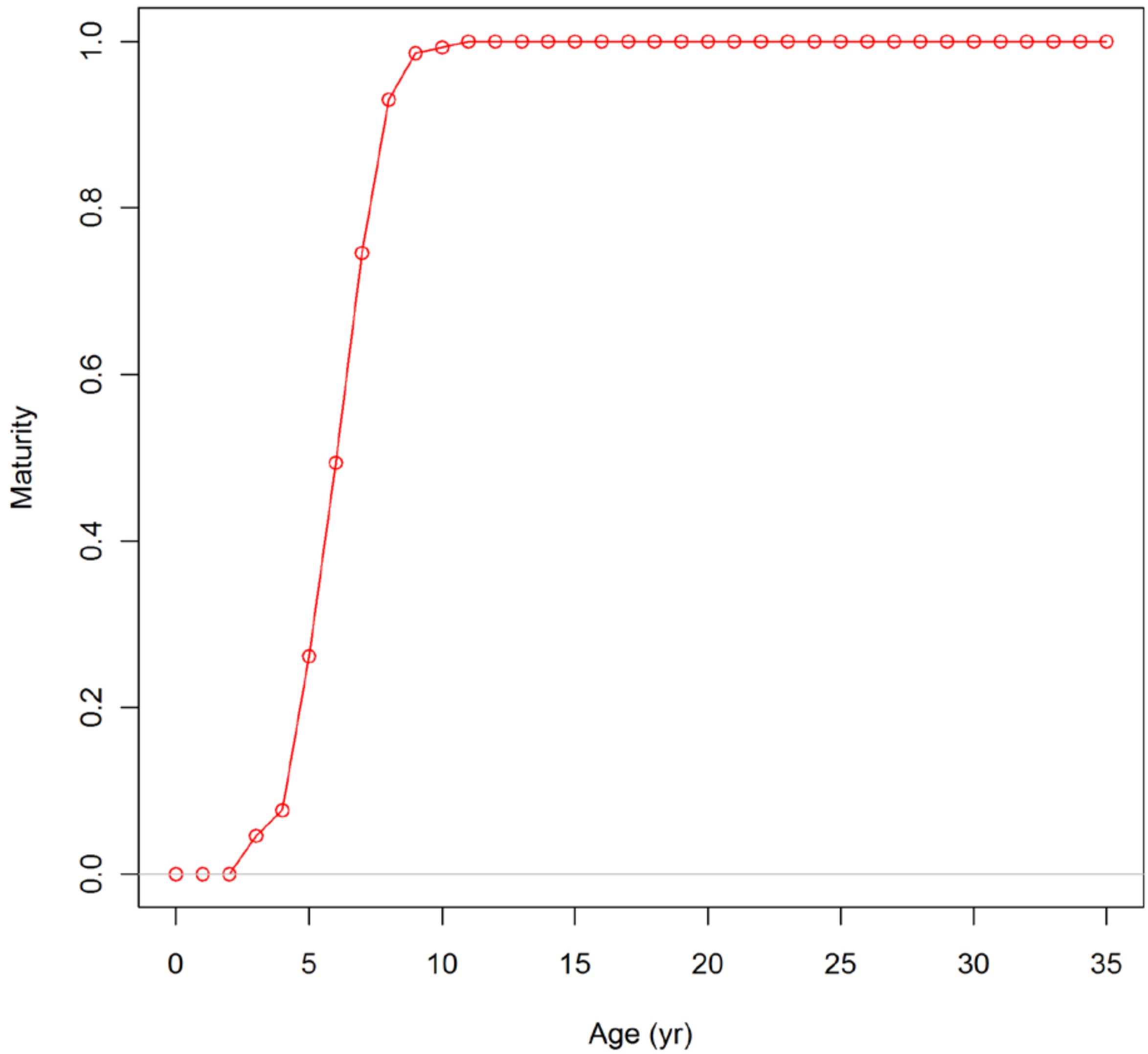


Figure 4. Maturity by age of widow rockfish.

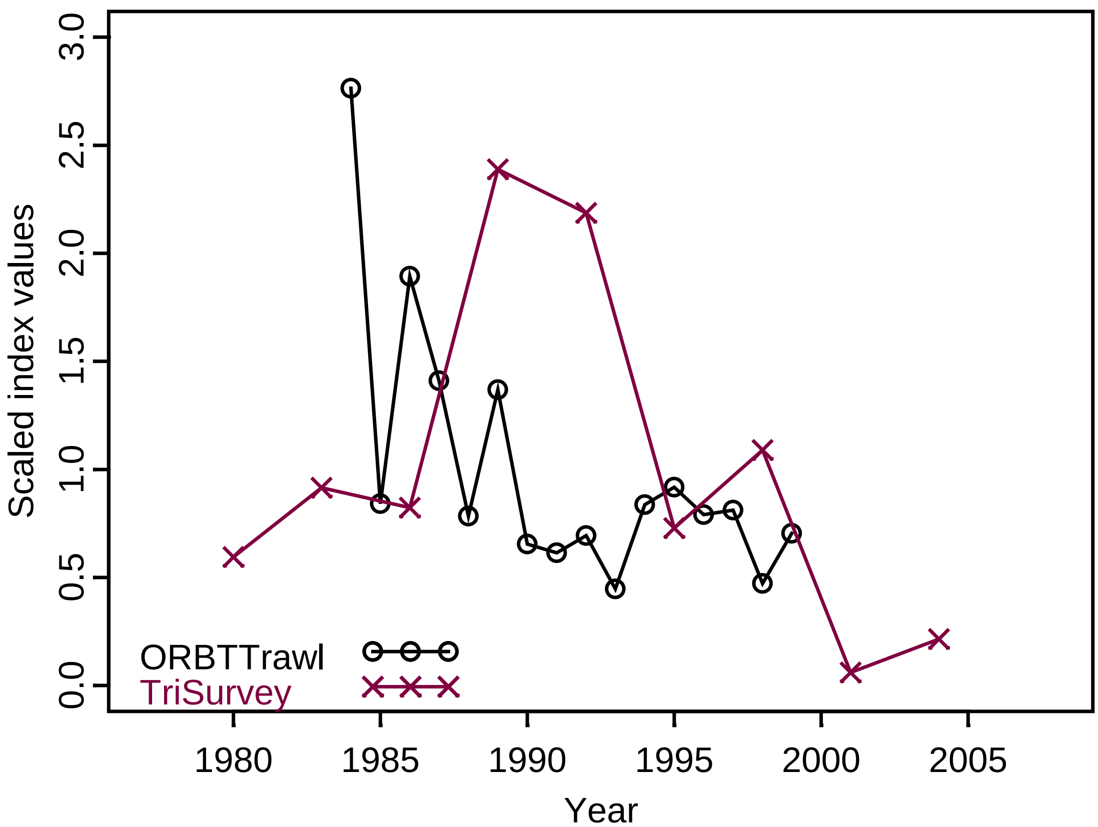


Figure 5. Time series of scaled abundance indices of the Oregon bottom trawl logbook and triennial survey.

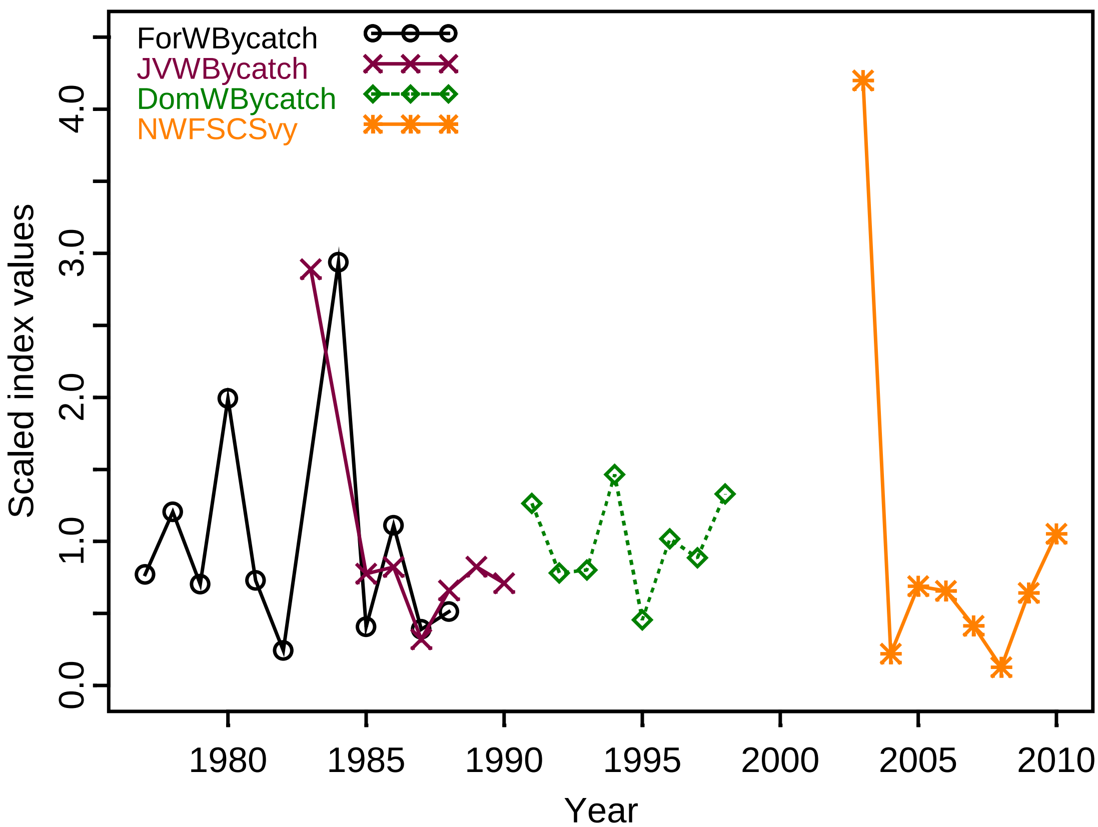


Figure 6. Time series of scaled abundance indices of three whiting bycatch fisheries (foreign, joint venture, and domestic), and the NWFSC survey.

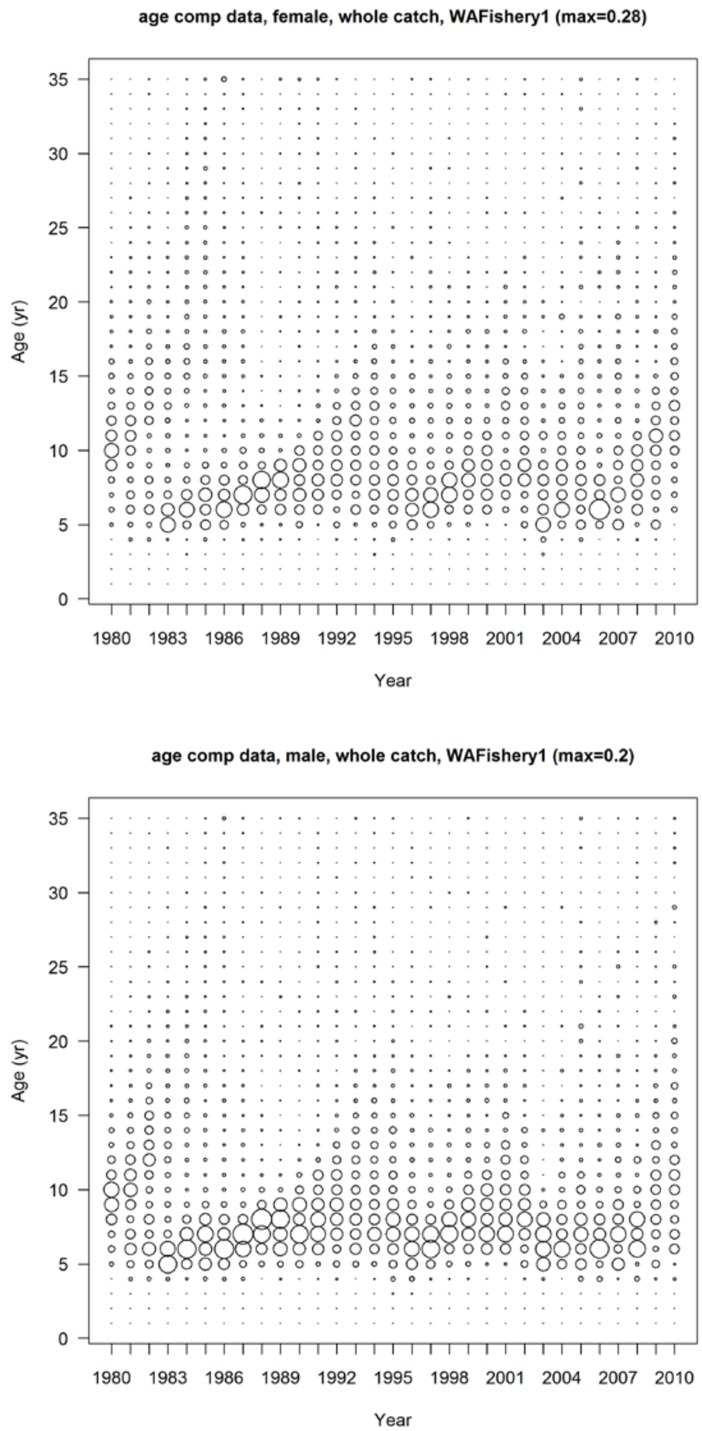


Figure 7. Age composition data from the Washington (WA) fisheries (Vancouver-Columbia area) from 1980 to 2010 for females (upper panel) and male (lower panel).

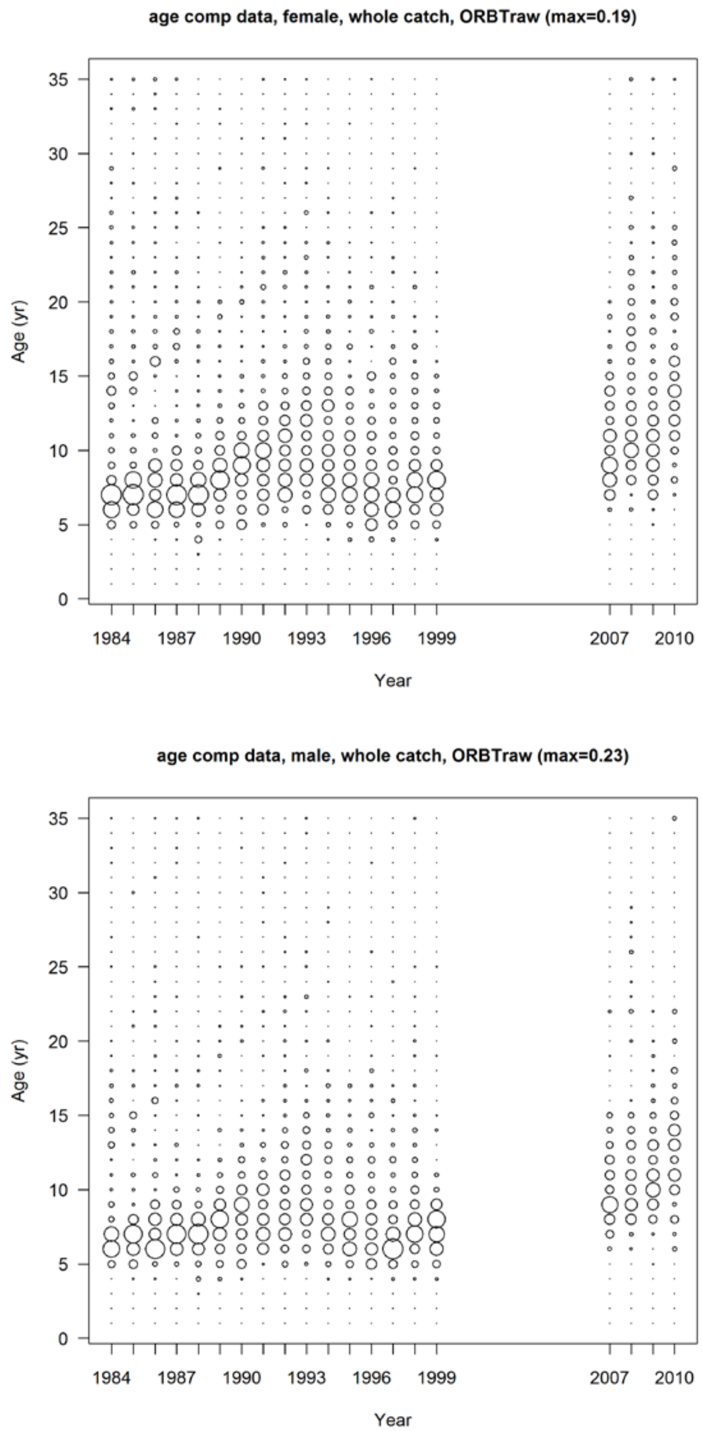
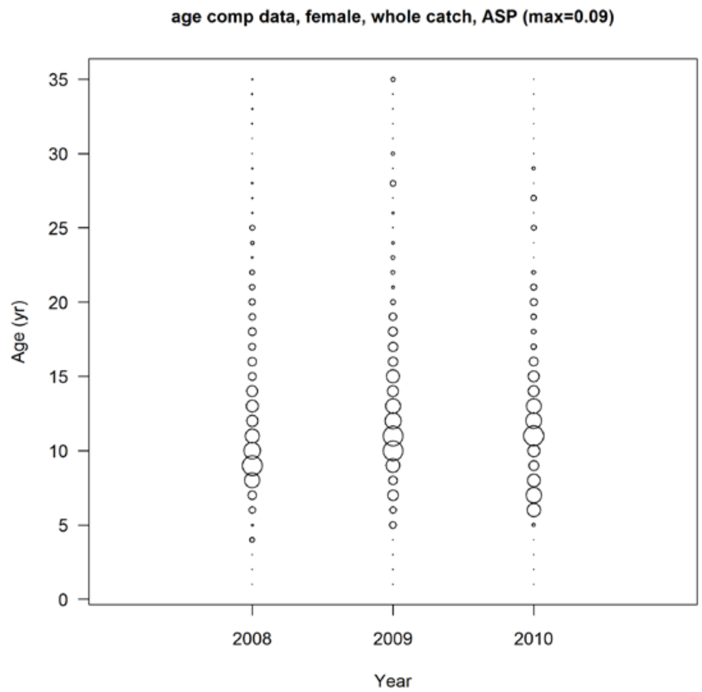


Figure 8. Age composition data from the Oregon bottom trawl fisher from 1984 to 2010 for females (upper panel) and male (lower panel).



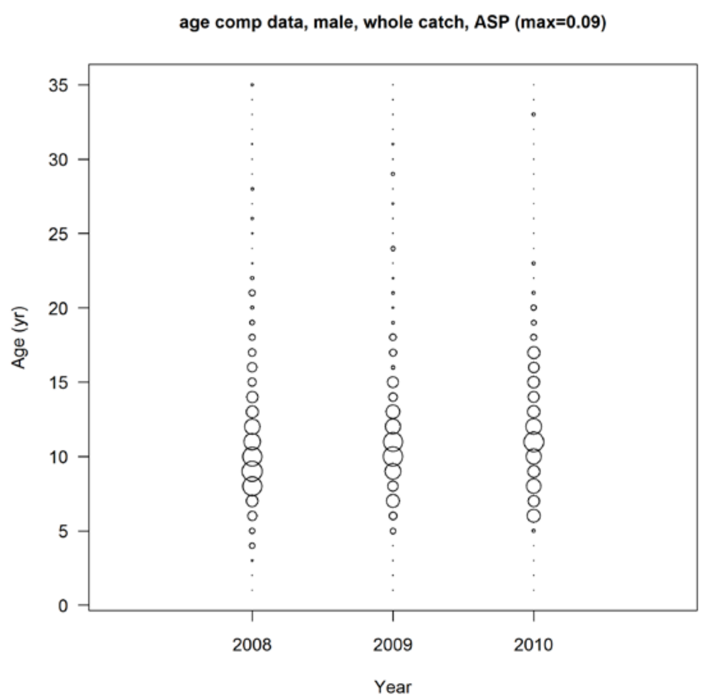


Figure 9. Age composition data from the at-sea whiting fishery from 2008 to 2010 for females (upper panel) and male (lower panel).

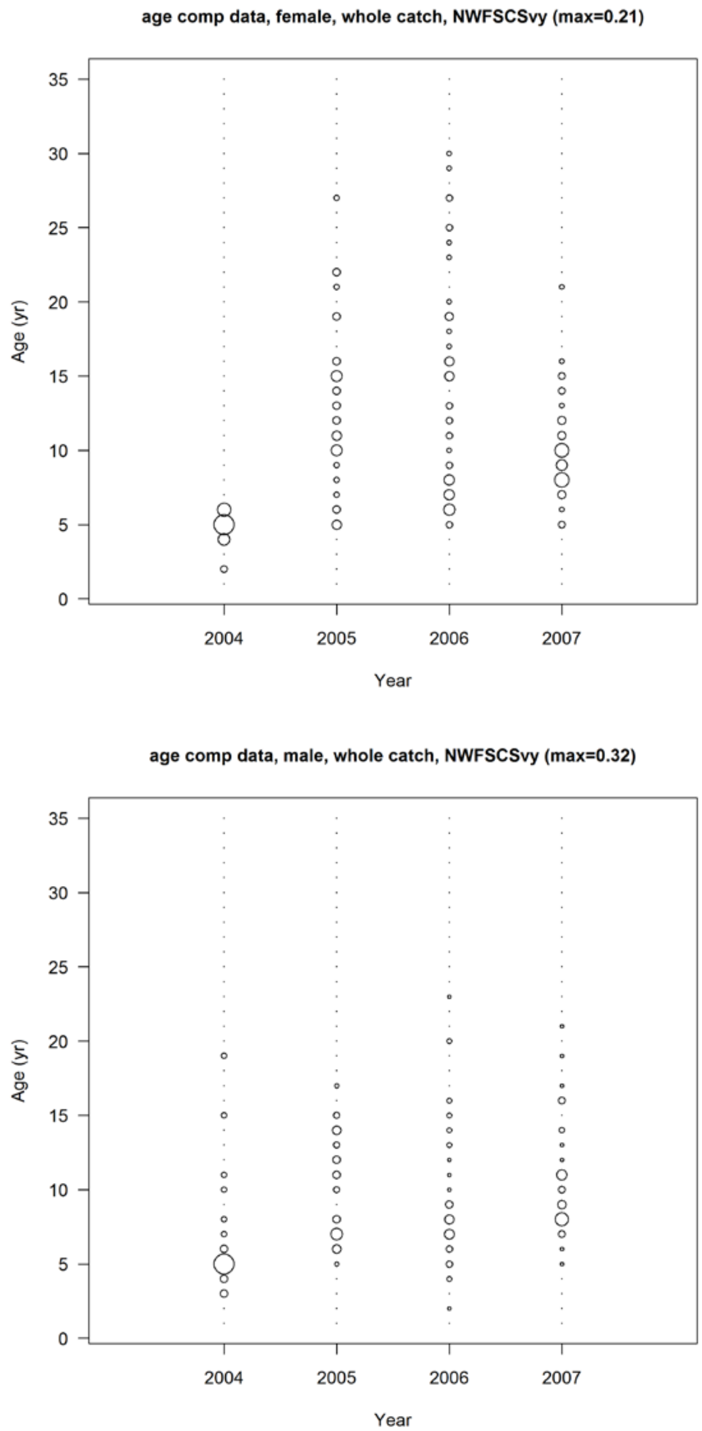


Figure 10. Age composition data from the NWFSC survey from 2004 to 2007 for females (upper panel) and male (lower panel).

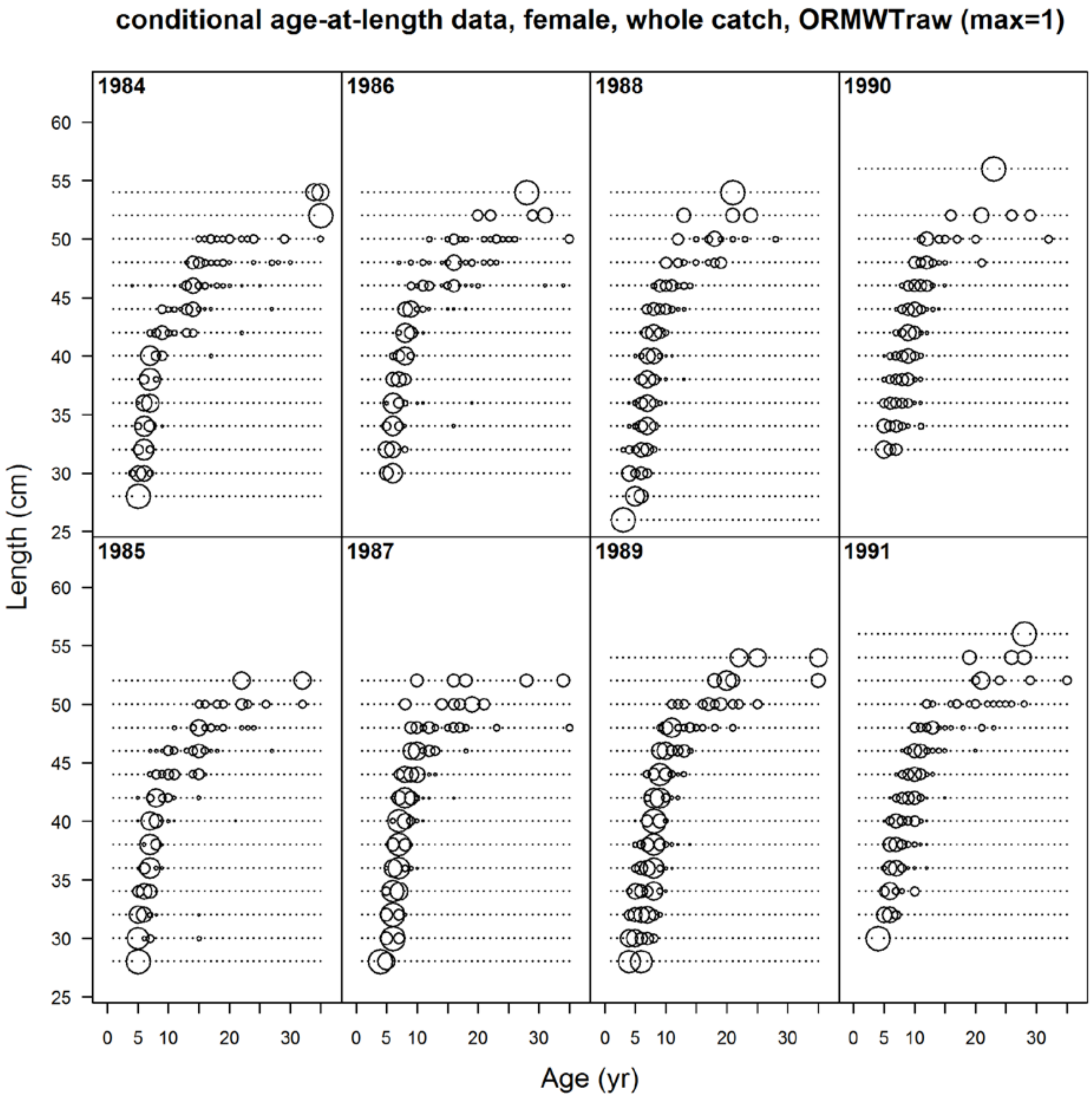


Figure 11a. Conditional age-at-length data for female from the Oregon mid-water trawl fisheries from 1984 to 1991.

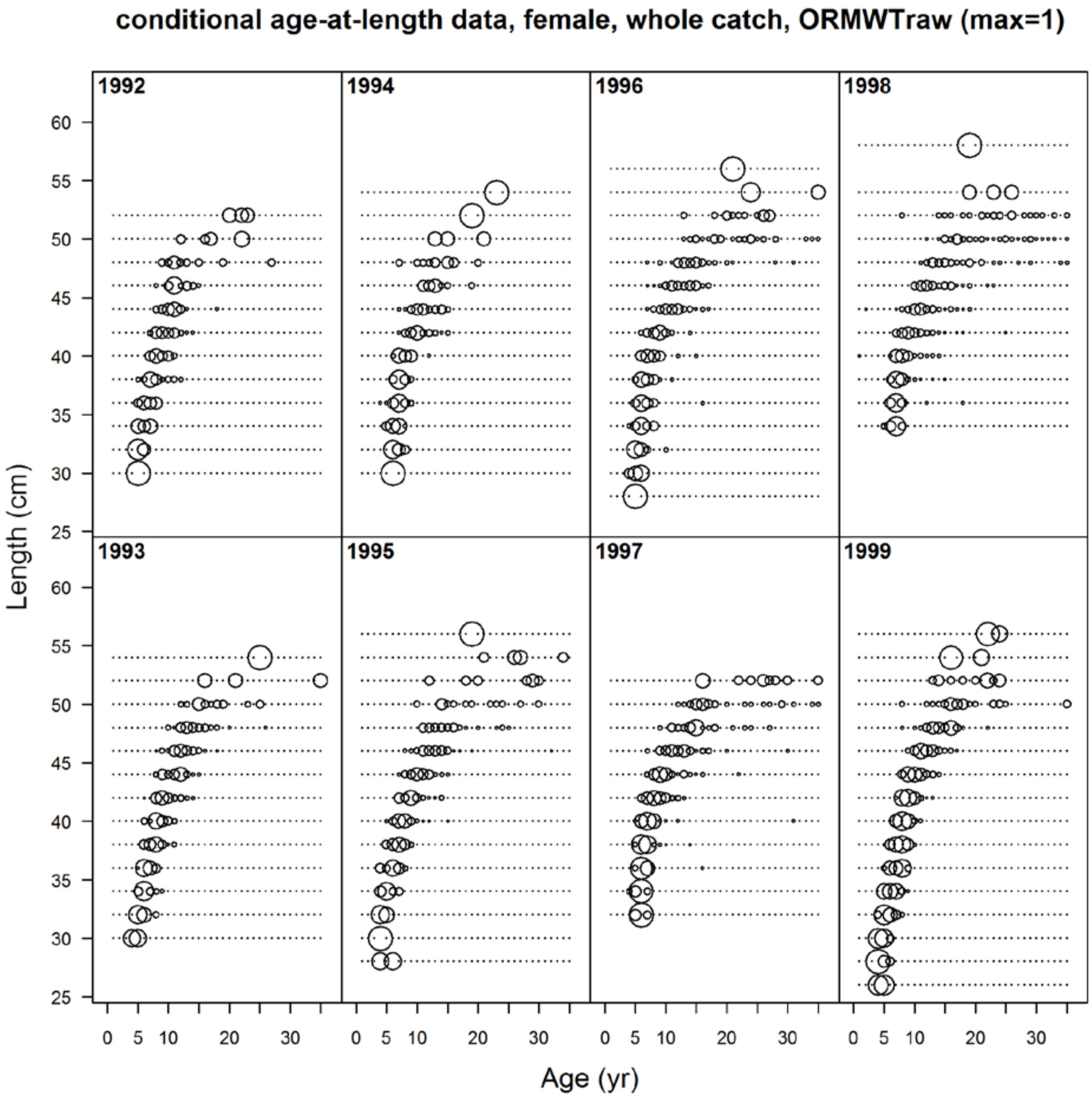


Figure 11b. Conditional age-at-length data for female from the Oregon mid-water trawl fisheries from 1992 to 199.

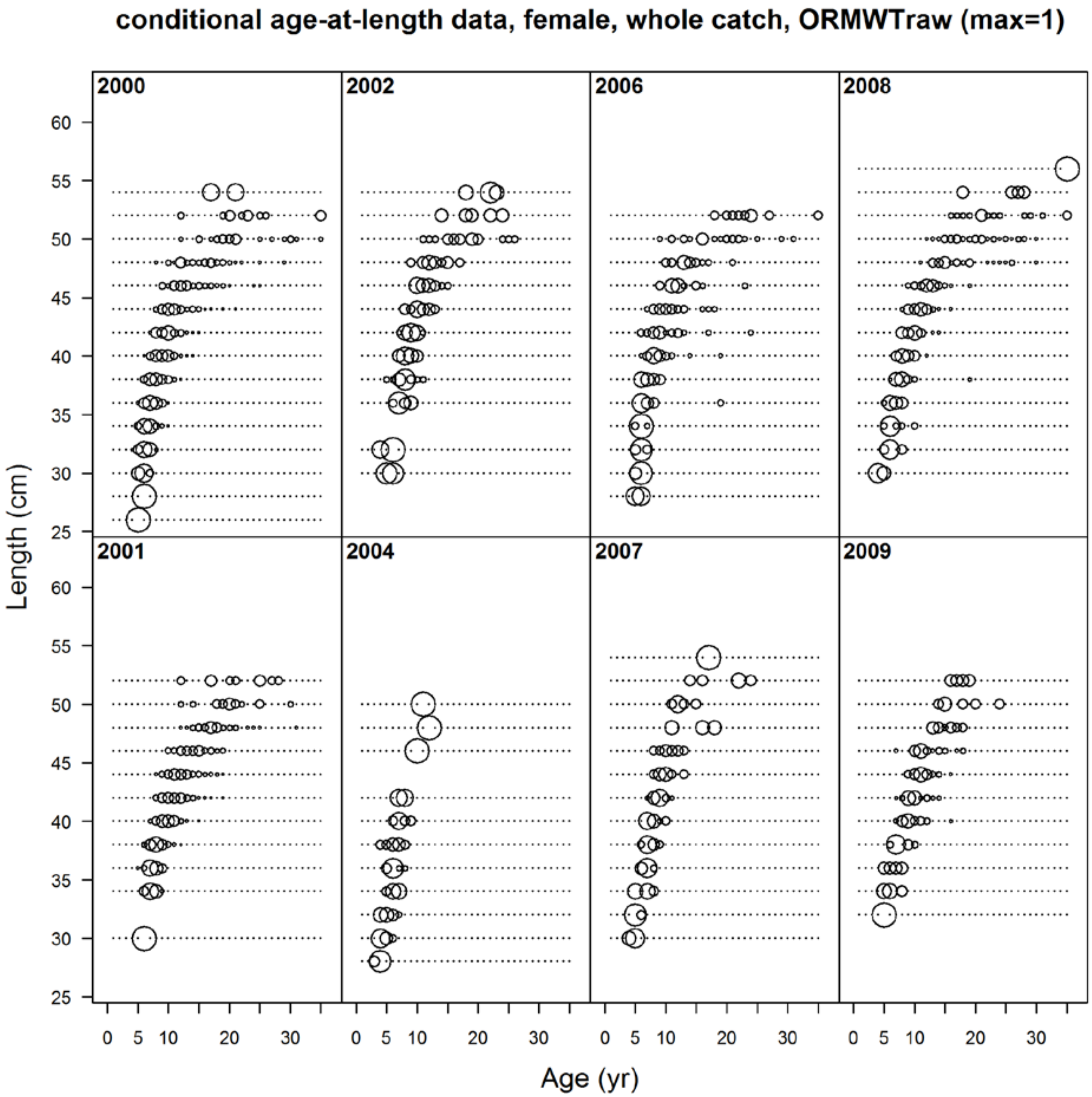


Figure 11c. Conditional age-at-length data for female from the Oregon mid-water trawl fisheries from 2000 to 2009.

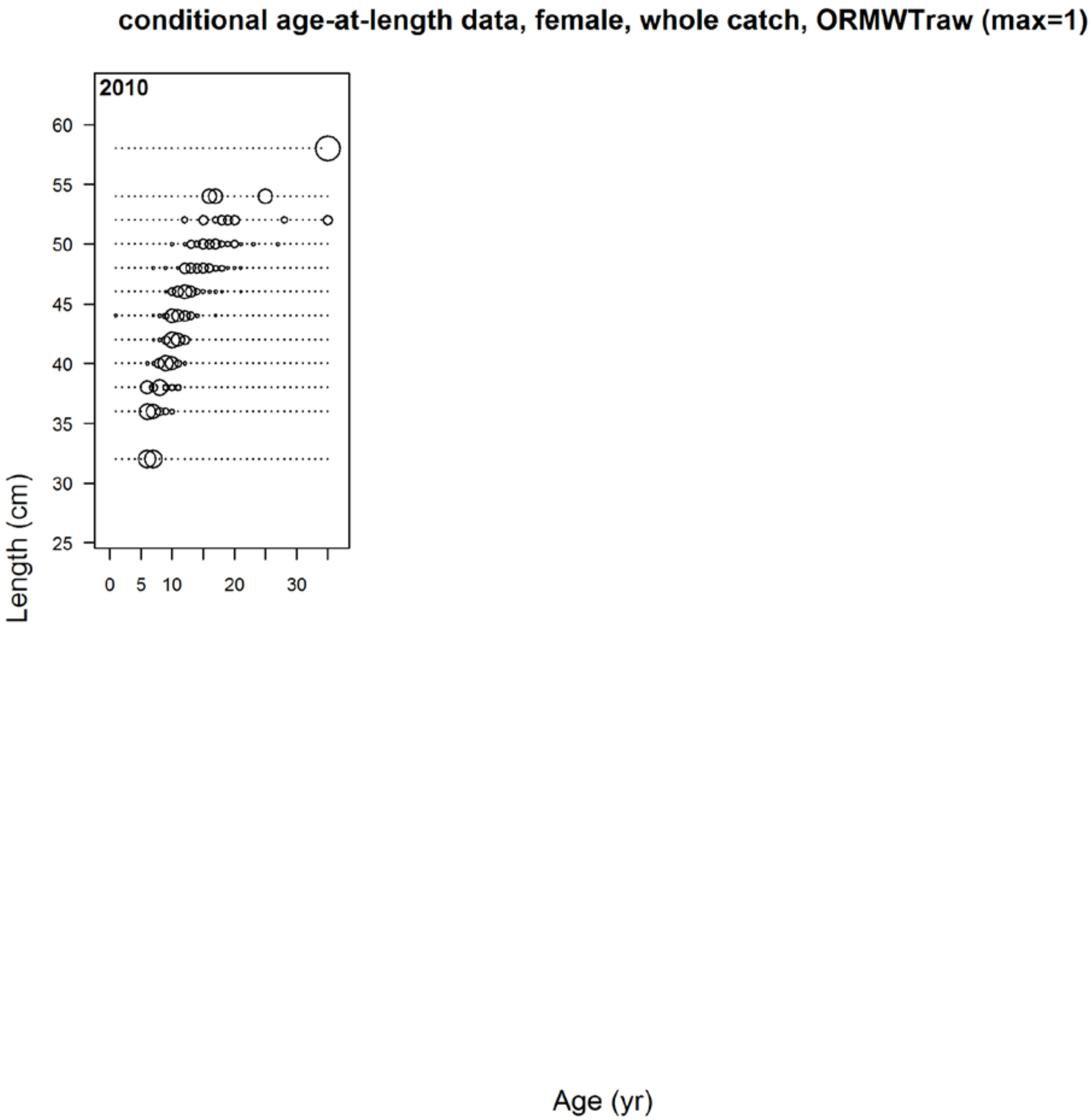


Figure 11d. Conditional age-at-length data for female from the Oregon mid-water trawl fisheries from 2010.

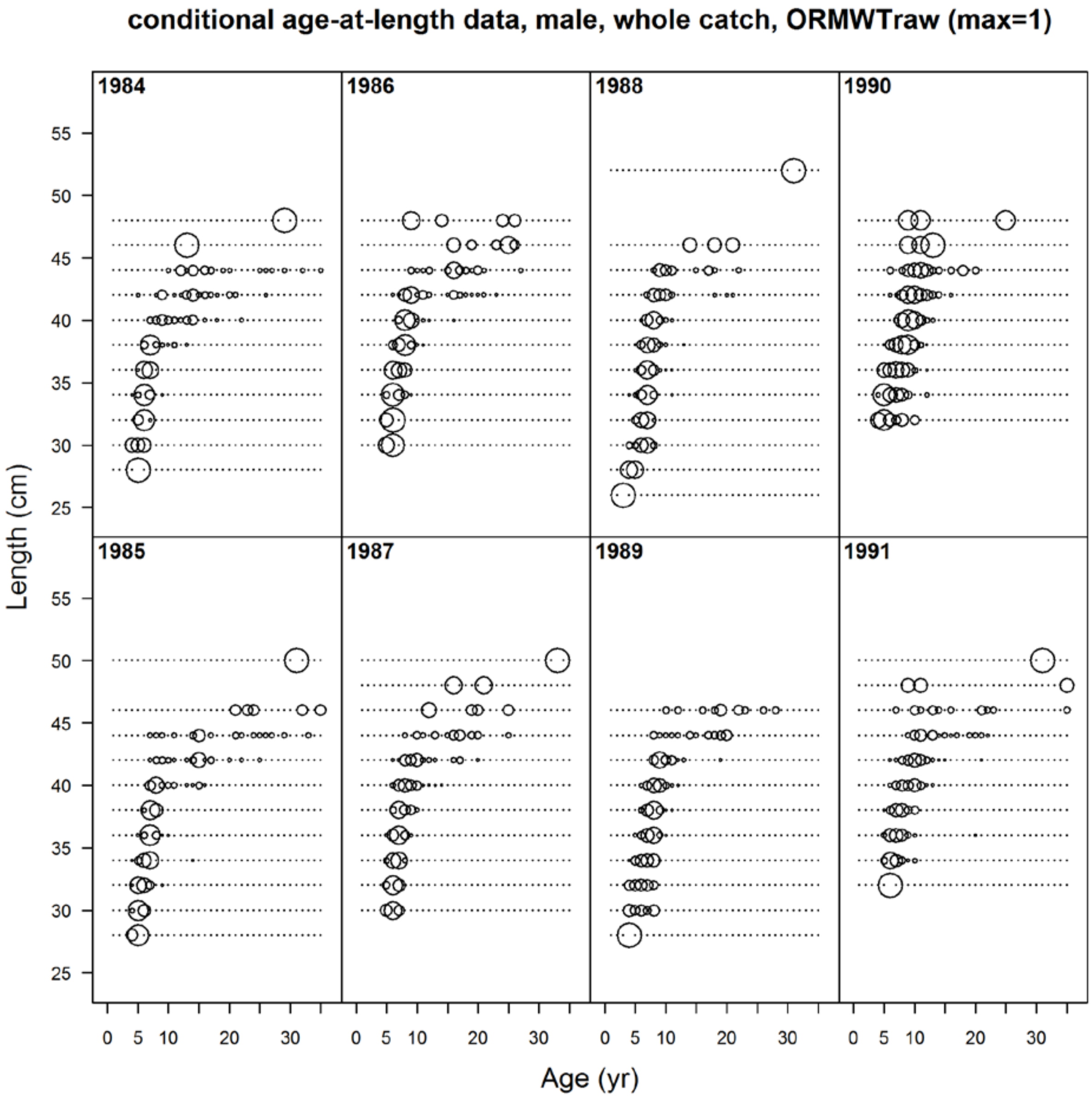


Figure 11e. Conditional age-at-length data for male from the Oregon mid-water trawl fisheries from 1984 to 1991.

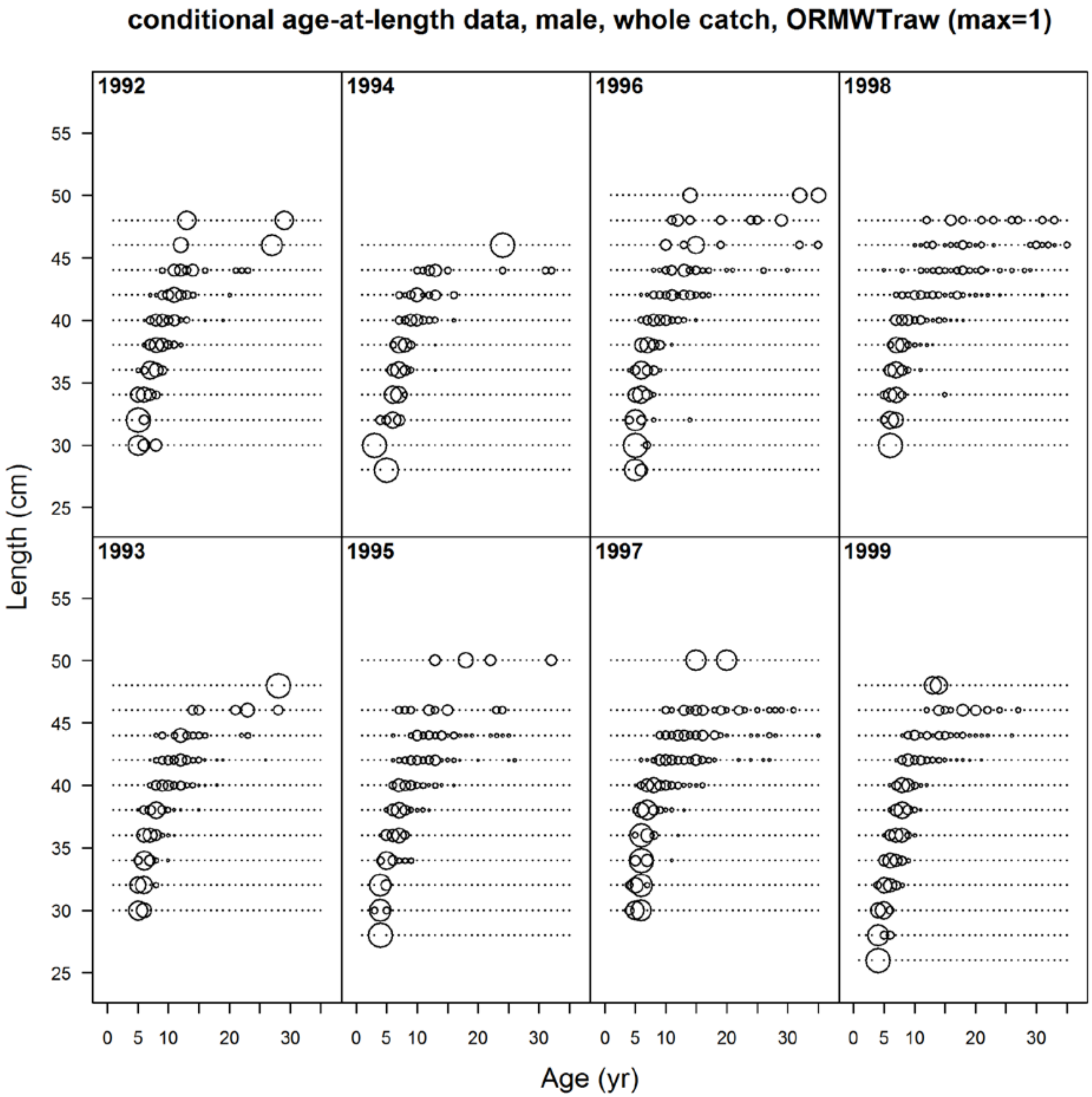


Figure 11f. Conditional age-at-length data for male from the Oregon mid-water trawl fisheries from 1992 to 1999.

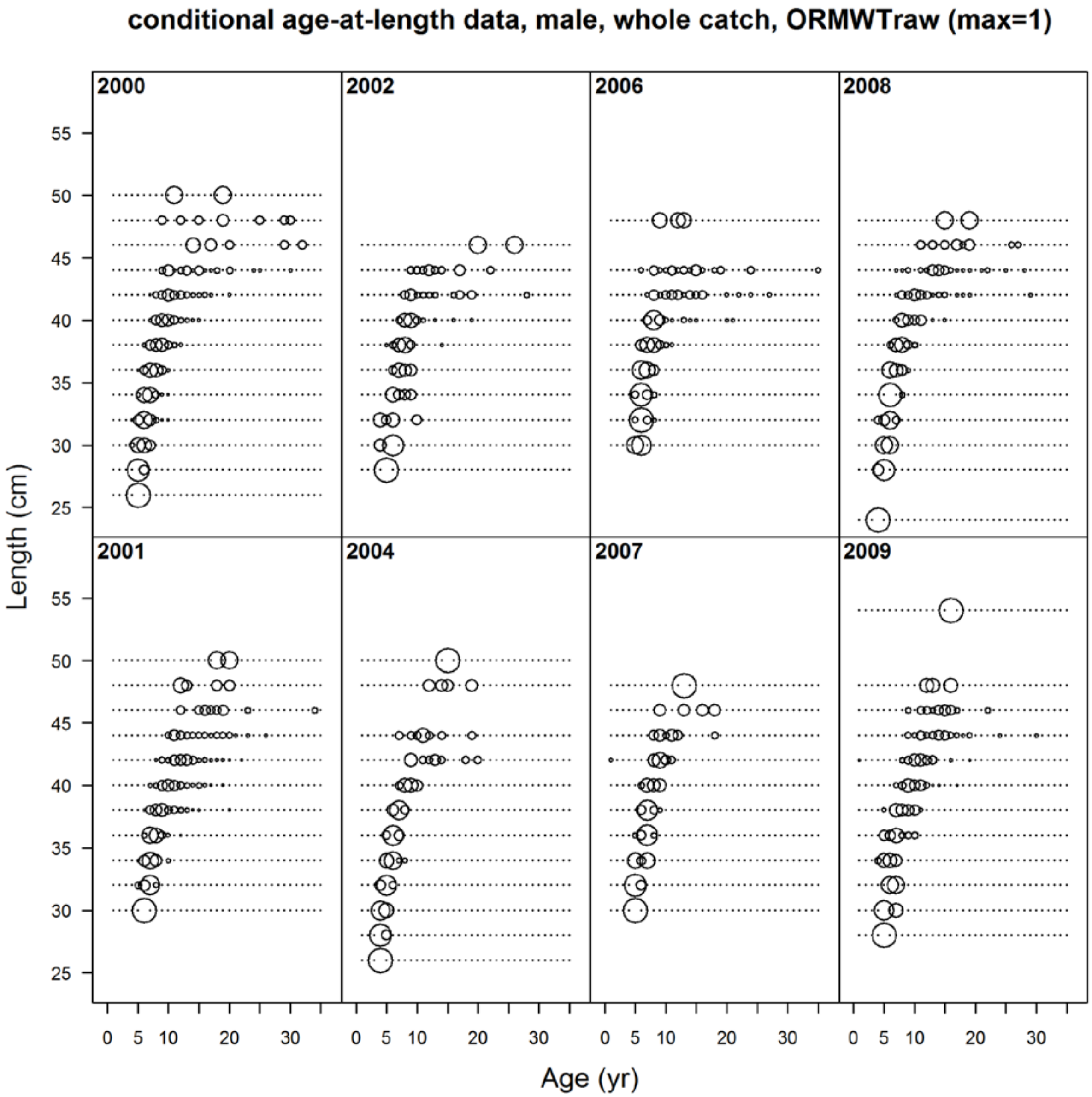


Figure 11g. Conditional age-at-length data for male from the Oregon mid-water trawl fisheries from 2000 to 2009.

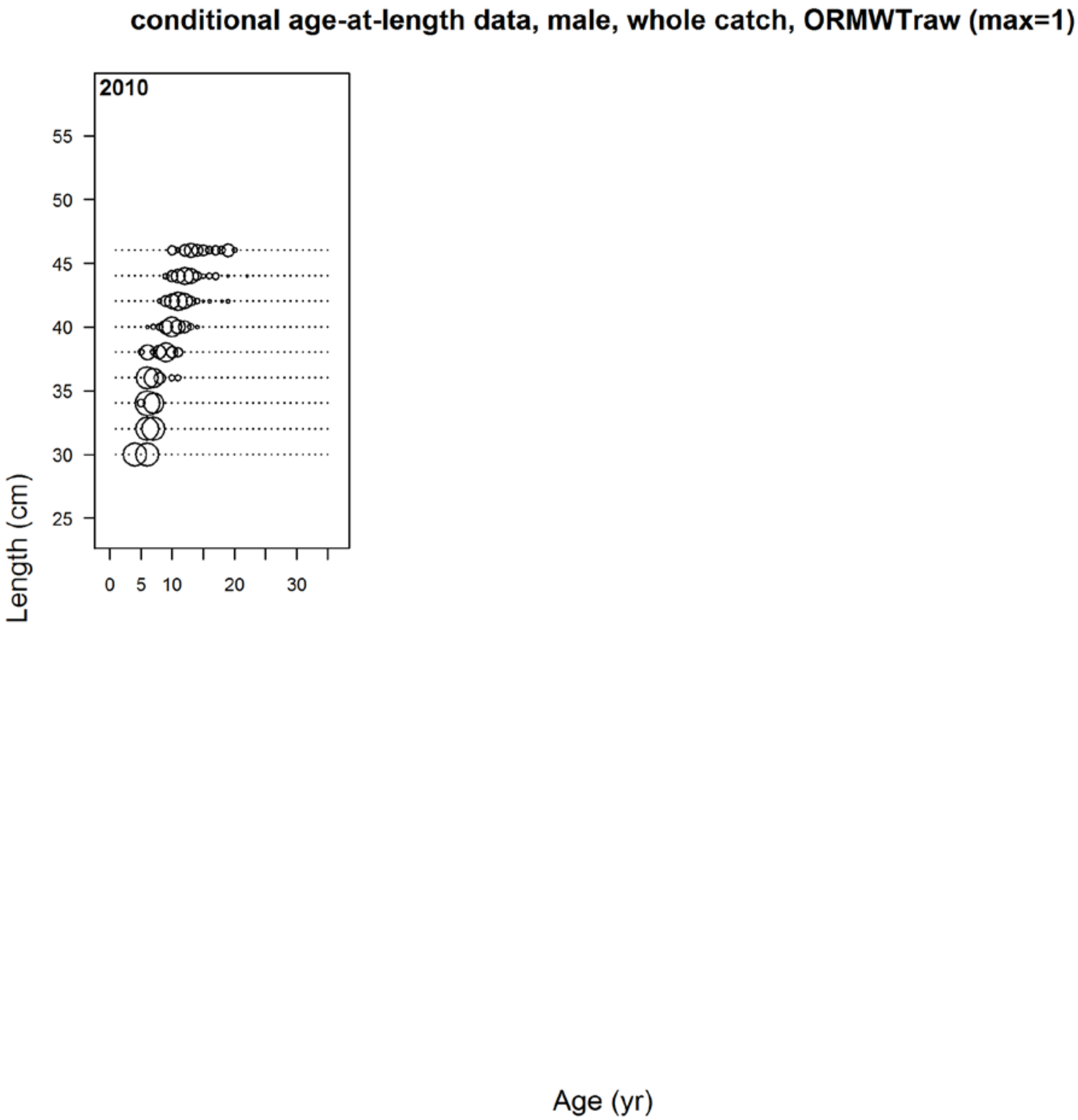


Figure 11h. Conditional age-at-length data for male from the Oregon mid-water trawl fisheries from 2010.

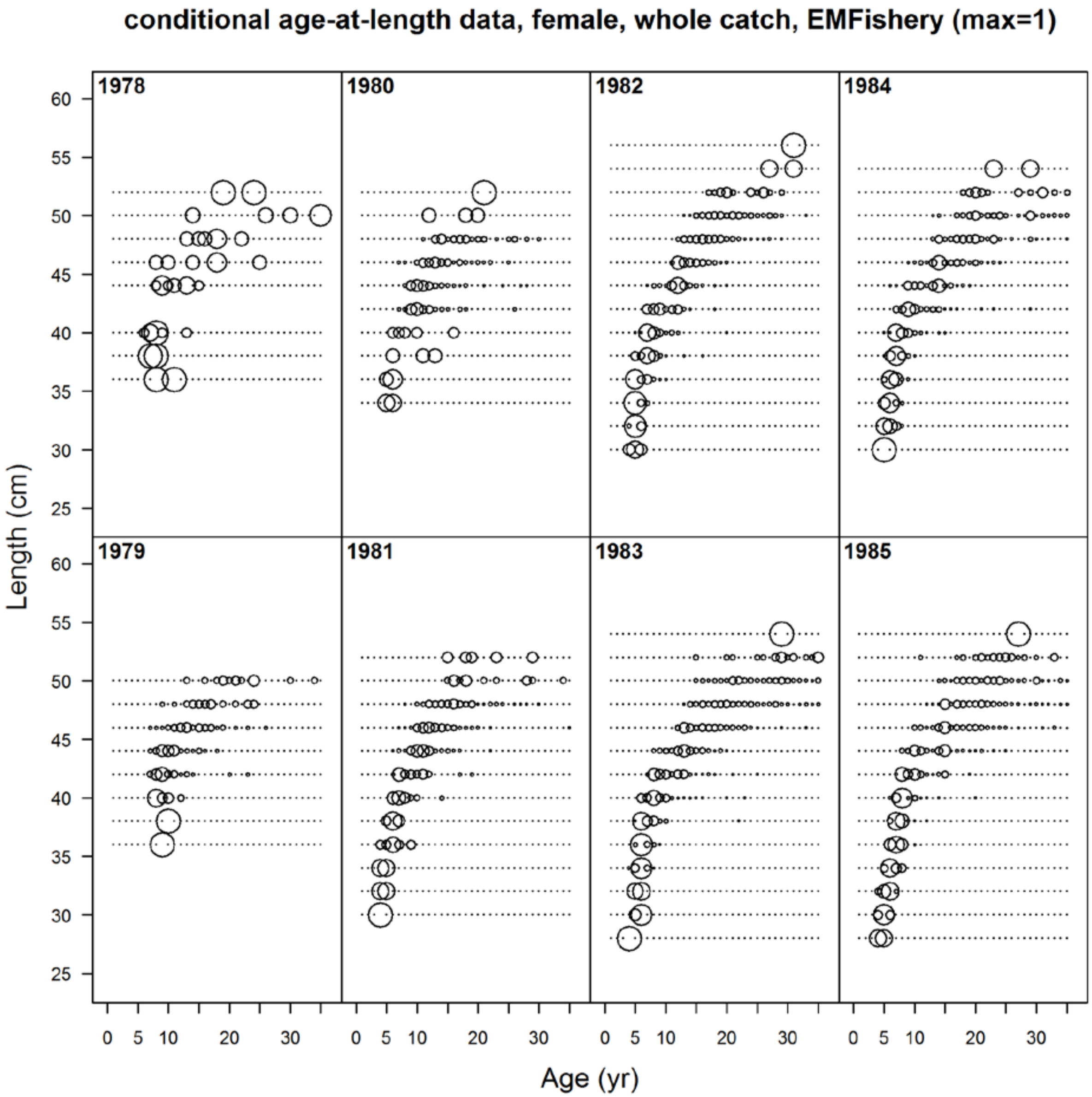


Figure 12a. Conditional age-at-length data for female from California (EMFishery1) fisheries from 1978 to 1985.

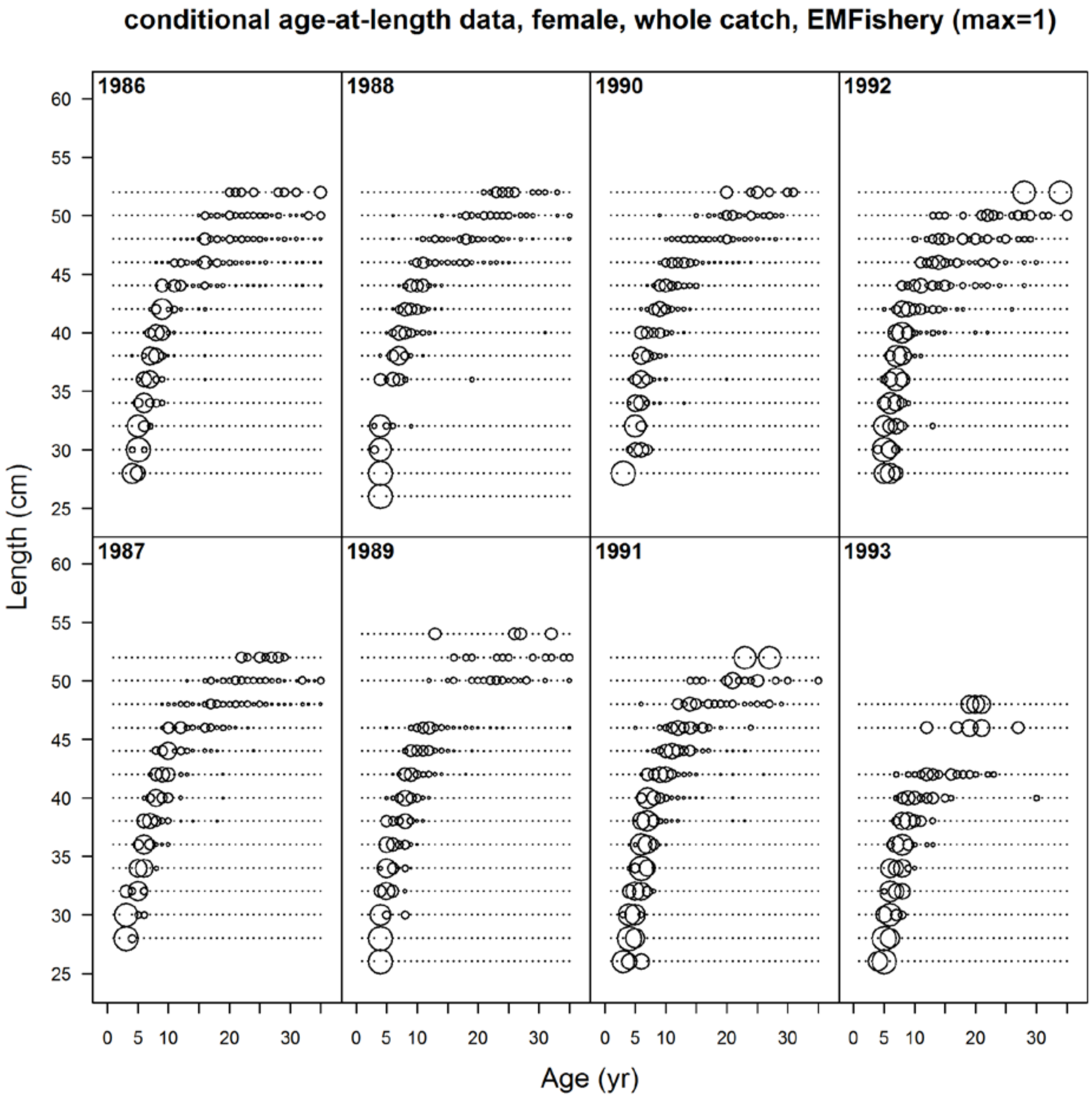


Figure 12b. Conditional age-at-length data for female from California (EMFishery1) fisheries from 1986 to 1993.

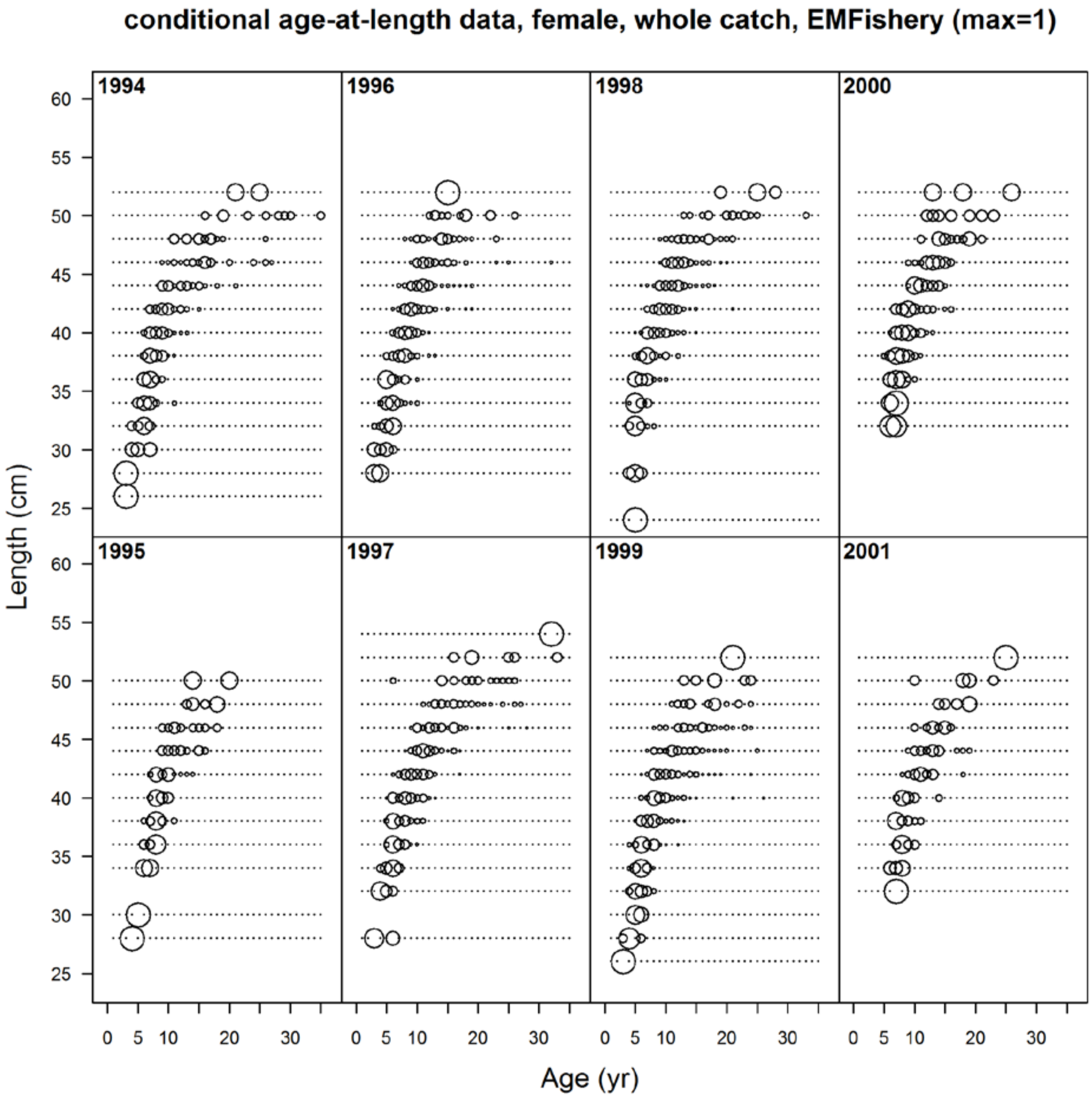


Figure 12c. Conditional age-at-length data for female from California (EMFishery1) fisheries from 1994 to 2001.

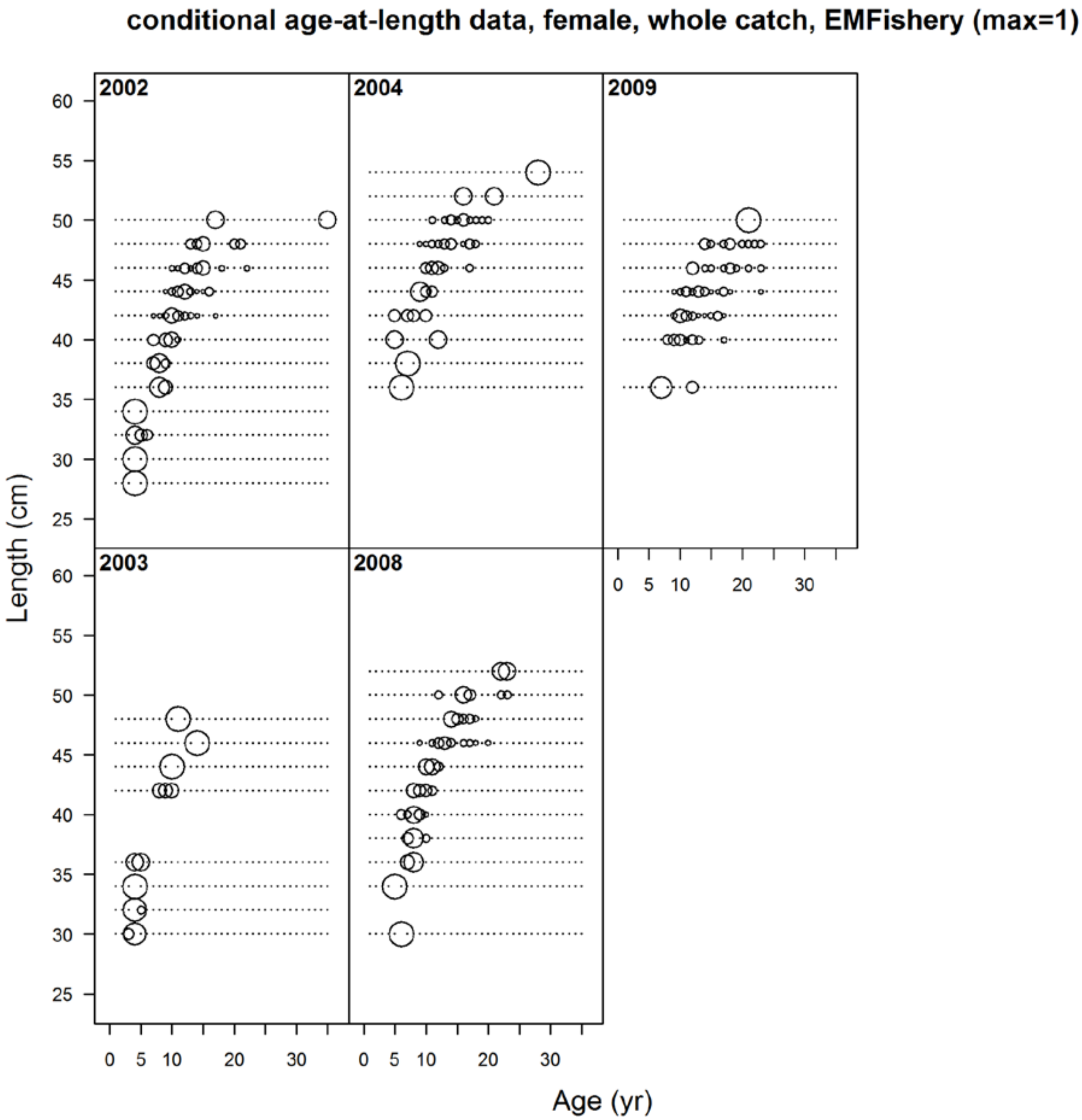


Figure 12d. Conditional age-at-length data for female from California (EMFishery1) fisheries from 2002 to 2008.

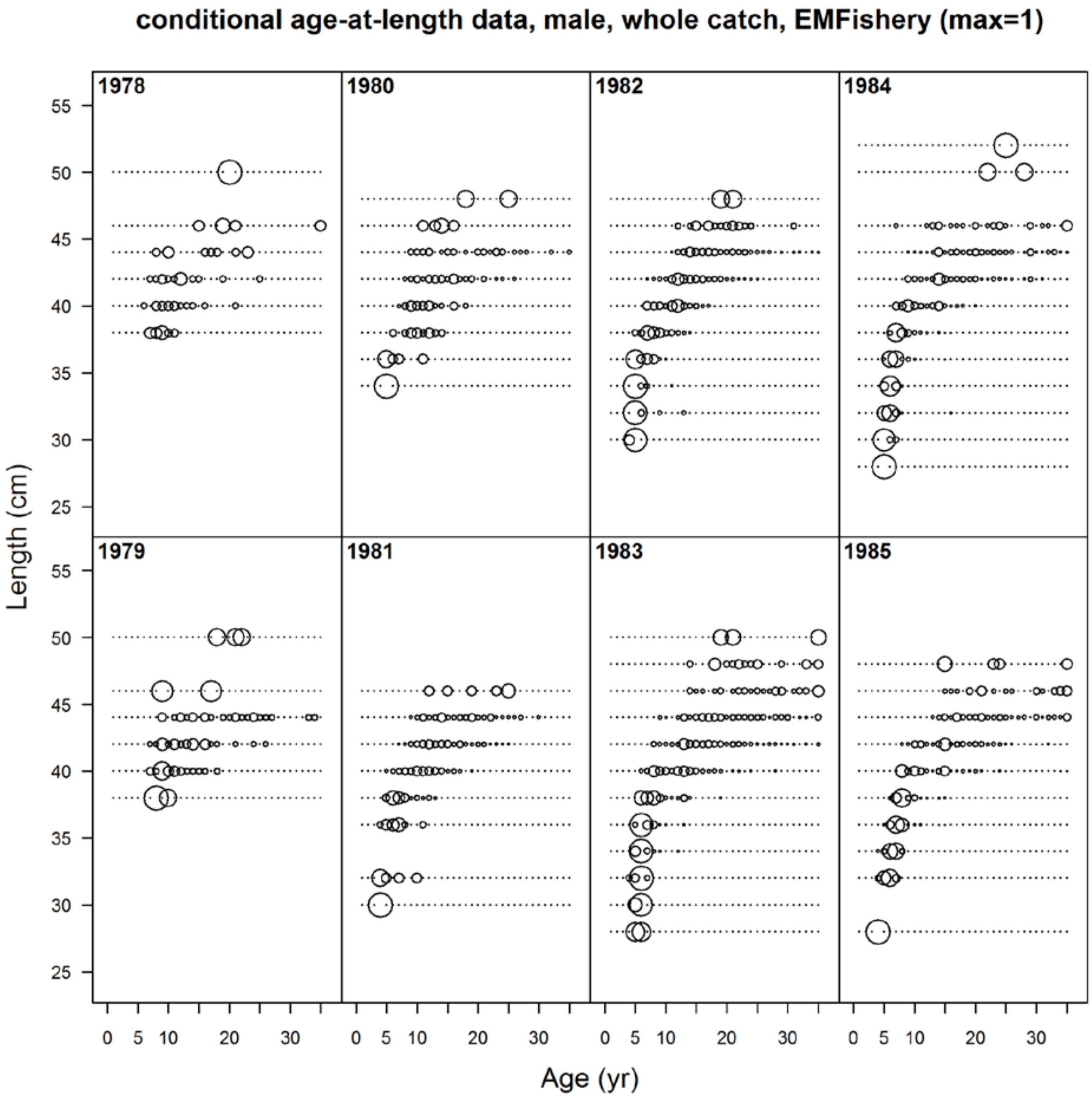


Figure 12e. Conditional age-at-length data for male from California (EMFishery1) fisheries from 1978 to 1985.

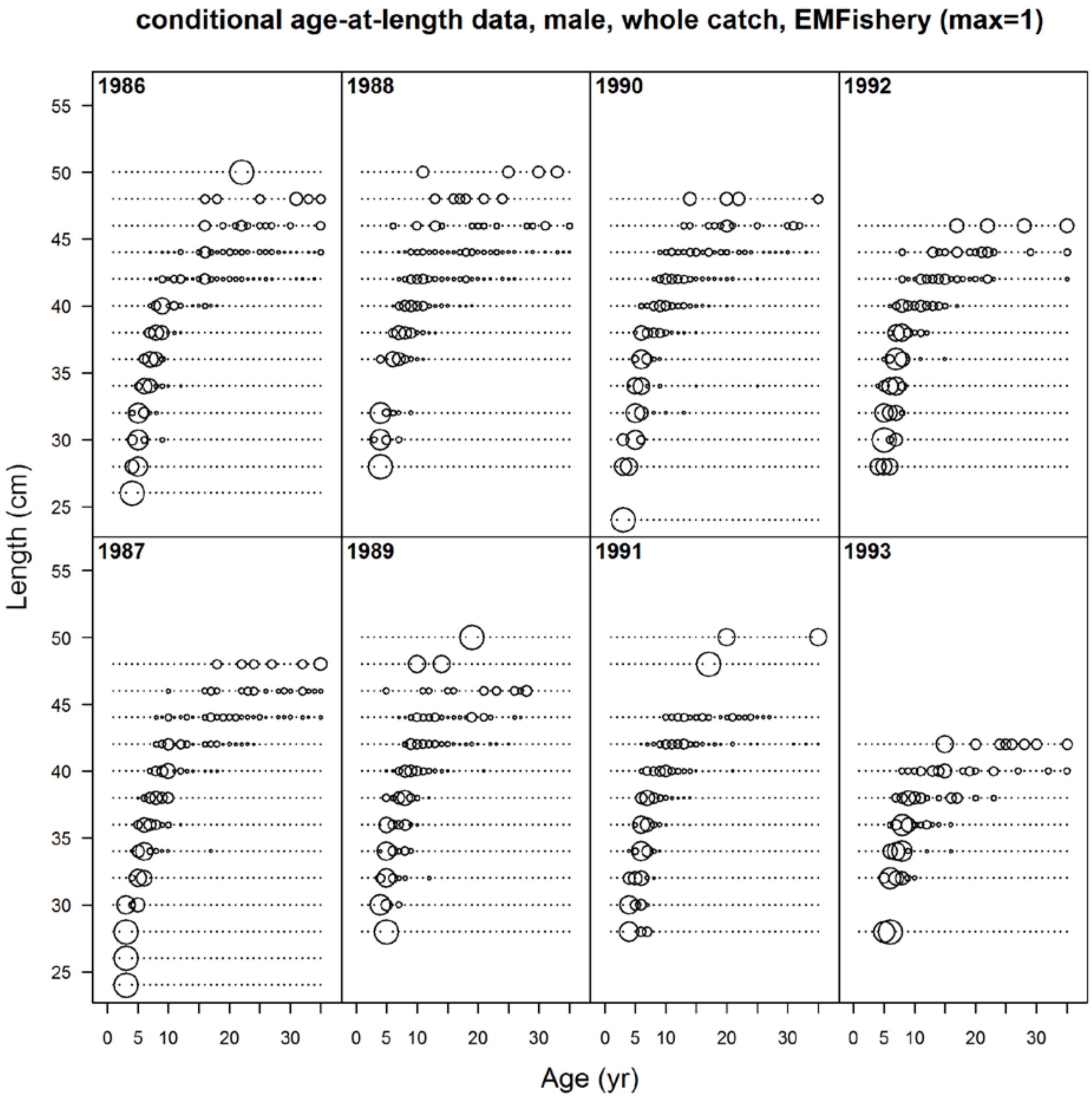


Figure 12f. Conditional age-at-length data for male from California (EMFishery1) fisheries from 1986 to 1993.

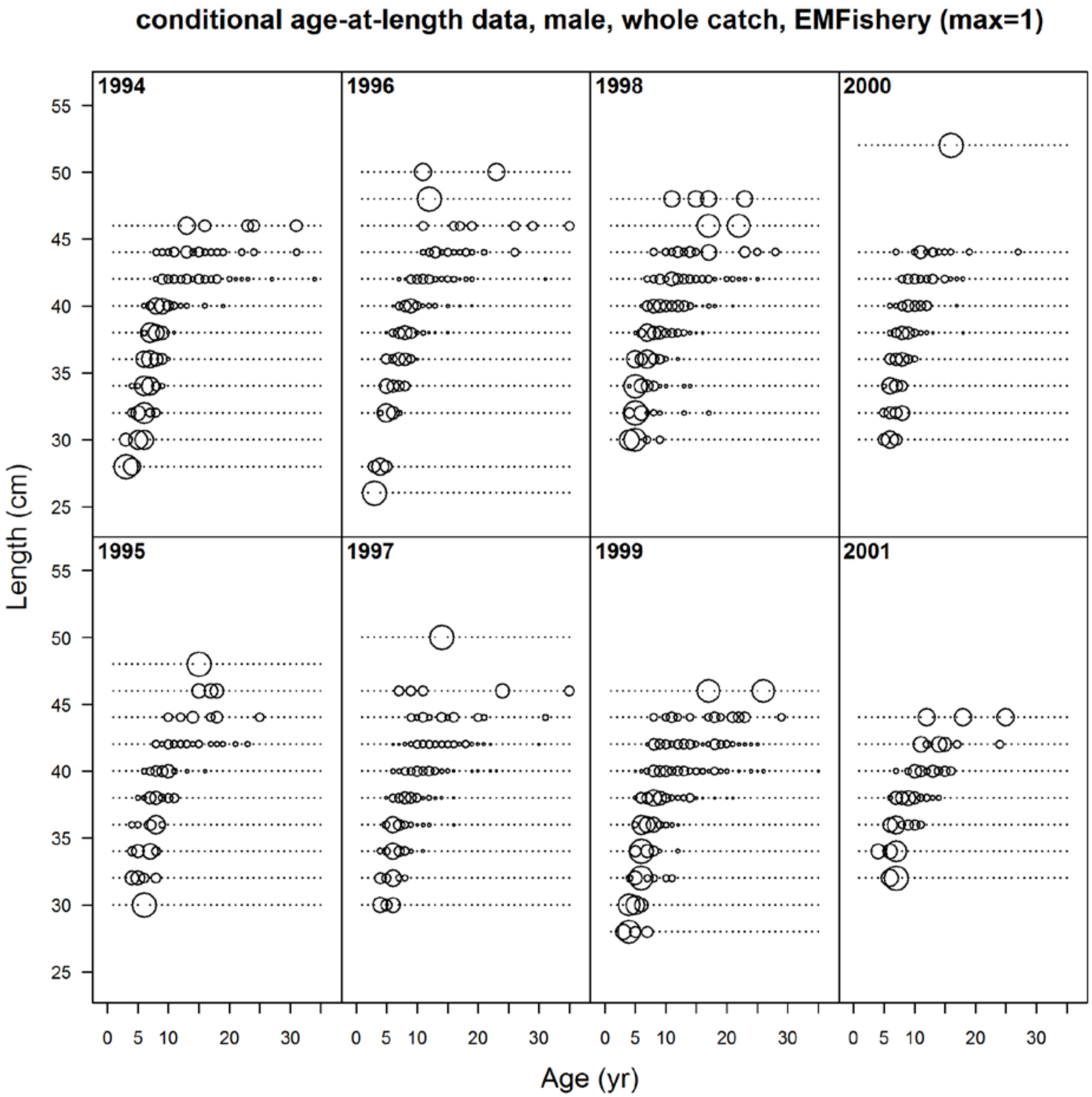


Figure 12g. Conditional age-at-length data for male from California (EMFishery1) fisheries from 1994 to 2001.

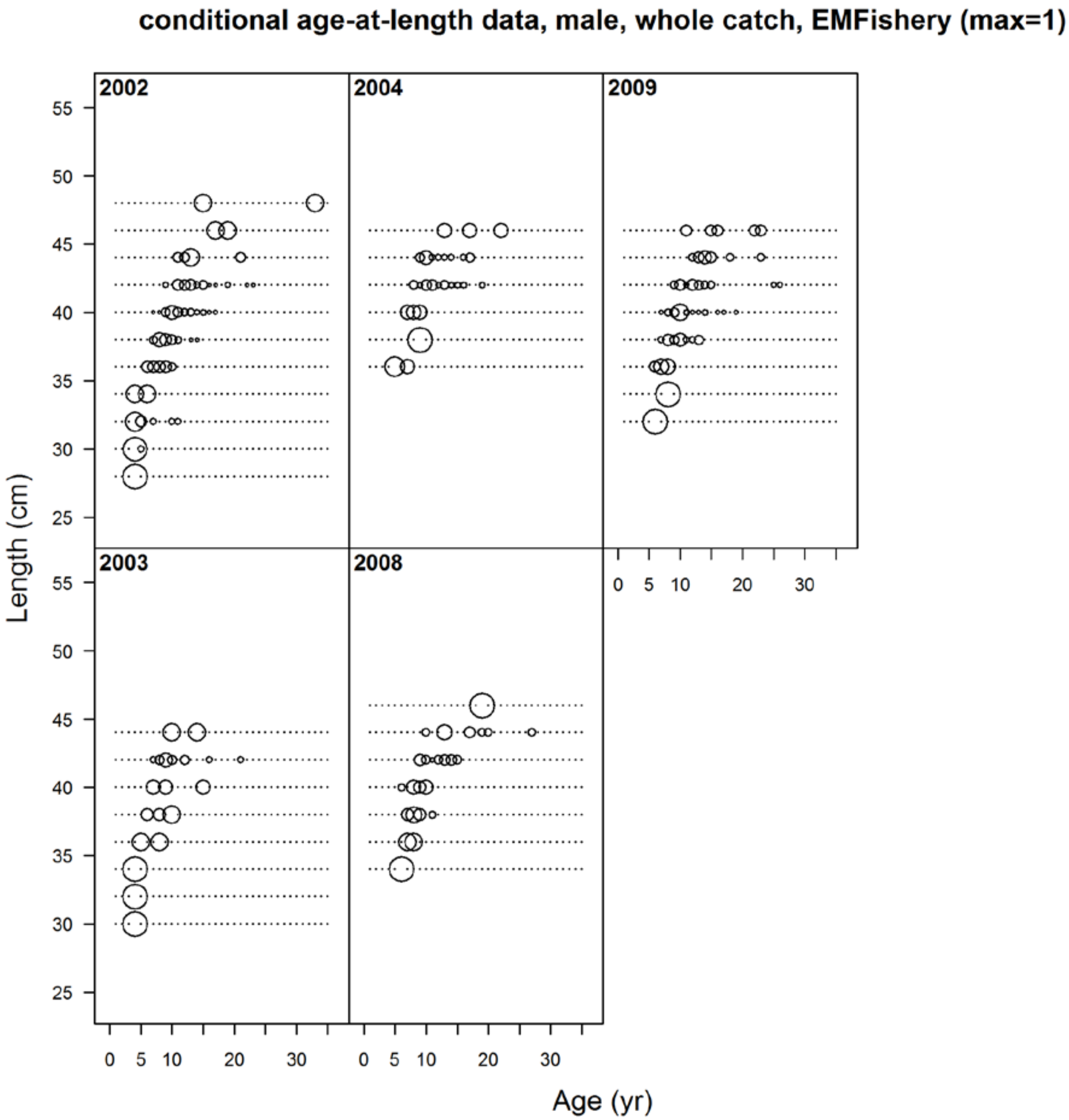


Figure 12h. Conditional age-at-length data for male from California (EMFishery1) fisheries from 2002 to 2008.

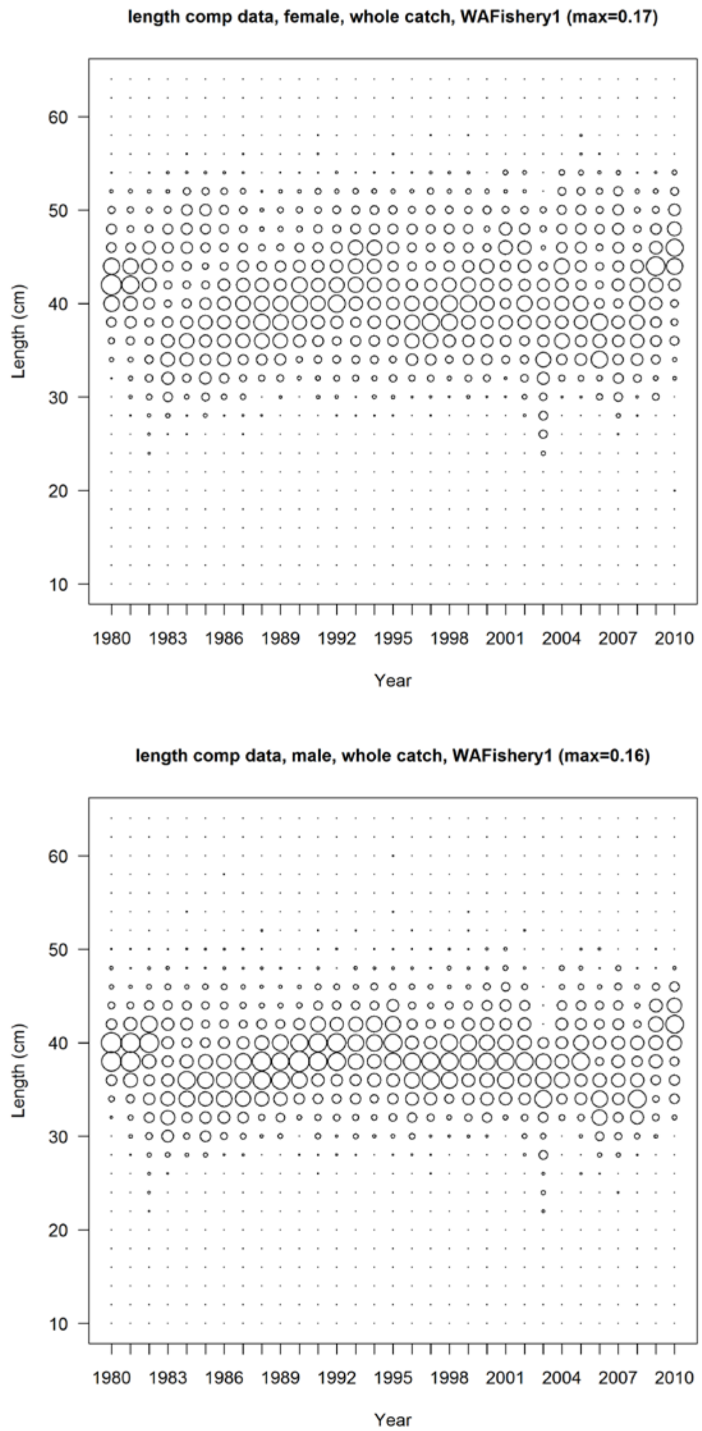


Figure 13. Length composition data from the Washington (WA) fisheries (Vancouver-Columbia area) from 1980 to 2010 for females (upper panel) and male (lower panel).

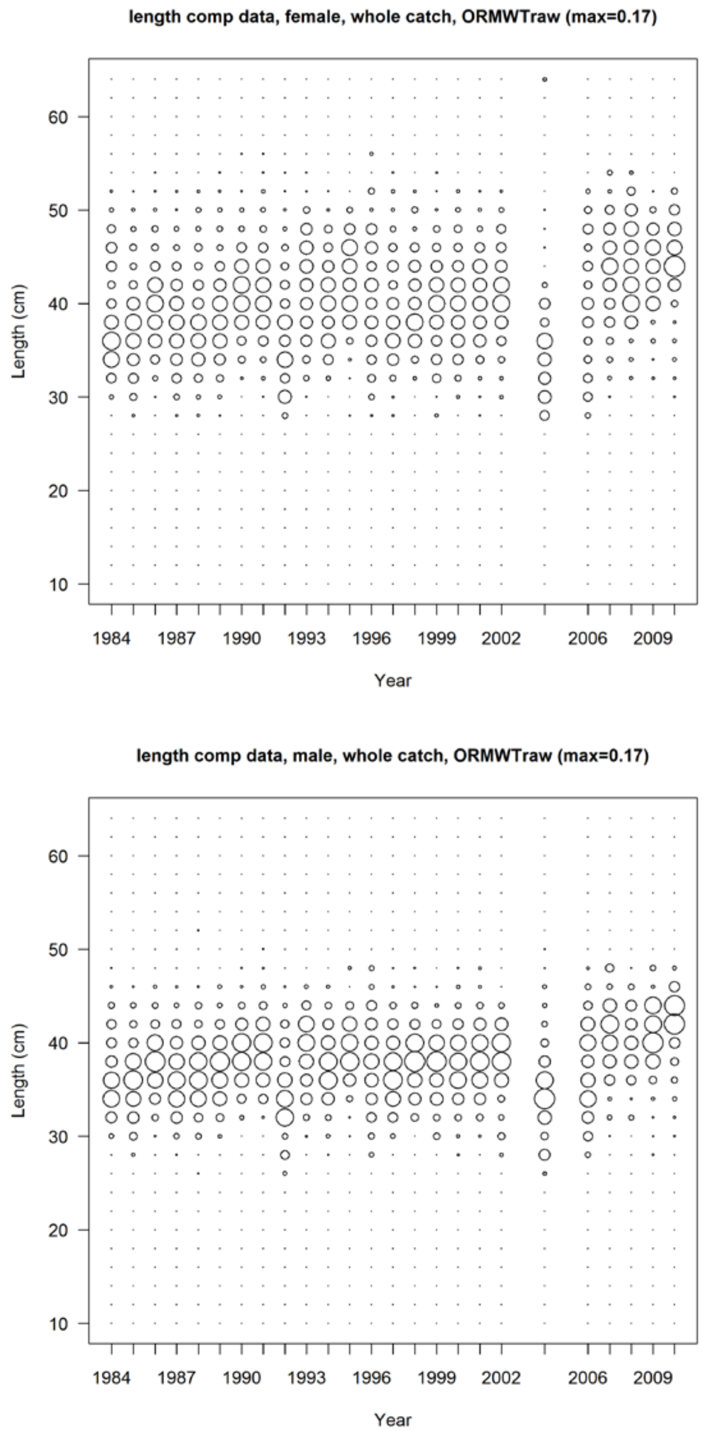


Figure 14. Length composition data from the Oregon mid-water trawl fishery from 1984 to 2010 for females (upper panel) and male (lower panel).

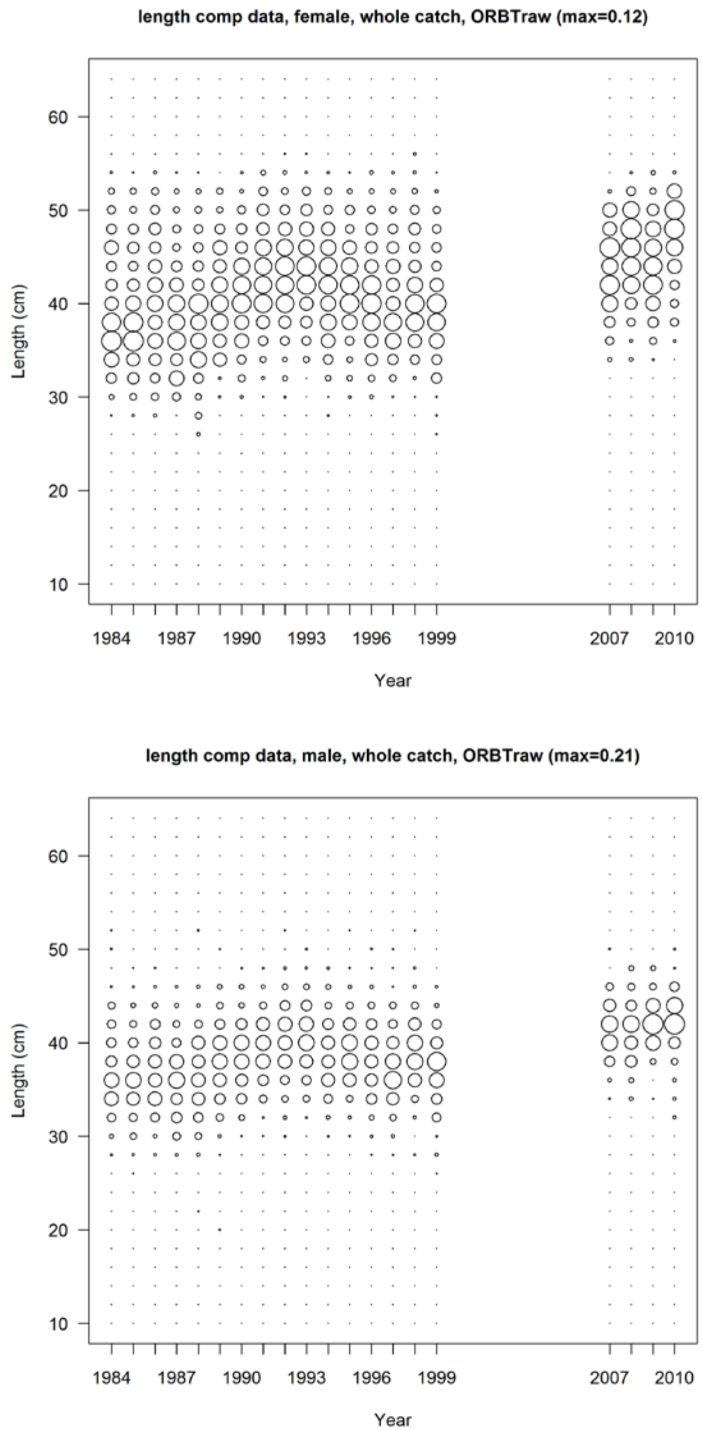


Figure 15. Length composition data from the Oregon bottom trawl fisheries from 1984 to 2010 for females (upper panel) and male (lower panel).

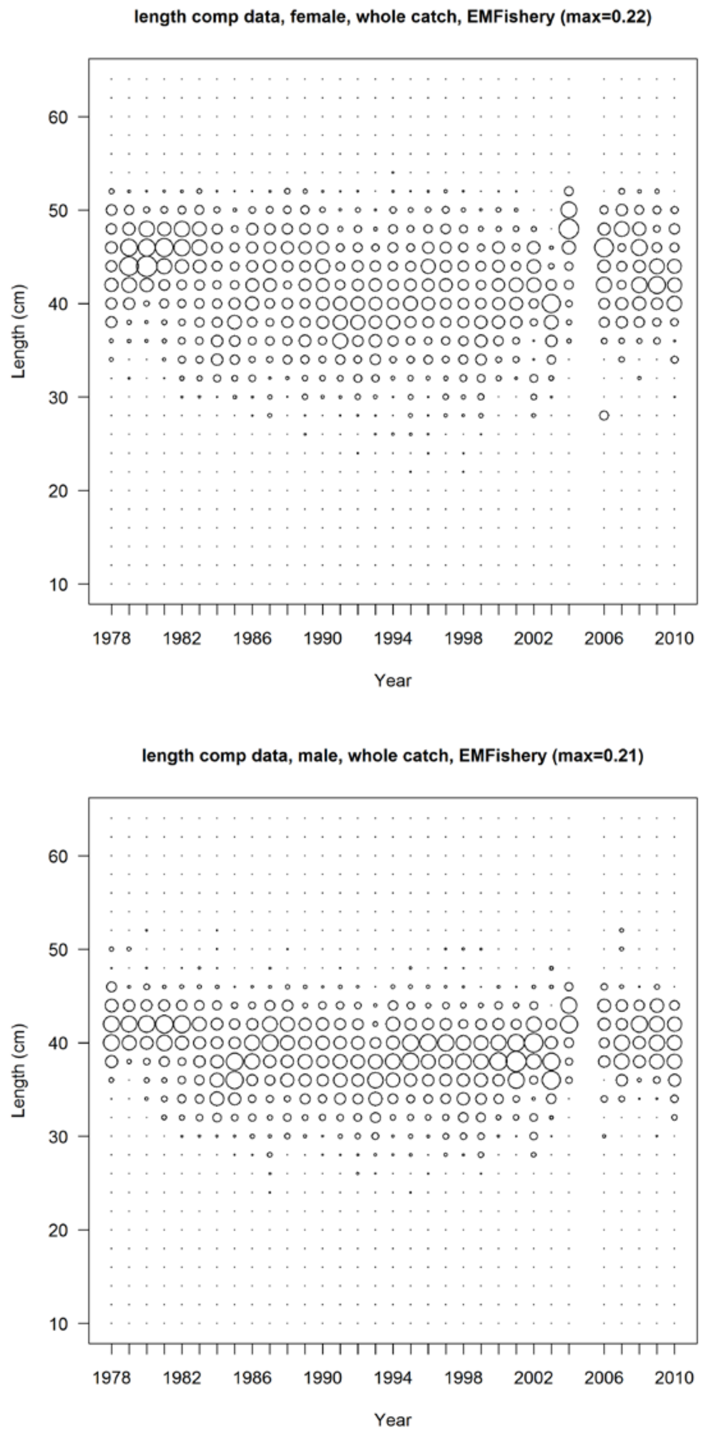


Figure 16. Length composition data from the California fisheries (EMFishery1) from 1978 to 2010 for females (upper panel) and male (lower panel).

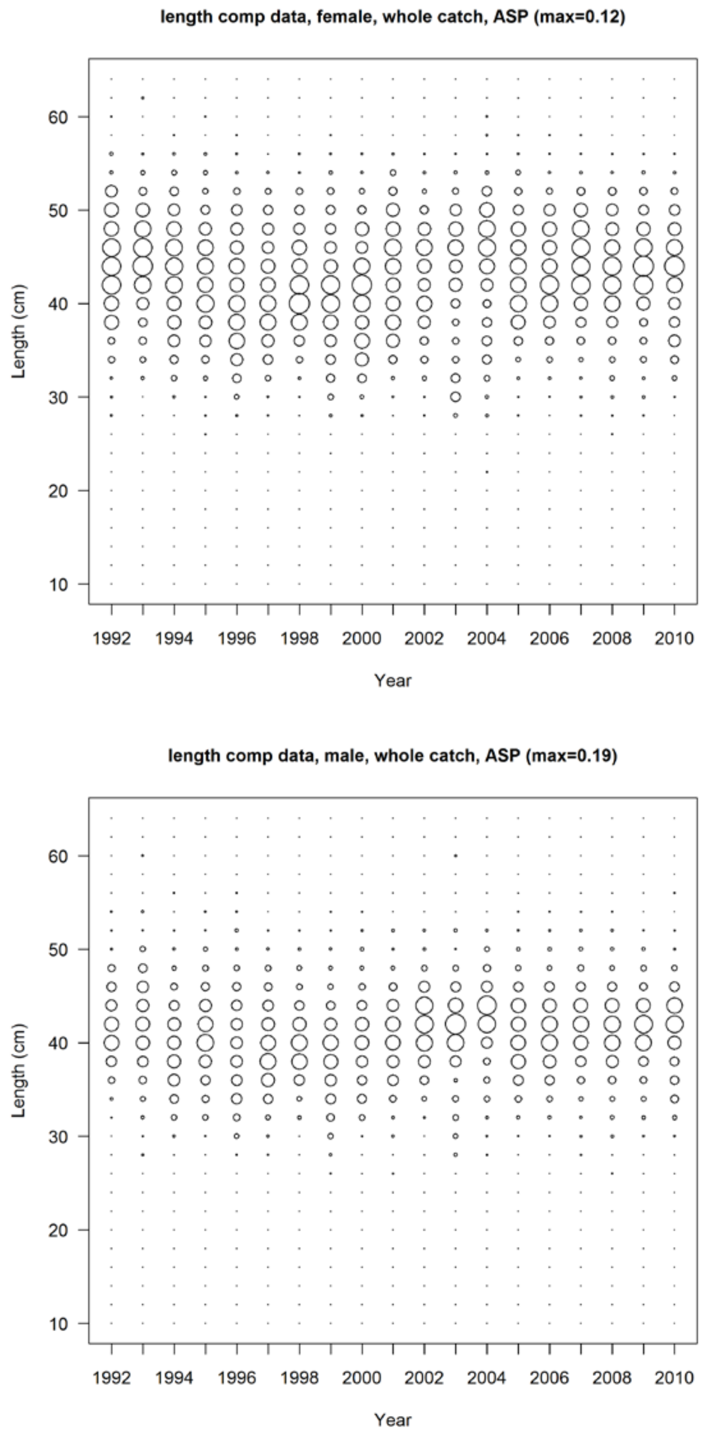


Figure 17. Length composition data from the at-sea whiting fishery from 1992 to 2010 for females (upper panel) and male (lower panel).

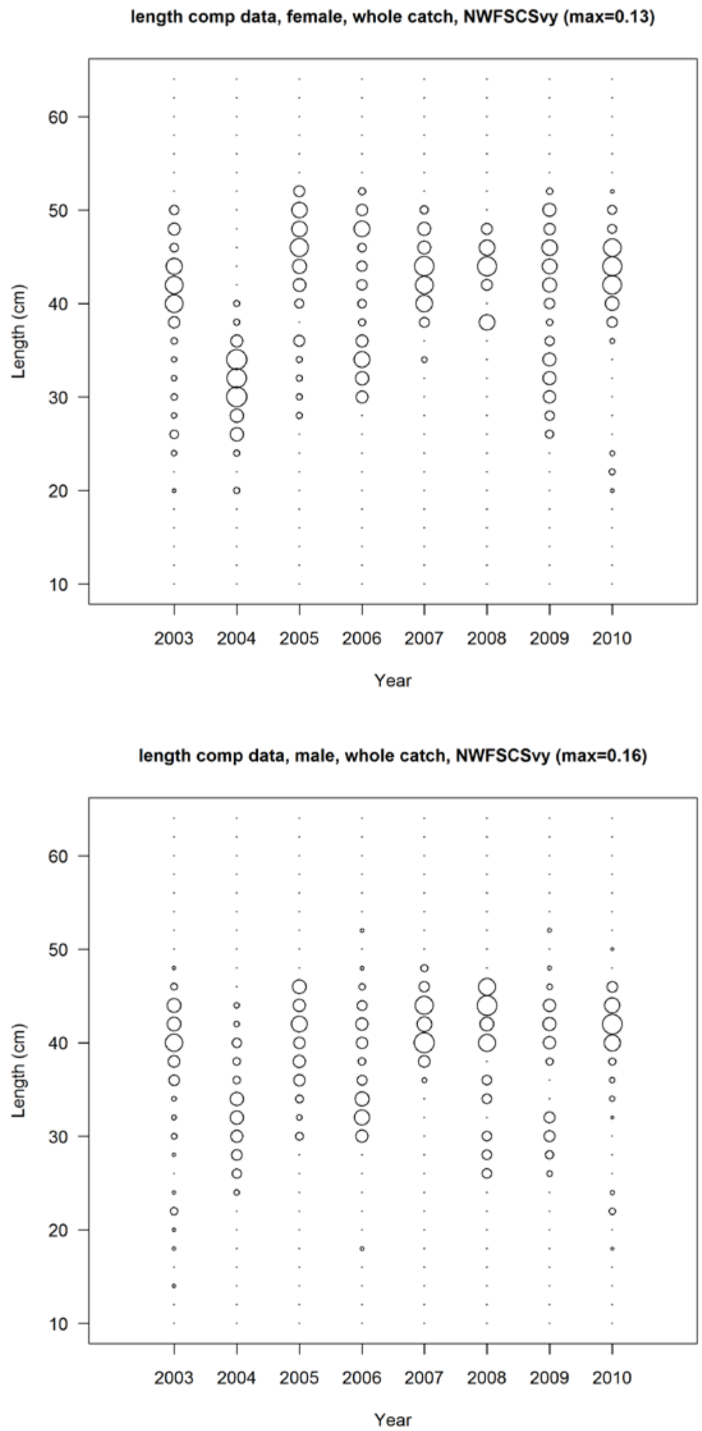


Figure 18. Length composition data from the NWFSC survey from 2003 to 2010 for females (upper panel) and male (lower panel).

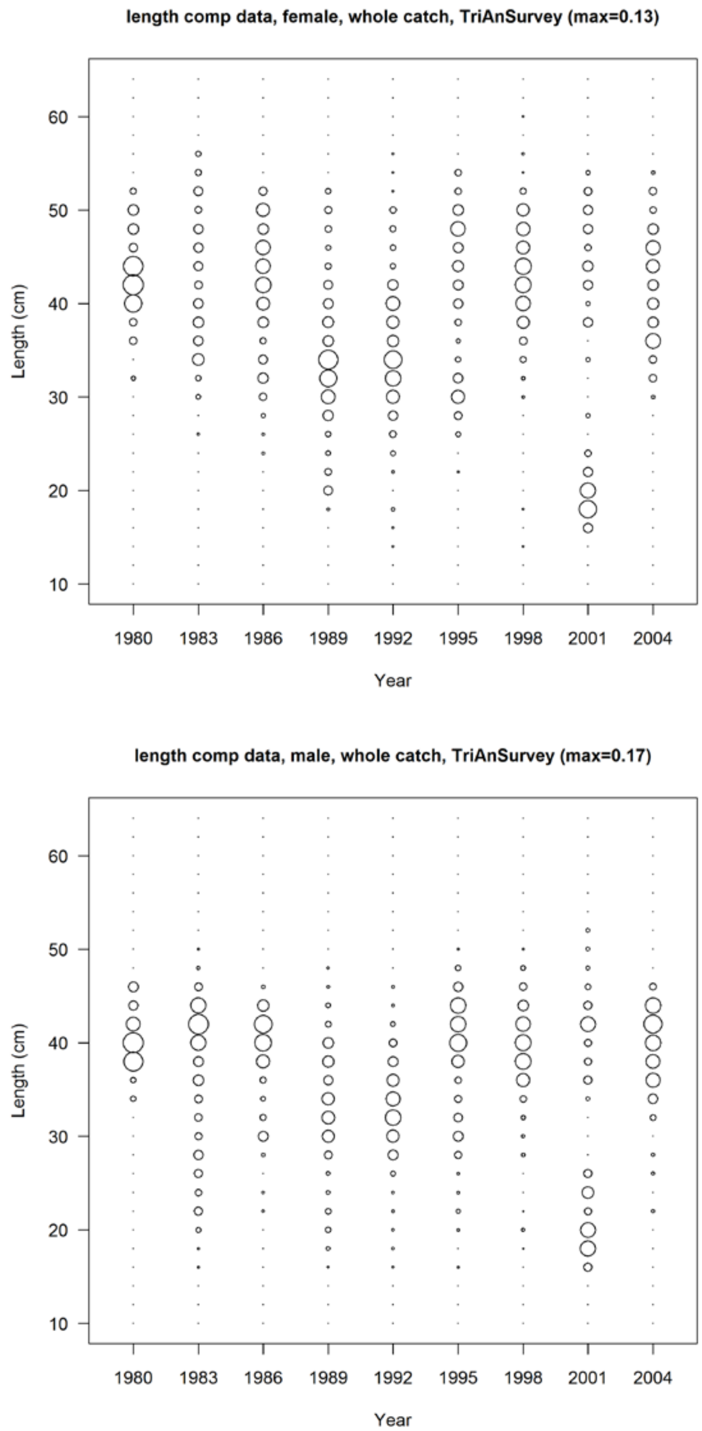


Figure 19. Length composition data from the triennial survey from 1980 to 2004 for females (upper panel) and male (lower panel).

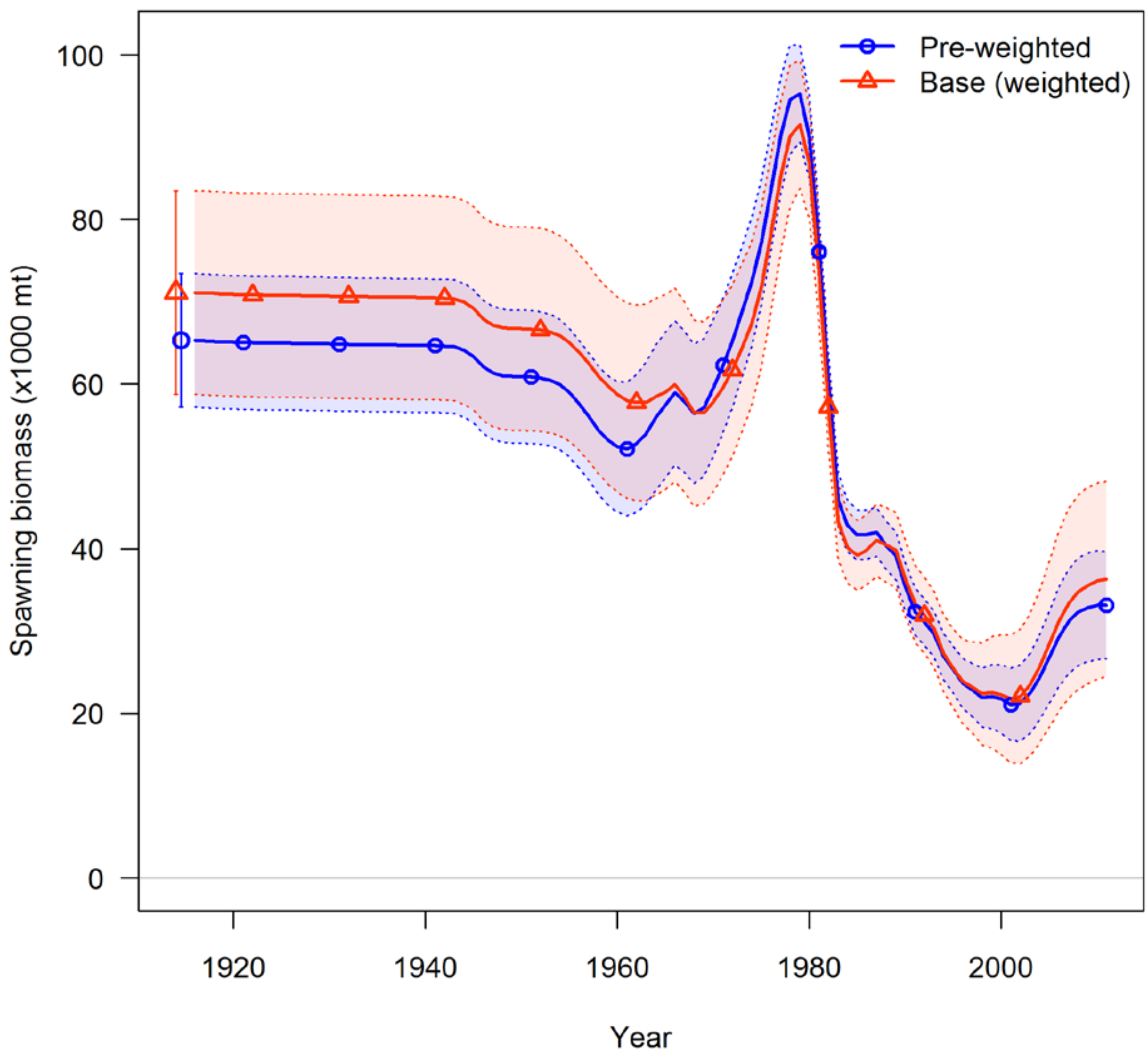


Figure 20. Comparisons of time series of spawning biomass with 95% asymptotic intervals between the pre-weighted and weighted (base) models. Two models are: Pre-weighted = model before weighting; and Base (weighted) = model with data weighted, which is the base model for this assessment.

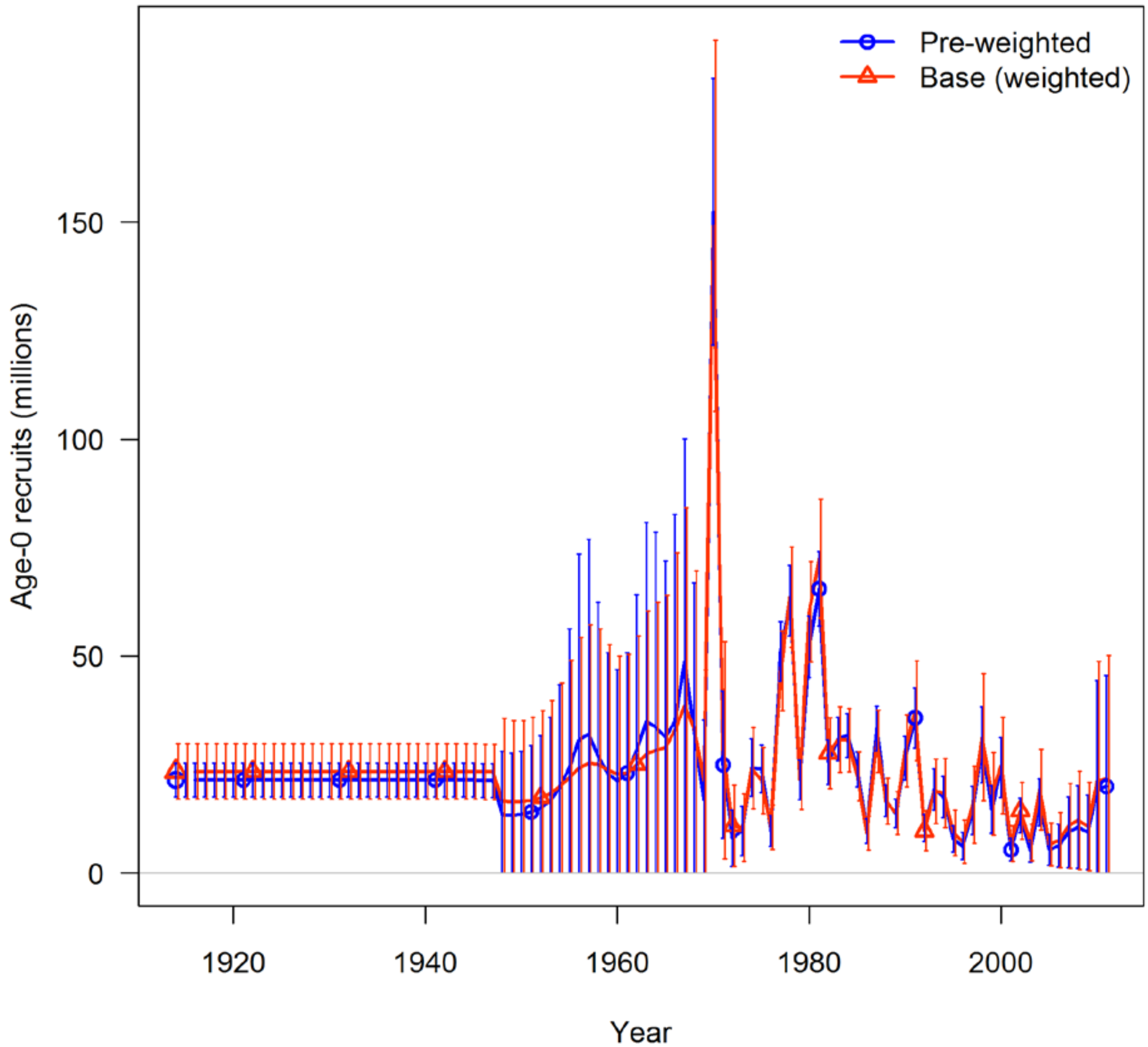


Figure 21. Comparisons of time series of recruits with 95% asymptotic intervals between the pre-weighted and weighted (base) models. Two models are: Pre-weighted = model before weighting; and Base (weighted) = model with data weighted, which is the base model for this assessment.

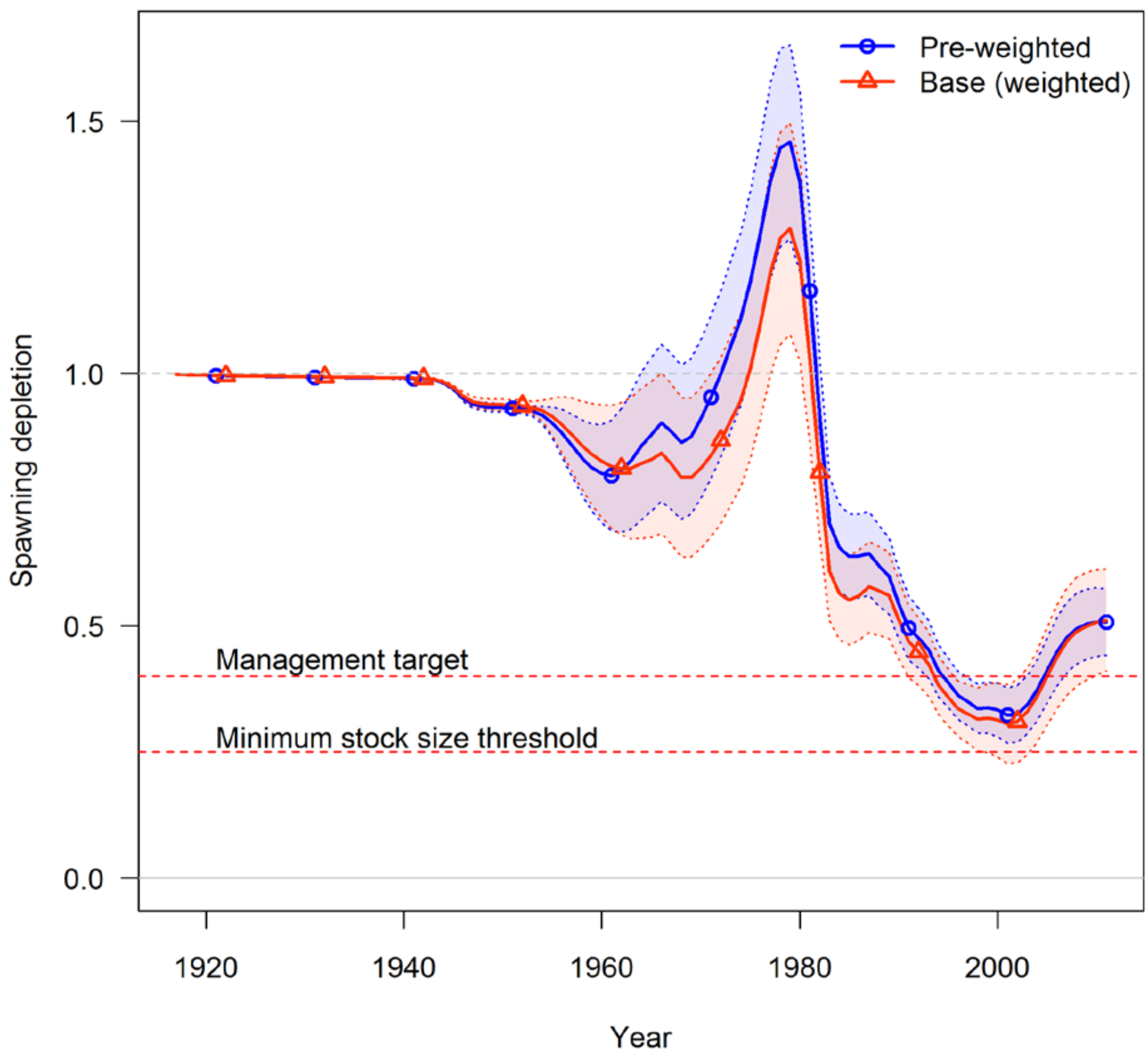


Figure 22. Comparisons of time series of stock depletion with 95% asymptotic intervals between the pre-weighted and weighted (base) models. Two models are: Pre-weighted = model before weighting; and Base (weighted) = model with data weighted, which is the base model for this assessment.

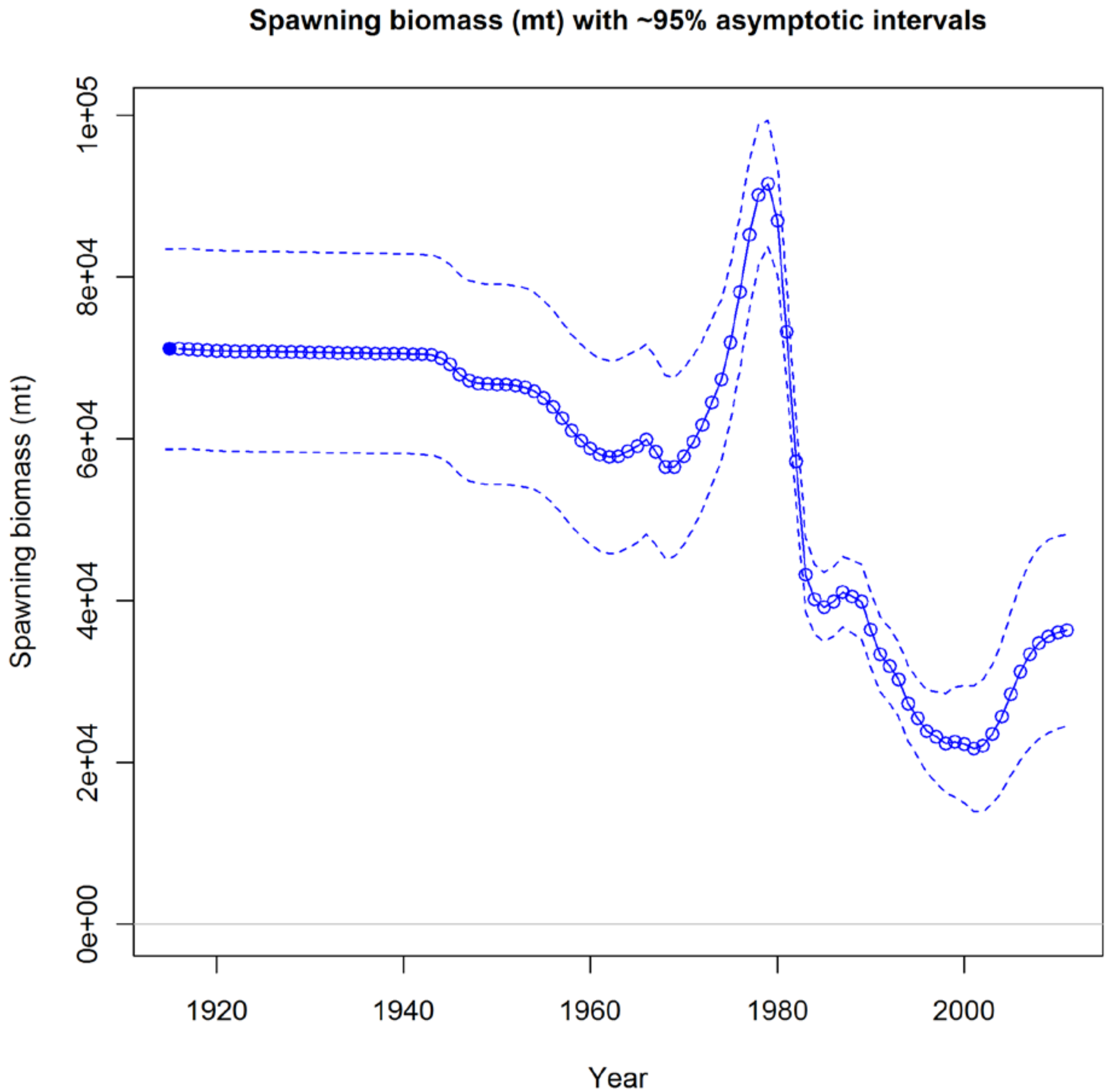


Figure 23. Time series of spawning biomass (mt) with 95% of asymptotic intervals from the base model.

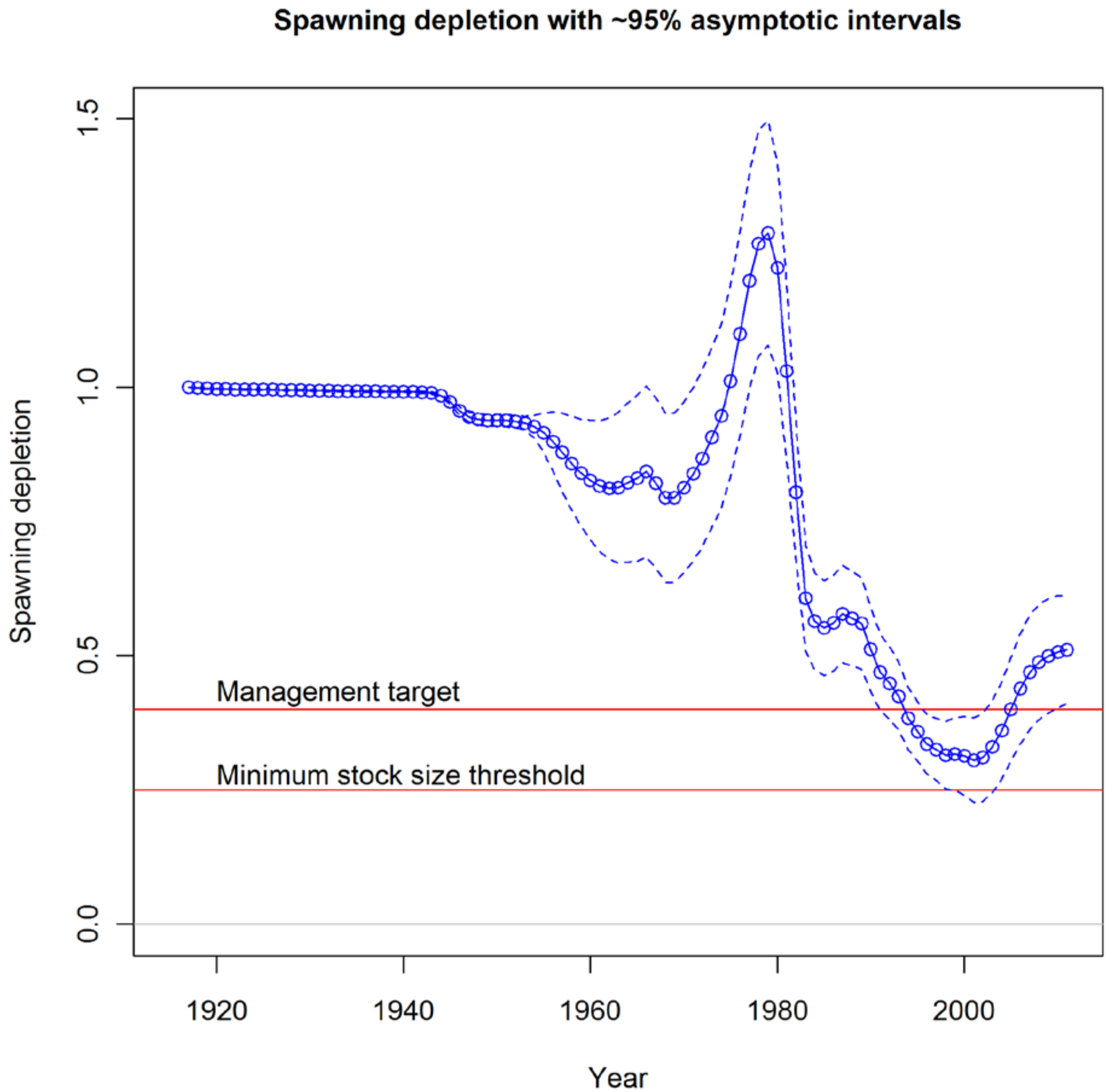


Figure 24. Time series of depletion with 95% of asymptotic intervals from the base model.

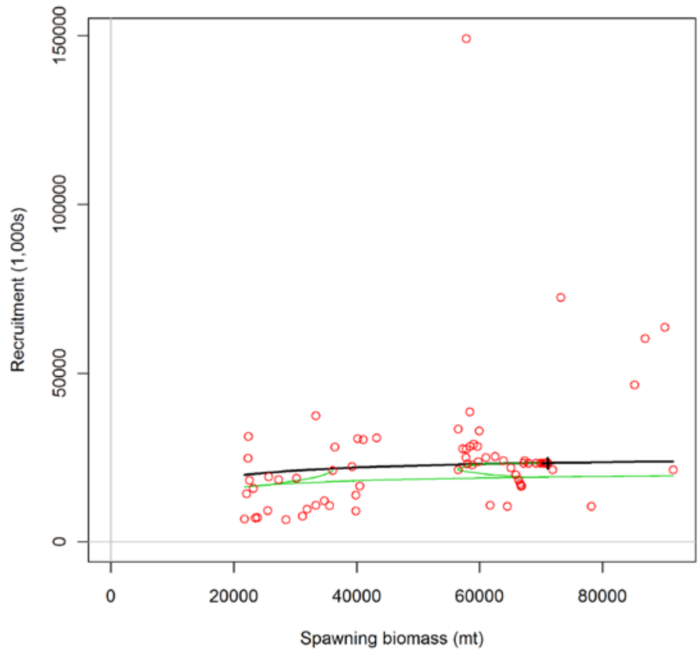


Figure 25. Estimated stock-recruit relationship from the base model (dark line). The expected recruits are bias-adjusted (green line). Open circles are estimated annual recruitments.

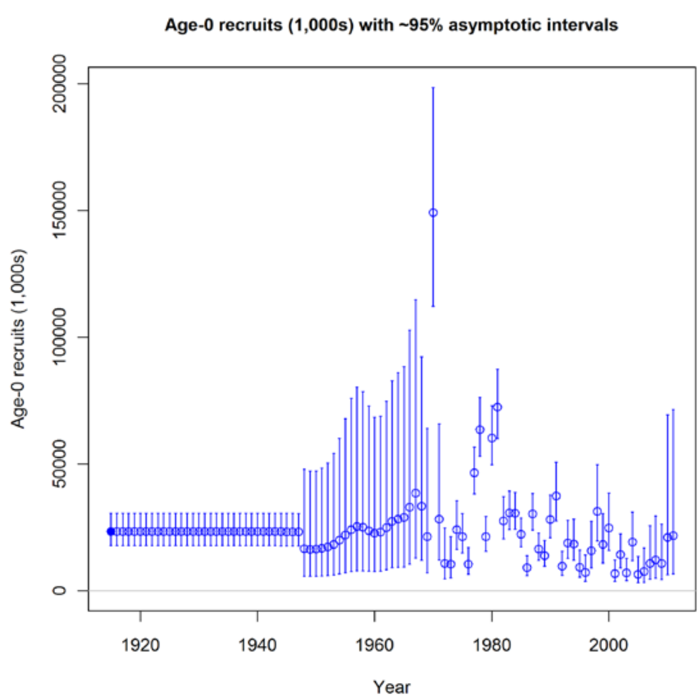


Figure 26. Estimated total recruitment and their 95% of asymptotic confidence intervals from 1915 to 2011 from the base model.

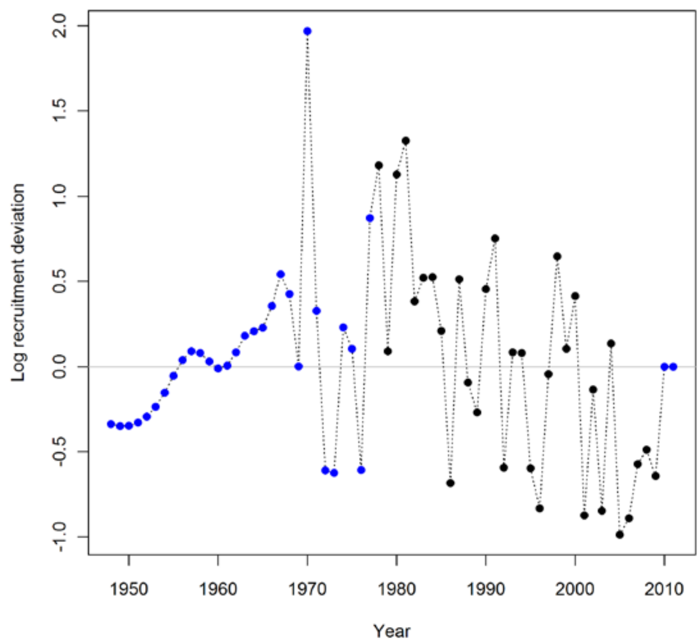


Figure 27. Time series of recruitment deviations estimated from the base model from 1948 to 2011.

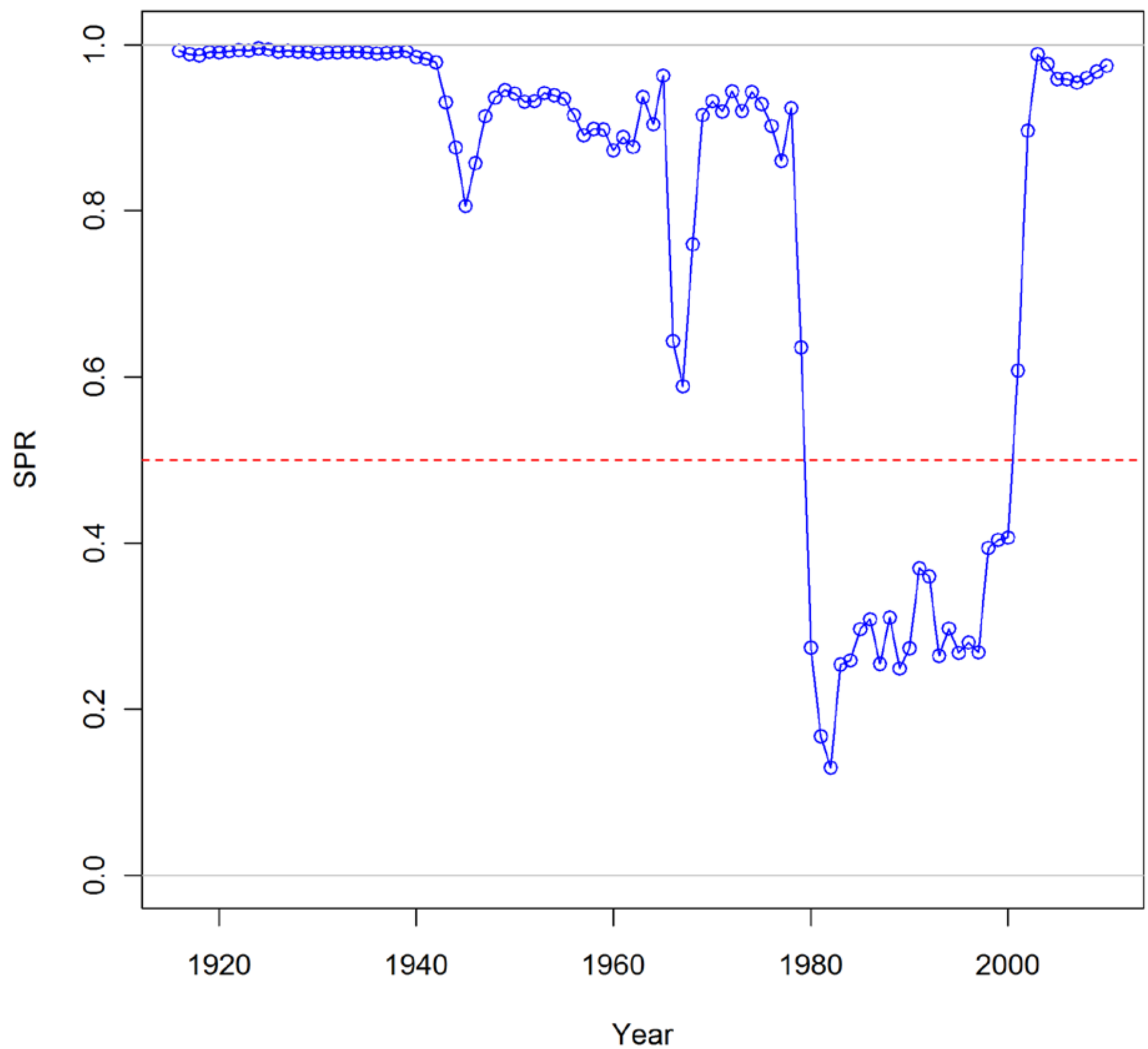


Figure 28. Time series of estimated spawning potential ratios (SPR) from 1916 to 2011. The target SPR level of 0.5 is also shown. Values below the target level indicate that overfishing occurred.

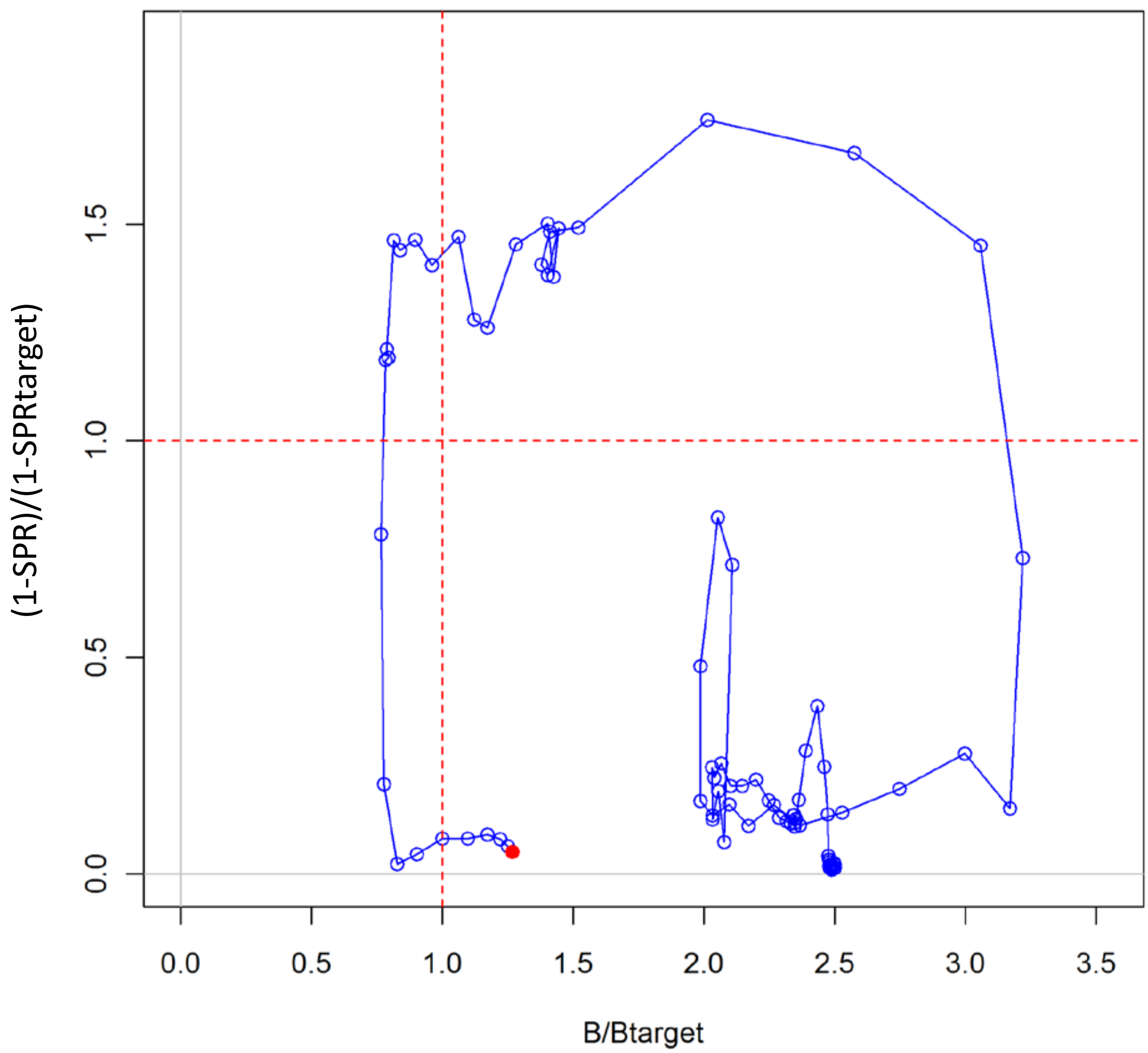


Figure 29. Phase plot of estimated annual spawning potential ratios (SPR) to the target of 0.5 and estimated spawning output relative to the target of SB40%. The last point on the lower-left quadrant corresponds to the estimated value in 2011 (red).

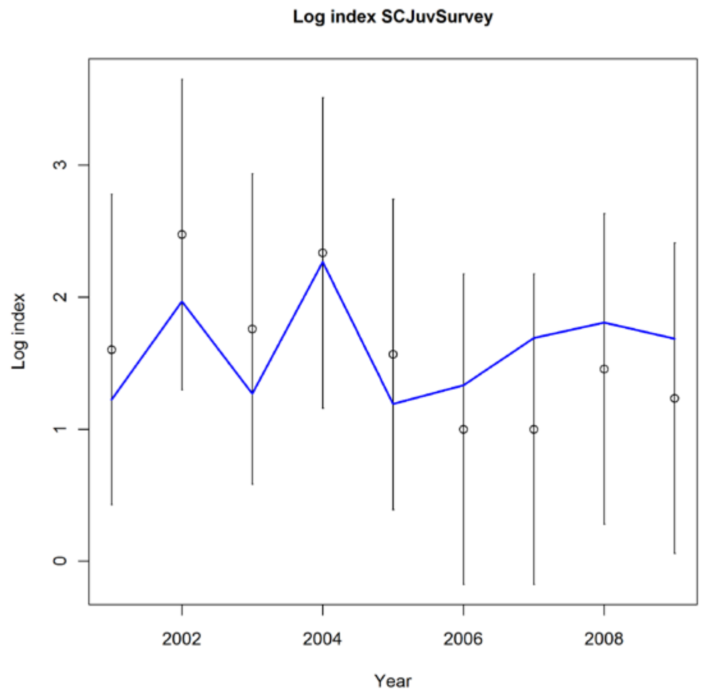


Figure 30. Model fit to the index of the juvenile fish survey from 2001 to 2009.

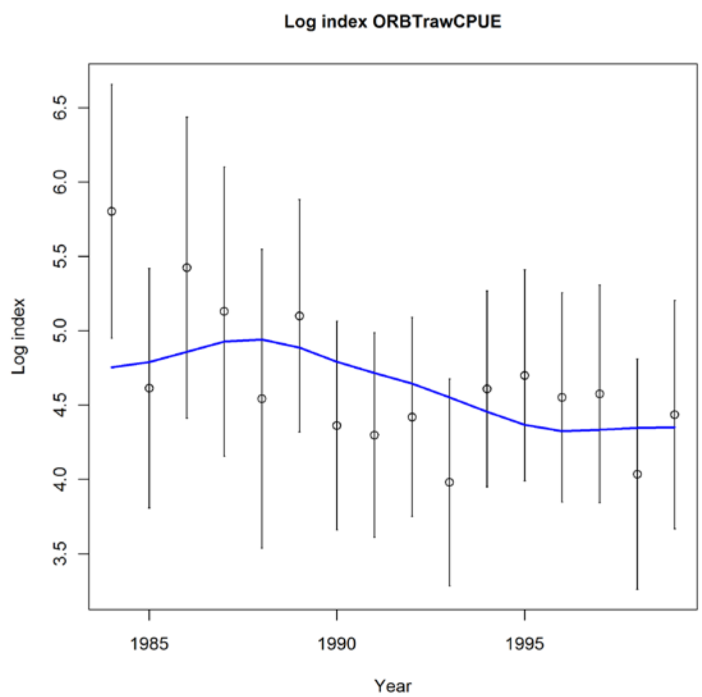


Figure 31. Model fits to the Oregon bottom trawl logbook index.

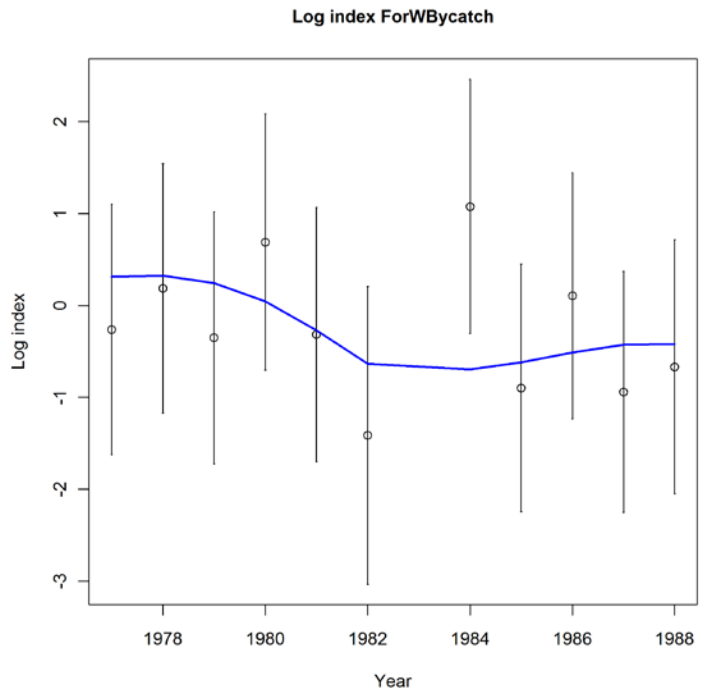


Figure 32. Model fits to the Pacific whiting foreign fishery bycatch index.

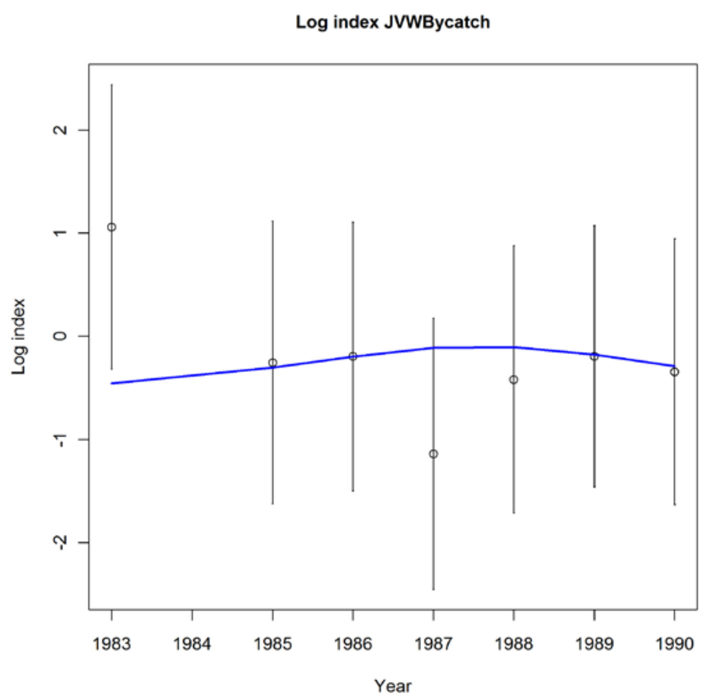


Figure 33. Model fits to the Pacific whiting joint venture fishery bycatch index.

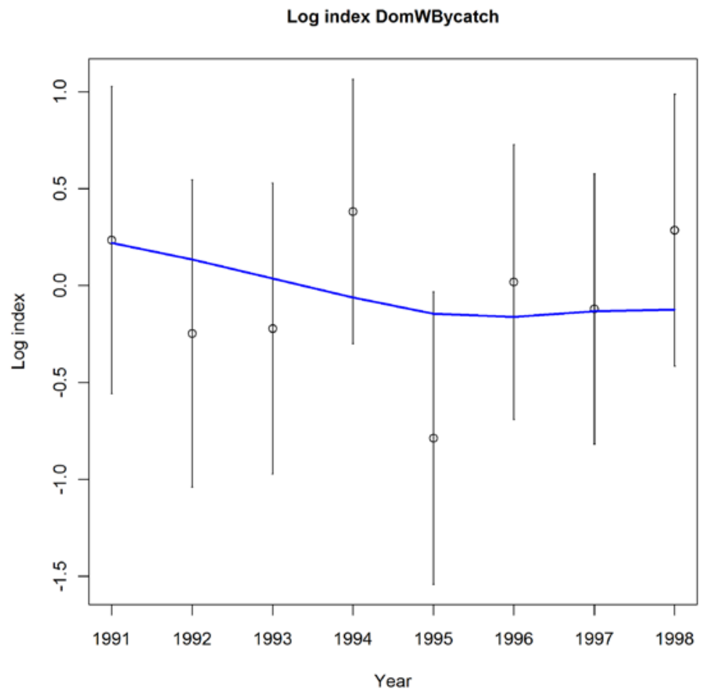


Figure 34. Model fits to the Pacific whiting domestic fishery bycatch index.

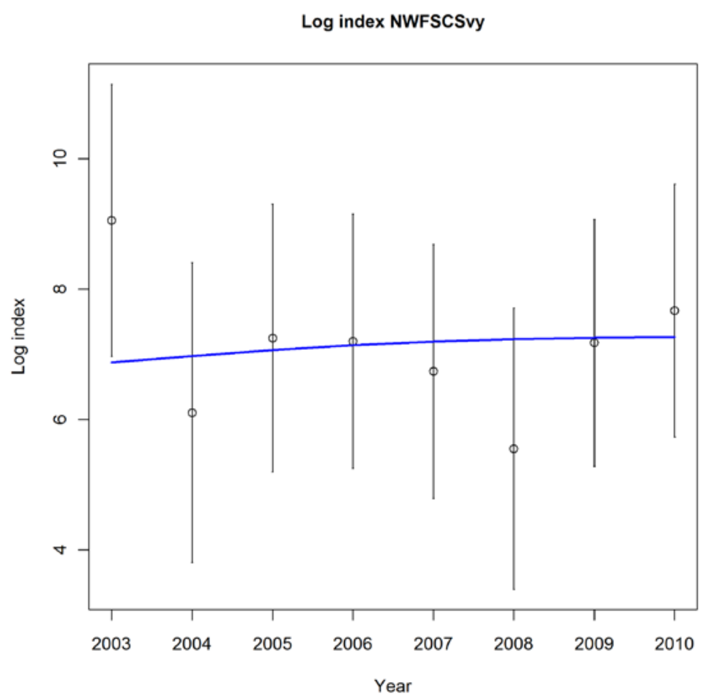


Figure 35. Model fits to the NWFSC survey index.

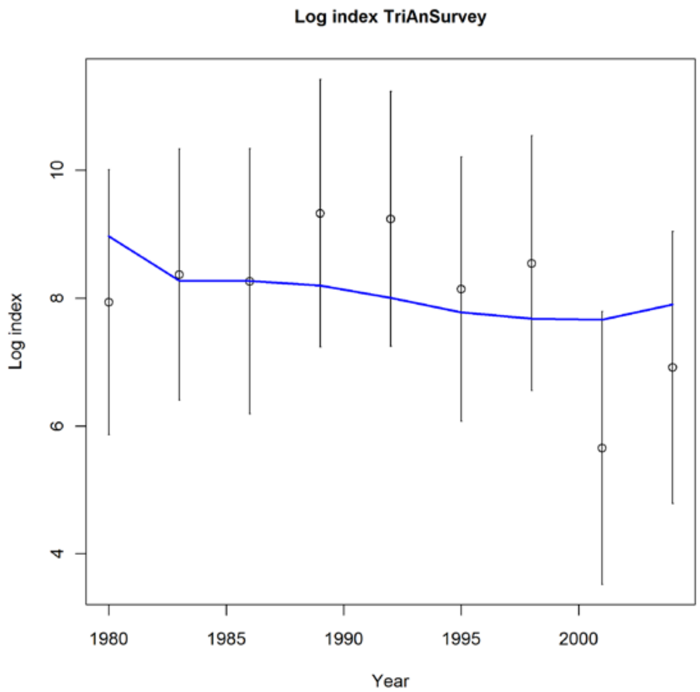


Figure 36. Model fits to the triennial survey index.

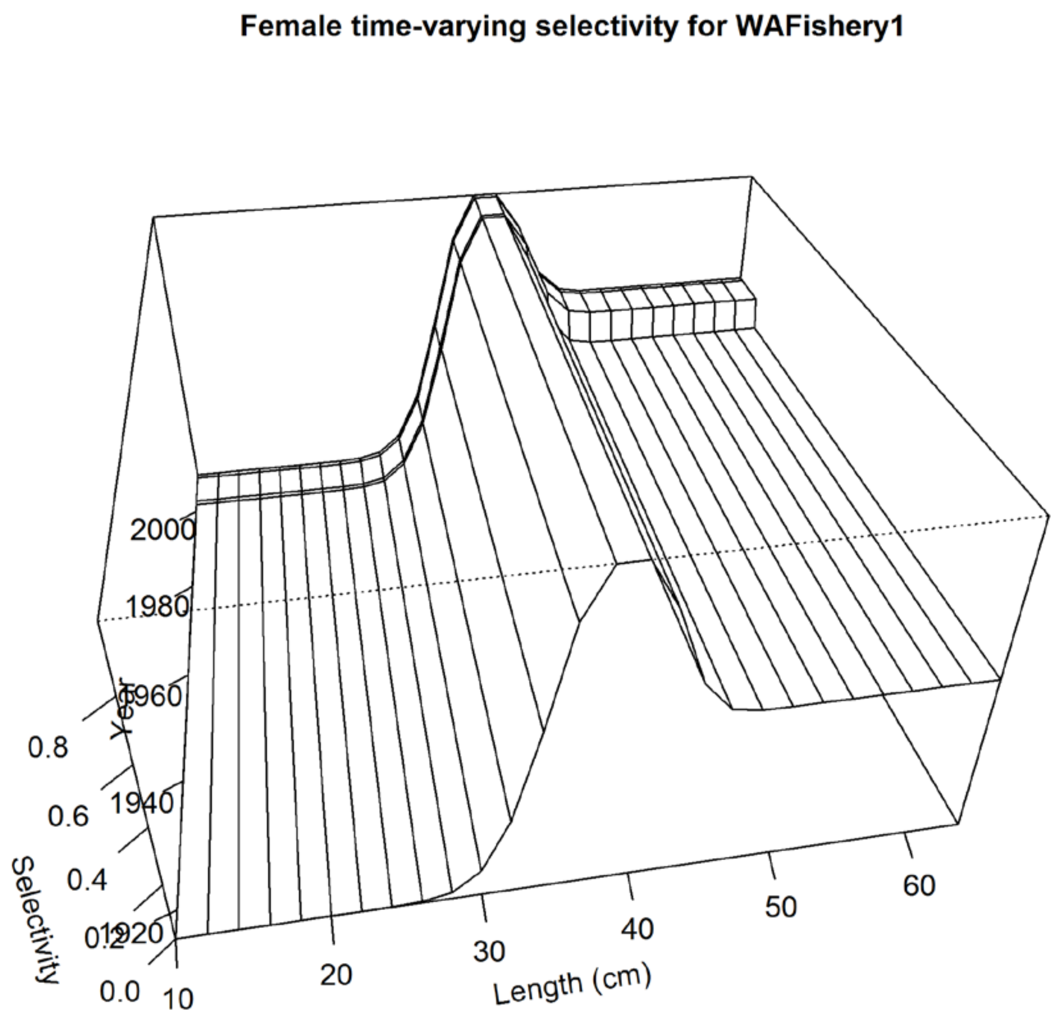


Figure 37. Estimated length selectivity curves for the Washington fishery for females (same for males). Selectivity varies between two time periods (1916-2002, and 2003-2010).

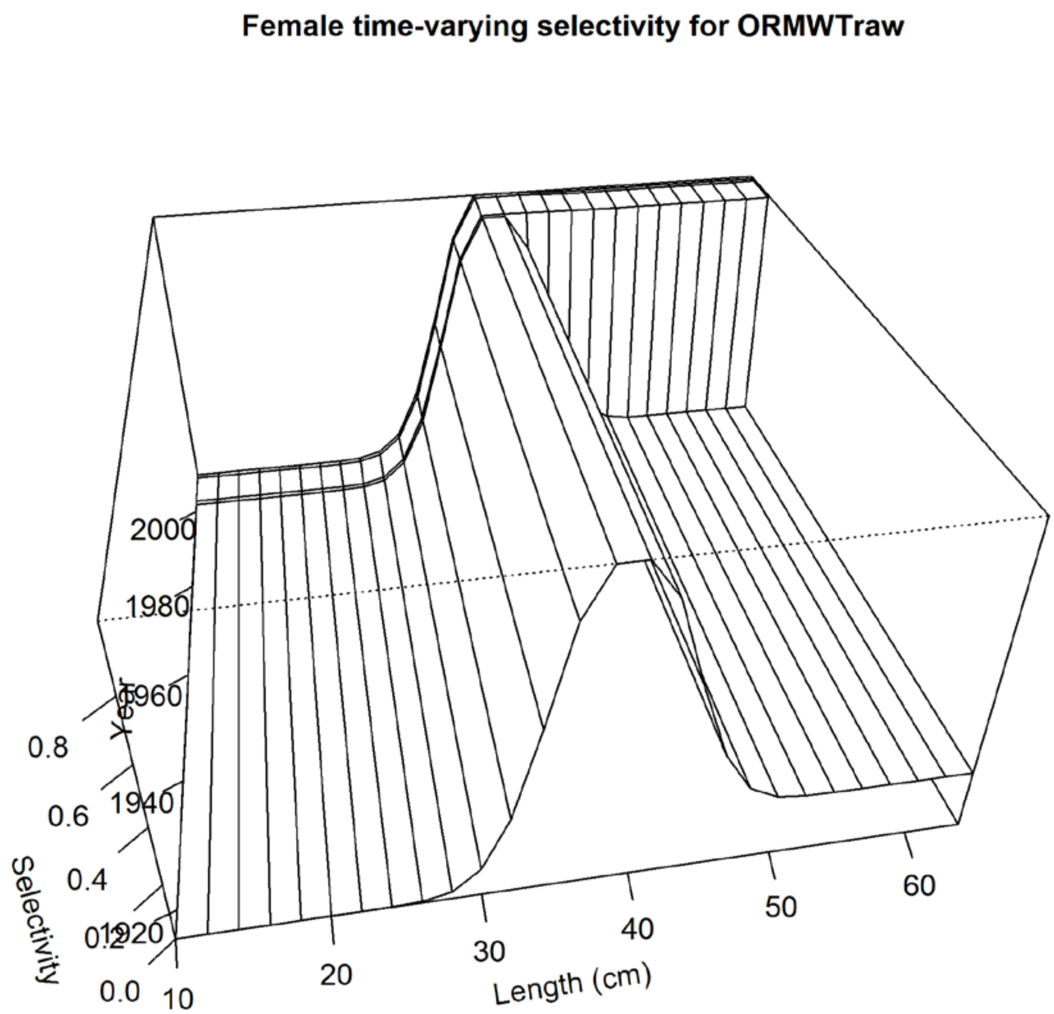


Figure 38. Estimated length selectivity curves for the Oregon mid-water trawl fishery for females (same for males). Selectivity varies between two time periods (1916-2002, and 2003-2010).

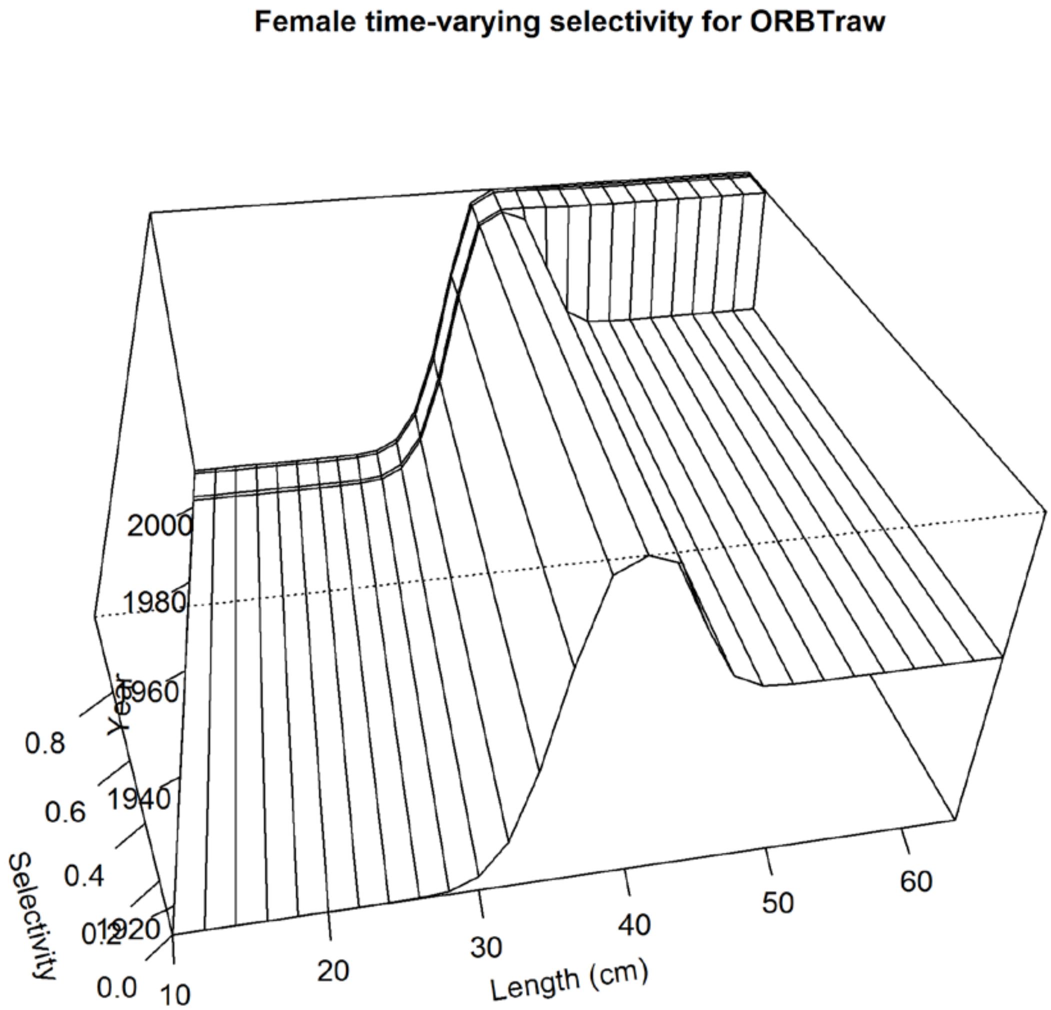


Figure 39. Estimated length selectivity curves for the Oregon bottom fishery for females (same for males). Selectivity varies between two time periods (1916-2002, and 2003-2010).

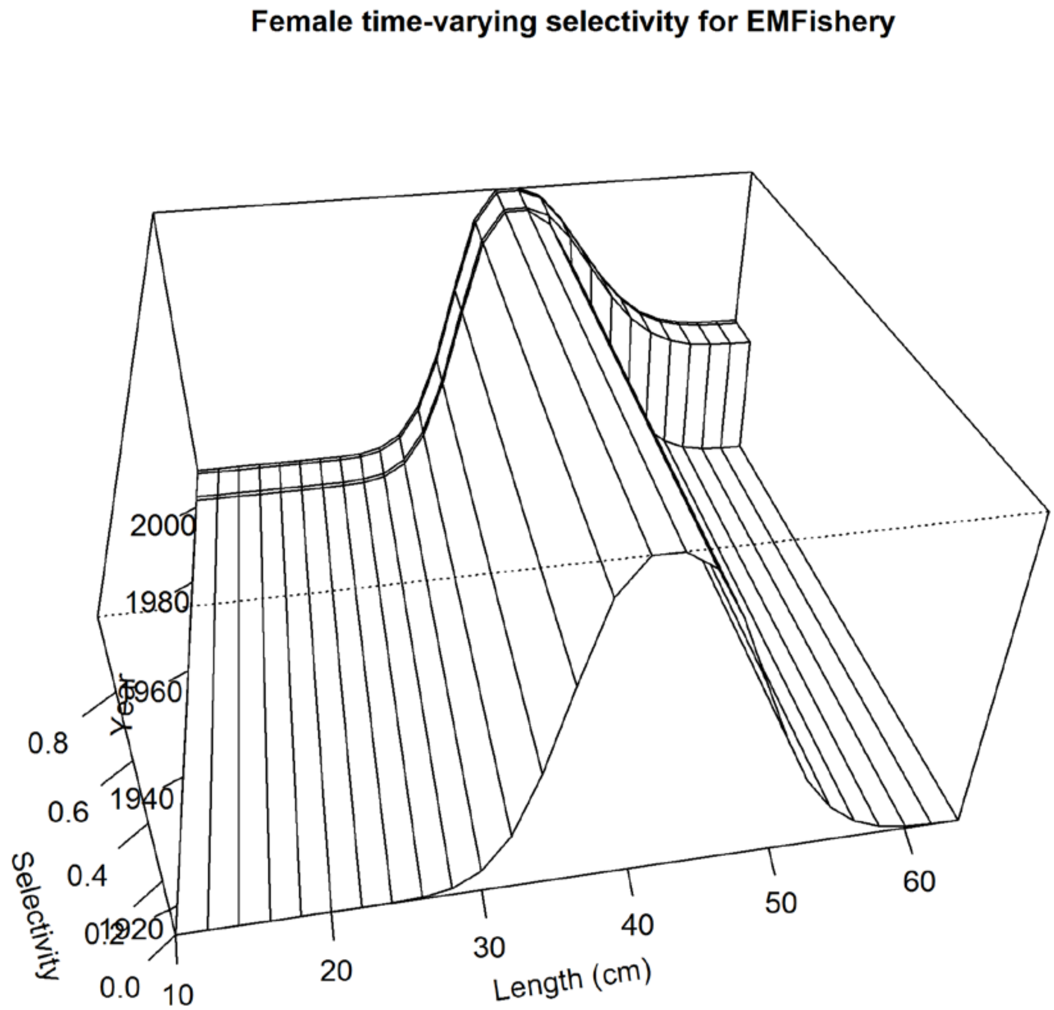


Figure 40. Estimated length selectivity curves for the California fishery for females (same for males). Selectivity varies between two time periods (1916-2002, and 2003-2010).

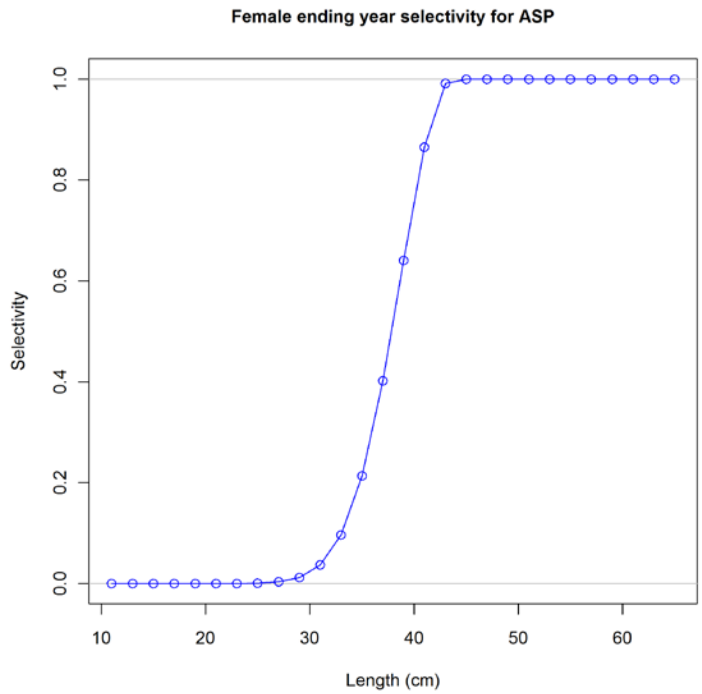


Figure 41. Estimated length selectivity curves for the at-sea processor whiting fishery for females (same for males).

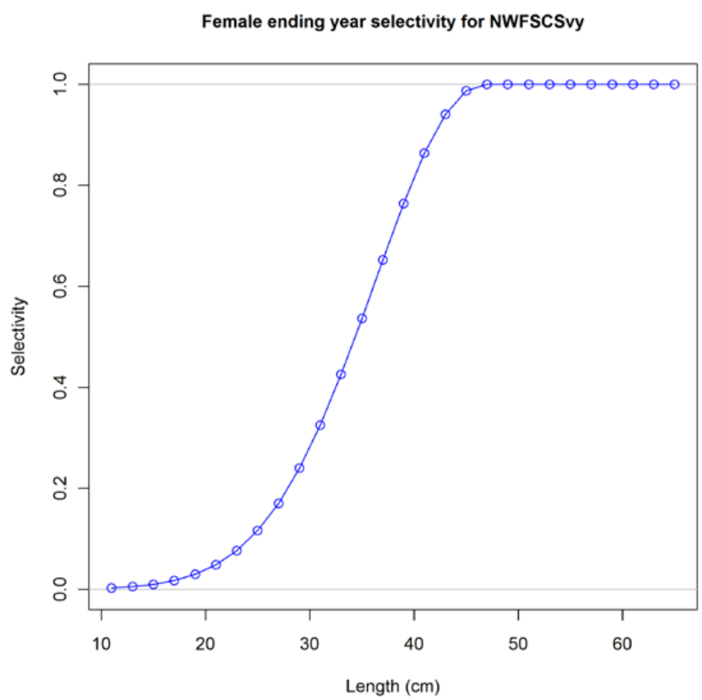


Figure 42. Estimated length selectivity curves for the all surveys for females (same for males).

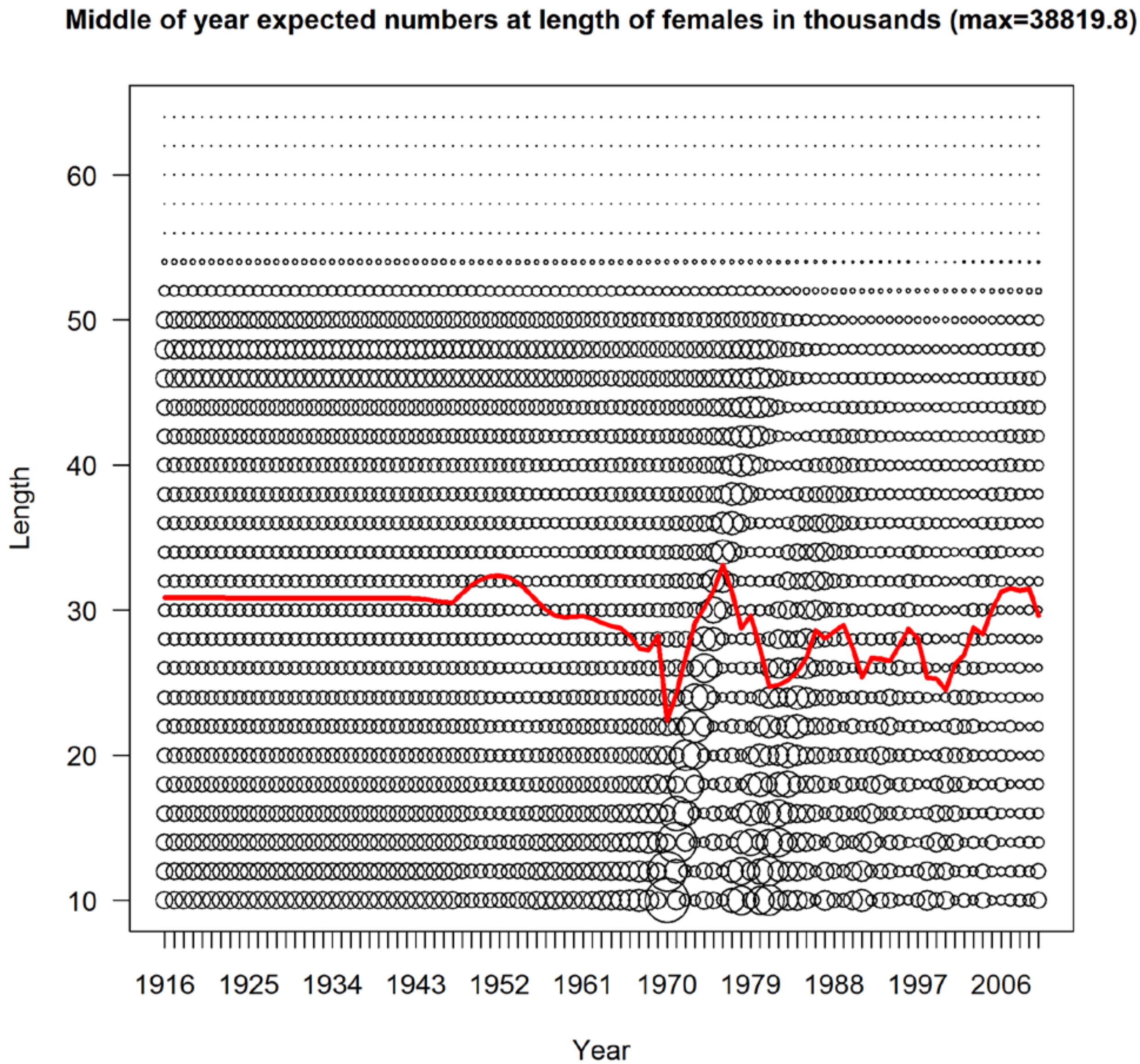


Figure 43. Scaled expected numbers of fish at length of females from the base model.

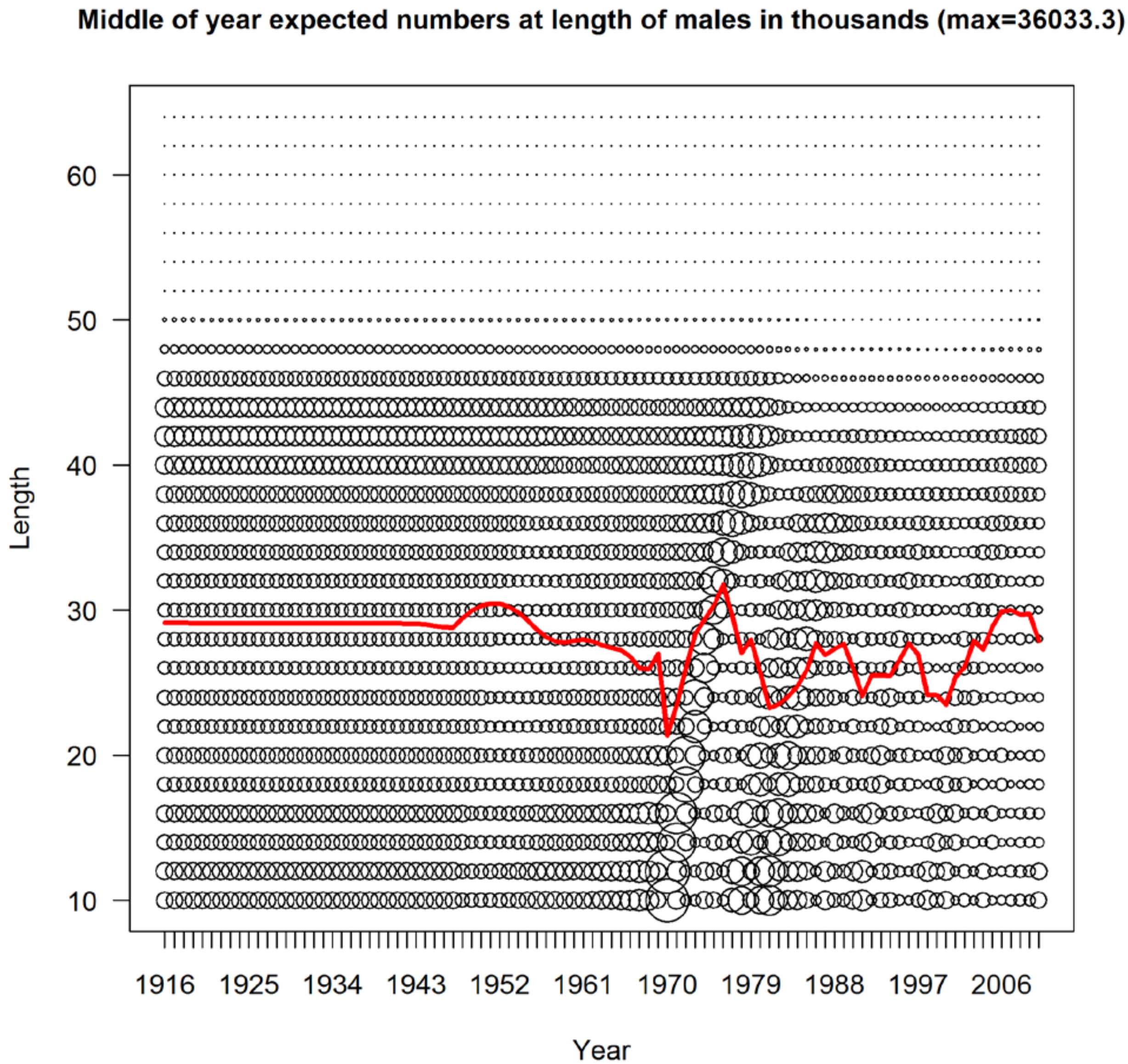


Figure 44. Scaled expected numbers of fish at length for males from the base model.

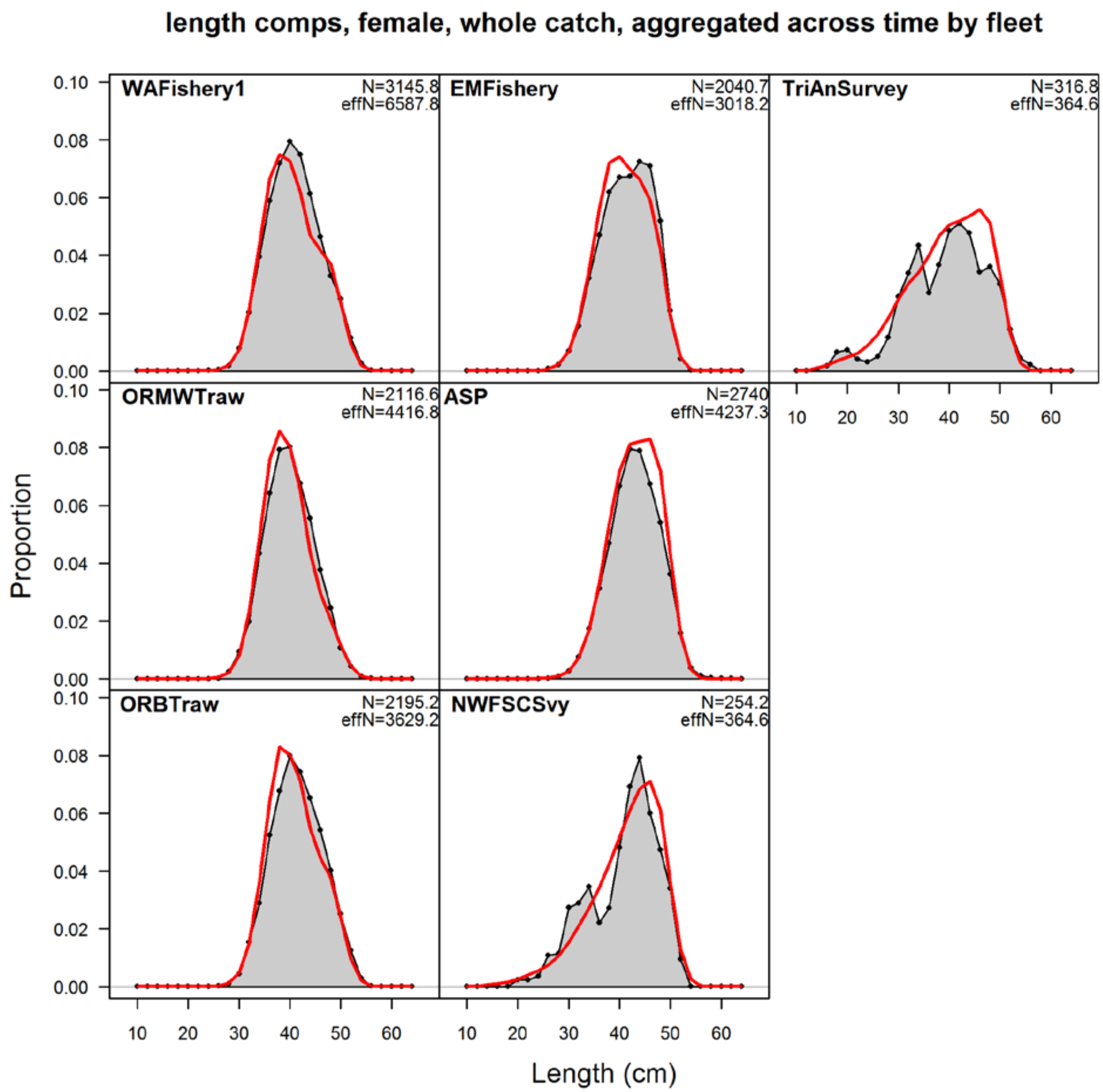


Figure 45. Aggregated model fists to female length composition data for all fleets and surveys across all years.

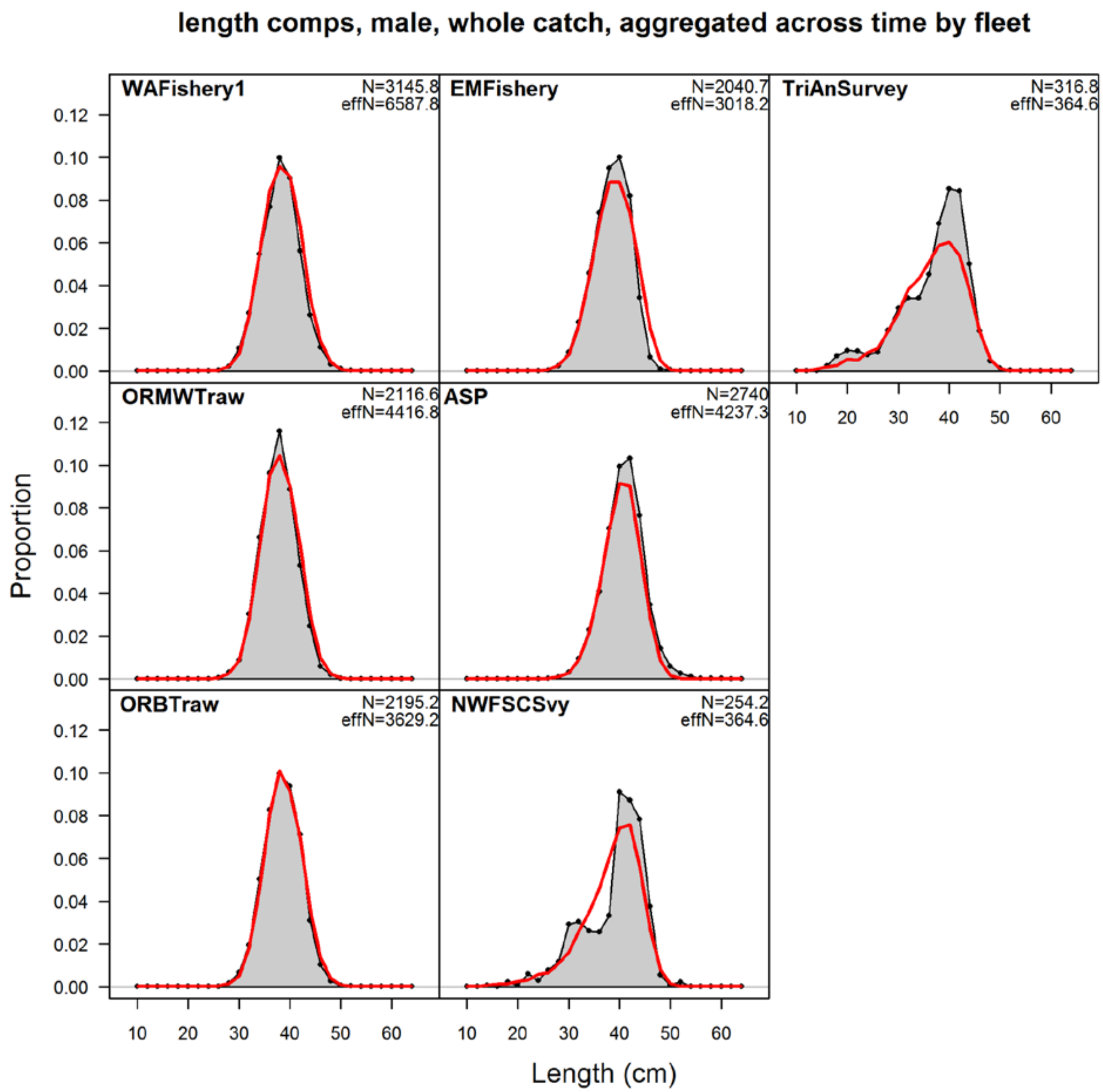


Figure 46. Aggregated model fists to male length composition data for all fleets and surveys across all years.

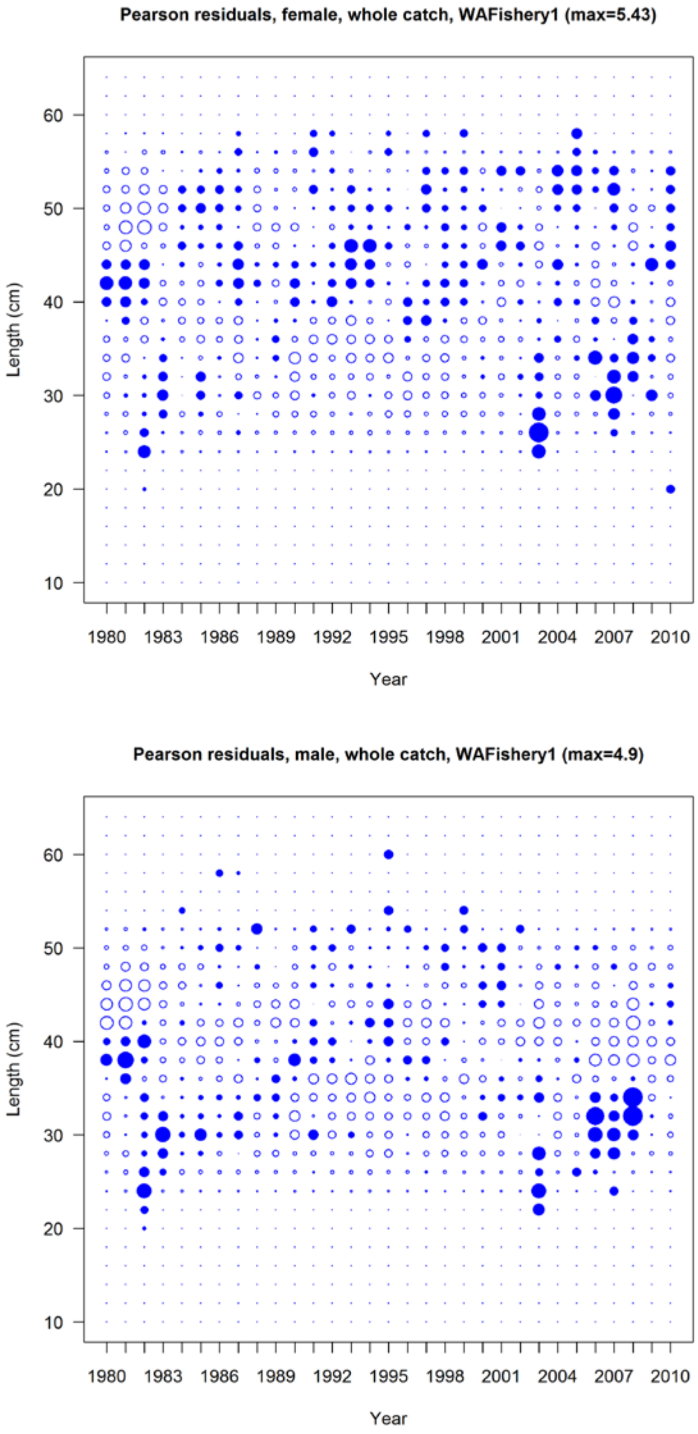


Figure 47. Length composition residuals of females (upper panel) and male (lower panel) for the Washington fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

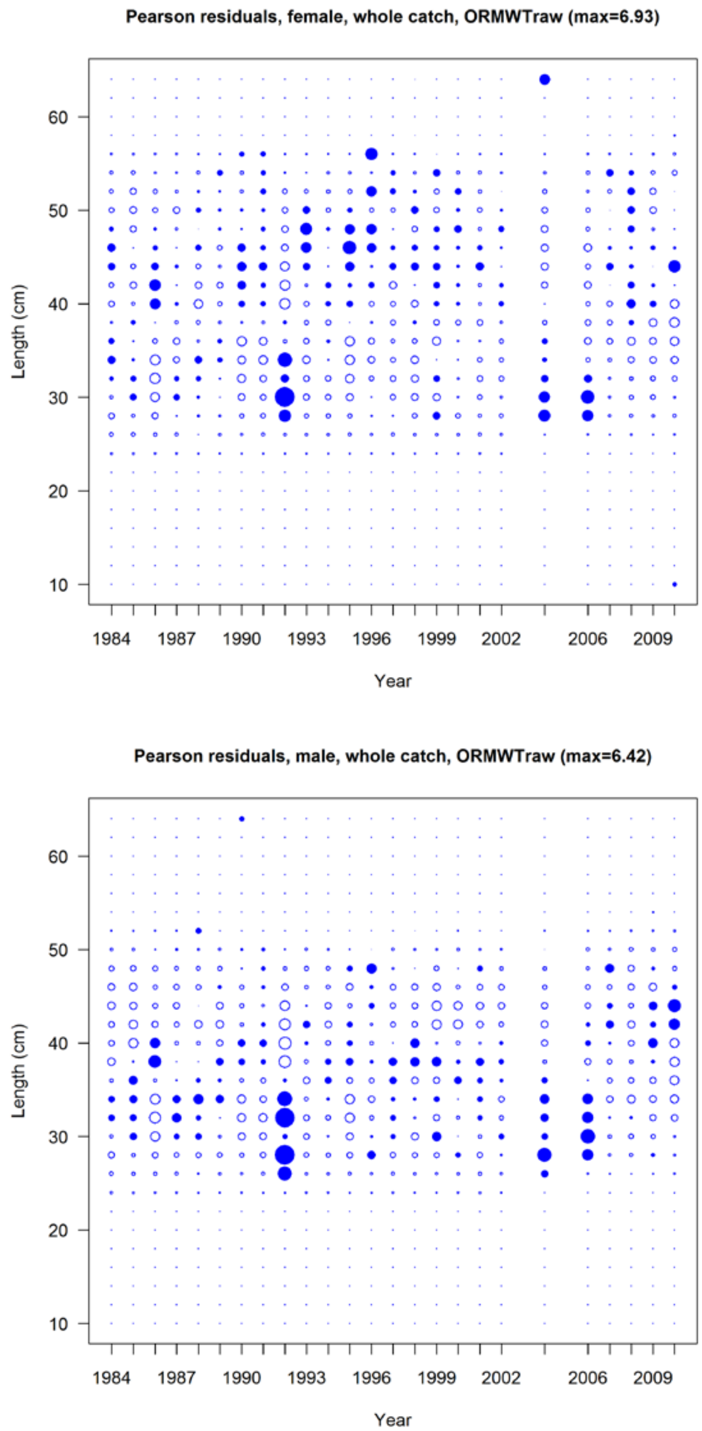
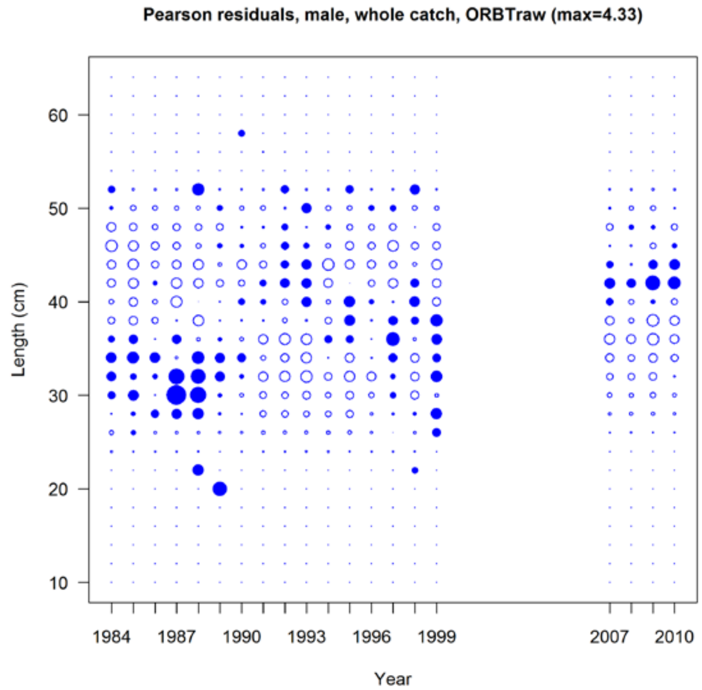


Figure 48. Length composition residuals of females (upper panel) and male (lower panel) for the Oregon mid-water trawl fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



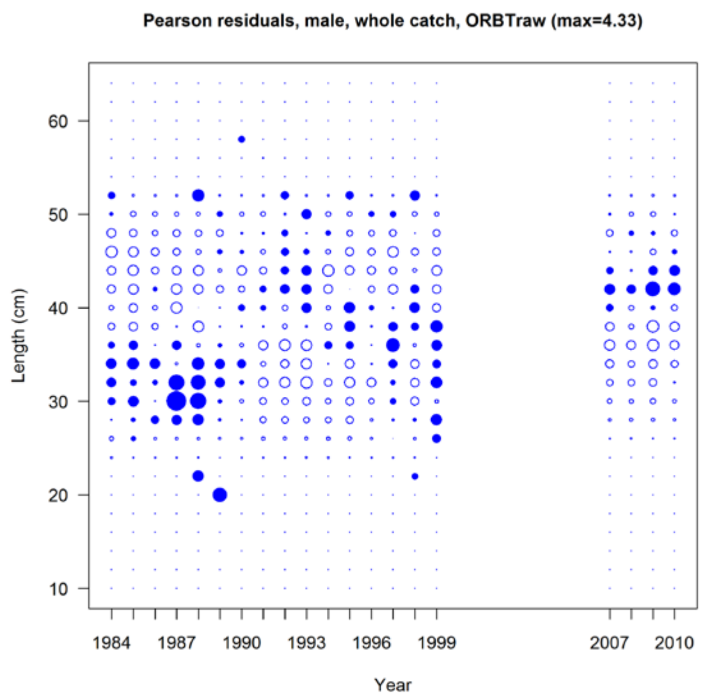
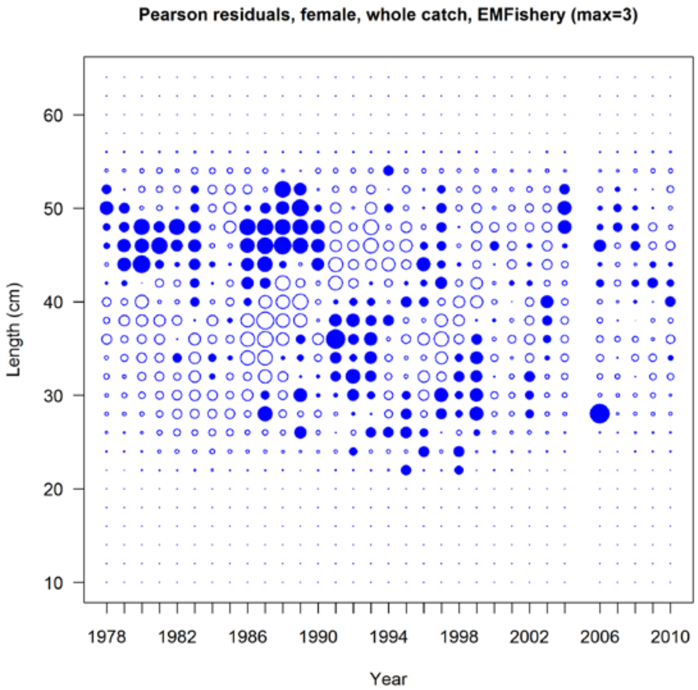


Figure 49. Length composition residuals of females (upper panel) and male (lower panel) for the Oregon bottom trawl fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



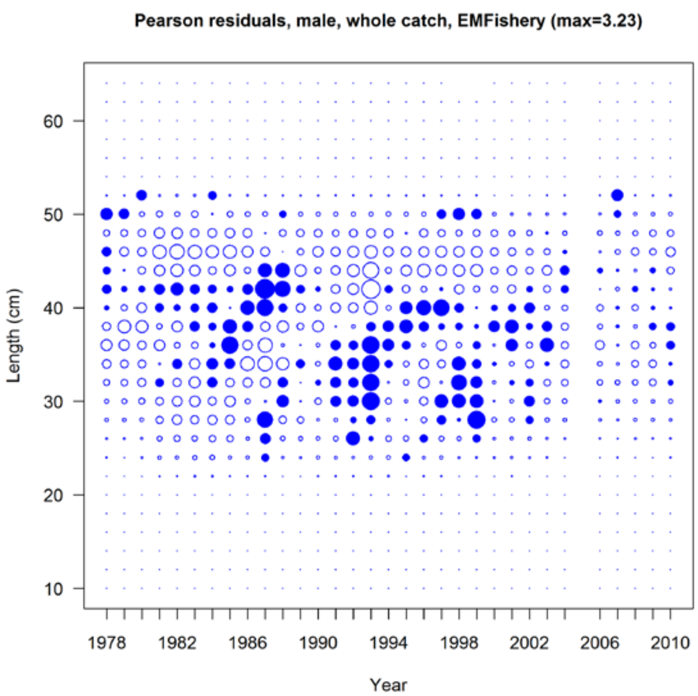
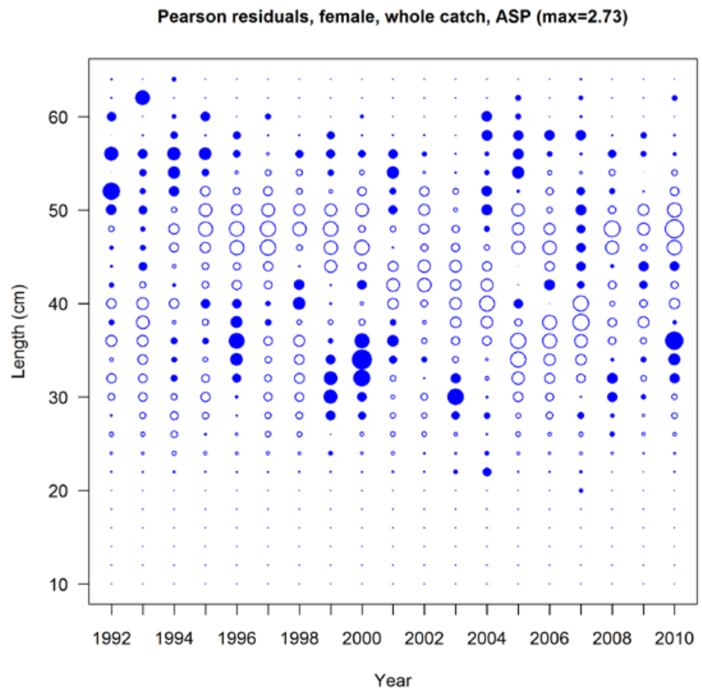


Figure 50. Length composition residuals of females (upper panel) and male (lower panel) for the California (EMFishery1) fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



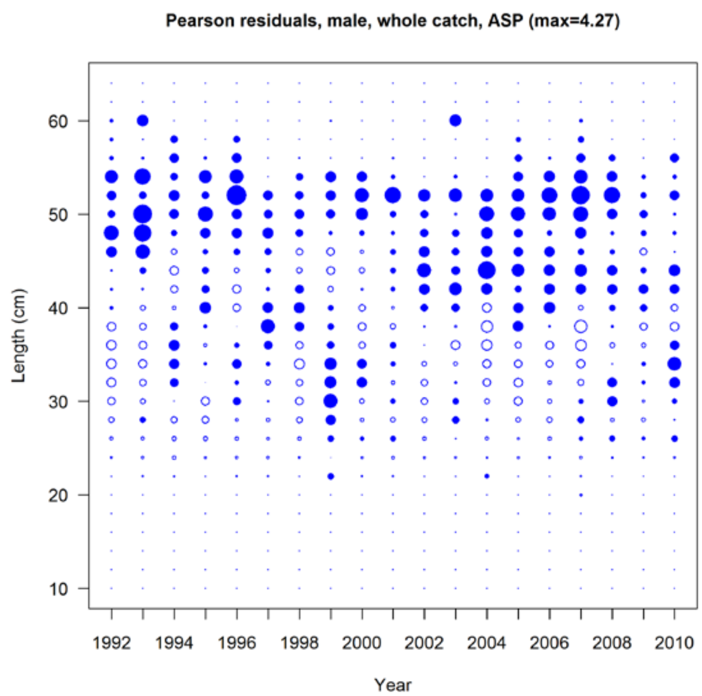


Figure 51. Length composition residuals of females (upper panel) and male (lower panel) for the ASP (at-sea processor whiting fishery) fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

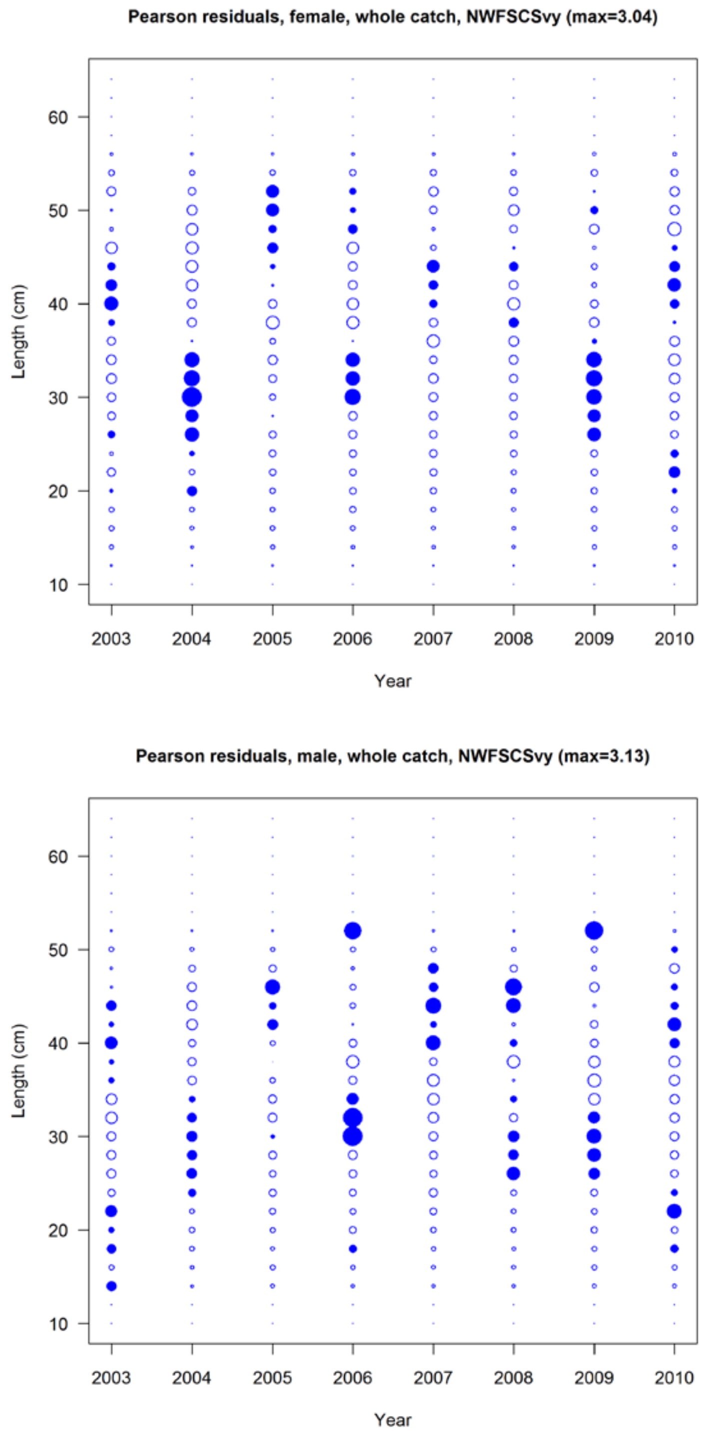


Figure 52. Length composition residuals of females (upper panel) and male (lower panel) for the NWFSC survey from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

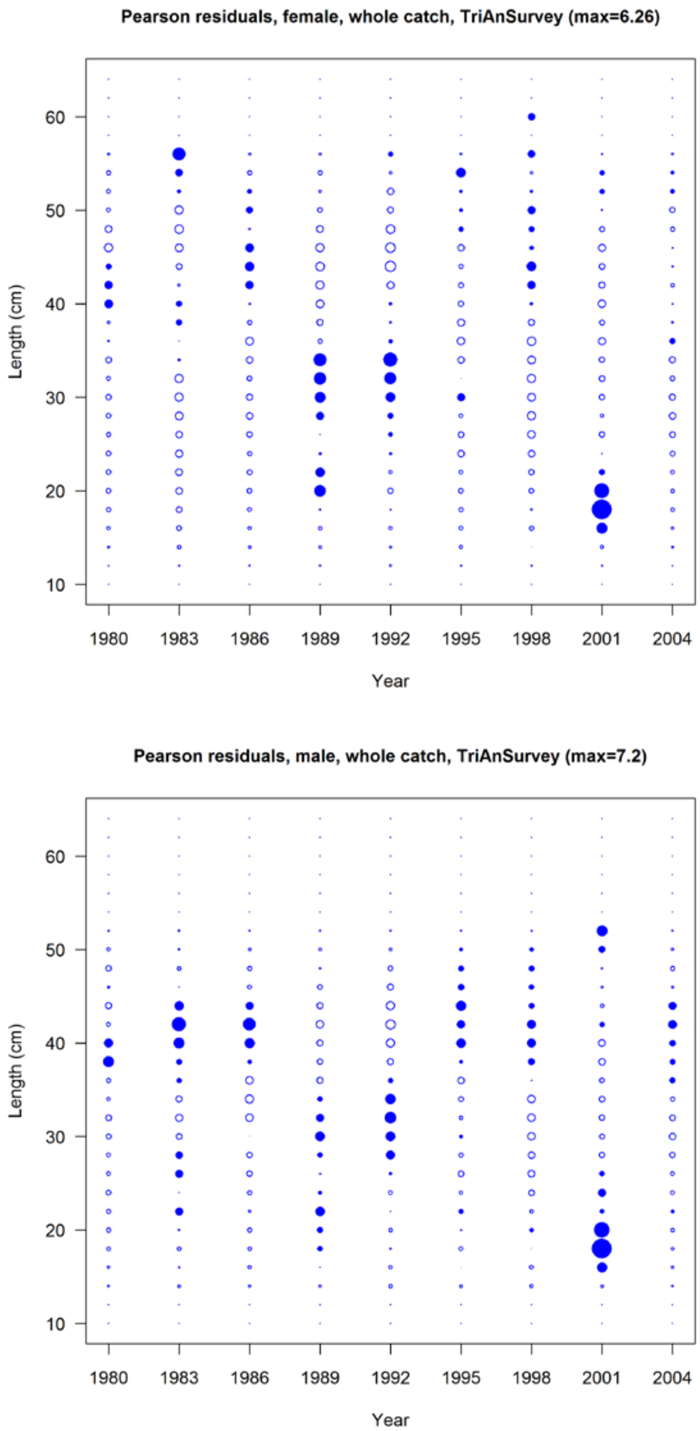


Figure 53. Length composition residuals of females (upper panel) and male (lower panel) for the triennial survey from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

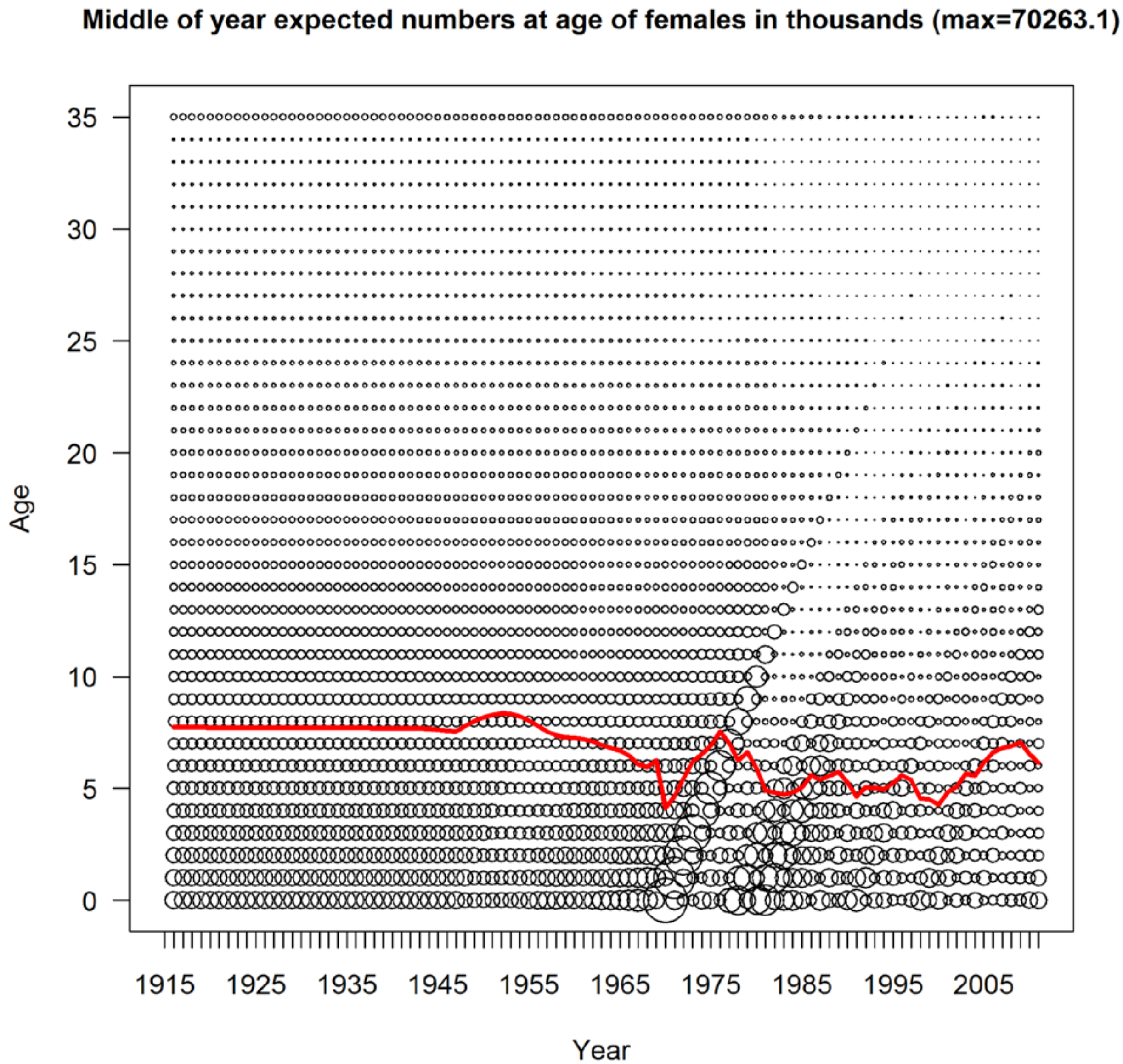


Figure 54. Scaled expected numbers of fish at age of females from the base model.

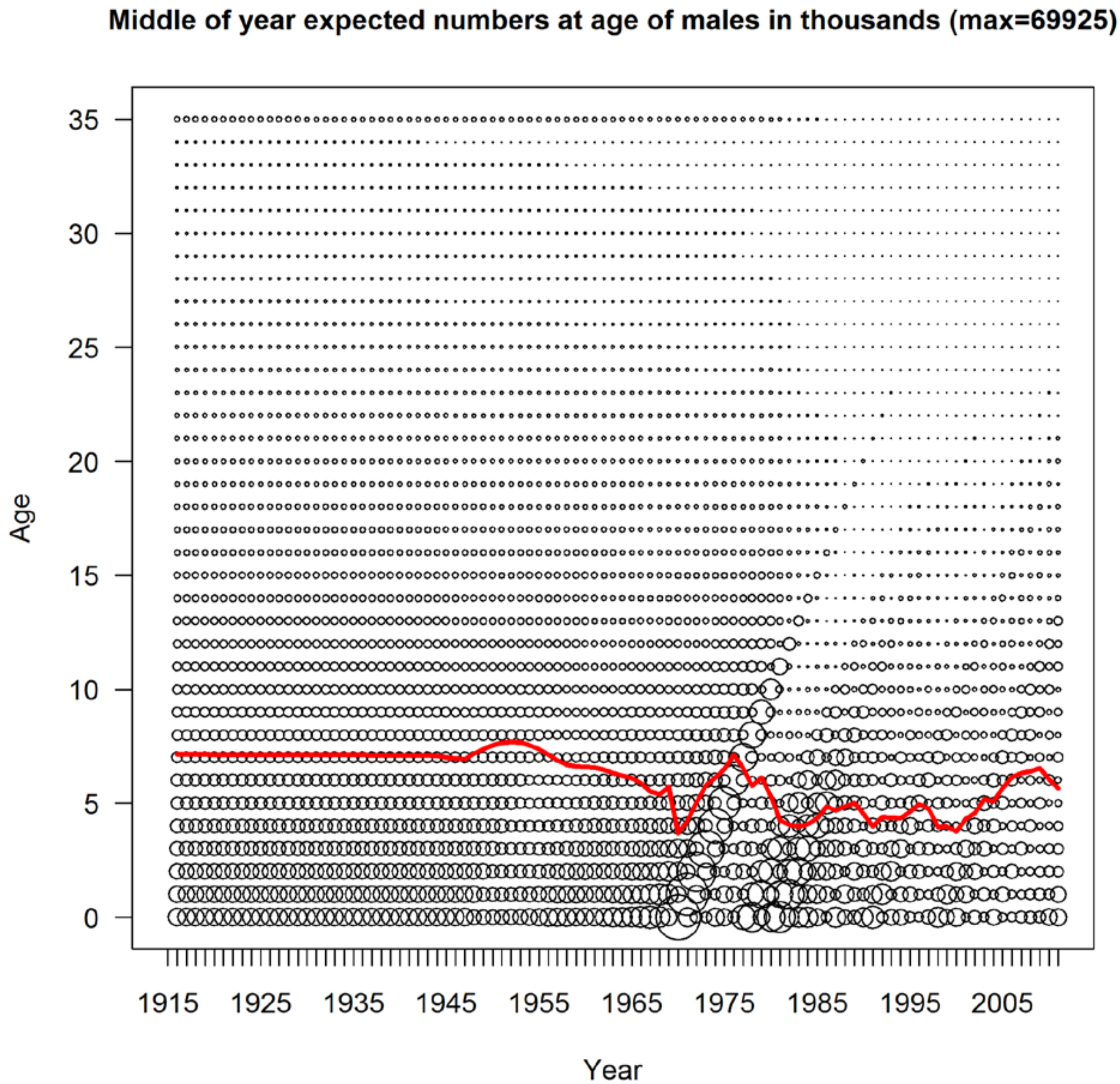


Figure 55. Scaled expected numbers of fish at age of males from the base model.

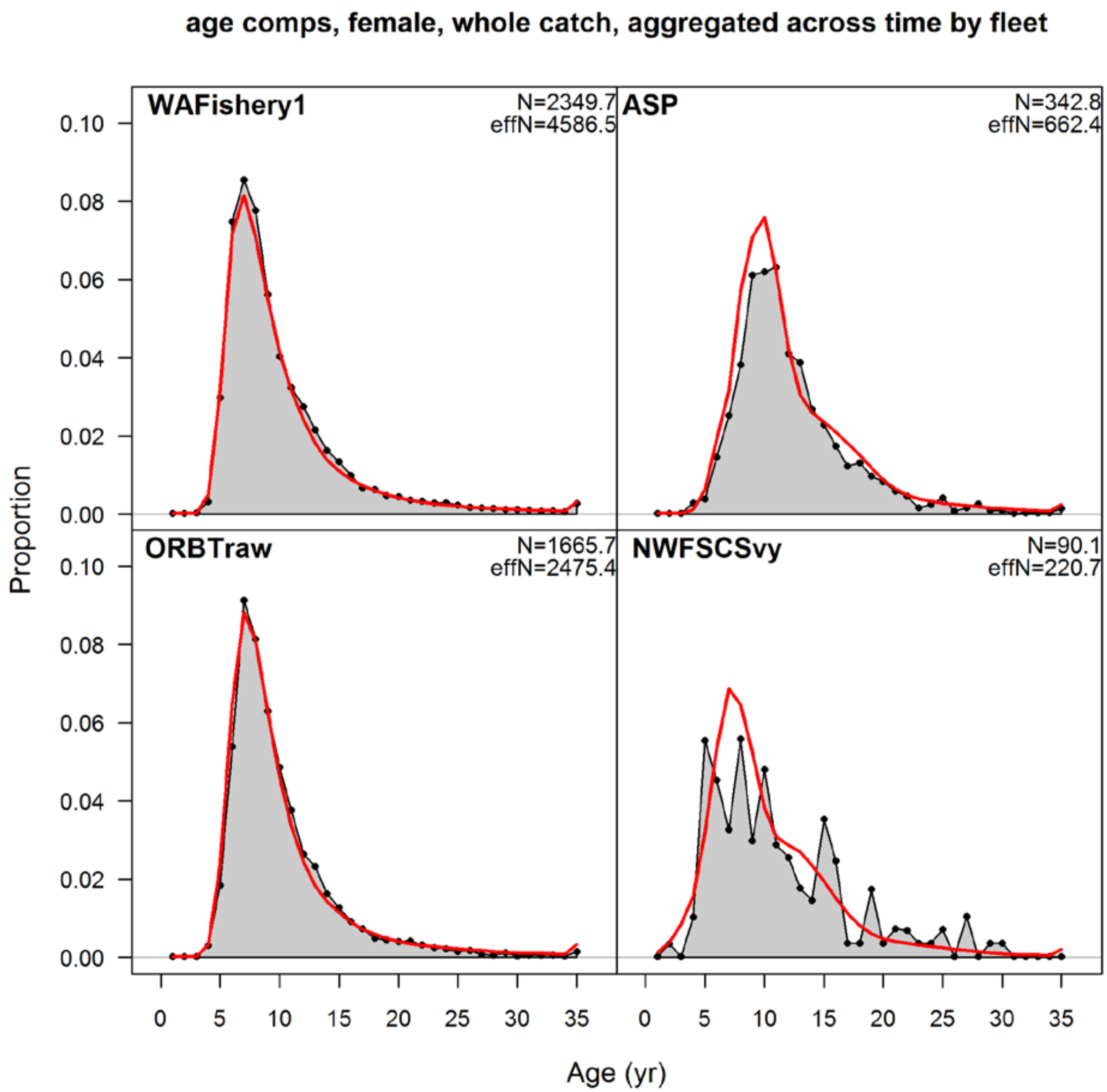


Figure 56. Aggregated model fists to female age composition data for three fishing fleets and the NWFSC survey across all years.

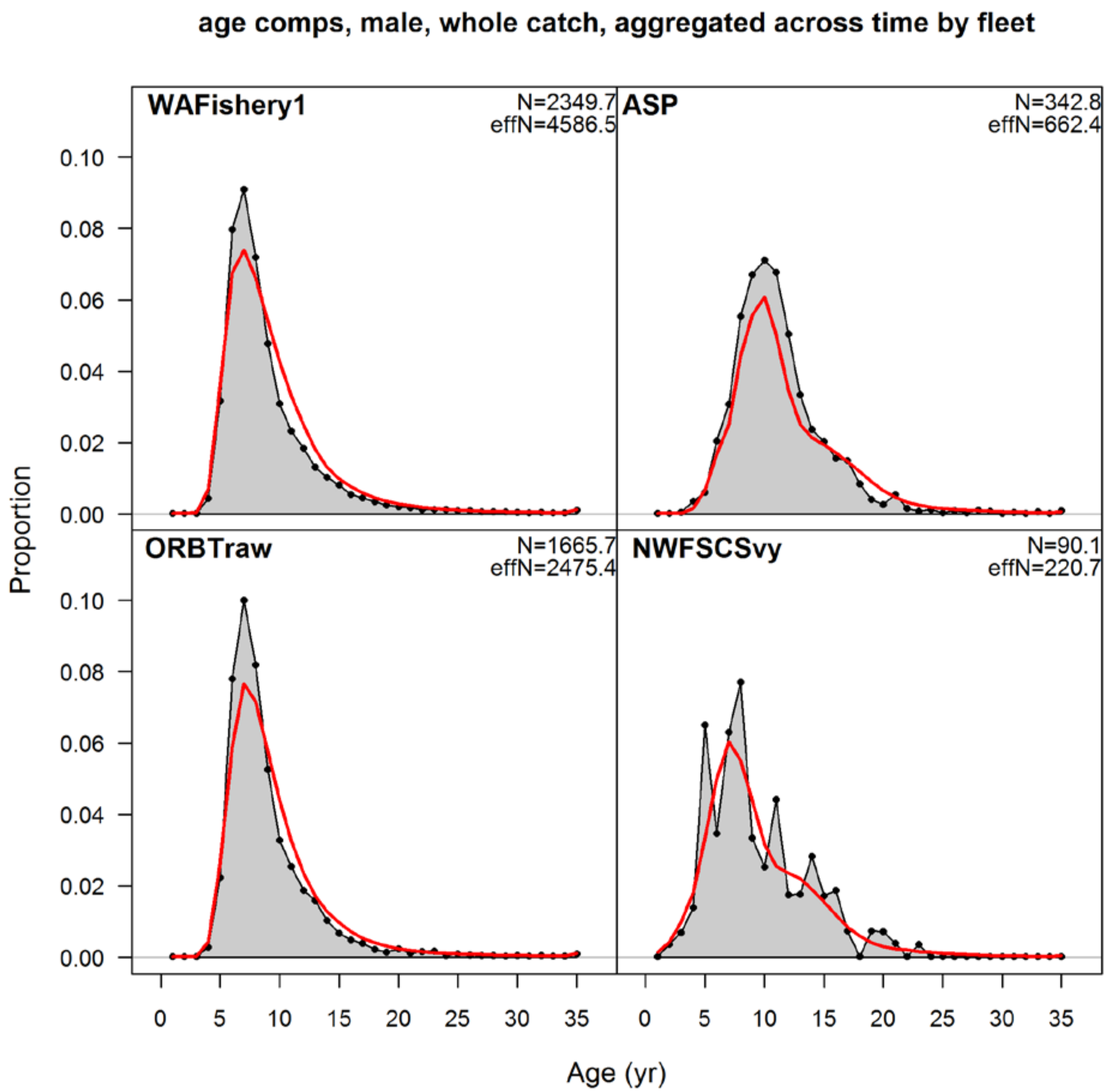
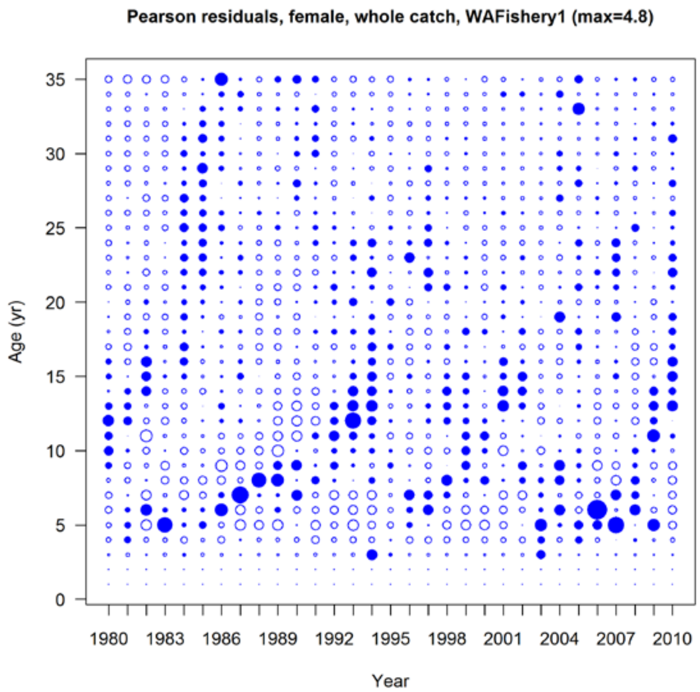


Figure 57. Aggregated model fists to female age composition data for three fleets and the NWFSC survey across all years.



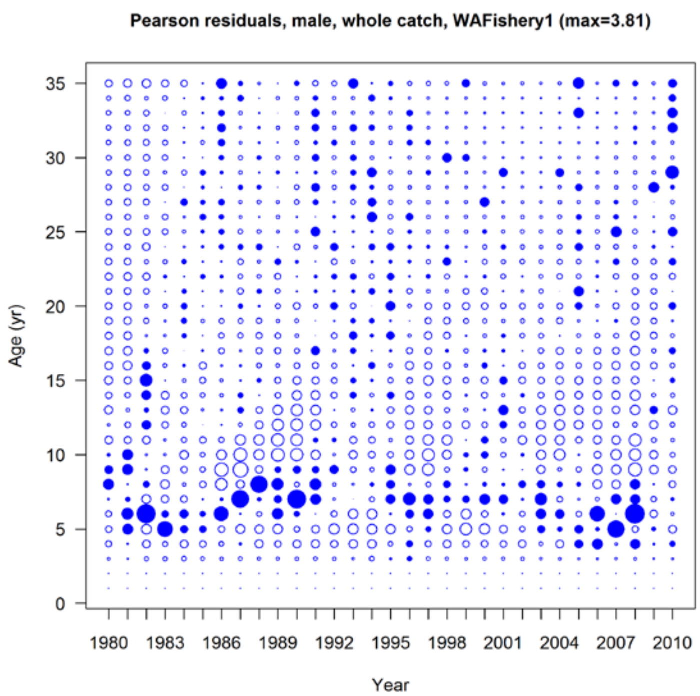


Figure 58. Age composition residuals of females (upper panel) and male (lower panel) for the Washington fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

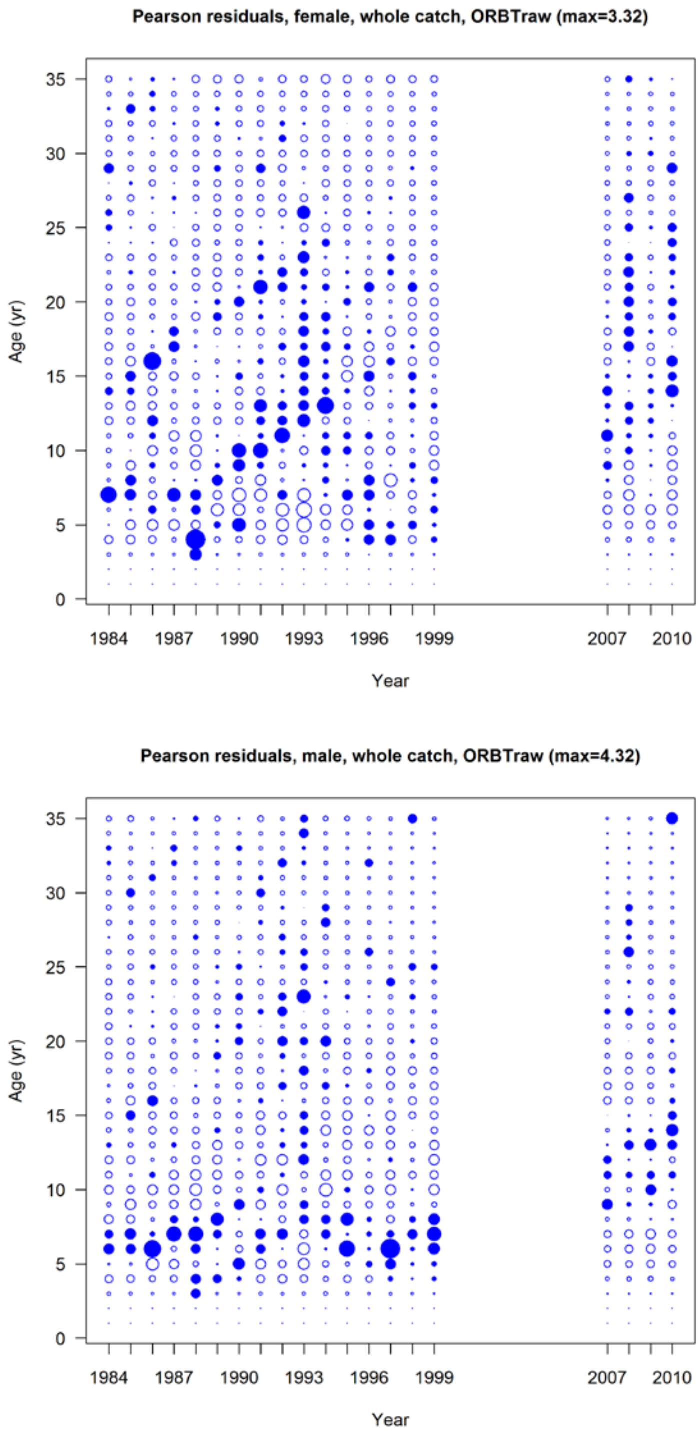


Figure 59. Age composition residuals of females (upper panel) and male (lower panel) for the Oregon bottom trawl fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

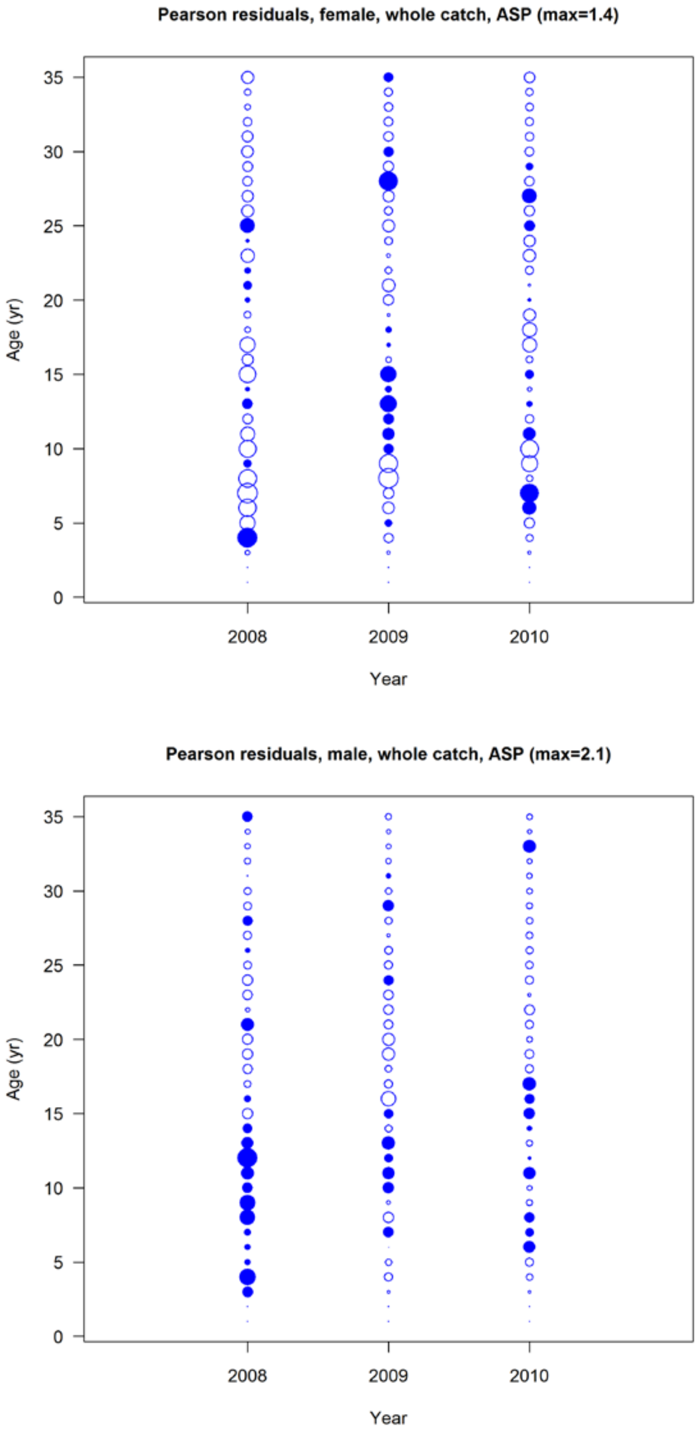


Figure 60. Age composition residuals of females (upper panel) and male (lower panel) for the ASP (at-sea processor) whiting fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

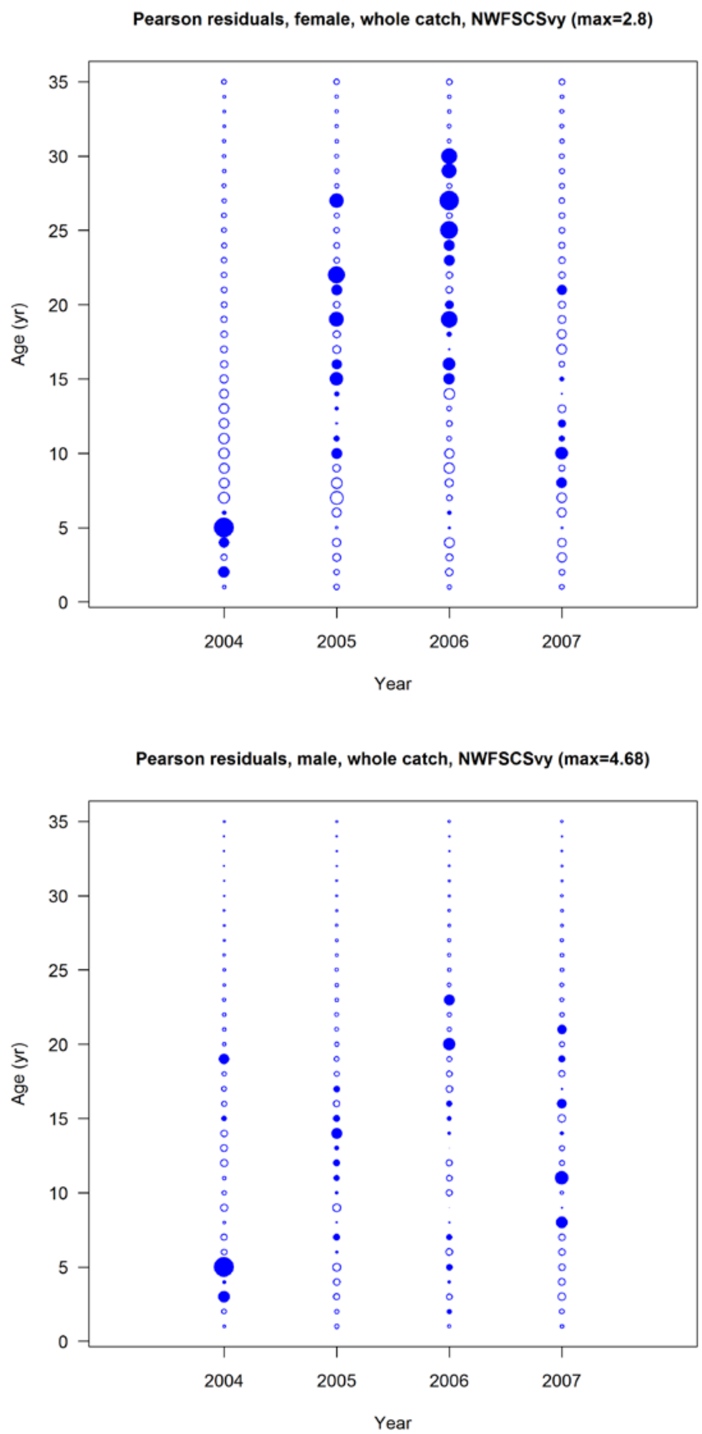


Figure 61. Age composition residuals of females (upper panel) and male (lower panel) for the NWFSC survey from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

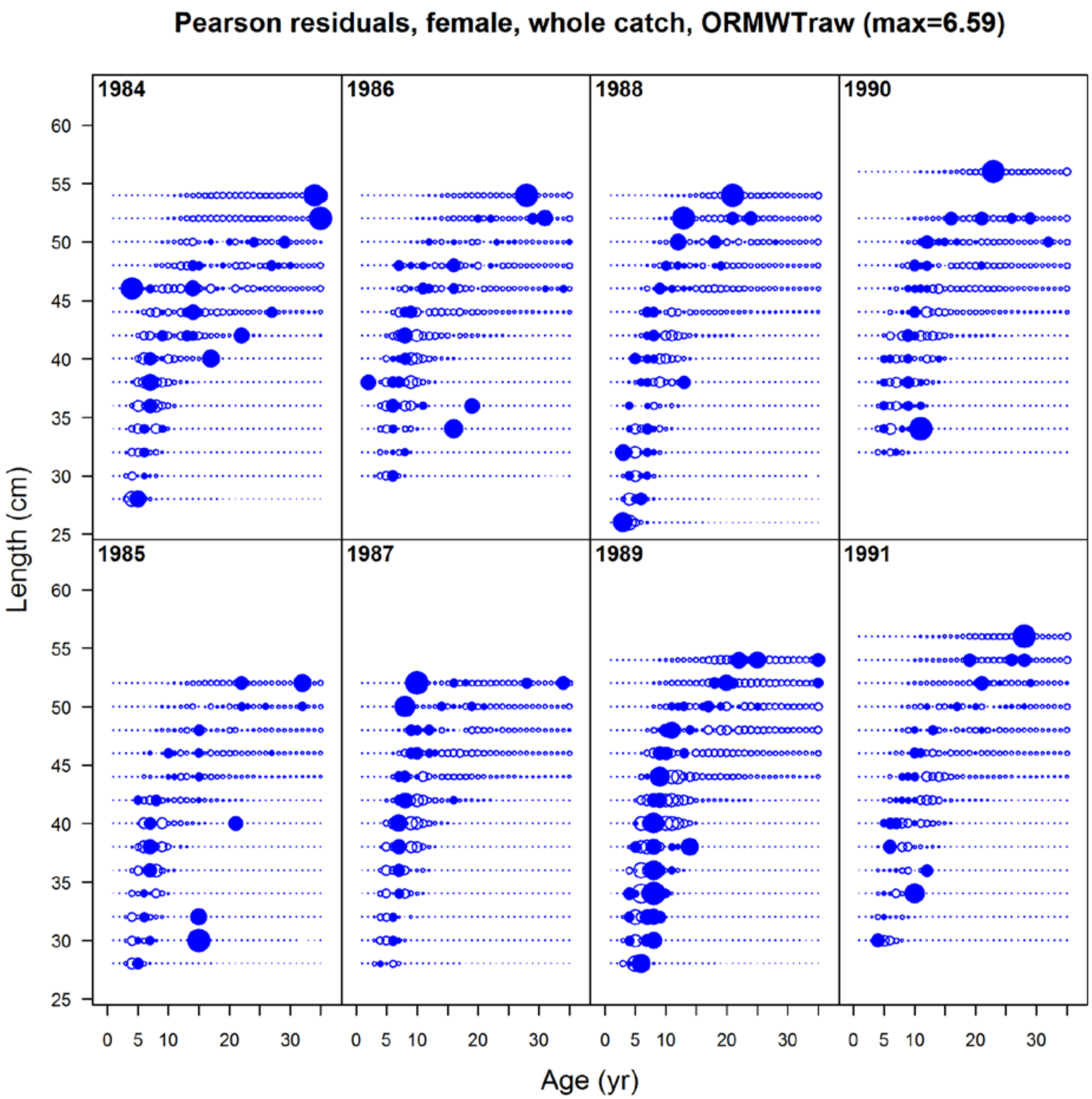


Figure 62a. Residuals for the fit to female age-at-length composition data from the Oregon mid-water trawl fishery from 1984 to 1991. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

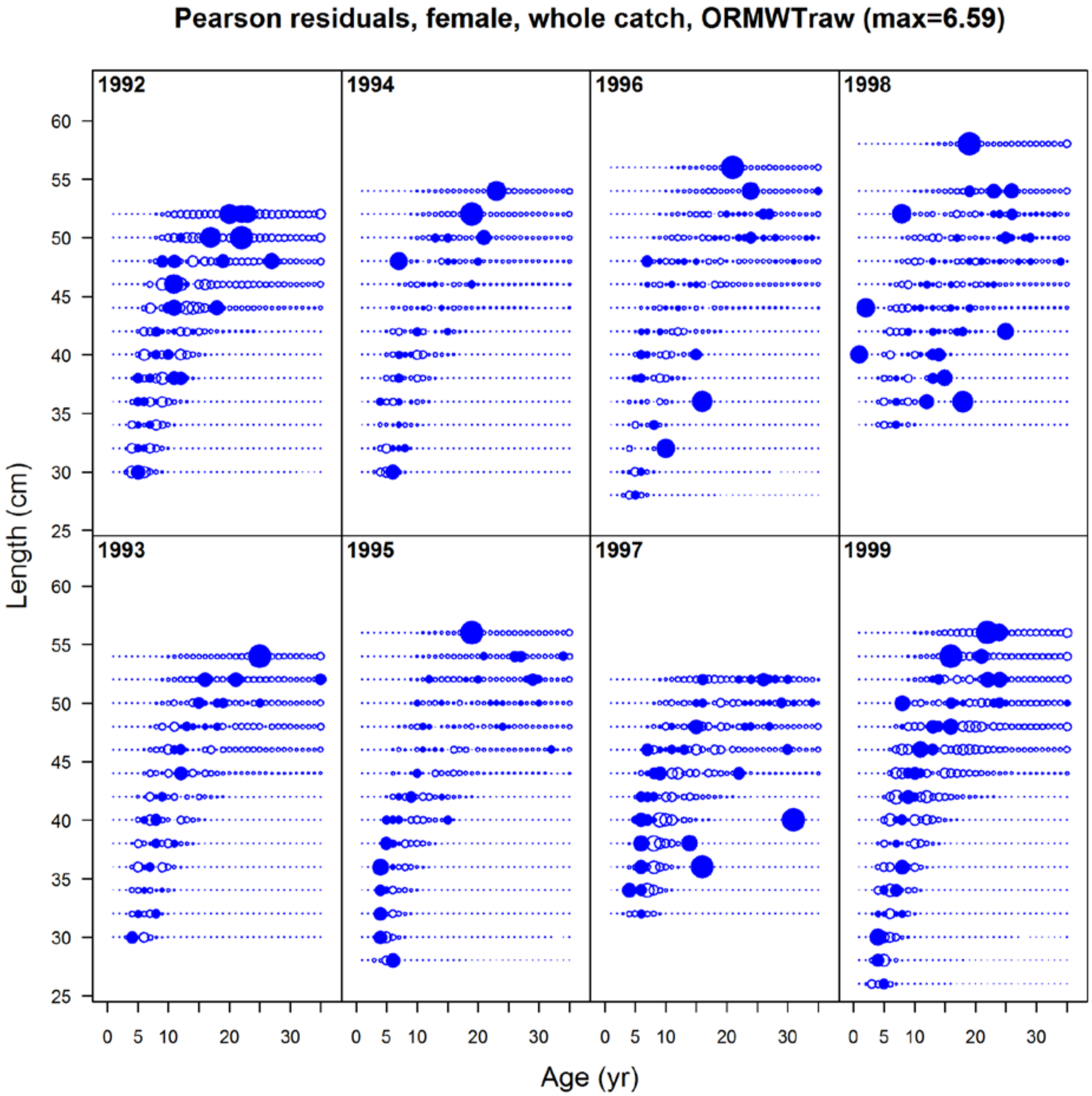


Figure 62b. Residuals for the fit to female age-at-length composition data from the Oregon mid-water trawl fishery from 1992 to 1999. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

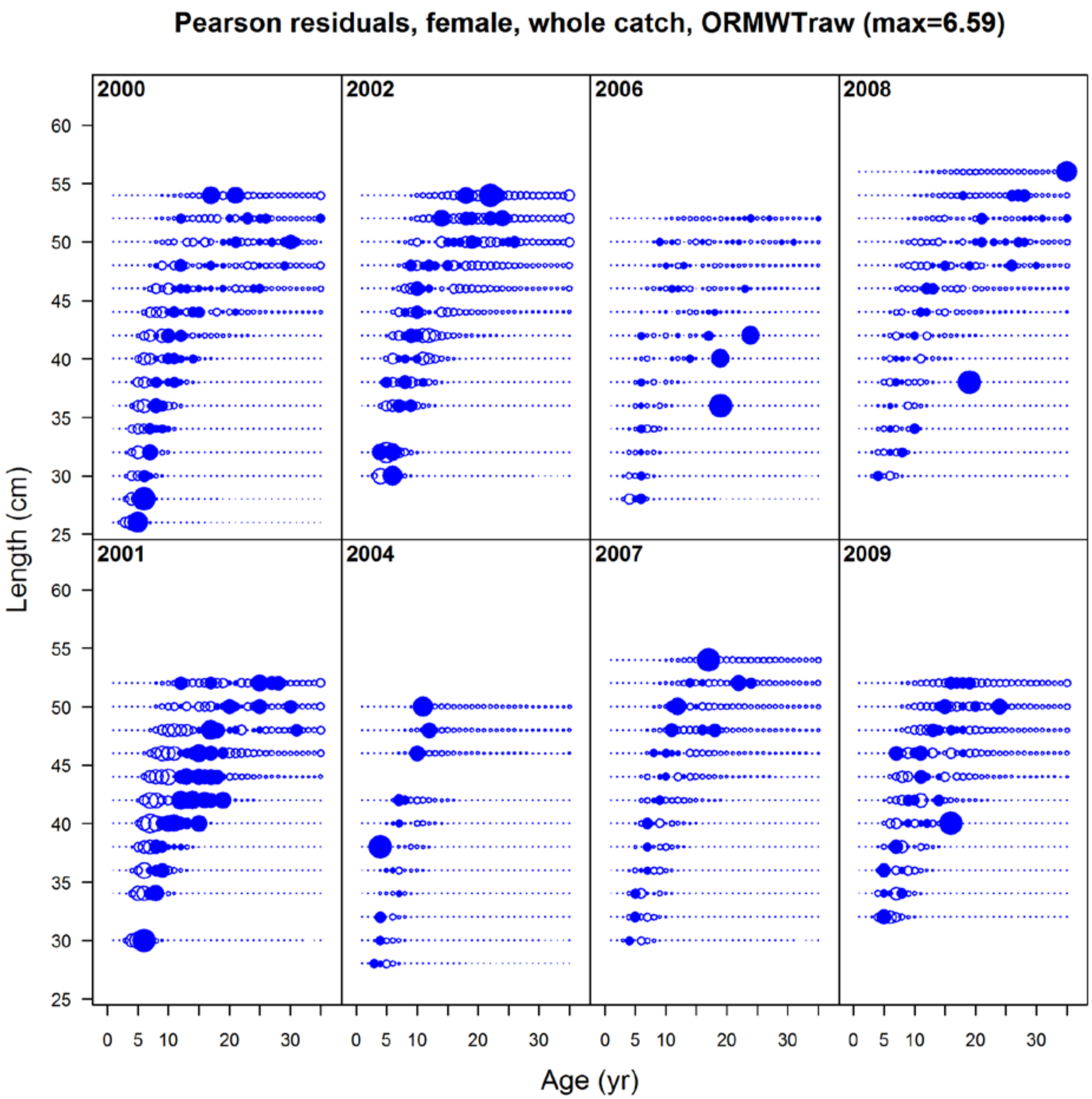


Figure 62c. Residuals for the fit to female age-at-length composition data from the Oregon mid-water trawl fishery from 2000 to 2009. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

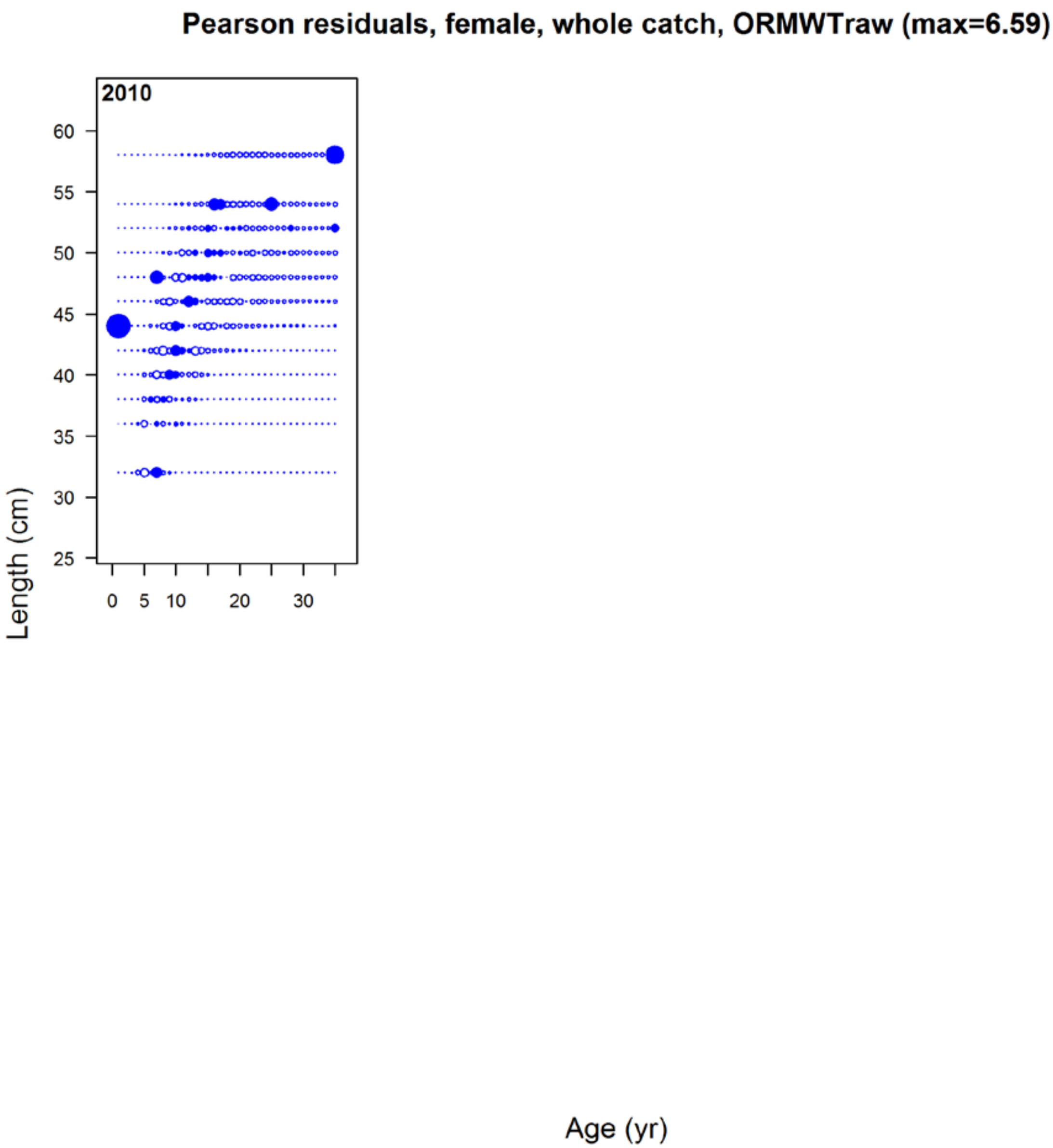


Figure 62d. Residuals for the fit to female age-at-length composition data from the Oregon mid-water trawl fishery from 2010. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

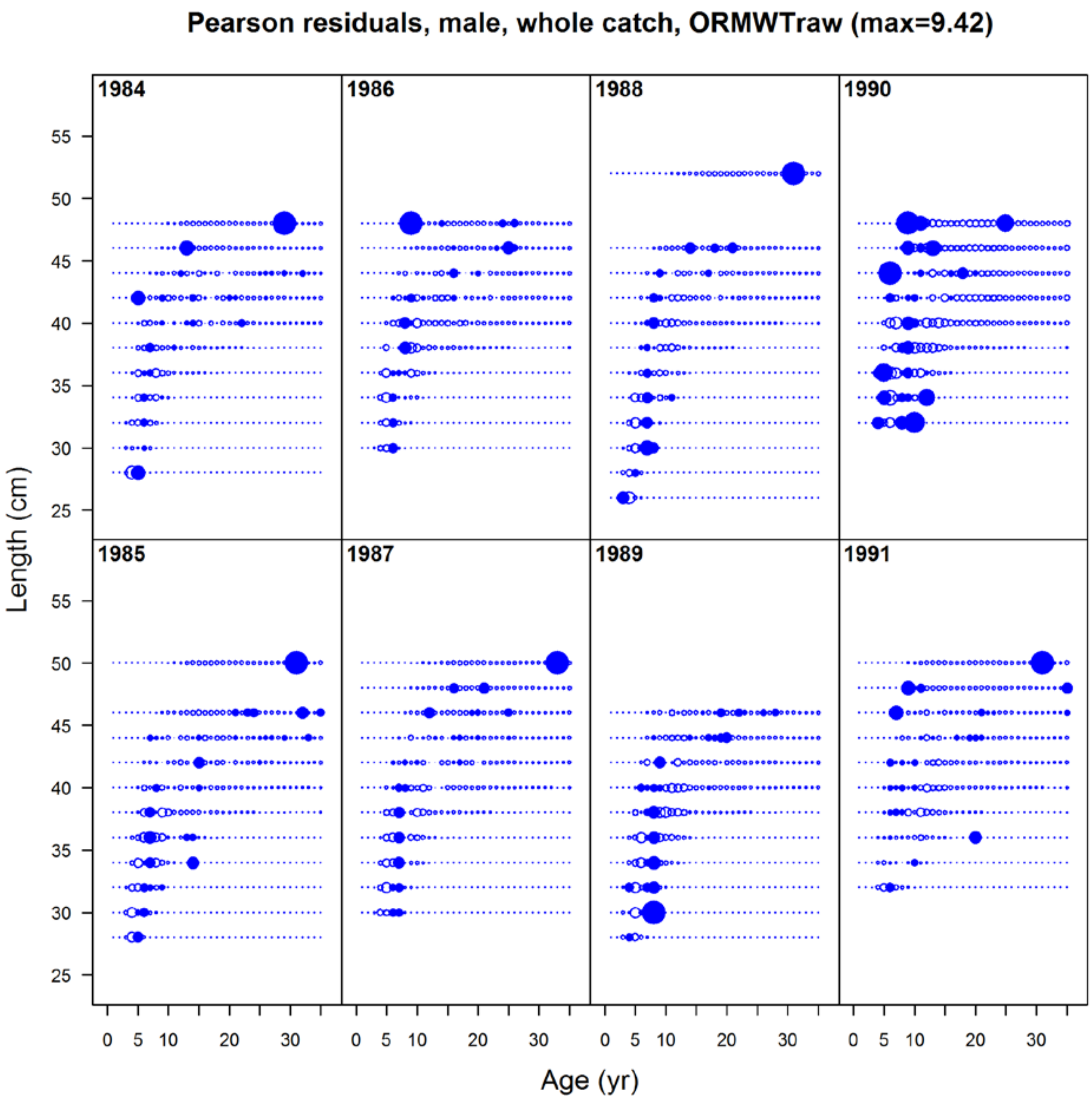


Figure 62e. Residuals for the fit to male age-at-length composition data from the Oregon mid-water trawl fishery from 1984 to 1991. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

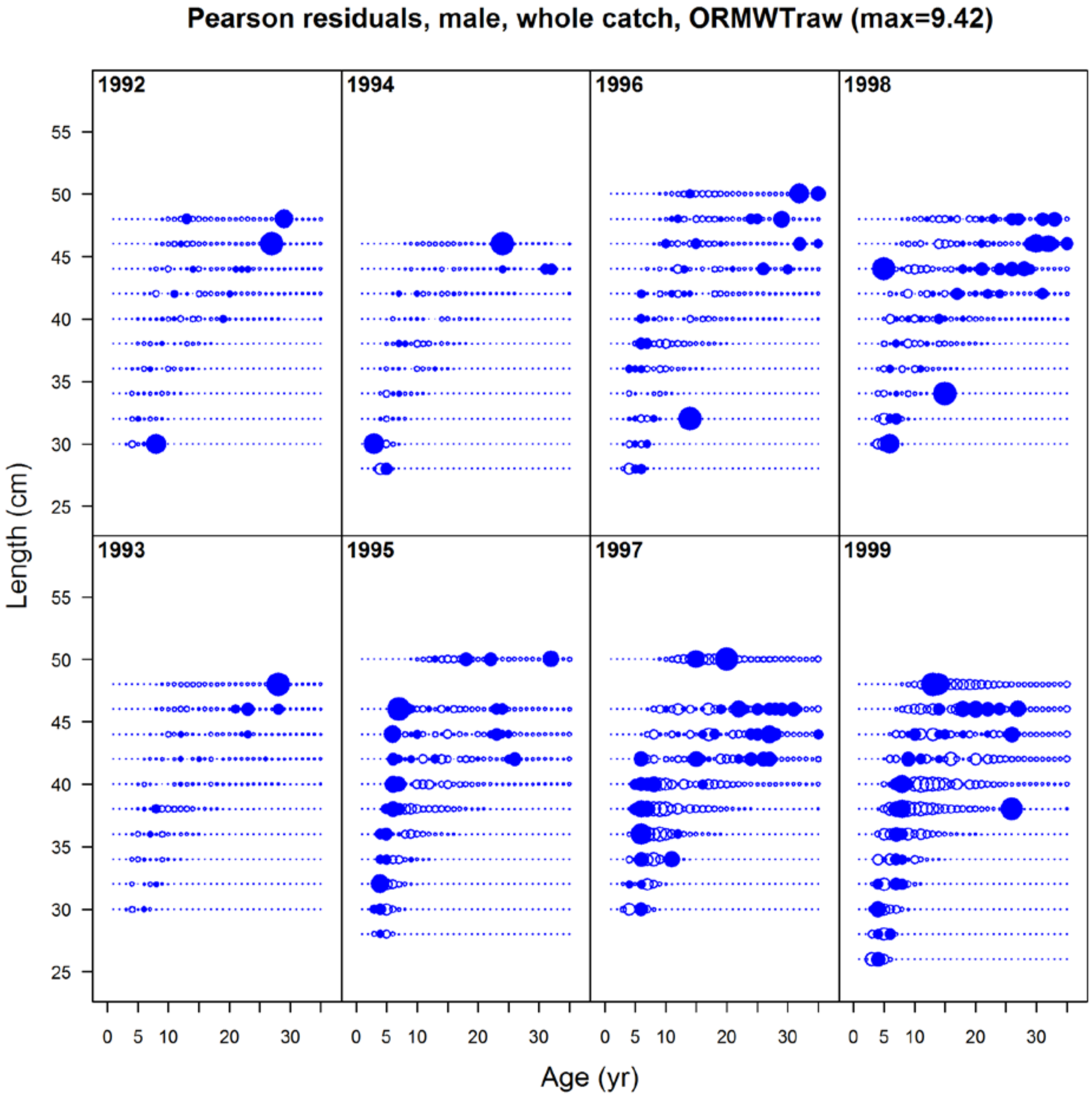


Figure 62f. Residuals for the fit to male age-at-length composition data from the Oregon mid-water trawl fishery from 1992 to 1999. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

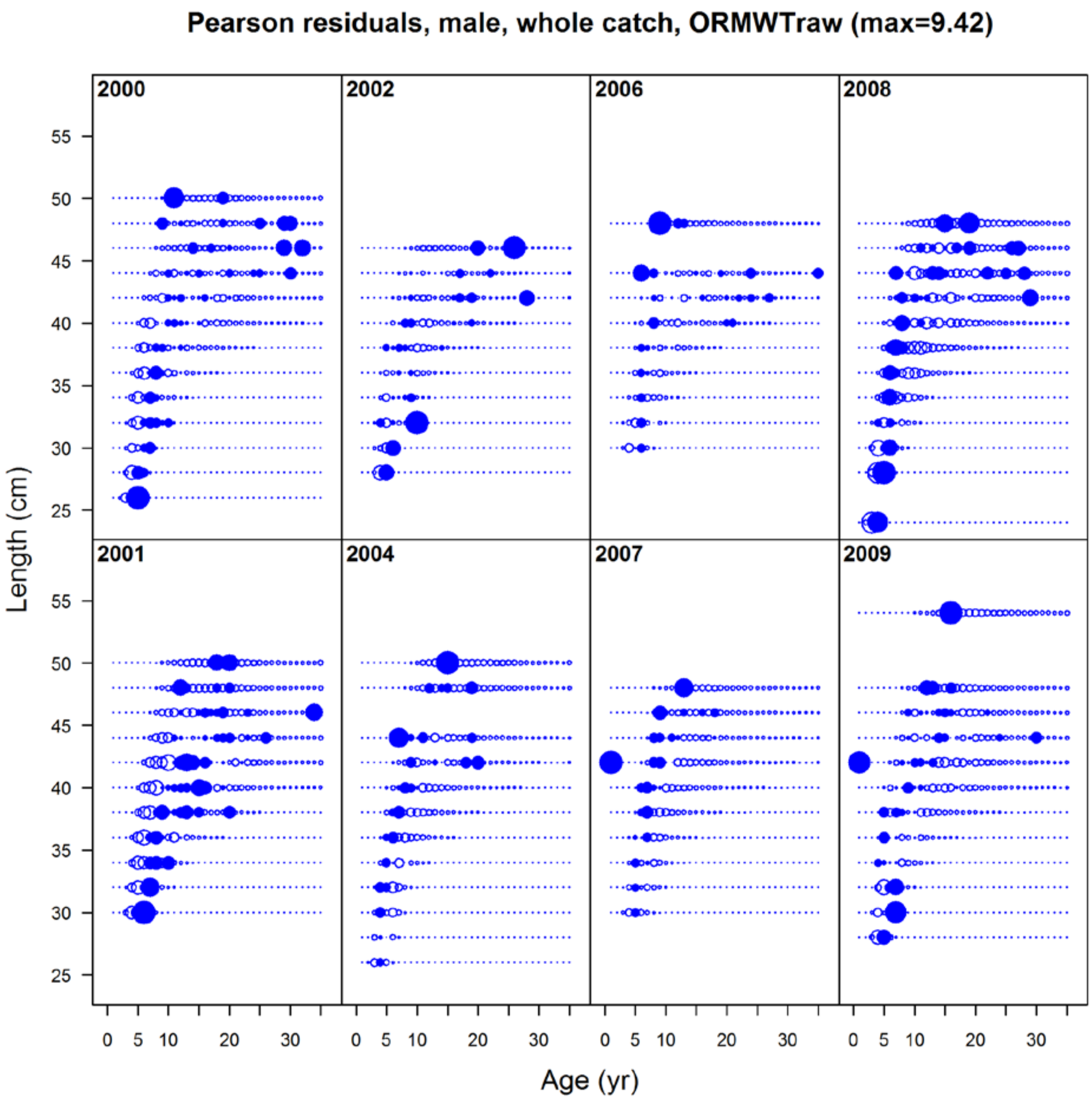


Figure 62g. Residuals for the fit to male age-at-length composition data from the Oregon mid-water trawl fishery from 2000 to 2009. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

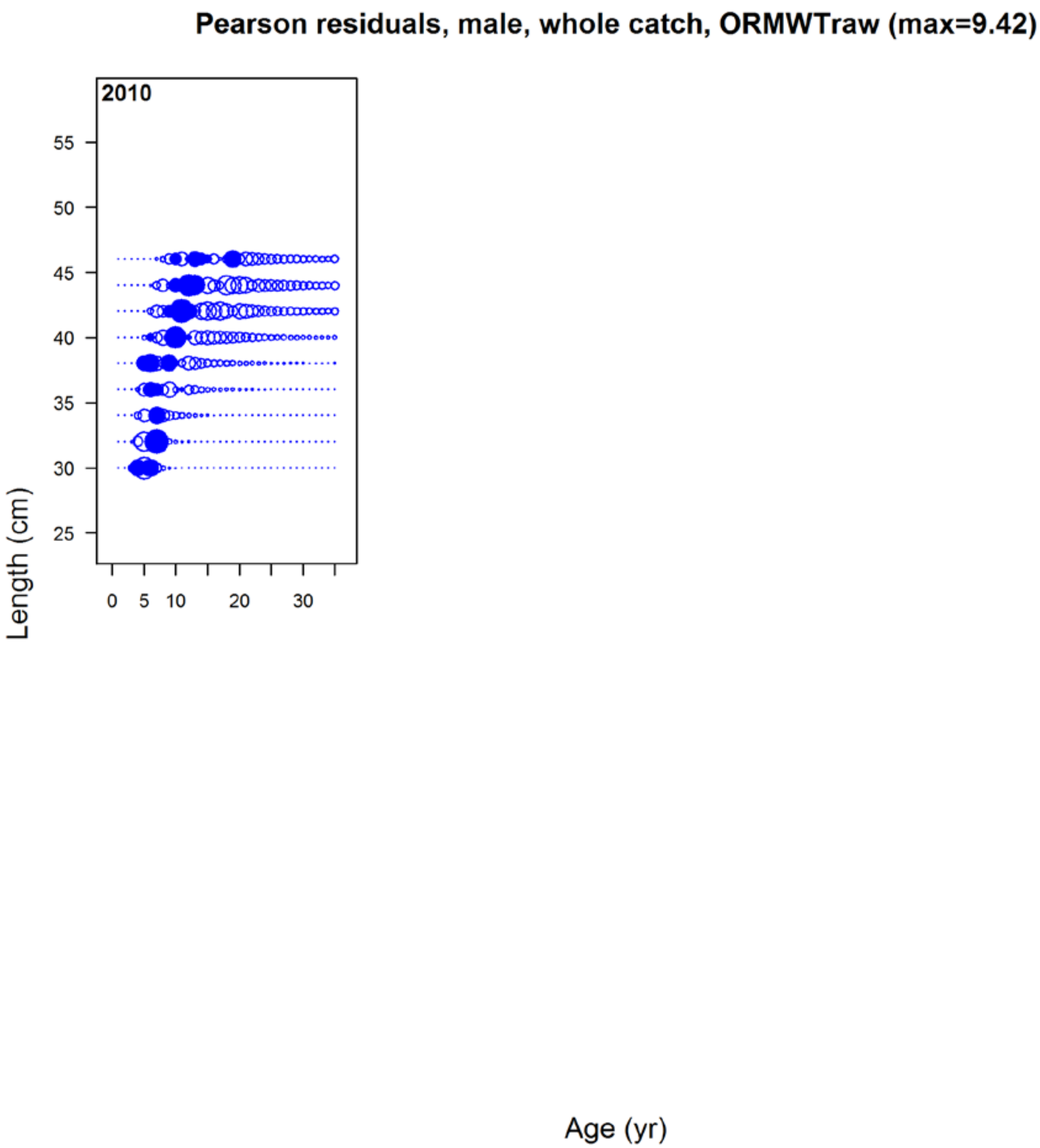


Figure 62h. Residuals for the fit to male age-at-length composition data from the Oregon mid-water trawl fishery from 2010. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

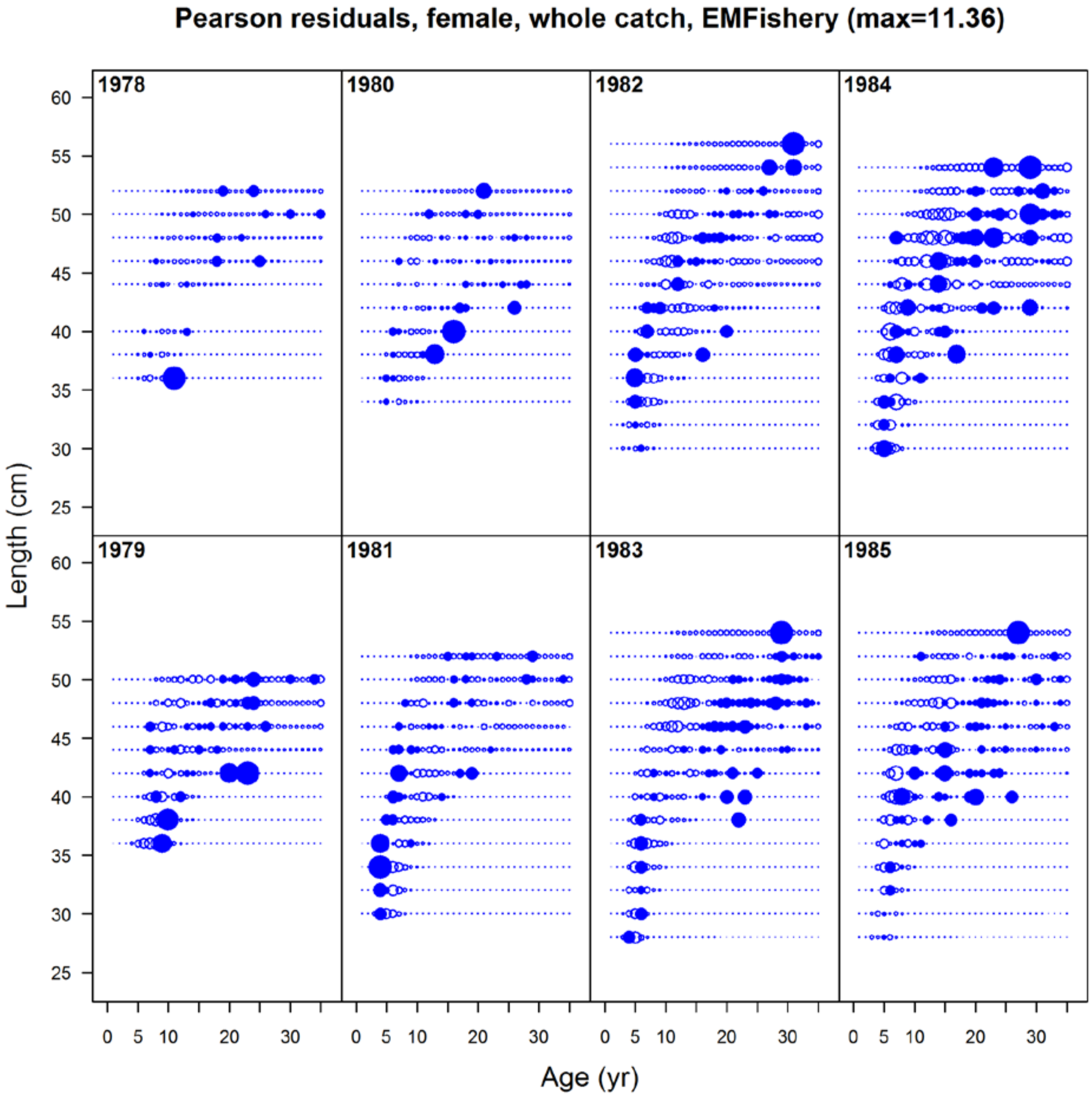


Figure 63a. Residuals for the fit to female age-at-length composition data from the California (EMFishery1) fishery from 1978 to 1985. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

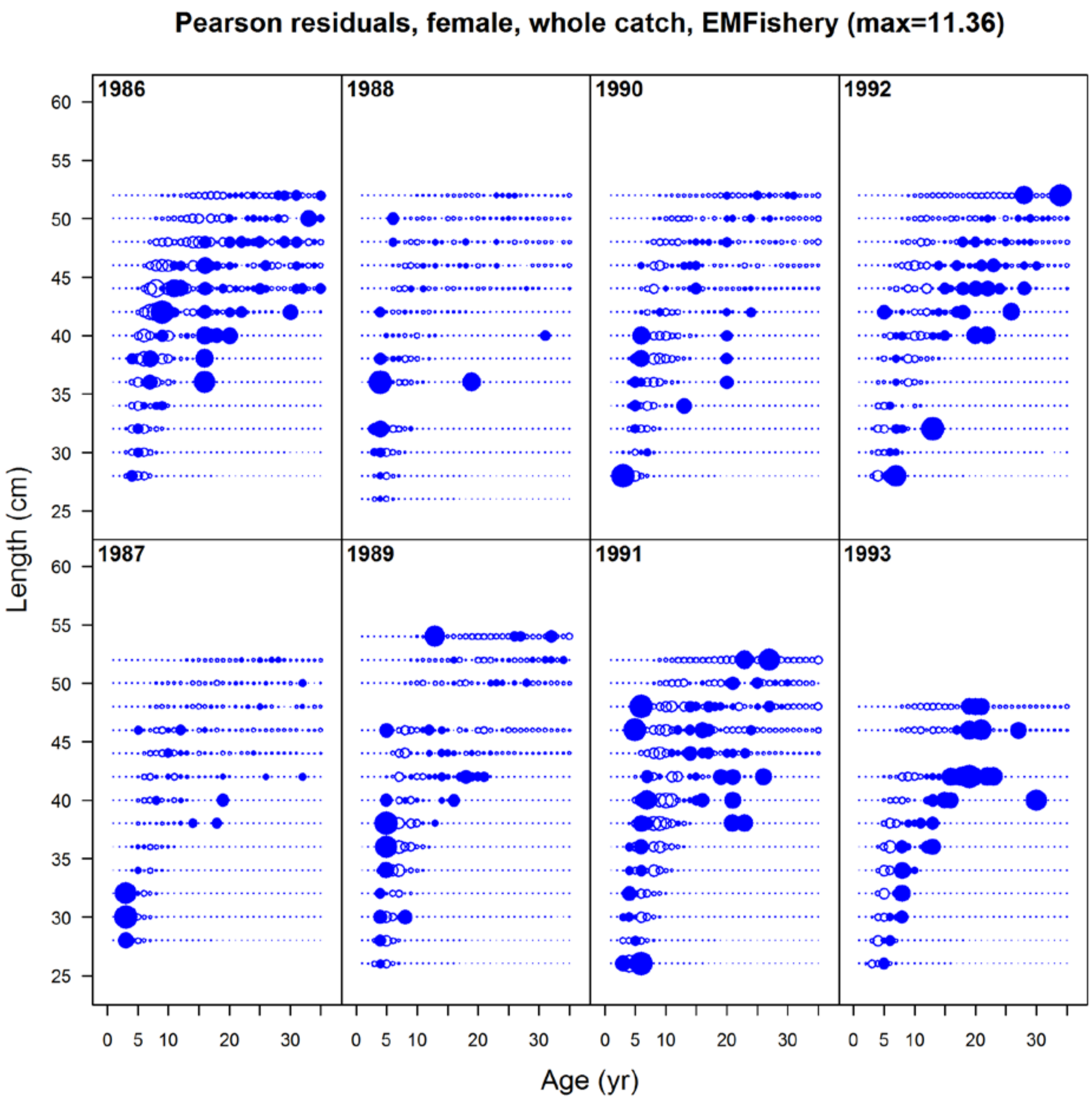


Figure 63b. Residuals for the fit to female age-at-length composition data from the California (EMFishery1) fishery from 1986 to 1993. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

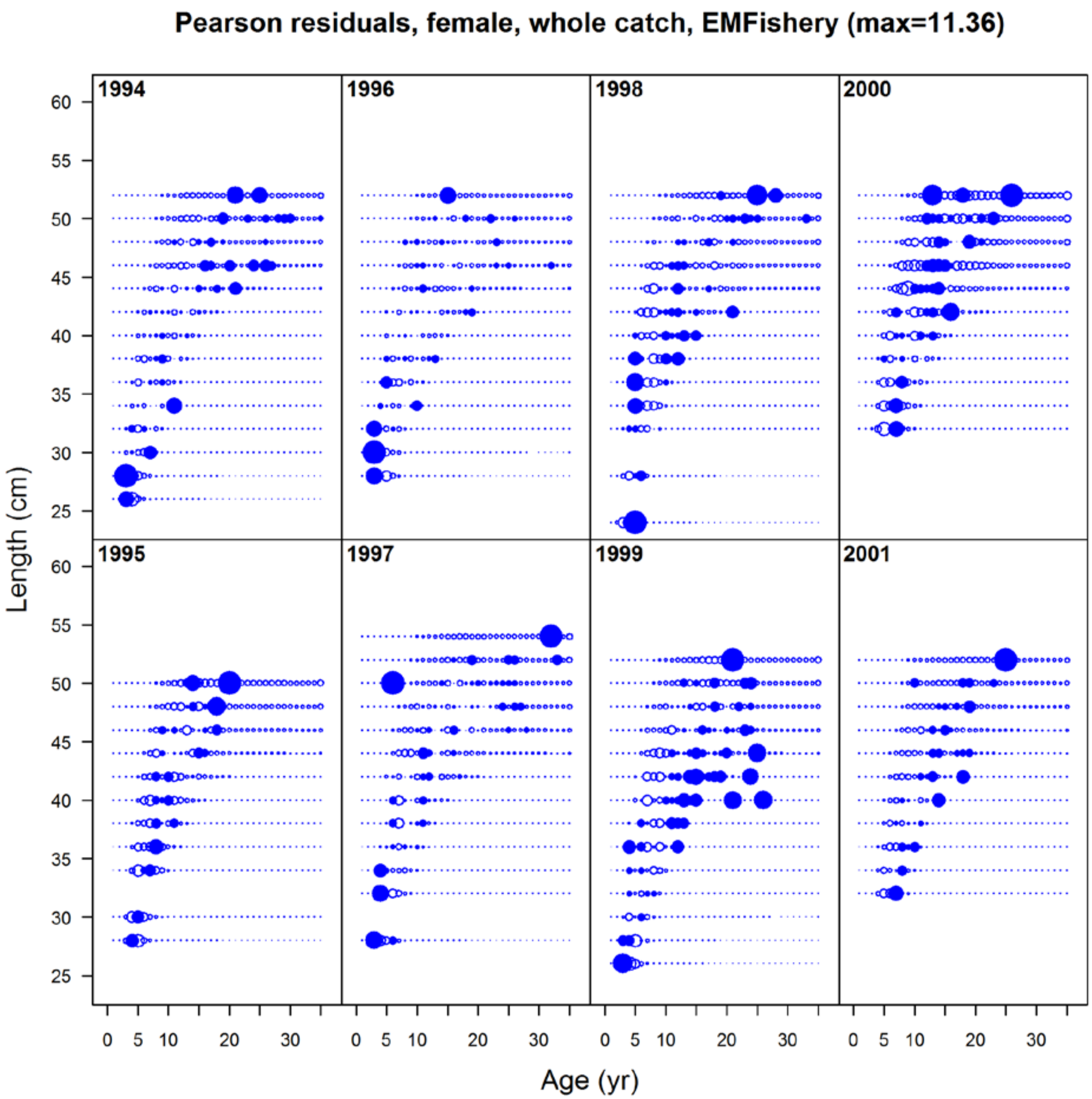


Figure 63c. Residuals for the fit to female age-at-length composition data from the California (EMFishery1) fishery from 1994 to 2001. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

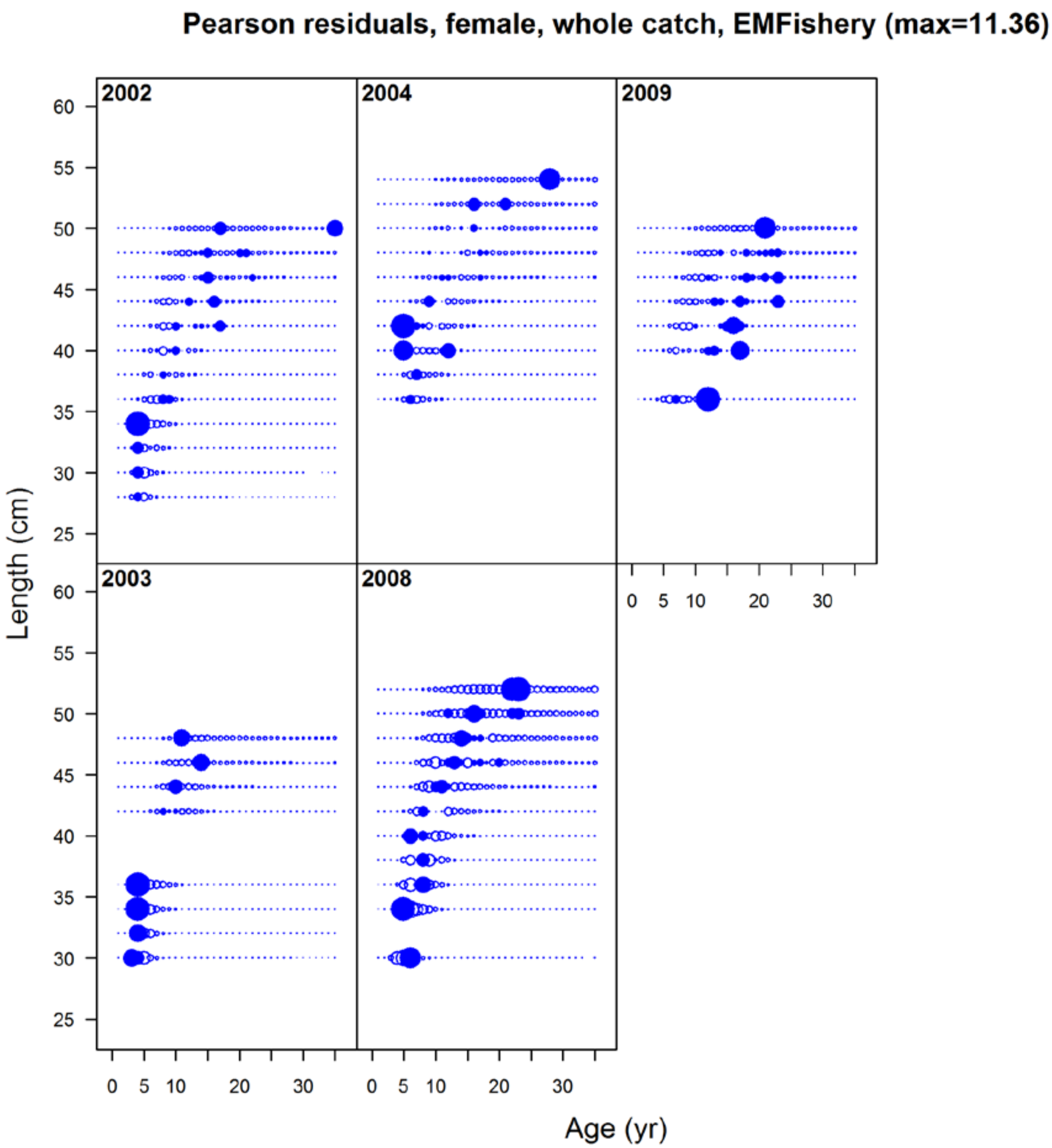


Figure 63d. Residuals for the fit to female age-at-length composition data from the California (EMFishery1) fishery from 2002 to 2009. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

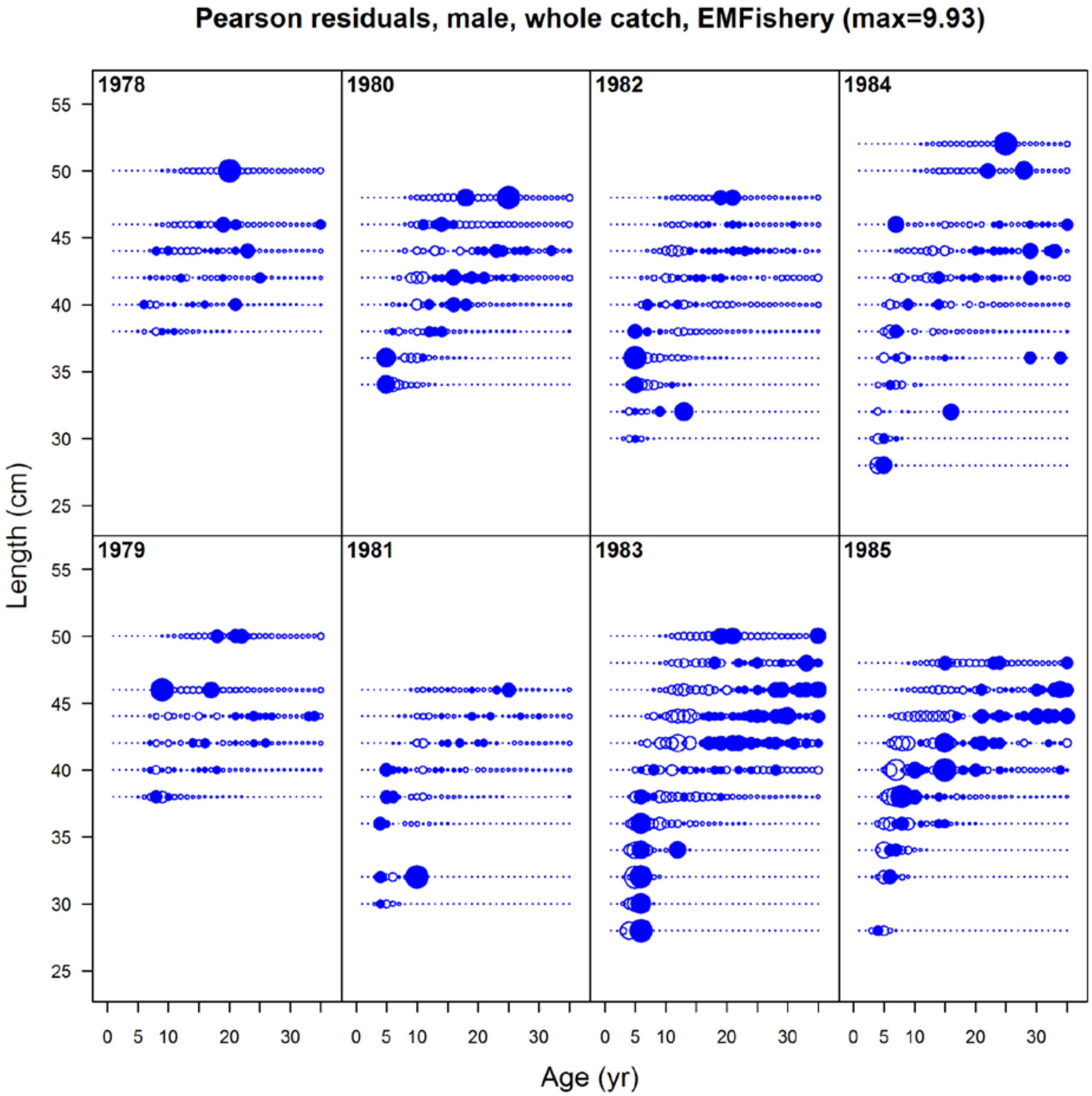


Figure 63e. Residuals for the fit to male age-at-length composition data from the California (EMFishery1) fishery from 1978 to 1985. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

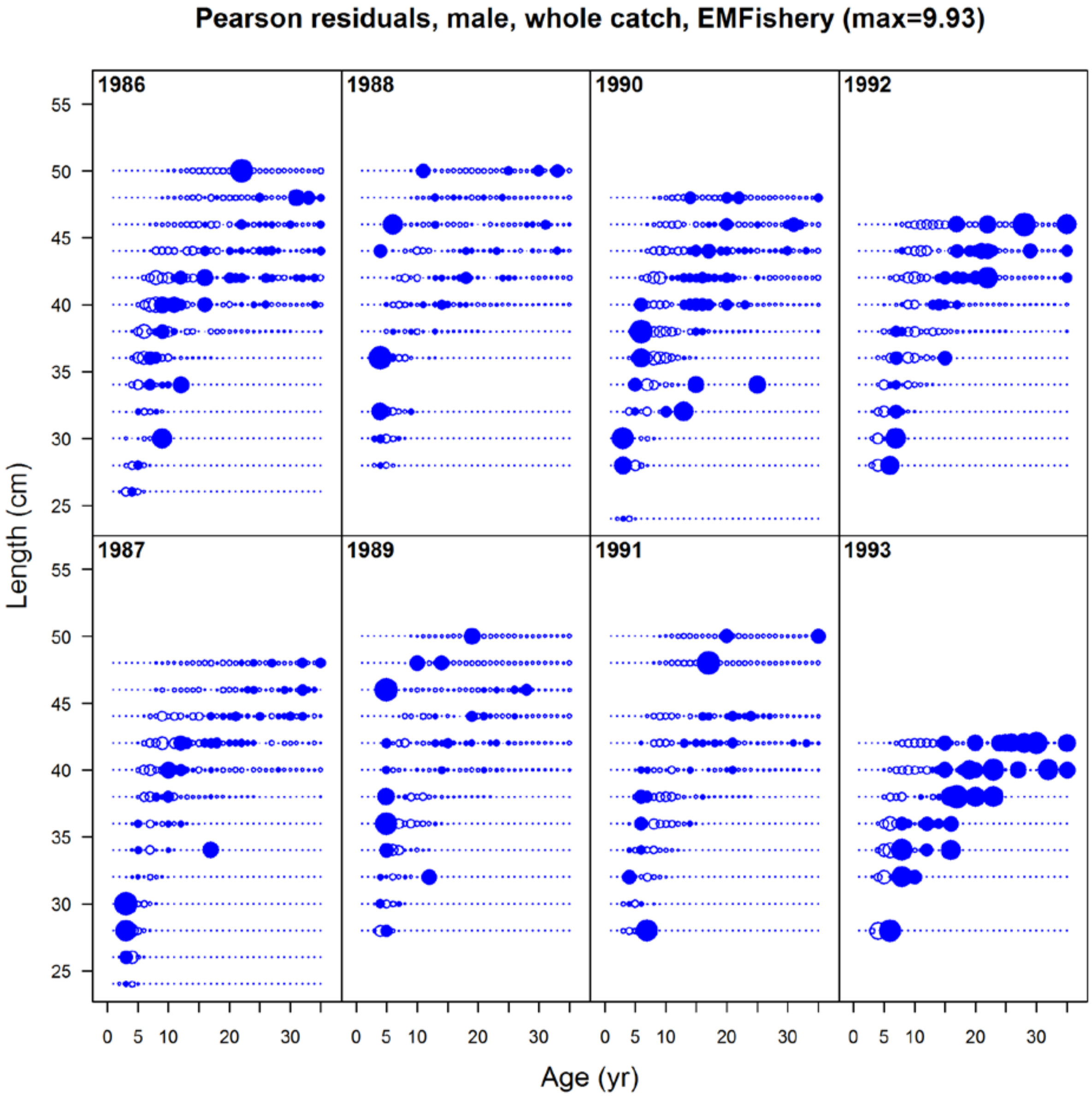


Figure 63f. Residuals for the fit to female age-at-length composition data from the California (EMFishery1) fishery from 1986 to 1993. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

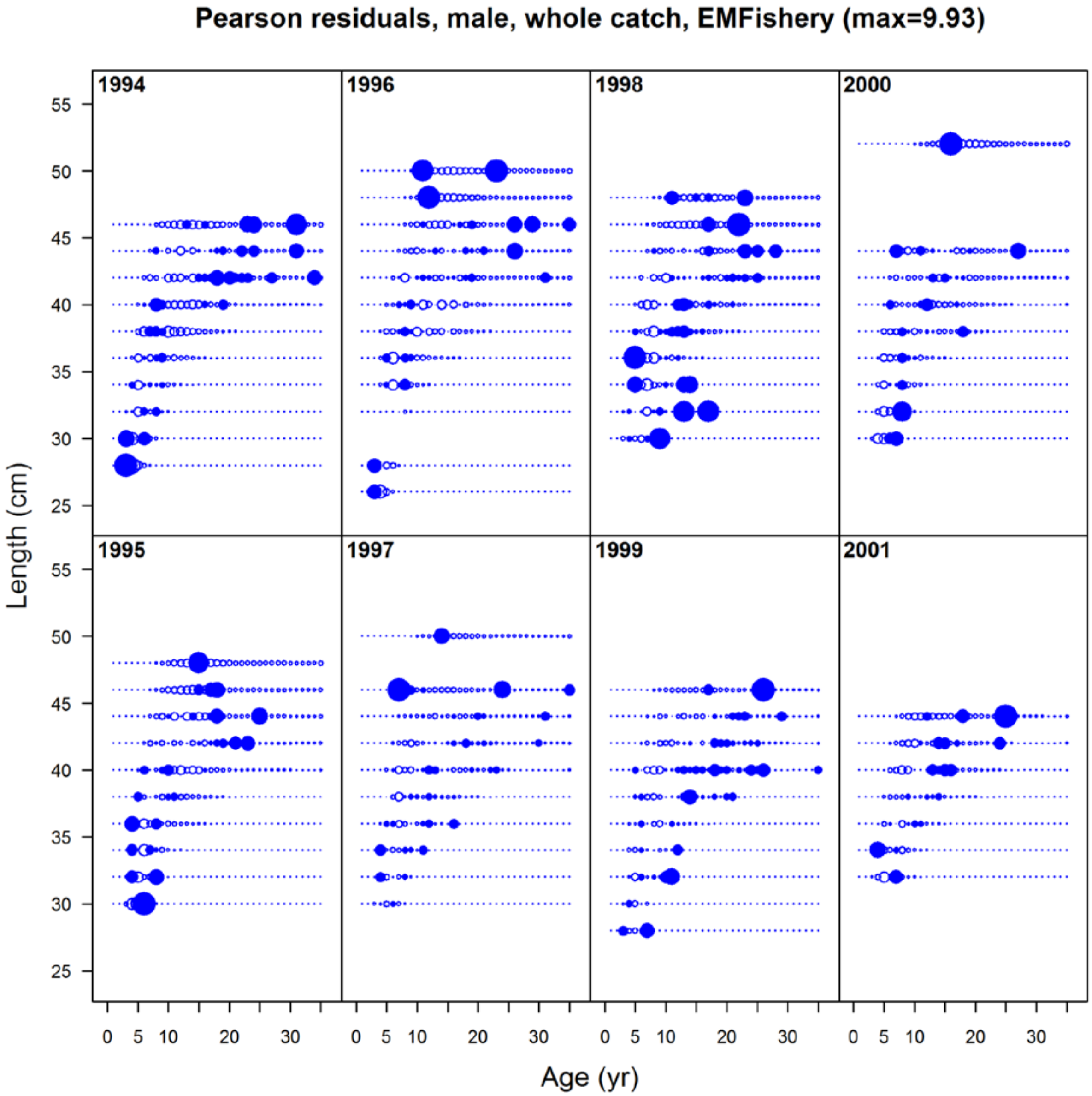


Figure 63g. Residuals for the fit to female age-at-length composition data from the California (EMFishery1) fishery from 1994 to 2001. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

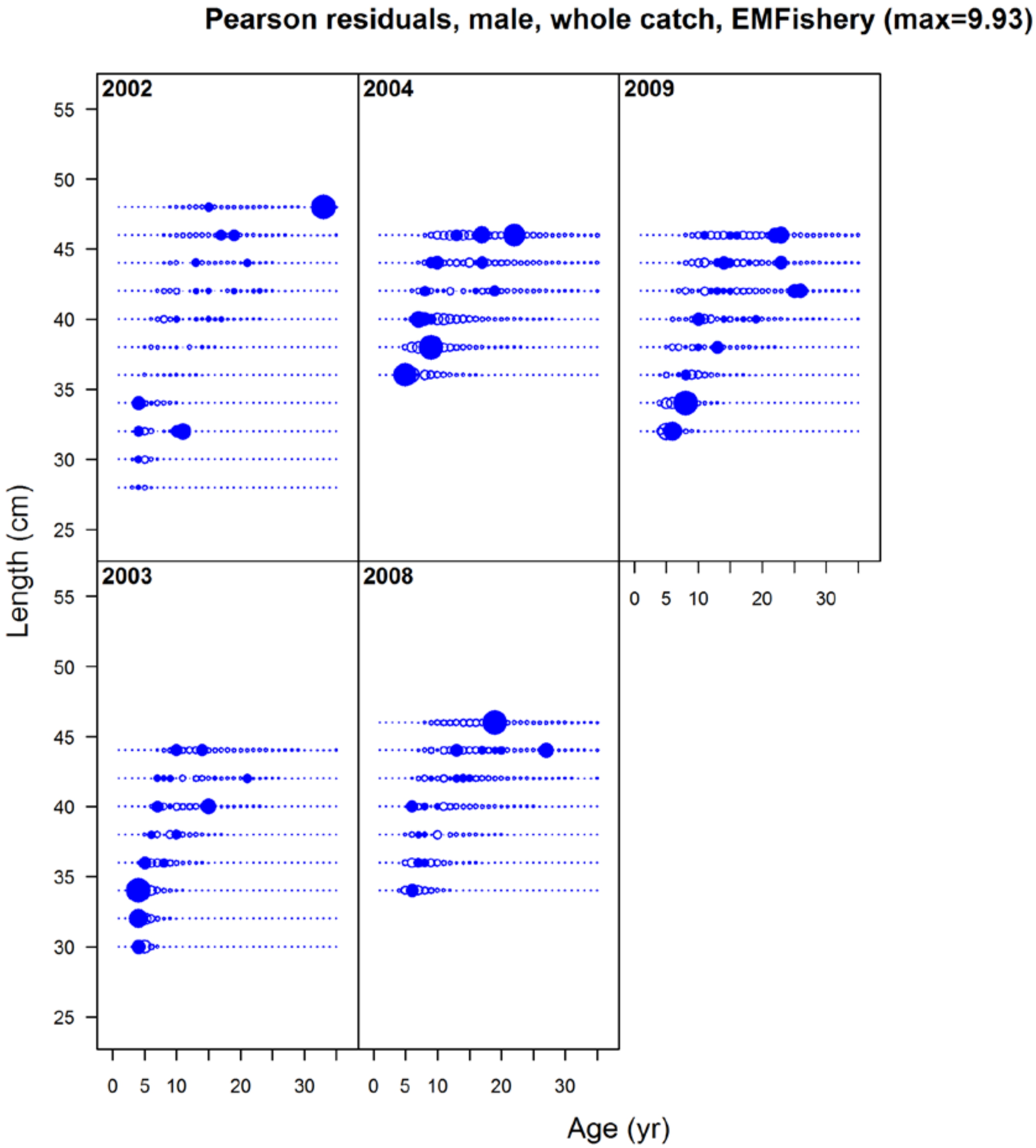


Figure 63h. Residuals for the fit to female age-at-length composition data from the California (EMFishery1) fishery from 2002 to 2009. Residuals are standardized differences of Pearson residuals (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.

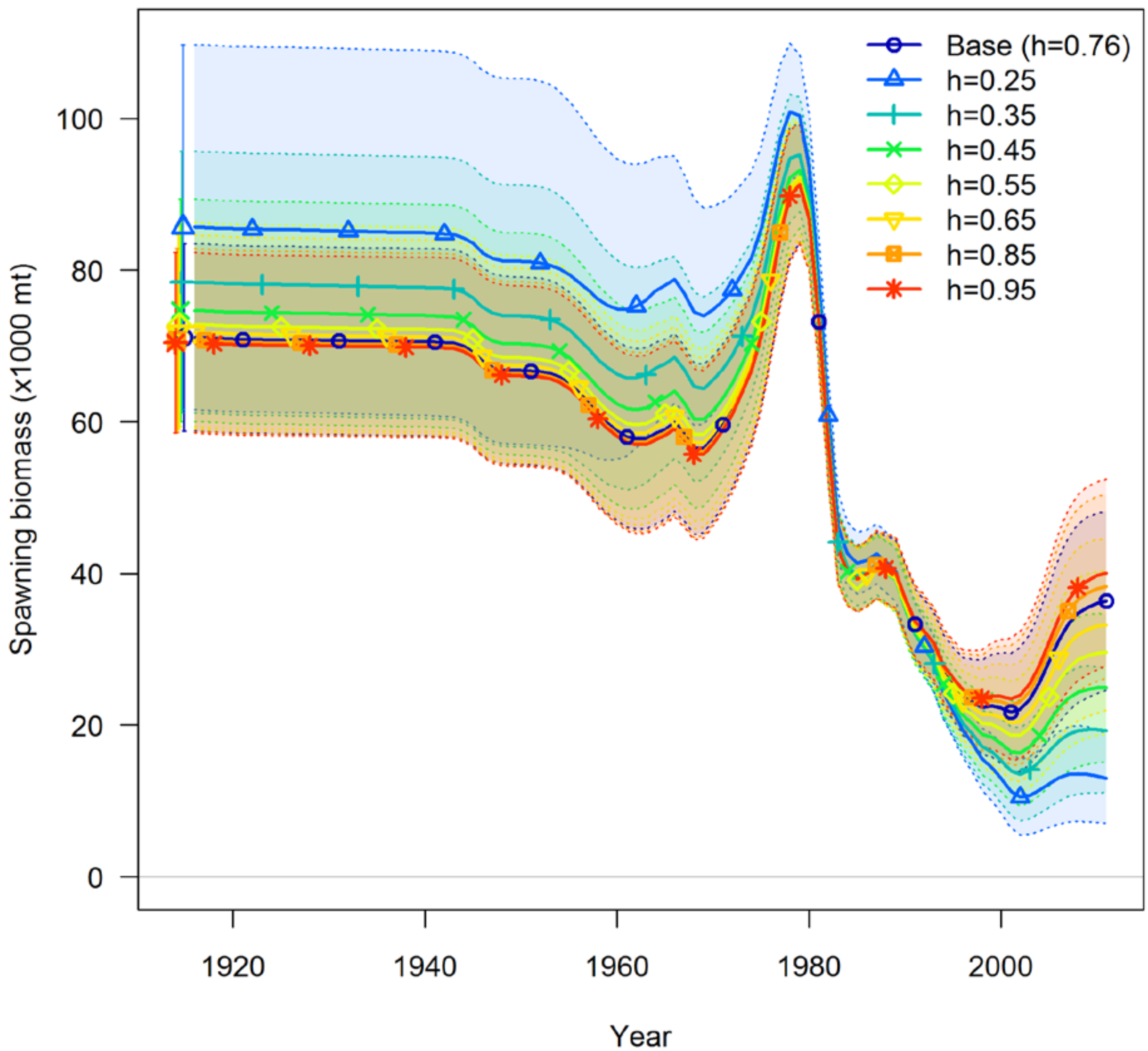


Figure 64. Comparisons of time series of spawning outputs with 95% asymptotic intervals from the sensitivity analysis on steepness (*h)* while estimating natural mortality (*M).* The results from the base model is also included for comparisons.

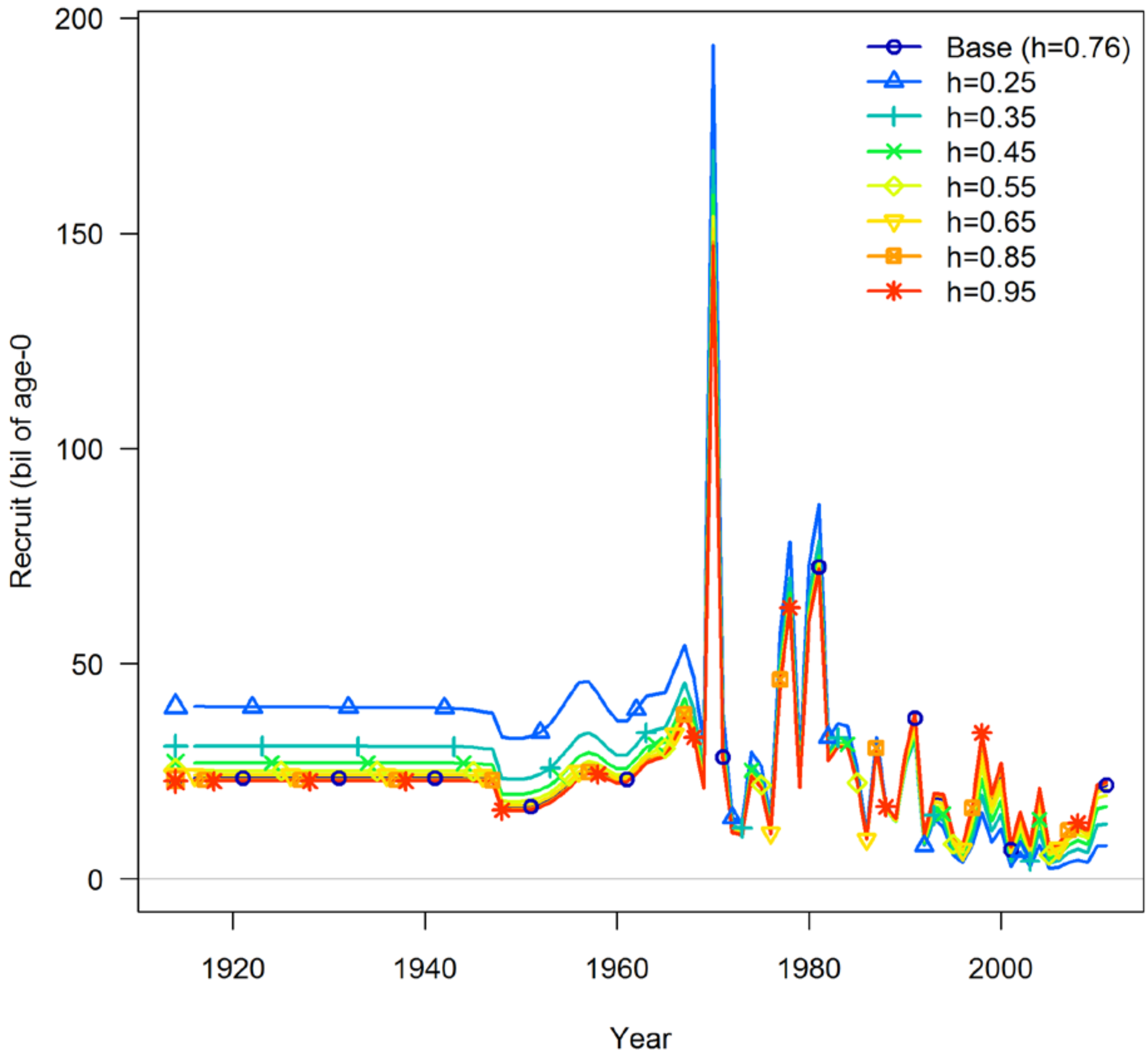


Figure 65. Comparisons of time series of recruits from the sensitivity analysis on steepness (*h*) while estimating natural mortality (*M)*. The results from the base model is also included for comparisons.

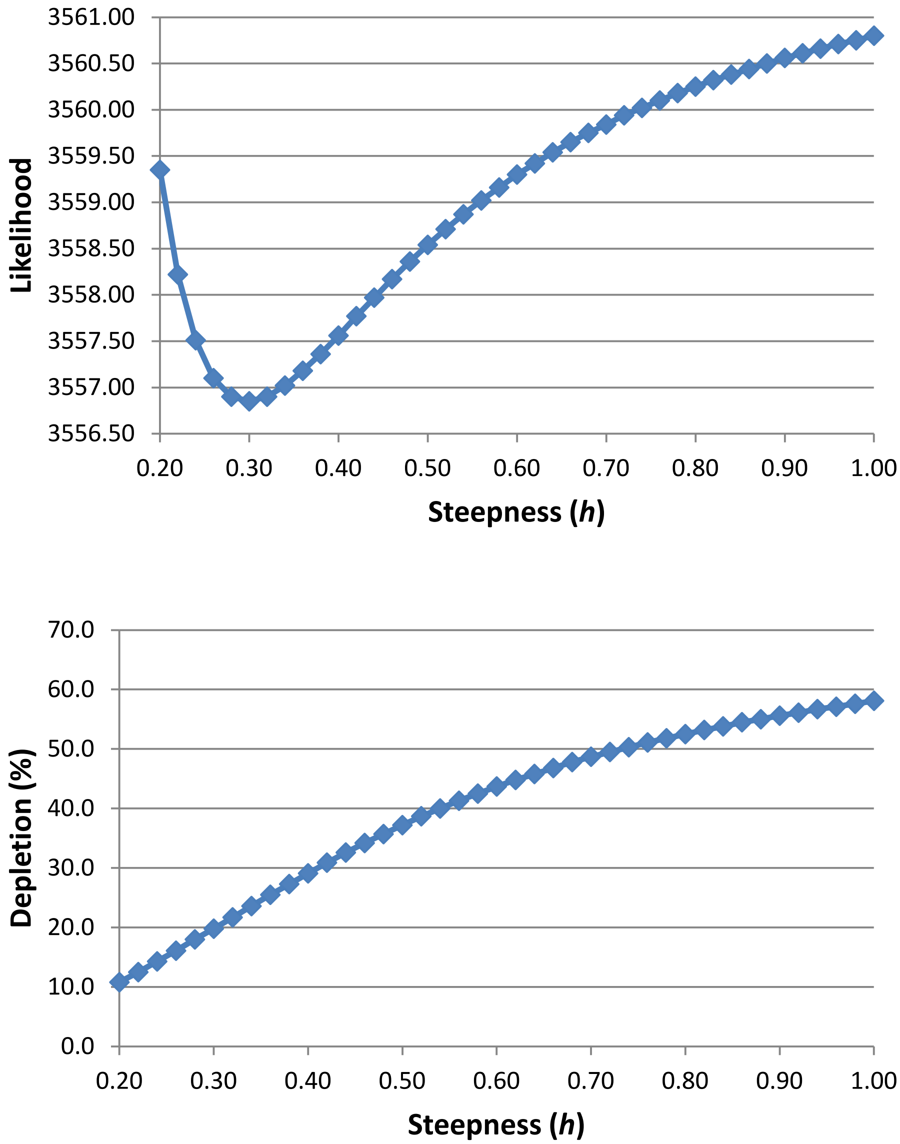


Figure 65b. Plots of likelihood profile for steepness (*h*, at interval of 0.02) (upper panel) and 2011 depletion levels (bottom panel) from the sensitivity analysis on steepness while estimating natural mortality (*M*).

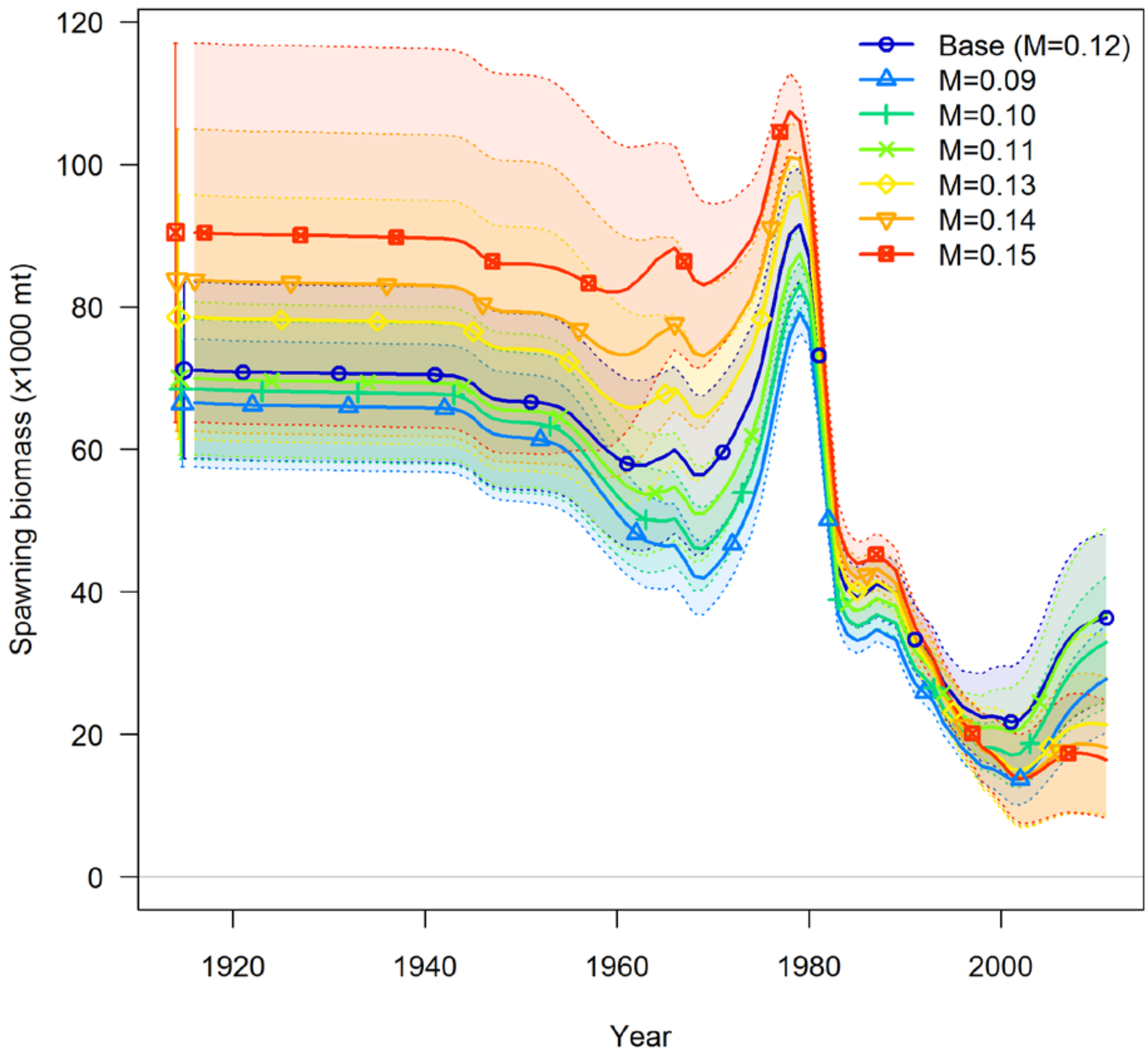


Figure 66. Comparisons of time series of spawning outputs with 95% asymptotic intervals from the sensitivity analysis on natural mortality (*M)* while estimating *h*. The results from the base model is also included for comparisons.

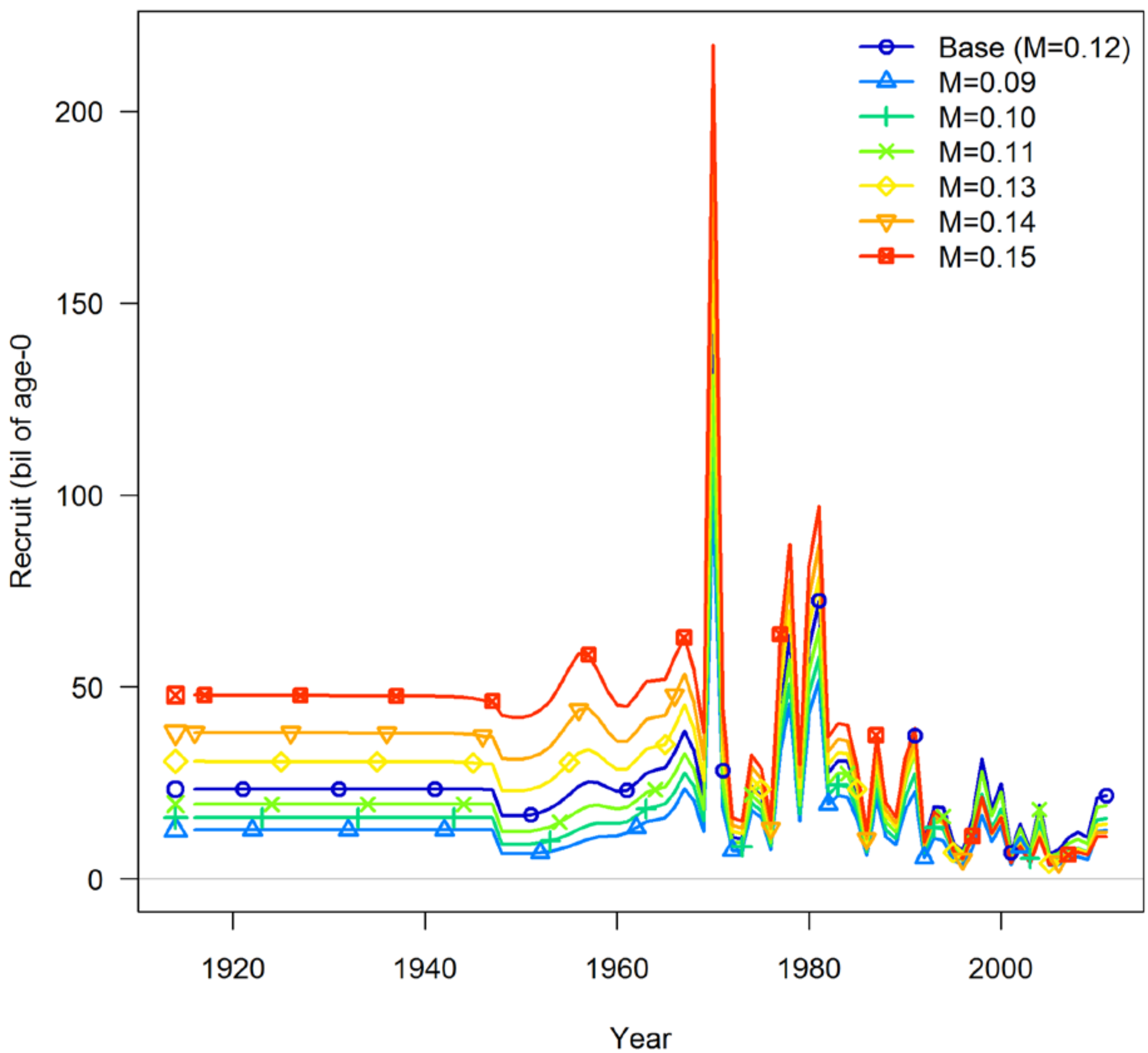


Figure 67. Comparisons of time series of recruits from the sensitivity analysis on natural morality (*M*) while estimating *h*. The results from the base model is also included for comparisons.

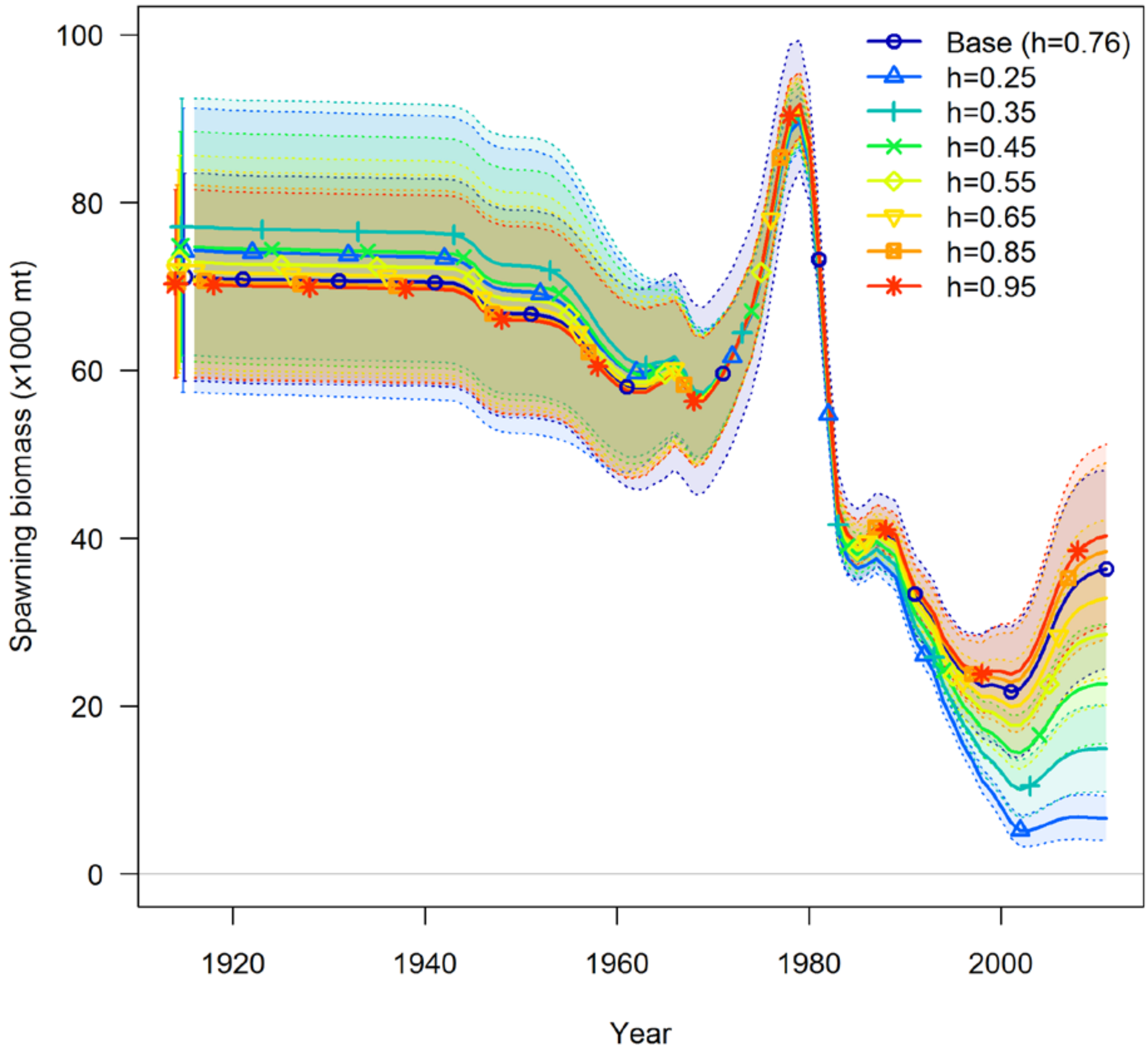


Figure 68. Comparisons of time series of spawning outputs with 95% asymptotic intervals from the sensitivity analysis on steepness (*h*) with *M* fixed at the base model value (M_{female}=0.1198, M_{male}=0.1294). The results from the base model is also included for comparisons.

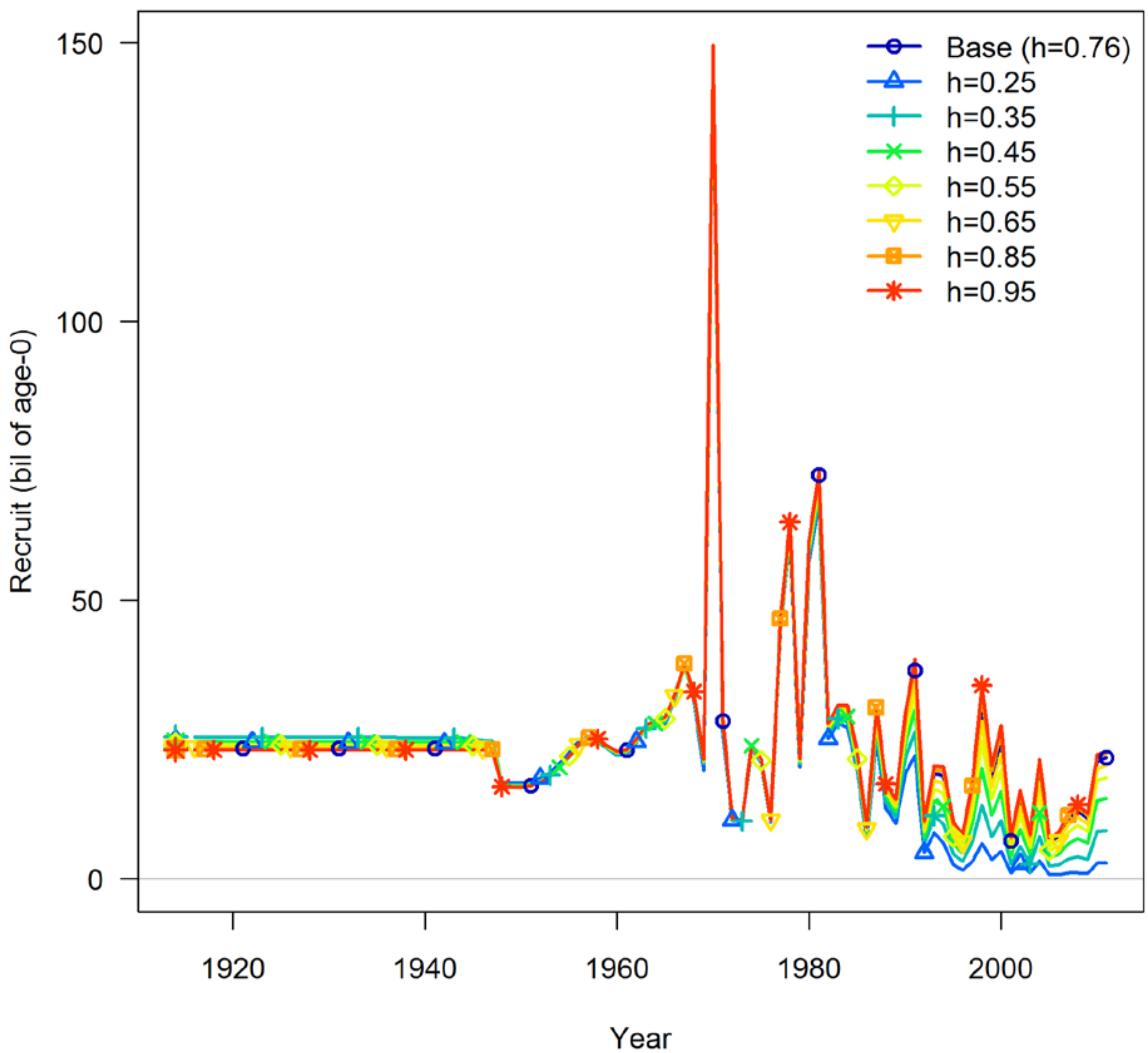


Figure 69. Comparisons of time series of recruits from the sensitivity analysis on steepness (*h*) with *M* fixed at the base model values (M_{female}=0.1198, M_{male}=0.1294). The results from the base model is also included for comparisons.

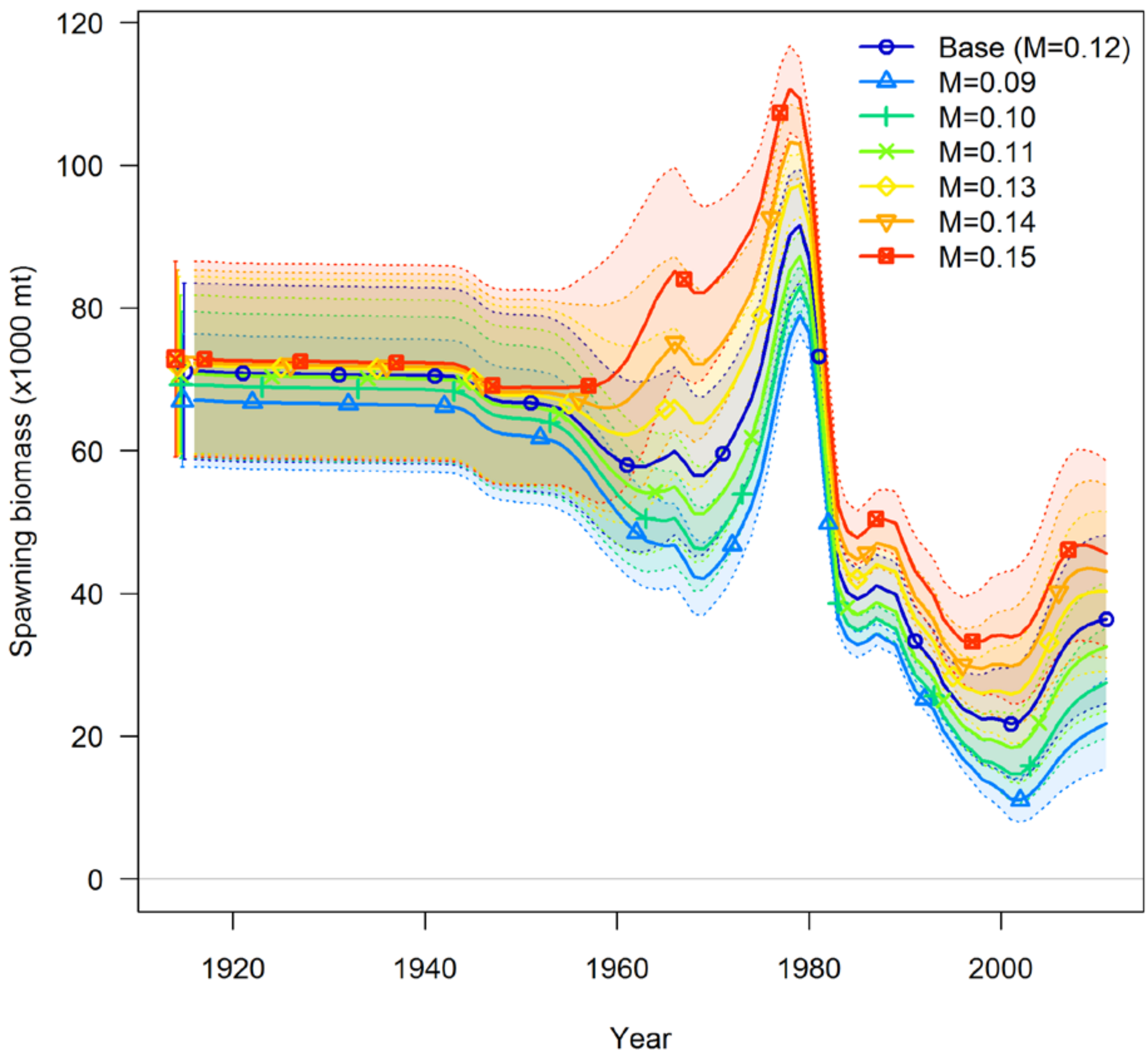


Figure 70. Comparisons of time series of spawning outputs with 95% asymptotic intervals from the sensitivity analysis on natural mortality (*M)* with *h* fixed at the base model value (*h*=0.76). The results from the base model is also included for comparisons.

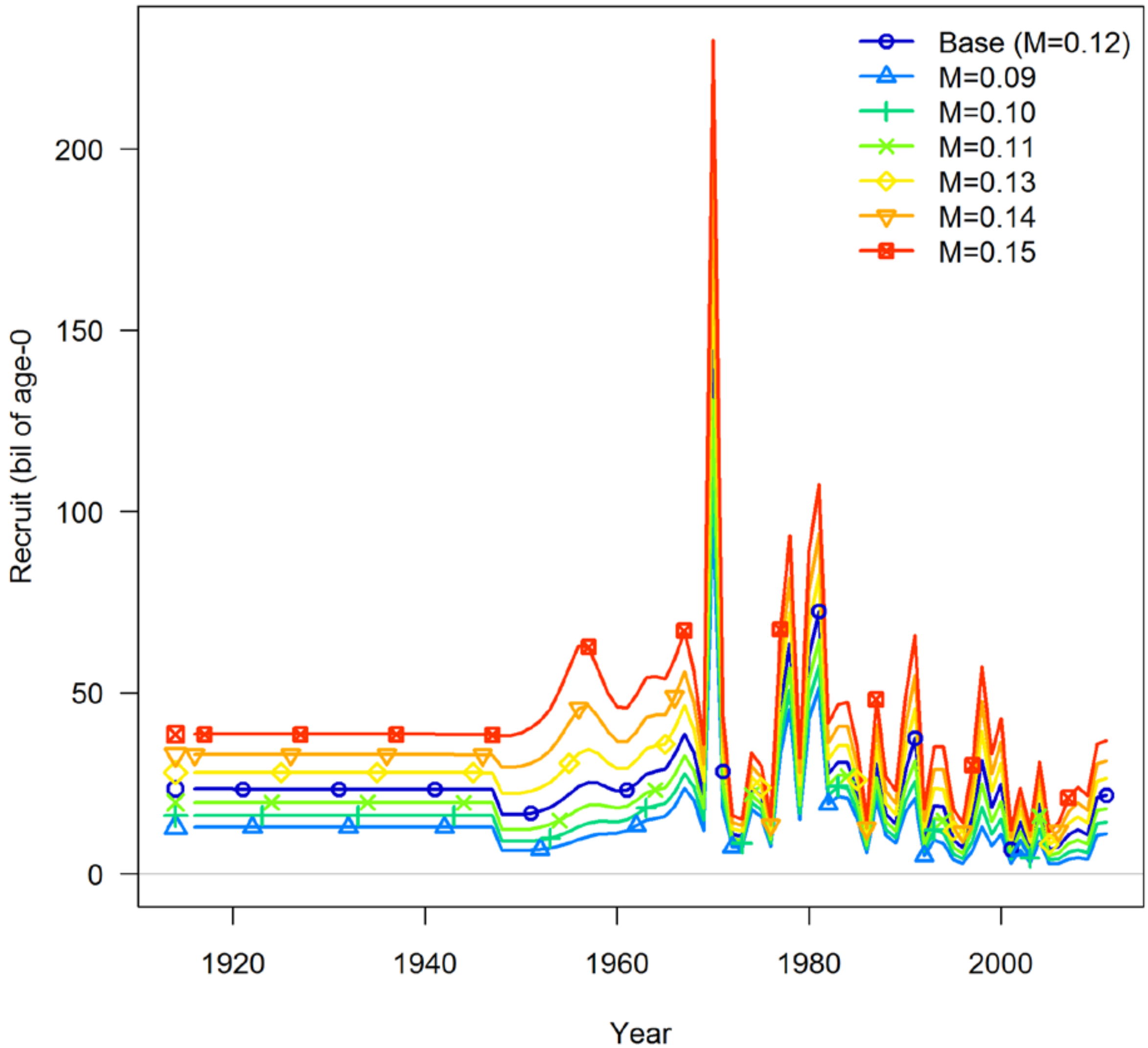


Figure 71. Comparisons of time series of recruits from the sensitivity analysis on natural mortality (*M*) with *h* fixed at the base model value (*h*=0.76). The results from the base model is also included for comparisons.

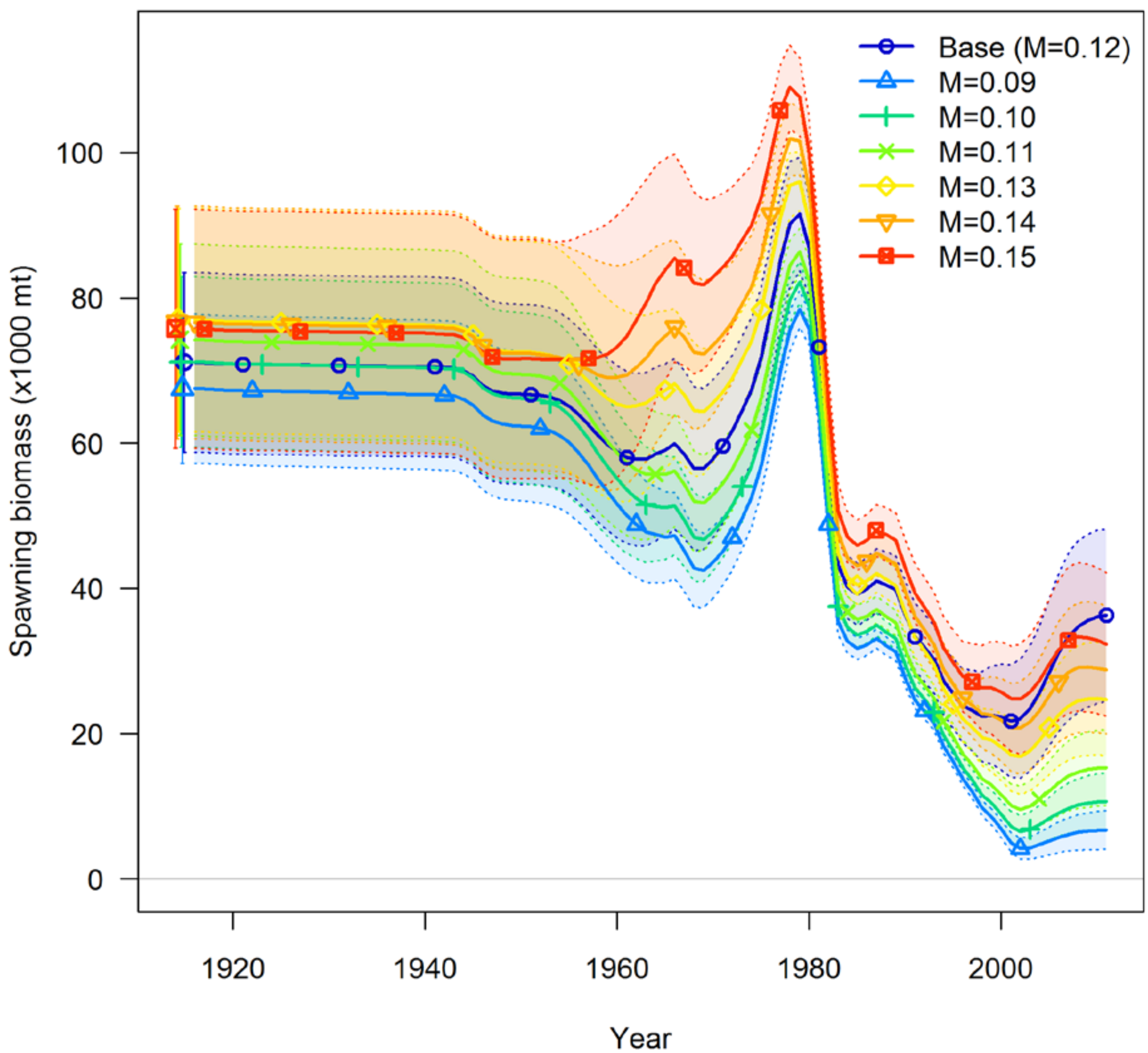


Figure 72. Comparisons of time series of spawning outputs with 95% asymptotic intervals from the sensitivity analysis on natural mortality (*M)* with *h* fixed at 0.41. The results from the base model is also included for comparisons.

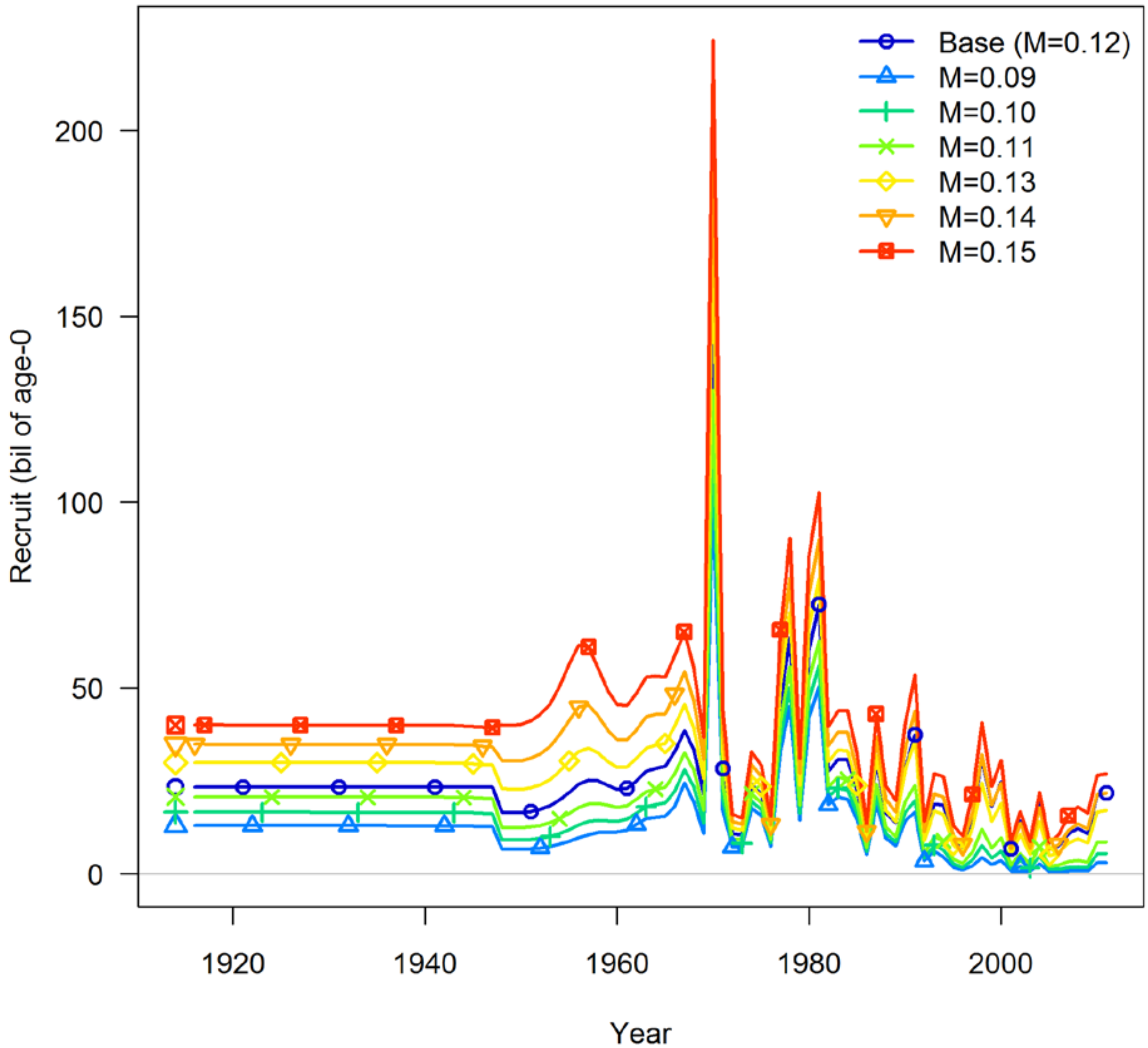


Figure 73. Comparisons of time series of recruits from the sensitivity analysis on natural mortality (*M*) with *h* fixed at 0.41. The results from the base model is also included for comparisons.

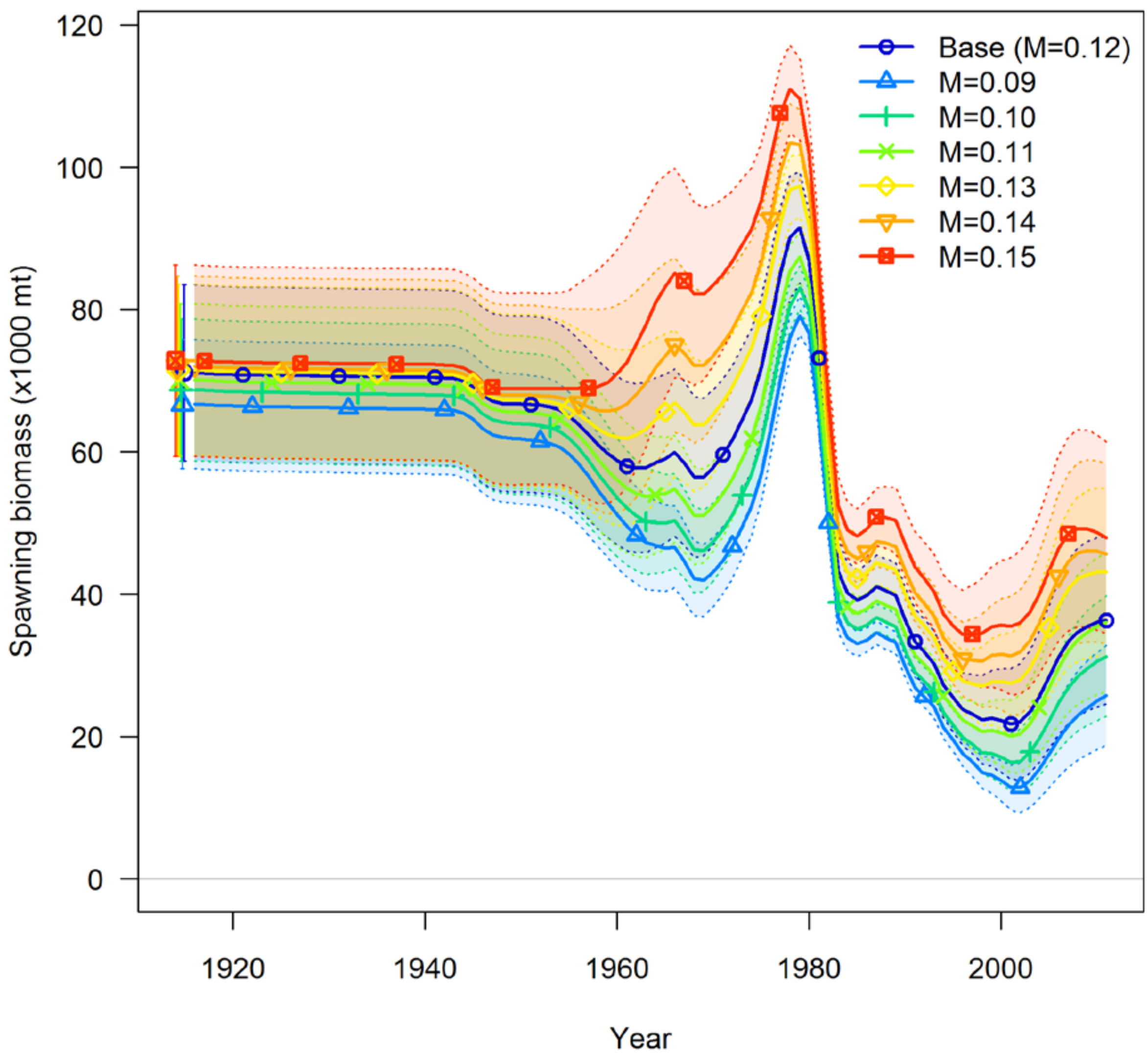


Figure 74. Comparisons of time series of spawning outputs with 95% asymptotic intervals from the sensitivity analysis on natural mortality (*M)* with *h* fixed at 0.9. The results from the base model is also included for comparisons.

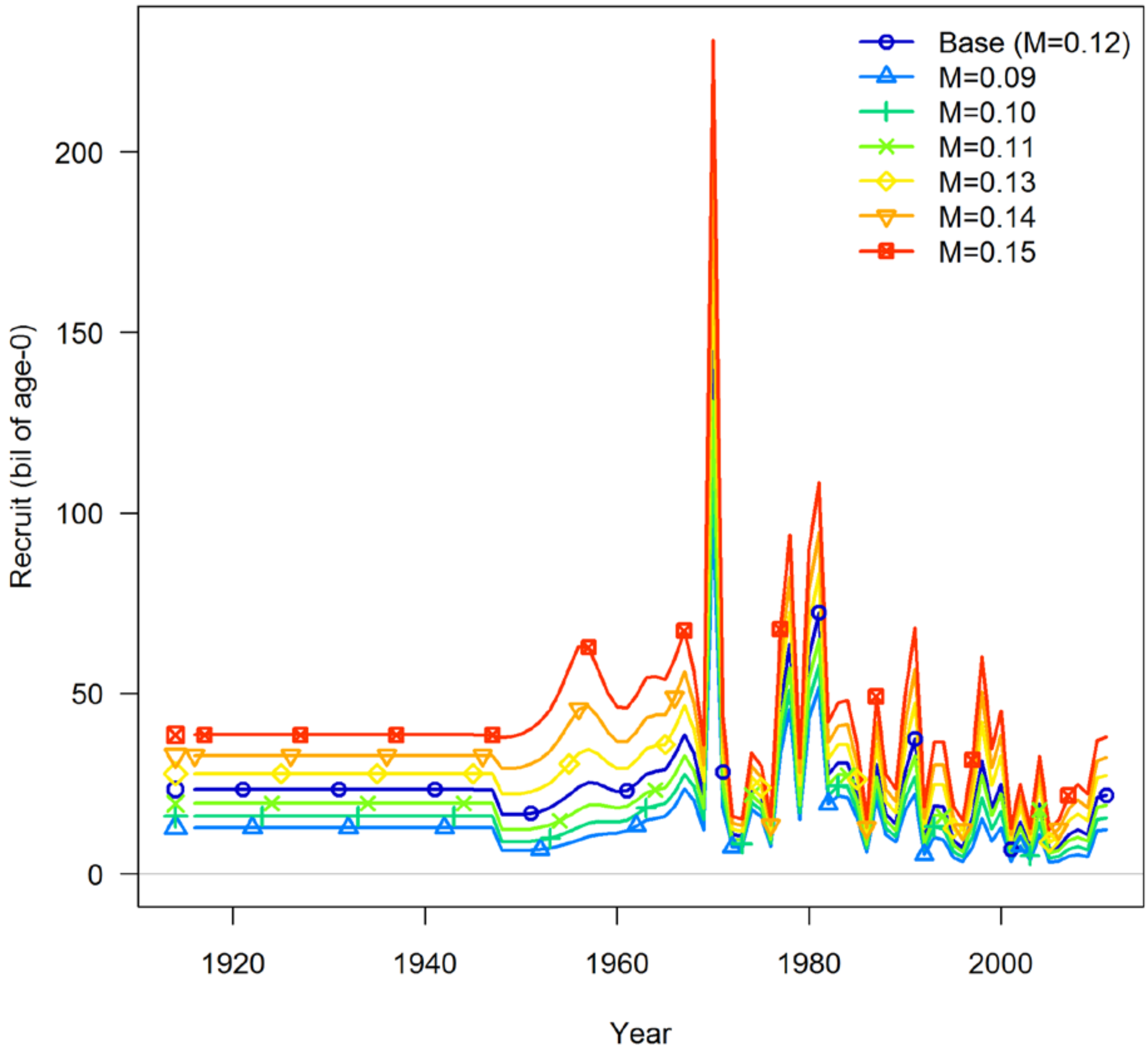


Figure 75. Comparisons of time series of recruits from the sensitivity analysis on natural mortality (*M*) with *h* fixed at 0.9. The results from the base model is also included for comparisons.

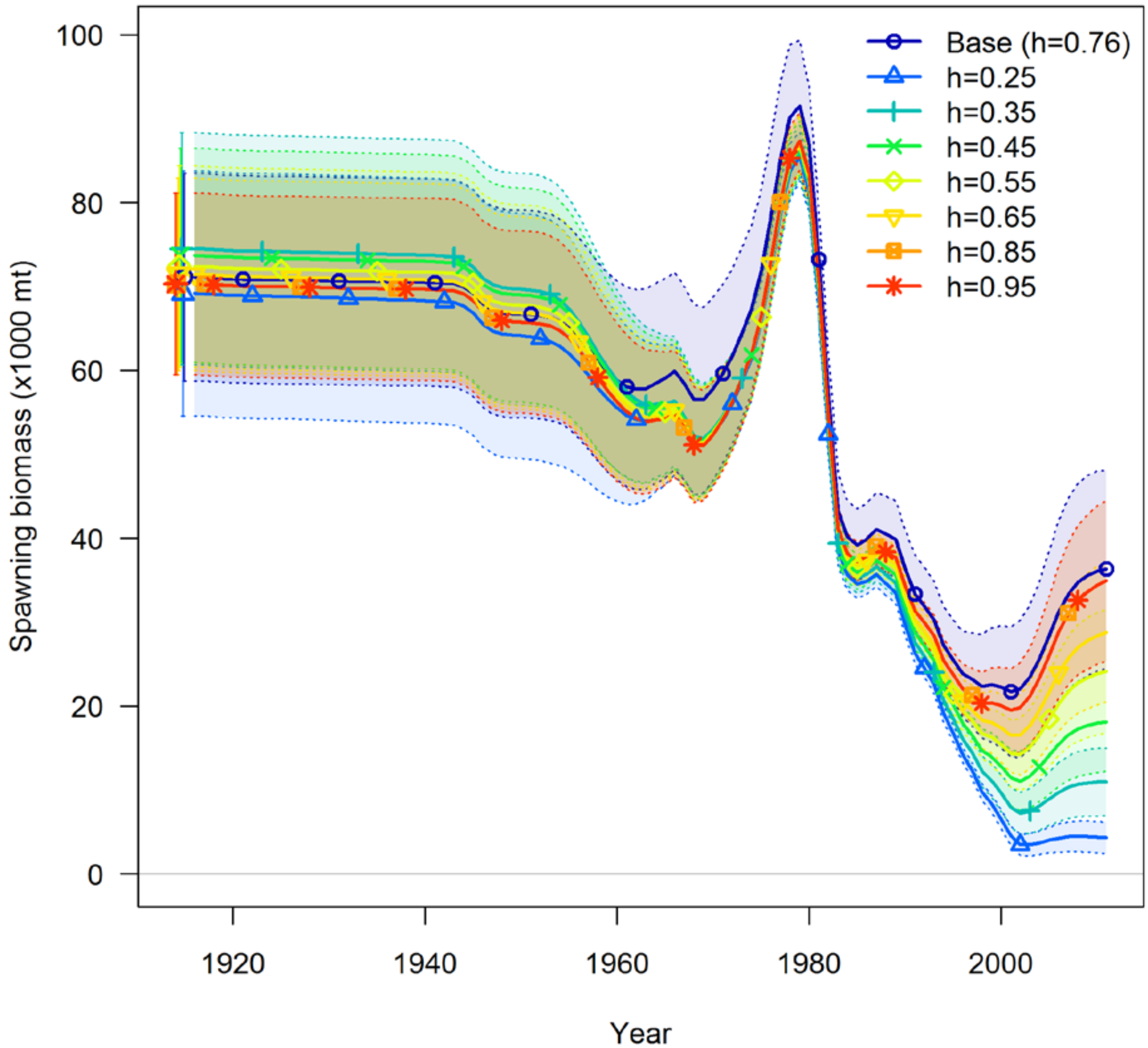


Figure 76. Comparisons of time series of spawning outputs with 95% asymptotic intervals from the sensitivity analysis on steepness (*h)* with *M* fixed at M_{female}=0.11 and M_{male}=0.12. The results from the base model is also included for comparisons.

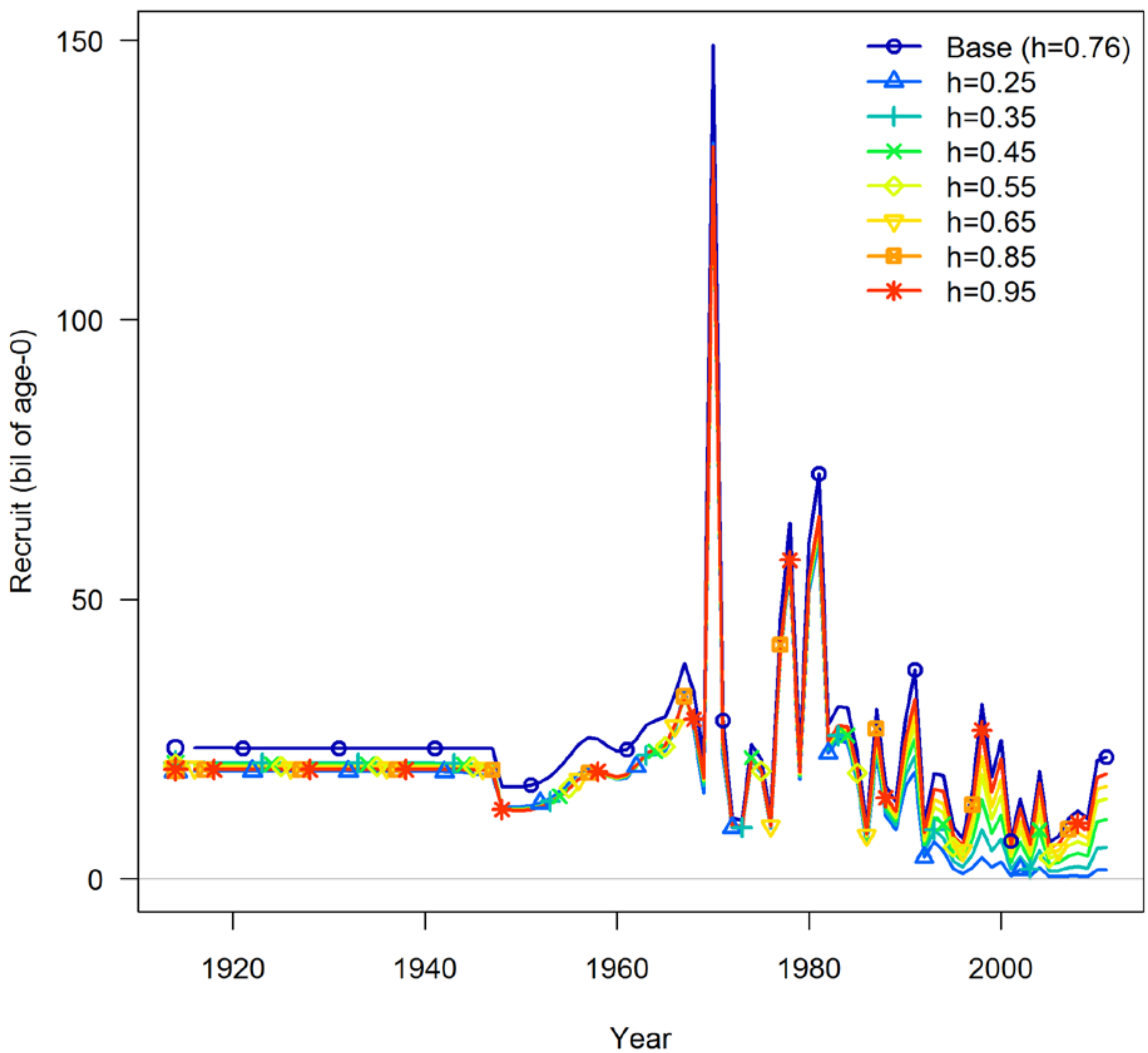


Figure 77. Comparisons of time series of recruits from the sensitivity analysis on steepness (*h)* with *M* fixed at M_{female}=0.11 and M_{male}=0.12. The results from the base model is also included for comparisons.

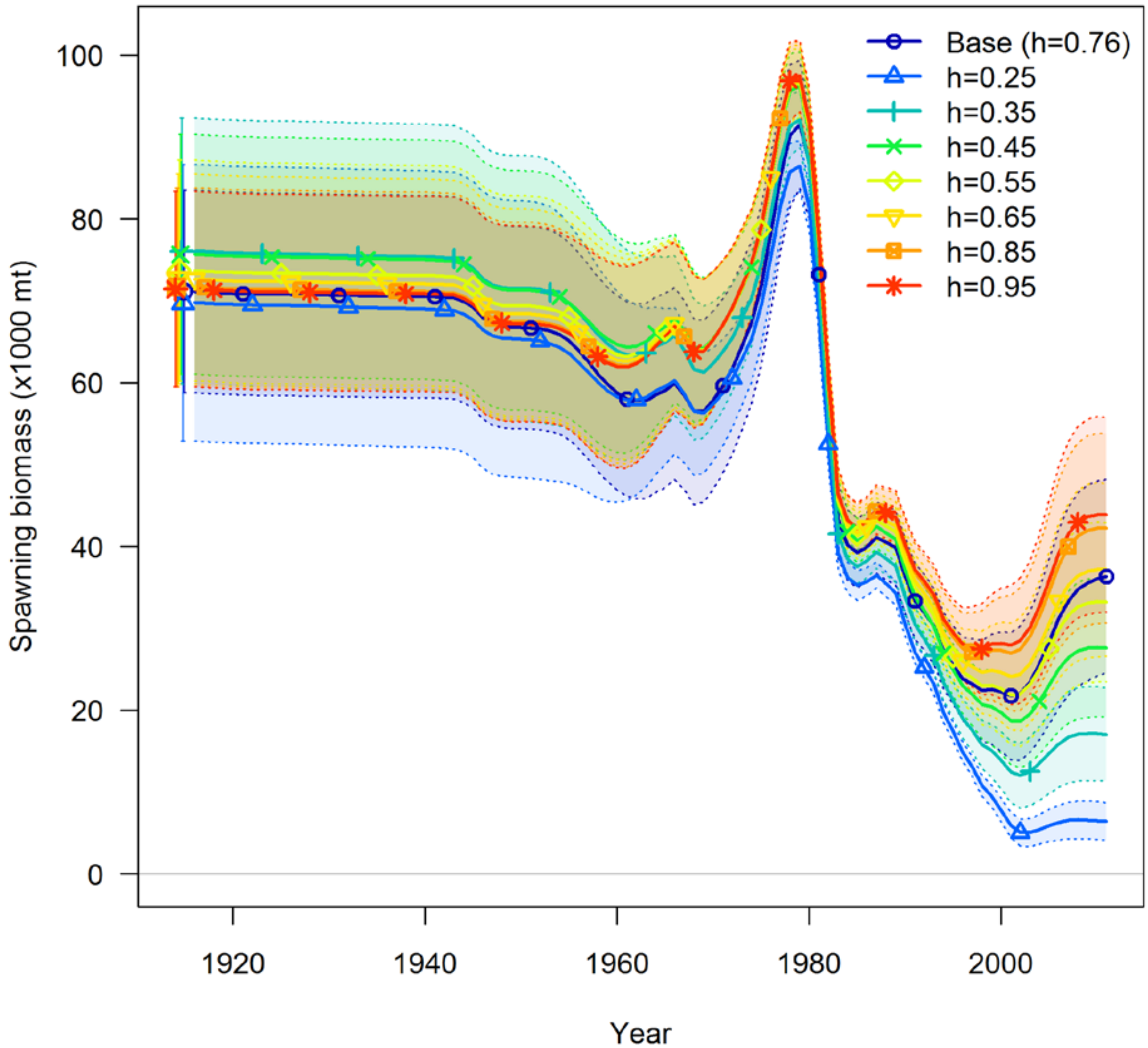


Figure 78. Comparisons of time series of spawning outputs with 95% asymptotic intervals from the sensitivity analysis on steepness (*h)* with *M* fixed at M_{female}=0.13 and M_{male}=0.14. The results from the base model is also included for comparisons.

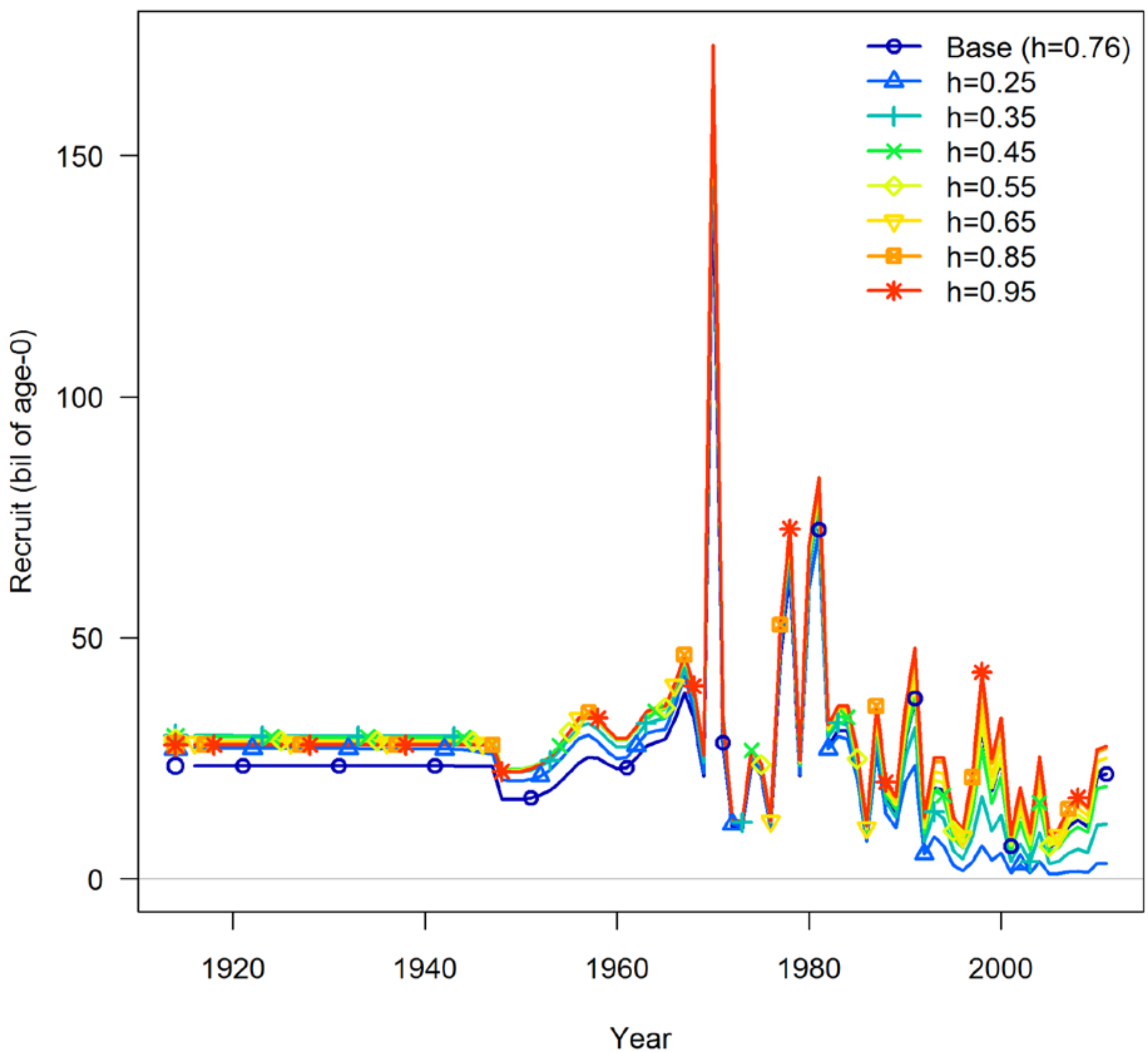


Figure 79. Comparisons of time series of recruits from the sensitivity analysis on steepness (*h*) with *M* fixed at M_{female}=0.13 and M_{male}=0.14. The results from the base model is also included for comparisons.

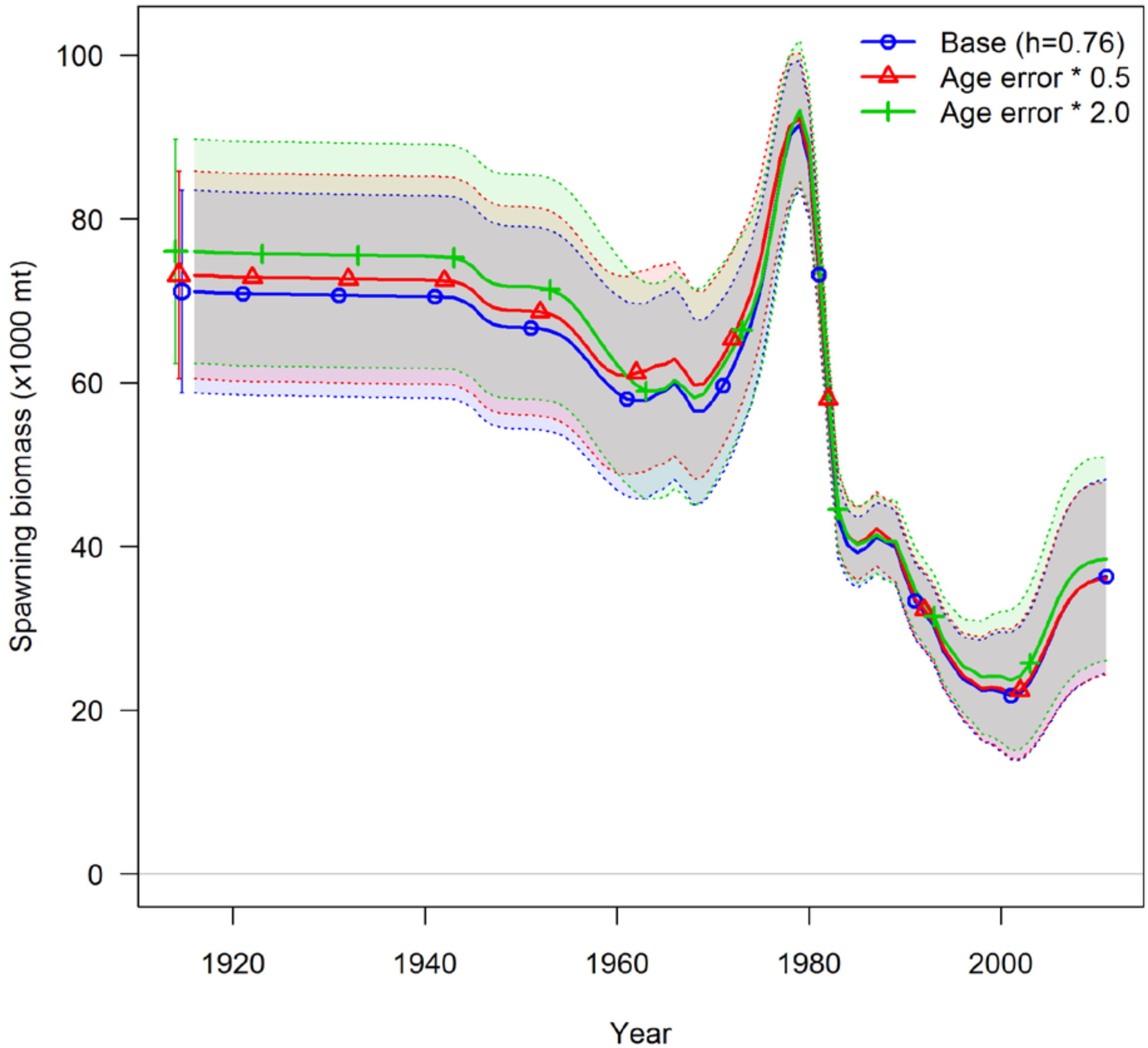


Figure 80. Comparisons of time series of spawning outputs with 95% asymptotic intervals from the sensitivity analysis on ageing error (age errors * 0.5 and 2.0, respectively). The results from the base model is also included for comparisons.

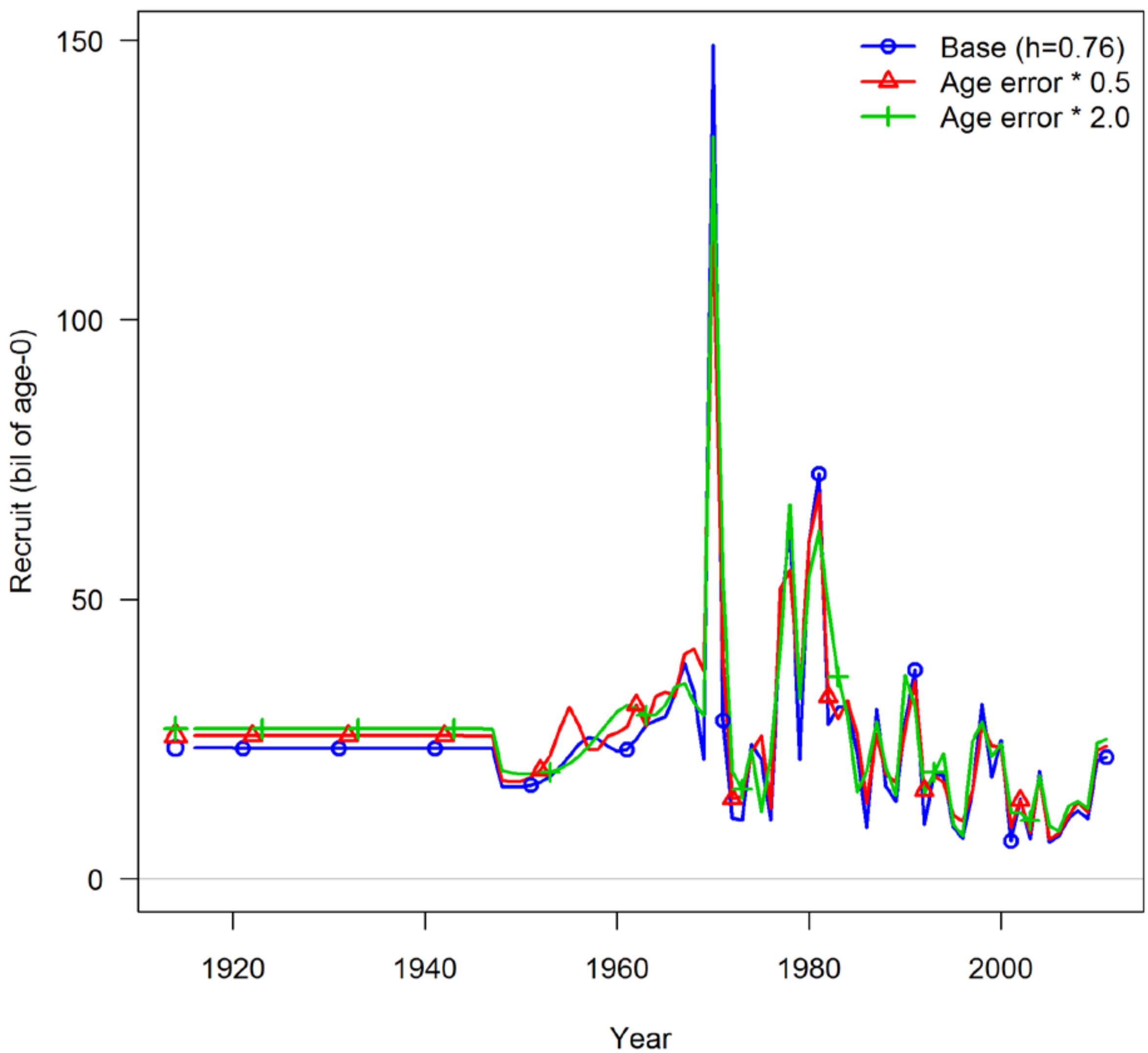


Figure 81. Comparisons of time series of recruits from the sensitivity analysis on ageing error (age erros * 0.5 and 2.0, respectively). The results from the base model is also included for comparisons.

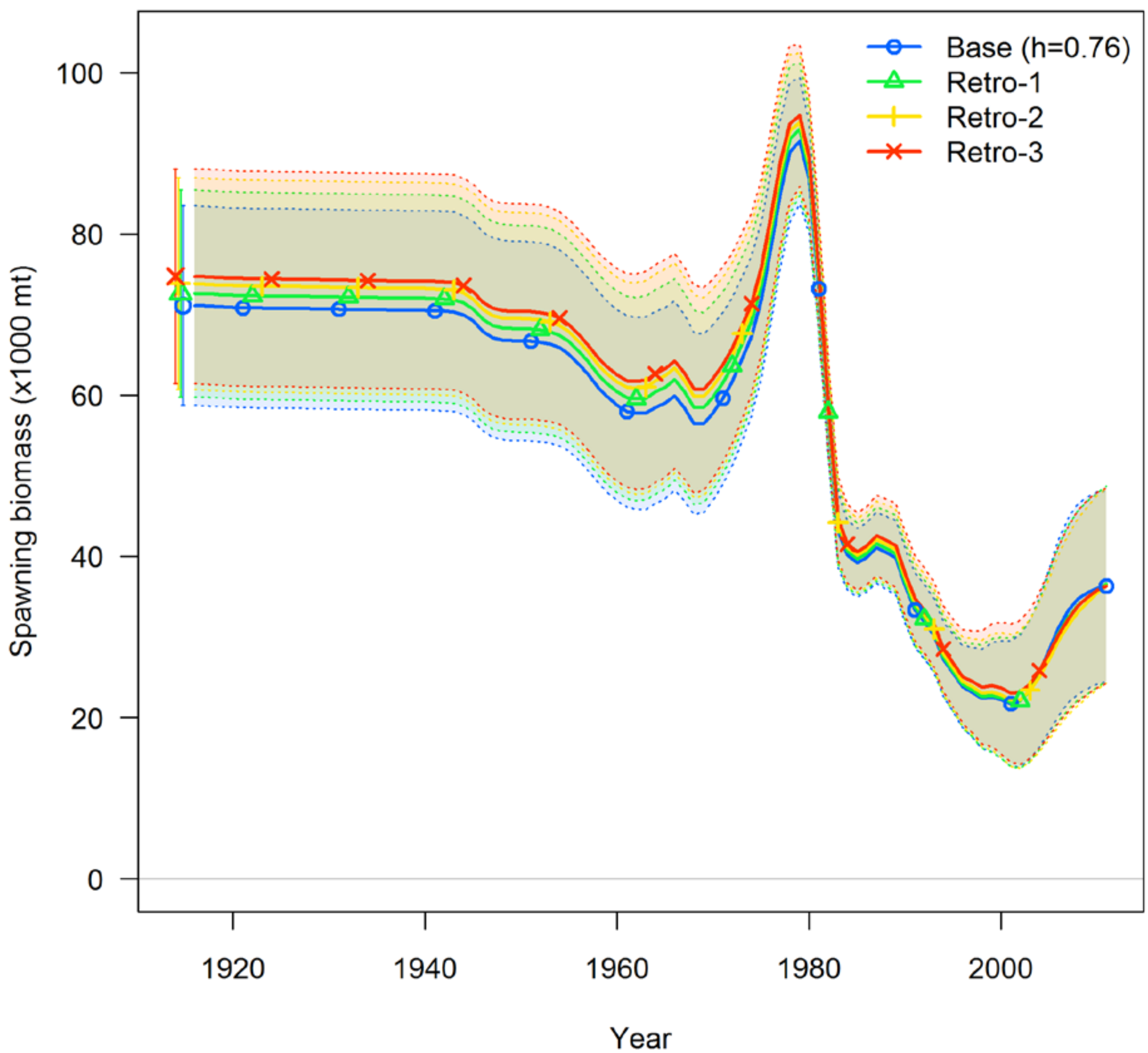


Figure 82. Comparisons of time series of spawning outputs with 95% asymptotic intervals from the retrospective analysis to previous three years. The results from the base model is also included for comparisons.

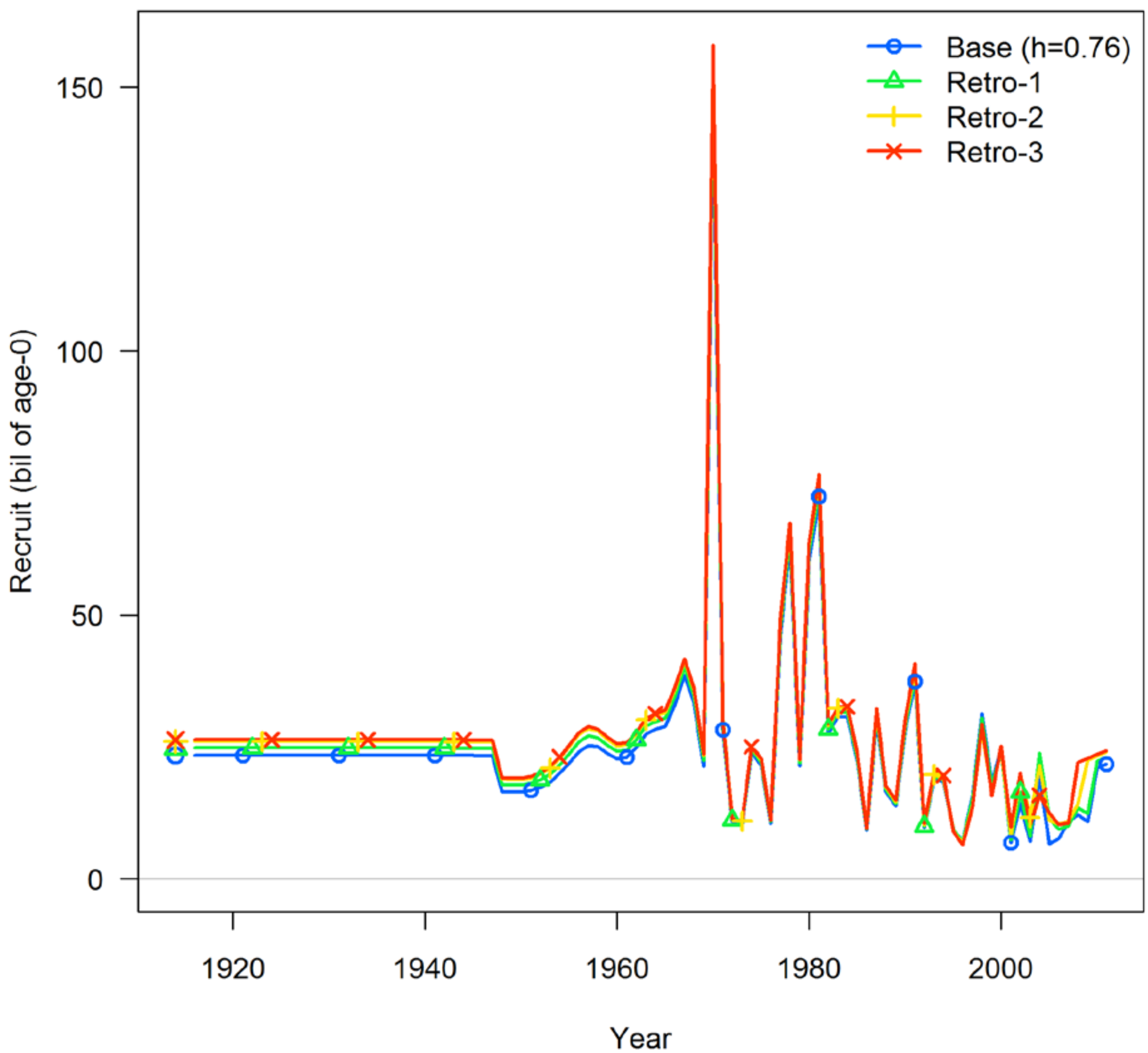


Figure 83. Comparisons of time series of recruits from the retrospective analysis to previous three years. The results from the base model is also included for comparisons.

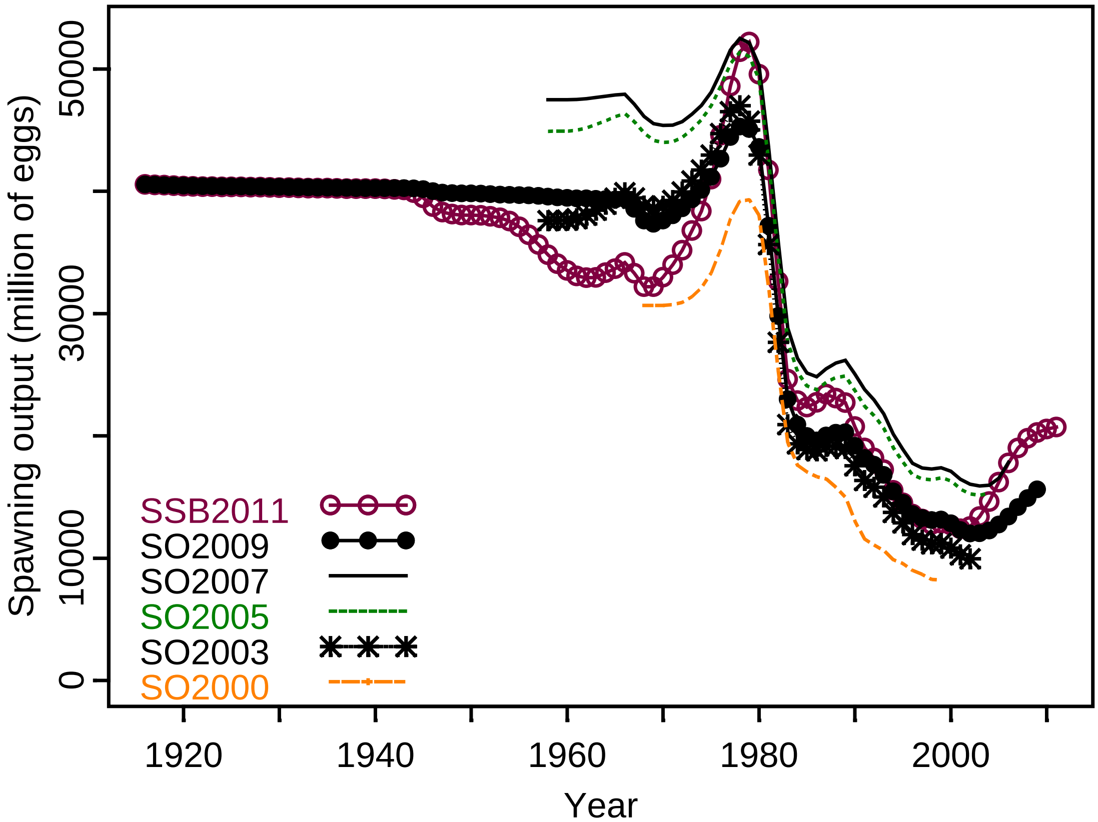


Figure 84. Comparisons of time series of spawning outputs (SO) between the 2011 base model and five previous assessments (2000, 2003, 2005, 2007, and 2009). Note that stock abundance in the 2011 assessment is expressed as spawning stock biomass (SSB) which is different from spawning outputs that were used in all previous assessment. The 2011 outputs were scaled to the 2009 outputs for purpose of comparisons only.

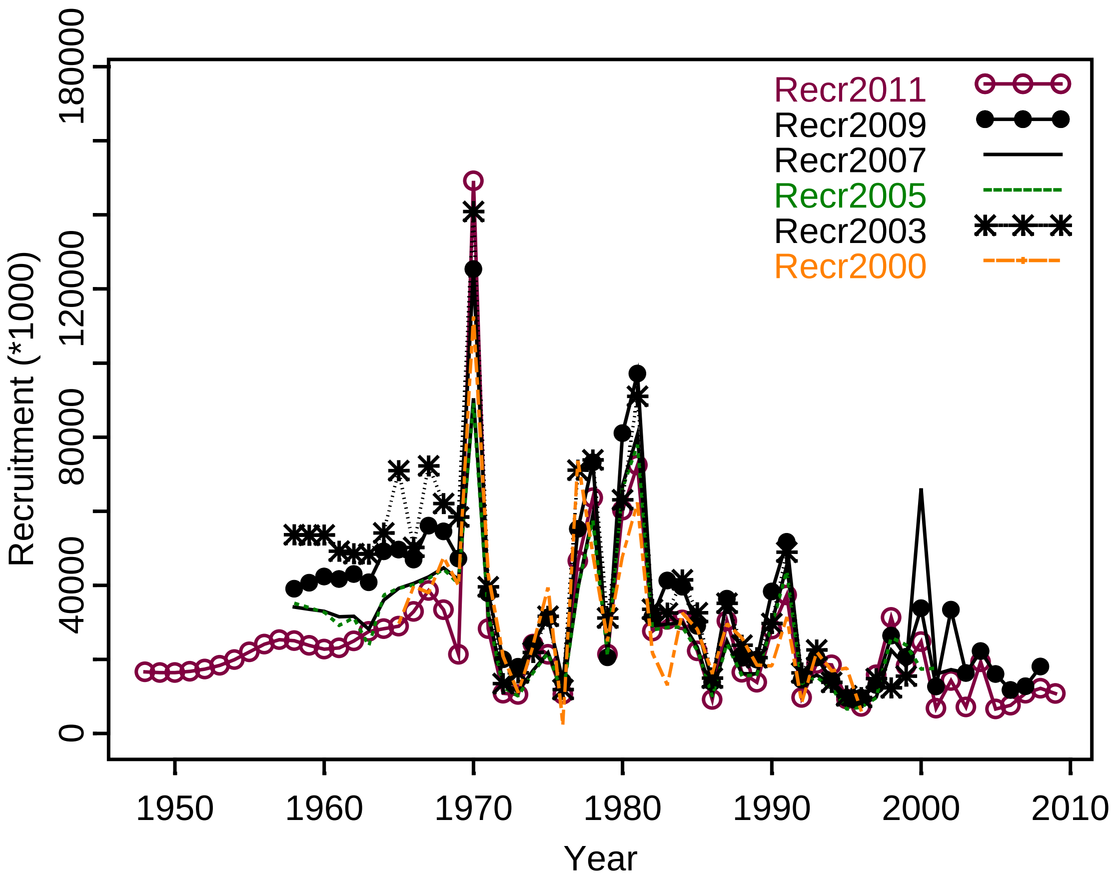


Figure 85. Comparisons of time series of recruits between the 2011 base model and five previous assessments (2000, 2003, 2005, 2007, and 2009)

10 Appendixes

10.1 Appendix A. Chronology of the regulatory history of widow rockfish by the Pacific Fishery Management Council.

Date	Regulation
10/13/82	75,000 lb trip limit.
1/30/83	30,000 lb trip limit.
9/10/83	1,000 lb trip limit.
1/1/84	50,000 lb trip limit once per week.
5/6/84	40,000 lb trip limit once per week.
8/1/84	Closed fishery with 1,000 trip limit for incidental catch.
9/9/84	Closed fishery.
1/10/85	30,000 lb trip limit once a week or 60,000 lb trip limit once per two weeks, unlimited trips of less than 3,000 lbs.
4/28/85	Dropped 60,000 lb biweekly option.
7/21/85	3,000 lb trip limit, unlimited number of trips.
1/1/86	30,000 lb trip limit, only one weekly landing greater than 3,000 lbs.
9/28/86	3,000 lb trip limit, unlimited number of trips.
1/1/87	30,000 lb trip limit, only one weekly landing greater than 3000 lbs.
11/25/87	Closed fishery.
1/1/88	30,000 lb trip limit, only one weekly landing greater than 3000 lbs, unlimited number of trips less than 3,000 lbs.
9/21/88	3,000 lb trip limit, unlimited number of trips.
1/1/89	30,000 lb trip limit, only one weekly landing greater than 3,000 lbs.
4/26/89	10,000 lb trip limit once per week.
10/11/89	3,000 lb trip limit with unlimited number of trips.
1/1/90	15,000 lb trip limit once per week or 25,000 lb trip limit once per two weeks with only one landing greater than 3,000 lbs each week.
12/12/90	Closed fishery.
1/1/91	10,000 lb trip limit per week or 20,000 lb trip limit every two weeks with only one landing greater than 3,000 lbs per week.
9/25/91	3,000 lb trip limit with unlimited number of trips.
1/1/92	30,000 lbs cumulative landings every 4 weeks
5/9/92	Change from 3" mesh to 4.5" mesh in codend for roller gear north of Point Arena.
8/12/92	3,000 lb trip limit with unlimited number of trips.
12/2/92	30,000 lb cumulative trip limit per 4 weeks.
12/1/93	3,000 lb trip limit with unlimited number of trips.
1/1/94	30,000 lb cumulative limit per calendar month.
12/1/94	3,000 lb trip limit with unlimited number of trips.
1/1/95	30,000 lb cumulative limit per calendar month.

4/14/95	45,000 lb cumulative limit per calendar month.
9/8/95	4.5" mesh applies to entire net and bottom trawl.
1/1/96	70,000 lb cumulative limit per two months.
9/1/96	50,000 lb cumulative limit per two months.
11/1/96	25,000 lb cumulative limit per two months.
1/1/97	70,000 lb cumulative limit per two months.
5/1/97	60,000 lb cumulative limit per two months.
1/1/98	Limited entry: 25,000 lb cumulative per two month period. Open access: 12,500 lb cumulative per two month period.
5/1/98	Limited entry: 30,000 lb cumulative per two month period
7/1/98	Open access: 3,000 lb cumulative per month
10/1/98	Limited entry: 19,000 lb cumulative per month
1/1/99	Limited entry: cumulative limits: phase 1 - 70,000 lbs per period, phase 2 - 16,000 lbs per period, phase 3 - 30,000 lbs per period. Open access: 2,000 lbs per month.
5/1/99	Limited entry: decrease phase 2 and phase 3 limits to 11,000 lbs.
7/2/99	Open access: 8,000 lb cumulative limit per month.
10/1/99	Limited entry: vessels in Oregon and Washington using 30,000 lb cumulative monthly limit must have midwater trawl gear aboard or a state cumulative limit will be imposed.
1/1/00	Widow rockfish classified as a shelf species for regulatory purposes. Limited entry trawl: 30,000 lbs/2 months. Limited entry fixed gear: 3,000 lbs/month. Open access: 3,000 lbs/month.
1/1/01	Limited entry trawl: 20,000 lbs/2 months for months of Jan-Apr and Sep-Oct; otherwise 10,000 lbs/2 months for midwater trawls; 1,000 lbs/months for small footrope trawls. Limited entry fixed gear: 3,000 lbs/month. Open access: north - 3,000 lbs/month; south - 3,000 lbs per month with some monthly closures in some areas.
7/1/01	Limited entry midwater trawl in the north: 1,000 lbs/month.
10/1/01	Closed fishery for all except midwater, which may land 2,000 lbs/month in north for October, then 25,000 lbs/2 months.
1/1/02	Limited entry trawl in the north: closed through November to midwater trawl except for small bycatch in whiting fishery, in November 13,000 lbs/2 month with no more than 2 trips, small footrope trawl 1000 lbs/month through September, then closed Sept-Oct, then 500 lbs/month Nov-Dec. Limited entry trawl in the south: midwater closed year round except for a small bycatch in the whiting fishery; small footrope trawl 1,000 lbs/month through July, then closed.
1/1/03	Limited entry trawl RCA in the north: 75-200 fm during Jan-Aug, 50-200 fm during Sep-Oct, and shoreline to 200 fm (petrale areas open) during Nov-Dec. Limited entry trawl RCA in the south: between 34 -□27’ N

	200 fm during Jan-Oct, and shoreline to 200 fm (petrale areas open) during Nov-Dec; south of 34□27' N. lat. - 100-200 fm during Jan-Oct, and shoreline to 200 fm (petrale areas open) during Nov-Dec.
	Limited entry and open access fixed gear RCA established as follows (seaward boundaries held static until Jan 2009; shoreward boundaries south of the OR-WA border vary): shoreline to 100 fm north of the OR-WA border (46 -□16' N. Canada border; seaward boundary of 100 fm north of 40 □ of 150 fm south of 40 □10' N. lat.
	Limited entry trawl in the north: midwater trawl closed through November except for small amount of bycatch in whiting fishery, 12,000 lbs/2 months for Nov-Dec; small footrope trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1000 lbs/month May-Oct.
	Limited entry fixed gear in the north: 200 lbs/month.
	Open access in the north: 200 lbs/month.
	Limited entry trawl in the south: same as north for midwater and small footrope trawl.
	Limited entry fixed gear in the south: closed Mar-Apr, then variable 100 lbs/2 months to 250 lbs/2 months.
	Open access in the south: same as limited entry fixed gear.
1/1/04	Limited entry trawl RCA in the north: 75-200 fm during Jan-Feb (petrale areas open), 60-200 fm during Mar-Apr, 60-150 fm during May-Jun, 75-150 fm during Jul-Sep, and shoreline to 250 fm during Oct-Dec.
	Limited entry trawl RCA in the south: 75-150 fm during Jan-Apr and Sep, and 100-150 fm May-Aug; between 38□ N. lat. and 40□10' N. lat. - shoreline to 250 fm during Oct-Dec; between 36□ N. lat. and 38□ N. lat. - shoreline to 200 fm during Oct-Dec; south of 36□ N. lat. - shoreline to 150 fm during Oct-Dec.
	Limited entry trawl in the north: midwater trawl closed through November except for small amount of bycatch in whiting fishery (500 lbs/month during primary whiting season; combined widow and yellowtail trip limit of 500 lbs/trip with trips of at least 10,000 lbs of whiting), 12,000 lbs/2 months for Nov-Dec; small footrope trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1000 lbs/month May-Oct.
	Limited entry fixed gear in the north: 200 lbs/month.
	Open access in the north: 200 lbs/month.
	Limited entry trawl in the south: closed.
	Limited entry fixed gear in the south: between 40°10’ and 34°27’ N lat. - 300 lbs/2 months Jan-Feb and Sep-Dec, closed Mar-Apr, 200 lbs/2 months May-Aug; south of 34°27’ N lat.: closed Jan-Feb, 2,000 lbs/2 months Mar-Dec.
	Open access in the south: between 40°10’ and 34°27’ N lat. - same as limited entry fixed gear; south of 34°27’ N lat. - closed Jan-Feb, 500 lbs/2 months Mar-Dec.
1/1/05 (regs. for 2005 and 2006)	Limited entry trawl RCA in the north: 75-200 fm during Jan-Feb and Nov-Dec (petrale areas open), and 100-200 fm during Mar-Oct.
	Selective flatfish trawls required shoreward of the RCA in the north (new permanent reg. implemented from 2005 to present).
	Limited entry trawl in the north: large and small footrope trawl- 300 lbs/2 months; midwater trawl- closed except for small amount of bycatch in whiting fishery (500

	lbs/month during primary whiting season; combined widow and yellowtail trip limit of 500 lbs/trip with trips of at least 10,000 lbs of whiting); selective flatfish trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1,000 lbs/month May-Oct.
	Limited entry fixed gear in the north: 200 lbs/month.
	Open access in the north: 200 lbs/month.
	Limited entry trawl in the south: large footrope and midwater trawl- closed; small footrope trawl- 300 lbs/month.
	Limited entry fixed gear in the south: between 40°10' and 34°27' N lat. - 300 lbs/2 months Jan-Feb and Sep-Dec, closed Mar-Apr, 200 lbs/2 months May-Aug; south of 34°27' N lat.: 2,000 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr.
	Open access in the south: between 40°10' and 34°27' N lat. - same as limited entry fixed gear; south of 34°27' N lat. - 500 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr.
7/1/05	Limited entry fixed gear south of 34°27' N lat.: 3,000 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish/2 months Jul-Dec.
	Open access south of 34°27' N lat.: 750 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Jul-Dec.
10/1/05	Limited entry trawl RCA north of 38° N lat. extended from shoreline to 250 fm; 36° N lat. to 38° N lat.: limited entry trawl RCA extended from shoreline to 200 fm; south of 36° N lat.: limited entry trawl RCA extended from 50 fm to 200 fm.
1/1/06	Limited entry fixed gear south of 34°27' N lat.: 3,000 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Jan-Feb.
	Open access south of 34°27' N lat.: 750 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Jan-Feb.
3/1/06	Limited entry fixed gear south of 34°27' N lat.: 3,000 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Mar.-Dec.
	Open access south of 34°27' N lat.: 750 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Mar.-Dec.
10/1/06	Widow bycatch cap in the non-tribal limited entry whiting trawl fishery increased from 200 mt to 220 mt.
1/1/07 (regs. for 2007 and 2008)	Widow bycatch cap of 200 mt adopted for the limited entry whiting trawl fishery.
	Limited entry trawl RCA: 75-250 fm in Jan-Apr and Nov-Dec; 75-200 fm in May-Jun and Sep-Oct; 100-200 fm in Jul-Aug.
	Limited entry trawl in the north: large and small footrope trawl- 300 lbs/2 months; midwater trawl- closed except for small amount of bycatch in whiting fishery (500 lbs/month during primary whiting season; combined widow and yellowtail trip limit of 500 lbs/trip with trips of at least 10,000 lbs of whiting; cumulative widow limit of 1,500 lbs/month); selective flatfish trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1,000 lbs/month May-Oct.
	Limited entry fixed gear in the north: 200 lbs/month.
	Open access in the north: 200 lbs/month.
	Limited entry trawl in the south: large footrope and midwater trawl- closed; small footrope trawl- 300 lbs/month.
	Limited entry fixed gear in the south: between 40°10' and 34°27' N lat. - 300 lbs/2

	months Jan-Feb and Sep-Dec, closed Mar-Apr, 200 lbs/2 months May-Aug; south of 34°27’ N lat.: 3,000 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr.
	Open access in the south: between 40°10’ and 34°27’ N lat. - same as limited entry fixed gear; south of 34°27’ N lat. - 750 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr.
5/1/07	Widow bycatch cap in the limited entry whiting trawl fishery increased from 200 mt to 220 mt.
	Limited entry trawl in the north: RCA extended to the shore from Cape Alava (48°10’ N lat.) to U.S.-Canada border and from Cape Arago (43°20.83' N. lat.) to Humbug Mountain (42°40.50' N. lat.); the shoreward boundary of the trawl RCA is shifted shoreward to 60 fm from April 17 through October 31, 2007 between Leadbetter Point (46°38.17' N. lat.) and the Oregon/Washington border (46°16’ N. lat.); shoreward boundary of the trawl RCA shifted shoreward to 75 fm in all other areas through Dec.; the seaward boundary of the trawl RCA is shifted shoreward to 150 fm from the U.S.-Canada Border to Cascade Head (45°03.83’ N. lat.) from April 17 through August 31, 2007; the seaward boundary of the trawl RCA is shifted shoreward to 200 fm between Cascade Head (45°03.83’ N. lat.) and 40°10 N. lat. from April 17 through April 30, 2007.
7/26/07	Limited entry whiting trawl fishery closed due to attainment of 220 mt widow bycatch cap.
9/1/07	Limited entry fixed gear in the south between 40°10' N. lat. and 34°27' N. lat.: combined the trip limit for bocaccio and the trip limit for minor shelf rockfish, shortbelly rockfish, and widow rockfish into a single cumulative trip limit of 500 lb/2 months from Sep-Dec.
10/1/07	Limited entry trawl RCA north of Cape Alava (48°10’ N lat.) to U.S.-Canada border and from Cape Arago (43°20.83' N. lat.) to Humbug Mountain (42°40.50' N. lat.): shoreward boundary moved to the 75 fm line.
10/7/07	Limited entry whiting trawl fishery re-opened after widow bycatch cap is increased to 275 mt; shoreside whiting sector required to fish seaward of the 150 fm line; at-sea sectors voluntarily fish seaward of the 150 fm line.
1/1/08	Limited entry trawl RCA in the north: the seaward boundary north of 40 □1 the U.S.-Canada border is shifted to the modified petrale 200 fm line in Jan-Feb and Nov-Dec; the seaward boundary from the OR-WA border (46 □16 Canada border is shifted to 150 fm from May-Oct; all other areas and times will have a seaward boundary of 200 fm; the shoreward boundary is shifted to the shoreline from north of Cape Alava (48°10’ N lat.) to the U.S.-Canada border and from Cape Arago (43°20.83' N. lat.) to Humbug Mountain (42°40.50' N. lat.) for the entire year; the shoreward boundary from the OR-WA border (46 □ 60 fm in Mar-Oct; all other times and areas will have a shoreward boundary of 75 fm for the year.
	Limited entry trawl RCA in the south: 100-150 fm for the year.
	Limited entry fixed gear in the south between 40°10' N. lat. and 34°27' N. lat.: modify the chilipepper rockfish limit of 2,000 lb/2 months by recombining it into a single combined cumulative limit with minor shelf rockfish, shortbelly, widow rockfish and bocaccio, and increase the trip limit from 500 lb/2 months to 2,500 lb/2 months of which no more than 500 lb/2 months may be any species other than chilipepper rockfish.
3/08	Widow bycatch cap of 275 mt adopted for the limited entry whiting trawl fishery.

5/1/08	Limited entry trawl RCA in the north: the seaward boundary is shifted to the 200 fm line from the OR-WA border (46 [illegible] N. lat.) from May-Jun; the seaward boundary is shifted to the 150 fm line from Cape Falcon (45°46’ N. lat.) to the OR-WA border from May-Aug; the shoreward boundary is shifted to the 60 fm line from north of Cape Alava (48°10’ N lat.) to the U.S.-Canada border and from Cape Arago (43°20.83' N. lat.) to Humbug Mountain (42°40.50' N. lat.) from May-Oct; no other changes to the trawl RCA for all other times and areas.
	Darkblotched rockfish bycatch cap in the limited entry whiting trawl fishery increased to 40 mt to decrease impacts on widow rockfish.
8/19/08	Limited entry whiting trawl fishery closed due to attainment of 4.7 mt canary bycatch cap.
10/10/08	Limited entry trawl RCA in the north: the shoreward boundary of the is shifted from 60 fm to 75 fm, with the exception of the areas north of Cape Alava (48°10’N. lat.) and between Cape Arago (43°20.83’ N. lat.) and Humbug Mountain (42°40.50’N. lat.).
10/12/08	Limited entry whiting trawl fishery reopened after the canary bycatch cap is increased from 4.7 mt to 6.4 mt and the widow bycatch cap is increased from 275 mt to 284 mt.
10/26/08	Canary bycatch cap in the limited entry whiting trawl fishery is increased from 6.4 mt to 6.7 mt.
11/1/08	Open access south of 34 27’N. lat. shelf rockfish trip limit increased from 750 lb/2 months to 1,000 lb/2 months in period 6 (Nov-Dec).
1/1/09 (regs. for 2009 and 2010)	Sector-specific bycatch caps adopted for the limited entry whiting trawl fishery for canary, darkblotched, and widow rockfish distributed on a pro rata basis in relation to the sectors' whiting allocation. Additionally, NMFS has the authority to restrict fishing depths by sector of the limited entry whiting trawl fishery if a bycatch cap is attained inseason.
	Limited entry trawl RCA: north of Cape Alava (48°10’N. lat.) - shoreline to 200 fm during Jan-Mar (petrale areas open) and Sep-Dec (petrale areas open Nov-Dec), and shoreline to 150 fm during Apr-Aug; north of Cape Falcon (45 46’ Alava - 75-200 fm during Jan-Apr (petrale areas open Jan-Mar) and Sep-Dec (petrale areas open Nov-Dec), and 75-150 fm during May-Aug; north of 40 Falcon - 75-200 fm year-round (petrale areas open during Jan-Mar and Nov-Dec); south of 40 10'N. lat. - 100-150 fm year-round.
	Limited entry and open access fixed gear RCA: seaward boundary shifted from 100 fm to 125 fm between Cascade Head (45°03.83’ N. lat.) and Cape Blanco (43 on days when the directed fishery for Pacific halibut is open; otherwise, seaward boundary of 100 fm north of 40 10’ N. la
	Limited entry trawl in the north (combined limits of widow, yelloweye, shortbelly, and minor shelf rockfish): large and small footrope trawl- 300 lbs/2 months; midwater trawl- closed except for small amount of bycatch in whiting fishery (500 lbs/month during primary whiting season; combined widow and yellowtail trip limit of 500 lbs/trip with trips of at least 10,000 lbs of whiting; cumulative widow limit of 1,500 lbs/month); selective flatfish trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1,000 lbs/month of which no more than 200 lbs/month can be yelloweye during May-Oct.; multiple bottom trawl gear - 300 lbs/ month Jan-Apr and Nov-Dec, 300 lbs/2 months of which no more than

	200/lbs/month can be yelloweye during May-Oct.
	Limited entry trawl in the south: large footrope and midwater trawl - closed; small footrope trawl for minor shelf rockfish, shortbelly, widow, and yelloweye - 300 lbs/ month year-round.
	Limited entry and open access fixed gear in the north: 200 lbs/ month (combined limit for minor shelf rockfish, shortbelly, widow, and yellowtail) year-round.
	Limited entry fixed gear in the south: between 34°27' N. - 2,500 lbs/2 months (combined limit for minor shelf rockfish, shortbelly, widow, bocaccio, and chilipepper) of which no more than 500 lb/2 months may be any species but chilipepper; south of 34°27' N. lat. (combined limit for minor shelf rockfish, shortbelly, widow, and bocaccio) - 3,000 lbs/2 months during Jan-Feb and May-Dec, and closed during Mar-Apr.
	Open access in the south (combined limit for minor shelf rockfish, shortbelly, widow, and chilipepper):: between 34°27' N. lat. and 40°10' N. lat. - 300 lbs/2 months during Jan-Feb and Sep-Dec, closed during Mar-Apr, and 200 lbs/2 months during May-Aug; south of 34°27' N. lat. - 250 lbs/2 months during Jan-Feb and May-Dec, and closed during Mar-Apr.
3/09	Widow bycatch caps for sectors of the limited entry whiting trawl fishery are adopted as follows: 105 mt to shoreside whiting, 85 mt to catcher-processors, and 60 mt to motherships.

10.2 Appendix B: Comparisons of surface and break-and-burn ageing methods for widow rockfish

Donald E. Pearson
Fisheries Ecology Division
Southwest Fisheries Science Center
Santa Cruz, California 95060

August 2010

In response to a request from the previous STAR panel, we compared ages derived from surface ages versus break and burn for smaller (and presumably younger fish). When the primary ager was trained in widow rockfish aging (1986), it was known from previous studies that surface ages agreed well with break-and-burn ages for smaller and younger fish. The primary question has been at what size to make the cutoff between surface and break-and-burning methods. Typically that has been at about 40 cm (fork length) based on previous examinations. It was always understood that if the ager was not comfortable with the age from a surface read, that the otolith would be broken and burned.

We selected 100 otoliths from fish between 30 and 40 cm and read them twice, first using surface aging and then using the break-and-burn method. The break-and-burn ages were obtained without reference to the surface ages. Table C1 shows the results of this comparison. The results showed very comparable ages between two methods, with 88% of fish aged having the same ages.

Table B1. Summary of differences between surface and break-and-burn ageing methods for widow rockfish for 100 otoliths.

	(Surface age) – (break-n-burn age)			
Surface age	-1	0	1	Total
4		5		5
5		5		5
6	3	14		17
7	3	12		15
8	1	41	4	46
9		9	1	10
10		2		2
Total	***7***	***88***	***5***	***100***

10.3 Appendix C. Model fits to age and length composition data.

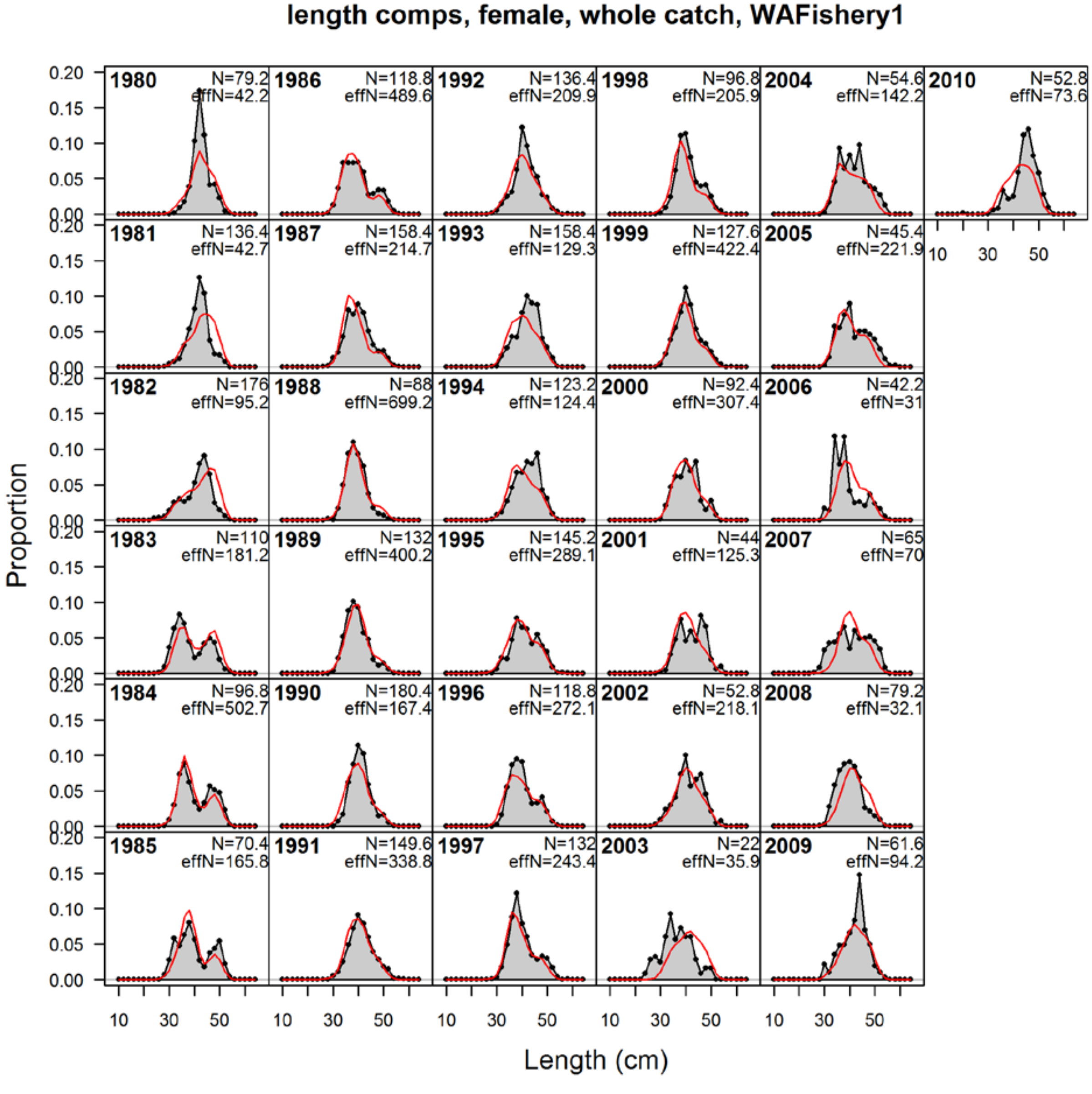


Figure C1. Model fits to the Washington fishery female length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

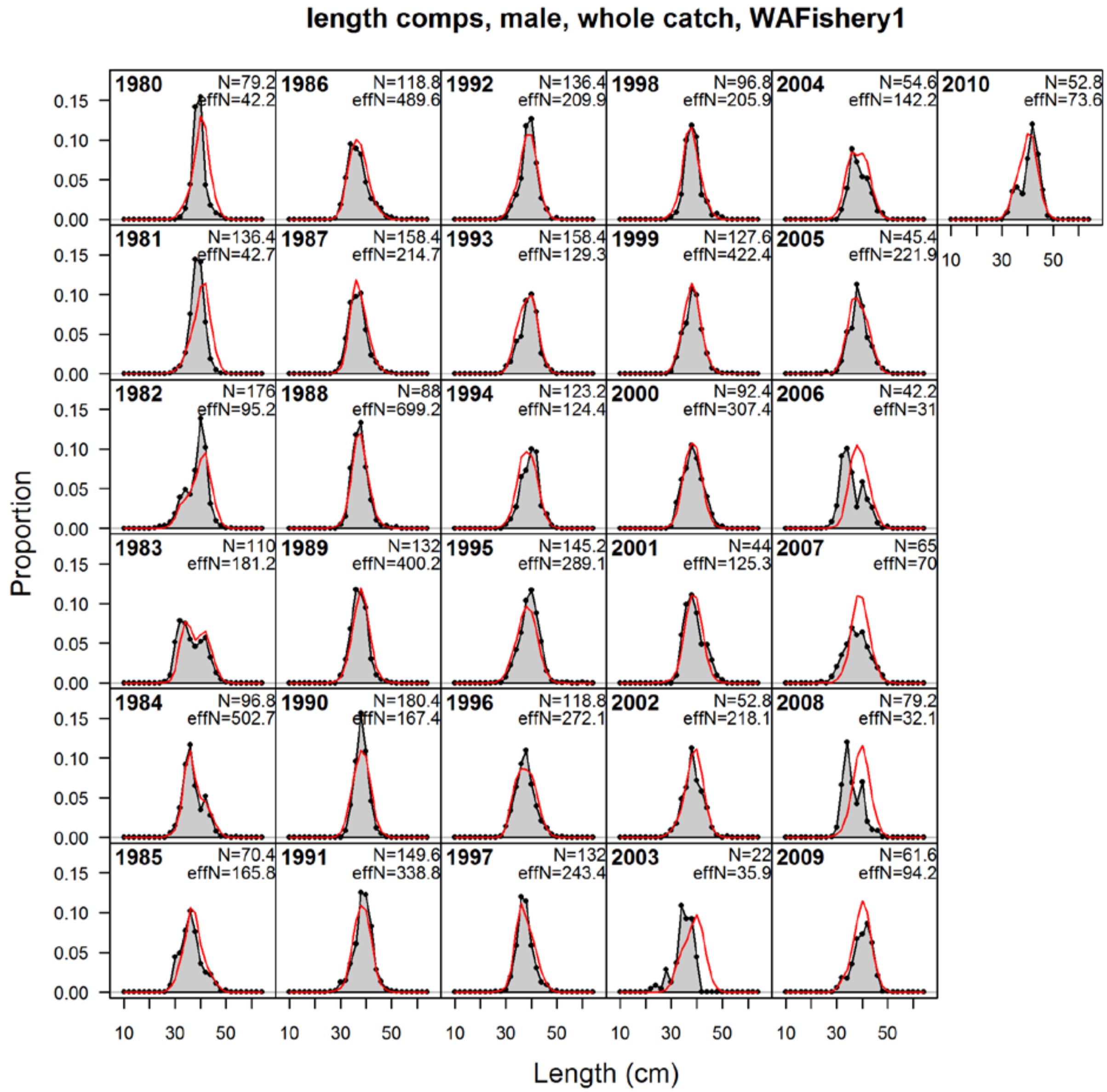


Figure C2. Model fits to the Washington fishery male length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

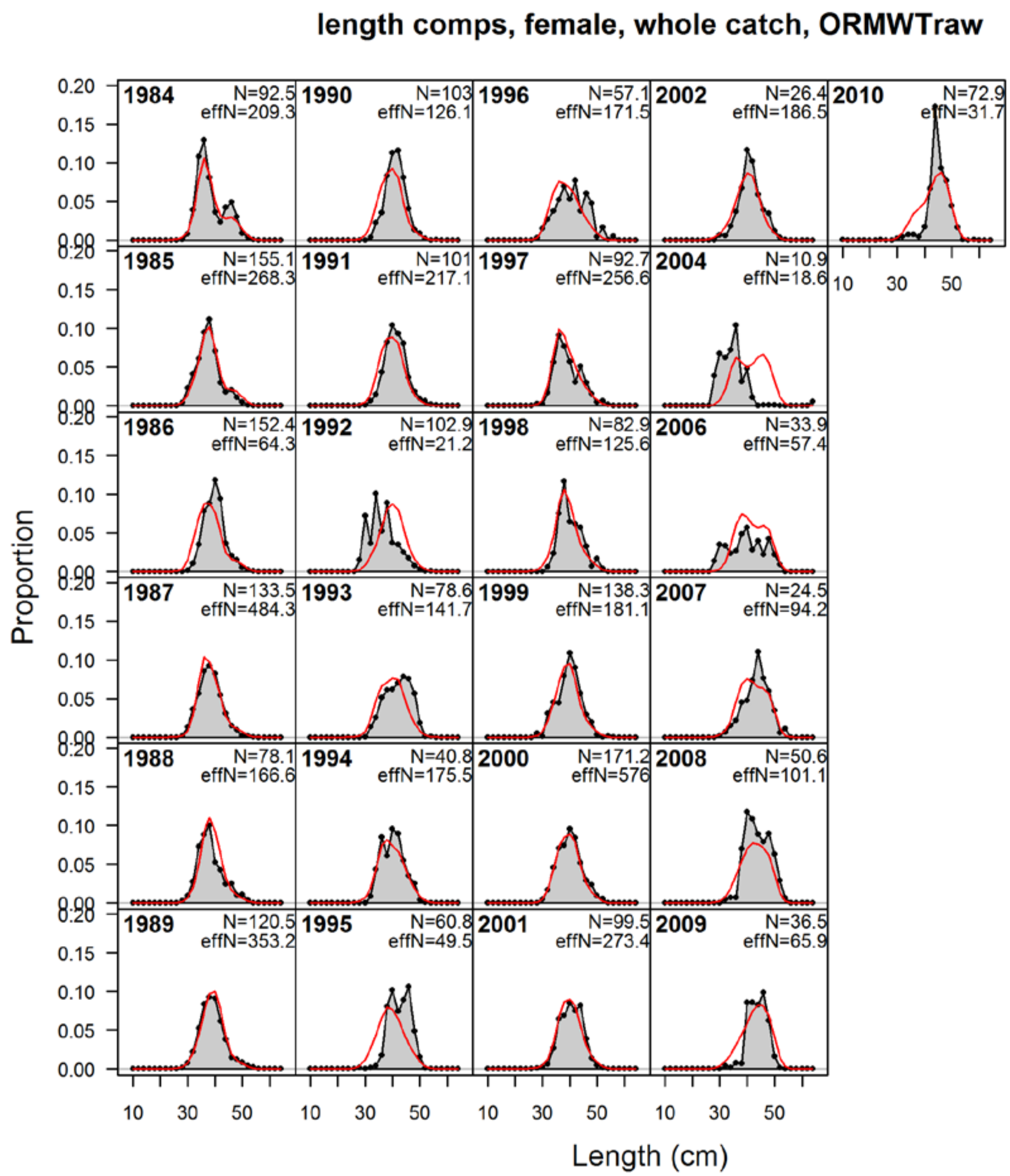


Figure C3. Model fits to the Oregon mid-water trawl fishery female length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

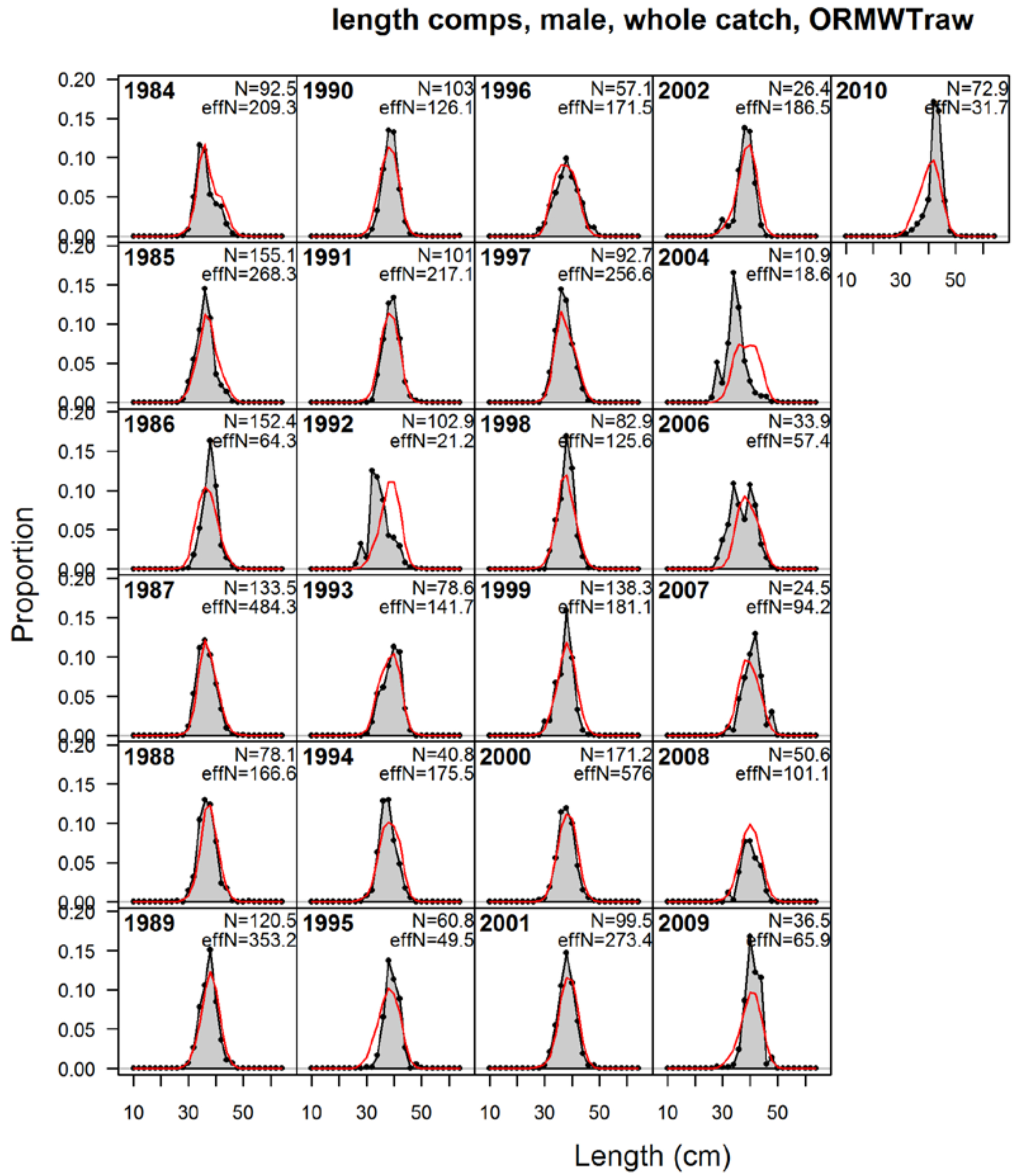


Figure C4. Model fits to the Oregon mid-water trawl fishery male length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

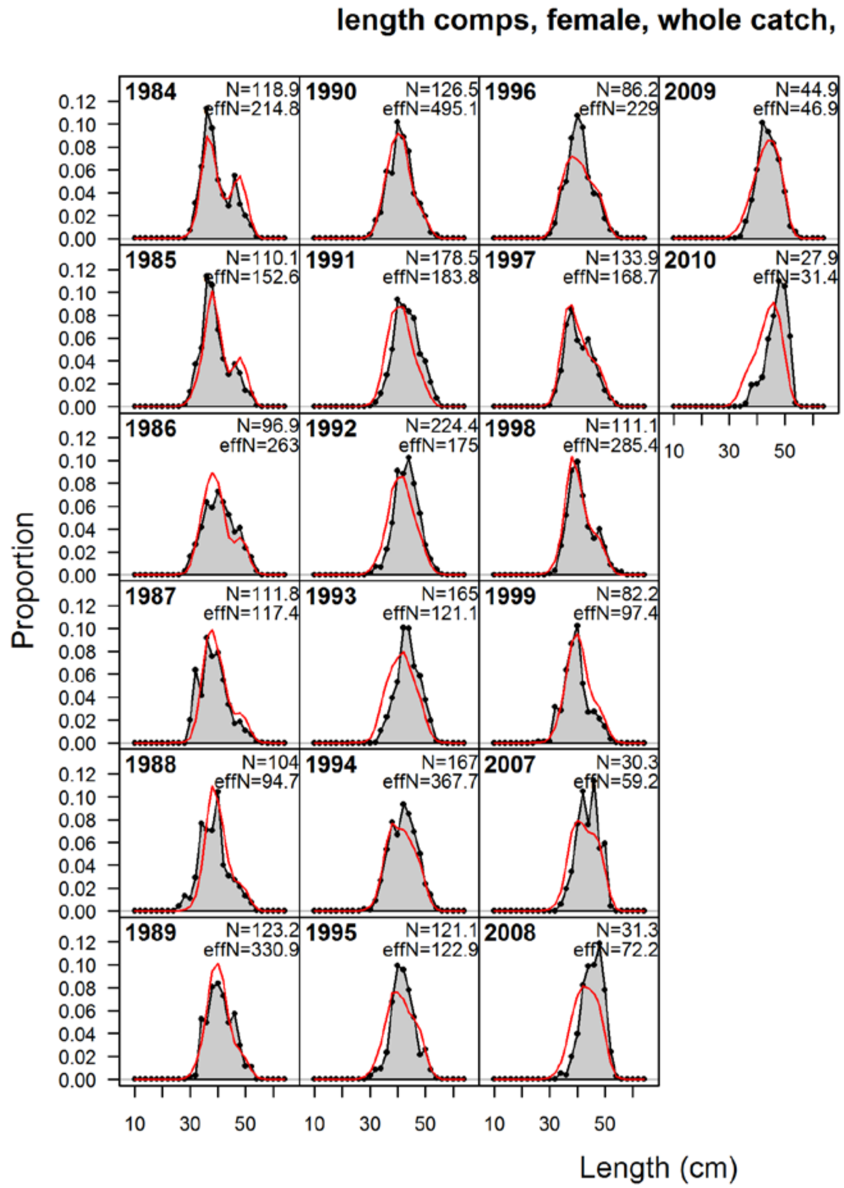


Figure C5. Model fits to the Oregon bottom trawl fishery female length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

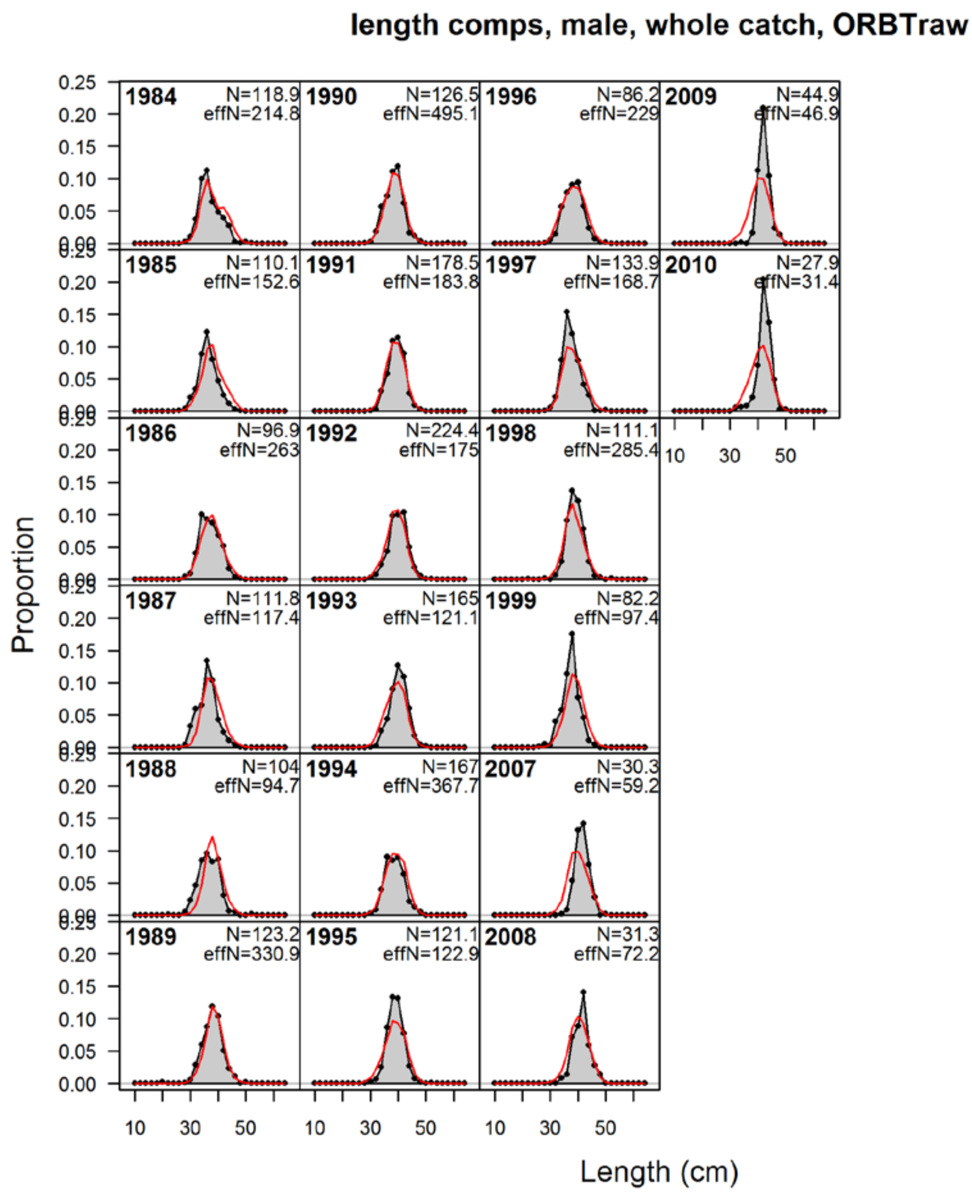


Figure C6. Model fits to the Oregon bottom trawl fishery male length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

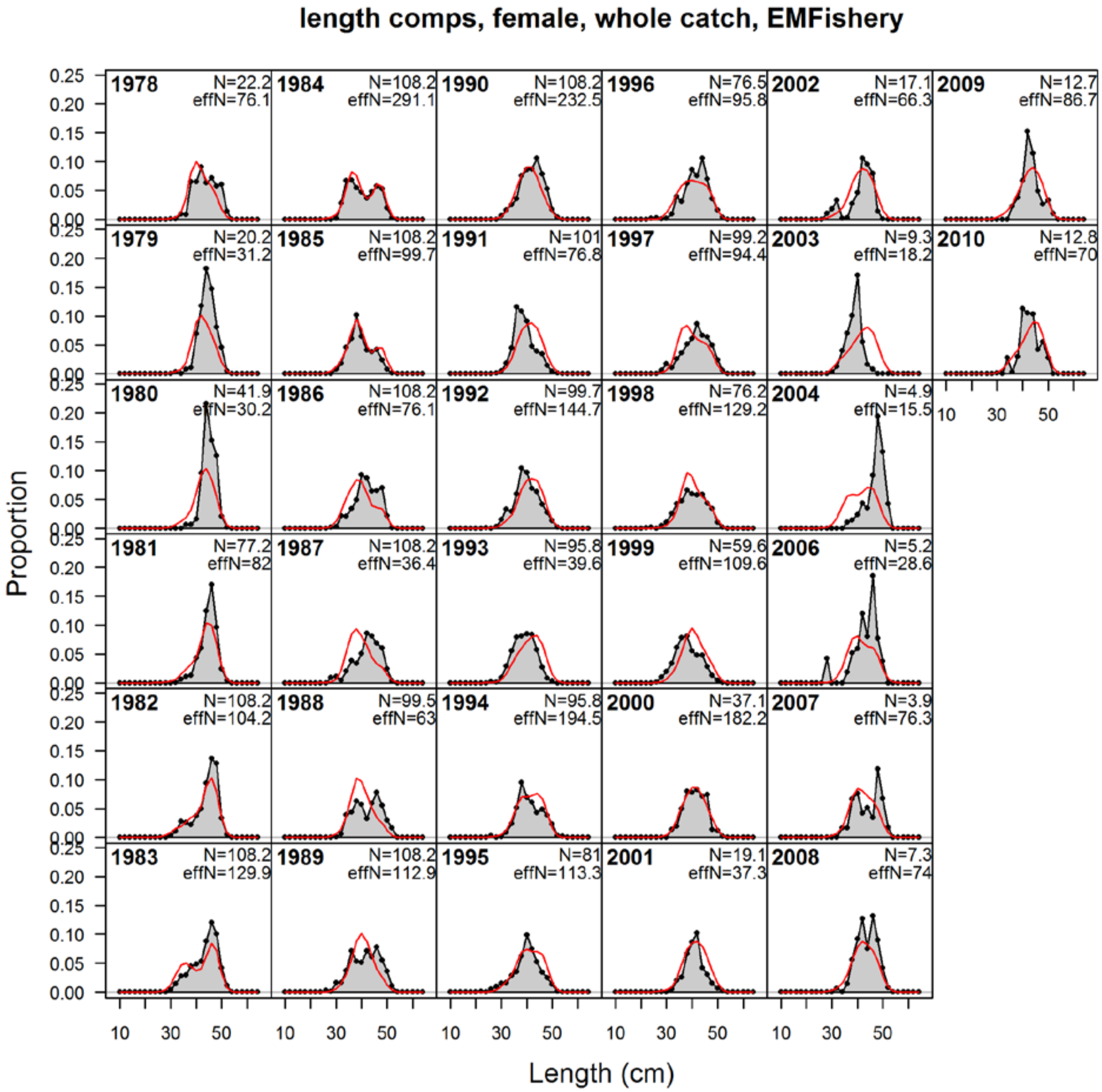


Figure C7. Model fits to the California (EMFishery) fishery female length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

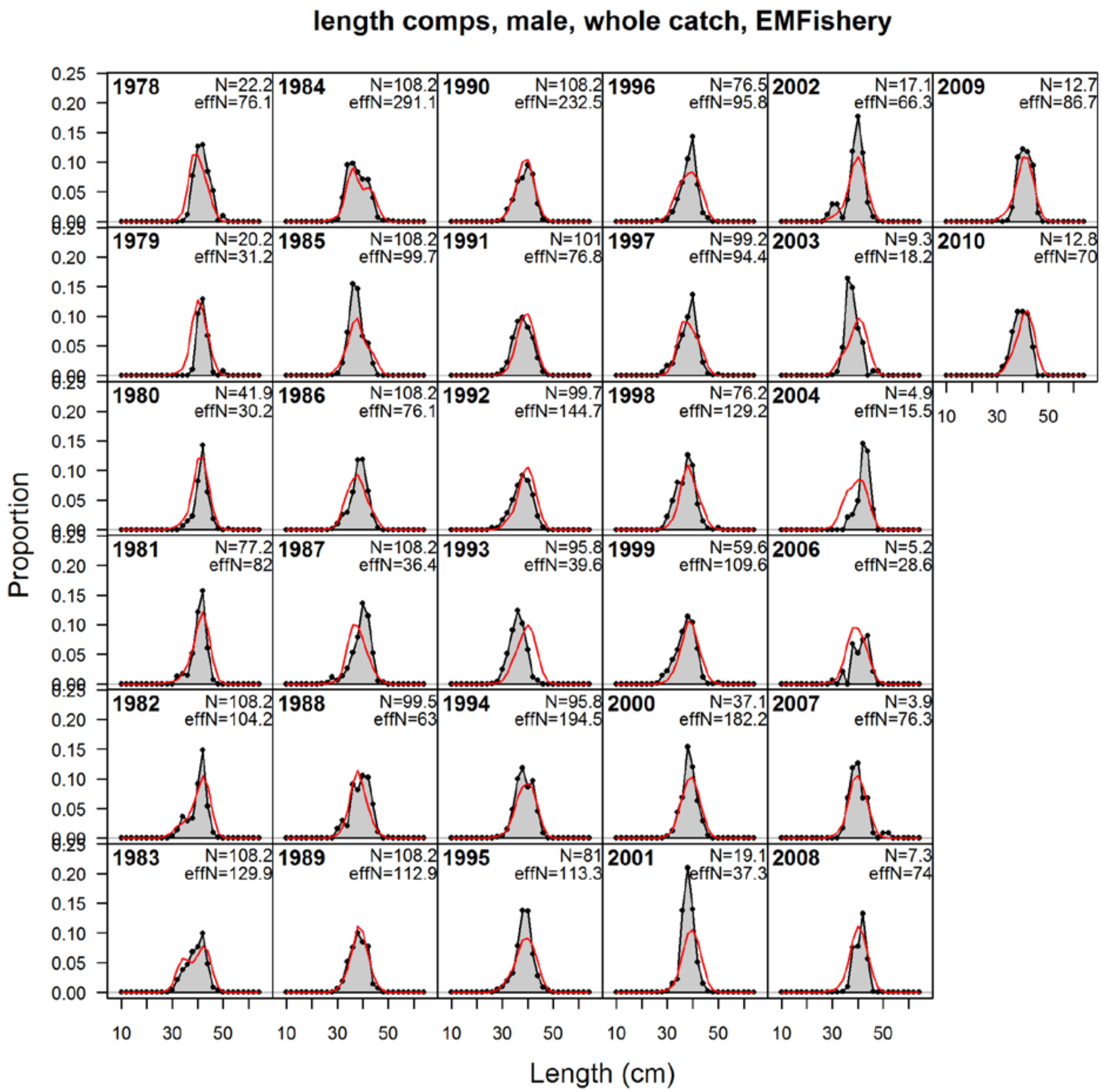


Figure C8. Model fits to the California fishery (EMFishery) male length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

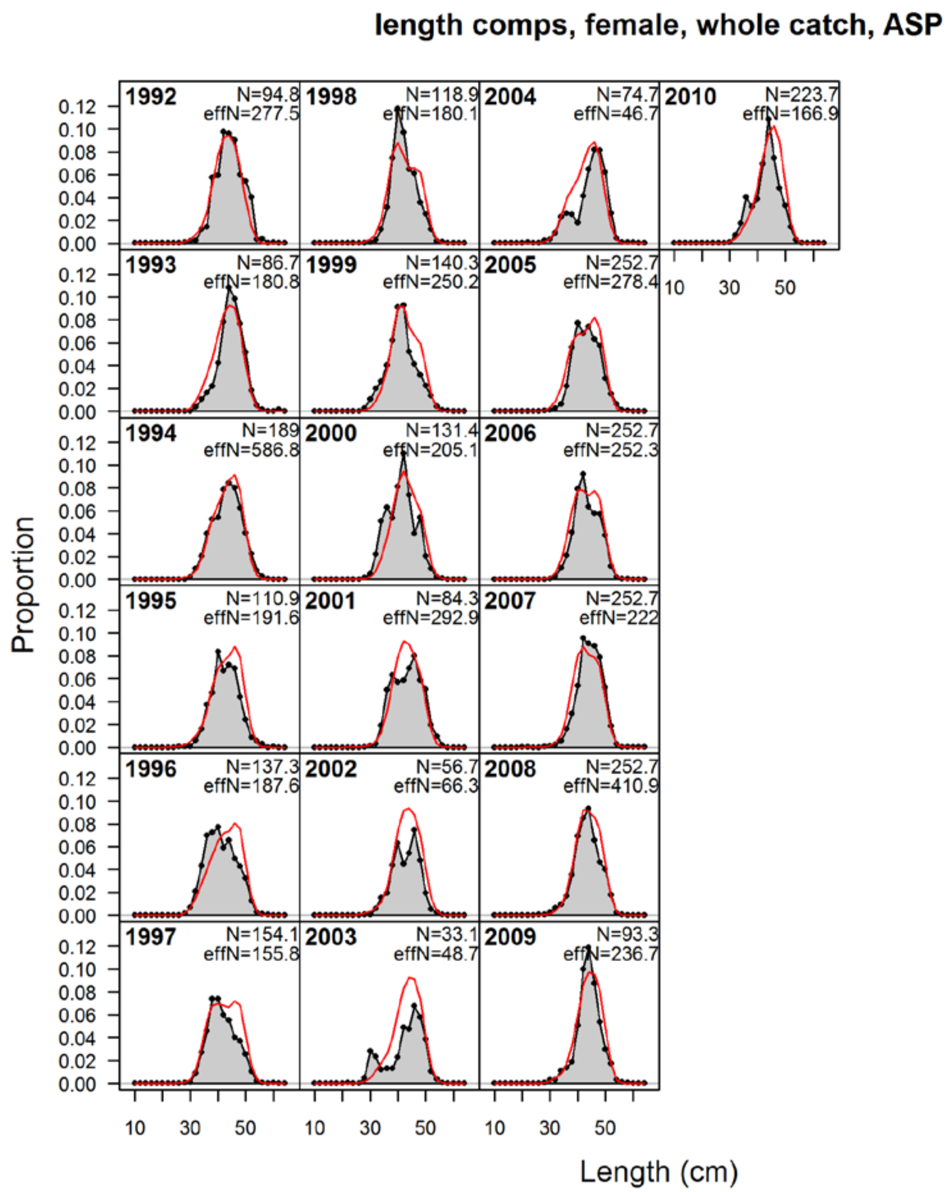


Figure C9. Model fits to the at-sea whiting processor (ASP) fishery female length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

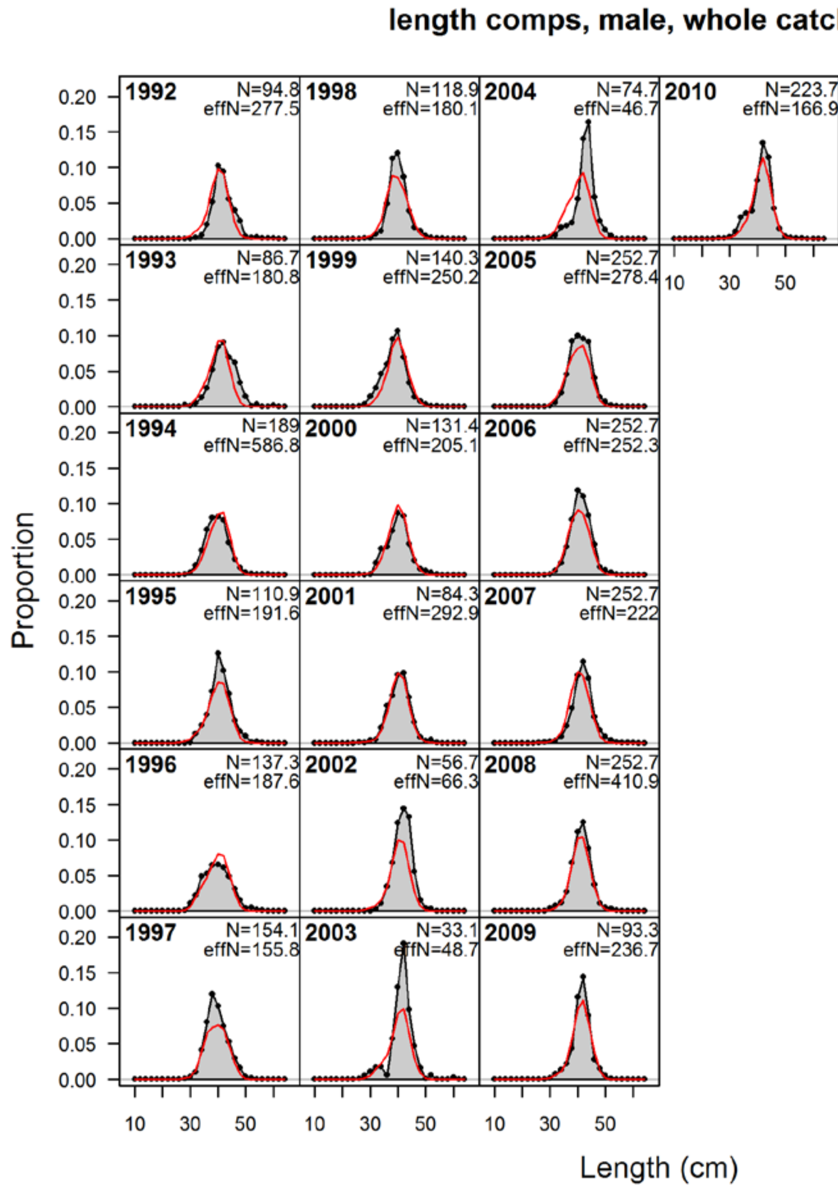


Figure C10. Model fits to the at-sea whiting processor (ASP) fishery male length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

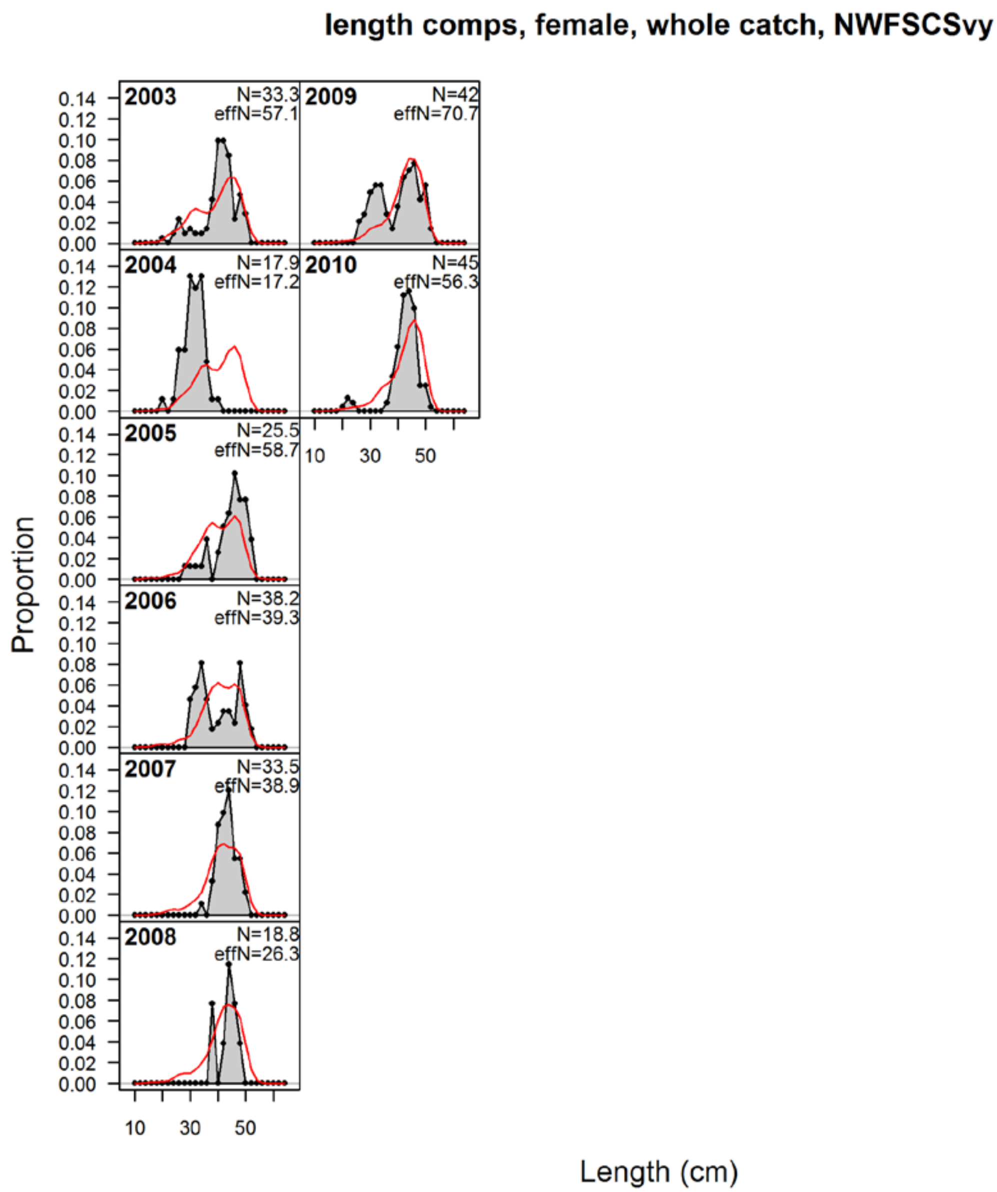


Figure C11. Model fits to the NWFSC survey female length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

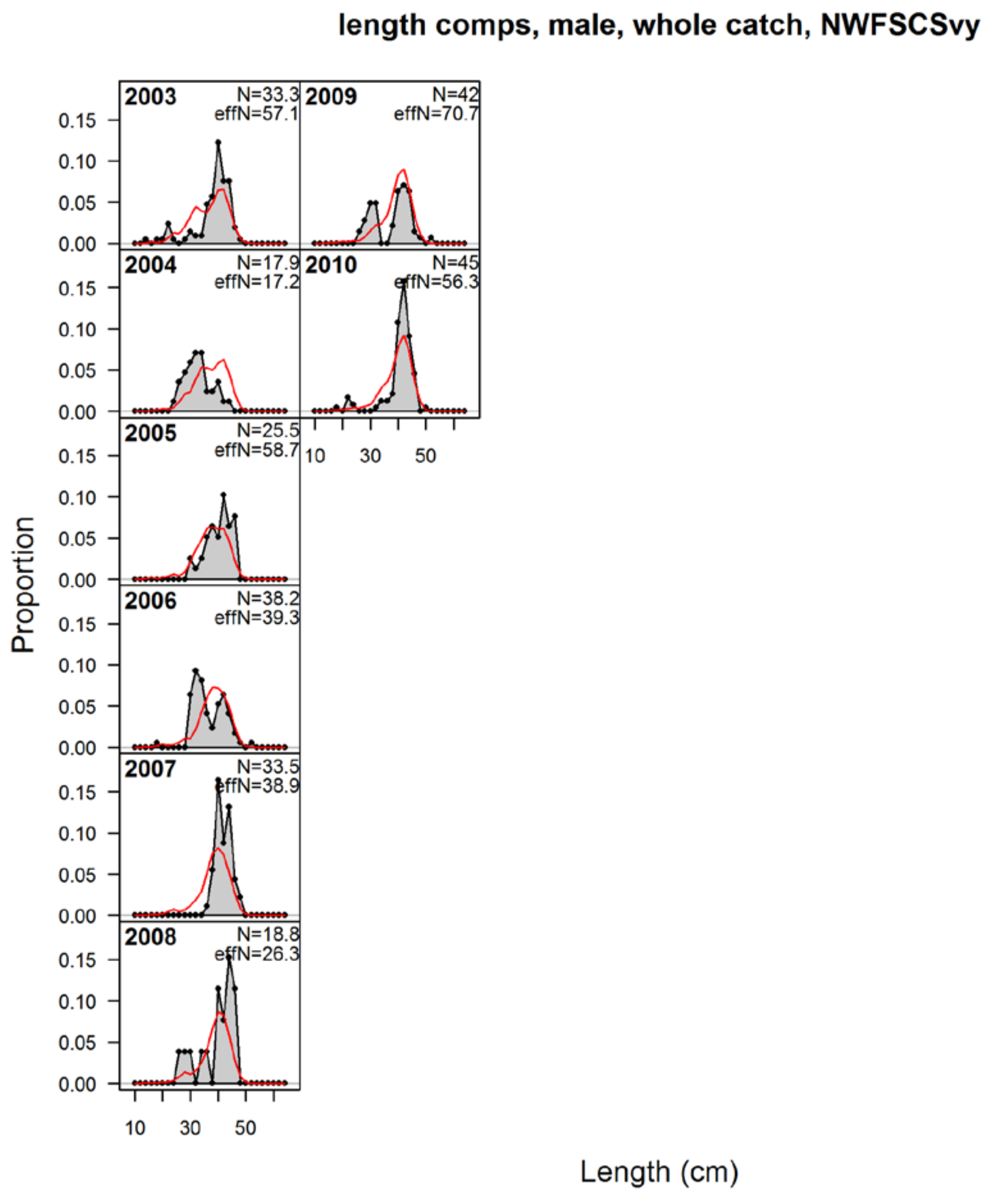


Figure C12. Model fits to the NWFSC survey male length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

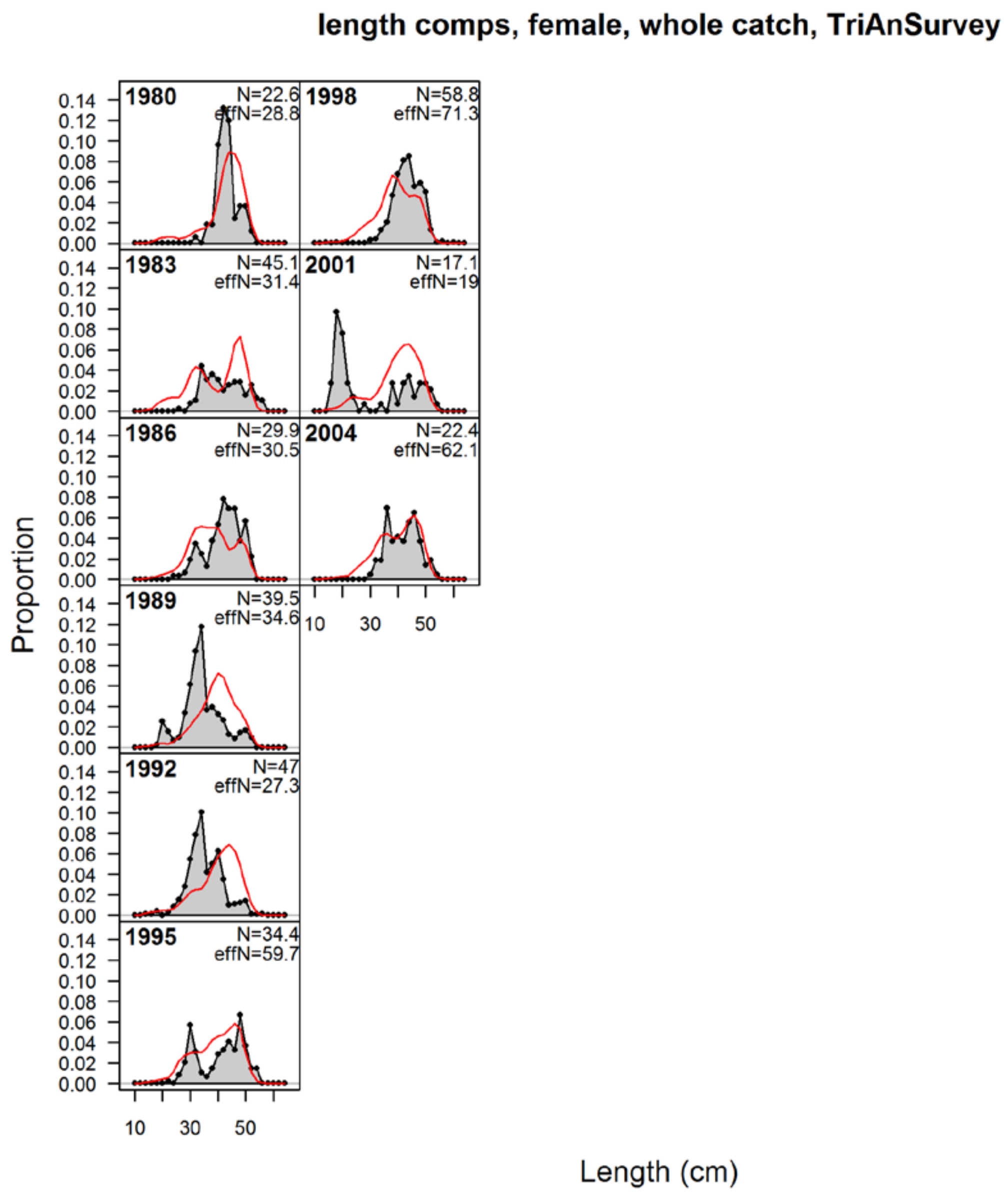


Figure C13. Model fits to the triennial survey female length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

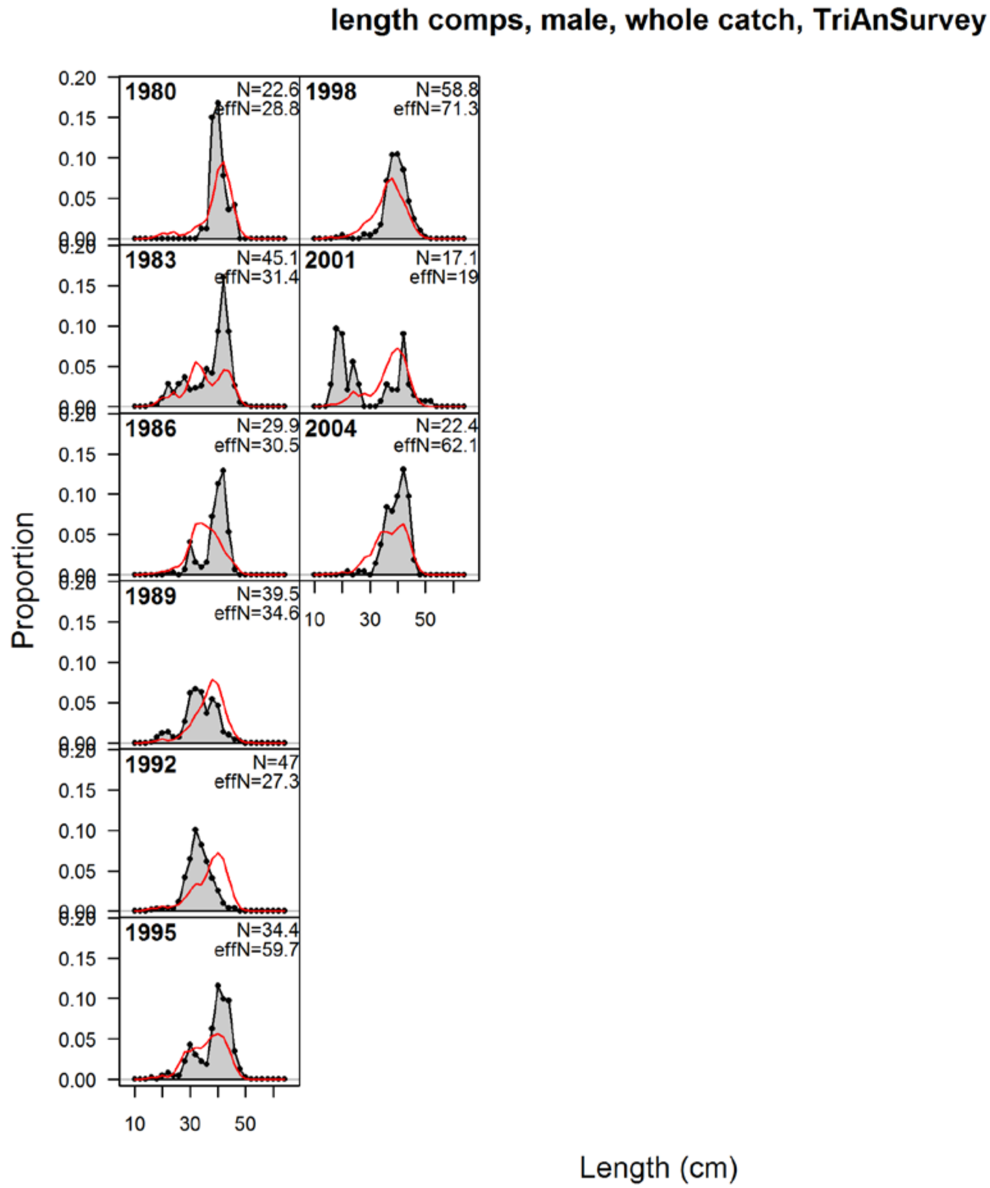


Figure C14. Model fits to the triennial survey male length composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

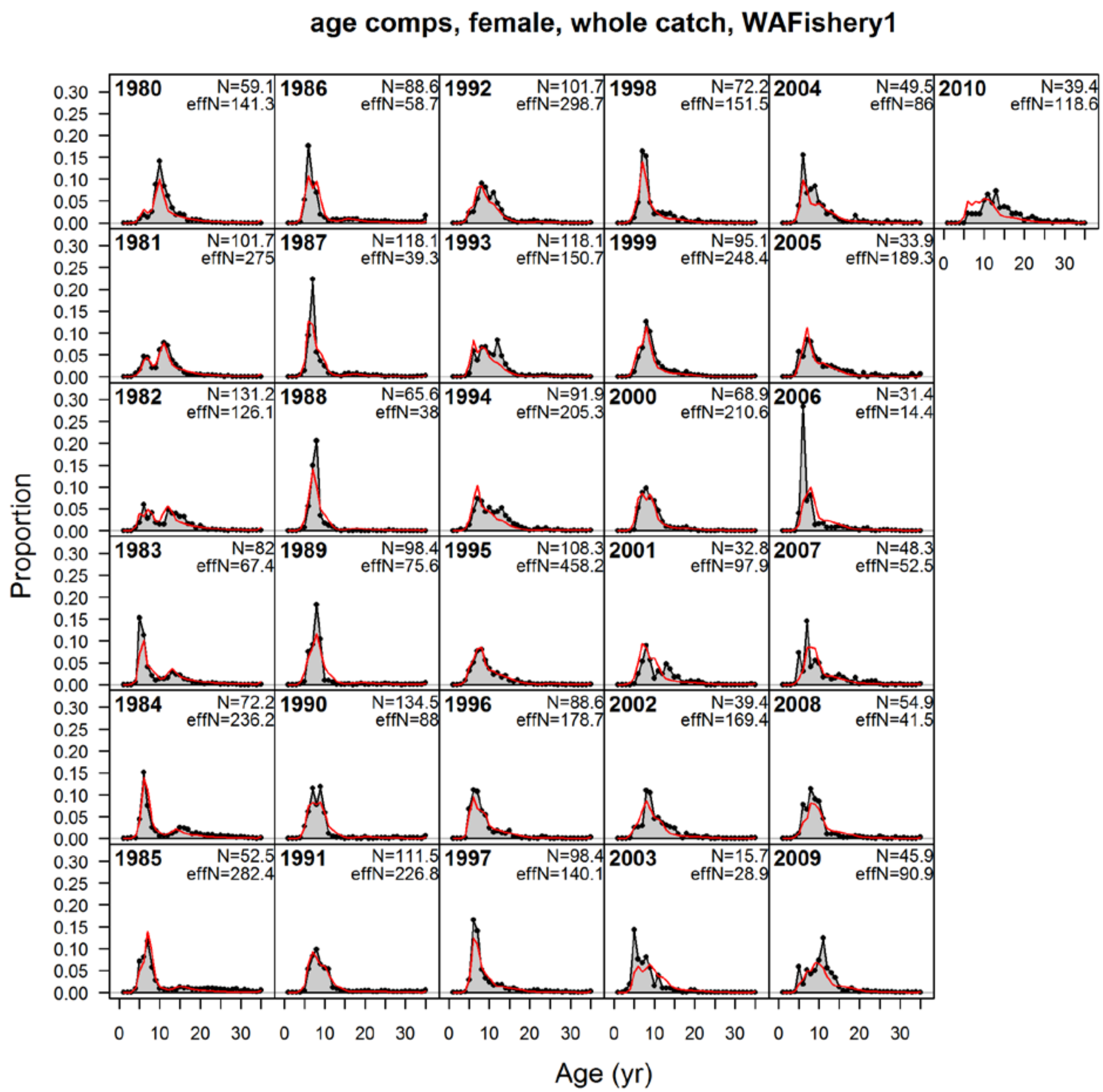


Figure C15. Model fits to the Washington fishery female age composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

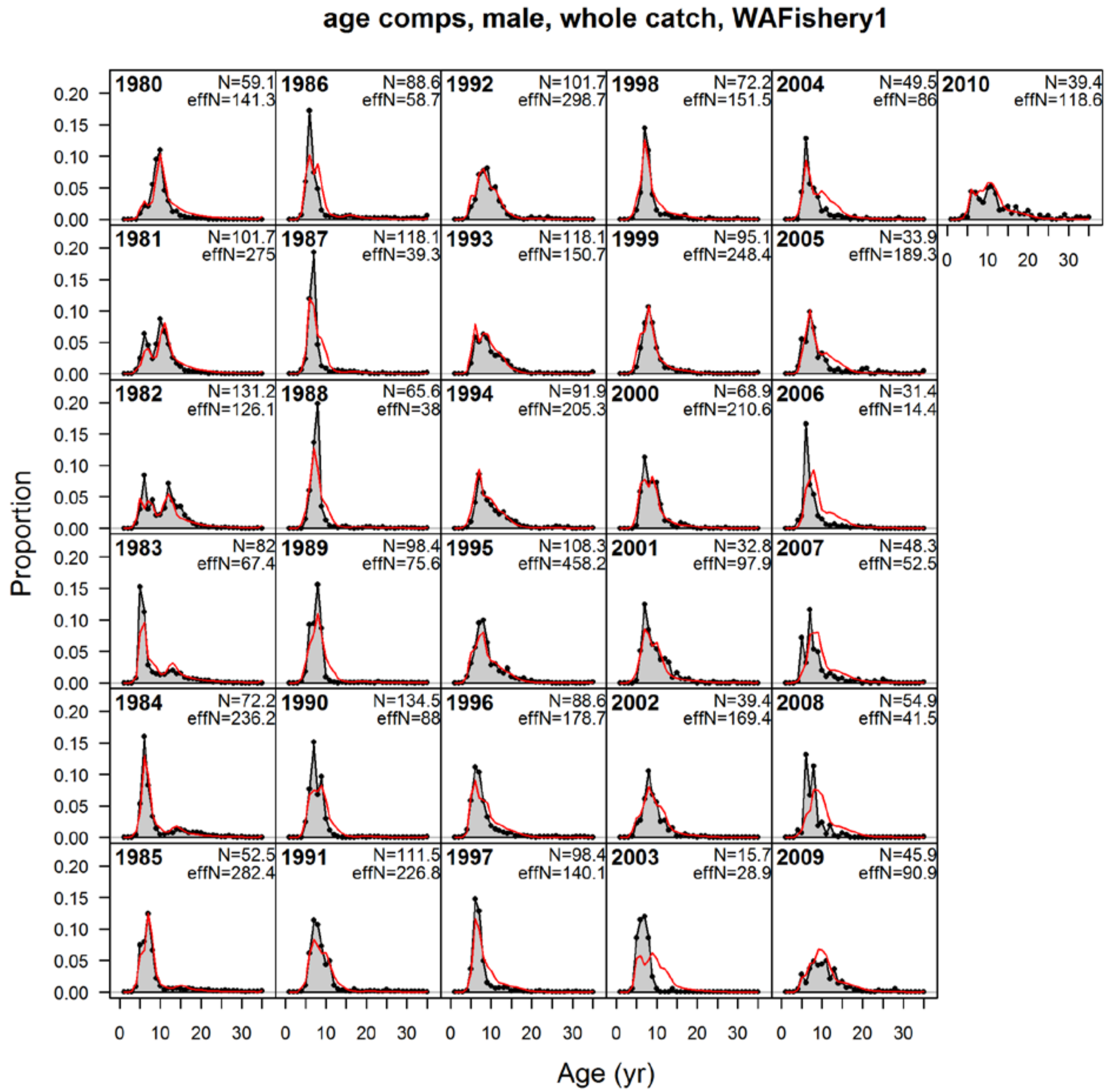


Figure C16. Model fits to the Washington fishery male age composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

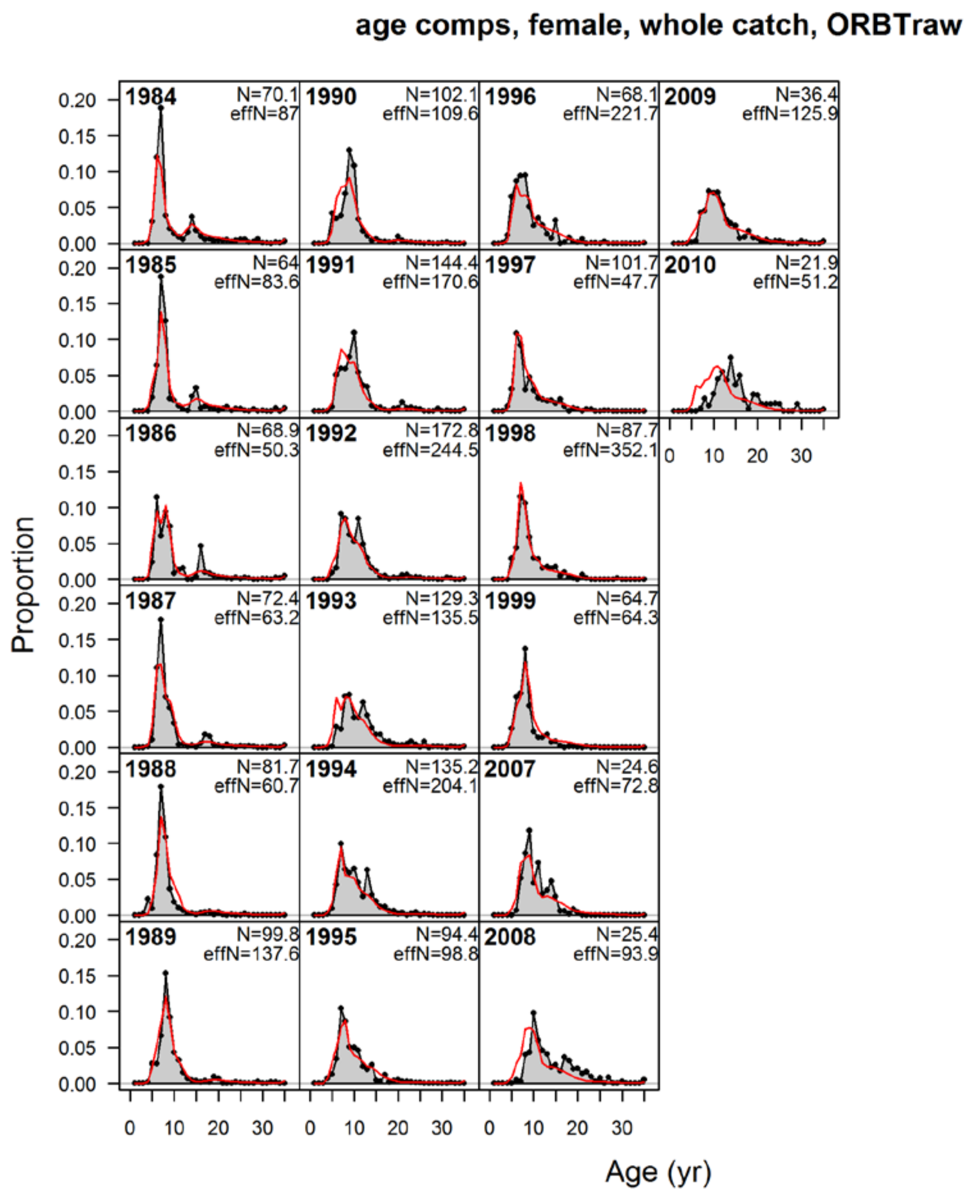


Figure C17. Model fits to the Oregon bottom trawl fishery female age composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

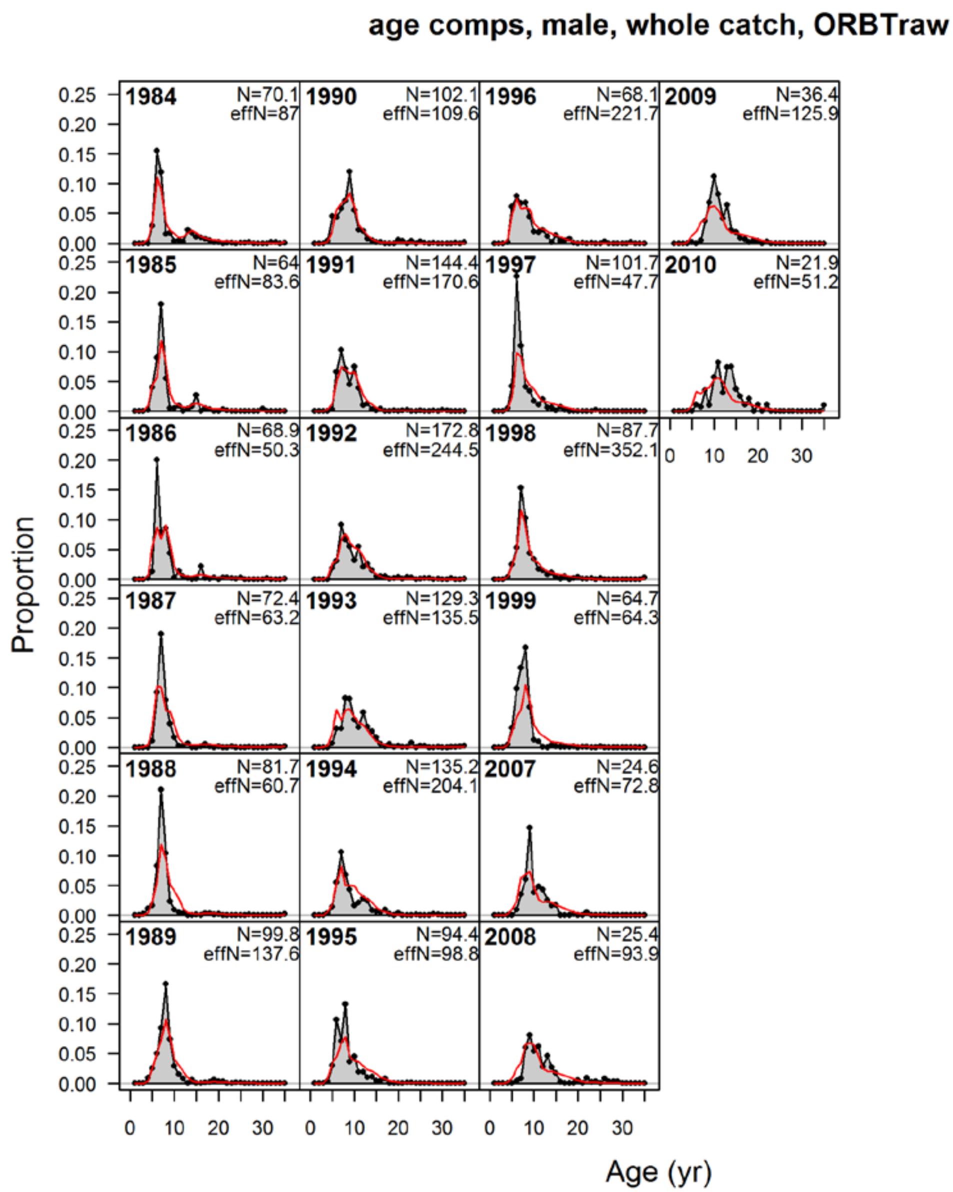


Figure C18. Model fits to the Oregon bottom trawl fishery male age composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

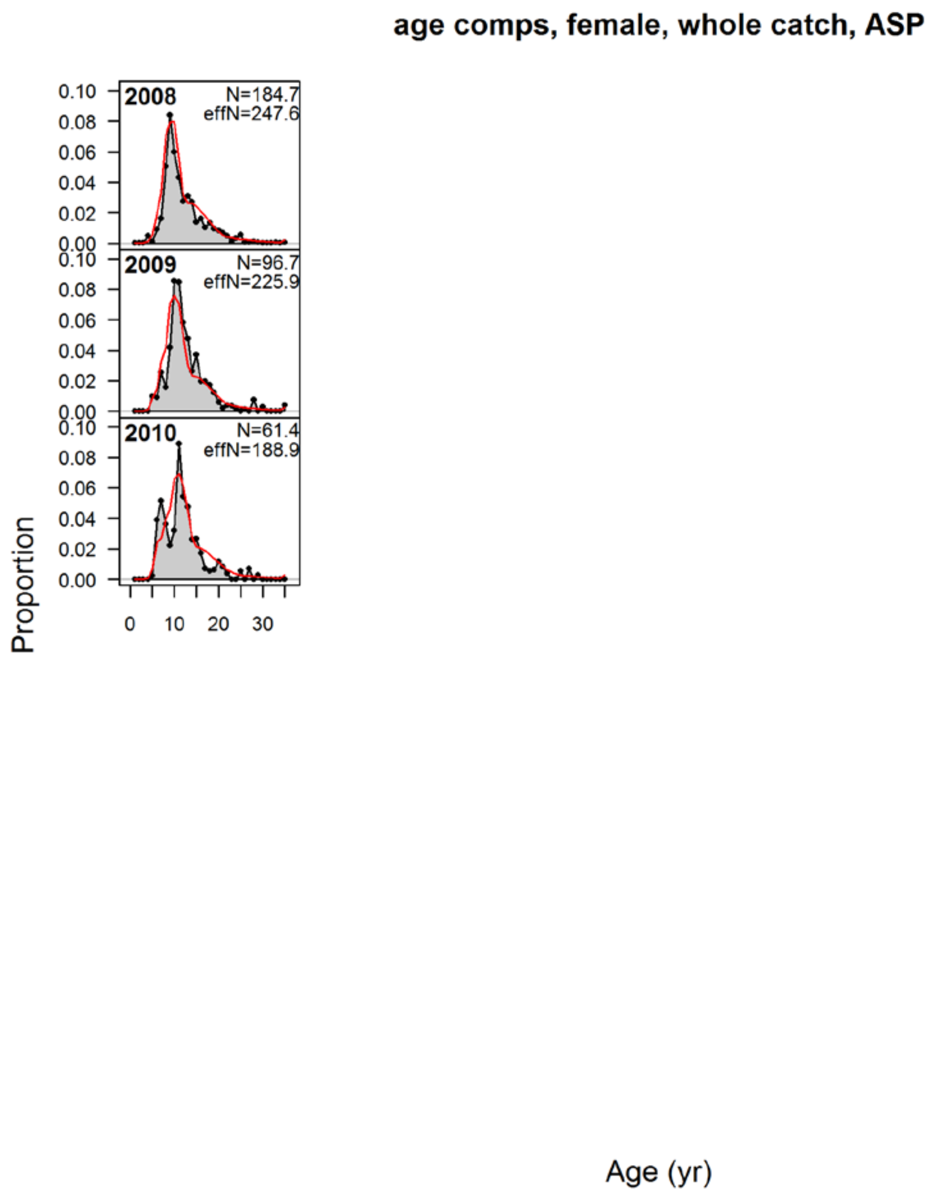


Figure C19. Model fits to the at-sea whiting processor (ASP) fishery female age composition data. Note that N is not the actual sample size, but the effective sample size from the previous iteration.

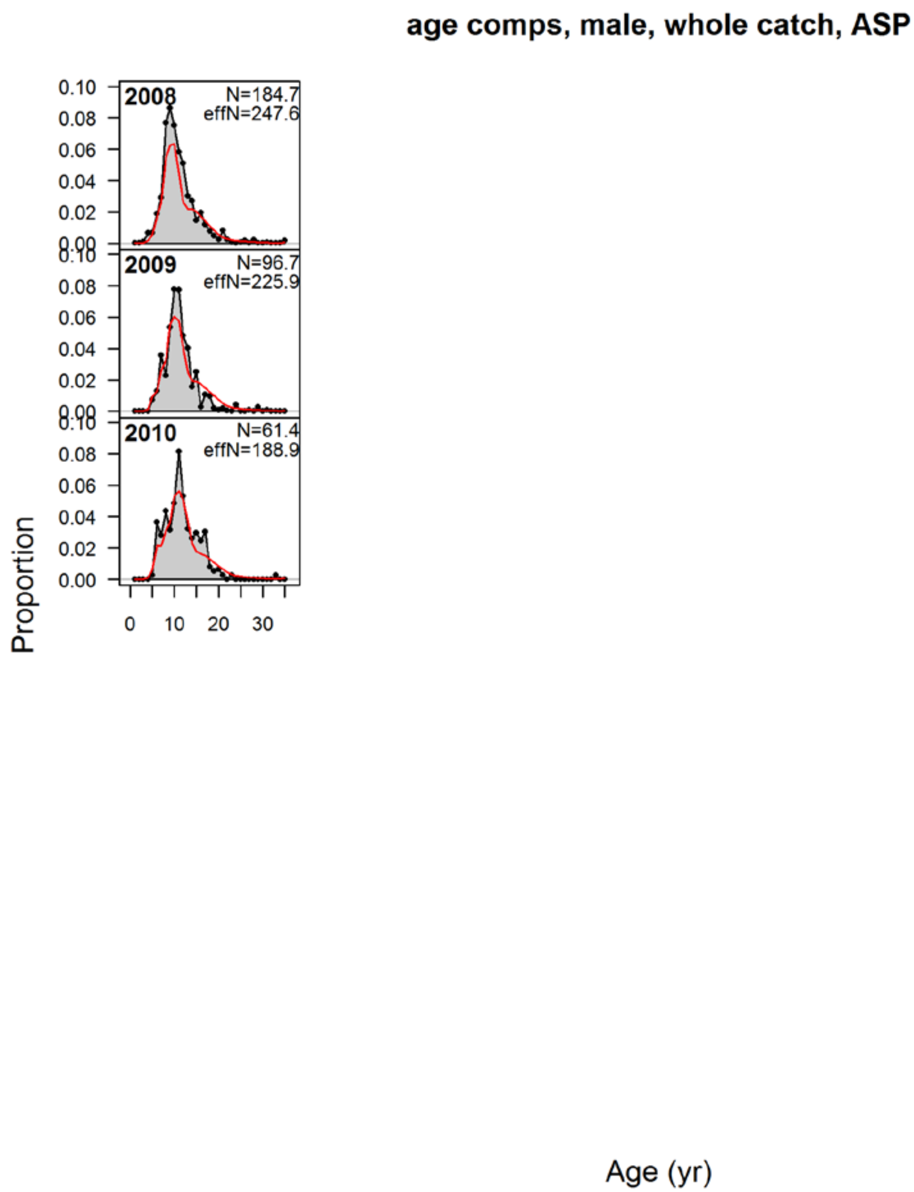


Figure C20. Model fits to the at-sea whiting processor (ASP) fishery male age composition data. Note that N is not the actual sample size, but the effective sample size from the previous

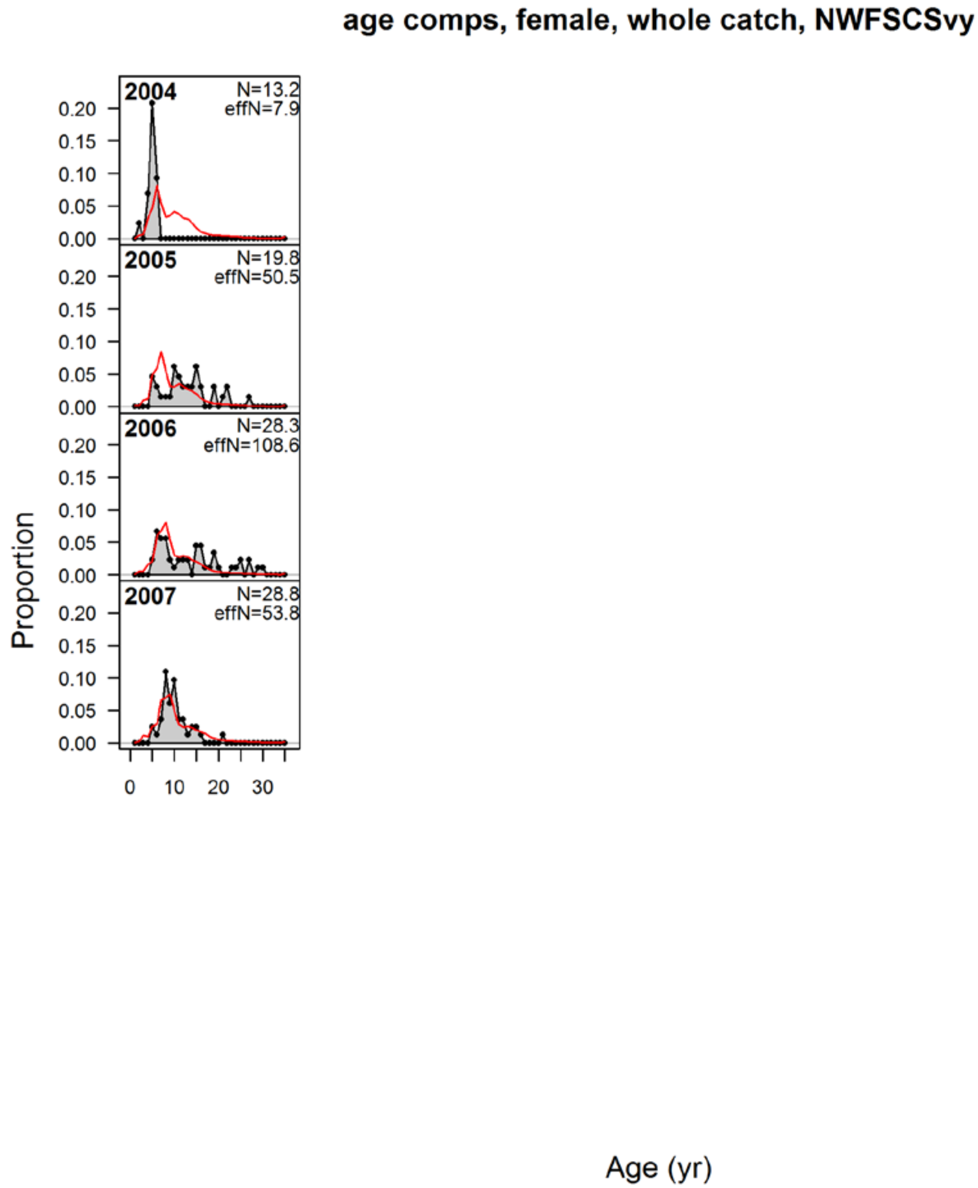


Figure C21. Model fits to the NWFSC survey female age composition data. Note that N is not the actual sample size, but the effective sample size from the previous

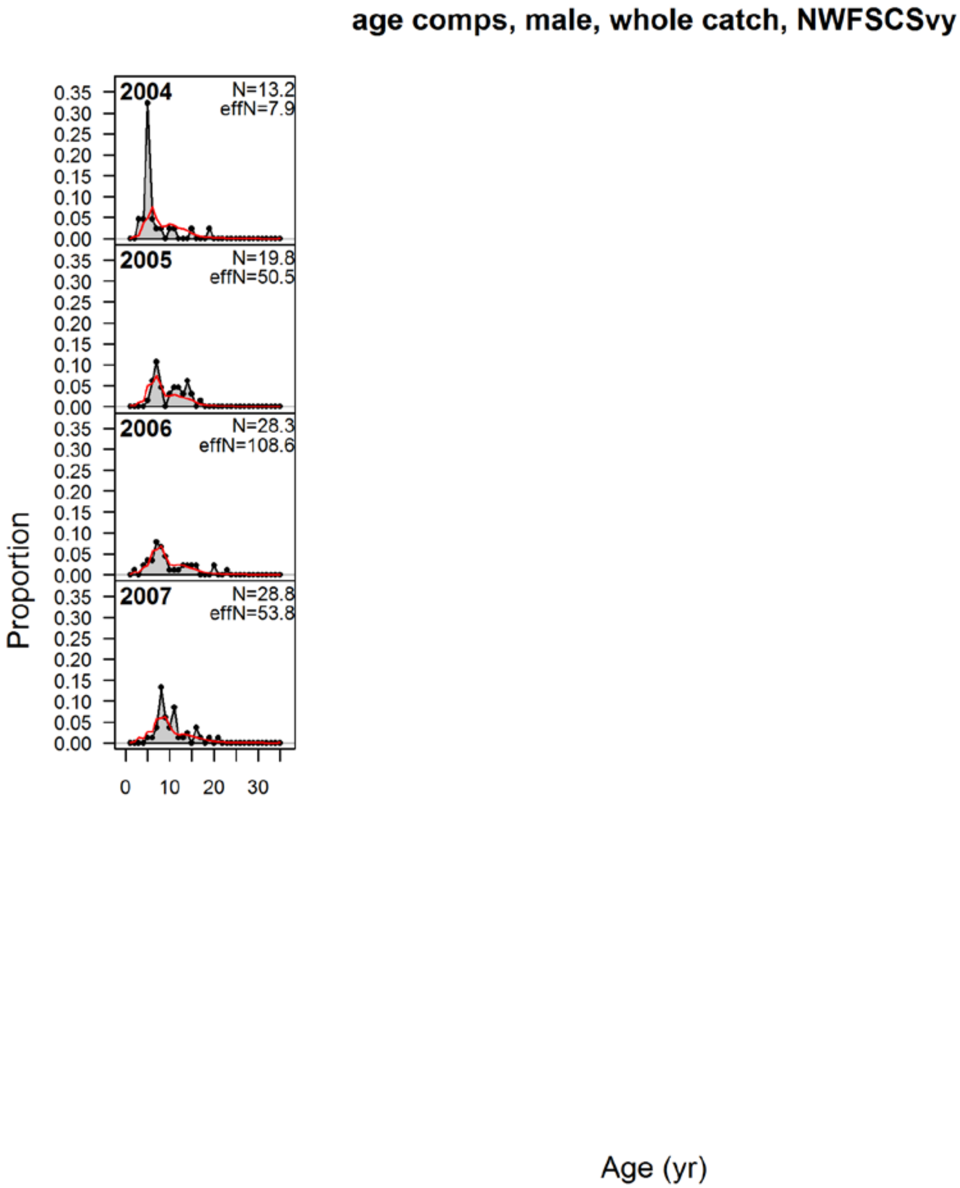


Figure C22. Model fits to the NWFSC survey male age composition data. Note that N is not the actual sample size, but the effective sample size from the previous

10.4 Appendix D. Input SS3 files for widow rockfish stock assessment base model.

There were four input files for the SS3 program: (1) Starter.SS; (2) Forecast.SS; (3) control file (wdw1.ctl); and (4) data file (wdw1.dat).

10.4.1 Starter.SS

```
#C 2011_Widow_rockfish_ stockassessment__Xi_He__NMFS_SWFSC__Santa_Cruz_CA
#C SS-V3.21e;_06/9/2011;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMB

wdw1.dat
wdw1.ctl

0          # 0=use init values in control file; 1=use ss3.par
1          # run display detail (0,1,2)
1          # detailed age-structured reports in SS2.rep (0,1)
0          # write detailed checkup.sso file (0,1)
1          # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms)
2          # write to cumreport.sso (0=no,1=like&timeseries; 2=add survey fits)
0          # Include prior_like for non-estimated parameters (0,1)
1          # Use Soft Boundaries to aid convergence (0,1) (recommended)
1          # Number of bootstrap datafiles to produce
9          # Turn off estimation for parameters entering after this phase
10         # MCMC burn interval
2          # MCMC thin interval
0.1        # jitter initial parm value by this fraction
-1         # begin annual SD report in start year
-2         # end annual SD report in end year (-2=end of annual SD report in last forecast year
0          # N individual STD years (0=none)

#vector of year values

0.0001  # final convergence criteria (e.g. 1.0e-04)
0          # retrospective year relative to end year (e.g. -4)
0          # min age for calc of summary biomass
1          # Depletion basis:  denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1          # Fraction (X) for Depletion denominator (e.g. 0.4)
4          # (1-SPR)_reporting:  0=skip; 1=rel(1-SPR); 2=rel(1-SPR_MSY); 3=rel(1-SPR_Btarget); 4=no denominator (report actural 1-SPR values)
```

```
1                    # F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(Frates); 4=true F for range of ages
#COND 10 15 #_min and max age over which average F will be calculated with F_reporting=4

#1                   # F_std reporting: 0=skip; 1=exploit(Bio); 2=exploit(Num); 3=sum(frates) -> old
1                    # F_report_basis: 0=raw; 1=rel Fspr; 2=rel Fmsy ; 3=rel Fbtgt

999                  # check value for end of file
```

10.4.2 forecast.SS

```
#C 2011_Widow_rockfish_ stockassessment__Xi_He__NMFS_SWFSC__Santa_Cruz_CA
#C SS-V3.21e;_06/9/2011;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMB
#C  generic forecast file

# for all year entries except rebuilder; enter either: actual year, -999 for styr, 0 for endyr, neg number for rel. endyr
1         # Benchmarks: 0=skip; 1=F(SPR); 2=F(MSY);3=F(Btarget); 4=F(endyr); 5=Ave recent F (not implemented); 6= read Fmult (not implemented)
2         # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.5 # SPR target (e.g. 0.40), 0.5 for west coast groundfish
0.4 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
2010 2010 2010 2010 2010 2010
#  2008 2008 2008 2008 2008 2008 # after processing
2 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below

#
1         # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar
12        # N forecast years
1         # F scalar (only used for Do_Forecast==5)
#_Fcast_years:  beg_selex, end_selex, beg_relF, end_relF  (enter actual year, or values of 0 or -integer to be rel. endyr)
0 0 -10 0

1                    # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB) )
0.4                  # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40)
0.1       # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
0.75      # Control rule target as fraction of Flimit (e.g. 0.75)

3                    #_N forecast loops (1-3) (fixed at 3 for now)
```

3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)

2023 #FirstYear for caps and allocations (should be after years with fixed inputs)
0.0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error) (if=0, there will be N_forecase_years less parameters estimated)
0 # Do West Coast gfish rebuilder output (0/1)
-1 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
-1 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below

Note that fleet allocation is used directly as average F if Do_Forecast=4
2 # basis for fcast catch tuning and for fcast catch caps and allocation (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
Conditional input if relative F choice = 2
Fleet relative F: rows are seasons, columns are fleets
#_Fleet: WAFishery1 ORMWTraw ORBTraw EMFishery
0 0 0 0
max totalcatch by fleet (-1 to have no max) must enter value for each fleet
-1 -1 -1 -1 -1

max totalcatch by area (-1 to have no max); must enter value for each fleet
-1

fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
0 0 0 0 0

#_Conditional on >1 allocation group
allocation fraction for each of: 0 allocation groups
no allocation groups
60 # Number of forecast catch levels to input (else calc catch from forecast F)
2 # basis for input Fcast catch: 2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in SSV3.20)
Input fixed catch values
Setting 2011 and 2012 OYs are both 600mt and cathc allocations are average of 2001 to 2010, see C:\XiHe1\Widow2011\ForecastFiles\ALLLanging4.xlsx
#Year Seas Fleet Catch(or_F)
2011 1 1 117.7
2011 1 2 225.4

2011	1	3	9.2
2011	1	4	113.4
2011	1	5	134.3
2012	1	1	117.7
2012	1	2	225.4
2012	1	3	9.2
2012	1	4	113.4
2012	1	5	134.3
2013	1	1	58.9
2013	1	2	112.7
2013	1	3	4.6
2013	1	4	56.7
2013	1	5	67.1
2014	1	1	58.9
2014	1	2	112.7
2014	1	3	4.6
2014	1	4	56.7
2014	1	5	67.1
2015	1	1	58.9
2015	1	2	112.7
2015	1	3	4.6
2015	1	4	56.7
2015	1	5	67.1
2016	1	1	58.9
2016	1	2	112.7
2016	1	3	4.6
2016	1	4	56.7
2016	1	5	67.1
2017	1	1	58.9
2017	1	2	112.7
2017	1	3	4.6
2017	1	4	56.7
2017	1	5	67.1
2018	1	1	58.9
2018	1	2	112.7
2018	1	3	4.6
2018	1	4	56.7
2018	1	5	67.1

```
2019	1	1	58.9
2019	1	2	112.7
2019	1	3	4.6
2019	1	4	56.7
2019	1	5	67.1
2020	1	1	58.9
2020	1	2	112.7
2020	1	3	4.6
2020	1	4	56.7
2020	1	5	67.1
2021	1	1	58.9
2021	1	2	112.7
2021	1	3	4.6
2021	1	4	56.7
2021	1	5	67.1
2022	1	1	58.9
2022	1	2	112.7
2022	1	3	4.6
2022	1	4	56.7
2022	1	5	67.1

#
999 # verify end of input
```

10.4.3 Control file (wdw1.ctl)

```
#C 2011_Widow_rockfish_ stockassessment__Xi_He__NMFS_SWFSC__Santa_Cruz_CA
#C SS-V3.21e;_06/9/2011;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMB

#_data_and_control_files: wdw1.dat wdw1.ctl

1	#_N_Growth_Patterns
1	#_N_Morphs_Within_GrowthPattern

#_Recruit_Setup
#2	# N recruitment designs goes here if N_GP*nseas*pop>1
#0	# placeholder for recruitment interaction request

# GP seas area for each recruitment assignment
#1 1 1
#2 1 2

# 1 1 1  # example recruitment design element for GP=1, seas=1, pop=1

# N_movement_definitions goes here if pop > 1
#0

# 0 # N_movement_definitions goes here if pop > 1
# 1.0 # first age that moves (real age at begin of season, not integer)
# 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10

2		#_Nblock_Designs
1	3	#_blocks_per_pattern
2003 2010				# begin and end years of first blocks
1916 1979 1980 2000 2001 2010	# begin and end years of second blocks

0.5	#_fracfemale
0	#_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
#1	#_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
#4	#_N_breakpoints
#3 4 25 26	# age(real) at M breakpoints
1	# GrowthModel: 1=vonBert with L1&L2; 2=vonBert with A0&Linf; 3=Richards; 4=readvector
```

```
5	#_Growth_Age_for_L1
15	#_Growth_Age_for_L2 (999 to use as Linf)
0	#_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
1	#_CV_Growth_Pattern:  0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)
3	#_maturity_option:  1=length logistic; 2=age logistic; 3=read age-maturity for each femlae GP; 4=read age-fecundity for each female GP

#_Age_Maturity by growth pattern (Muturity by age for GP1 and GP2)
0.000000	0.000000	0.000000	0.046000	0.077000	0.262000	0.494000	0.746000	0.930000
	0.986000	0.993000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
	1.000000	1.000000	1.000000
#0.000000	0.000000	0.000000	0.000000	0.000000	0.262000	0.494000	0.746000	0.930000
	0.986000	0.993000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
	1.000000	1.000000	1.000000

# for MaxAge=35
# Combined for one area model
# new growth parameters
#0.000000	0.000000	0.000000	0.000000	0.000305	0.022925	0.085323	0.191593	0.314121
	0.408335	0.481675	0.550139	0.609215	0.662401	0.709951	0.752218	0.789607
	0.822546	0.851465	0.876781	0.898888	0.918153	0.934912	0.949467	0.962093
	0.973033	0.982503	0.990694	0.997774	1.003890	1.009170	1.013727	1.017658
	1.021048	1.023971	1.026491

# Old growth parameters (sheet CombinedMat$fec in "OneArea Widow AgeLengthWeight maturity fecundity2.xls")
#0.000000	0.000000	0.000000	0.000000	0.000000	0.005061	0.057423	0.158923	0.275324
	0.367611	0.440086	0.507405	0.565337	0.617227	0.663401	0.704271	0.740292
	0.771932	0.799646	0.823867	0.844996	0.863401	0.879413	0.893330	0.905416
	0.915907	0.925008	0.932900	0.939742	0.945672	0.950812	0.955265	0.959124
	0.962467	0.965364	0.967874

# for two-area model: north and south
#0.000000	0.000000	0.000000	0.000000	0.000000	0.007230	0.048819	0.158084	0.279150
	0.376601	0.449400	0.518599	0.578021	0.632178	0.681194	0.725300	0.764794
	0.800010	0.831301	0.859020	0.883513	0.905106	0.924107	0.940800	0.955444
```

0.968275 0.979507 0.989329 0.997911 1.005406 1.011947 1.017652 1.022626
1.026962 1.030739 1.034029
#0.000000 0.000000 0.000000 0.000650 0.002100 0.019200 0.077500 0.160883 0.266395
0.346636 0.418351 0.481285 0.535740 0.582344 0.621884 0.655201 0.683122
0.706418 0.725787 0.741843 0.755124 0.766088 0.775126 0.782566 0.788685
0.793714 0.797843 0.801233 0.804013 0.806293 0.808163 0.809695 0.810951
0.811980 0.812822 0.813513

0 #_First_Mature_Age
5 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b;(4)eggs=a+b*L;(5)eggs=a+B*W !!! No used if maturity_option = 4
0 # no gender Change
1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
1 #_env/block/dev_adjust_method (1=standard; 2=with logistic trans to keep within base parm bounds)

growth parameter see: (sheet CombinedMat$fec in "OneArea Widow AgeLengthWeight maturity fecundity2.xls")
#_growth_parms
#_LO HI INIT PRIOR PR_type SD PHASE env usdev dminyr dmaxyr dev_std Block Block_Fxn
0.01 0.3 0.124 -2.09 3 0.3 3 0 0 0 0
0 0 0 # NatM_p_1_Fem_GP_1
10 50 30.3608 29.55 -1 99 2 0 0 0 0
0 0 0 # L_at_Amin_Fem_GP_1
40 60 47.5490 47.37 -1 99 2 0 0 0 0
0 0 0 # L_at_Amax_Fem_GP_1
0.01 0.4 0.1855 0.2005 -1 99 2 0 0 0 0
0 0 0 # VonBert_K_Fem_GP_1
0.01 0.4 0.06475 0.069 -1 99 6 0 0 0 0
0 0 0 # CV_young_Fem_GP_1
0.01 0.4 0.04621 0.046 -1 99 6 0 0 0 0
0 0 0 # CV_old_Fem_GP_1

0.01 0.3 0.129 -2.05 3 0.3 3 0 0 0 0
0 0 0 # NatM_p_1_Fem_GP_1
10 50 30.2180 30.67 -1 99 2 0 0 0 0
0 0 0 # L_at_Amin_Fem_GP_2
40 60 43.4792 43.53 -1 99 2 0 0 0 0
0 0 0 # L_at_Amax_Fem_GP_2
0.01 0.4 0.2679 0.2505 -1 99 2 0 0 0 0
0 0 0 # VonBert_K_Fem_GP_2

```
0.01 0.4 0.05270 0.052 -1 99 6 0 0 0 0
 0 0 0 # CV_young_Fem_GP_2
0.01 0.6 0.05194 0.052 -1 99 6 0 0 0 0
 0 0 0 # CV_old_Fem_GP_2

-3 3 0.00000545 0.00000545 -1 99 -1 0 0 0 0
 0 0 0 # Wtlen1_Fem
-3 10 3.28781 3.28781 -1 99 -1 0 0 0 0
 0 0 0 # Wtlen2_Fem
-3 50 7 7 -1 99 -1 0 0 0
 0 0 0 0 # Mat50_Fem !! ignored if maturity option=4
-3 3 -1 -1 -1 99 -1 0 0 0
 0 0 0 0 # Mat_slope_Fem !! ignored if maturity option=4
-1 1 0 0 -1 99 -1 0 0 0
 0 0 0 0 # Eggs/kg_inter_Fem !! ignored if maturity option=4
0 1 1 1 -1 99 -1 0 0 0
 0 0 0 0 # Eggs/kg_slope_wt_Fem !! ignored if maturity option=4

-3 3 0.00001188 0.00001188 -1 99 -1 0 0 0 0
 0 0 0 # Wtlen1_Mal
-3 10 3.06631 3.06631 -1 99 -1 0 0 0 0
 0 0 0 # Wtlen2_Mal

-4 4 0 0 -1 99 -1 0 0 0 0 0 0 0 # RecrDist_GP_1
-4 4 0 0 -1 99 -3 0 0 0 0 0 0 0 # RecrDist_Area_1
-4 4 0 0 -1 99 -3 0 0 0 0 0 0 0 # RecrDist_Seas_1
-4 4 0 0 -1 99 -3 0 0 0
 0 0 0 0 # CohortGrowDev

# 0 #custom_MG-env_setup (0/1)
# -2 2 0 0 -1 99 -2 #_placeholder for no MG-environ parameters

# 1 #custom_MG-block_setup (0/1)
# -2 2 0 0 -1 99 6 #_placeholder for no MG-block parameters
# -2 2 0 0 -1 99 6 #_placeholder for no MG-block parameters
# -2 2 0 0 -1 99 6 #_placeholder for no MG-block parameters

#_seasonal_effects_on_biology_parms
```

#_femwtlen1 femwtlen2 mat1 mat2 fec1 fec2 Malewtlen1 malewtlen2 L1 K
0 0 0 0 0 0 0 0
0 0

-2 2 0 0 -1 99 -2 #_placeholder for no seasonal MG parameters
-2 2 0 0 -1 99 -2 #_placeholder for no MG dev parameters
if use Rick's recruit dist dev, active next line (phase for MGparm_dev)
#7 # placeholder for #_MGparm_Dev_Phase

#_Spawner-Recruitment
#_SR functions: 1=Beverton Holt with flat-top beyond Bzero; 2=Ricker; 3= Standard BH; 4=SCAA; 5=Hockey; 6=Shepard_3Parm
3 #_SR_function

#_LO HI INIT PRIOR PR_type SD PHASE
1 20 9.97 9.97 -1 99 1 # SR_R0
0.2 1 0.76 0.76 -1 99 -2 # SR_steep: Martin's new prior (see email 5/18/2010)
#0.2 1 0.76 0.76 2 0.17 2 # SR_steep: Martin's new prior (see email 5/18/2010)
0 2 0.65 0.65 -1 99 -3 # SR_sigmaR
-5 5 0 0 -1 1 -3 # SR_envlink
-5 5 0 0 -1 1 -3 # SR_R1_offset
0 0.5 0 0 -1 99 -2 # SR_autocorr

0 #_SR_env_link
0 #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness

1 # do_recdev: 0=none; 1=devvector; 2=simple deviations
1978 # first year of main recr_devs; early devs can preceed this era
2009 # last year of main recr_devs; forecast devs start in following year
3 #_recdev phase

1 # (0/1) to read 13 advanced options: Mark all lines in next section if = 0

#_start of advanced SR options
-30 #_recdev_early_start (0=none; neg value makes relative to recdev_start)
3 #_recdev_early_phase
0 #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)
1 #_lambda for forecast recr dev occurring before endyr+1

```
1966    #_last_early_yr_nobias_adj_in_MPD
1974    #_first_yr_fullbias_adj_in_MPD
2004    #_last_yr_fullbias_adj_in_MPD
2011    #_first_recent_yr_nobias_adj_in_MPD

0.93    # Max bias adjustment
0               # future use
-5              #min rec_dev
5               #max rec_dev
0               #_read_recdevs
#_end of advanced SR options

#Fishing Mortality info
0.05    # F ballpark for tuning early phases
1982    # F ballpark year (neg value to disable)
3               # F_Method:  1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
2.9             # max F or harvest rate, depends on F_Method

# no additional F input needed for Fmethod 1
# read overall start F value; overall phase; N detailed inputs to read for Fmethod 2
# read N iterations for tuning for Fmethod 3 (recommend 3 to 7)

# if F_Method=2 (instan.), active next line
# 0.01  1       0       # overall start F value; overall phase; N detailed inputs to read

# Number of tuning iterations in hybrid F: 4 or 5 may be good - check how catches data match estimated catches
# if F_Method=3 (hybrid), activate next line
5

#Fleet Year Seas F_value se phase (for detailed setup of F_Method=2)

#_initial_F_parms
#_LO    HI      INIT    PRIOR   PR_type SD      PHASE
0               0.5     0               0               -1      1000    -1      # InitF_1WAFishery1
0               0.5     0               0               -1      1000    -1      # InitF_2ORMWTraw
0               0.5     0               0               -1      1000    -1      # InitF_3ORBTraw
0               0.5     0               0               -1      1000    -1      # InitF_4EMFishery
```

```
0            0.5     0            0            -1      1000    -1      # InitF_5ASP

#_Q_setup - no Q parameters - median unbiased, also Extra SDs added to each survey ==========
# A=do power: 0=skip, index is linear proportiona to abundance, 1= add power parameter (non-linear)
# B=env link: 0=skip, 1= add para for env effect on Q
# C=extra SD: 0=skip, 1= add para for additive constant to input SE (in log space)
# D=type: <0=mirror lower abs(#) fleet, 0=no para Q is median unbiased, 1=no para Q is mean unbiased, 2=estimate par for ln(Q)
#    3=ln(Q) + set of devs about ln(Q) for all years. 4=ln(Q) + set of devs about Q for indexyr-1
#A B C D
 0 0 0 0 # 1 WAFishery1
 0 0 0 0 # 2 ORMWTraw
 0 0 0 0 # 3 ORBTraw
 0 0 0 0 # 4 EMFishery
 0 0 0 0 # 5 ASP
 0 0 0 0 # 6 SCJuvSurvey
 0 0 0 0 # 7 ORBTrawCPUE
 0 0 0 0 # 8 ForWBycatch
 0 0 0 0 # 9 JVWBycatch
 0 0 0 0 # 10 DomWBycatch
 0 0 0 0 # 11 NWFSCSvy
 0 0 0 0 # 12 TriAnSurvey
# Q =======

#_size_selex_Setup
#_SelPattern    Do_retain     Do_male      Special
24 0 0 0  # 1 WAFishery1
24 0 0 0  # 2 ORMWTraw
24 0 0 0  # 3 ORBTraw
24 0 0 0  # 4 EMFishery
24 0 0 0  # 5 ASP
 0 0 0 0  # 6 SCJuvSurvey
 5 0 0 3  # 7 ORBTrawCPUE
 5 0 0 2  # 8 ForWBycatch
 5 0 0 2  # 9 JVWBycatch
 5 0 0 2  # 10 DomWBycatch
24 0 0 0  # 11 NWFSCSvy
 5 0 0 11       # 12 TriAnSurvey
```

```
#_age_selex_Setup
#_SelPattern	Do_retain	Do_male	Special
 10 0 0 0	# 1 WAFishery1
 10 0 0 0	# 2 ORMWTraw
 10 0 0 0	# 3 ORBTraw
 10 0 0 0	# 4 EMFishery
 10 0 0 0 # 5 ASP
 11 0 0 0	# 6 SCJuvSurvey
 10 0 0 0	# 7 ORBTrawCPUE
 10 0 0 0	# 8 ForWBycatch
 10 0 0 0	# 9 JVWBycatch
 10 0 0 0	# 10 DomWBycatch
 10 0 0 0	# 11 NWFSCSvy
 10 0 0 0 # 12 TriAnSurvey

# double normal parameter comments
# P1=PEAL: beginning size for the plateau; P2=TOP: width of plateau, as logistic between PEAK and MAXLENG
# P3=ASC-WIDTH: ln(width); P4=DESC-WIDTH: ln(width); P5=INIT: logistive between 0 and 1; P6=FINAL: logistic between 0 and 1
# for initial P5 parameter: -999 or -1000: ignore the inital selectivity algorithm and simply decay small fish according to P3

#LO	HI	INI	PRIOR	PR_ty	SD	PHA	envar	usdev dvminyr	dvmaxyr devstdv	Block
	Block_Fxn
18	60	38.9579	40	-1	99	3	0 0 0 0 0.5 0 0 # SizeSel_1P_1_WAFishery1
-15 3	-11.8234-3	-1	99	3	0 0 0 0 0.5 0 0 # SizeSel_1P_2_WAFishery1
-8	12	3.25239	3	-1	99	1	0 0 0 0 0.5 0 0 # SizeSel_1P_3_WAFishery1
-20	18	2.35537	-0.5	-1	99	1	0 0 0 0 0.5 0 0 # SizeSel_1P_4_WAFishery1
-18	5	-999	-999	-1	99	-1	0 0 0 0 0.5 0 0 # SizeSel_1P_5_WAFishery1
-10	5	0.131888	1	-1	99	1	0 0 0 0 0.5 1 1 # SizeSel_1P_6_WAFishery1

18	60	38.9969	40	-1	99	3	0 0 0 0 0.5 0 0 # SizeSel_2P_1_ORMWTraw
-15	3	-12.6273-3	-1	99	3	0 0 0 0 0.5 0 0 # SizeSel_2P_2_ORMWTraw
-8	12	3.33304	3	-1	99	1	0 0 0 0 0.5 0 0 # SizeSel_2P_3_ORMWTraw
-12	18	3.30179	-0.5	-1	99	1	0 0 0 0 0.5 0 0 # SizeSel_2P_4_ORMWTraw
-18	5	-999	-999	-1	99	-1	0 0 0 0 0.5 0 0 # SizeSel_2P_5_ORMWTraw
-10	5	-1.2824	1	-1	99	1	0 0 0 0 0.5 1 1 # SizeSel_2P_6_ORMWTraw

18	60	40.0244	40	-1	99	3	0 0 0 0 0.5 0 0 # SizeSel_3P_1_ORBTraw
-15	3	-11.8043-3	-1	99	3	0 0 0 0 0.5 0 0 # SizeSel_3P_2_ORBTraw
```

-8 12 3.30539 3 -1 99 1 0 0 0 0 0.5 0 0 # SizeSel_3P_3_ORBTraw
-12 18 2.59535 -0.5 -1 99 1 0 0 0 0 0.5 0 0 # SizeSel_3P_4_ORBTraw
-18 5 -999 -999 -1 99 -1 0 0 0 0 0.5 0 0 # SizeSel_3P_5_ORBTraw
-10 5 0.331688 1 -1 99 1 0 0 0 0 0.5 1 1 # SizeSel_3P_6_ORBTraw

18 60 41.1932 40 -1 99 3 0 0 0 0 0.5 0 0 # SizeSel_4P_1_EMFishery
-15 3 -12.0046-3 -1 99 3 0 0 0 0 0.5 0 0 # SizeSel_4P_2_EMFishery
-8 12 3.69497 3 -1 99 1 0 0 0 0 0.5 0 0 # SizeSel_4P_3_EMFishery
-12 18 4.28579 -0.5 -1 99 1 0 0 0 0 0.5 0 0 # SizeSel_4P_4_EMFishery
-18 5 -999 -999 -1 99 -1 0 0 0 0 0.5 0 0 # SizeSel_4P_5_EMFishery
-10 5 -9.175591 -1 99 1 0 0 0 0 0.5 1 1 # SizeSel_4P_6_EMFishery

18 63 43.9574 50 -1 99 1 0 0 0 0 0.5 0 0 # SizeSel_5P_1_ASP
-15 20 12 12 -1 99 -1 0 0 0 0 0.5 0 0 # SizeSel_5P_2_ASP
-2 9 3.93639 4 -1 99 2 0 0 0 0 0.5 0 0 # SizeSel_5P_3_ASP
-5 20 12 12 -1 99 -2 0 0 0 0 0.5 0 0 # SizeSel_5P_4_ASP
-20 1 -999 -999 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_5P_5_ASP
-9 19 12 12 -1 99 -2 0 0 0 0 0.5 0 0 # SizeSel_5P_6_ASP

-5 40 -1 -1 -1 99 -2 0 0 0 0 0.5 0 0 #
SizeSel_7P_1_ORBTrawCPUE
-5 40 -1 -1 -1 99 -2 0 0 0 0 0.5 0 0 #
SizeSel_7P_2_ORBTrawCPUE
-5 40 -1 -1 -1 99 -2 0 0 0 0 0.5 0 0 # SizeSel_8P_1_ForWBycatch
-5 40 -1 -1 -1 99 -2 0 0 0 0 0.5 0 0 # SizeSel_8P_2_ForWBycatch
-5 40 -1 -1 -1 99 -2 0 0 0 0 0.5 0 0 # SizeSel_9P_1_JVWBycatch
-5 40 -1 -1 -1 99 -2 0 0 0 0 0.5 0 0 # SizeSel_9P_2_JVWBycatch
-5 40 -1 -1 -1 99 -2 0 0 0 0 0.5 0 0 #
SizeSel_10P_1_DomWBycatch
-5 40 -1 -1 -1 99 -2 0 0 0 0 0.5 0 0 #
SizeSel_10P_2_DomWBycatch

18 63 46.3784 45 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_11P_1_NWFSCSvy
-10 20 12 12 -1 99 -1 0 0 0 0 0.5 0 0 # SizeSel_11P_2_NWFSCSvy
-2 9 5.40119 5 -1 99 6 0 0 0 0 0.5 0 0 # SizeSel_11P_3_NWFSCSvy
-15 15 12 12 -1 99 -2 0 0 0 0 0.5 0 0 # SizeSel_11P_4_NWFSCSvy
-20 5 -999 -999 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_11P_5_NWFSCSvy
-9 19 12 12 -1 99 -2 0 0 0 0 0.5 0 0 # SizeSel_11P_6_NWFSCSvy

-5	40	-1	-1	-1	99	-2	0 0 0 0 0.5 0 0 # SizeSel_12P_1_TriAnSurvey
-5	40	-1	-1	-1	99	-2	0 0 0 0 0.5 0 0 # SizeSel_12P_2_TriAnSurvey
0	6	0	0	-1	99	-2	0 0 0 0 0.5 0 0 # AgeSel_6P_1_SCJuvSurvey
0	6	0	0	-1	99	-2	0 0 0 0 0.5 0 0 # AgeSel_6P_2_SCJuvSurvey

#_Cond 0 #_custom_sel-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no enviro fxns
#_Cond 0 #_custom_sel-blk_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no block usage
#_Cond No selex parm trends
#_Cond -4 # placeholder for selparm_Dev_Phase
#_Cond 0 #_env/block/dev_adjust_method (1=standard; 2=logistic trans to keep in base parm bounds; 3=standard w/ no bound check)
#

#_Cond 0 #_custom_sel-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no enviro fxns

1 #_custom_sel-blk_setup (0/1)
-5 5 0 0 -1 99 5 #_placeholder when no block usage
-5 5 0 0 -1 99 5 #_placeholder when no block usage
-5 5 0 0 -1 99 5 #_placeholder when no block usage
-5 5 0 0 -1 99 5 #_placeholder when no block usage
2

#_Cond No selex parm trends
#_Cond -4 # placeholder for selparm_Dev_Phase
#_Cond 0 #_env/block/dev_adjust_method (1=standard; 2=logistic trans to keep in base parm bounds; 3=standard w/ no bound check)
#

Tag loss and Tag reporting parameters go next
0 # TG_custom: 0=no read; 1=read if tags exist
#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0 #_placeholder if no parameters

1 #_Variance_adjustments_to_input_values
#_fleet: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

#_1 2 3 4 5 6 7 8 9 10 11 12 13 14

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2233	0.5802	0.5832	0.2792	0.7080	0.8382
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

0.6231	0.3854	0.6239	0.2164	0.5054	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.4372
0.4647	0.4434	0.5056	0.3272	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.8760	1.0000
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

#_Default

0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1

#
1 #_maxlambdaphase
1 #_sd_offset
#

0 # number of changes to make to default Lambdas (default value is 1.0)
#12 # number of changes to make to default Lambdas (default value is 1.0)
Like_comp codes: 1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;
9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp; 16=Tag-negbin
#like_comp fleet/survey phase value sizefreq_method

4 1 1 0.5 1
4 2 1 0.5 1
4 3 1 0.5 1
4 4 1 0.5 1
4 5 1 0.5 1
4 11 1 0.5 1
5 1 1 0.5 1
5 2 1 0.5 1

5 3 1 0.5 1
5 4 1 0.5 1
5 5 1 0.5 1
5 11 1 0.5 1

0 # (0/1) read specs for more stddev reporting
 # 0 1 -1 5 1 5 1 -1 5 # placeholder for selex type, len/age, year, N selex bins, Growth pattern, N growth ages, NatAge_area(-1 for all), NatAge_yr, N Natages
 # placeholder for vector of selex bins to be reported
 # placeholder for vector of growth ages to be reported
 # placeholder for vector of NatAges ages to be reported
999

END of Control file
Below are alternative setups

Length asymptotic setup
14 63 44 50 -1 10 1 0 0 0 0 0.5 0 0 # SizeSel_5P_1_ASP
-15 20 12 12 -1 10 -1 0 0 0 0 0.5 0 0 # SizeSel_5P_2_ASP
-2 9 4 4 -1 10 2 0 0 0 0 0.5 0 0 # SizeSel_5P_3_ASP
-5 20 12 12 -1 10 -2 0 0 0 0 0.5 0 0 # SizeSel_5P_4_ASP
-20 1 -12 -12 -1 10 3 0 0 0 0 0.5 0 0 # SizeSel_5P_5_ASP
-9 19 12 12 -1 10 -2 0 0 0 0 0.5 0 0 # SizeSel_5P_6_ASP

two parameter sex offsets
-10 15 0 0 -1 5 3 0 0 0 0 0.5 0 0 # SzSel_5Fem_Peak_ASP
-15 10 0 0 -1 5 3 0 0 0 0 0.5 0 0 # SzSel_5Fem_Ascend_ASP
-10 20 0 0 -1 5 -3 0 0 0 0 0.5 0 0 # SzSel_5Fem_Descend_ASP
-5 9 0 0 -1 5 -3 0 0 0 0 0.5 0 0 # SzSel_5Fem_Final_ASP
0.5 1.5 1 1 -1 5 -3 0 0 0 0 0.5 0 0 # SzSel_5Fem_Scale_ASP

double normal dome-shaped
18 40 40 40 -1 99 3 0 0 0 0 0.5 0 0 # AgeSel_1P_1_WAFishery1
-15 3 -3 -3 -1 99 3 0 0 0 0 0.5 0 0 # AgeSel_1P_2_WAFishery1
(logistic width of plateau)
-8 12 3 3 -1 99 1 0 0 0 0 0.5 0 0 # AgeSel_1P_3_WAFishery1
-12 18 -0.5 -0.5 -1 99 1 0 0 0 0 0.5 0 0 # AgeSel_1P_4_WAFishery1 (ln(desc width))
-18 5 -999 -999 -1 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_5_WAFishery1

```
-10 5 1 1 -1 99 1 0 0 0 0 0.5 0 0 # AgeSel_1P_6_WAFishery1
(final- logistic)

# Age asymptotic (P5 set to -999?)
0 40 6.82196 7 -1 99 3 0 0 0 0 0.5 0 0 # AgeSel_1P_1_WAFishery1
-15 20 12 12 -1 99 -3 0 0 0 0 0.5 0 0 # AgeSel_1P_2_WAFishery1
-8 12 0.605793 1 -1 99 1 0 0 0 0 0.5 0 0 # AgeSel_1P_3_WAFishery1
-12 18 14 12 -1 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_4_WAFishery1
-18 5 -15.6933-10 -1 99 1 0 0 0 0 0.5 0 0 # AgeSel_1P_5_WAFishery1
-10 15 12 12 -1 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_6_WAFishery1

# Age double normal with sex offsets setup
0 40 6.82196 7 -1 99 3 0 0 0 0 0.5 0 0 # AgeSel_1P_1_WAFishery1
-15 3 -1 -1 -1 99 3 0 0 0 0 0.5 0 0 # AgeSel_1P_2_WAFishery1
(logistic width of plateau)
-8 12 0.605793 1 -1 99 1 0 0 0 0 0.5 0 0 # AgeSel_1P_3_WAFishery1
-12 18 1 1 -1 99 1 0 0 0 0 0.5 0 0 # AgeSel_1P_4_WAFishery1
(ln(desc width))
-18 5 -15.6933-10 -1 99 1 0 0 0 0 0.5 0 0 # AgeSel_1P_5_WAFishery1
-10 5 -5 -5 -1 99 1 0 0 0 0 0.5 0 0 # AgeSel_1P_6_WAFishery1
(final- logistic(
-5 5 -0.311834 0 -1 5 2 0 0 0 0 0.5 0 0 # AgeSel_1Male_Peak_WAFishery1
-15 10 -0.279212 0 -1 5 2 0 0 0 0 0.5 0 0 # AgeSel_1Male_Ascend_WAFishery1
-10 10 -9.181140 -1 5 2 0 0 0 0 0.5 0 0 # AgeSel_1Male_Descend_WAFishery1
-5 7 0 0 -1 5 -2 0 0 0 0 0.5 0 0 #
AgeSel_1Male_Final_WAFishery1
0.5 1.5 1 1 -1 5 -2 0 0 0 0 0.5 0 0 #
AgeSel_1Male_Scale_WAFishery1

#_Q_setup - with estimated ln(Q) ========
 # Q_type options:  <0=mirror, 0=median_float, 1=mean_float, 2=parameter, 3=parm_w_random_dev, 4=parm_w_randwalk,
5=mean_unbiased_float_assign_to_parm
 #_Den-dep  env-var  extra_se  Q_type
 0 0 0 0 # 1 WAFishery1
 0 0 0 0 # 2 ORMWTraw
 0 0 0 0 # 3 ORBTraw
 0 0 0 0 # 4 EMFishery
 0 0 0 0 # 5 ASP
```

```
 0 0 0 2 # 6 SCJuvSurvey
 0 0 0 2 # 7 ORBTrawCPUE
 0 0 0 2 # 8 ForWBycatch
 0 0 0 2 # 9 JVWBycatch
 0 0 0 2 # 10 DomWBycatch
 0 0 0 2 # 11 NWFSCSvy
 0 0 0 2 # 12 TriAnSurvey

#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index
#_Q_parms(if_any)
# LO     HI        INIT      PRIOR    PR_type          SD                  PHASE
 -25 0 -6.645 -6 -1 10 2 # Q_base_6_SCJuvSurvey
 -25 0 -5.847 -6 -1 10 2 # Q_base_7_ORBTrawCPUE
 -25 0 -11.55 -11 -1 10 4 # Q_base_8_ForWBycatch
 -25 0 -11.21 -11 -1 10 6 # Q_base_9_JVWBycatch
 -25 0 -10.35 -11 -1 10 4 # Q_base_10_DomWBycatch
 -25 0 -2.771 -8 -1 10 4 # Q_base_11_NWFSCSvy
 -25 0 -2.092 -8 -1 10 4 # Q_base_12_TriAnSurvey
# Q ========

#_Q_setup - alternative no Q parameters - median unbiased ==========
# A=do power: 0=skip, index is linear proportiona to abundance, 1= add power parameter (non-linear)
# B=env link: 0=skip, 1= add para for env effect on Q
# C=extra SD: 0=skip, 1= add para for additive constant to input SE (in log space)
# D=type: <0=mirror lower abs(#) fleet, 0=no para Q is median unbiased, 1=no para Q is mean unbiased, 2=estimate par for ln(Q)
#    3=ln(Q) + set of devs about ln(Q) for all years. 4=ln(Q) + set of devs about Q for indexyr-1
#A B C D
 0 0 0 0 # 1 WAFishery1
 0 0 0 0 # 2 ORMWTraw
 0 0 0 0 # 3 ORBTraw
 0 0 0 0 # 4 EMFishery
 0 0 0 0 # 5 ASP
 0 0 0 0 # 6 SCJuvSurvey
 0 0 0 0 # 7 ORBTrawCPUE
 0 0 0 0 # 8 ForWBycatch
 0 0 0 0 # 9 JVWBycatch
 0 0 0 0 # 10 DomWBycatch
 0 0 0 0 # 11 NWFSCSvy
```

0 0 0 0 # 12 TriAnSurvey
Q =======

#_Q_setup - no Q parameters - median unbiased, also Extra SDs added to each survey ==========
A=do power: 0=skip, index is linear proportiona to abundance, 1= add power parameter (non-linear)
B=env link: 0=skip, 1= add para for env effect on Q
C=extra SD: 0=skip, 1= add para for additive constant to input SE (in log space)
D=type: <0=mirror lower abs(#) fleet, 0=no para Q is median unbiased, 1=no para Q is mean unbiased, 2=estimate par for ln(Q)
3=ln(Q) + set of devs about ln(Q) for all years. 4=ln(Q) + set of devs about Q for indexyr-1
#A B C D
0 0 0 0 # 1 WAFishery1
0 0 0 0 # 2 ORMWTraw
0 0 0 0 # 3 ORBTraw
0 0 0 0 # 4 EMFishery
0 0 0 0 # 5 ASP
0 0 1 0 # 6 SCJuvSurvey
0 0 1 0 # 7 ORBTrawCPUE
0 0 1 0 # 8 ForWBycatch
0 0 1 0 # 9 JVWBycatch
0 0 1 0 # 10 DomWBycatch
0 0 1 0 # 11 NWFSCSvy
0 0 1 0 # 12 TriAnSurvey

#LO	HI	INI		PRIOR	PR_ty	SD		PHA		
-2	0.8	-0.16	0		-1		99		-6	# 6 SCJuvSurvey
-2	2	0.20	0		-1		99		-6	# 7 ORBTrawCPUE
-2	2	0.56	0		-1		99		-6	# 8 ForWBycatch
-2	2	0.55	0		-1		99		-6	# 9 JVWBycatch
-2	2	0.28	0		-1		99		-6	# 10 DomWBycatch
-2	2	0.70	0		-1		99		-6	# 11 NWFSCSvy
-2	2	0.82	0		-1		99		-6	# 12 TriAnSurvey

Q =======

10.4.4 Data file (wdw1.dat)

```
#C 2011_Widow_rockfish_ stockassessment__Xi_He__NMFS_SWFSC__Santa_Cruz_CA
#C SS-V3.21e;_06/9/2011;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMB

1916    #_styr
2010    #_endyr
1               #_nseas
12              #_months/season
1               #_spawn_seas
5               #_Nfleet
7               #_Nsurveys
1               #_N_areas

#_SCJuvSurvey: assigned to area 1 or 2?
WAFishery1%ORMWTraw%ORBTraw%EMFishery%ASP%SCJuvSurvey%ORBTrawCPUE%ForWBycatch%JVWBycatch%DomWBycatch%NWFSCSvy%TriAnSurvey

#WA     ORMWT   ORBT    EM      ASP     SJSurv  ORBTCPUE        ForBy   JVBy    DomBy   NWFSCSvy        TriAnSurvey
0.5     0.5             0.5             0.5     0.5     0.5             0.5                     0.5             0.5             0.5
        0.5                     0.5                     #_surveytiming_in_season
1       1               1               1       1       1               1                       1               1               1
        1                       1                       #_area_assignments_for_each_fishery_and_survey

#_Fishery information (4 Fisheries)
#       WA              ORMWT   ORBT    EM              ASP
        1               1               1               1               1               #_units of catch:  1=biomass (mt); 2=numbers
        0.05    0.05    0.05    0.05    0.05    #_stderr of log(catch)

2                       #_Ngenders
35                      #_Nages
0 0 0 0 0  #_init_equil_catch_for_each_fishery

95                      #_N_lines_of_catch_to_read

# Note: Number F_Rate parameters estimated = number of yearly non-zero catches

#_catch_biomass(mt):_columns_are_fisheries,year,season
#  Fish1   Fish2   Fish3   Fish4   Fish5     Fish6     Year  Season
     0.2     0.0     0.3    82.7     0.0   1916  1
```

0.2	0.0	0.3	128.8	0.0	1917	1
0.2	0.0	0.3	148.1	0.0	1918	1
0.2	0.0	0.4	102.1	0.0	1919	1
0.2	0.0	0.4	104.5	0.0	1920	1
0.2	0.0	0.4	86.6	0.0	1921	1
0.3	0.0	0.4	75.1	0.0	1922	1
0.3	0.0	0.4	82.5	0.0	1923	1
0.3	0.0	0.4	52.8	0.0	1924	1
0.3	0.0	0.5	65.5	0.0	1925	1
0.3	0.0	0.5	99.9	0.0	1926	1
0.3	0.0	0.5	82.8	0.0	1927	1
0.5	0.0	0.8	95.0	0.0	1928	1
0.9	0.0	1.4	92.6	0.0	1929	1
0.8	0.0	1.2	120.2	0.0	1930	1
0.6	0.0	1.0	108.1	0.0	1931	1
0.5	0.0	0.7	109.3	0.0	1932	1
0.5	0.0	0.8	95.0	0.0	1933	1
0.4	0.0	0.6	101.3	0.0	1934	1
0.4	0.0	0.7	108.9	0.0	1935	1
1.2	0.0	1.9	121.2	0.0	1936	1
1.8	0.0	2.8	114.3	0.0	1937	1
0.9	0.0	1.4	94.9	0.0	1938	1
1.7	0.0	2.8	84.5	0.0	1939	1
29.6	0.0	48.1	89.2	0.0	1940	1
45.5	0.0	73.8	71.9	0.0	1941	1
84.4	0.0	137.0	21.6	0.0	1942	1
292.0	0.0	473.9	54.0	0.0	1943	1
504.6	0.0	819.0	201.7	0.0	1944	1
788.7	0.0	1280.0	450.8	0.0	1945	1
489.6	0.0	794.7	457.4	0.0	1946	1
297.7	0.0	483.2	208.6	0.0	1947	1
195.8	0.0	317.8	205.2	0.0	1948	1
178.3	0.0	289.3	145.9	0.0	1949	1
188.2	0.0	305.4	166.8	0.0	1950	1
165.6	0.0	268.7	343.7	0.0	1951	1
173.0	0.0	280.7	317.5	0.0	1952	1
138.3	0.0	224.5	293.4	0.0	1953	1
174.8	0.0	283.7	216.4	0.0	1954	1
181.5	0.0	294.6	232.4	0.0	1955	1
236.2	0.0	383.3	294.8	0.0	1956	1
320.1	0.0	519.6	324.2	0.0	1957	1
248.5	0.0	403.3	393.9	0.0	1958	1

269.8	0.0	437.8	319.7	0.0	1959	1
397.6	0.0	645.3	249.1	0.0	1960	1
355.0	0.0	576.1	171.0	0.0	1961	1
407.7	0.0	661.7	175.4	0.0	1962	1
124.4	0.0	202.0	288.6	0.0	1963	1
315.3	0.0	511.7	154.9	0.0	1964	1
54.4	0.0	88.3	230.1	0.0	1965	1
3969.8	0.0	486.6	317.9	0.0	1966	1
4389.1	0.0	793.9	495.0	0.0	1967	1
1853.7	0.0	260.8	585.5	0.0	1968	1
510.3	0.0	250.4	79.6	0.0	1969	1
576.1	0.0	35.8	74.8	0.0	1970	1
738.3	0.0	60.5	61.8	0.0	1971	1
457.5	0.0	65.9	88.6	0.0	1972	1
592.3	0.0	33.8	314.4	0.0	1973	1
277.0	0.0	20.5	393.5	0.0	1974	1
450.1	0.0	17.8	482.9	0.0	1975	1
911.6	0.0	68.9	555.1	0.0	1976	1
1078.3	0.0	372.5	1046.6	0.0	1977	1
312.3	0.0	384.5	632.7	0.0	1978	1
1024.0	3970.7	582.9	2583.6	0.0	1979	1
8705.7	8968.3	464.1	6006.0	0.0	1980	1
7278.4	14693.6	1642.2	5453.8	0.0	1981	1
6344.9	8675.5	846.1	11851.4	0.0	1982	1
3728.1	1734.9	1646.0	4950.0	0.0	1983	1
1685.1	4620.0	1664.4	3909.2	0.0	1984	1
1783.0	3971.1	1045.0	3930.3	0.0	1985	1
2959.9	3654.6	1441.5	3176.0	0.0	1986	1
4306.0	5932.8	1387.4	3427.0	0.0	1987	1
3569.6	4994.5	1339.8	2306.8	0.0	1988	1
3916.1	5750.9	2355.3	2587.7	0.0	1989	1
2588.8	3889.2	2670.0	2791.8	0.0	1990	1
1332.4	2108.7	2343.1	1602.7	271.7	1991	1
1085.4	1409.1	3175.0	1350.7	348.1	1992	1
1993.3	2084.5	4070.6	1406.9	151.1	1993	1
1234.0	2059.2	3035.3	1085.8	288.2	1994	1
1255.6	1711.3	2780.5	2034.7	195.1	1995	1
1109.0	1708.4	2679.5	1605.3	212.3	1996	1
1166.8	1838.2	2927.4	1623.6	205.4	1997	1
636.8	894.7	1935.7	1125.4	258.8	1998	1
599.8	2088.7	1120.4	774.6	186.1	1999	1
454.1	3103.8	28.2	868.1	207.3	2000	1

```
    349.5   1297.8     35.0    402.5    173.5   2001  1
     64.8    154.7      6.8     50.4    154.9   2002  1
     14.4      7.6      1.7      4.8     14.5   2003  1
     31.6     12.3     10.1     25.5     21.2   2004  1
     42.8     59.0      5.6     11.9     80.1   2005  1
     44.9     11.3      3.0     12.6    143.3   2006  1
     37.1     44.6      9.7     19.4    147.7   2007  1
     49.2     34.7      1.7     36.4    115.0   2008  1
    105.2     52.8      2.4      8.2     26.0   2009  1
     62.1     36.6      3.0     11.4     39.0   2010  1

68 #_N_cpue_and_surveyabundance_observations

#_Units:  0=numbers; 1=biomass; 2=F
#_Errtype:  -1=normal; 0=lognormal; >0=T
#_Fleet Units Errtype
1 1 0       # 1 WAFishery1
2 1 0       # 2 ORMWTraw
3 1 0       # 3 ORBTraw
4 1 0       # 4 EMFishery
5 1         0           # 5 ASP
6 0 0       # 6 SCJuvSurvey
7 1 0       # 7 ORBTrawCPUE
8 1 0       # 8 ForWBycatch
9 1 0       # 9 JVWBycatch
10 1 0      # 10 DomWBycatch
11 1 0      # 11 NWFSCSvyN
12 1 0      # 12 NWFSCSvyS

#_NO BLANK LINE ALLOWED IN cpue DATA and DO NOT delete this line
#_year seas index obs se(log)
# Juvenile survey indices copied from Ralston report (11/29/2010) - updated for 2011
 2001 1  6    4.9700    0.6000
 2002 1  6   11.8700    0.6000
 2003 1  6    5.8100    0.6000
 2004 1  6   10.3400    0.6000
 2005 1  6    4.7900    0.6000
 2006 1  6    2.7200    0.6000
 2007 1  6    2.7200    0.6000
 2008 1  6    4.2900    0.6000
 2009 1  6    3.4400    0.6000
```

```
# Oregon bottom trawl survey same as in previous assessments
 1984 1  7  331.4700    0.2121
 1985 1  7  100.8800    0.1875
 1986 1  7  227.0800    0.2928
 1987 1  7  169.0800    0.2730
 1988 1  7   93.9700    0.2897
 1989 1  7  164.1000    0.1749
 1990 1  7   78.4900    0.1348
 1991 1  7   73.5900    0.1275
 1992 1  7   83.1600    0.1179
 1993 1  7   53.5800    0.1314
 1994 1  7  100.3400    0.1128
 1995 1  7  109.9600    0.1387
 1996 1  7   94.8100    0.1357
 1997 1  7   97.2300    0.1502
 1998 1  7   56.5600    0.1718
 1999 1  7   84.4600    0.1684

# ForWBycatch
 1977 1  8    0.7700    0.1153
 1978 1  8    1.2050    0.1118
 1979 1  8    0.7030    0.1186
 1980 1  8    1.9930    0.1311
 1981 1  8    0.7280    0.1257
 1982 1  8    0.2430    0.2467
 1984 1  8    2.9370    0.1254
 1985 1  8    0.4070    0.1074
 1986 1  8    1.1110    0.1027
 1987 1  8    0.3900    0.0881
 1988 1  8    0.5130    0.1243

# JVWBycatch
 1983 1  9    2.8890    0.1202
 1985 1  9    0.7760    0.1165
 1986 1  9    0.8230    0.0809
 1987 1  9    0.3200    0.0875
 1988 1  9    0.6590    0.0774
 1989 1  9    0.8240    0.0635
 1990 1  9    0.7100    0.0740

# DomWBycatch
 1991 1  10    1.2640    0.1251
```

1992 1 10 0.7810 0.1251
1993 1 10 0.8010 0.1038
1994 1 10 1.4650 0.0685
1995 1 10 0.4550 0.1057
1996 1 10 1.0180 0.0824
1997 1 10 0.8860 0.0767
1998 1 10 1.3300 0.0786

new 2011 John Wallace's program Run - One area 100K MCMC (data from
"C:\XiHe1\Widow2011\CPUE\NWFSCSurvey\OneAreaFinal10KRun\CPUE1AreasOut2_10KRunFinalForAssessment.csv")
2003 1 11 8551.726986 0.356317
2004 1 11 447.085872 0.466576
2005 1 11 1404.009079 0.339829
2006 1 11 1337.594810 0.286944
2007 1 11 842.947020 0.286992
2008 1 11 256.862916 0.392575
2009 1 11 1306.339551 0.258935
2010 1 11 2142.273642 0.281881

new 2011 John Wallace's program run - one area MCMC (data from "C:\XiHe1\Widow2011\CPUE\TriSurveyOneArea\Run1\CPUE1AreasOut2_50000UpdateToUse.csv")
1980 1 12 2808.2215 0.2205
1983 1 12 4324.7890 0.1652
1986 1 12 3890.9995 0.2218
1989 1 12 11294.5465 0.2304
1992 1 12 10337.8437 0.1800
1995 1 12 3441.7335 0.2178
1998 1 12 5152.6905 0.1793
2001 1 12 286.3295 0.2524
2004 1 12 1012.2409 0.2487

0 #_N_fleets_with_discard
0 #_N_discard_obs

0 #_N_meanbodywt_obs
30 #_DF_for_meanbodywt_T-distribution_like

#1 # length bin method: 1=use databins; 2=generate from width, min,max below; 3=read nbins, then vector
no additional input for option 1
read binwidth, minsize, lastbin size for option 2
read N poplen bins, then vector of bin lower boundaries, for option 3

2 # length bin method: 1=use databins; 2=generate from width, min,max below; 3=read nbins, then vector

```
2 10 64
# no additional lines to read

-1                        #_comp_tail_compression
0.0001     #_add_to_comp
0                         #_combine males into females at or below this bin number

28          #_N_LengthBins
10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64

144         #_N_Length_obs

#New length comp groups: grouped by 2cm interval and length range 10-64cm
#Year Seas  Flt   Gend PartNSmp    10   12   14   16   18   20   22   24   26   28   30  32   34    6    38   40   42   44   46   48   50   52   54   56   58   60   62   64   10   12   14   16   18   20
22   24   26   28   30  32   34    6    38   40   42   44   46   48   50   52   54   56   58   60   62   64

1980    1    1    3    0  127.08 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000180 0.000000 0.001086 0.008543 0.017077 0.038914
0.103459 0.174565 0.112002 0.041276 0.042187 0.022548 0.004545 0.001091 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.002542 0.013793 0.043983 0.142548 0.154740 0.043278 0.018003 0.008183 0.004910 0.000546
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1981    1    1    3    0  218.86 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000601 0.005027 0.008033 0.011365 0.030489 0.053880
0.082239 0.126827 0.104593 0.037870 0.018529 0.017168 0.007818 0.000000 0.000437 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000765 0.005082 0.009836 0.026665 0.075952 0.145294 0.141307 0.065192 0.018747 0.004864 0.000929 0.000492
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1982    1    1    3    0  282.40 0.000000 0.000000 0.000000 0.000000 0.000000 0.000153 0.000000 0.002757 0.003522 0.005522 0.013868 0.024988 0.029973 0.026327 0.031198
0.052739 0.079892 0.091538 0.065442 0.024324 0.014583 0.006210 0.001129 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000153 0.000613 0.002757 0.003628 0.007618 0.018729 0.039237 0.049273 0.043093 0.073714 0.139439 0.102301 0.031213 0.009445 0.003646 0.000565
0.000411 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1983    1    1    3    0  176.50 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000902 0.009021 0.036722 0.063751 0.083001 0.070265 0.044662
0.021691 0.027032 0.041997 0.049934 0.043203 0.019515 0.005865 0.003873 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.001804 0.009321 0.051983 0.078446 0.075293 0.055377 0.046243 0.052146 0.056925 0.031962 0.013162 0.004888 0.001015
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1984    1    1    3    0  155.32 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000530 0.001061 0.009317 0.029769 0.073907 0.089241 0.062402
0.034386 0.024076 0.033097 0.056760 0.051266 0.047755 0.023288 0.002813 0.000530 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.005465 0.014781 0.037657 0.092334 0.117263 0.065273 0.034945 0.052406 0.028146 0.007659 0.001753 0.001591
0.000000 0.000530 0.000000 0.000000 0.000000 0.000000 0.000000
1985    1    1    3    0  112.96 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.007076 0.027714 0.057929 0.047905 0.062598 0.080307
0.056696 0.026603 0.017310 0.037237 0.043767 0.054308 0.021930 0.003655 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.008255 0.044367 0.048943 0.077388 0.102198 0.076204 0.035848 0.025093 0.022027 0.010989 0.001462 0.002193
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1986    1    1    3    0  190.62 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.001126 0.012723 0.036498 0.072364 0.072842 0.072245
0.073251 0.059437 0.027493 0.028891 0.034417 0.033751 0.018112 0.003923 0.000171 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
```

0.000000 0.000000 0.000000 0.000000 0.000000 0.001296 0.018471 0.052308 0.094996 0.089897 0.082341 0.046765 0.025821 0.019749 0.013797 0.003923 0.002490
0.000341 0.000000 0.000000 0.000563 0.000000 0.000000 0.000000
1987 1 1 3 0 254.16 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000894 0.001788 0.012973 0.021207 0.043273 0.080591 0.074503
0.088862 0.076765 0.050856 0.031910 0.022738 0.023096 0.012357 0.002584 0.001198 0.000304 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.001940 0.013277 0.044185 0.090122 0.097784 0.101817 0.055612 0.023542 0.014547 0.007359 0.002262 0.001350
0.000152 0.000000 0.000000 0.000152 0.000000 0.000000 0.000000
1988 1 1 3 0 141.20 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.001994 0.000514 0.016635 0.049733 0.094406 0.110527
0.093676 0.076635 0.037898 0.017384 0.008895 0.006559 0.002057 0.000343 0.000343 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.004502 0.015498 0.075886 0.118330 0.133956 0.077727 0.035905 0.010095 0.004114 0.003708 0.000514
0.002165 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1989 1 1 3 0 211.80 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.003840 0.021201 0.052212 0.088903 0.101415
0.093604 0.057603 0.048312 0.019761 0.010931 0.013921 0.006141 0.000690 0.000460 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.009090 0.029341 0.068263 0.117885 0.113536 0.095675 0.029872 0.009951 0.004731 0.002200 0.000460
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1990 1 1 3 0 289.46 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.006838 0.017020 0.062059 0.087763
0.114548 0.103085 0.059639 0.033005 0.014756 0.016660 0.005553 0.001028 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000514 0.000000 0.008637 0.041235 0.096349 0.157635 0.109100 0.046014 0.012185 0.005347 0.001028 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1991 1 1 3 0 240.04 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.005545 0.010474 0.025252 0.048795 0.071852
0.090977 0.078629 0.060154 0.039128 0.028194 0.018527 0.014310 0.001232 0.001753 0.000616 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000616 0.001232 0.012323 0.014692 0.035770 0.060770 0.126027 0.123423 0.083324 0.028047 0.012887 0.003601 0.001232
0.000616 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1992 1 1 3 0 218.86 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000899 0.004733 0.014775 0.025140 0.031418 0.062275
0.122473 0.096335 0.064649 0.052585 0.026938 0.023680 0.008329 0.003104 0.000000 0.000407 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.001306 0.003020 0.016980 0.030688 0.051572 0.118426 0.126924 0.071363 0.026868 0.012908 0.000407 0.001798
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1993 1 1 3 0 254.16 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.001177 0.001177 0.016659 0.026879 0.043370 0.042731
0.076822 0.100641 0.090890 0.088754 0.040712 0.027853 0.013431 0.000924 0.000185 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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1994 1 1 3 0 197.68 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.001297 0.007399 0.011182 0.027113 0.045701 0.067199
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0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1995 1 1 3 0 232.98 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000345 0.000691 0.005605 0.022265 0.020422 0.047332 0.077697
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1996 1 1 3 0 190.62 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.002399 0.016043 0.055706 0.086967 0.095357
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0.000000 0.000000 0.000000 0.000000 0.000000 0.001574 0.013796 0.033888 0.063727 0.093148 0.110537 0.067689 0.039537 0.020651 0.011956 0.004011 0.000787
0.000787 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

1997 1 1 3 0 211.80 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000753 0.002830 0.017937 0.049086 0.088039 0.122109
0.079185 0.060907 0.034755 0.028731 0.032611 0.029873 0.016545 0.003971 0.000000 0.000662 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000662 0.000662 0.002830 0.019534 0.058784 0.120465 0.115264 0.058922 0.030602 0.012757 0.008786 0.001415 0.001324
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1998 1 1 3 0 155.32 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.001533 0.008664 0.024304 0.062191 0.111062
0.113963 0.080519 0.045009 0.039178 0.041244 0.024993 0.008664 0.003910 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.003144 0.008586 0.031590 0.100370 0.118707 0.104289 0.030902 0.022538 0.005365 0.006976 0.002299
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
1999 1 1 3 0 204.74 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.004655 0.018619 0.038834 0.055074 0.077763
0.112089 0.088492 0.053884 0.037770 0.033449 0.021760 0.010718 0.004331 0.000000 0.000866 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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0.000866 0.000866 0.000000 0.000000 0.000000 0.000000 0.000000
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1985 1 3 3 0 176.50 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000229 0.002200 0.013241 0.036992 0.051136 0.114430 0.106898
0.067529 0.041803 0.028123 0.037076 0.029133 0.014399 0.011511 0.000966 0.000071 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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1986 1 3 3 0 155.32 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.003137 0.016245 0.026795 0.042014 0.063523 0.059001
0.073333 0.063798 0.052996 0.037827 0.041285 0.023270 0.015664 0.003707 0.000177 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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1987 1 3 3 0 179.21 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.020377 0.064051 0.041728 0.092076 0.076232
0.079145 0.054963 0.033726 0.016775 0.018452 0.010575 0.007445 0.001325 0.000025 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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1988 1 3 3 0 166.69 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.004345 0.012928 0.011180 0.029586 0.076857 0.071241 0.070873
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1979 1 4 3 0 93.41 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.002695 0.000000 0.008086 0.010781
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1980 1 4 3 0 193.53 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000002 0.006216 0.006354
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1982 1 4 3 0 500.00 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000057 0.002767 0.010697 0.028286 0.026185 0.022389
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0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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2 3 1 1 0 0 0 0 0 0 0 0 0 0
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15 8 12 4 2 0 0 0 0 0 0 0 0 0
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2010 1 11 3 0 44.97 0 0 0 0 0 1 3 2 0 0 0 0 0 2 8 15 27 28 24 6 6 1 0 0 0 0 0 0 0 0 0 0 1 0 4 2 0 0 0 1 3 3 5 26 38 22 11 0 1 0 0 0 0 0 0 0

1980 1 12 3 0 51.74 0 0 0 0 0 0 0 0 0 0 0 1 0 3 3 16 22 20 4 6 6 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 25 28 13 6 7 0 0 0 0 0 0 0 0 0
1983 1 12 3 0 103.22 0 0 0 0 0 0 0 0 1 0 3 4 17 12 14 12 8 10 11 11 6 10 5 4 0 0 0 0 0 0 0 1 1 4 11 7 11 14 8 9 10 18 16 36 62 36 10 2 1 0 0 0 0 0 0 0
1986 1 12 3 0 68.41 0 0 0 0 0 0 0 1 1 2 6 11 8 4 12 17 25 22 22 12 18 7 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 2 13 5 3 5 23 36 41 17 2 0 0 0 0 0 0 0 0 0
1989 1 12 3 0 90.41 0 0 0 0 2 18 11 5 7 24 44 67 84 26 28 23 19 9 6 10 12 7 0 0 0 0 0 0 0 0 0 1 5 9 10 5 5 19 44 48 45 26 39 33 10 7 3 2 0 0 0 0 0 0 0 0
1992 1 12 3 0 107.41 0 0 1 1 3 0 2 6 11 20 39 56 72 30 36 45 25 7 8 9 10 1 1 1 0 0 0 0 0 0 0 1 2 2 3 2 8 30 46 72 59 44 29 18 7 3 3 0 0 0 0 0 0 0 0 0
1995 1 12 3 0 78.71 0 0 0 0 0 0 1 0 4 10 28 15 5 3 7 14 16 20 16 33 18 7 7 0 0 0 0 0 0 0 0 1 0 2 4 2 2 11 21 15 11 9 31 57 49 48 17 6 1 0 0 0 0 0 0 0
1998 1 12 3 0 134.48 0 0 1 0 1 0 0 0 0 0 3 4 12 19 43 62 74 78 51 54 46 12 1 2 0 1 0 0 0 0 0 0 1 4 1 0 0 5 4 8 16 65 95 96 78 42 22 9 2 0 0 0 0 0 0 0
2001 1 12 3 0 39.18 0 0 0 4 14 11 4 2 0 1 0 0 1 0 4 1 4 5 2 4 4 3 1 0 0 0 0 0 0 0 0 4 14 13 3 8 4 0 0 0 1 4 3 3 13 4 2 1 1 1 0 0 0 0 0 0
2004 1 12 3 0 51.13 0 0 0 0 0 0 0 0 0 1 4 4 15 8 9 8 12 14 8 3 4 1 0 0 0 0 0 0 0 0 0 0 1 0 1 1 0 3 8 18 17 21 28 21 4 0 0 0 0 0 0 0 0 0

35 #_N_age_bins
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35

1 #_N_ageerror_definitions
0.5 1.5 2.5 3.5 4.5 5.5 6.5 7.5 8.5 9.5 10.5 11.5 12.5 13.5 14.5 15.5 16.5 17.5 18.5 19.5 20.5 21.5 22.5 23.5 24.5 25.5 26.5 27.5 28.5 29.5 30.5 31.5 32.5 33.5 34.5 35.5

Old age Error SD, MaxAge=35
#0.5150 0.5190 0.5230 0.5270 0.5310 0.5359 0.5408 0.5457 0.5506 0.5555 0.5604 0.5653 0.5702 0.5751 0.5800 0.5849 0.5898 0.5947 0.5996 0.6045 0.6106 0.6166 0.6227 0.6287 0.6348 0.6408 0.6469 0.6529 0.6590 0.6639 0.6688 0.6737 0.6786 0.6835 0.6884 0.6933

Mean SD, MaxAge=35
#0.2575 0.2595 0.2615 0.2635 0.2655 0.2680 0.2704 0.2729 0.2753 0.2778 0.2802 0.2827 0.2851 0.2876 0.2900 0.2925 0.2949 0.2974 0.2998 0.3023 0.3053 0.3083 0.3113 0.3144 0.3174 0.3204 0.3234 0.3265 0.3295 0.3319 0.3344 0.3368 0.3393 0.3417 0.3442 0.3466

New Age Error SD (from Punt's program, run files are in "C:\XiHe1\Widow2011\AgeingError\FinalRun"

MaxAge=35
0.08620 0.08620 0.15216 0.22106 0.29303 0.36820 0.44672 0.52873 0.61440 0.70388 0.79735 0.89497 0.99695 1.10346 1.21472 1.33093 1.45231 1.57910
1.71154 1.84987 1.99436 2.14529 2.30294 2.46760 2.63960 2.81925 3.00691 3.20292 3.40766 3.62151 3.84489 4.07821 4.32192 4.57649 4.84238
5.12012

#112 #_N_Agecomp_obs - if not use any CAAL
#1331 #_N_Agecomp_obs - if use ORMWT and CA CAAL
#1276 #_N_Agecomp_obs
#984
#1252
1276
3 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
0 #_combine males into females at or below this bin number

#_NO BLANK LINE ALLOWED IN AGE COMP DATA and DO NOT delete this line
#Yr Seas Flt/Svy Gend Part Agerr Lbin_lo Lbin_hi Nsamp datavector(female-male)

1980 1 1 3 0 1 -1 -1 127.08 0.00000 0.00000 0.00000 0.00000 0.00915 0.01848 0.01356 0.02572 0.08794 0.14181 0.08461 0.06275 0.03471 0.01774
0.02125 0.01851 0.00527 0.00702 0.00644 0.00585 0.00234 0.00253 0.00117 0.00019 0.00059 0.00000 0.00000 0.00059 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00936 0.02151 0.02034 0.05554 0.09555 0.11058 0.04602 0.02920 0.01189 0.01306 0.00585
0.00410 0.00234 0.00234 0.00117 0.00117 0.00176 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
1981 1 1 3 0 1 -1 -1 218.86 0.00000 0.00000 0.00000 0.00749 0.01721 0.04658 0.04392 0.02038 0.02043 0.06235 0.07845 0.07129 0.03738 0.02832
0.01854 0.01016 0.00539 0.00578 0.00517 0.00489 0.00272 0.00472 0.00367 0.00339 0.00234 0.00083 0.00272 0.00067 0.00033 0.00017 0.00033 0.00000
0.00017 0.00033 0.00000 0.00000 0.00000 0.00044 0.00661 0.02443 0.06374 0.04552 0.02404 0.04774 0.08777 0.06757 0.04708 0.02576 0.01710 0.01166
0.00533 0.00428 0.00339 0.00289 0.00211 0.00200 0.00033 0.00100 0.00145 0.00050 0.00061 0.00000 0.00000 0.00000 0.00017 0.00000 0.00017 0.00017
0.00000 0.00000
1982 1 1 3 0 1 -1 -1 282.40 0.00000 0.00000 0.00031 0.00756 0.01837 0.05959 0.02884 0.04157 0.01882 0.01498 0.01468 0.04925 0.03998 0.04034
0.03274 0.03228 0.01656 0.01511 0.00593 0.01120 0.00511 0.00218 0.00349 0.00291 0.00255 0.00130 0.00016 0.00187 0.00084 0.00115 0.00057 0.00042
0.00084 0.00125 0.00125 0.00000 0.00000 0.00016 0.00849 0.03050 0.08438 0.03069 0.04496 0.02057 0.02149 0.03265 0.07169 0.04494 0.03431 0.03486
0.02110 0.01407 0.00881 0.00547 0.00526 0.00302 0.00146 0.00255 0.00042 0.00084 0.00167 0.00042 0.00042 0.00042 0.00000 0.00000 0.00000 0.00000
0.00042 0.00000
1983 1 1 3 0 1 -1 -1 176.50 0.00000 0.00000 0.00000 0.00557 0.15331 0.11397 0.04033 0.02055 0.00918 0.01352 0.01333 0.01629 0.02928 0.02280
0.02159 0.01315 0.01031 0.00688 0.00452 0.00639 0.00254 0.00361 0.00483 0.00380 0.00072 0.00163 0.00030 0.00193 0.00103 0.00000 0.00000 0.00000
0.00072 0.00000 0.00030 0.00000 0.00000 0.00000 0.00757 0.15372 0.11349 0.02842 0.01747 0.01426 0.01310 0.01359 0.01836 0.02014 0.01478 0.01532
0.00881 0.00634 0.00669 0.00567 0.00361 0.00434 0.00434 0.00163 0.00247 0.00030 0.00030 0.00145 0.00000 0.00072 0.00000 0.00000 0.00000 0.00072
0.00000 0.00000
1984 1 1 3 0 1 -1 -1 155.32 0.00000 0.00000 0.00106 0.00194 0.04400 0.15202 0.07538 0.02555 0.01816 0.00527 0.00650 0.00701 0.01138 0.01683
0.02513 0.02372 0.02010 0.01089 0.01354 0.01005 0.00742 0.00864 0.00901 0.00601 0.00850 0.00582 0.00707 0.00372 0.00282 0.00407 0.00264 0.00194
0.00106 0.00053 0.00212 0.00000 0.00000 0.00000 0.00335 0.05370 0.16103 0.08334 0.03342 0.01385 0.00439 0.00560 0.00680 0.00752 0.01293 0.01279
0.01068 0.00680 0.00768 0.00768 0.00682 0.00474 0.00280 0.00386 0.00157 0.00104 0.00104 0.00317 0.00104 0.00000 0.00088 0.00053 0.00053 0.00000
0.00053 0.00000

```
1985   1   1   3   0   1  -1  -1 112.96  0.00000  0.00000  0.00000  0.00830  0.07081  0.08146  0.11726  0.05756  0.02751  0.00857  0.00695  0.00532  0.00753  0.00546
0.01239  0.00959  0.01092  0.00722  0.00753  0.00796  0.00826  0.00988  0.00957  0.00884  0.00796  0.00589  0.00487  0.00589  0.00929  0.00295  0.00575  0.00354
0.00295  0.00074  0.00501  0.00000  0.00000  0.00000  0.00830  0.07482  0.08042  0.12478  0.06645  0.02161  0.00947  0.00356  0.00591  0.00532  0.00605  0.00546
0.00266  0.00591  0.00472  0.00251  0.00325  0.00280  0.00384  0.00207  0.00207  0.00207  0.00295  0.00192  0.00133  0.00192  0.00059  0.00000  0.00074  0.00059
0.00074  0.00147
1986   1   1   3   0   1  -1  -1 190.62  0.00000  0.00000  0.00000  0.00202  0.05331  0.17762  0.09124  0.06975  0.02015  0.01325  0.00395  0.00697  0.00765  0.00614
0.00888  0.00840  0.00772  0.00916  0.00350  0.00484  0.00494  0.00484  0.00322  0.00322  0.00449  0.00322  0.00161  0.00137  0.00247  0.00213  0.00230  0.00223
0.00137  0.00189  0.01652  0.00000  0.00000  0.00000  0.00700  0.06018  0.17364  0.07517  0.04895  0.01438  0.00597  0.00529  0.00522  0.00346  0.00312  0.00463
0.00607  0.00322  0.00230  0.00154  0.00230  0.00161  0.00230  0.00171  0.00230  0.00213  0.00171  0.00189  0.00069  0.00086  0.00120  0.00154  0.00189  0.00120
0.00069  0.00548
1987   1   1   3   0   1  -1  -1 254.16  0.00000  0.00000  0.00015  0.00447  0.01390  0.09509  0.22405  0.05680  0.03697  0.02557  0.00942  0.00674  0.00375  0.00196
0.00706  0.00754  0.00483  0.00752  0.00422  0.00527  0.00333  0.00407  0.00436  0.00272  0.00091  0.00183  0.00122  0.00196  0.00076  0.00076  0.00076  0.00076
0.00150  0.00181  0.00335  0.00000  0.00000  0.00000  0.00626  0.02405  0.12001  0.19421  0.04619  0.01287  0.00853  0.00284  0.00419  0.00554  0.00421  0.00301
0.00405  0.00375  0.00211  0.00150  0.00314  0.00030  0.00061  0.00015  0.00194  0.00015  0.00046  0.00030  0.00105  0.00015  0.00000  0.00015  0.00015  0.00000
0.00089  0.00179
1988   1   1   3   0   1  -1  -1 141.20  0.00000  0.00000  0.00000  0.00245  0.00735  0.05615  0.15087  0.20625  0.03527  0.01727  0.01207  0.00820  0.00296  0.00034
0.00262  0.00052  0.00034  0.00086  0.00017  0.00052  0.00017  0.00069  0.00000  0.00034  0.00052  0.00262  0.00103  0.00052  0.00034  0.00017  0.00000  0.00000
0.00000  0.00000  0.00052  0.00000  0.00000  0.00000  0.00000  0.01486  0.06014  0.13687  0.19886  0.03497  0.01327  0.00455  0.00245  0.00086  0.00262  0.00314
0.00086  0.00017  0.00052  0.00069  0.00262  0.00279  0.00052  0.00052  0.00245  0.00017  0.00052  0.00000  0.00103  0.00052  0.00086  0.00052  0.00052  0.00034
0.00017  0.00052
1989   1   1   3   0   1  -1  -1 211.80  0.00000  0.00000  0.00000  0.00256  0.00710  0.07590  0.09290  0.18362  0.10439  0.00897  0.00979  0.00582  0.00070  0.00105
0.00105  0.00151  0.00000  0.00093  0.00361  0.00128  0.00023  0.00151  0.00070  0.00023  0.00326  0.00198  0.00128  0.00151  0.00000  0.00093  0.00023  0.00023
0.00128  0.00023  0.00511  0.00000  0.00000  0.00000  0.00256  0.01760  0.09336  0.09497  0.15702  0.08737  0.00920  0.00372  0.00116  0.00000  0.00128  0.00023
0.00093  0.00023  0.00046  0.00151  0.00093  0.00070  0.00000  0.00244  0.00093  0.00046  0.00023  0.00023  0.00046  0.00070  0.00000  0.00023  0.00000  0.00023
0.00000  0.00093
1990   1   1   3   0   1  -1  -1 289.46  0.00000  0.00000  0.00000  0.00144  0.02760  0.06205  0.11559  0.07780  0.11935  0.05906  0.01220  0.00551  0.00252  0.00293
0.00046  0.00103  0.00247  0.00098  0.00093  0.00407  0.00098  0.00051  0.00149  0.00149  0.00154  0.00051  0.00247  0.00355  0.00046  0.00206  0.00149  0.00103
0.00103  0.00000  0.00664  0.00000  0.00000  0.00000  0.00046  0.02508  0.07734  0.15250  0.06807  0.09741  0.02997  0.01148  0.00453  0.00098  0.00046  0.00000
0.00046  0.00051  0.00098  0.00103  0.00000  0.00149  0.00144  0.00149  0.00000  0.00051  0.00051  0.00000  0.00000  0.00046  0.00000  0.00000  0.00000  0.00000
0.00000  0.00154
1991   1   1   3   0   1  -1  -1 240.04  0.00000  0.00000  0.00000  0.00000  0.00385  0.05429  0.08432  0.09903  0.06562  0.05673  0.05360  0.01080  0.00933  0.00466
0.00414  0.00248  0.00062  0.00300  0.00238  0.00362  0.00424  0.00114  0.00114  0.00424  0.00352  0.00238  0.00124  0.00186  0.00124  0.00300  0.00248  0.00124
0.00248  0.00062  0.00557  0.00000  0.00000  0.00000  0.00124  0.01005  0.06167  0.11410  0.10725  0.07367  0.04353  0.04959  0.01028  0.00395  0.00290  0.00166
0.00062  0.00405  0.00114  0.00114  0.00062  0.00186  0.00176  0.00124  0.00052  0.00310  0.00062  0.00124  0.00186  0.00062  0.00124  0.00062  0.00114  0.00124
0.00062  0.00000
1992   1   1   3   0   1  -1  -1 218.86  0.00000  0.00000  0.00000  0.00303  0.02347  0.02534  0.05535  0.09135  0.08186  0.05667  0.06935  0.04588  0.02985  0.01169
0.00785  0.00442  0.00090  0.00360  0.00212  0.00360  0.00532  0.00343  0.00090  0.00311  0.00311  0.00221  0.00082  0.00000  0.00041  0.00000  0.00000  0.00000
0.00000  0.00000  0.00131  0.00000  0.00000  0.00000  0.00262  0.01954  0.03090  0.07154  0.07726  0.08193  0.04874  0.05152  0.02944  0.01979  0.00793  0.00491
0.00270  0.00172  0.00000  0.00090  0.00270  0.00090  0.00221  0.00000  0.00270  0.00090  0.00090  0.00041  0.00000  0.00000  0.00000  0.00090  0.00000  0.00000
0.00000  0.00000
1993   1   1   3   0   1  -1  -1 254.16  0.00000  0.00000  0.00000  0.00099  0.00824  0.05949  0.03773  0.06809  0.06964  0.05408  0.04986  0.08460  0.04758  0.02967
0.01536  0.00885  0.00291  0.00452  0.00192  0.00471  0.00155  0.00272  0.00452  0.00452  0.00235  0.00136  0.00155  0.00074  0.00099  0.00099  0.00000  0.00118
```

0.00099 0.00000 0.00056 0.00000 0.00000 0.00019 0.00019 0.01642 0.05843 0.05075 0.06302 0.05670 0.03519 0.02906 0.03079 0.02292 0.02033 0.01221
0.00651 0.00533 0.00434 0.00198 0.00000 0.00118 0.00198 0.00037 0.00099 0.00056 0.00099 0.00000 0.00118 0.00099 0.00099 0.00000 0.00099 0.00000
0.00000 0.00316
1994 1 1 3 0 1 -1 -1 197.68 0.00000 0.00000 0.00353 0.00266 0.01335 0.04676 0.07388 0.06786 0.04380 0.05438 0.04144 0.04327 0.05212 0.03475
0.02463 0.01604 0.01295 0.00759 0.00443 0.00176 0.00270 0.00626 0.00266 0.00579 0.00086 0.00180 0.00313 0.00133 0.00043 0.00000 0.00180 0.00043
0.00090 0.00000 0.00090 0.00000 0.00000 0.00000 0.00133 0.01058 0.04137 0.08687 0.05705 0.04536 0.03711 0.02812 0.02280 0.02596 0.01647 0.01295
0.01115 0.00493 0.00360 0.00270 0.00090 0.00180 0.00000 0.00090 0.00180 0.00090 0.00313 0.00223 0.00090 0.00223 0.00000 0.00000 0.00090 0.00000
0.00090 0.00090
1995 1 1 3 0 1 -1 -1 232.98 0.00000 0.00000 0.00069 0.00937 0.03205 0.05033 0.07766 0.08161 0.05547 0.03681 0.02349 0.02722 0.01720 0.02054
0.00967 0.00687 0.01075 0.00476 0.00157 0.00511 0.00069 0.00123 0.00035 0.00088 0.00246 0.00069 0.00000 0.00088 0.00000 0.00123 0.00000 0.00000
0.00000 0.00000 0.00035 0.00000 0.00000 0.00069 0.01025 0.03094 0.05624 0.09620 0.09981 0.06392 0.02860 0.03060 0.01866 0.01497 0.02361 0.01040
0.00741 0.00614 0.00722 0.00246 0.00441 0.00123 0.00177 0.00088 0.00177 0.00000 0.00000 0.00000 0.00000 0.00000 0.00035 0.00000 0.00000 0.00000
0.00035 0.00123
1996 1 1 3 0 1 -1 -1 190.62 0.00000 0.00000 0.00000 0.00158 0.06843 0.11211 0.10759 0.06434 0.05369 0.02392 0.01438 0.01825 0.01345 0.01112
0.01743 0.00477 0.00394 0.00158 0.00240 0.00000 0.00158 0.00079 0.00552 0.00237 0.00079 0.00000 0.00158 0.00000 0.00079 0.00079 0.00000 0.00000
0.00079 0.00082 0.00319 0.00000 0.00000 0.00082 0.01212 0.05914 0.11186 0.10422 0.05756 0.03292 0.01833 0.01345 0.01036 0.00793 0.00635 0.00793
0.00237 0.00316 0.00319 0.00240 0.00082 0.00000 0.00079 0.00079 0.00079 0.00079 0.00158 0.00000 0.00000 0.00000 0.00000 0.00079 0.00079 0.00079
0.00000 0.00000
1997 1 1 3 0 1 -1 -1 211.80 0.00000 0.00000 0.00000 0.00066 0.02872 0.16724 0.14184 0.05282 0.03318 0.02357 0.01685 0.01799 0.01733 0.01004
0.00729 0.01061 0.00539 0.00199 0.00265 0.00274 0.00531 0.00531 0.00066 0.00332 0.00265 0.00133 0.00199 0.00000 0.00265 0.00000 0.00000 0.00000
0.00000 0.00066 0.00265 0.00000 0.00000 0.00000 0.00283 0.03676 0.14894 0.12910 0.04963 0.01522 0.00955 0.00624 0.00681 0.00663 0.00814 0.00133
0.00332 0.00265 0.00066 0.00075 0.00000 0.00066 0.00133 0.00000 0.00066 0.00000 0.00000 0.00000 0.00000 0.00066 0.00000 0.00066 0.00000 0.00000
0.00000 0.00000
1998 1 1 3 0 1 -1 -1 155.32 0.00000 0.00000 0.00000 0.00109 0.01205 0.04774 0.16517 0.15343 0.04665 0.02032 0.02276 0.02306 0.01954 0.02145
0.01427 0.00440 0.01127 0.00466 0.00248 0.00248 0.00548 0.00083 0.00083 0.00165 0.00083 0.00083 0.00109 0.00000 0.00109 0.00000 0.00109 0.00000
0.00000 0.00000 0.00083 0.00000 0.00000 0.00000 0.00109 0.01427 0.04277 0.14569 0.10966 0.03977 0.01453 0.00714 0.00853 0.00770 0.00331 0.00248
0.00248 0.00661 0.00083 0.00000 0.00000 0.00083 0.00000 0.00248 0.00083 0.00000 0.00000 0.00000 0.00000 0.00000 0.00165 0.00000 0.00000 0.00000
0.00000 0.00000
1999 1 1 3 0 1 -1 -1 204.74 0.00000 0.00000 0.00000 0.00124 0.01222 0.04600 0.06684 0.12652 0.10482 0.05295 0.03286 0.02284 0.01508 0.01319
0.01438 0.00856 0.00582 0.01131 0.00549 0.00399 0.00366 0.00275 0.00215 0.00092 0.00000 0.00000 0.00092 0.00000 0.00000 0.00092 0.00092 0.00000
0.00000 0.00000 0.00215 0.00000 0.00000 0.00000 0.00183 0.01104 0.04093 0.08073 0.10702 0.08193 0.04142 0.02262 0.00991 0.00980 0.00915 0.00458
0.00522 0.00366 0.00458 0.00183 0.00000 0.00032 0.00092 0.00092 0.00032 0.00000 0.00000 0.00000 0.00000 0.00000 0.00092 0.00000 0.00000 0.00000
0.00000 0.00183
2000 1 1 3 0 1 -1 -1 148.26 0.00000 0.00000 0.00000 0.00000 0.00182 0.05312 0.08778 0.09763 0.07606 0.06874 0.04601 0.02091 0.00974 0.00915
0.00610 0.00610 0.00610 0.00915 0.00203 0.00385 0.00000 0.00102 0.00000 0.00000 0.00000 0.00102 0.00102 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00465 0.05869 0.11342 0.07261 0.07485 0.07292 0.03868 0.01219 0.01236 0.00508 0.00203
0.00893 0.00610 0.00305 0.00203 0.00000 0.00000 0.00203 0.00000 0.00000 0.00102 0.00000 0.00203 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
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2002 1 2 1 0 1 46 46 3.1187 0 0 0 0 0 0 0 0 0 5 4 4 2 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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2002 1 2 1 0 1 48 48 2.2015 0 0 0 0 0 0 0 0 1 0 2 3 2 1 2 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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0 0 0 0 0 0 1 1 1 0 2 2 2 0 3 2 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0

2002 1 2 1 0 1 52 52 0.9173 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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2002 1 2 1 0 1 54 54 0.7338 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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2002 1 2 2 0 1 32 32 1.1007 0 0 0 2 1 2 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2

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1994 1 3 3 0 1 -1 -1 267.48 0.00000 0.00000 0.00000 0.00216 0.00907 0.04231 0.10020 0.06430 0.05899 0.06500 0.04592 0.02575 0.06380 0.02861
0.01939 0.01214 0.01212 0.00639 0.00585 0.00176 0.00330 0.00045 0.00179 0.00424 0.00008 0.00217 0.00111 0.00000 0.00061 0.00001 0.00000 0.00000
0.00000 0.00000 0.00001 0.00000 0.00000 0.00000 0.00305 0.01444 0.05591 0.10645 0.06805 0.04297 0.01653 0.02111 0.02821 0.02421 0.00801 0.00603
0.00524 0.00935 0.00234 0.00000 0.00455 0.00000 0.00000 0.00056 0.00117 0.00014 0.00000 0.00000 0.00249 0.00154 0.00000 0.00001 0.00000 0.00000
0.00000 0.00012
1995 1 3 3 0 1 -1 -1 186.73 0.00000 0.00000 0.00000 0.00644 0.01221 0.03376 0.10463 0.08664 0.05098 0.05009 0.04614 0.02355 0.01907 0.02566
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0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00282 0.03020 0.10734 0.07105 0.13306 0.03604 0.04555 0.01872 0.01949 0.00986 0.01087 0.00417
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0.00000 0.00000

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0.00000 0.00018
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0 2 4 7 10 9 17 16 15 11 8 3 4 3 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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1982 1 4 1 0 1 30 30 0.6160 0 0 0 1 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
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24 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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6 44 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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0.01943 0.01216 0.00778 0.00455 0.00238 0.00807 0.00234 0.00045 0.00000 0.00049 0.00152 0.00013 0.00189 0.00000 0.00000 0.00041 0.00000 0.00000
0.00000 0.00158
2009 1 5 3 0 1 -1 -1 96.73 0.00000 0.00000 0.00000 0.00000 0.00999 0.00913 0.02562 0.01588 0.04192 0.08590 0.08513 0.05863 0.04798 0.02628
0.03740 0.01954 0.01947 0.01738 0.01212 0.00581 0.00215 0.00377 0.00345 0.00192 0.00000 0.00115 0.00000 0.00755 0.00000 0.00266 0.00000 0.00000
0.00000 0.00000 0.00398 0.00000 0.00000 0.00000 0.00000 0.00712 0.01302 0.03592 0.02282 0.05391 0.07827 0.07773 0.04831 0.04055 0.01582 0.02530
0.00273 0.01067 0.00957 0.00192 0.00067 0.00183 0.00058 0.00000 0.00422 0.00000 0.00000 0.00079 0.00000 0.00266 0.00000 0.00079 0.00000 0.00000
0.00000 0.00000
2010 1 5 3 0 1 -1 -1 61.44 0.00000 0.00000 0.00000 0.00000 0.00242 0.03906 0.05181 0.03633 0.02234 0.03220 0.08914 0.05434 0.04779 0.02636
0.02677 0.01718 0.00680 0.00532 0.00628 0.01171 0.00806 0.00379 0.00000 0.00000 0.00548 0.00000 0.00680 0.00000 0.00266 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00242 0.03664 0.02812 0.04360 0.03153 0.04884 0.08202 0.05326 0.03227 0.02607 0.02976
0.02472 0.03058 0.00797 0.00531 0.00633 0.00266 0.00000 0.00266 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00266
0.00000 0.00000

2004 1 11 3 0 1 -1 -1 15.04 0 1 0 3 9 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2
14 2 1 1 0 1 1 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2005 1 11 3 0 1 -1 -1 22.60 0 0 0 0 3 2 1 1 1 4 3 2 2 2 4 2 0 0 2 0 1 2 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1
4 7 3 0 2 3 3 2 4 2 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2006 1 11 3 0 1 -1 -1 32.29 0 0 0 0 2 6 5 5 2 1 2 2 2 0 4 4 1 1 3 1 0 0 1 1 2 0 2 0 1 1 0 0 0 0 0 0 1 0 2 3
3 7 6 4 1 1 1 2 2 2 2 0 0 0 2 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
2007 1 11 3 0 1 -1 -1 32.87 0 0 0 0 2 1 3 9 5 8 3 3 1 2 2 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
1 3 11 5 3 7 1 1 2 0 3 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0

-1 #_N_MeanSize-at-Age_obs
#Yr Seas Flt/Svy Gender Part Ageerr Ignore datavector(female-male)
samplesize(female-male)

0 #_N_environ_variables
0 #_N_environ_obs
0 # no wtfreq data
0 # no tag data
0 # no morphcomp data

999

ENDDATA

OR MWT Age composition data - 25 lines
1984 1 2 3 0 1 -1 -1 174.62 0.00000 0.00000 0.00000 0.00136 0.02102 0.17033 0.18341 0.01418 0.02705 0.00650 0.00684 0.00338 0.02539 0.05573
0.01481 0.00805 0.00617 0.00523 0.00530 0.00390 0.00000 0.00241 0.00043 0.00160 0.00083 0.00000 0.00250 0.00101 0.00129 0.00077 0.00000 0.00000
0.00000 0.00083 0.00198 0.00000 0.00000 0.00000 0.00208 0.01809 0.18382 0.11316 0.01030 0.01751 0.00700 0.00782 0.00684 0.01399 0.02038 0.00167
0.00701 0.00319 0.00170 0.00072 0.00301 0.00171 0.00155 0.00000 0.00000 0.00093 0.00154 0.00113 0.00000 0.00136 0.00000 0.00000 0.00043 0.00000
0.00000 0.00074
1985 1 2 3 0 1 -1 -1 280.53 0.00000 0.00000 0.00000 0.00000 0.05048 0.06449 0.25084 0.08734 0.01138 0.01254 0.00912 0.00000 0.00119 0.00666
0.01813 0.00307 0.00139 0.00124 0.00213 0.00000 0.00090 0.00171 0.00145 0.00076 0.00000 0.00063 0.00045 0.00000 0.00000 0.00000 0.00000 0.00071
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00228 0.06399 0.06823 0.22314 0.06609 0.00705 0.00531 0.00305 0.00000 0.00156 0.00497 0.01330
0.00237 0.00208 0.00000 0.00000 0.00083 0.00123 0.00169 0.00035 0.00119 0.00101 0.00120 0.00031 0.00000 0.00031 0.00000 0.00038 0.00038 0.00045
0.00000 0.00063
1986 1 2 3 0 1 -1 -1 328.41 0.00000 0.00059 0.00000 0.00000 0.00920 0.13125 0.08195 0.16787 0.06738 0.00486 0.01185 0.00416 0.00000 0.00037
0.00467 0.01643 0.00133 0.00262 0.00203 0.00100 0.00129 0.00187 0.00145 0.00013 0.00049 0.00013 0.00000 0.00054 0.00049 0.00000 0.00063 0.00000
0.00000 0.00056 0.00089 0.00000 0.00000 0.00000 0.00000 0.00549 0.09908 0.07423 0.19626 0.06320 0.00508 0.00667 0.00400 0.00000 0.00045 0.00111
0.01246 0.00388 0.00269 0.00137 0.00151 0.00048 0.00000 0.00140 0.00068 0.00197 0.00118 0.00077 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
1987 1 2 3 0 1 -1 -1 310.37 0.00000 0.00000 0.00000 0.00128 0.01640 0.11295 0.19489 0.07868 0.03665 0.02047 0.00193 0.00503 0.00253 0.00013
0.00091 0.00185 0.00237 0.00144 0.00026 0.00000 0.00013 0.00000 0.00091 0.00000 0.00000 0.00000 0.00000 0.00040 0.00000 0.00000 0.00000 0.00000
0.00000 0.00056 0.00059 0.00000 0.00000 0.00000 0.00000 0.01455 0.12880 0.21860 0.07163 0.04194 0.02295 0.00256 0.00317 0.00296 0.00042 0.00023

0.00276 0.00403 0.00000 0.00176 0.00143 0.00042 0.00000 0.00000 0.00000 0.00099 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00046
0.00000 0.00000
1988 1 2 3 0 1 -1 -1 197.56 0.00000 0.00000 0.00097 0.00459 0.01423 0.07529 0.18931 0.09825 0.02774 0.01987 0.01060 0.00610 0.00503 0.00128
0.00103 0.00000 0.00199 0.00590 0.00328 0.00000 0.00214 0.00000 0.00079 0.00051 0.00000 0.00000 0.00000 0.00087 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00045 0.00110 0.01334 0.07551 0.23948 0.12714 0.03319 0.02046 0.00824 0.00000 0.00141 0.00043 0.00083
0.00000 0.00258 0.00200 0.00000 0.00064 0.00176 0.00096 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00070 0.00000 0.00000
0.00000 0.00000
1989 1 2 3 0 1 -1 -1 304.84 0.00000 0.00000 0.00000 0.00478 0.02574 0.03561 0.07754 0.19318 0.08746 0.02617 0.01417 0.00609 0.00497 0.00256
0.00074 0.00148 0.00115 0.00230 0.00131 0.00126 0.00220 0.00120 0.00000 0.00000 0.00154 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00088 0.00000 0.00000 0.00000 0.00562 0.01865 0.05443 0.11940 0.19610 0.06753 0.01791 0.00953 0.00278 0.00077 0.00110 0.00051
0.00067 0.00215 0.00167 0.00402 0.00226 0.00000 0.00120 0.00000 0.00000 0.00000 0.00058 0.00000 0.00078 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
1990 1 2 3 0 1 -1 -1 266.27 0.00000 0.00000 0.00000 0.00000 0.01894 0.03586 0.05346 0.07960 0.15158 0.10093 0.04005 0.02150 0.00806 0.00276
0.00190 0.00057 0.00083 0.00000 0.00000 0.00043 0.00277 0.00000 0.00069 0.00000 0.00000 0.00043 0.00000 0.00000 0.00043 0.00000 0.00000 0.00084
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00323 0.03335 0.03168 0.05600 0.09611 0.12970 0.06685 0.03099 0.01445 0.00786 0.00350 0.00000
0.00145 0.00000 0.00176 0.00000 0.00054 0.00000 0.00000 0.00000 0.00000 0.00092 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
1991 1 2 3 0 1 -1 -1 257.99 0.00000 0.00000 0.00000 0.00013 0.01118 0.06441 0.09321 0.06451 0.06790 0.09763 0.04669 0.01322 0.01052 0.00423
0.00301 0.00156 0.00070 0.00046 0.00228 0.00292 0.00467 0.00081 0.00172 0.00137 0.00086 0.00161 0.00000 0.00222 0.00082 0.00000 0.00000 0.00000
0.00000 0.00000 0.00048 0.00000 0.00000 0.00000 0.00000 0.00817 0.06444 0.09797 0.10318 0.06131 0.08846 0.03831 0.00944 0.01063 0.00298 0.00233
0.00158 0.00126 0.00000 0.00077 0.00182 0.00400 0.00128 0.00094 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00060 0.00000 0.00000
0.00000 0.00141
1992 1 2 3 0 1 -1 -1 101.04 0.00000 0.00000 0.00000 0.00000 0.02431 0.02249 0.05846 0.08384 0.05013 0.07008 0.09314 0.02794 0.01443 0.00739
0.00206 0.00226 0.00231 0.00253 0.00071 0.00208 0.00000 0.00503 0.00124 0.00000 0.00000 0.00000 0.00071 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.03366 0.02849 0.07010 0.09049 0.09169 0.04985 0.08262 0.03197 0.02227 0.01361 0.00000
0.00244 0.00000 0.00000 0.00136 0.00071 0.00071 0.00253 0.00183 0.00000 0.00000 0.00000 0.00332 0.00000 0.00124 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
1993 1 2 3 0 1 -1 -1 203.80 0.00000 0.00000 0.00000 0.00063 0.01040 0.06543 0.03792 0.08433 0.06525 0.03731 0.04577 0.06767 0.03230 0.02290
0.01994 0.01031 0.00404 0.00510 0.00180 0.00123 0.00008 0.00000 0.00123 0.00000 0.00264 0.00116 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00008 0.00000 0.00000 0.00000 0.00000 0.01570 0.07184 0.05470 0.08538 0.04974 0.03879 0.03281 0.05731 0.02508 0.01753 0.01434
0.00651 0.00000 0.00239 0.00116 0.00000 0.00131 0.00110 0.00434 0.00000 0.00000 0.00118 0.00000 0.00125 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
1994 1 2 3 0 1 -1 -1 105.80 0.00000 0.00000 0.00000 0.00006 0.00792 0.04598 0.15649 0.06016 0.06315 0.04432 0.03196 0.02595 0.02689 0.01406
0.01918 0.00427 0.00000 0.00000 0.00218 0.00262 0.00054 0.00000 0.00006 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00006 0.00156 0.00793 0.07639 0.16237 0.08515 0.04656 0.04062 0.01106 0.01828 0.02946 0.00000 0.00151
0.00506 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00653 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00006 0.00165 0.00000
0.00000 0.00000
1995 1 2 3 0 1 -1 -1 153.89 0.00000 0.00000 0.00000 0.00393 0.00455 0.02518 0.07270 0.09226 0.09331 0.05066 0.04302 0.03582 0.02656 0.04190
0.01031 0.00609 0.01150 0.00101 0.00012 0.00002 0.00001 0.00118 0.00082 0.00013 0.00431 0.00001 0.00013 0.00038 0.00002 0.00013 0.00000 0.00001
0.00000 0.00003 0.00000 0.00000 0.00000 0.00003 0.00338 0.01385 0.02846 0.14418 0.10232 0.06417 0.03559 0.02620 0.01847 0.02419 0.00570 0.00114
0.00048 0.00016 0.00436 0.00008 0.00001 0.00000 0.00001 0.00005 0.00001 0.00064 0.00002 0.00000 0.00000 0.00000 0.00000 0.00000 0.00038 0.00001
0.00000 0.00000

1996 1 2 3 0 1 -1 -1 143.54 0.00000 0.00000 0.00000 0.00341 0.07448 0.06571 0.06427 0.06737 0.04584 0.02588 0.04343 0.01946 0.01611 0.02524
0.02222 0.00710 0.00085 0.00107 0.00070 0.00345 0.01065 0.00841 0.00294 0.00044 0.00049 0.00121 0.00057 0.00030 0.00000 0.00000 0.00011 0.00000
0.00001 0.00004 0.00003 0.00000 0.00000 0.00000 0.00891 0.08825 0.10065 0.06597 0.05824 0.03213 0.03581 0.01125 0.00356 0.02913 0.01132 0.02088
0.00985 0.00071 0.00000 0.00547 0.00004 0.00020 0.00000 0.00000 0.00527 0.00002 0.00003 0.00000 0.00000 0.00031 0.00001 0.00000 0.00021 0.00000
0.00000 0.00002
1997 1 2 3 0 1 -1 -1 214.36 0.00000 0.00000 0.00000 0.00239 0.01884 0.17365 0.08317 0.03964 0.03140 0.01726 0.01314 0.01069 0.01204 0.01222
0.00636 0.01529 0.00136 0.00224 0.00000 0.00029 0.00000 0.00160 0.00031 0.00001 0.00000 0.00024 0.00001 0.00001 0.00001 0.00180 0.00001 0.00000
0.00000 0.00000 0.00001 0.00000 0.00000 0.00000 0.00229 0.02770 0.24734 0.12211 0.04518 0.02153 0.02620 0.01492 0.01020 0.00811 0.00280 0.01279
0.01181 0.00022 0.00029 0.00058 0.00172 0.00000 0.00002 0.00004 0.00000 0.00004 0.00000 0.00001 0.00004 0.00004 0.00000 0.00000 0.00000 0.00000
0.00000 0.00001
1998 1 2 3 0 1 -1 -1 214.95 0.00001 0.00001 0.00000 0.00003 0.00402 0.03721 0.15404 0.09475 0.04939 0.03323 0.03433 0.01309 0.01621 0.01077
0.00347 0.00170 0.00593 0.00069 0.00241 0.00004 0.00043 0.00036 0.00026 0.00134 0.00035 0.00017 0.00017 0.00026 0.00033 0.00006 0.00004 0.00002
0.00010 0.00005 0.00006 0.00000 0.00000 0.00000 0.00000 0.01303 0.07795 0.19019 0.11696 0.05418 0.01589 0.02563 0.01338 0.00273 0.00654 0.00052
0.00074 0.01060 0.00200 0.00046 0.00027 0.00166 0.00009 0.00006 0.00077 0.00000 0.00010 0.00005 0.00020 0.00006 0.00012 0.00014 0.00011 0.00003
0.00000 0.00022
1999 1 2 3 0 1 -1 -1 326.79 0.00000 0.00000 0.00000 0.00121 0.02244 0.04220 0.08279 0.17452 0.09207 0.04842 0.03014 0.00876 0.01478 0.01237
0.00291 0.00852 0.00310 0.00042 0.00001 0.00002 0.00002 0.00019 0.00022 0.00010 0.00001 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00018 0.00000 0.00000 0.00000 0.00232 0.02215 0.04419 0.09588 0.16422 0.08003 0.02558 0.00524 0.00486 0.00068 0.00214 0.00095
0.00050 0.00057 0.00082 0.00228 0.00047 0.00072 0.00089 0.00000 0.00001 0.00000 0.00011 0.00001 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
2000 1 2 3 0 1 -1 -1 390.95 0.00000 0.00000 0.00000 0.00005 0.01216 0.05725 0.08608 0.08519 0.07798 0.08811 0.03242 0.02706 0.00807 0.00601
0.00923 0.00395 0.00493 0.00120 0.00413 0.00246 0.00283 0.00001 0.00001 0.00001 0.00235 0.00064 0.00000 0.00000 0.00001 0.00007 0.00004 0.00000
0.00000 0.00000 0.00013 0.00000 0.00000 0.00000 0.00011 0.01052 0.05783 0.09548 0.09055 0.09569 0.06133 0.02785 0.02117 0.00490 0.00555 0.00677
0.00249 0.00300 0.00082 0.00007 0.00217 0.00000 0.00000 0.00000 0.00001 0.00001 0.00000 0.00000 0.00000 0.00128 0.00006 0.00000 0.00000 0.00000
0.00000 0.00000
2001 1 2 3 0 1 -1 -1 241.20 0.00000 0.00000 0.00000 0.00000 0.00148 0.01771 0.06415 0.06650 0.07684 0.05964 0.04727 0.05074 0.02937 0.01525
0.01277 0.00720 0.00971 0.00679 0.00346 0.00032 0.00171 0.00007 0.00008 0.00000 0.00021 0.00000 0.00005 0.00007 0.00000 0.00007 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00443 0.03469 0.11022 0.11069 0.09838 0.04800 0.03990 0.03355 0.01641 0.00779 0.00617
0.00508 0.00091 0.00587 0.00397 0.00235 0.00004 0.00005 0.00001 0.00000 0.00000 0.00002 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
2002 1 2 3 0 1 -1 -1 64.58 0.00000 0.00000 0.00000 0.00300 0.00973 0.01905 0.06932 0.11975 0.08891 0.08068 0.03819 0.03520 0.01524 0.00497
0.00997 0.00005 0.00492 0.00005 0.00166 0.00005 0.00000 0.00007 0.00002 0.00005 0.00159 0.00002 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00926 0.00935 0.04649 0.08824 0.13925 0.11554 0.02821 0.01369 0.00912 0.01002 0.00678 0.00000
0.00699 0.00499 0.00000 0.00791 0.00002 0.00000 0.00159 0.00000 0.00000 0.00000 0.00002 0.00000 0.00002 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
2004 1 2 3 0 1 -1 -1 28.24 0.00000 0.00000 0.00542 0.11051 0.07520 0.15198 0.07073 0.02258 0.00587 0.00056 0.00056 0.00056 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.08001 0.14015 0.20279 0.08066 0.02610 0.01455 0.00168 0.00224 0.00168 0.00112 0.00168 0.00112
0.00000 0.00000 0.00056 0.00112 0.00056 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
2006 1 2 3 0 1 -1 -1 85.45 0.00000 0.00000 0.00000 0.00000 0.01624 0.13520 0.02794 0.04297 0.03728 0.01421 0.02105 0.00944 0.02370 0.00465
0.00418 0.00823 0.01052 0.01104 0.01103 0.00492 0.00616 0.00847 0.00429 0.00187 0.00032 0.00000 0.00032 0.00000 0.00032 0.00000 0.00089 0.00000

```
0.00000 0.00032 0.00035 0.00000 0.00000 0.00000 0.00000 0.01851 0.20614 0.11221 0.11128 0.01657 0.00907 0.01924 0.00728 0.02350 0.01296 0.00810
0.01434 0.00000 0.00047 0.00187 0.01056 0.00958 0.00069 0.00000 0.00116 0.00000 0.00000 0.00990 0.00035 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00035
2007 1 2 3 0 1 -1 -1 42.36 0.00000 0.00000 0.00000 0.00095 0.01155 0.01196 0.07210 0.08650 0.10573 0.07188 0.05367 0.02753 0.00518 0.01010
0.00017 0.02020 0.00061 0.00593 0.00000 0.00000 0.00000 0.00122 0.00000 0.00017 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.01010 0.00000 0.00000 0.00000 0.01541 0.02511 0.10327 0.09252 0.15198 0.03322 0.02196 0.02020 0.03031 0.00000 0.00000
0.00017 0.00000 0.01027 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
2008 1 2 3 0 1 -1 -1 117.18 0.00000 0.00000 0.00000 0.00050 0.00068 0.01612 0.04254 0.11205 0.05953 0.09809 0.05845 0.04748 0.03714 0.03045
0.03030 0.01613 0.02069 0.00803 0.02144 0.01081 0.01853 0.01253 0.00434 0.00256 0.00342 0.00352 0.00275 0.01392 0.00007 0.00171 0.00085 0.00000
0.00000 0.00000 0.00141 0.00000 0.00000 0.00000 0.00088 0.00080 0.03033 0.04480 0.07863 0.03551 0.02752 0.02188 0.01327 0.01585 0.00984 0.01390
0.00591 0.00982 0.00036 0.00641 0.00000 0.00013 0.00017 0.00000 0.00000 0.00379 0.00006 0.00013 0.00021 0.00379 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
2009 1 2 3 0 1 -1 -1 84.69 0.00000 0.00000 0.00000 0.00000 0.00445 0.00537 0.01175 0.01219 0.11789 0.05116 0.06424 0.07142 0.01835 0.00959
0.00271 0.01503 0.02639 0.03915 0.00075 0.00013 0.00000 0.00000 0.00000 0.00018 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00013 0.00000 0.00000 0.00015 0.00529 0.01682 0.03901 0.06681 0.11356 0.08038 0.09513 0.02200 0.02107 0.01529 0.02871
0.02724 0.01352 0.00027 0.00084 0.00000 0.00000 0.00127 0.00000 0.00127 0.00000 0.00000 0.00000 0.00000 0.00000 0.00045 0.00000 0.00000 0.00000
0.00000 0.00000
2010 1 2 3 0 1 -1 -1 170.69 0.00638 0.00000 0.00000 0.00000 0.00030 0.01246 0.02750 0.02119 0.04240 0.10102 0.07891 0.09525 0.06415 0.03881
0.02059 0.00956 0.01321 0.01897 0.00270 0.01550 0.00730 0.00000 0.00030 0.00000 0.00017 0.00000 0.00052 0.00017 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00093 0.00000 0.00000 0.00000 0.00054 0.00117 0.03772 0.00602 0.00367 0.03359 0.07403 0.09906 0.07120 0.04090 0.01722 0.00242
0.01158 0.00563 0.00083 0.00429 0.00580 0.00000 0.00030 0.00575 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000

# CA age composition data - 29 lines
1978 1 4 3 0 1 -1 -1 21.77 0.00000 0.00000 0.00000 0.00000 0.00013 0.01219 0.05735 0.13228 0.03156 0.01912 0.00851 0.00000 0.07505 0.00025
0.01232 0.01219 0.00000 0.02463 0.00013 0.00000 0.00000 0.01219 0.00000 0.00007 0.00826 0.00013 0.00000 0.00000 0.00000 0.00013 0.00000 0.00000
0.00000 0.00000 0.02305 0.00000 0.00000 0.00000 0.00000 0.00000 0.00007 0.03992 0.05103 0.09615 0.06438 0.09887 0.02944 0.02889 0.01232 0.02896
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